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MICROCOMPUTING T.M.

DESK-TOP COMPUTERS

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Microcomputing Expands Its Horizons

The Invasion Takes Root in Many Lands

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MICROCOMPUTING

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Volume V
No. 2

This month:

It is truly appropriate that this issue, which takes a look at microcomputing around the world, also marks the 50th issue of **Kilobaud Microcomputing**. Since the magazine was first issued in January 1977, **Kilobaud Microcomputing** has played, and continues to play, a significant role in the growth of the microcomputing industry.

As you read the section on microcomputing in other lands (beginning on page 26), you will be surprised to learn—as we were when we decided to put together this international issue—how widespread the brotherhood of microcomputing has become. From out of the shadows of the pyramids in Egypt to the sprawling peanut fields on the outskirts of a village in southern India, microcomputing affects the lives of millions of people every day.

But the emphasis in these articles is not so much on the present as on the future. For example, in Ireland, which is actively trying to lure the microelectronics industry into the country, future growth means "tremendous political, cultural, sociological, psychological and philosophical implications." So too in Egypt, Indonesia, Puerto Rico and India, where, as author V. Kaliaperumal states, "the common man must be shown the benefits of computers. At present he looks at computers as machines that will take away his job. His fears and apprehensions must be removed."

We agree. In its first 50 issues **Kilobaud Microcomputing** has endeavored to help the computerist, and the non-computerist, come to grips with the microcomputing phenomenon and grow to understand and make use of the benefits of microcomputing. This will be our goal in our next 50 issues, and for 50 multiples of 50 after that.

—The Editors

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This month's cover:
Illustration by Alexander Stevens.

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By Wayne Green

Japanese Lead the Field

New Technology Innovative and Coming This Way

The Tour

I was disappointed that more of our microcomputer industry people did not take advantage of the October tour of consumer electronic shows in Tokyo, Seoul, Taipei and Hong Kong. The price was right, the time required was minimal, and the educational benefits were immense. The food was great!

There, to be seen within a few days, were the latest developments in consumer electronics, which included an impressive array of microcomputers, many of them new.

The general impression I've gathered after going on this tour for two years in a row is that Japan is way out front in technology, with heavy competition between Taiwan and Korea to get in there to produce lower-cost models of the Japanese developments. In general their products are two or three years behind Japan.

Hong Kong has gotten into the faster lane, making copies of the Japanese products within months of their introduction, rather than two or three years. A good example is the enormously successful Sony Walkman cassette stereo player, which I first heard in January 1980 when Chuck Martin of Tufts Electronics (Medford, MA) brought a couple along on a ham industry conference in Aspen. After listening to that player, anyone with a love of quality hi-fi music will be hooked.

The Mitsubishi micro does a good job displaying Japanese ideographs.

How about a keyboard, numeric pad, printer, two minifloppies and a CRT in one enclosure? This one is called the if 800.

This year there are several similar units being made in Japan, one in Taiwan and three in Hong Kong. All cost considerably lower than the Sony, without sacrificing sound quality. Of course, by this time Sony had introduced the

Elaborate and expensive displays attracted large crowds to Japan's 1980 Information Processing Exhibition.

✓ Reader Service—see page 194

This Hitachi unit features color graphics and a light pen.

Another Hitachi system—the Basic Master.

next generation—their stereo miniature cassette recorder. By next year I'm sure there will be a half dozen imitations of this. The one I brought back has made all my mono recorders obsolete for recording talks and meetings.

Another Chinese Computer

During my recent visit to Taiwan I had the opportunity to give a talk on the future of microcomputers to the Chinese Youth Organization at the famous Grand Hotel, one of the most lavish hotels in the Republic of China. The talk was a bit slow because it had to be translated as I went, but the response was enthusiastic and well worth the effort.

After the talk, which was sponsored by the leading electronics magazine of Taiwan (IBS Publications), I had an opportunity to see a new microcomputer which happened to be on display on another floor of the hotel. This system, the Sigma 10, is made in Massachusetts! The character generator for the Chinese characters required a look-up table and breaking down the characters into components. The numbers corresponding to the various character elements were entered with the key pad on the keyboard, and the system put them together into any of some 10,000 different characters.

It takes a good video display to clearly show the complex Chinese characters. The same can be said for their printer, which is even able to print the characters in various sizes. No matter what approach you take to tackling the Chinese characters it is a hard row to hoe—and I wish 'em luck.

Fear of Polls

Hardly a week goes by without some promotion for an expensive study of the microcomputing industry crossing my desk. I don't know who buys these reports, which range from around $200 to over $1000, but I have yet to see one which I thought was accurate in its projections.

While the changes going on in the microcomputer market are occurring at a slower rate than those which influenced the recent election, I think it is these changes which are helping to screw up some of the polls on micro applications. For instance, there is no question that the micro is going to be a powerful tool for use in offices, both as a stand-alone computer (now starting to be called a desktop computer) and as a terminal for accessing data and services. Yet any survey of actual usage of micros today would give little hint of the real size of this developing market.

Schools are just starting to cope with the micro, so again, any survey, no matter how careful, would tend to indicate this would be no big deal. I think it is going to be.

Just as this publication has helped to bring about a growth in the sale of microcomputers, coming publications for businessmen and for educators will speed up changes in the marketing of microcomputers. *I* can see these things and many of *you* can, but few of the people involved with generating those expensive reports really know much about our industry or where it is going—except what is reflected in a single moment, which they study with a questionnaire.

For instance, a recent survey by IDC (International Development Corporation) shows the educational market for micros in 1984 at only 3.2 percent of the market.

Biorhythms—Japanese style—on Sanyo's PHC-1000.

National showed its Personal Information Terminal with built-in cassette.

The Sigma 10 features Chinese character capability and displays 1520 Chinese characters (38 lines of 40 characters) or 4800 alphanumeric characters (60 lines of 80 characters).

I expect it to be around 25 percent to even 30 percent, not so much for applications in running schools as for teaching students.

The IDC sales projection for desk-top computers for 1984 is about $14 billion. Taking into consideration the impending invasion from Japan and the amount of consumer advertising that will have to accompany this, it seems to me that there is no reason to project a slower growth than we have had over the last five years in this field. If the market were just going to consist mostly of Tandy, Apple and Commodore, yes, I would project a slowdown in overall growth.

Considering such factors as the entry of Japanese products, followed in a year by more from Hong Kong and then a year after by micros from Taiwan, Korea and Singapore, coupled with the emergence of adequate software, I expect the growth of the micro industry to continue at 100 percent per year, at the least.

Thus, hardware sales of about $1.25 billion this year would expand by 1984 to $20 billion. I do not find the *Business Week* projection of a $25 billion market for mass-produced software for 1985 at all difficult to believe, with perhaps $40 billion for hardware.

There can always be invisible factors which can upset this growth. Certainly the current recession and high inflation rate have slowed down business enthusiasm for microcomputers. If we manage to have an even more serious blight of these problems, that could bend the growth curve substantially.

The factors pushing in the other direction are a growing awareness that much

NEXT PC
9FB9 0100
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究竟美國目前的經濟衰退要繼續多久，各方面的
繼續衰退下去，在今年夏天的三個月中將繼續有
率將繼續上升到百分之八點五左右，甚至也有人
另一方面，銀行的優惠貸款率已由四月份的百分
購買汽油與購買房屋的利率也開始下降，因此也
興起來持後者看的人同時指出，今年是大選年，
黨都會以促進經濟繁榮為政治號召，因此，卡特
續惡化下去.
　　共和黨的總統後選人雷根和國會中國會的共
查削減聯邦所得稅的方案，主張以促進經濟的，
方案，在九月一日以前提出.

Partial sample printout from the Sigma 10.

of the loss of productivity in our country has occurred in the office, not on the production line. The need for increasing office productivity is imperative, and little else is in view other than computers to bring about any massive improvement in this part of industry.

The introduction of electronic mail would, in my estimation, save our industries billions of dollars now wasted in fruitless phone calls. In light of a recent study that showed that 73 percent of business phone calls failed to get through on the first try, a communications problem is clearly defined.

I am counting on some computer hobbyists to come up with a practical electronic mail system—preferably starting out with a TRS-80 as the host system. I've written on this need before, but the results have so far been disappointing. We need a box that will allow our microcomputers to use the telephone lines to exchange messages, and a program to accomplish all of the nitty-gritty for this. The box must take the message and phone number from the computer, dial up the number, turn on the computer on the other end, check the line, dump the message and get an acknowledgement that it was received. Not much to ask.

I suppose these proliferating studies are of some interest to large corporations who are trying to decide where they are going over the next few years and who can well afford to spend a kilobuck on a lot of detail and a little imagination, which many reports represent.

Issue on Word Processing

Kilobaud Microcomputing will feature a special word processing issue in May. Manufacturers of word processing software for any microcomputer who want to be included in this issue should contact the *Microcomputing* editorial department immediately. Please send spec sheets of your software system. We will contact you if we need additional information.

By Walter Koetke

Vicarious Learning

Sometimes Simulations Say It Better

Simulation Suggestions

Simulations are models of the real world. They help answer that persistent question "What if. . .?" What if we use interferon as a treatment for cancer? What if two of the three engines in the proposed new plane design fail at the same time? What if New York City dumps its refuse two miles further from shore? What if we reduce the price of a widget in an effort to increase sales? Simulations can assist us with many very critical decisions. In general, they are used when real-world situations would be too dangerous, too expensive, too difficult or too time consuming.

The use of computers in simulations is a concept that should be understood by all who are computer literate. There are several available quasi-simulations that are appropriate for most school software libraries. All are described as quasi-simulations because they are gross oversimplifications of a real-life situation. They can, however, be used to demonstrate the concept of simulation to those with little or no experience using computers.

I suggest you add Taipan, Westward 1847 and Hammurabi to your library of educational software. Taipan (by Art Canfil, available from Cybernautics) simulates the China trade of the 1800s. Set in the British colony of Hong Kong, you begin with a small boat, working capital and a nagging debt. Your goal is wealth, and the path to that goal is to trade general cargo, arms, silk and opium. You must avoid pirates, pay your debts and make decisions regarding the acquisition of larger ships and arms for defense. Taipan is certainly enjoyable and can be used in a variety of classroom settings from history to business.

Westward 1847 (by Jon Sherman, available from The Software Exchange) simulates the experience of those traveling the Oregon Trail in the mid 1800s. As you begin your journey, you allocate your financial resources for food, supplies, ammunition and a team of oxen. You are permitted to purchase additional items from the forts along the trail as the journey progresses. The simulated journey includes many hazards—sickness, accidents, bad weather, hostile strangers and starvation. Interaction is enhanced whenever you hunt by requiring a time-sensitive user response. The time can be adjusted to challenge all age groups, thus Westward 1847 can be used and enjoyed by students in all grades from 3 through 12. When enhanced with class discussions of the Oregon Trail, using this simulation should be a positive educational experience.

Hammurabi (public domain software, versions available from many sources) simulates the management of an ancient Sumerian city. As city manager, you must make decisions regarding the purchase and/or sale of land, the number of acres to plant for food production and the amount of food to distribute. Variables with which you must contend include the fluctuating price of land, the unpredictable harvest, occasional disasters and additional people moving into the city.

This simulation has been available for many years, and many history and economics teachers have incorporated its use into their lesson plans. Those applications that I've observed nicely demonstrate the proper use of the computer. This program has been used as part of a history course for two or three class periods each year. The history teachers involved used Hammurabi to support the concepts and ideas they were interested in teaching. Those same teachers ignored the computer when available software would not support their educational goals.

Writing simulations that validly represent even a small portion of real life is not often easy. There are, however, several controllable examples that can be used with younger students. Perhaps the simplest is to write a program that simulates the tossing of a coin. The TRS-80 program illustrated in Listing 1 will simulate the tossing of a coin as often as requested. Note that the use of FOR/NEXT is not necessary for students who have not yet discussed these commands. Note also that this and all other examples require modification of the line containing RND when used on a computer other than the TRS-80. In most cases, this modification is completed by replacing RND(X) with INT(X*RND(1)+1) using the value of X given in the example.

The simulation concepts of this program can be understood at the elementary school level. The random number generator is used to select a random 1 or 2. The programmer elected to let 1 represent a toss of heads and 2 represent a toss of tails. Students should realize that this is the programmer's choice; the relation-

(continued on page 195)

```
10 LET H=0
20 INPUT "HOW MANY TOSSES"; N
30 FOR C=1 TO N
40 IF RND(2)=1 THEN LET H=H+1
50 NEXT C
60 PRINT "THERE WERE" H "HEADS AND" N-H "TAILS."

READY
>RUN
HOW MANY TOSSES? 500
THERE WERE 241 HEADS AND 259 TAILS.
READY
>RUN
HOW MANY TOSSES? 500
THERE WERE 234 HEADS AND 266 TAILS.
READY
>RUN
HOW MANY TOSSES? 500
THERE WERE 259 HEADS AND 241 TAILS.
READY
>
```

Listing 1. Coin-tossing TRS-80 program.

```
10 LET S=0
20 FOR C=1 TO 3000
30 IF RND(6) + RND(6) = 7 THEN LET S=S+1
40 NEXT C
50 PRINT "THERE WERE" S "SEVENS."
```

Listing 2. Dice-rolling TRS-80 program that counts "sevens."

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By Robert W. Baker

Your Data Is In Good Hands

With the Data Manager from Jini Micro-Systems

Jinsam

Jinsam is a fast and extremely flexible data manager for the 16K and 32K PET/CBM from Jini Micro-Systems, Inc., PO Box 274, Bronx, NY 10463. It was designed for the business or personal user with no previous programming experience. Functions are selected via menus, then the program prompts the user to enter needed information. New data bases are defined and created by the user, prompted by the system each step of the way. Facilities are provided to create, delete, change, display, print, retrieve and protect the integrity of your data.

There are now three basic versions available. Jinsam 1.0 is the original version first introduced for the 16/32K CBM 2001 with a CBM 2040 or Compu/Think disk. Jinsam 4.0 requires BASIC 4.0 in a 32K CBM 2001 plus a CBM 2040 disk with DOS 2.1. This version has most of Jinsam 1.0 functions plus a machine-language sort that will sort 1000 records in about 10 seconds. Jinsam 8.0 is for the 80-column 8032 CBM with a 2040 (with DOS 2.1) or 8050 disk. This version has all the functions of Jinsam 4.0 but with display formats upgraded to utilize the expanded screen width.

All versions have a ROM that is installed in one of the open ROM sockets of the PET/CBM. Two diskettes are required for each data base you create, and they must be kept as a pair. The data disk is installed in drive 0 and contains the actual data records of the data base. The program disk is installed in drive 1 and contains the Jinsam program modules and the key files for the matching data disk. With Jinsam 4.0, however, you may have more than one data base on the same pair of disks.

To create a new data base, you're first asked for the number of fields (information items) in each record, then the name and length of each field. You have complete control of the data form and should carefully plan the structure of the fields.

A correction feature lets you verify that all field names and lengths have been entered correctly. If not, you have an opportunity to make corrections before saving the field descriptors. The maximum length of any one descriptor field is 60 characters. With a CBM 2040, the maximum length of all fields plus the number of fields may not exceed 255. With Compu/Think disks and old or new ROMs, the maximum length of all fields is 255 characters.

The next step in implementing your data base is to define the specific limited viewing fields to be displayed or printed by any printer routine. You specify the field numbers and the order in which they should be displayed. As few as one or as many as all fields may be preset.

When selecting fields, you must take into account the printer width. The width of each column is the width of the field or the field name (whichever is larger) plus three spaces. Any number of fields that will fit within the form width can be printed in a report. For selective screen print, nine fields appear vertically on the screen at one time. Anyone will be able to review or print the preset fields, but a special password is necessary to make any changes to these fields.

A four-level security system limits the amount of data seen within a record and the ability to manipulate and print records. You select your own private passwords, which can be changed at any time.

A user with the highest-level (level 4) password can manipulate the entire data base and define or revise passwords. A level 3 password allows you to manipulate the entire data base, but you cannot change the passwords. A level 2 password allows you to display all fields of all records, but denies the ability to change any records. Level 1 really has no password, but only preset fields may be viewed or printed.

The program will ask you to enter a password whenever one is called for. Jinsam even has an auto time-out function for further security. After five minutes with no user activity, the program will terminate any current operation and automatically return to the function select menu.

Before entering records into the data base, you must define the first prime key. A key manipulation menu provides various options to set, edit and display the random access key files. A security code is necessary to access these functions.

A key file is a sorted list containing one description field (or a part of a field) and identifying pointers. The pointer contains the location of a data record on the disk, indicating the track and sector where it is stored. A key is used during searches to represent the data record. You never need to know a record's location on the disk to retrieve it; the program takes care of everything for you.

There are two types of keys available: prime and select. A prime key is a file containing one descriptor field (or leading part) and pointers to *each* record in the data base. You can have up to five prime keys. The first prime key should be a field in the data base that has some unique attribute for each record such as a name, ID number, part number, etc., since it is the main pointer file to locate all records in the data base. A select key is a file containing one descriptor field (or leading part) and pointers to *selected* records in the data base which meet your specific requirements.

For each key (prime or select) you must indicate the number of significant characters in the key. The maximum is five with a 16K PET or ten with a 32K PET. The smaller the key size, the quicker the PET will seem to operate.

Since a key contains only the contents of one descriptor field and a pointer to the record, the entire key file can be held in memory at one time. A binary search is performed, and any record can be retrieved with only a few machine operations. Once the proper key is found, the program takes only that record directly from the disk for processing. The average

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time to search for and retrieve any record is 1.75 seconds, with actual times ranging from 0.5 to 3.0 seconds.

If you pick a key that is very common and then set secondary criteria to select a record, this time increases proportionally to the number of records that meet the criteria. Two records double the time, three records triple the time, etc.

When adding or deleting a record, the program automatically loads the first prime key, which is also loaded and processed to get information needed in creating, deleting or manipulating any prime key. The first prime key is automatically updated whenever you add or delete records. Any other prime keys must be manually updated if records have been added or deleted from the data base. Any prime key must be updated if information located in that prime key field has been changed anywhere in the data base.

The select key is defined for selective record access using specific criteria from one field or specific criteria from every field in your data base. The select key file is named (up to 12 characters) for later recall and can only be updated by redefining the key. There is no limit to the number of select keys you can have as long as there is disk space available on the program disk. When a select key is no longer active, you can scratch the corresponding select key file from the disk to free up additional disk space.

Once the format of the data base has been defined and the first prime key established, you can then begin to enter actual data records. A record manipulation menu provides various options to add, retrieve, update (edit) or delete records in the data base. The fields viewed and the operations allowed on the records depend on the security password entered by the user.

When adding new records, the program displays a tally of records on the data disk and the number of records now being entered. You are prompted to enter data according to the original descriptor fields. After an entire record is entered, the contents are displayed for you to check.

When the record is correct, it is written to disk and the program prompts for the next entry. The program normally accepts up to 25 record entries at one time. You can enter less than 25 entries by typing END for the first field entry.

When you end your data entry, the program sorts the new entries by the field you chose as the first prime key field and performs a merge sort to integrate this information into the first prime key field. When new records are entered, the first prime key is automatically updated and is always valid. All other keys (prime or selected print keys) must be recreated.

There are three methods of record retrieval: 1) sequential, in key order; 2) random, criteria based; and 3) track and sector, exact disk location. The program loads the proper program module and prompts for a prime or select key, or the exact track and sector. When choosing a prime or select key to retrieve records, the chosen key file is loaded into main memory.

In a sequential review, records are retrieved and displayed in prime or select key order, alphabetic or numeric. When you ask for a random display, the program prompts for the field criteria, multiple field criteria, ranges or track and sector needed to retrieve the specified records.

There are three methods of record selection: 1) wild-card search, 2) prime/select key range and 3) secondary key range. You can use only one or all three as necessary.

The wild-card search allows you to enter the leading portion of specified criteria, and the program will display all records that match this portion. If you're not sure of the spelling of SMITH, for example, simply enter SM, and all records that have SM as the leading portion will be displayed.

If you want to view a group of records, you can use a prime or select key range with the greater than (>) and less than (<) symbols. You can even specify an inclusive range (<>), if desired. Entering >N displays all consecutive alphabetic records beginning with N and continuing to the end of the data base. If you enter <N, the program starts at the first alphabetic N and displays all records in reverse alphabetic order. An inclusive range with limits of M and N displays all records beginning with M and N as expected. Likewise, the ranges can be used for numeric records with the obvious results.

After choosing one key criterion, you can optionally specify a second, third, fourth, . . . criterion as necessary. For example, you may want to display all companies located in zip code areas 33406 through 33411 whose company names begin with the letters C, D, E or F, and specialize in business software for the PET (as identified in a coded status field). This task is simple with the Jinsam features and controls.

Once your criteria have been entered, the program searches for, retrieves and displays only those records that meet *all* the specified criteria. You may choose to view preset fields or all fields in each record. Various controls are available at different times as you view the selected records:

C/+—display next record
——display previous record
Shift-D—delete currrently displayed record
Shift-E—edit currently displayed record
Shift-K—select a new key
Shift-M—return to option menu
Shift-N—select new search criteria
Shift-P—print record currently displayed

Jinsam also provides various options for printing labels, reports and other printed documents. Labels are consecutively printed or displayed from the contents of records, in ascending or descending order, according to the prime or select key chosen. Each label can contain up to four lines with a maximum of three data base fields in each line as limited by the physical label size.

A label description can be saved to avoid reentering the desired label format each time you print labels. The label format can be displayed on the CRT one label at a time, or printed with up to five labels across the page. You can stop the display or printing at any time and then continue, abort or restart the operation.

When using individual sheets of labels, you can even specify the number of labels per sheet. The program will then stop at the appropriate time to allow inserting the next sheet of labels. This handy feature even allows printing envelopes or file cards, if required.

When printing reports, you have three options concerning the fields to be printed: 1) print only preset display fields, 2) print fields selected now or 3) print all fields. The preset fields are those fields defined when establishing the data base. These display fields do not require a password to be viewed or printed.

To specify specific fields to be displayed, you must have a minimum of a level 2 password. You are prompted for the fields to be included and the order of the fields. Take care when specifying all fields in the data base, since you may exceed the limits of your printer unless it has an auto carriage return/line feed like the CBM 2022/2023 printers.

Before printing the report, enter the printer device number, any line feed or page feed functions, the printing order (ascending or descending), page headings, etc. The number of pages is unlimited and will be automatically numbered.

If your printer has a page feed option (form feed), the program will automatically feed to the top of the next page when the specified number of items is reached on each page. Otherwise, the program will stop and wait for you to manually adjust the paper at the end of each page. Jinsam 4.0 allows more complex reports, and common report formats can be saved on disk for repeated use.

A dump option allows you to dump the entire contents (or preset display fields) of each record or selected records in the data base according to the prime or select key chosen. The track and sector numbers are included for each record dumped to the screen or printer.

Other utility options allow you to dump the descriptor file, dump named key files, restructure the data base, convert a former data base and recover records. Jinsam 4.0 even provides a copy function to copy specific fields of each record in the current data base to create a new data base as a subset of the original version.

In addition to these standard features of Jinsam, there are five accessory interface modules available:

• A Wordpropack module provides an intelligent interface for Wordpro 3 or 4. It creates variable blocks with data or up to ten conditions based on data base contents. This allows creating form letters, checks, invoices, etc., directly from the data base. This module is much more powerful than you can imagine; you really have to play with it to see how versatile it can be.

• The Multilabel module prints multiple labels per record with consecutive numbering and up to two lines for messages. You can easily produce inventory labels, bulk mailing labels, etc.

• A Mathpack module provides numerical addition, subtraction, multiplication and division of any field by another field or a constant. You can sum fields in each record or create a running sum of a single field for all records. This function can be used to extract information or effect a permanent change in the data base. Data can be replaced in the same field or placed in a new field.

• For statistical analysis there are two additional modules. The Descriptive Statpack can compute the mean, median, mode, standard deviation, variance and range. It can even generate histogram and Z-score reports. The Advanced Statpack must be used in conjunction with the Descriptive Statpack. It generates crosstabs (number of occurrences), chi square and linear regression with graphic representation and prediction. Linear correlation and simple analysis of variance are also provided.

The program modules and documentation are thorough, clear and easily understood. If you decide to use Jinsam, you can start with Jinsam 1.0 and upgrade at any time. Choose from the available accessory modules to suit your current applications and add more later.

The Jinsam user's guide ($25) is a 90+ page manual that covers every feature in great detail with a large number of examples. A demo disk is also available for a minimal cost. This disk shows many of the features offered by Jinsam and sample outputs of the program. A Jinsam newsletter brings information on the latest updates, user inputs and new functions or features. The Jinsam User's Group publishes the newsletter on a quarterly basis with a small annual subscription fee.

```
10 REM TAPE-TO-DISK DATA FILE COPY
20 REM
30 REM BY: ROBERT W. BAKER, ATCO, NJ
40 :
50 PRINT"▯▯TAPE-TO-DISK COPY▯▯"
60 GOSUB 380
70 PRINT"THIS PROGRAM COPIES ANY TAPE DATA FILE":PRINT
80 PRINT"FROM TAPE TO DISK, IN EXACTLY THE SAME":PRINT
90 PRINT"FORMAT.":PRINT
100 GOSUB 380
110 PRINT"INSERT TAPE IN TAPE#1":PRINT
120 PRINT"& DEPRESS ANY KEY WHEN READY
130 GET R$:IF R$="" THEN 130
140 PRINT"OK":PRINT
150 OPEN 1
160 OPEN 15,8,15
170 PRINT"▯ENTER THE ENTIRE FILE NAME AS DESIRED:":PRINT
180 INPUT"DISK FILE NAME";FL$
190 PRINT
200 PRINT"DRIVE# 0 OR 1: ";
210 GET D$:IF D$<>"0" AND D$<>"1" THEN 210
220 PRINT D$:PRINT"OK"
230 OPEN 2,8,2,D$+":"+FL$+",S,W"
240 INPUT#15,EN,EM$
250 IF EN THEN 320
260 PRINT"▯COPYING DATA....."
270 GET#1,C$
280 IF ST<>0 THEN 350
290 PRINT#2,C$;
300 INPUT#15,EN,EM$
310 IF EN=0 THEN 270
320 PRINT"▯▯DISK ERROR":PRINT
330 PRINT EN,EM$
340 GOTO 370
350 IF ST=64 THEN PRINT"▯COPY DONE▯▯":GOTO 370
360 PRINT"▯▯TAPE READ ERROR▯  STATUS =";ST
370 CLOSE 1:CLOSE 2:CLOSE 15:END
380 PRINT"------------------------------------":RETURN
READY.
```

Tape-to-disk PET BASIC program.

Tape-to-Disk

With more and more people upgrading to disk, many are finding it very easy to convert their existing programs to use disk instead of tape for storing data. However, how do you get any existing data files that are currently on tape into new disk data files? Do you have to reenter all that data you've been accumulating for weeks, months or even longer? Why should you, when there is a very simple solution?

This handy little BASIC program will read any data file on tape and create an exact copy on disk. It performs a byte-by-byte copy of the data from tape to disk so there is no change in the data format or contents.

Furthermore, any program that previously read the data from tape should now be able to read the data from the new disk file. All you have to do is change the OPEN commands to correctly open the disk data file. This normally means just changing the device number to eight (for the disk) and possibly adding the drive number before the file name with a separating colon.

For example, a typical OPEN command to read a tape data file from tape 1 might be:

```
OPEN n,1,0,"filename"
```

where n is any logical file number and filename is the name of the file on the tape to be read. To convert this to read a similar data file from disk, simply change the device number (1) to indicate the disk, which is device number 8.

After the filename (but still inside the quotes) add ",S,R" to indicate the file is a sequential data file that you want to read. You might even want to include a specific disk drive number before the filename with a separating colon:

```
OPEN n,8,0,"0:filename,S,R"
```

A typical OPEN command to write a tape data file might be:

```
OPEN n,1,1,"filename"
```

Again, to convert this command to write to disk, simply change the device number (1) to indicate the disk (8). Then add ",S,W" after the filename to indicate that you want to write a sequential data file:

```
OPEN n,8,1,"0:filename,S,W"
```

The only other changes that are required are to change any PRINT#n commands that write to disk. BASIC normally sends a carriage return (13 decimal) and line feed (10 decimal) at the end of each line printed or transmitted. This would normally be written at the end of each string written in the disk file. To be able to read this data back from the disk, BASIC expects only a carriage return at the end of the string. Thus, you must write only a carriage return at the end of each string written in the data file. You should therefore change any

```
PRINT#n,".........."
```

statements to the following form:

```
PRINT#n,"..........";CHR$(13);
```

to eliminate the trailing line feed character normally written. For convenience, you might want to define a variable CR$ =CHR$(13) in your program and then simply use this form to write data on disk:

PRINT#n,". . . . .";CR$;

Don't forget the ending semicolon, or else you'll still get the ending line feed character as before (along with an added carriage return). With the new DOS 2.1 ROMs, this last problem has been corrected, and BASIC will only write a carriage return to the disk file (if the logical file number is less than 128). However, making this simple change will work with either version DOS.

The rest of the program should run unchanged. However, when reading or writing disk data files, it is customary to read the disk error and command channel (channel 15) to check for any disk errors. With the new DOS 2.1 ROMs, you only have to check the DS or DS$ disk status variables to check for any errors.

I'll be happy to provide a copy on tape of any of my programs published in this column if you send $2 to cover expenses. In this case, I'll even include a copy of another utility program that will copy data files from disk back to tape. Together, these two programs allow copying data files back and forth between disk and tape without destroying the format of the data in the files.

Magician's Hat

I just recently previewed The Magician's Hat from Southern Software Limited of New Zealand. This fantasy simulation game with animated graphics presents a simplified role-playing character in an easy-to-comprehend fashion. The game is simple enough for most children to learn and enjoy, yet complex enough to present a real challenge for adults.

The game sends you forward to locate the good magician's hat that has been stolen and hidden in the land. You have three weeks to find the hat along with as many treasures as possible. As typical of adventure games, you move throughout the confines of the game and fight off various monsters while searching for the hat. There are nine commands to control your normal movement or actions, along with casting spells or imbibing vials of magic potions, etc.

Even though the material is similar, the Magician's Hat differs in concept from contemporary fantasy games. In most fantasy games, the character has pre-defined intelligence and wisdom. In Magician's Hat, more realistically perhaps, the game player must possess these attributes, while the real-world attributes such as strength and health are looked after by the program.

The combat system is quite different from the more usual dice-rolling systems. Actual blows are traded while being graphically animated. There are 13 commands to control your character's actions when fighting while you watch the results.

The documentation clearly defines the major commands and basically how to play the game. It is, however, deliberately sparse in some aspects to allow the player to discover the "hidden" features of the game, e.g., just what does and does not score points and what the effects of the various treasures are.

The program in general was interesting, challenging and very well written. It should be available here in the USA very shortly with a suggested price of $25. However, the sample copy that I previewed would not run with the new disk ROMs. Hopefully, they'll have a version for DOS 2.1 by the time the program is available.

By the way, the authors have included a rather unique disk protection which will not allow you to display the disk directory. Whenever you attempt to list the directory, you get a program title and copyright notice displayed instead.

MICRO QUIZ

What Does This Program Do?

After the following program is executed, what is the value of S?

```
DATA 5, 20, 15, 60, 60, 72
S=0
FOR I=1 TO 5
    READ X
    S=S+(X/I)
NEXT I
```

(answer on page 172)

By Frank J. Derfler, Jr.

Mobile Micros

Overcoming the "Limitation of Location"

In this series dedicated to the use of microcomputers in data communications, we have reviewed many different kinds of message systems and have met some of the personalities behind them. We have looked at quite a bit of hardware and software designed to help you move information over the phone lines with your microcomputer. The coming year promises to be even more exciting. We have some proven systems available now and can turn to devising more innovative uses for message systems and communicating terminals.

In this issue we will first look at the past and the future. Then we will return to the present and describe two very important communications systems for today and tomorrow.

Plus and Minus 12 Months

When I first started writing about data communications using microcomputers, I had to carefully introduce terms such as CBBS, ABBS and Forum-80. Over the last few months, thousands of computer users have entered these systems for the first time. The system operators consider themselves to already be in the third generation of the microcomputer-based electronic message system phenomenon. The systems have increased greatly in capability and ease of use. The number of proven hardware and software packages for smart terminal operation has expanded so rapidly that the owners of some systems, such as the TRS-80, have about ten alternative routes to terminal operation.

In the past, our communications systems (TV, radio and phone) have forced us to be hooked up and ready to receive at the specific time a message is sent. I have called this the "time tyranny of telecommunications." Our various computer-based electronic message and information systems have broken this time tyranny; they store messages and information so it is available when and how we want it. But there is still another limiting factor: place. I still have to physically be near a terminal to use the message systems. The terminals have been only semi-portable.

Now, the "limitation of location" is being broken too. Radio Shack, Sharp and Panasonic have introduced completely portable microcomputers. Panasonic advertises theirs as a terminal (complete with printer), and modem capability for the other units should be advertised very soon.

I can't see too many other practical functions for these handheld computers except for data terminal use. This is perhaps the ultimate extension of distributed processing. The proliferation of handheld computer terminals will require new formats for our message and information systems, but these changes will be mainly cosmetic. These portable computers/terminals will begin to break down the limitation of location. The next steps?

Well, we will certainly have to integrate our cars into the systems. Energy crisis or not, Americans still love their mobility too much to give it up just to telecommunicate. Amateur radio and particularly CB have proved the popularity of communicating on the go. We want our communications with us as we motor along.

Who will be the first to tackle the problems involved in mobile data communications? I have heard only a few discussions of possible data transmission on CB channels, and, of course, I have described some of AMRAD's activities. But these have not tackled the tough problems of simplex vs duplex, error correction, etc. Many more exciting challenges

The CompuServe information service allows owners of microcomputer systems (such as the one shown above) and of computer terminals to access a variety of information—from up-to-the-minute news to family service information, from personal financial programs to current and historical stock data, from programming languages to electronic games.

There must be a better way to get information "inside" the mind.

and opportunities are coming.

After the limitation of location is shattered, I suggest the "man-machine barrier" will be next. Reading information is just too slow. It also prevents you from driving and doing many other things simultaneously. There must be a better way to get information "inside" the mind. Perhaps some sort of bioelectronic or bioelectromechanical link will be next.

Ridiculous? Well, 18 months ago what would you have said about a palm-sized BASIC-speaking complete microcomputer? The man-machine barrier must fall.

Back to Today

The future is intriguing, but the present is pretty good too! Let's look at two present systems. One is an information utility, and the other is a communications carrier. Both have new ideas and healthy competition.

CompuServe

You have read about MicroNet and seen their ads in this magazine. CompuServe is the parent corporation of MicroNet. They are gradually lowering the profile of the MicroNet information utility in favor of a larger system under the CompuServe label. CompuServe is moving rapidly from a computer utility to an information utility. The difference comes from the amount of prepackaged and stored information and the number of ready-to-run features available.

A CompuServe user can still write his own programs in any of about six higher-order languages and use megabytes of memory for file storage. But now he can also receive the Associated Press news reports, news from major newspapers, stock quote services, bulletin boards, electronic mail, electronic newsletter services and games, too.

Entry into CompuServe is made either through their own dedicated local telephone ports or through the Tymnet packet transmission network. Simply stated, this means you call a local phone number, hook up your modem and sign on, *if* you are in an area covered by CompuServe or Tymnet.

The network is getting bigger each month, but if you are in many stretches of the north central U.S. or away from major cities, you may have to make a long-distance phone call to access the system. If you enter through a CompuServe port, the service costs you $5 an hour. You have to add $2 more an hour if you enter through the Tymnet system. Your $5-$7 an hour buys you 72K bytes of working memory and 128K of disk storage with no additional charge. The system is available from 6 PM to 5 AM your local time on weekdays and all day Saturday, Sunday and holidays.

The system still retains some of its original computer-utility flavor. Entry into some special users' bulletin boards is done by inserting a long command including periods, abbreviations and brackets. The system managers are moving away from this difficult form of entry, and easy-to-use menus are appearing. Service is very fast, and the system is reliable. You are actually using a network of 21 Digital Equipment Corporation mainframes when you use CompuServe. There is a lot of redundancy built in.

The news feature uses menus to sort down to general topics. This is the same concept used by viewdata and other videotext services. This is in contrast to the word or subject sorts available on The Source. It is easy to read messages on the electronic mail system, and the service is very fast, but it is difficult to enter messages previously prepared off line. The entry program spends too much time sending line numbers and page tops. The common user bulletin board really has too many commands available. A long learning curve is needed to get the most out of this feature.

Some very fine special-interest bulletin boards are available on CompuServe. There are Heath, TRS-80, Micro-Connection and amateur radio groups currently active. The command programs on these bulletin boards are very smooth and easy to use. If you spend some time on these special-interest bulletin boards, the CompuServe hourly rate will probably be less than the equivalent cost in long-distance phone calls.

Other features include high-quality multi-player games (real-time Startrek is my favorite), food and recipe information from the *Better Homes and Gardens* magazine and news from 12 regional newspapers. The MicroQuote service gives very complete stock prices and history, but it costs extra to use.

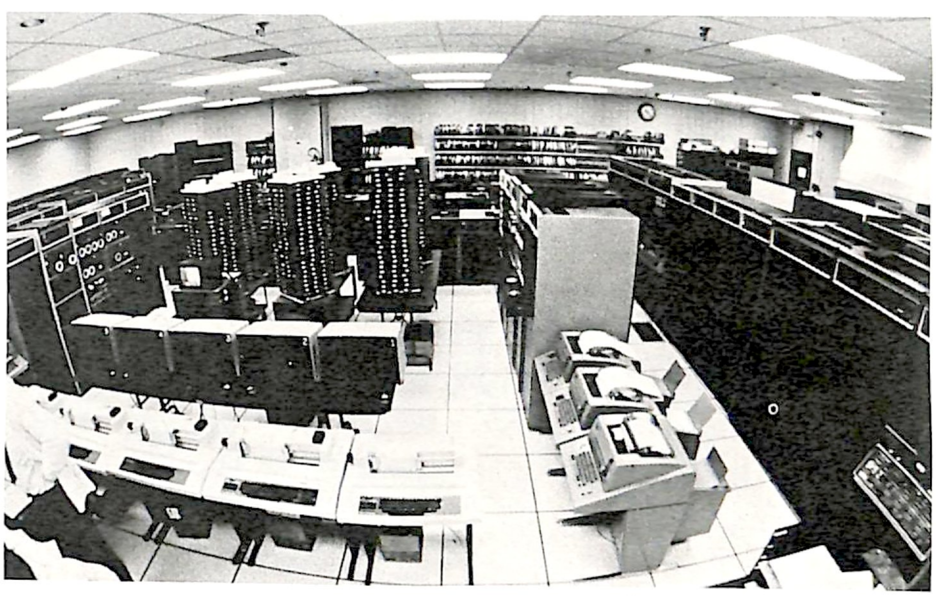
If you need a lot of disk space or working memory, or if you want to use several different computer languages, CompuServe is a bargain. If you have a lot of correspondents across the country, the electronic mail system is reliable. If you have the money to play challenging interactive games with other users, the system can be a lot of fun. Otherwise, CompuServe can give you the experience of entering into the future world of information utilities with litte initial cost.

CompuServe has joined with Radio Shack in marketing their service. In many Radio Shack stores you can buy a package containing a CompuServe access code, a program to allow a TRS-80 to work into the system through a modem and one hour of service time for less than $30.

MCI

MCI Communications Corporation is a long-distance telephone company. I introduced you to the Sprint long-distance telephone service (August 1980 *Microcomputing*), which is practically identical to the service MCI provides. Both companies are in the business of building and operating facilities to provide long-distance telephone service at rates substantially lower than AT&T.

This is certainly good news for users of



CompuServe's computers are located in two modern computer centers in central Ohio, such as the one shown above at 5000 Arlington Centre Blvd., Columbus, OH.

message and information systems a long-distance call away. The service is easy to use and reliable. MCI has about 60,000 business customers who can attest to its value. The cost savings over regular telephone services range up to 50 percent, especially in the evening.

Before we all applaud, I have to say a word about the relationship between these long-distance carriers and the traditional telephone companies. MCI and Sprint are skimming the cream. Remember who has to run the local circuits to the little old lady in tennis shoes 40 miles from the telephone exchange. Remember who has to maintain and update all of the switching systems and who made the initial investment in what has been the world's best telephone system. Remember these things when you pay your local bill, but then consider using the cheaper long-distance services because, after all, it is your money.

If you have long-distance charges of over $25 a month, you should consider an alternative long-distance carrier like MCI. The service is available 24 hours a day. Your savings from 8 AM to 5 PM during the week average 30 percent. Between 7 PM and 11 PM the savings range from 40 percent to 60 percent. There is a $10 monthly service subscription fee.

MCI also offers a Super Saver service with a subscription price of $5 a month. This service is only available from 5 PM to 8 AM local time and weekends and holidays. MCI's services are not available everywhere. Check your phone book or write: MCI Telecommunications Corp., 1500 17th St., N.W., Washington, DC 20036.

System Lists

My list of electronic message systems has over 225 phone numbers on it, but many of them are not valid. I have had some agonizing experiences trying to keep current lists published, despite close cooperation from *Microcomputing*'s editors. For these reasons, I am not going to publish general lists of systems any longer. If you have a data communications capability, I suggest you check one of three systems for the most accurate listings. On the east coast, check the AMRAD CBBS (703/734-1387); in the central area, check Bill Abney's Forum 80 at 816/861-7040; on the west coast, Bill Blue's ABBS (714/449-5689) always has a good list. If you don't have data communications capability yet, but would like to know if there are any systems near you, drop me a self-addressed stamped envelope and include your area code. I will tell you if there are any systems in your vicinity.

If you have any data communications comments or questions, send them to me and include a stamped envelope if you want a reply. Send electronic mail to TCB967 on The Source; 70003,455 on CompuServe or the AMRAD CBBS.

AS THE WORD TURNS By Eric Maloney

Data Are Dead: Long Live Data

"Data" is one of the most misunderstood words in the English language.

Once upon a time, it was simply the plural of the word "datum." The *Oxford English Dictionary* defines "datum" as "a thing given or granted; something known or assumed as fact, and made the basis of reasoning or calculation; an assumption or premise from which inferences are drawn."

But "data" refused to sit still. By the middle of this century, it had come to mean "facts," "information" or "statistics." And to the horror of purists in England and America, everybody started using it as a singular noun, as in "Check your data to make sure it is correct." Swords were drawn, and the battle has raged ever since.

H. W. Fowler's *A Dictionary of Modern English Usage*, published originally in 1926, stated flatly that "data" "is plural only." Margaret Nicholson's *Dictionary of American-English Usage*, published in 1958, agreed. So did the *New York Times*' Theodore Bernstein, the preeminent word hound of American journalism; he declared that "The use of 'data' as if it were a singular noun is a common solecism. . . . Data is plural."

Even as late as 1966, Wilson Follett's *Modern American Usage* stated that "those who treat *data* as a singular doubtless think of it as a generic noun, comparable to *knowledge* or *information* . . . . The mistake is easy for anyone who has no feeling for Latin. But there is as yet no obligation to change the number of data under the influence of error mixed with innovation."

Not everyone has been as unequivocal. William Strunk and E. B. White, in their book *The Elements of Style*, write that "data" is best with a plural verb, but concede that the word "is slowly gaining acceptance as a singular." Rudolf Flesch's book *The ABC of Style* gives its seal of approval to data as a singular, too, as do the *Harbrace College Handbook* and the United Press International *Stylebook*.

Meanwhile, back at the data bank, the computerists continue to bang away at their keyboards, oblivious to the fact that a controversy even exists. Data *is* entered, data *is* retrieved, data *is* analyzed, and no one gives it a second thought. If data *are* processed anymore, the computerist is probably a grammarian, too.

Unwittingly and without regard to etymological propriety, computerists have swarmed the purists' bastions and annihilated once and for all the word "data" as a plural. I wonder what the late Mssrs. Fowler, Bernstein and Follett would have to say. I would like to think that even though they might not approve of the face-lift, they would be pleased to see data's long and promising future as a living word.

A note on the words "disk" and "disc." Most of our authors use the former spelling, but occasionally we get a manuscript from someone who uses the latter. Our style is to use "disk." This is not because one is innately better or worse than the other—they essentially mean the same thing. But "disk" is the preferred spelling, and we use it exclusively in order to be consistent. Besides, "disc" is too much like "discus," which is tossed vigorously into the air, a procedure we do not recommend to our readers.

By Eric Maloney

Home Banking Experiments

Industry Awaits Results

Banking at Home—Pt. 2

Last month's Micro-Scope discussed the Electronic Information home banking service being offered by the United American Bank, Radio Shack and CompuServe in Knoxville, TN. This month, we'll review some other experiments going on around the country.

Electronic home banking is still in its gestation period. Yet, several experimental projects around the country are bringing such service closer to the home of the average American.

- In Columbus, OH, Banc One recently completed a three-month home banking experiment called Channel 2000. Some 200 customers were able to use their television sets to take advantage of four basic banking services via their phone lines.
- Mission Cable of San Diego, owned by Cox Communications of Atlanta, is field-testing a two-way cable service called Interactive Data Exchange (Indax) that includes several home banking services. Indax will also be available in Omaha, NE, starting June 1.
- The Chemical Bank of New York will use microcomputers (it won't say which make) as part of a home banking experiment to start in the second quarter of this year. The project will involve some 400 customers.
- Viewtron, an experimental interactive videotext system conducted by Knight-Ridder and AT&T in Coral Gables, FL, offered several home banking services to its 160 test families.

So what have these experiments revealed to date? Not much more than that home banking is a technological reality, but an unknown commodity for an undefined marketplace.

"We're still getting our house in order," says John Fisher, senior vice president of Banc One. "It's awful early yet to determine who the players are, where the capital is going to come from, what the regulatory problems are going to be, and what marketing skills are necessary. We'll be spending the next couple of years refining, trying to construct what the real world will look like."

William Cornfield of the Chemical Bank of New York agrees, and says that projections and marketing studies have little to do with what the future really will be.

"While the studies are possibly indicative, it's hard to ask someone for an opinion on something people don't have and, in my opinion, don't understand." he says. "Also, the information is skewed toward certain types of people that aren't necessarily representative of the customer base."

Most of the projects are offering traditional banking services at the outset, related mostly to basic funds transfer and account reporting. Other services, such as budget control and tax preparation, are still down the road.

To access a home banking service, the customer is given some kind of personal ID number that he must type in on his keyboard. In the case of Indax, the code number will only work on his own terminal. Customers of the Express Information service in Knoxville, TN, are also given a special security ROM pack for their TRS-80 Color Computer. All of the systems provide two or three levels of security in the hardware and software to protect the customer against unauthorized access.

Once the customer has gained entry into the bank's computer, he views a menu of possible services, and selects one. He may, for instance, decide to pay some bills. He'll tell the bank how much money he wants taken from his account, to which businesses he wants it transferred and on what date. The computer then asks the customer to verify each transaction. In the case of Indax, the customer must type "99" to complete the transfer. He can then call up a record of his transactions and the standing of his account.

Nearly everyone agrees that to succeed, home banking must be sold to the consumer as part of a larger package. A terminal, intelligent or not, is an investment that most families won't be able to justify merely by the convenience of banking at home instead of at the bank.

Thus, in most of the experiments, the customers have a variety of other services available to them. Indax, for example, will provide its subscribers with the opportunity to shop by computer, and the chance to access the electronic information service The Source. Channel 2000 customers were able to use a card catalogue of the public library and a video encyclopedia. And the Chemical Bank is investigating possible hook-ups with The Source and CompuServe.

And what about the advantages and disadvantages of viewdata—over telephone lines—vs teletext—via television signals?

"The press shouldn't allow that to be controversial," says Fisher. "You should care less what the communications medium is. You should encourage them."

He acknowledged, however, that it's "hard to get cable TV's attention. The cable mentality is still entertainment. The people running cable are TV people. They think pictures, we think data."

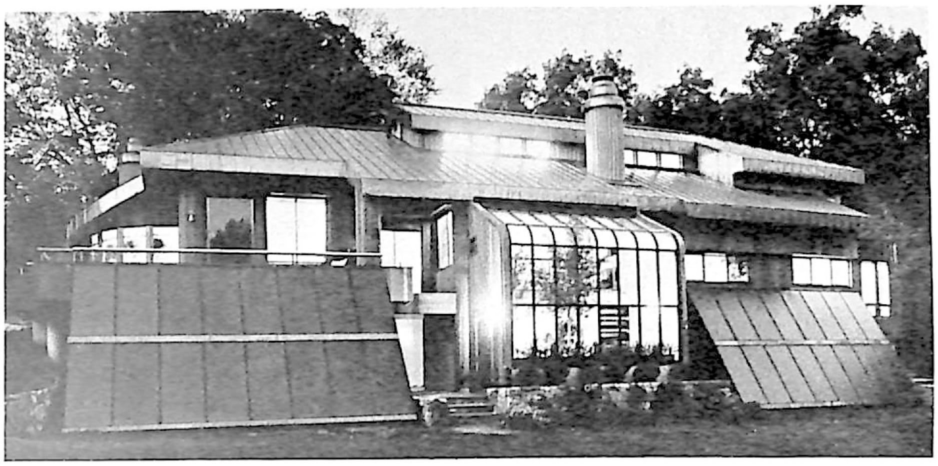
So how soon will it be before the average microcomputerist on the street can add home banking to his list of applications? No one is making predictions. The banking industry is still in the early stages of marketing research and analysis, and won't move ahead until it's convinced that people want home banking and other videotext services. The experiments of 1980 and 1981 should give them a better idea.

Heats the Hot Tub, Too

We couldn't make it to the gala opening, but the news release was impressive.

"One of the most computerized homes ever built, the Sun/Tronic House is

✓Reader Service—see page 194



Night view of the rear of Sun/Tronic House emphasizes the greenhouse/solarium (center), and reveals, inside to the right, one of the home's passive copper solar walls. On either side of the greenhouse are solar collectors that, with the various passive solar systems, supply more than 60 percent of the home's space heating and domestic hot water needs.

equipped with a highly sophisticated computer system that controls all aspects of the home's energy and other mechanical systems, and also acts as servant, nursemaid, secretary, guard, in-home entertainer and accountant."

The house, built in Stamford, CT, includes an Apple II computer system. Situated in the library—"the home's operational control center"—the Apple:

- retrieves, on a TV screen, data on the home's energy performance.
- controls the home's mechanical systems, including the solar collector and photovoltaic arrays on the back lawn, and
- operates the home's security systems, including emergency lighting and power, the burglar alarm, the fire sprinkler system and smoke detectors and summons the police or fire department.

The second Apple, in the family room, is devoted to fun and recreation, and includes a 45-inch television set.

A remote terminal with television set is located in the kitchen for information retrieval: "A typing in of simple instructions commands the computer to retrieve recipes and menus, guest lists of previous dinner parties, and what wines are stocked in the wine cellar, for example."

A second terminal is located in the master bedroom, permitting its occupants to control the home's security lighting, temperature control and insulating shade system, "as well as get the latest stock market readings and determine how much income tax they will have to pay based on current expenditures."

The home's solar collector array supplies about 45 percent of the house's heating and hot water needs. But perhaps most importantly, it will also heat the hot tub.

Also involved in this display of garish decadence are C&D Batteries Division of Eltra Co. (lead-acid storage batteries), Edison Electric Institute (energy systems and programs), W. W. Gaertner Research (computer software, security systems), General Electric (major appliances, housewares, television and audio, lighting, heat pumps) and Solarex (photovoltaic solar cells). The whole thing is orchestrated by the Copper Development Association, which can be reached at 405 Lexington Ave., New York, NY 10174.

Teaching Electronic Journalism

The success of electronic news and information distribution through videotext services depends largely on whether young people interested in journalism are given the chance to develop skills in data communications. Is higher education adapting to the changing climate?

At least two major universities are. Both Brigham Young University in Provo, UT, and Indiana University in Bloomington, IN, are offering courses in electronic news, and hope to initiate on-campus videotext services.

At BYU, mainframes at the library and the campus daily have been hard-wired to an Onyx, which will act as a switching computer. Students, faculty and staff will be able to access the data bases over the campus telephone system, with terminals and modems.

William C. Porter, who teaches a course called "Electronic Publishing" in the school's Department of Communications, says that the paper, *The Daily Universe*, hopes to be publishing an electronic edition called Unitext by the end of this spring.

"We see so much happening, and we feel a need to keep abreast of what's going on," he says.

The department has already conducted several limited experiments to test student response to such a service. For instance, the newspaper sometimes announces in a story that more information is available through several public terminals set up for the purpose. During a recent basketball tournament, the terminals were used to update the scores.

Porter says that BYU has 28 public terminals in the library and about 350 VDTs around campus. He hopes that the service will eventually spread out into the Provo community, and says that the university might also develop a teletext service with a Provo cable television outlet.

The newspaper community has been ambivalent about electronic news, Porter says.

"As we've gone to various conventions, we've found that the working-level editors aren't too concerned. But management is beginning to become interested."

The project is beginning to accumulate an "enormous" amount of information on videotext, Porter says, and might eventually offer it through an electronic bulletin board.

At Indiana University, journalism professor John Alhauser has been tracking electronic news since 1972, and teaches a course called "Electronic Newspaper." Last November, the school sponsored a conference entitled "Electronic Home News Delivery—Journalistic and Public Policy Implications."

Alhauser agrees with Porter that until recently, the print media have not paid much attention to videotext.

"At first, I got nothing but scorn," he says. "There were people who didn't even see the need for electric typewriters, and felt that editors didn't need to learn anything more than spelling and editing."

But he says that as the economic implications for newspapers become more clear, journalists are beginning to take note. Alhauser has spoken on electronic news to a number of organizations, including, recently, the staff of the Milwaukee *Journal*.

Alhauser's course does not deal so much with the electronic newsroom as it does with the electronic home delivery of news. Students discuss regulatory problems, revenue strategies and legal ramifications.

The school's plans for a videotext system are not as far along as BYU's. Alhauser says that a campus committee is studying the possibilities, and the cable company in town is interested.

"But we want to do it in a very sophisticated manner," he says. "And that means trying to drum up some money."

TI and The Source

Owners of the Texas Instruments TI-99/4 microcomputer can now subscribe to Texnet, a home information and communications service being offered by TI and the Source Telecomputing Corp.

Customers will have available all services currently available on The Source, as well as new data bases designed specifically for the TI-99/4. It will also include a text-to-speech capability that lets users hear any messages typed on the computer keyboard or transmitted over the Texnet system.

The Source provides such features as the United Press International Newswire, world airline schedules and travel services, restaurant and wine guides, consumer buying services, The New York Times news and consumer data bases, foreign language drills, an electronic mail service and a job listing service.

The TI news release says the company is actively seeking new software, new data bases and new peripherals for the TI-99/4, and expects to develop a variety of new services for Texnet, from within the company and from third-party developers.

TI spokesman Dan Garza says that details on the arrangement and the necessary software would be released sometime in the first quarter of 1981, but says that Texnet's emphasis will be on the "unique color, sound, graphics and speech capabilities" of the TI-99/4.

Time Frame	Projected Revenues ($ millions)	Percentage Leakage From Paper YP/CA (%) To EYP
1980	<1	-
1981	5	-
1982	10	.1
1983	30	.3
1984	110	1.0
1985	250	2.0
1986	580	4.0
1987	940	6.0
1988	1400	8.0
1989	1900	10.0
1990	2500	12.0

Ten-year projections for electronic yellow pages/classified advertising revenues.

Electronic Yellow Pages

Electronic yellow pages are just around the corner and should help stimulate the home terminal market, says a report recently issued by the International Resource Development, Inc.

The report says that revenues derived from such services should reach $200 million by 1985 and $2.5 billion by 1990.

The IRD report cites several recent developments in the electronics industry that should promote the development of EYP:

- GTE is offering an Infovision service to the Washington *Post* and other newspapers that will let them become a local EYP operator. Local information banks will be supplemented by access to centrally-provided databases and services.
- The *Arizona Republic* and the Phoenix *Gazette* have formed a joint company, RG Cable, and will sell classified advertising and editorial content on three leased channels to cable companies.
- AT&T has designated electronic yellow page service as one of the priorities of its new nonregulated subsidiary.

In France, the government-controlled Post, Telephone & Telegraph organization is planning to phase out paper telephone directories over the next 15 years. Customers will get a $100 terminal with a keyboard to access directory information.

The terminals, manufactured by the French company Telic, will also be used for GTE's Infovision service in the U.S.

The report says that such EYP services will supplement such videotext services as Source Telecomputing and CompuServe.

Not everyone is overwhelmed by excitement at the prospect of electronic classifieds. The newspaper industry would like to restrict AT&T's role in EYP, and foresees a significant loss in advertising revenues.

For more information on the report, entitled "Electronic Yellow Pages," contact the IRD, 30 High St., Norwalk, CT 06851 (203-866-6914; Telex 643 452).

"Hi. My name is..."

"I never thought a desk-top computer could impress me so much, but that's exactly what happened when I experienced the Apple II personal computer."

So begins the full-page Apple ad that has been appearing in major dailies around the country. The author: Dick Cavett.

Paying a well-known personality to trot out your product is a time-honored marketing strategy. But Cavett's enthusiastic endorsement of the Apple II is the first of its kind in the micro industry.

It undoubtedly presages important things to come. For instance, a news release recently crossed our desk announcing that Pele, "the greatest soccer player of all time and a living legend," will be pushing Atari's new home video soccer game cartridge.

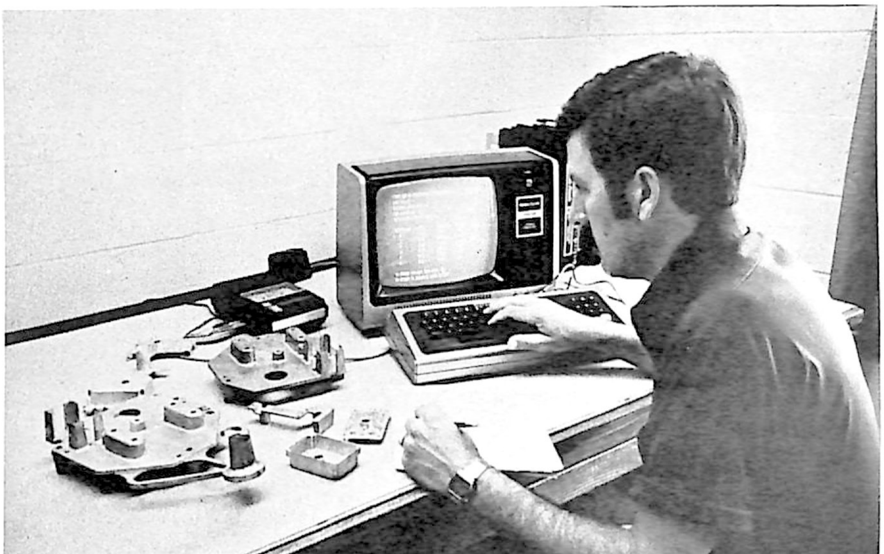
"Pele's personal approval of Atari's soccer game cartridge will be especially valuable overseas, where soccer is the number one sport in more than 140 countries," the release quotes Chairman and Chief Executive Officer Raymond E. Kassar.

Who's next? Benjamin Spock for TRS-80s in the schools? Neil Armstrong for space games? Marilyn Chambers for Interlude?

Micros and the Handicapped

A contest designed to stimulate ideas and inventions to aid the handicapped through computer technology is being sponsored by Johns Hopkins University.

Johns Hopkins, along with the National Science Foundation and Radio Shack,



I Zinc, Therefore... *A TRS-80 computer is being used by the St. Clair Die Casting Co. in St. Clair, MO, to design the zinc die castings that go into solid-state computers for service station gasoline pumps. The program, called ThinWall, is being offered to die casters around the country by the Zinc Institute.*

is offering a $10,000 grand prize and 100 other awards, including 15 personal computer systems.

Submission categories include computer-based aids for the blind, deaf, and mentally retarded; individuals with learning disabilities, neurological or neuromuscular conditions; and the orthopedically handicapped. Entries can be a device, system or computer program.

The contest runs through June, 1981.

For more information, write Personal Computing for the Handicapped, Johns Hopkins University, PO Box 670, Laurel, MD 20810.

First CRTs, Now Teleprinters

Last month, "Micro-Scope" mentioned a *Monosson View* report that only 20 of 150 cathode ray tube manufacturers would survive the 80s. This month's shake-out prediction comes from Venture Development Corporation, which says that as many as 14 of 32 U. S.-based teleprinter manufacturers could be in trouble.

The report mentions that three companies controlled over 60 percent of 1980 shipments. These and 15 other manufacturers have good growth potential, but the rest "will continue to lose market share."

VDC predicted late last year that teleprinter sales would decline in 1980, even though DEC and Teletype can't keep up with their orders. They quote one manufacturer as saying, "Competition from the big guys is getting fierce. They're lowering their prices, and we can't afford to do that. It looks like we will be getting out of this business pretty soon."

Non-impact teleprinters are the fastest-growing sector of the market, while the daisywheel segment of the impact teleprinter market is also doing well.

Further information on the report, titled "The Teleprinter Terminal Industry: A Strategic Analysis" is available from Wendy Abramowitz, Market Research Analyst, VDC, 1 Washington St., Wellesly, MA 02181 (617-237-5080).

A View from Beyond

A friend of ours in San Francisco who knows nothing about microcomputers recently read a copy of *Microcomputing*, and passed along the following observations:

"The issue of *Microcomputing* you sent me was just the right thing to thumb through while vaguely conscious between naps on the living room carpet. After my perusal—which was much more than that, really, since I read almost all of every article—I can see why one needs to be a good editor in the face of all this carefully thought out incomprehensibility.

"It was a delight to read those articles about I don't know what and feel the voices of their individual authors coming through to me. Some hum, some instruct, some climb over your shoulder, some lead the way with a torch, some sit back and laugh at everybody wandering around so eagerly. Man vs Hardware. The battlefront of the age.

"The overall picture I received of this particular point in the contest was that the hardware is trying to overwhelm the software, the program, the soft human noodle, with sheer unexplored capability, irrascibility, and sudden charming spurts of unexpected strength. Sparks are flying, little things are being experimentally soldered to big things, plugs are being turned upside down and plugged back in, more or less just to see what happens, MAC is put into contact with PET so they can gossip about the recent rumors concerning LUG's new hat and see what they can come up with for themselves, in the hasty half-hour before they go out on the town.

"Opera, that's what it was like to watch this show unfold, all the words incomprehensible but the gestures and voices and music behind them pretty much giving me the drift, and myself enjoying filling in the wide blanks with hilarity or tragedy as fit the mood of the moment, and no worries about accuracy to trouble me up here high in the peanut gallery. My thanks for the free ticket to the show."

How's your love life?

A little dull around the edges? Routine? Predictable? Boring? Maybe all it needs is a little Interlude. Interlude is the most stimulating computer game ever conceived. It combines a computer interview, an innovative programming concept, and a one-of-a-kind manual to turn your love life into exciting, adventurous, delicious fun!

Interlude is: romantic...playful...outrageous...a fantasy. Interlude is: ■ A Bed of Roses (Interlude #1) ■ Mata Hari (Interlude #49) ■ The Chase (Interlude #7) ■ Rodeo! (Interlude #71) ■ The King and I (Interlude #60) ■ Some Enchanted Evening (Interlude #84) ■ Caveman Caper (Interlude #82) ■ From Here to Ecstasy (Interlude No. 30) ■ Satin Dreams (Interlude #72).

More than 100 Interludes are included in the program. Most are described in detail in the accompanying manual, but several surprise Interludes are buried in the program awaiting that very special time when your interview says you're ready. (When you learn secret Interlude #99, your love life may never again be the same!) Interlude can give you experiences you'll never forget. Are you ready for it?

Interlude™ 235
The Ultimate Experience.

INTERLUDE, 10428 Westpark, Houston, Texas 77042. I'm really ready. Send my Interlude today.

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☐ Cassette ($16.95)
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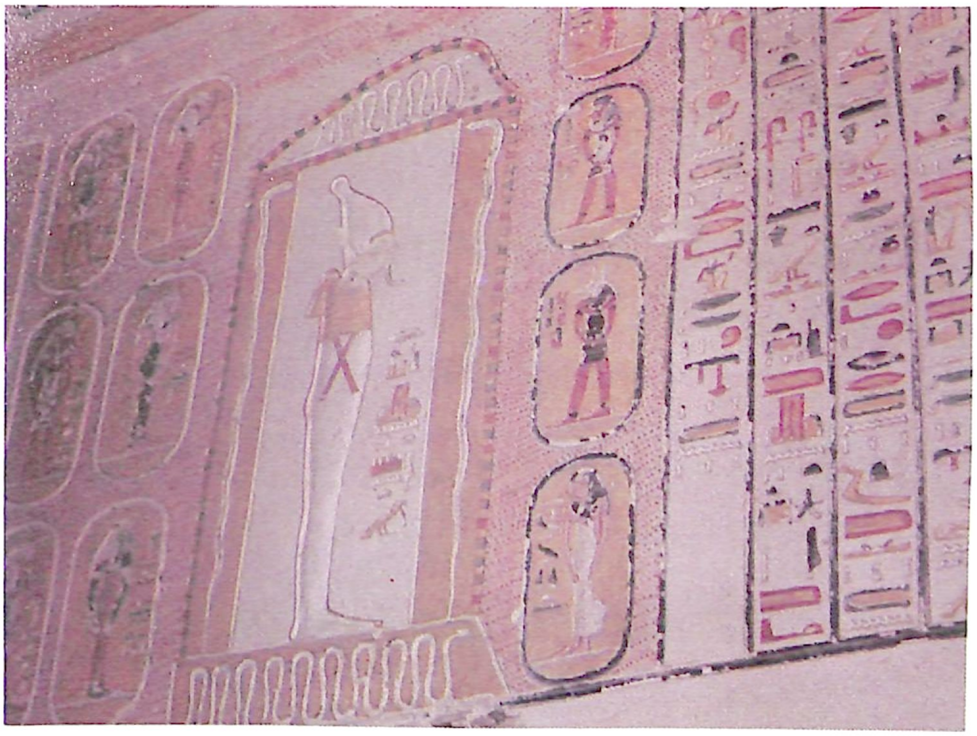
Micros in the Land of the Pharaohs

By Dr. Lloyd A. Case

It is hard to imagine that the microcomputer could revolutionize Egypt. How can revolution have meaning in a land synonymous with the timeless Sphynx, the pyramids and the origins of science itself?

Yet micros and other computers will play an important role in Egypt's future. And though Egypt faces many problems developing its computer capabilities, its leaders are well aware of the potentials.

As part of its program to develop its technological resources, the Egyptian government has been contacting American companies that supply computer-related services. My company—System and Computer Technology Corp.—was one of them. The Egyptians asked us, as specialists in computer facilities management in higher education, to visit their universities, observe their computer facilities and computer science curricula, and evaluate their programs.



Computer language of its day? Egypt abounds with the art of the pharaohs. This figure at Karnak represents Hapshepsut, a female pharaoh. Her name and face were scratched out in this art at the order of her successor, who believed it would kill her soul and end her immortality. The vengeful successor missed finding all her art, and she lives in memory today.

During our 17 days in Egypt, from the Delta to the Nubian regions, we gave a seminar on computering to a large group of university administrators from throughout the country, spoke with the minister of education and scientific research, visited the Aswan Dam and discussed computers with a number of educators. All in all, we were impressed with the number of educational and technological contrasts between Egypt and the U.S., and the explosive potential of computer technology there.

We Arrive

Upon our arrival, we were met at the Cairo airport by Dr. Mostafa Helmy, the minister of education and scientific research. He was accompanied by others from the ministry, who graciously welcomed us with smiles and handshakes. We were particularly appreciative of their welcome, because throughout the airport, Egyptian soldiers with fixed

Dr. Lloyd A. Case is director of Systems and Computer Technology Corp., 2900 Community College Ave., Cleveland, OH 44115.

bayonets were on guard.

Early the next morning, we were escorted from our hotel to the office of the minister. Although the building was being painted, its size and stature left no mistake that it was a national government office. Everyone we met there was cordial and pleasant; everyone seemed to speak fluent English.

In our time with Helmy, he described the country, its educational system and the effects of the war with Israel. He described a need for technicians in Egypt and the lack of any educational system to really meet that need. We discussed cooperative ventures between United States and Egyptian educational institutions.

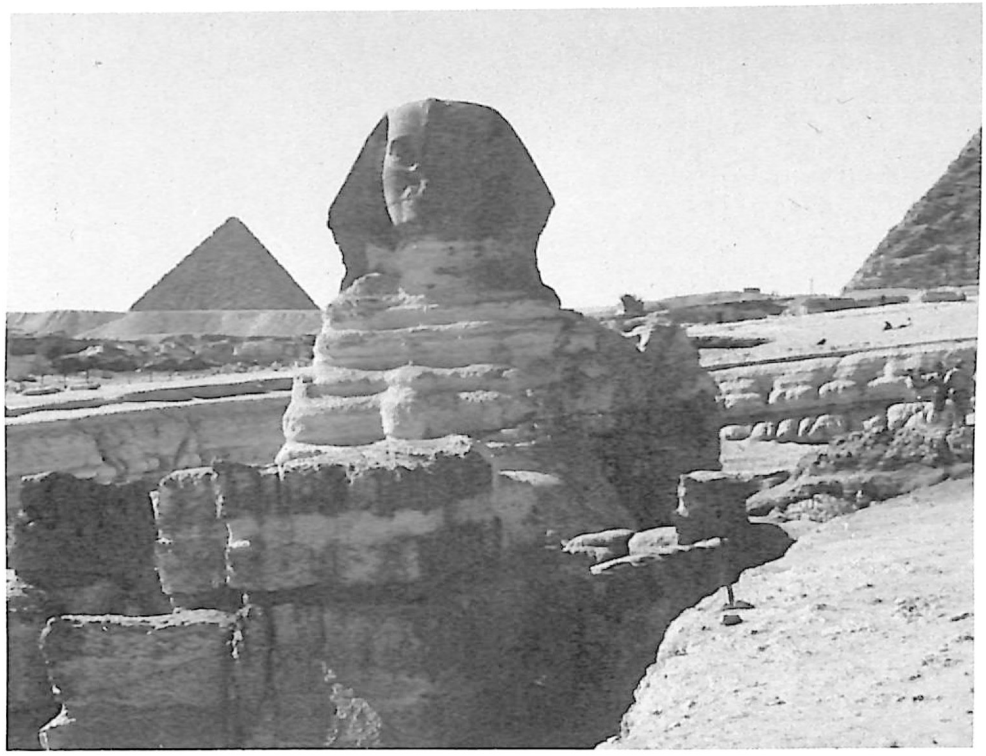
Egypt's educational system is based on Britain's. Post-secondary educational institutions train people for technical careers. Dr. Helmy expressed interest in establishing technical institutes or something similar to a community college system throughout his country.

He told us that Egypt's industry and economy suffered from a lack of technicians. But it should not be inferred they have weak universities. We were impressed throughout our visit by the skills and high level of the graduate programs in the university system.

After leaving the minister we visited some of the universities in Egypt. A number of the presidents, vice-presidents and deans showed an impressive computer literacy and appreciation for state-of-the-art technology. They were well aware of microcomputers, large-scale integrated circuits and advances in home computers. One dean of medicine asked about 16-bit microprocessor chips.

They all expressed a desire to see Egypt benefit from the latest technology. They often echoed the one major concern that Dr. Helmy had stressed: they felt that their country could never leap ahead economically and industrially without plentiful technological capacity, particularly in computing and electronics.

One can appreciate this need when considering that the two largest universities in Cairo (enrollments of about 90,000 and 180,000 each) operate admissions and registration, and keep all student records without the aid of computer. Such a task is unthinkable in American universities of even one-tenth their size.



The famous Sphinx represents Egypt in many ways. Egyptians say in ancient times the Sphinx was nearly covered with sand. A young man slept between its paws and dreamed that the Sphinx asked for his help to be uncovered and repaired. In return, the Sphinx promised that he would become ruler of the land. This came to pass, and as pharaoh of Egypt, the man placed a stone telling the tale at the spot he slept. The stone remains today.

Physicist Dr. Said, director of the computer center at Ain Shaims University, works closely with their computer science program. Said was educated in the United States, at the University of California at Berkeley. We were impressed by his knowledge of some of the most recent developments from Silicon Valley in California.

Later we walked around his computer center. We could have been in any university in the United States. We saw students at terminals scratching their heads, pondering programming bugs in FORTRAN listings. Other students bustled about mounting tapes and ripping paper from the line printer.

These, however, were privileged graduate students in the computer science program. They were some of the few with access to the computer hardware. Said indicated that undergraduates in computer science spent the majority of their time with theoretical matters.

Most of the interest in the computer that we saw at Ain Shaims was in statistical or scientific areas. The faculty of engineering had recently requested terminal access to the computer. The business faculty had indicated some interest but had not yet been given service. Other areas of the university, such as medicine, the arts and agriculture, apparently were not yet interested.

The Computer Center at Ain Shaims is equipped with a Data General Eclipse and an IBM 1130. They were donated by Nobel-prize-winning physicist Dr. Lewis Alverez of the University of California at Berkeley. The equipment came to Cairo as part of Alverez's search for hidden chambers in the Great Pyramid at Giza. Alverez placed scintillation counters to measure the scattering of cosmic rays from the Great Pyramid. The pattern and intensities of the scattered radiation was digitized and sent back to California to be analyzed by scattering formulas. From this the internal structure of the pyramid could be deduced. The process is similar to X-raying the pyramid, except that it uses mathematics rather than a fluorescent screen.

(Incidentally, Alverez's study did not locate any chambers which were not already known.)

In cooperation with Ain Shaims University we gave a seminar on computing to a group of university administrators. The general topic of the seminar was the state-of-the-art in academic computing. The seminar was entirely in English. This was no apparent problem to the Egyptian university people, who all spoke English. Typical questions were: "What evidence is there that the ex-

Today's Egypt is a mixture of ancient and modern: pyramids beside microwave towers. Cairo has begun to improve its telecommunications network using modern state-of-the-art technology but falls behind in the service and reliability in other parts of the world.

penses of computer-assisted instruction are matched by significant learning taking place?" and "Are you aware of efforts anywhere to translate programs or courseware into forms useful to Arabic-speaking students?"

While the vast majority of students appear to be veterans in their mid-twenties, they are like students anywhere. I met a friendly young student named Mostafa selling garments on the banks of the Nile at Luxor. He explained (in fluent English) that he was an engineering student, studying air conditioning and heating. He said that he moonlighted to support his new family. He and his wife had just had a little boy three months before. He complained about inflation and the work at the university.

Other Uses

Continuing our travels, we found other computers being used in Egypt. The University of Cairo's computer equipment serves statisticians in social and urban planning analysis. Toward the end of our trip, we traveled to Ismailia, the headquarters for the Suez Canal Authority. We toured the research and engineering facilities, which use IBM gear to analyze traffic flow and the hydrodynamics of the canal. The Authority also models the economic behavior related to the canal-broadening project now underway.

Suez Canal University is located in Ismailia, but we saw no evidence of cooperation between the university programs and such government projects. The faculty and students did not participate in any cooperative education. This separation of theory and practice is probably part of their British educational tradition.

Although we saw no examples of it, we were told that some Egyptian banks are using computers. We had ample evidence that none of the airlines do. We arrived on Swiss Air from Geneva. We had clockwork service until we reached Cairo, where three of us lost luggage, one for a period of six days. Although the people were courteous and helpful, their efforts weren't aided by a computerized system for flights, reservations or baggage. Swiss Air coordinates its service in Egypt with Air Egypt.

Problems

As a developing country, Egypt is faced with many problems, not the least of which is an inadequate technical education program.

Cairo's universities are huge, and the tuition is free. But the data processing and computer science programs do not have sufficient modern equipment to provide hands-on experience for undergraduates. The electronic laboratories lack digital logic trainers, integrated circuits, digital test equipment and other desirable equipment.

Some students do transfer to American, British or other foreign universities with the hope of receiving superior educations. But Egypt does not have what Americans would consider a middle or upper class, and most students can't afford overseas schooling.

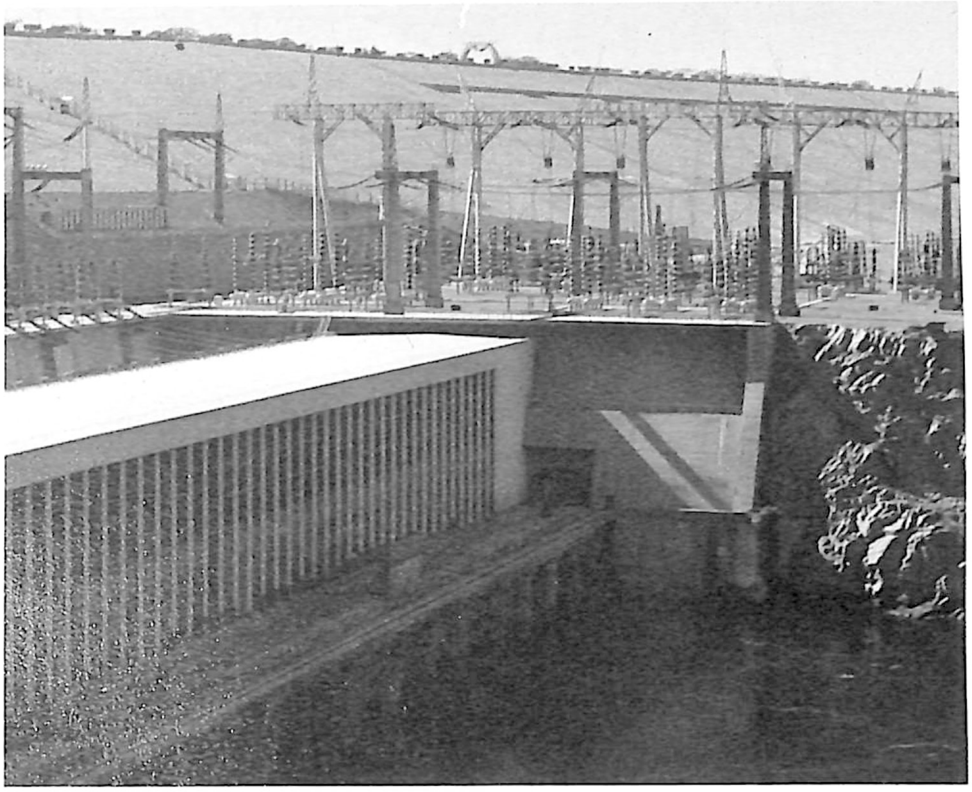
Also, Egypt has an unreliable power supply. The Aswan Dam supplies 60 percent of the country's electricity, and has taken giant steps toward providing power throughout the country. The beautiful 800-year-old Mohamed Ali Mosque, for example, is illuminated by a giant chandelier in which oil lamps have been replaced by electric bulbs. But many large buildings and hotels feel the need for their own power-generating equipment. Blackouts are common, and service interruptions are frequent. In a large computer installation such unreliable power supply would be a terrible source of frustration. Any loss of electrical power more than a few thousandths of a second requires that a computer's memory be reloaded and the machine rebooted, an operation that can take from half an hour to several hours. If this happened frequently, it would be difficult to generate any productive work on even the best computer system.

The telephone service poses another problem. It is nearly impossible to telephone across Cairo. The United States has provided funds to improve the network, but the system still has problems placing calls, finding available connections and maintaining signal levels.

A computer service would have a hard time supporting the telecommunications network. A large installation will probably have to be in the form of batch rather than terminals. This would be a disappointing and dated approach to computer service. The alternative would be for a computer network to maintain its own separate lines or microwave links, but this would cause new problems.

Difficulties are aggravated by a shortage of technicians. The country doesn't have enough to maintain the equipment. If foreigners are hired, they might displace Egyptian workers. This would be a cardinal sin in Egypt—full employment is one of the government's primary goals.

This move toward self-sufficiency applies to products, too. For example, I asked an administrator how he used a new plotter device I noticed. He explained with a smile that it couldn't be used. The special paper it required was not produced anywhere in Egypt, and regulations prevented its



The Aswan High Dam best represents Egypt's commitment to technology and growth. It is a modern-day Egyptian monument in a land of historic engineering accomplishment.

purchase outside the country.

Technicians educated in Egypt often don't stay. Egypt's technical, scientific and engineering students are in great demand in the Middle East. Their abilities in Arabic and English are important in the Arab world, because technological transfer and production depend on interactions with Europe and America. Several government and educational administrators proudly told me they export hundreds of Egyptians throughout the Middle East, particularly to Saudia Arabia and Kuwait. They receive salaries of five to ten times what they might earn at home.

Finally, IBM is the only significant vendor of mainframes in Egypt. But while they sell and service their equipment, they do not manufacture there. Egypt has apparently done nothing special to encourage such manufacture, such as offer tax breaks or incentive purchases. In fact, Egyptian regulations on employment make it unattractive for non-Egyptian businesses to import foreign personnel. Also, import tariffs have been imposed to prevent loss of capital from foreign competition with Egyptian products.

A Visit with Osman Osman

At his home between Cairo and Memphis, we visited with Dr. Osman Ahmed Osman. His company, Arab Contractors, grossed about $300 million dollars in 1978. Their construction activities include ports, bridges, industrial plants, transmission lines, housing developments, railroads, dams, tunnels, reservoirs, hospitals, airports, ship building and land reclamation. They were also the prime contractor for the Aswan Dam and the Suez Canal broadening project.

Osman is proud of his country and is quite pro-Western. He told us that while he worked with the Russians in completing the Aswan Dam, he felt that they had set Egyptian engineering and technology back a decade or more. He said the equipment that they brought to Egypt was highly unreliable, and caused a great deal of delay and frequent problems. He said he angered them by refusing to use it.

Osman was pleased with what President Sadat had done to increase cooperation with the West. He felt Egypt had benefited a great deal from the improvements in equipment and engineering when the Soviets left.

Osman is anxious to improve Egyptian education. His company donated the land and buildings for the Suez Canal University in Ismailia. Its goal is to upgrade the use and benefits of the Suez Canal, its associated ports and the Sinai region. The university has mechanical engineering and building trade programs aimed at development of the Sinai Peninsula.

One of the current projects of the Arab Contractors is the Ahmed Hamdi tunnel under the Suez Canal to the Sinai Peninsula. Osman explained that access to the Sinai via the tunnel would aid in the economic development of this vast area.

Egypt's Future

Microcomputers are particularly suited to skirting some of Egypt's problems.

Unlike mainframes and minicomputers, micros do not need a reliable telecommunications network. The tight Egyptian economy (half its people earn under $500 a year) makes the price attractive, particularly as the number of compilers and the variety of software increase. The unreliable power supply system can be solved by an inexpensive battery.

Finally, the flexibility of micros makes it easier to locate the computing power where it may be needed. Micros can be used in such areas as agriculture, engineering, government, business, transportation, communications, medical science and education.

We saw no evidence that micros had yet arrived in Egypt. But several educators were aware of microtechnology and were anxious to use various chips and systems when they became available. There certainly is sufficient understanding and ability to take advantage of microcomputers.

Conclusion

The time for Egypt to use more modern computer technology has come.

Egypt would probably prefer equipment and technological information more than foreign capital investments. Both private companies and the U.S. government are interested in providing such aid. It is a business opportunity and a boost to the economic stability in that part of the world.

At least one community college in the U.S. is interested. Wayne County Community College in Detroit is considering contributing both computer technology and curriculum designs related to microelectronics and microcomputing. They've proposed an exchange of faculty and students between the community college and the Egyptian universities. It would provide the community college with an exciting foreign campus. ■

✓Reader Service—see page 194

INFORMATIKA experiments in low-budget education.

Teaching Micros in Indonesia

By Maruto Kolopaking

The story began in October 1977 when I read an article in *Popular Science* magazine about computers that cost under $600. Since I worked with systems that cost tens to hundreds of thousands of dollars (the TIAC 827A2, the PDP 11/40 and the IBM 370 model 145), I realized that microcomputers would be a giant step in computing. They would soon produce a revolutionary change in both my country and all over the world.

Since most of our people always misunderstand the concept of electronic data processing (EDP) and are scared of computers, I thought, "Why don't you give them the correct idea and concept of EDP, instead of letting them be confused?" I also thought that my country would lack data processing people in several years, both in large- and small-scale systems.

So in December 1978, a friend and I started working to establish our foundation. The Lembaga Pendidikan Komputer "INFORMATIKA" (Information Educational Foundation), a nonprofit organization, opened in March 1979.

Establishing the Organization

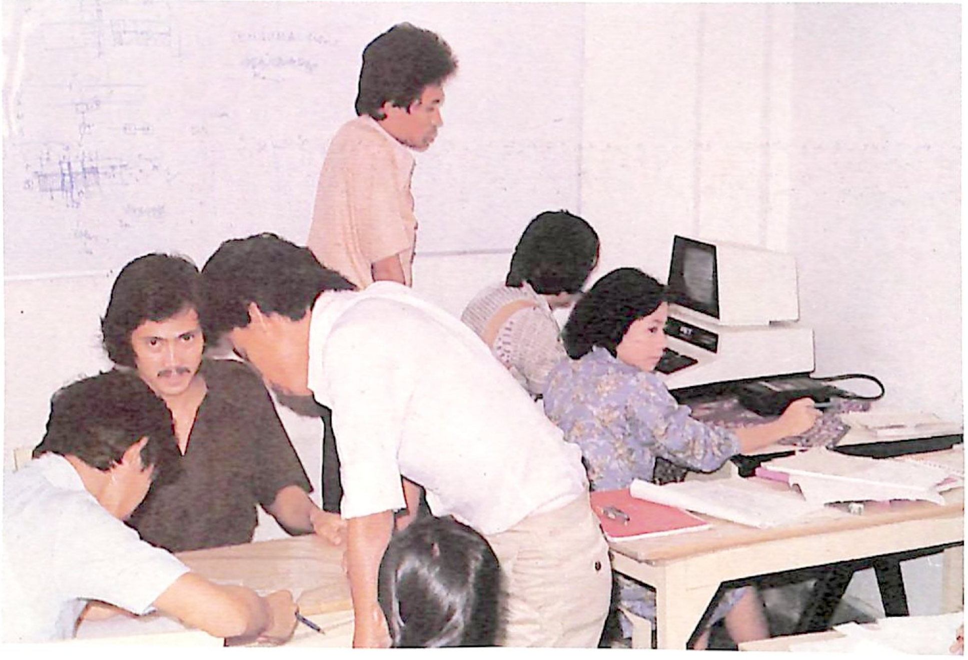
My city is 265 meters (about 870 feet) above sea level at the foot of Mount Salak (10,000 feet), and has a beautiful panoramic view. The rainfall makes the climate not as hot as in other tropical cities. Night temperatures are around 22 degress Celsius, and at noon it is 28 to 30 degrees Celsius. The population is about 300,000, and the city is renowned for the most complete botanical garden in the world. The Bogor Institute of Agriculture is the best agricultural university in Indonesia.

We started promoting our organization by putting small display advertisements and promotional brochures in local newspapers. The response was good. People came and the first class—Introduction to EDP—started with 28. Since our classes can accept 30 people, this number made me quite glad.

Our fees were relatively low by U.S. standards—about $16 for three two-hour classes a week for four weeks. We needed the funds to maintain our organization and for advertising and, of course, to develop our organization.

The class finished in one month, and we started our FORTRAN IV

Maruto Kolopaking, Informatika Educational Foundation, Box 284, Jalah Gunung Gede No. 11, Bogor, Indonesia.



Three students discuss a problem in BASIC programming.

course. We didn't have a computer yet, but this didn't discourage us. The FORTRAN course was useful since many universities in our city work in the scientific field.

Five weeks later we started the FORTRAN programming workshop. We used one IBM 370/145 in Jakarta (68 km from here) and paid $200 per hour. This relatively high charge scared our students, and some people didn't continue the workshop. Of course, we had to charge them more, because we needed to pay the instructor too, and we did not see any alternative.

The class continued with PL/1, COBOL and, of course, FORTRAN IV, but after the theory class, students never had access to the computer because of its higher charge.

An instructor gives guidance to a student.

Software Development in Courses

During the courses in programming languages, we give simple applications such as:

- Calculating the average of several numbers
- Solving some statistical problem with data given
- Solving a simple business problem; print formatting of a list of items in a small inventory system
- An education program

Their response is quite positive. They actively participate and try not to discuss problems with friends when trying to solve them.

The programming workshop has progressed rapidly since we acquired a PET and a TRS-80 computer. We provide workshops in BASIC, and most of the applications are for business. This is because our city is close to Jakarta, which is the capital and the most crowded city in Indonesia. We think the BASIC workshop is worthwhile because we can charge students less, and because we think it is easier for them to program in COBOL and other languages after they have learned BASIC.

We emphasize programming technique—how to sort effectively, how to use variables, when to use matrices and so on. We cover such areas as statistics, payroll, personnel, inventory and graphics.

Hardware

Before we had our own micros, we emphasized large-system programming, with a higher course fee. After three months, I completed a part-time software project for a large system and dedicated the money to our organization. We bought the standard PET 2001 system with 16K and the TRS-80 with 16K, both with cassette. It may surprise you that they each cost about $2400.

After more than a year, we have had no trouble—they are quite good systems. But one item is still in our plans, and it depends on the funds we have. We do not have any printer or disk yet. Our students just write down the results of the program or the listing directly from the CRT screen.

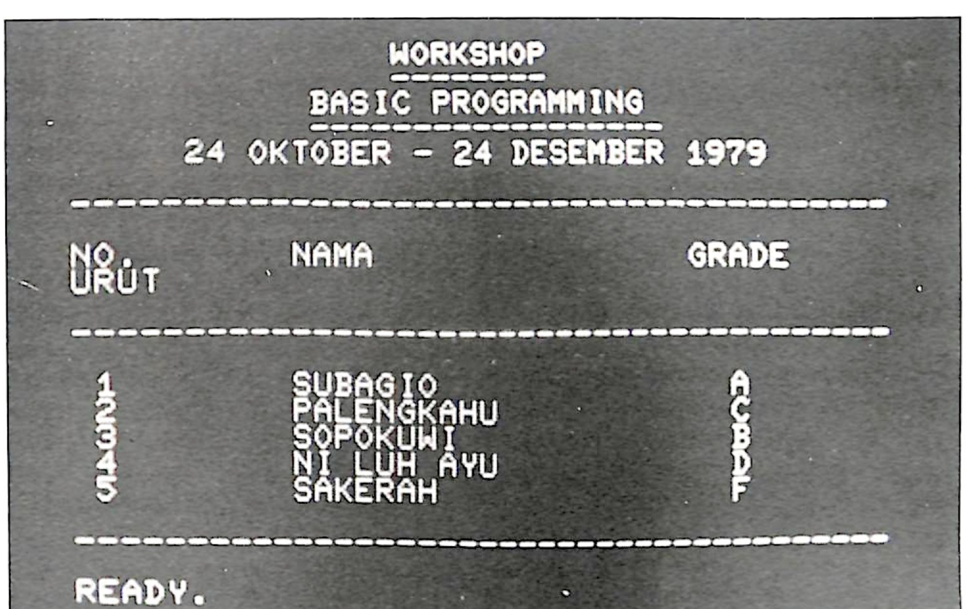
Microcomputer Use

We have learned that most microcomputers here are used for small to medium businesses. We don't have any data on how many microcomputers there are, but we estimate about 30–40 units, predominantly Commodore, Radio Shack and Apple II systems. Most of them are in Jakarta, and the companies are involved in such areas as furniture, manufacturing (for inventory), textiles (for payroll and inventory), construction and electronics design.

Since the price of hardware in the U.S. is going down, we assume that this will affect prices here, and hope that in the coming two or three years microcomputer use will increase considerably.

Conclusion

After running our organization for over two years, we still have some problems, particularly in the area of funding. We have successfully maintained our computers and organization, but it is difficult to buy more



The grade calculations of five students in the BASIC programming workshop.

hardware when we have only 20 to 25 students per month. We cannot charge them too much, because ours is a small city and the income level is relatively low. Most of our students are in their 20s and get their course money from their parents.

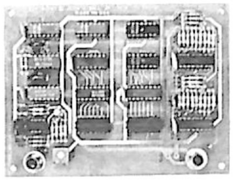
But in spite of our problems, we are very optimistic that our organization will develop. We are the first and only organization in the city that provides such courses, and the first in Indonesia that owns Commodore and TRS-80 computers for education. ■

We would like to add a printer and disk drive to our system, mostly for our Commodore, but we don't know when this can be done. We would appreciate if any organization or person who reads this article could donate the hardware and software. Any used printer or disk drive would be very useful to us, and we would try to pay the freight from the U.S.

We also would like magazines and books on microcomputing; they cannot be bought here, and are difficult and expensive to get. We have complimentary subscriptions from *80 Microcomputing*, *Kilobaud Microcomputing*, *Personal Computing* and *Recreational Computing*.

We would also like information from any PET or TRS-80 users groups.

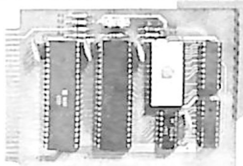
A-D & D-A CONVERTER



JBE A-D & D-A Converter can be used with any system having parallel ports • Interfaces with JBE Parallel I/O Card • D-A conversion time — 5 μs • A-D conversion time — 20 μs • Uses JBE 5V power supply • Parallel inputs & outputs include 8 data bits, strobe lines & latches • Analog inputs & outputs are medium impedance 0 to 5 volt range.

79-287 ASSM. **$79.95**
Bare Board **$29.95** Kit **$59.95**

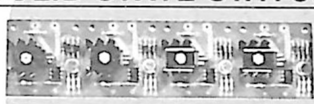
6502 MICROCOMPUTER



This control computer has: • 1024 bytes RAM (two 2114s) • 2048 bytes EPROM (2716) • Uses one 6522 VIA (comp. doc. incl.) • Interfaces with JBE Solid State Switches & A-D & D-A Converter • Uses JBE 5V power supply • 2716 EPROM available separately (2716 can be programmed with an Apple II & JBE EPROM Programmer & Parallel Interface) • 50 pin connector included in kit & assm.

80-153 ASSM. **$110.95**
Bare Board **$24.95** Kit **$ 89.95**

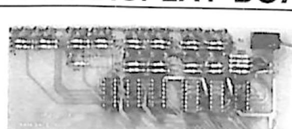
SOLID STATE SWITCH



Your computer can control power to your printer, lights, stereo & any 120VAC appliances up to 720 watts (6 amps at 120VAC). Input 3 to 15VDC • 2-14MA TTL compatible • Isolation — 1500V • Non zero crossing • Comes in 1 or 4 channel version • Includes doc. for interfacing with Dimmer Control.

79-282-1 ASSM. **$13.95**
Bare Board **$6.95** Kit **$10.95**
79-282-4 ASSM. **$49.95**
Bare Board **$24.95** Kit **$39.95**

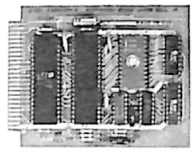
APPLE II DISPLAY BOARD



• Has run-stop, single step switch • Has 16 address LEDs, 8 data LEDs & 1 RDY LED • All lines are buffered.

80-144 ASSM. **$49.95**
Bare Board **$25.95** Kit **$42.95**

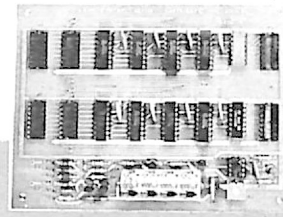
Z80 MICROCOMPUTER



JBE is announcing a single board dedicated computer designed for control functions. It features: • A Z80 Microprocessor software compatible with the Z80, 8080 & 8085 Microprocessors • Uses a Z80 PIO chip for I/O which has 2 independent 8 bit bidirectional peripheral interface ports with handshake & data transfer control • Uses one 2716 EPROM (2K) & two 2114 RAM memories (1K) • Single 5V power supply at 300MA req. • Clock frequency is 2MHz, RC controlled • Board comes with complete doc. • 50 pin connector is included • 2716 EPROM available separately.

80-280 ASSM. **$129.95**
Bare Board **$29.95** Kit **$119.95**

DIMMER CONTROL



JBE Dimmer Control features: • 4 channels • 256 brightness levels • Onboard power supply • Four 8 bit parallel input ports • Interfaces with JBE Solid State Switch & Apple II Parallel Interface.

80-146 ASSM. **$89.95**
Bare Board **$25.95** Kit **$79.95**

POWER SUPPLIES

• Use wall transformers for safety • Protected against short circuit and thermal breakdown.

5 VOLT POWER SUPPLY

Rated at 5V 500MA • Operates JBE A-D & D-A Converter, Z80 & 6502 Microcomputers, 8085 & 8088 Microcomputers.

80-160 ASSM. **$20.95**
Bare Board **$8.95** Kit **$16.95**

± 12 VOLT POWER SUPPLY

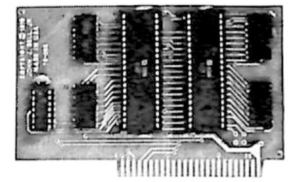
Rated at ± 12V 120MA • Can be used as a single 24V power supply • Ideally suited to OP-AMP experiments.

80-161 ASSM. **$22.95**
Bare Board **$8.95** Kit **$18.95**

ICS

6502	$9.95
6522	$9.95
Z80	$9.95
Z80 PIO	$9.95
2716 5V	$19.95

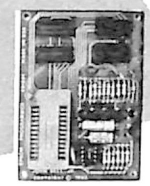
6522 APPLE II INTERFACE



• Interfaces printers, synthesizers, keyboards, JBE A-D & D-A Converter & Solid State Switches • Has handshaking logic, two 6522 VIAs & a 74LS74 for timing. Inputs & outputs are TTL compatible.

79-295 ASSM. **$69.95**
Bare Board **$22.95** Kit **$59.95**

2716 EPROM PROGRAMMER



JBE 2716 EPROM Programmer was designed to program 5V 2716 EPROMS • It can also read 2716s. It interfaces to the Apple II using JBE Parallel I/O Card & four ribbon cable connectors • An LED indicates when power is being applied to the EPROM • A textool zero insertion force socket is used for the EPROM • Comes with complete doc. for writing and reading in the Apple II or Apple II + • Cables available separately.

80-244 ASSM. **$49.95**
Bare Board **$24.95** Kit **$39.95**

BARE BOARDS

APPLE II EXTENDER BOARD

3½" x 2½". Price includes 50 pin Apple Connector.

80-143 **$12.95**

8085 3 CHIP SYSTEM

State-of-the-art system using an 8085, 8156 & either an 8355 or 8755 • Instruction set 100% upward compatible with 8080A.

Bare Board **$24.95**

8088 5 CHIP SYSTEM

An 8086 family microcomputer system using an 8088 CPU, 8284, 8155, 8755A & an 8185.

Bare Board **$29.95**

CRT CONTROLLER

This intelligent CRT Controller is based on an 8085A Microprocessor & an 8275 Integrated CRT Controller. It features: • 25 lines, 80 characters/line • 5x7 dot matrix • Upper case only • Two 2716s • Serial Interface RS232 & TTL • Baud rates of 110, 150, 300, 600, 1200, 2400, 4800 & 9600 • Keyboard scanning system • Req's. unencoded keyboard • Uses +5V & ± 12V power supplies.

Bare Board **$39.95**

50 pin connector **$5.95**
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16 Pin, 2 ft. **$4.25**

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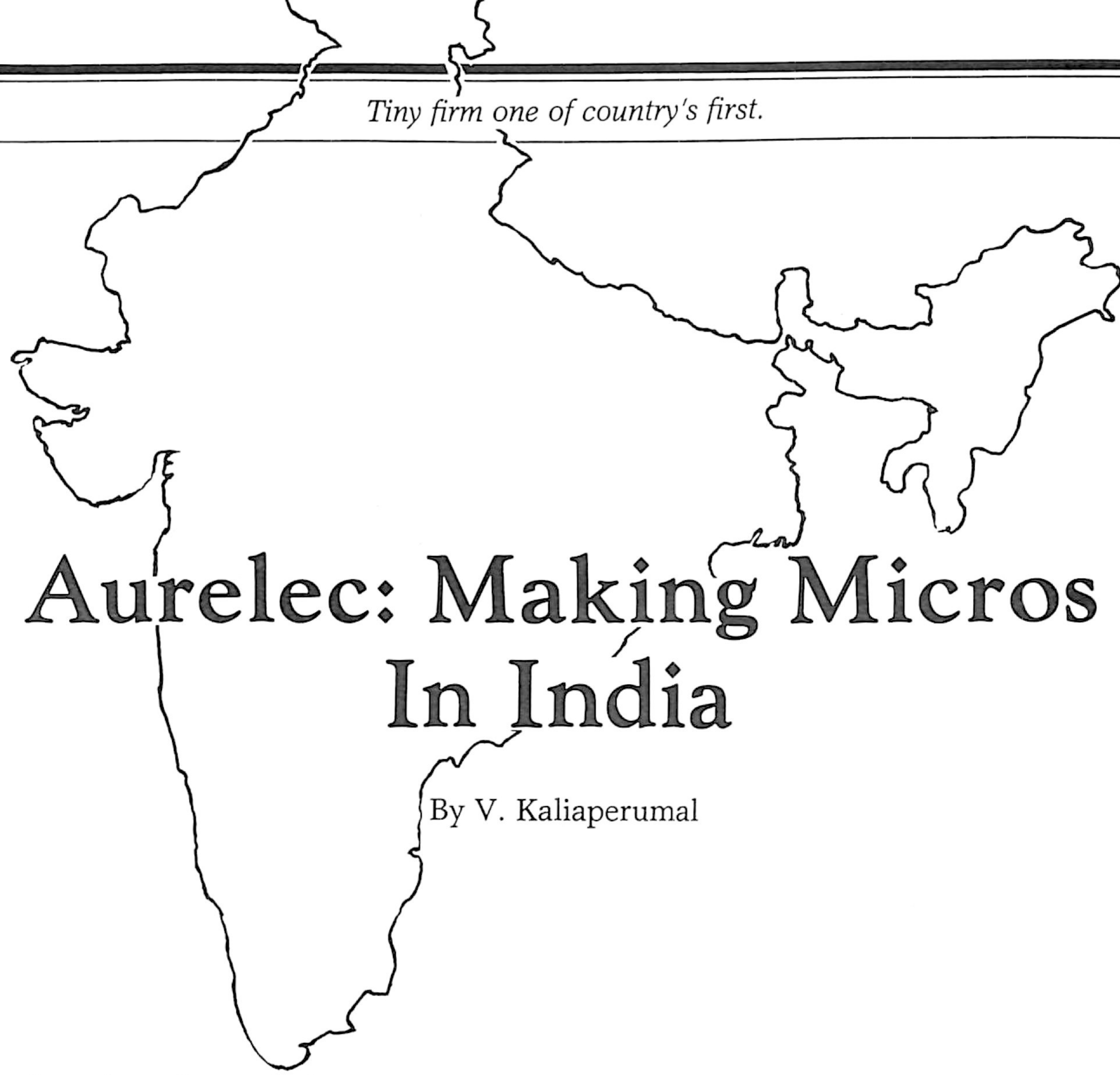


Aurelec: Making Micros In India

By V. Kaliaperumal

After cycling a few miles north of Pondicherry, a small town in southern India, my friend and I turned onto a sandy road. For a while we had to keep getting down from our bicycles—sometimes because the sand was too soft; other times because of lumbering bullock carts or village women carrying immense bundles of hay on their heads. Then we came to a small but stiff slope. All this made my friend a little breathless, so we slowed down.

As we were passing under big shady trees, looking at the green peanut fields all around with villagers working in them, my friend spotted a low building. He asked me, "What is that?"

"That's a computer company."

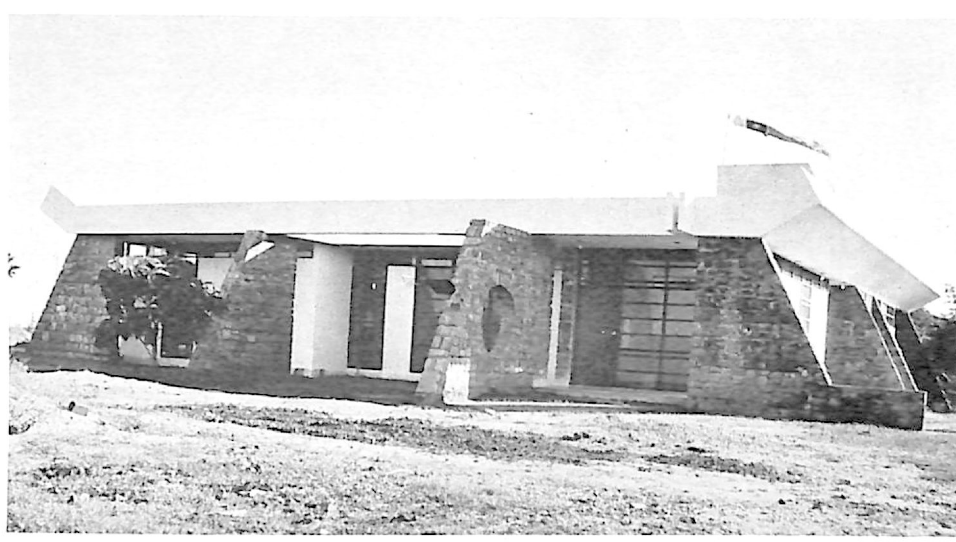
Still short of breath, my friend was hardly amused.

"Murti, there is a time for everything. I'm in no mood for your silly jokes!"

"Okay, let's go in and find out."

* * * * *

True, it is an unlikely location for such a company. But then, Aurelec is a unique company in many ways.



Front view of Aurelec.

It was started in late 1973 by Kalya, a science student who had just graduated from Sri Aurobindo International Centre of Education (SAICE), and Andre Viozat. Their first products? Electronic metronomes and toy organs—a far cry from the data entry stations and microcomputer development systems of today!

Their next product was an electronic machine, the first of its kind in India to measure surface areas of hides and other skins. India exports a lot of hides, whose irregular shapes make the measurement of area difficult. So this machine, which could display the areas in metric standards or in

V. Kaliaperumal, 112, Mutthu Mariammane Koil St., Pondicherry 605001, India.

square feet, was received with great enthusiasm in the market. It won the first prize for the Best Indian Machine at the Indian Leather Fair of 1976 in Madras.

Soon after, they were joined by Ulli Blass, who was working with Deutsche Telefonwerke. He had studied electrical engineering at Aachen University in West Germany and had worked with microprocessors. He added a microprocessor unit to the area-measuring machine and interfaced a printer. This enabled the machine to print out the area of each skin, and the area of each batch as well as the cumulative total. A stamping machine was made available to print the surface area of each skin.

The KTF-80 Data Entry Station.

In a short period the company sold about 80 units. But with Ulli on the staff, and with Kalya having worked at the Computer Centre of SAICE, the company started developing microprocessor-based products.

Micros in India—an Overview

Let us leave Aurelec for a moment and look at the Indian computer scene.

Until the last few years, the Indian computer market had been dominated by American computers. Even as recently as mid-1978, about 75 percent of the 450 computers installed in India were from U.S. companies. IBM led with 154 computers, followed by ECIL (Electronics Corporation of India) with 99 and DEC with 59.

ECIL, the first Indian computer-manufacturing company, is government-owned. It made its first minicomputer in 1971, capturing a big portion of the market in the 1970s. But apart from ECIL there were no Indian companies worth noting. It was American computers all the way.

Interestingly, most of the IBM computers were from their 1400 and 1600 series. And even now, numerous IBM 1400s are in operation, representing probably the world's largest collection of obsolete computers on active duty.

(IBM has wound up its operations in India; it did not agree to regulations requiring it to dilute its equity holdings in its Indian subsidiary to less than 50 percent.)

Only in the last three years has the Indian government encouraged private companies to some extent. Big Indian companies such as Delhi Cloth Mills (DCM) of the Shri Ram group, whose assets are worth 274 million dollars (assuming a U.S. dollar equals 7.50 Indian rupees), and the Tata group, with assets worth $1.47 billion, have started their own computer divisions. Other companies such as the Hindustan Computers Limited (HCL) have been formed in joint partnership with local state governments. But apart from ICIML—a former subsidiary of International Computers Limited—which has been allowed to manufacture a hundred ICL 2904s, the rest of the companies are making either microcomputers or minicomputers. DCM uses the 8080 in their Spectrum Series; HCL uses a Rockwell PPS eight-bit processor. Other popular microprocessors include the Z-80, IMP-16 and 8085. So India will still be importing computers whenever bigger systems are required.

In the past, not many private companies could afford to have their own computer systems; few Indian computers were available and there were severe restrictions and stiff duties on imported systems. Nearly 50 percent of the systems were owned by the government, and another 25 percent by educational and research institutes.

But now with private companies themselves making systems at more competitive rates than ECIL, there has been a boom in the use of computers. In fact, in the last two or three years both DCM and HCL, companies employing hundreds of people, have sold more than 50 systems. Of all the new companies, DCM is the clear leader, with its popular Spectrum and Galaxy series.

Back to Aurelec

Let us come back to Aurelec. It is tiny compared to the other companies. The small $80,000 firm, employing 13 people, is housed in a five-room building with 1300 square feet. All the rooms have big glass windows which overlook the fields, and have a view of the blue ocean on the eastern side.

At the entrance is the office, where the typists work. This opens into the library, which is also used by the programmers. Next is the workshop where the boards are wired and the systems assembled.

Then we enter the computer laboratory. It has two microcomputer systems. One of them is mainly used by the programmers, while the other one is used to check the boards or new designs. Kalya, Ulli and Nini Palande work in the last room. Nini designs I/O interfaces and makes the printed-circuit board layouts. She worked for nearly six years at the Computer Center of SAICE before joining Aurelec.

As everywhere, small computer companies have to work and think hard to survive. But as Kalya notes, "It is especially difficult in India. Each manufacturer has his own bus standards. No company divulges any details on its hardware or its interfacing specifications. Sometimes they do not even disclose the microprocessor used.

"For example, one company would try to hide its 8080 saying that their system used the latest NMOS eight-bit processor with 78 instructions. All this precludes the possibility of a manufacturer designing a single memory board or I/O interface and selling it.

"If the big manufacturers had adopted a standard bus like the S-100, it would have opened up the market. There would have been room for the smart entrepreneur who could make a product with a small investment. It would have helped the end user also. He could buy a minimal system, then add on boards at a lesser cost as his needs grew. He would have had the opportunity of building up a flexible and more affordable computer system.

"As there is no market for separate add-on boards, even the small companies have to develop entire systems. This requires a big investment, and also entails bigger risks. Designing a complete system takes a long time, and if the system does not sell fast the firm has to close down very soon."

Aurelec studied the market carefully before designing their two systems—the Aurelec Microcomputer Development Systems (Aurelec MDS) and the Aurelec Key to Floppy Data Entry Station (Aurelec KTF-80). Both systems are built on the newly established IEEE standard for the S-100 bus. As such they are probably the only Indian systems using it at present.

The MDS is for companies who market it as their own or as a part of their product. Aurelec gives them the entire hardware documentation and also trains their staff. This allows the small company to free itself from having to keep many maintenance personnel. It is the only company which gives hardware manuals. The rest of the companies maintain the systems they sell and annually charge around 10 percent of the system cost.

The System

The basic system looks like North Star's Horizon. It has a motherboard with eight or 12 connectors. The CPU board's description might sound like a Cromemco card or like so many other boards. It has a 4 MHz Z-80A, 1K RAM, capacity for 8K ROM, 24 parallel I/O lines for a keyboard and a line printer, an RS-232C or a 20 mA current loop serial interface, vectored interrupts, a four-channel programmable counter timer, buffered outputs and an on-board memory management system expanding address space to 16 megabytes.

The memory board has 16K of static RAM operating at 450 ns, or optionally at 250 ns. It uses TMS 4044 chips. Software and hardware write-protects and bank-selects are standard. Memory blocks of 4K bytes are individually deselectable. There can be zero, one or two wait states. RAM and ROM can be overlayed by using the Phantom line. The memory is expandable in increments of 4K. A 16K byte–250 ns board costs $1800. A 64K memory board using 16K bits dynamic RAM is scheduled to be made available. This same board will become a 256K board when the 64K bit chips are available.

The floppy-disk controller board uses the WD1771 chip, which can control four single-density, single- or double-sided Shugart drives. The board also has an 8255 with drivers to enable an additional keyboard and a second line printer to be added. The basic system is completed by a single-sided, single-density Shugart 800 floppy-disk drive and a power supply. The back panel has all the connectors to directly interface a keyboard, a line printer and additional floppy-disk drives.

All this for nearly $10,400—exorbitant by U.S. standards. But you must not forget that in India one has to pay heavy duties. Most of the chips have to be imported. A Z-80A, which can be bought in the U.S. for $11, costs around $50 in India. Even the lowly 7400 costs 55 cents. ICs cost three to five times the U.S. price.

A few Indian companies have started making chips—mostly the usual TTL and CMOS chips—and some voltage regulators, op amps, audio amps and so on. But these local products are as costly as, if not more expensive than, the imported chips. It will take some time before India makes its own microcomputer components.

Aurelec also makes video terminals. The keyboard has 85 keys. Fifteen of these are for cursor and screen control, and 13 others are user-programmable. The video controller board displays 64 characters by 16 lines on a 12-inch imported video monitor. This terminal sells for $2300. Again, this is the only company willing to sell their CPU, memory, floppy disk or video controller boards separately.

In India there are only around 1000 computers and microcomputers, whereas Radio Shack alone has sold over 250,000 TRS-80s in the last four years.

I asked Ulli about the company's software. He explained, "We cannot afford to have scores of programmers like DCM or ECIL have. And we do not feel the need either. There is so much software available in the U.S. at a very reasonable rate. Why reinvent the wheel?

"For example, our system can be easily configured to use the CP/M DOS, which sells for $150. This has become the de facto standard, with over 100,000 users. The end user can get it from the U.S. We will give them the small input/output routines required to interface it with our system.

"Everybody profits this way. The user gets a good and reliable DOS at a much lower rate than we could offer if we wrote a similar DOS on our own. He gets access to the numerous programs which use CP/M. He also has the possibility of exporting software. (As early as 1978, Indian software companies exported $5 million worth of software.) We benefit also because we do not try to keep a big programming staff. However, our OEM buyers would be writing their own systems software.

"Similarly we can recommend the

well-accepted assemblers, interpreters and compilers from the U.S. after having tested them extensively," he continued. "We can help the user if he runs into any difficulty. So our system can run not only BASIC, which is provided by all Indian manufacturers (of course, all these BASICs are quite different from each other), but also Pascal, FORTRAN and COBOL. Languages like FORTRAN and COBOL, which is the most commonly used language, enable the customers to reuse their old programs also."

It is not the same with application programs. Indian conditions are very different. It would take a lot of work to modify imported programs. So these programs are written at Aurelec. They have two full-time application programmers. The most used programs are the payroll, inventory and accounting packages. Business houses in India do not require word processors, since the labor is cheap. A typist would be very happy to earn $50 a month.

Almost all the computer companies write their own application software. There are very few software companies. All manufacturers have different language standards, and since the number of systems sold is small, it will take some time before more software houses come up.

The KTF-80

Aurelec's other product is geared to the printing companies. In recent years, these companies have imported a lot of phototypesetters from companies like Linotype Paul, Monotype and Compugraphic. Not only are these used for local work but also for a lot of foreign companies, who get their typesetting work done in India at lower rates.

These machines are essentially word processors, whose output is in the form of negatives for offset printing. Most of the time, the phototypesetter is used to type and edit the text. Only in the final stage is the part of the machine that makes the negatives used. A Linoterm photosetter with a floppy disk option made by Linotype Paul costs around $35,000 in India. Yet most of the time it is used as a $35,000 word processor, which is surely very expensive!

So why not have an additional and less costly word processor which can prepare the text and store it on a floppy disk? This disk can then be placed in the photosetter's floppy drive. The text is read and justified quickly and the negatives are made.

This is where the Aurelec KTF-80 Key to Floppy Data Entry Station fits in. It is similar to the basic MDS system, but also has the video terminal. The master floppy disk contains a simple DOS, which gets loaded on system initialization. Next, the text editor is loaded. Then the user types his text and corrects it. When the text is finally put on the hard-sectored floppy disk, the DOS takes care that the text is stored in a format compatible with the Linoterm photosetter.

Its cost is less than $8600. So if a typesetter uses a Linoterm photosetter and also a KTF-80, he gets the equivalent of two photosetters for only $43,600. To keep the Linoterm photosetter busy 100 percent of the time, three KTF-80 stations are required. And for faster Linoterm models, six KTF-80s give the maximum use. Aurelec is also writing the software to enable this system to be used with the phototypesetters of other companies.

Many Indian companies have not bought printers along with their phototypesetters, because they are expensive options. So they use expensive phototypesetting paper to get a hard copy of the text, which has to be sent to the author or others to get the final approval. The KTF-80 has a built-in printer interface, so proofs can be easily obtained by using any printer on ordinary cheaper paper. This results in a big economy also!

This product was announced in July 1980 and within a month three stations were sold. Kalya is confident that their entire production, four systems per month, can easily be sold. Four systems per month would definitely not satisfy an American company. But one must remember that in India there are only around 1000 computers and microcomputers, whereas Radio Shack alone has sold over 250,000 TRS-80s in the last four years.

Developing the Industry

A thousand computers in a country of 650 million people! A single computer per 650,000 persons! This indicates not only an immense potential market, but also a tremendous need for developing this industry. The government has to take the lead, remove all obstacles and encourage the computer industry.

At present, a manufacturer has to pay heavier duties on imported components than a user who imports an entire system. Hardly encouraging!

The manufacturer is usually given permission to make only about 50 to 100 systems per year. This small production naturally increases the system's cost. The government could allow the companies to make an unlimited number or at least a much bigger number of systems. I'm sure that no U.S. company needs to get any approval from the government on the number of systems it can make during the year!

An employer has to get the approval of his employees or their unions prior to acquiring a computer system. The reason? The computer might replace the employees or force them to take up other functions in the same company. Yet the same employer can install a lot of automatic tools which also could reduce or force reorganization of the labor. The government could remove all these anomalies.

The private sector must also cooperate within itself. If this industry is to develop rapidly, we cannot afford to have 50 different companies, each with its own software and hardware standards. They must come together and decide on common standards. This would encourage the small-scale manufacturers. It would increase healthy competition and lower prices, which would encourage more companies to buy these systems. This, in turn, would help the computer industry grow.

The common man must be shown the benefits of computers. At present he looks at computers as machines that will take away his job. His fears and apprehensions must be removed.

True, the task is difficult. But so was the work of educating the Indian farmer and teaching him to use modern technology, the benefits of which are now evident. Just a few years ago, the country was importing millions of tons of wheat. The green revolution has made India self-sufficient.

We will have to wait to find out what the future portends, but hopefully hundreds of Aurelecs will spring up all over the country.

* * * * *

When we left Aurelec, all my friend's annoyance had disappeared. Looking again at the long sandy stretch on which we would have to cycle back, and remembering the cool air-conditioned computer lab at Aurelec and the cold lime drink that we'd enjoyed, he said, "Hey, Murti! Sometimes I like your silly jokes!" ■

ORDER ENTRY/ACCOUNTS RECEIVABLE SYSTEMS

Fyrnetics President, Larry Larsen, and Controller, Dennis Turek, considering some of the features of their new security system.

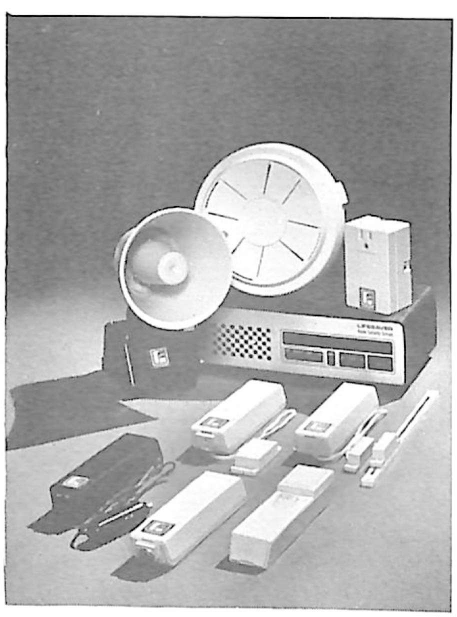
THE COMPANY:
FYRNETICS, INC.
1021 DAVIS ROAD
ELGIN, ILLINOIS 60120
312-742-0282

Fyrnetics, Inc. of Elgin, Illinois has grown from a private manufacturer of ionization smoke detectors for companies, such as Sears & Roebuck, to a full line manufacturer of wireless security products which are sold through a worldwide network of dealers and distributors. Since saturation of the residential security market is estimated to be less than 3% in the United States, their major marketing effort has been directed toward distribution through dealers who demonstrate and sell electronic products to the consumer. This marketing approach generated such a high volume of sales orders and invoices that it became necessary to install a computer system in 1977 in order to handle the multi-million dollar annual sales volume.

"Fyrnetics initially installed a Wang 2200 computer system, equipped with seven CRT terminals, four 10 megabyte hard disk drives, and two line printers at a monthly lease cost of over $4000.00. By late 1979, the company had invested nearly six man-years in our own software development", comments Fyrnetics president, Larry Larsen "As a part of a cost cutting program, we decided to replace the Wang equipment with a microcomputer system. We reviewed all available micro systems and concluded that the MSI hardware and software packages were best suited to our needs."

The modern production facility at Fyrnetics, Inc. where wireless home security products are designed and manufactured. The company also has production facilities in Hong Kong where larger quantities of their products are manufactured.

"We were particularly pleased with the system-generation capability of the MSI business packages, which allowed us to utilize our existing continuous form sales orders, invoices, and packing lists. The requirements for our computer system were rather demanding since we had large customers such as Montgomery Wards and Wicks, each having up to 300 stores. Each store is treated as an individual customer during the order entry and shipping process. However, payment is made from a central accounting office with many stores on a single check. Our system had to allow us to properly credit the payment to many different store locations and invoices. This feature was a part of the MSI Accounts Receivable software package. **Our accounts receivable system handles over 750 regular customers with over 3000 open invoices and 10,000 transactions per month for us."**



The LIFESAVER line of wireless home security products manufactured by Fyrnetics, Inc. Anyone desiring more information on this interesting product line should contact Fyrnetics, Inc. at the above address.

CONSIDERATIONS FOR THE SELECTION OF ACCOUNTS RECEIVABLE SYSTEMS

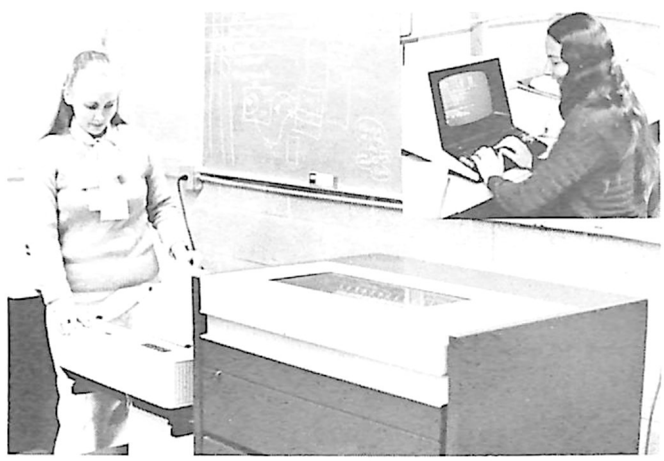
The selection of business computer systems today involves the careful consideration of many different factors. Even though the cost of computer systems has dropped substantially, we considered the selection process to be highly critical to us because of the tremendous need for a highly reliable computer system in our daily operations. Due to our high volume of sales transactions we were highly dependent upon the system for order processing and for information. We considered the following issues to be key to our selection of the MSI system:

LARGE DATA BASE - The processing of over 700 orders per month, with 3000 open invoices and 5000 active statement items required that we have easy and efficient on-line access to our large data base. The MSI system provides a large selection of data reports for open orders, backorders, invoices, credit memos, as well as customer statements and account status information.

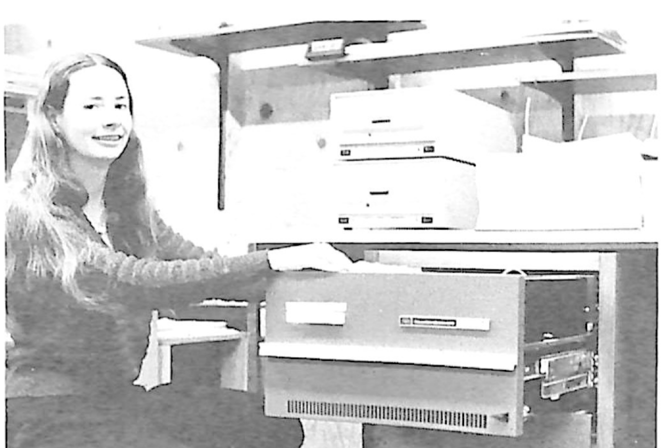
EFFICIENT PAPERWORK FLOW - The processing of our large volume of sales orders required an efficient system for printing sales orders, packing lists, invoices, and customer statements. The MSI system offers a convenient system generation program which allows the use of any desired format for pre-printed continuous forms. In addition, packing lists and customer invoices are generated automatically as sales orders are processed.

GENERAL LEDGER TIE-IN - Due to the large volume of individual invoices and cash receipts, we required an automatic posting procedure for our general ledger programs in order to minimize the data entry process. The MSI system offers a complete general ledger program package which links automatically to the other business program modules. All invoices, as well as cash receipts, are automatically written to the general ledger posting files from which individual journals are created. This procedure insures the generation of balanced journals and greatly reduces the time requirement for generation of monthly income statement and balance sheets.

SYSTEM INTEGRATION - The MSI system is fully integrated. The order entry system is linked to inventory for correct pricing, description of items on order. The inventory system is also linked to general ledger to allow different categories of products sold to be automatically posted to the correct sales accounts. The MSI inventory system provides complete cost accounting information for both labor and material. **The MSI programs provide the big machine capability that we need and yet provide the flexiblilty that we desire.**



The MSI computer system drives two line printers at Fyrnetics, Inc.



The MSI computer system at Fyrnetics, Inc. employs 10 megabyte hard disk drives to contain the large on-line data base.

SUPPORT - The availability of source listings for all of the MSI business software was an added incentive to select the MSI system. This has allowed us to make some specialized enhancements to our programs easily. **MSI really delivered for us allowing the replacement of an expensive WANG 2200 system with a comparable MSI system at a fraction of the cost.**

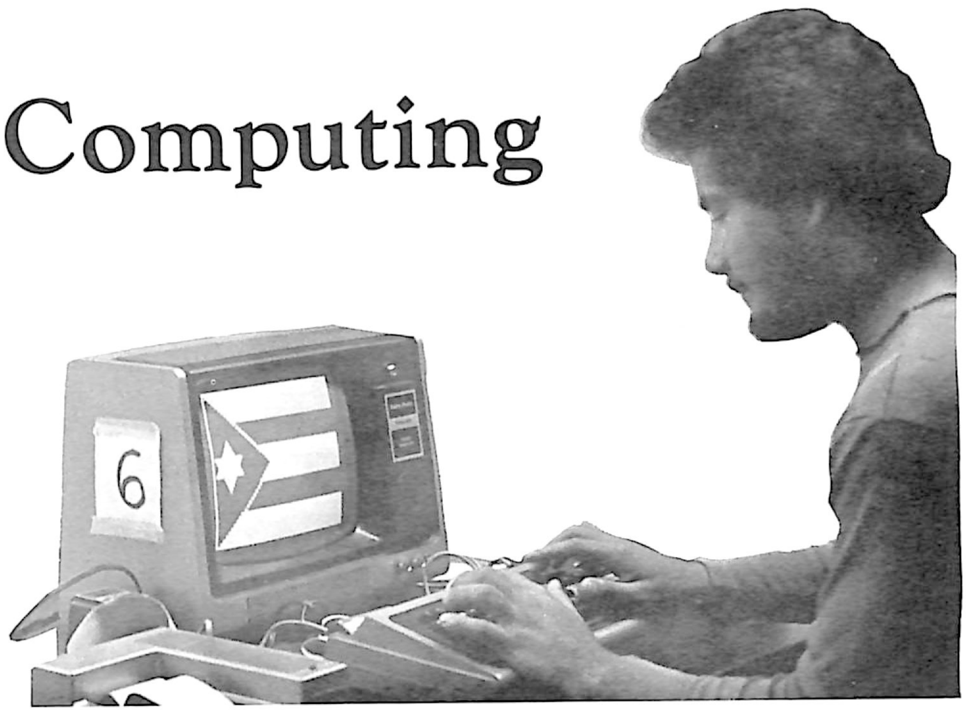
If you would like to have more information on MSI business computer systems, call or write, **Midwest Scientific Instruments, Inc., 220 W. Cedar, Olathe, KS 66061, 800-255-6638, Telex 42525(MSI A OLAT).**

MSI ..... Helping to make your business run better.

The microcomputer invasion at Catholic University will have far-reaching effects in Puerto Rico.

Island Computing

By Richard R. Eckert



The impact of the microcomputer revolution has not yet been felt in Puerto Rico. But Catholic University is helping to remedy this situation with a two-year associate degree program in digital electronics and computer programming.

The program, which began last August with 20 students, will teach technical personnel how to troubleshoot and repair common electronic circuits, particularly those using microelectronic components, and how to use and program the relatively inexpensive microcomputer systems now appearing in both business and scientific settings. We hope to produce people with broad training and background, permitting their future employer to refine and complete the training according to their needs.

The situation in Puerto Rico is unique. As a Commonwealth of the United States, it does not enjoy the benefits of statehood. This, its geographical isolation and its low standard of living means that technological advances are slow in arriving, and even slower in being used effectively. For example, Ponce is the second largest city in Puerto Rico with over 300,000 residents, yet the only store even remotely related to microcomputers is a Radio Shack franchise. It's the only operating Radio Shack store in the Commonwealth; the one in San Juan (Puerto Rico's capital and largest city) went out of business last year.

But Puerto Rico's Commonwealth status does offer some advantages. Under certain conditions a U.S.-based company with a plant in Puerto Rico is exempt from federal taxes. If the Commonwealth government thinks a company will bring new jobs, it will offer attractive local tax incentives. The upshot is that many high-technology corporations are beginning to set up operations in Puerto Rico. Those involved with electronics and computers include Digital Equip-

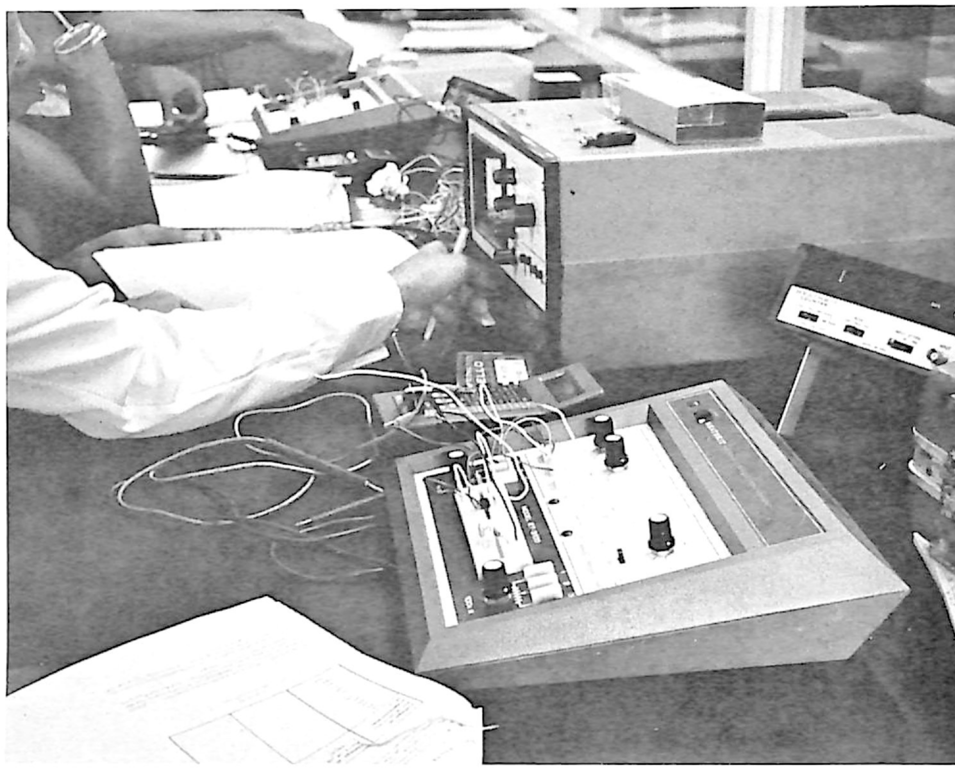
First Year			
English	3 cr.	English	3 cr.
Spanish	3 cr.	Spanish	3 cr.
Introduction to the Computer	3 cr.	BASIC Language Programming	3 cr.
Mathematics (Algebra)	3 cr.	Mathematics (Trigonometry)	3 cr.
Basic Physics	3 cr.	Introduction to Electricity and Electronics	3 cr.
Theology	2 cr.	Theology	2 cr.
Physical Education	0.5 cr.	Physical Education	0.5 cr.
	17.5 cr.		17.5 cr.
Second Year			
Accounting	4 cr.	Accounting	4 cr.
Social Science or Political Science	3 cr.	Philosophy	3 cr.
High Level Languages: FORTRAN, COBOL, Pascal	4 cr.	Assembly/Machine Language Programming	3 cr.
Introduction to Systems Programming	3 cr.	Applied Computer Programming	3 cr.
Electronics I (Analog Electronics)	3 cr.	Electronics II (Digital Electronics)	3 cr.
		Practicum	2 cr.
	17 cr.		18 cr.

Table 1. The curriculum of the two-year associate degree program in digital electronics and computer programming at Catholic University of Puerto Rico.

Richard R. Eckert, Colegio de Ciencias, Universidad Catolica de Puerto Rico, Ponce, Puerto Rico 00731.

ment Corporation, Intel, Hewlett-Packard, Data Products, Data General, Ohio Scientific and Centronics. And they've brought with them a tremendous new demand for people trained in digital electronics and computer programming, on an island where unemployment is estimated to be more than 30 percent.

At Catholic University, we became aware of the critical need to train people in computer hardware and software about two years ago. We also happened to be suffering through the first enrollment decline in our history. Administrators suddenly became very receptive to innovative course programs which could attract new students. (At Catholic University over 90 percent of the operating budget comes from student enrollment.) Since several people in the physics department had both the interest and the expertise, we decided to start the ball rolling.



Two groups of students running experiments on Heath Electronics Trainers.

On the Launching Pad

First we conducted a careful study of the employment possibilities for our prospective graduates. Armed with an impressive list of companies seeking the kinds of people we would train and willing to offer them on-the-job experience during their training, we wrote a proposal for the new program.

Originally our idea was to offer two options: computer programming with heavy emphasis on the use of microcomputers in a business setting and digital electronics with the emphasis placed on microcomputer hardware. But we soon found ourselves with an administrative problem: In which department would the new program be placed? Hardware was in the domain of the physics department, but business programming belonged with the College of Business Administration. We finally decided to develop a truly innovative program which would prepare a person in both computer programming and digital electronics. The graduate would then be able to move in either direction, depending on his interests.

As our proposal moved from committee to committee, the same objection kept coming up: the proposal was too ambitious, and our students would either all flunk out or wouldn't know enough about either programming or electronics to be of any use. Our answer had two parts. First, the situation in Puerto Rico is such that any preparation in these areas would guarantee our graduates employment. Second, since all indications were that each graduate of the program will have a good job awaiting him, we could maintain high standards. We would carefully screen applicants to assure that the students accepted had both the ability and the motivation necessary to complete the program.

These answers seemed to satisfy everyone, and the proposal quickly moved through both college and university committees and decision-making bodies. Early in 1980 the program received final approval in the New York Board of Regents, the ultimate University authority, and was duly registered.

The Program

The program emphasizes troubleshooting and repairing, and microcomputer programming and use in business and scientific settings. Table 1 shows the program's curriculum. The courses can be broken down into four areas: computer programming (software), 19 credits; electronics (hardware), 12 credits; general requirements, 37 credits; on-the-job experience, 2 credits.

Computer programming courses. The students start with an introduction to computers and data processing; learn to program first in BASIC, then in FORTRAN, COBOL and Pascal; learn assembly- and machine-language programming on the Z-80 and other common microprocessors; receive an introduction to systems programming and microcomputer operating systems; and finish by learning advanced techniques in applied programming.

Electronics courses. Here the students start with an introductory physics course followed by a survey of electricity and electronics which encompasses dc and ac circuits and semiconductor components. Following that, they take a course in analog electronic circuits and another emphasizing digital electronic circuits. In the latter they're exposed to microprocessor circuits and associated hardware.

General requirements. During the first year, students take enough math to prepare them for subsequent electronics and computer programming courses. Since our university is intimately connected with the Roman Catholic Church, students are also required to take courses in theology and philosophy to expose them to Christian ideals and morality. They take courses in social science or political science (depending on their interests) and in English and Spanish to develop the communications skills they will require on the job. A course in accounting gives them some notion of how businesses operate and how microcomputers can be used in a business setting.

On-the-job experience. All students must take a course called Practicum during their last semester. Here they gain on-the-job experience in local industrial or commercial settings.

Computer Equipment

During the past two years the physics department has gradually replaced a five-user DEC 11/34 floppy-disk-based minicomputer system loaned to us by the Digital Equipment Corporation of Aguadilla, PR, with several TRS-80 systems. Although we were sorry to see the 11/34 go, the cost of its required service contract ($5000 per year) gave us no choice.

We chose Radio Shack equipment primarily because we could get service and parts through the local store. The large library of available software for the TRS-80 was also a factor.

Our present computing equipment consists of five TRS-80 Model I's, each with a Quick Printer II; two TRS-80 Model I's complete with expansion interface, line printer and two disk drives apiece; a TRS-80 Model II with two eight-inch disk drives and a line printer (obtained with funds from an NIH-MBS research grant); an Ohio Scientific C1P; and two Heath microprocessor trainers. In addition, we have a Mark Sense Reader interfaced to one of the TRS-80s and a Radio Shack Vox-Box to another. The Mark Sense Reader, which detects graphite marks on a special card, will be used to simulate batch processing. The Vox-Box, which converts sounds into digital signals, offers the interesting possibility of verbal data entry.

Students working with a TRS-80 Model I disk-based system.

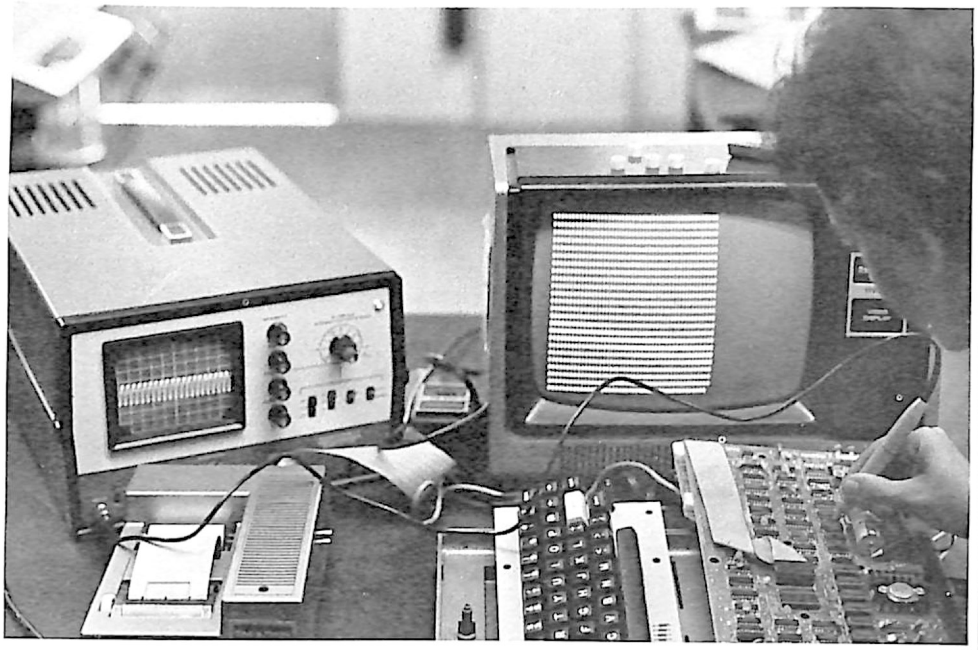
Our disk-based software is running under the TRSDOS and NEWDOS + operating systems, and we hope to obtain CP/M shortly. For languages, we now have BASIC on everything, FORTRAN on the Model I disk system and COBOL on the Model II. We will eventually be able to run FORTRAN, COBOL, Pascal and even PL/1 on all of the TRS-80 disk systems.

For assemblers, we have the Radio Shack tape version of Z-80 assembly language running on all of the TRS-80s, Microsoft's Z-80 macro assembler on the TRS-80 disk systems and Ohio Scientific's tape version of the 6502 assembler on the C1P. In addition, we can enter Z-80 machine code into all of the TRS-80s, 6502 code into the C1P and 6800 code into the Heath microprocessor trainers.

Electronics Equipment

We're in the process of acquiring the necessary equipment for the electronics courses. In all of the electronics laboratories we plan to use Heathkit trainers and the impressive body of components and coursework that accompanies them. These kits are relatively inexpensive and very complete, permitting interesting experiments covering the entire range of the subject.

In Introductory Electronics and in



A student troubleshooting the main board on a TRS-80 Model I.

the analog electronics course, Heath electronics experimenter/trainers will be used to carry out experiments in dc electronics, ac electronics, semiconductor devices and electronic circuits. For the digital electronics course, Heath digital electronics trainers and microprocessor trainers will permit an impressive number of useful experiments. We have not been able to find any other electronics laboratory equipment approaching the versatility, cost effectiveness and excellent documentation of the Heath equipment.

In an attempt to complete both the microcomputer and the electronics equipment (including oscilloscopes), we recently wrote a proposal to the Instructional Scientific Equipment Program (ISEP) of the National Science Foundation. If the proposal is successful, NSF will match some $20,000 of university funds (part of which has already been spent) to buy computer and electronics equipment for the new program.

Other Uses of Microcomputers at Catholic University

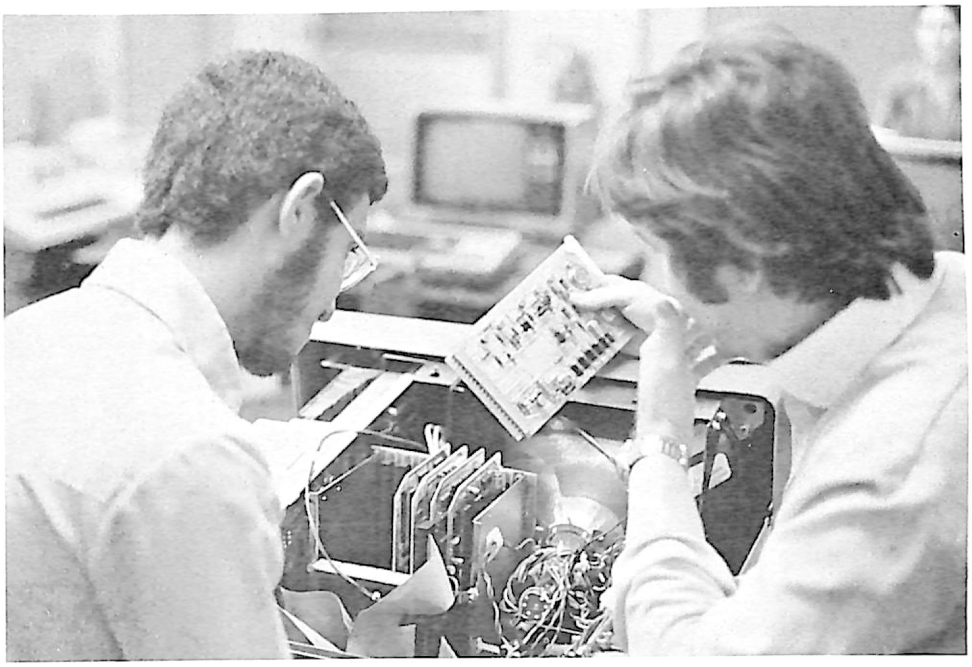
During the past two years there has been a dramatic increase in both interest and use of microcomputing equipment at Catholic University. What started as one TRS-80 Level II 4K system in the physics department has grown to many Level II and disk systems in several departments (physics, chemistry, psychology, social sciences, with biology, math and others about to join the parade). Through an ongoing series of seminars given to both faculty members and students, many people have seen what these systems can do and have become enthusiastic learners.

The biggest use of TRS-80s on campus (aside from teaching programming) is the tabulation of information obtained from various questionnaires used in the university's professor evaluation system. One type of questionnaire is administered to at least two groups of students taking courses with the professor being evaluated; another goes to his colleagues. In each case the responder enters his answers by filling in the blanks on an IBM-like card using an electrographic pencil. The cards for a given group are then read by a Mark Sense Reader interfaced with a TRS-80 and processed.

The Mark Sense Reader and TRS-80 is also being used to grade objective exams given by many different professors in the university. We have developed programs that will give the professor just about any information he desires from an objective exam. Here, students answer questions with the same kind of card used for professor evaluations.

In the chemistry department, in particular, several professors are using TRS-80 disk systems in the production of exams. The process consists of first creating question files on diskettes organized according to topics. When the professor wishes to give an exam, he simply runs a program that will select from a given file the questions on an exam. The professor has the option of making the selection himself or having the com-

✓Reader Service—see page 194



A professor explaining the function of one of the TRS-80 Model II circuit boards.

puter do it at random. A ditto master is then inserted into the line printer, and the exam is printed out (see references).

Many university professors are now calculating their final averages on the TRS-80s. In fact, several are using a disk system to maintain their class records. The programs we have developed permit entering exam, quiz or laboratory grades either manually or with the mark reader. Using this process, recordkeeping and the calculation of student averages at any time becomes a snap.

In the area of computer-assisted instruction (CAI), many of the general chemistry and physical chemistry lab experiments have become partially computerized. Students use TRS-80s as calculational aids or to run simulations in certain experiments. In physics, we have developed CAI programs for topics such as kinematics, projectile motion and atomic physics. In biology, a CAI program has been developed to aid the student in visualizing the DNA replication process. This program uses both graphics and sound effects (see references). All of these programs are still in the experimental stage, but we hope to soon be using CAI programs commonly in several university departments.

In the area of research, all of the recordkeeping and statistical analysis involved in a large interdisciplinary NIH-funded project are being carried out on TRS-80s. The purpose of the research is to determine the impact of air pollution on public health in southern Puerto Rico; it involves the storage and processing of data from physicians, schools, drug stores, hospital and area families, in addition to air pollution data from ten air quality monitoring stations and the results of several types of chemical analyses. TRS-80s are also being used in smaller research projects involving the psychology and sociology departments and to process the data involved in several on- and off-campus surveys.

I could continue to list present and proposed future applications of microcomputers at Catholic University, but it would be almost endless. Perhaps it is more important to mention that the microcomputer invasion at our institution has changed the entire university scene. We see our micros being used almost constantly by both students and faculty.

Whenever I enter the microcomputer room in the physics department, I never know what to expect: baseball games that talk in Spanish, electronic circuit diagrams being designed on a TV monitor, students yelling at one of the systems with the system responding, a professor entering grades or running a FORTRAN program—almost anything. This enthusiastic response to our microcomputers makes me certain that we are not far from the day in which micros will be as common as televisions or typewriters—even in Puerto Rico. ■

References

Richard Eckert, "Quiz Master," *80 Microcomputing*, June 1980, p. 148.

Catholic University has a faculty opening for someone with hardware and/or software training. Inquiries should be sent to the Physics Department, Catholic University of Puerto Rico, Ponce, PR 00731.

Videotext systems are gaining in popularity around the world, while the U.S. takes a cautious approach.

Consumer Information Systems

By Frank J. Derfler, Jr.

Videotext originated in England and, although it has been slow to gain momentum in the U.S., it has spread through Europe and Japan. The popularity of these TV-based systems—known as viewdata and teletext—is indicated by the effort and money being invested in testing and marketing them.

I first introduced *Microcomputing* readers to these services in the October 1979 article, "The Ultimate Consumer Computer" (p. 94). In that piece, I described the British Prestel viewdata service. Let's briefly review viewdata and teletext systems, and then take a quick tour around the world to see what's happening.

Viewdata and Teletext Explained

Both viewdata and teletext use the home TV as a data terminal to deliver news, sports, shopping information, catalogs, airline and transportation schedules, weather, stock reports and almost anything else you can imagine to their viewers on demand. The information pages in these systems are entered by companies and presented to viewers either for a fee or as a form of commercial advertising.

Viewdata uses the home telephone to connect the TV/terminal to a large computer center. The viewer selects the desired information either from menus or by directly entering the page number of the desired information into a keypad. The request goes up the phone line to the computer at 75 baud. The mainframe system then sends back a page or screen full of information at 1200 baud. The information can include colors and graphics. The user interacts with the mainframe throughout the session.

The amount of information available to the user is limited only by the disk space in the main computer. Viewdata systems can have as many as 200,000 pages of information on line.

Teletext is a broadcast-oriented system. The phone line is usually not used; instead, information is broadcast by a television station during the flyback time in the video scan of regular television programming. The user's TV/terminal has a sophisticated processing ability allowing it to decode the transmitted frames and grab the one designated by the user. The frames are constantly updated from the broadcast station. The teletext user does not interact with the central computer, only with his local terminal.

This system is limited in the number of pages it can transmit in a practical time period. Typically, about 800 pages of information are available.

Each system has its strengths and weaknesses. Teletext requires more local memory and processing ability, but only one central computer without extensive communications hardware and programming is needed at the television station. Viewdata can deliver more pages of information, but teletext can meet most users' needs with an average of about six seconds' update time. A maximum update time for teletext is about 25 seconds. Viewdata is quicker, but the use of the telephone line is controversial in many countries where each phone call is charged at a high rate and many homes may not have phones. Television transmissions are widely received, and homes without running water often have a TV set.

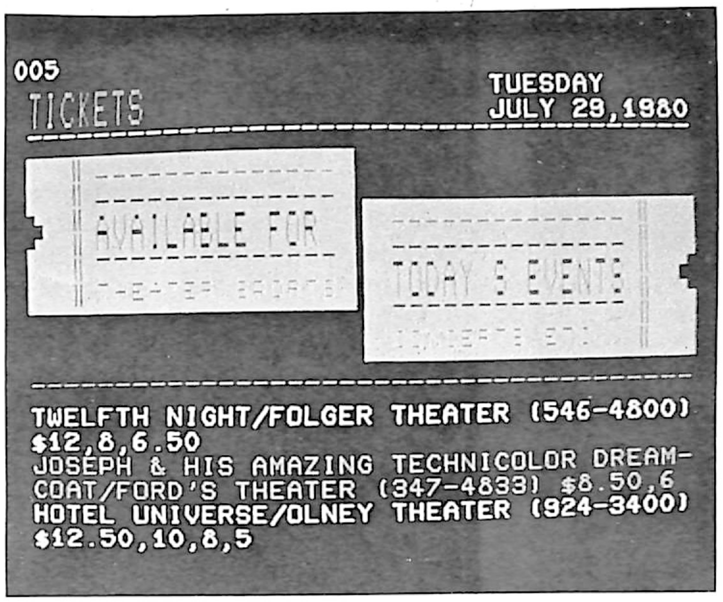
Britain's Prestel viewdata service, run by the British Post Office, now claims over 5000 subscribers. It connects customers to one of three computer centers. Its competition is another public agency, the British Broadcasting Company. The BBC operates a teletext service called CEEFAX. The private television company in Great Britain operates a similar teletext service called Oracle. All three systems use identical circuitry to decode the frames once the information is obtained by phone line or broadcast. The compatibility in format is an attempt to keep the price of a TV/terminal as low as possible.

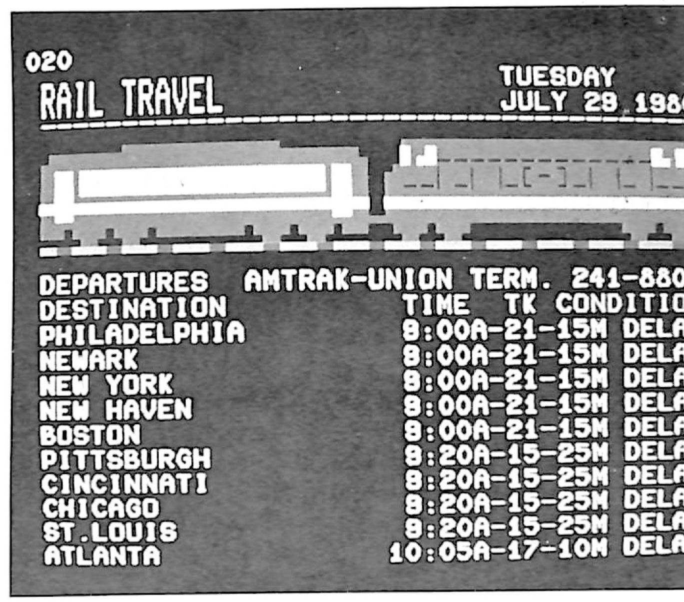
Over in France

Across the channel, the French seem to have clasped data communications to their bosoms as a means of exploiting and exporting a highly profitable technology. They have even devised a new term, Têlématique, which can variously mean the technology, the industry and the sociology of the interactive information media.

The Têlématique network includes a teletext system called Antiope. Antiope was developed by the French

Frank J. Derfler, Jr. (PO Box 691, Herndon, VA 22070), is the author of "Dial-up Directory," a monthly Microcomputing *feature on electronic and computer information systems.*





Typical "screens" of information from the French Antiope teletext system. The graphics are usually vividly displayed in color.

Television and Telecommunications Research Center as a part of a larger system including home facsimile transmission (on special low-cost facsimile machines) and an electronic telephone directory. The goals of this program include 25 million homes with electronic directory service by 1985, videotext terminals costing only $100 over the price of a standard television and $500 facsimile transceivers.

Last year, about 250,000 homes received electronic telephone directory service. The French view this industry as one which is highly desirable, nearly inevitable and very exportable. I predict you will be seeing some products from the Télématique wave very soon. An inexpensive French data communications terminal is due to hit the U.S. market as you read this article.

One of the first consumers of the French information export are the people in Belgium. The Belgian version of the French Antiope system is called Perceval. In the case of Belgium, the French are exporting the technology to a neighboring country that uses French as one of its languages. But the beauty of the Télématique product is the way it can be locally adapted. Local businesses or governments provide the information files. The French provide only hardware and software. Unlike many other computer exports, local adaptation is usually not a significant problem.

In the Orient

Problems do arise, however, on the other side of the world, when videotext tries to use the Japanese ideographic written language. Written Japanese can use three different forms of script, depending mainly on the subject matter. The interactive information systems are faced with the challenge of providing for all three forms of expression (including perhaps 3000 Chinese characters), numbers and the standard Western alphabet.

This challenge is being met in two different ways. The first approach is a marriage of teletext and viewdata. The home terminal is hooked to viewdata by phone line, but it also draws information from the teletext transmissions. Teletext provides the graphics characters needed for most displays. These graphics characters require a great deal of information to form, so there is little room left to send the other data on the teletext channel. Viewdata provides the easily decoded numbers and alphabet characters.

As an example, a page of stock market information can use titles transmitted by teletext to describe the contents of the listings and numbers from viewdata for the stock prices. The two inputs would be combined into one effective video display by the TV/terminal. This system has appeal because it is fast and very capable. It can supply huge quantities of information. The decoders used in the home terminals are essentially standard (except for the interweaving of teletext and viewdata in the display), so the hardware could be readily used for both domestic and export markets. The transmission programming, however, is considerably more complex because of the split transmission path.

The second approach to the Japanese character problem is to use a more sophisticated coding of a teletext signal. The Asahi Broadcasting Corporation is pushing this system called Telescan. Telescan strings together 16-bit digital words in sophisticated formats to present both ideographic and standard ASCII coded information. Telescan is not as fast or complete as the combined system, but it does not use phone lines, which are expensive in Japan. Entering information into data files is also much simpler because the information will only be transmitted over one path.

The Japanese are still trying to determine which method of transmission is the most effective for their situation. Their decision will probably lead the way for other countries using ideographic written languages.

Back in the USA

Americans are being very timid about videotext services. The words "test" and "experiment" are used to describe almost every use of these systems. There are many tests to describe, but none of them seem to be leading to full-scale systems marketing.

When I first described the Prestel system, I included an announcement that GTE had acquired the license for U.S. development. They have run a trial system called Viewdata aimed at corporate users, but no mass marketing has taken place.

Teletext tests have been or are being run in Philadelphia and Salt Lake City (CEEFAX systems) and Los

Angeles (Antiope). Cable TV operators have long been interested in this kind of interactive programming, and the "superstation" WTBS in Atlanta is offering a CEEFAX service through cable operators. However, none of these services has been heavily marketed.

Another test of a videotext system has just begun in the Washington, D.C., area. The Washington public television station (WETA) will be broadcasting a teletext signal based on the Canadian Telidon system. Telidon is a unique system providing sharper images than the original British or French devices. The Telidon terminals use microcomputers instead of hardwired logic hardware. This two-year Washington test will only involve about 60 receivers.

Similarly, AT&T and Knight-Ridder Newspapers are running a pilot test of a videotext service in Coral Gables, FL, involving about 200 customers.

This U.S. testing seems like a pretty slow start for a system that was technically mature over two years ago. I think there are several factors behind this very timid behavior on the part of some pretty rugged U.S. companies.

First, of course, the economy has been slow. This may not be the time to go head-to-head with video recorders and video games for the consumer dollar. Money for investment and willing sponsors may both be in short supply.

Second, the U.S. has other systems filling some of the videotext market. GTE must be faced with some internal decisions over where a Prestel kind of service would fit in light of its dedication to its Telenet packet switching network. Telenet, while it is not aimed at home users, already provides access to The Source and other electronic information and electronic mail utilities.

Finally, the regulatory situation in the U.S. is much more complex than in countries with a government monopoly or limited competition system. Many legal and regulatory questions have yet to be raised. The answer to some of these questions could mold the whole future of the information utility industry. Before any of these questions are asked, the companies involved want to have a lot of empirical evidence to back their positions.

Videotext systems fit one of my criteria for good mass communications systems. They break what I call the "time tyranny" of telecommunications. You can get the information you want out of these systems when you want it. They are bound, however, by the limitation of location. The user has to be near one of the terminals to get his information.

One could easily picture a portable videotext terminal the size of the TRS-80 Pocket Computer or the latest mini-TV sets. When this degree of portability is reached (and it could be tomorrow morning), I predict a tremendous spurt in the growth of videotext systems. These information systems, with their pages and pages of features, will only quicken their pace in the U.S. when they become as mobile as the "utility" they may replace—the newspaper.

Videotext systems are gaining in popularity around the world. The systems are still developing, but it appears certain your future will include interactive data communications devices.■

The U.S.: A View From the U.K.

By Robin Bradbeer

The microcomputing scenes in Europe and the U.S. differ in a number of ways, the most obvious of which is the way that equipment is actually sold. Two years ago, when I first made my way into the cradle of the microcomputer, there were only five computer retail outlets in England. Imagine my surprise and feeling of Nirvana when I came across as many shops in as many miles in Silicon Valley.

Two years later, things have changed on both sides of the Atlantic. There are nearly 400 companies selling personal computers in the U.K., about 200 through retail outlets. Taking into account the population difference, and discounting multiple outlets like Radio Shack, this is a higher figure than in America. Similarly, the two most popular computer magazines in the U.K. sell just half the number of copies as *Byte*—but for just less than one quarter the population!

Emphasis on Business

Yet this rapid growth, which is paralleled in Germany, France and Italy, has produced a different emphasis, especially in the percentage of sales aimed at the small-businessman. In the U.S., microcomputing is inexpensive. If prices in the U.K. are compared, the rate of exchange works out at nearly £1 = $1. For example, a Radio Shack TRS-80 Level I system will cost $599 in the U.S. compared to $1000 in the U.K. An 8K PET is only $795 compared to $1400, and an Apple is $1100 compared to $2000.

Disposable income is lower in the U.K. than in the U.S. and this has stopped microcomputer interest from growing. When the cost of carriage, insurance, duty and distribution is taken into account, actual costs of imported systems are about 35–50 percent higher. This means that in real terms systems can be twice as expensive as in the U.S. This must make a difference to the eventual usage of computers.

The hobby market has never been large in the U.K. Business systems have been at the forefront of most marketing exercises ever since small systems took off a couple of years ago. Consequently, the PET is now Europe's biggest-selling small-business computer (something that most Americans cannot understand). This has meant that most marketing emphasis, and space in retail outlets, is aimed at the small-businessman with only £5000 ($12,000) to spend on an initial system.

Software and Hardware

The other side of the coin, however, is that development of sophisticated software to run on these systems has grown at a faster rate than in the States. The British forte for programming has come to the fore, with word-processing packages like WordCraft and a Pascal compiler for the PET now being marketed back to the States. In fact, a large amount of the software sold by American software companies such as Personal Software, Programma and others has been originally written in Europe.

This trade in software is not one-way, though. A number of expatriate Americans have set up very profitable businesses "Europeanizing" stateside software. As one acquaintance told me, "When you get a good bit of European software it is probably better than a comparable American product—but when you get junk it's *really* junk!"

Most European companies that manufacture hardware have tended to leave the middle ground to imported American or Japanese models. They have concentrated on the low-end or high-end market. Typical of the former is Sinclair with its ZX-80, which is selling for under £80 ($200). Or they tend to rip off American single board computers; the UK101, for example, is a technical upgrade of the Superboard II. At the high end multi-user systems seem to be mostly European produced, although probably using American-made parts.

With government money available, education, business and industry are

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being subsidized in the "awareness" area. There are many courses and conferences aimed at the businessman, teacher and engineer, not so much in the use of computers but what they can do. Surveys have shown that the educational uses of small computers are far more important to the average Briton than business use, yet there is little government money available for actual purchase, although £9m ($22m) is available for training people on the nonexistent machines! However, by fundraising and judicial use of the budget, one secondary school in three now has access to a system of some sort.

Hobby clubs and exhibitions are another group area. Europe does not have the large exhibitions devoted to personal computers, but local shows can attract 3000–4000 over two days, while the two or three major shows attract 25,000 or more.

Micro Sales and Service

The differences between England and California are striking. Microcomputing in the U.S. is considered normal. Tandy is selling over 200,000 TRS-80 systems a year in the U.S. The fastest-selling system in the U.K., the Commodore PET, is probably selling around 300 systems per week at its peak. With one quarter of all the people in Silicon Valley, for example, involved in electronics, it is no surprise that the schools in the area are teaching programming to seven-year-old children. By the time they reach high school, using the computer will be as usual as using a calculator.

A brief look into some of the stores in the area illustrates the variety of approaches. Around some of these stores are a number of small electronics firms and consultancies, supplying all the software and hardware needs of the area. A lot of them were run as part-time companies by those employed in the local electronics industry. It was the first Byte Shop that placed the order for the Apple I computers that started Steve Wozniak off on his road to fame and fortune! This seemed to epitomize the difference between the retail selling of computers in the States and this country.

Computerland takes a totally different approach. This chain-store or franchise system aims to have over 100 stores around the country. The Bay area has three branches. Unlike the smaller, single-owner shops, Computerland sells a wide range of systems at prices ranging from $500 upwards. However, it does not have highly developed software expertise.

Radio Shack takes a similar approach. Although selling systems based on the TRS-80 computer, the nearly 6000 shops give Tandy massive coverage. Any relatively large shopping center has its Radio Shack. In the U.K. only the Level I and Level II systems are widely available. But in the States a large system containing disks and printers and encased in a modern-style desk would cost around $3000. This system is tailored for small businesses and is advertised on local radio.

Two retail chains in the U.K. are trying Radio Shack's approach. Curry's, an electrical retail chain with 400 outlets, set up a specialist group of stores concentrating on micro-based systems. Lasky's, an audio retailer, has recently purchased a micro shop as the basis for a group of shops.

One aspect of microcomputing that has not really been appreciated in the U.K. is the repair of home-based systems. Companies like the Computer Field Maintenance provide office and lab-based repair, but there is really no company providing comprehensive facilities for home computer freaks.

Two doors away from Byte of Palo Alto, I met the Microdoctors, three electronics engineers who provide a host of specialized operations, ranging from normal repair facilities, with sophisticated test gear, through fabrication and bit completion, to system configuration. The Microdoctors, all three of them, were obviously overworked.

Although available for the home user, they were spending most of their time servicing equipment under contract from five shops in the area. Their premises were, in fact, the first Byte Shop in the Bay area, and probably the first in the world! This seems to inspire them in that they see themselves pioneering a new form of service industry—and one that can do nothing but expand.

In conclusion, it is clear that the West Coast of the States has adopted microcomputing in a big way and is therefore three or four years ahead of the U.K. in attitudes. Whether marketing and education policies in the U.K. will permit a similar acceptance here is debatable. It is disappointing that circumstances here are not as conducive as in the States. In that sense we are all the losers.■

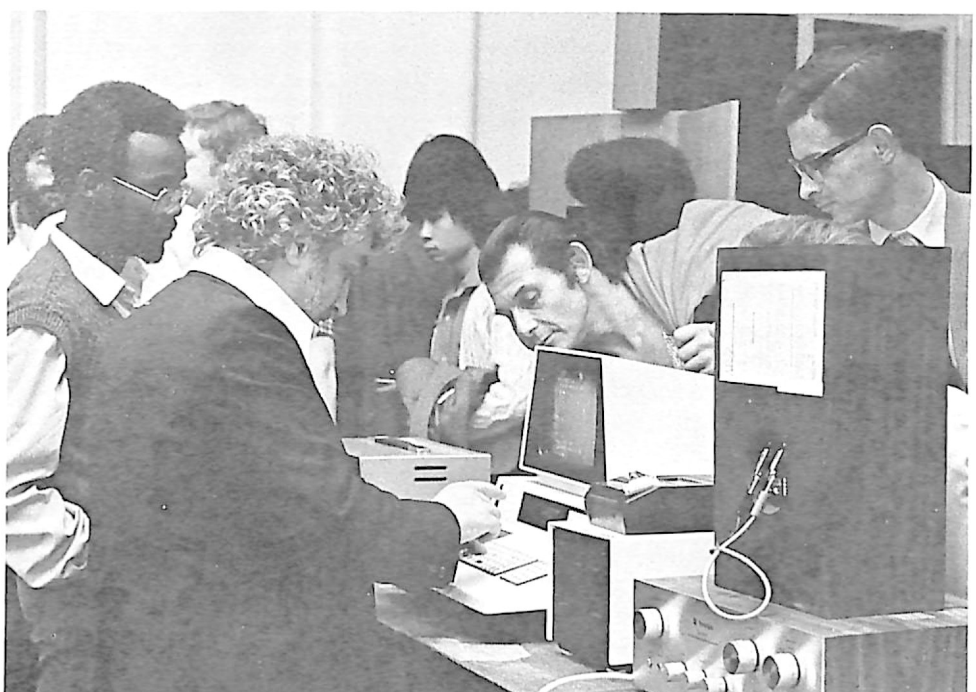
Despite size, clubbiness still emphasized.

London Computer Club A Huge Success

By Robin Bradbeer

The North London Hobby Computer Club started in October 1978, and is now one of the most successful in Europe. The idea was conceived a few months earlier by some of those at the Polytechnic of North London who were interested in personal computing. The library had been subscribing to American microcomputing magazines for a year or more, and the growth of computer clubs in the States augured well for similar activities in the U.K.

The Polytechnic was keen to back the club. It has an active community affairs programme and saw this new activity as an extension of existing work. Consequently, various contacts in the national, local and specialist press were cajoled into giving the idea editorial space. From the time of the first press comment, the telephones never stopped ringing. When we had our inaugural meetings in October, 400 people turned up over two nights.



Jim Butterfield, surrounded by club members at the NLHCC monthly meeting.

The charter members saw the club as a fortnightly get-together of about 50 people, swapping ideas and applications. Obviously with 400 interested, we needed a different approach. So we decided to split the club into different sections, each with different but complementary interests. Areas included do-it-yourself (homebrew) computing, basic programming, digital electronics, business news and particular computers such as PET, Nascom and Apple. Some local teachers were interested in setting up an education group, but this never got off the ground, so the club decided to set up a committee and other short courses in some of the areas mentioned.

From the beginning of 1979, the club ran evening courses in BASIC programming, digital electronics, computing for novices and assembly-language programming. Two labora-

Robin Bradbeer is the chairman of the North London Hobby Computer Club. Address correspondence to the NLHCC, Polytechnic of North London, Holloway Road, London N7 8DB, United Kingdom.

tories were in use weekly for the homebrew group, and PET and business groups were meeting fortnightly. An average of 200 people were using the Polytechnic premises each week. The Department of Electronic and Communication Engineering let the club use its computer hardware, and eventually we were able to purchase some single board computers ourselves.

Locally Based

The club is very much a locally-based organization, with around 80 percent of its current 250+ members living within four miles of the Polytechnic. About 40 members are associated with the Polytechnic as students or staff, while the rest are "members of the public." The cross section of members' occupations is fascinating. We have housewives, schoolchildren, bricklayers, accountants, DP managers, programmers—the list is nearly endless. This gives the club a good base to work from.

Our monthly meetings also reflect this varied background. About 150 of the members get together once a month for demonstrations by manufacturers of new systems or new programming techniques. Typically, their meetings revolve around a "beer break" in the nearby bar, with the first half of the evening devoted to an explanation of a concept—say, speech synthesis or colour graphics—and demonstrations of various applications later on.

Although between one and two hundred people come along, we have a sense of "clubbiness." This is essential to the future of the club and it is encouraged in many ways. Other than the smaller weekly meetings, with numbers varying from a dozen for the business users group to 40 for the homebrew sessions and 60+ for the software workshops, the club produces a quarterly magazine called *GIGO*. This keeps the members informed of committee decisions. Each group within the club has free access to a couple of pages to describe its activities.

The Polytechnic not only contributes to the club's activities by its investment in hardware. The library has extended its collection of computing books and journals, and we now have the most comprehensive range of personal computing journals in London. The Computer Unit has also agreed to let members use the new DEC-10 that has recently been installed, on a supervised basis. These two aspects give us a broader base of activities than could be envisaged otherwise.

Some of the 200+ who attended Jim Butterfield's talk on the Commodore PET.

Because of these developments, the programme and organization of the club has evolved. Instead of the initial specialized groups and short courses, the club programme now revolves around a series of workshops. On Mondays the homebrew workshop not only uses the labs for project work, but also includes a lecture programme covering topics like soldering techniques, printed-circuit fabrication, digital design methods and elementary wiring practice.

On Tuesdays the PET users group and the business users group alternate. The programme for these groups covers topics such as input/output techniques, accounting procedures and word processing.

On Thursdays what began as the software workshop and covered such things as advanced BASIC techniques, Pascal programming and game theory has evolved into two sections. A 6502 users workshop concentrates on OSI, PET, Apple, KIM and similar systems. Some very interesting machine code programmes have evolved from this group. The other section meets on alternate Wednesdays and concentrates on the Z-80/8080/Z8000 processors.

On Tuesdays a novice's group meets. This is a series of self-contained evening sessions on a six-week "rolling" basis. Those club members who know nothing about computers—and there are many who do not—are introduced to various aspects of the subject. They can then go into one of the workshop sessions with a decent background knowledge.

The DEC-10 is available on some evenings for development of programmes too large for the smaller machines. The monthly meetings on Wednesday night cover a whole range of subjects. Jim Butterfield has shown some amazing software tricks with 6502 microprocessors; we had a computer music disco and seminars on computer fraud and privacy on small machines. We hope to link into Prestel, the Post Office postal viewdata network, sometime this quarter to investigate networking.

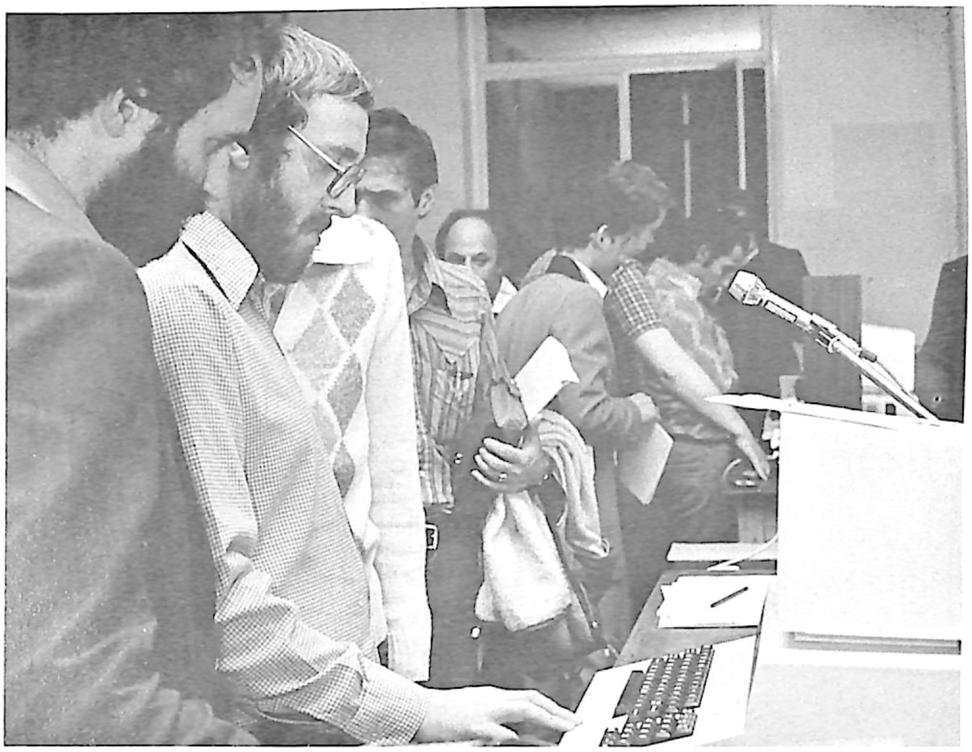
Teaching Each Other

With around 300 members and a comprehensive programme of activities, the club is now catering to a whole range of needs. However, we are aware that any complacency will mean falling numbers, and consequently less variety in our activities. One way we aim to overcome this is by involving those who know something to teach those who do not. In the homebrew area, for example, someone who has built a computer from scratch has invaluable knowledge, and this should be tapped.

If members are not able to expand their activities as they get to know more, they will become dissatisfied and leave. One of the problems with clubs such as ours is that when they become three or four years old, most of the members gather a fair amount of knowledge about all aspects of computing. People now entering often feel out of it, and do not return a second time.

We look on computing as a hobby. Although about one-third of our members are professionally involved in computing, the recreational angle is stressed quite strongly. A typical comment from a DP manager working within ICL was that he came along to play games because he couldn't at work. Others see computers as becoming an important element in their future lives, and they want to know what they are all about. We feel that part of our objective is to make computers human and to break down the mystique that has built up over the years. So, the message is come and play with one—it won't bite you.

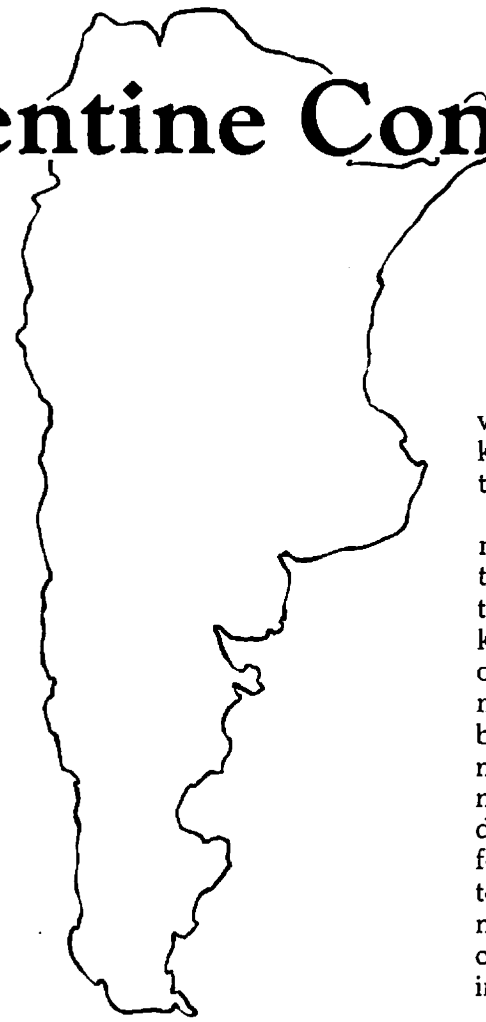
The club is a founding member of the Association of London Computing Clubs, and this links us to eight other clubs in the London area. The ALCC encourages reciprocal membership and has arranged some joint meetings. It also organized the London Computer Fair in July, with another one planned for 1981. Over 3500 people attended during the two days of the exhibition and saw 35 commercial and 12 club exhibitors. Profits from ventures such as this go to stimulate the starting of clubs in the parts of London without local groups. ■



User participation after Jim Butterfield's talk.

A microcomputing revolution has begun in Argentina.

The Argentine Connection



By William P. Winter, Jr.

Microcomputing in Argentina for the private citizen can best be described in one word—frustrating.

When I first looked around for dealers in Buenos Aires (pop. 10 million), I found almost nothing. Rumors had it that several outfits sold Radio Shack TRS-80s, but I couldn't find one. They didn't advertise or have a sales room. A flier I picked up at an industrial show a year ago gave an address, but it was a private home and no one answered the door or the phone. I later found out that they no longer sold Radio Shack products.

A friend who works as a programmer in the local factory of a large multinational company told me they had recently received a TRS-80 for evaluation. The price? Hold your hats —$4000 for a level II 16K system with CPU, monitor and cassette deck. Someone really made money on that deal. The price was high even by Argentine standards, where taxes boost prices by about 100 percent.

The company was having trouble with the computer because of little support or software; also, the instructions were in English, which the employees don't understand well. I suggested that we get together (I am also a TRS-80 owner) and exchange information—a sort of users group—but so far nothing has developed.

While doing my legwork I did discover that some equipment is available. The Motorola MEK6802D3 assembled circuit board sells for $480, which I understand is double the price in the U.S. It comes with complete documentation, but no accessories or power supply. The Cosmac VIP goes for $565, with no support.

Also on the market is the Texas Instruments TM990/189 for $665 (list price in the U.S. is $299). This unit is designed for the college classroom to be used for teaching microprocessing. It comes complete with literature. TI does have a field officer here, so support for their computer should be available.

Radio Shack Arrives

One day while out on the streets pursuing my regular activities as a missionary, I happened by a store being renovated. It had newly painted lettering on the window advertising Radio Shack computer products. It was empty as yet, but four men were sitting together talking. Lo and behold, a Radio Shack representative was setting up a new computer outlet with a local firm.

Several days later I met the manager, Nenson C. Lodi of Factorial Co. What a refreshing experience! Here was a man who knew computers, knew business and came directly to the point.

Lodi gave me a good outline of the microcomputing situation in Argentina—today and in the future. Up to this point, no manufacturing or marketing organization has made a serious attempt to serve the Argentine market. There have been some fly-by-night, quick-buck operations, but nothing serious. Now Texas Instruments is entering the field, with Radio Shack right behind. Radio Shack, for instance, is providing trained technical personnel and programmers to set up operating systems, complete with software and servicing.

Lodi game me a copy of the legitimate list prices for TRS-80 equipment. The Model I Level II 16K system sells for $2037, a far cry from the $4000 the local factory paid.

Software, as Lodi pointed out, is a real problem. Software available from the U.S. is not directly usable here; the business structures, taxing systems, employee laws and so on are very different from those in other parts of the world. So software must be developed from scratch to meet the unique needs of Argentina.

Microcomputing here is not for the hobbyist. High prices and lack of component parts and other hardware make it almost impossible for an individual to become involved. The major users are the small-to-medium businesses. Lodi predicts that there will be a massive development in this area during the 80s.■

William P. Winter, Jr., O'Higgins 3168, Buenos Aires, Argentina.

✓Reader Service—see page 194

The Skill of the Irish

By Robert O'Connor

Ireland, with its generous system of grants and tax relief and its access to the European market, is well poised to take full advantage of the coming revolution in microelectronics.

During the last four years a parade of American electronics firms has come to this small country. Companies that are naturally identified with Route 128 near Boston or with California's Silicon Valley are now happily doing business in such places as Dublin, Limerick and Cork.

Among the big names here are Mostek, Digital Equipment and Measurex. In the micro field, Apple Computer, Inc., of Cupertino, CA, moved into a 43,000-square-foot plant in Cork to supply personal computers for the European market. Analog Devices, of Massachusetts, which has been in Ireland since 1976, is concentrating the entire production of integrated circuits—from design to marketing—in Limerick.

In all, foreign-owned electronics companies have about 70 plants operating in Ireland, representing a fixed investment of about $600 million. American firms account for more than 80 percent of this investment.

The IDA

The Industrial Development Authority (IDA) is largely responsible for this influx of capital. The IDA has a mandate to create as many jobs as possible for an expanding Irish work force, and its range of incentives is impressive.

Ireland will pay up to 50 percent of the cost of plant and equipment and 100 percent of training costs. Firms that committed themselves before 1981 to coming in enjoy complete tax relief on exports until 1990. For newer arrivals, there will be a standard corporate tax rate of 10 percent. Repatriation of profits and full depreciation of costs are also allowed.

And there is Europe. Since 1973, when Dublin joined the European Economic Community (EEC), the IDA's salesmen have been getting the attention of American industrialists by telling them that Ireland (population 3.3 million) has, in effect, a bigger domestic market than the United States. The average return on investment for U.S. companies in Ireland is, at 29.9 percent, the highest for American firms doing business overseas.

"This compares with 13 percent for EEC countries as a whole," one IDA official here says.

The heavy activity in the computer field here can be traced to a decision by the IDA in the early 1970s to launch a major attempt to lure the electronics industry. The success of this policy, according to the agency, is reflected by the fact that one-half of U.S. electronics firms that decide to go abroad now choose Ireland. The development of electronics has paved the way for other, more dramatic, advances in the future.

James I. Whelan, project manager of the IDA's Overseas Division, says the decision to go after the electronics industry was made on the basis of that sector's high profitability, long-term stability and encouraging prospects for economic growth. He also mentions the fact that electronics is a clean industry.

The possibility for linkage with other areas is another consideration. Expansion into computers, for example, has led to the production of terminals, printers and disk drums. Business electronics has meant word-processing equipment and intelligent typewriters. And, Whelan says, there is the microchip, "the basic intelligence of the computer industry."

"In our studies of the electronics industry," Whelan says, "we found a close connection between the development needs of the Irish economy and certain areas of the electronics industry."

The late Sean Lemass, prime minister from 1959 to 1965, did much to attract foreign investment to a country that had traditionally relied on high tariff barriers to protect feeble native industry.

Lemass' successor, Jack Lynch, continued this opening-up process. In 1965, while still minister for industry and commerce, Lynch negotiated the Anglo-Irish Trade Agreement, which established a free trade area between the two countries.

Lynch recalls that the price Ireland had to pay was a ten-year phasing-out of tariffs against British industrial goods. Dublin agreed to this with a much larger prize—the Common Market—in mind.

"We felt," Lynch explains, "that if Irish industry could adjust itself to withstand British competition, then it would be in a good position to withstand competition from the industrial countries of Europe."

In 1969, under Prime Minister Lynch, the IDA was reorganized. In-

Freelance writer Robert O'Connor lives in Dublin, Ireland.

stead of civil servants, one official says, it now has "people who have business experience and therefore can have empathy with the business people that we deal with."

Helped by a pro-investment outlook from both of the major political parties, they have done their job well. Besides computers and electronics, Ireland has established a growing export trade in pharmaceuticals and health care products.

The Offshore Syndrome

Of course, Ireland is a small country. Its dependence on outside countries to buy its exports, coupled with foreign control of its industrial base, means that it could be dragged along by outside forces faster than it might otherwise choose to advance on its own.

Dr. Barry O'Shea, a member of the National Board for Science and Technology, recognizes this "offshore syndrome" and argues that part of the solution is to make foreign-based companies "more Irish." The decision of Analog Devices to established a front-end operation in Limerick is an example.

As Robert Cochrane, also a member of the NBST, puts it, companies that have started offshore operations "have become increasingly locked into the Irish economy, and this is desirable from our point of view because the possibility of a pullout becomes less and less."

Both men are optimistic. Cochrane points to trends in employment and exports. In 1980, according to the IDA, 13,500 electronics workers in Ireland produced about $800 million worth of exports. By 1985, employment is expected to rise to the 30,000 range, and exports, the IDA feels, will easily triple.

Cochrane says the 1980 figure represents 20 percent of the value of industrial exports. In 1985, he says it will be 35 percent. Another encouraging factor, he adds, is that in 1980 Ireland was already producing 2 percent of the European electronics output—with 1 percent of the work force. This share, he says, will increase as electronics becomes even more important in Ireland.

Cochrane acknowledges that the Irish government has been criticized for its generosity to the multinational corporations, but he contends that, in its efforts to compete on a world level, the country does not have a great deal of choice.

> The Irish government has been criticized for its generosity to the multinational corporation, but . . . the country does not have a great deal of choice.

Turning to social attitudes, O'Shea says that Ireland is more open to new ways of thinking than is its neighbor across the Irish Sea.

"In general," he says, "we have accepted change more readily than the U.K."

He cites two examples: membership in the Common Market and decimalization of the currency, each of which took effect in Britain and Ireland in the early 1970s. In Ireland, O'Shea says, neither issue is the subject of debate, whereas in Britain each can still touch off an argument.

Computer Automation

Computer Automation of Irvine, CA, has about 130 employees at an eight-acre site in Dublin, and, according to General Manager Stuart F. Dale, its experience in Ireland has been positive. The plant, whose staff is scheduled to expand eventually to 500, makes minicomputer products and data processing systems for companies that need computers capable of talking to each other. Dale says the plant's capacity will develop to the point where it will be producing programmable test equipment.

Computer Automation is a public company organized in 1967. The firm's board of directors and the IDA reached agreement on the Irish project in 1978, and production began in February 1979. The company is in line for a total grant package of about $5.1 million.

When asked why Ireland was chosen, Dale sounds for a moment like a pitchman for the IDA. He recites the usual list of attractions: the tax benefits and grants; the access to Europe; the availability of high-quality, English-speaking labor. This last consideration, he says, was important for his firm, which is undertaking its first foreign venture.

Labor costs, Dale reveals, are slightly lower in Dublin than at Computer Automation's two other plants, in Richardson, TX, and Irvine. He says there is "more compression" here and speculates that the Irish tax structure, which grabs bigger and bigger bites out of rising earnings, tends to lessen the difference between top and bottom.

"Interestingly enough," he remarks, "the starting rate in our lowest job classification here is a tiny bit above the lowest rate for starting classification in the States."

Seventy-five percent of Irish industrial workers are unionized. While Computer Automation's two U.S. plants are non-union, there is complete unionization at its Dublin facility. Dale says that labor relations here are good, and he says that the Dublin plant is making a profit, although he won't say how much. There have been no work stoppages at the Dublin plant.

"Overall," Dale says of labor costs, "I think it's costing slightly less here, but not substantially less. And wages have been increasing in Ireland faster over the last couple of years than they have in America. So what differences existed in the past have tended to be eroded."

He says technical education "is very good in terms of basic electronics training and is improving as regards the exposure to computers. The first thing is to give them (the students) a sound basis of electronics, and I think they stack up quite well."

Asked what problems he has found, Dale says, "The communications system is poor, particularly if you get located in some of the westerly areas."

He adds that there is a difficulty in finding qualified supervisory people and a lack of "the whole range of supports and services" that would normally be available in a large, metropolitan area in the United States.

Dale also indicates that an American businessman in Ireland might find himself more involved with the government than he would prefer. Services that are provided in the U.S. by utilities or by private companies are often in the hands of government agencies here. And Dale tactfully suggests that some of these bodies "are not as responsive or efficient" as they should be.

Data Terminal Systems

Like Computer Automation, Data Terminal Systems (DTS), of Maynard, MA, is a relative newcomer to Ireland. It began its Irish operations in a temporary site in 1978 and the following year moved into a permanent plant in Clondalkin, a village outside Dublin.

The factory produces electronic cash registers and "point-of-sale terminals," those sophisticated checkout monitors that can do so much to increase retail profit margins.

John J. Quinlan, DTS' personnel manager, says there are 160 people employed at the Clondalkin plant, of whom 20 are in marketing. Like Dale at Computer Automation, he will not discuss profits, but will say that the work force at the Clondalkin site is scheduled to increase to 800 in about five years.

Quinlan says DTS' start-up grant was 40 percent, or about $800,000. Also in the works is a training grant of almost $250,000.

"The whole idea of a training grant," he remarks, "is a realization by the Irish government that in some areas skills are not available in Ireland."

Quinlan, himself an Irishman, said that while skilled managerial and technical people are in short supply, it is much easier to fill production jobs in Dublin than in Maynard. Here, he said, there are ten applicants for every opening on the shop floor. The $200-plus a week general workers earn here, plus their higher level of benefits, makes labor costs between the two plants comparable.

DTS moved into a plant that was built for it by the IDA. The fact that the agency builds factories on speculation is a lure for computer firms, who rate the ability to get into production quickly over the need for elaborate facilities.

Marketing in America

The IDA's marketing program in the United States is, to say the least, aggressive. The importance the agency places on reaching the U.S. computer industry is underlined by the presence of an office in Menlo Park, CA, to serve the nearby Silicon Valley. There are seven IDA offices in the U.S. and one in Canada.

The IDA's representatives in America are marketing specialists who know how to knock on doors, and they do so about once a quarter at each of the major U.S. corporations.

Part of their approach, James Whelan says, is to convice American firms with customers in Europe that once they reach a certain level of sales on this side of the Atlantic, "it becomes prudent for them" to go into production in Europe as well. Then a location is gently suggested.

Whelan says some American companies will make the jump after European sales have hit $10 million. Others will wait until the figure reaches $30 million.

The goal of an IDA salesman abroad is to get a corporation to agree to a site visit. After that is arranged, the agency assembles a team in Dublin to begin planning. During the visit, which generally lasts from four to five days, the IDA introduces its guests to bankers, representatives of AnCo, the government training agency, and even competitors who have already set up shop here. If things progress to the stage of serious negotiation, Whelan says, they try to "satisfy the company without having to give away the kitchen sink."

Like Cochrane of the NBST, Whelan believes that the IDA's generosity is both justified and necessary.

"Our bottom line," he says, "is the creation of jobs."

He notes that Ireland has the youngest population in Europe, with more than 50 percent of its people under the age of 25 and more than 30 percent under 15. Unemployment, a persistent problem, was running at 8 to 9 percent in 1980.

The drop in farm employment, Whelan says, "is going to mean that there will be a flood of people in the next 10 to 20 years into other sectors of the economy, the industrial sector and the service sector."

The Future

Whelan can see no point in the future where the IDA will be able to relax. Ireland's strongest competition for investment is coming from the United Kingdom, particularly its "special development areas" in Northern Ireland and Scotland.

As of 1979, it was costing the IDA an average of $10,000 for every job that was created. The cost of recent projects has suggested that figure may have risen sharply. Whelan says the country gets its money back within 2½ years in the form of taxes and other economic benefits.

An economist for the Economic and Social Research Institute, an independent research organization that draws most of its funds from the government, believes that the IDA's poli-

(continued on page 66)

Glorious Utopia or Gloom and Unemployment?

Microtechnology comes to Ireland

To the average Irish citizen, the presence of so much foreign investment may mean the difference between having to emigrate and being able to live in his own country. The bulk of the business is in the Dublin area, but Limerick has emerged as an industrial center, and the IDA, by offering to increase grants, has been able to steer investment to rural areas where it is most needed.

The National Board for Science and Technology (NBST), a public body, is now involved in a definitive study of what Ireland can expect from microelectronics. The project, due for completion this year, is under the direction of Robert Cochrane and Dr. Barry O'Shea, two members of the NBST staff.

Cochrane and O'Shea explain that the study is aimed at sparking a general discussion of microtechnology in Ireland, something that has not yet happened.

"Some of the treatment in the news media has tended to be somewhat superficial," Cochrane observed, adding that the new technology has been painted as something that will either open the door to a glorious utopia or usher in an age of gloom and massive unemployment. They suggest that neither will be the case in Ireland.

Nevertheless, an interim report they released last year states, "The technology and application of microelectronics has tremendous political, cultural, sociological, psychological and philosophical implications. We are today in a unique position in that we can anticipate the changes which are ahead and so direct them, plan for them and prepare for them."

According to Cochrane and O'Shea, one factor that will tend to lessen the impact of the new technology here is the importance of agriculture. Cochrane points out that 22 percent of the Irish labor force is still on the farm.

"For a relatively developed Western country," he says, "it's an extremely high proportion."

In the United States and the United Kingdom, Cochrane says, only 3 to 4 percent of the workers are involved in agriculture. The figure for West Germany is 9 percent.

The percentage of agricultural workers in Ireland is expected to drop in the next few years, but this decrease will be offset in part by a sharp rise in the size of the labor force itself. Cochrane said the proportion of those involved in farming should eventually stabilize at about 11 percent.

While the microchip will introduce more efficiency in animal husbandry and crop management and thus permit some staff reductions, O'Shea says that "the new technology per se is not likely to have a major effect on agriculture in the foreseeable future." Cochrane adds that the small size of Irish farms means that massive automation on the scale of American-style agribusiness is not feasible.

Smallness should also inhibit the effects of automation in industry. Cochrane says the average firm here has about 50 people and notes that in Britain a company with 1000 employees is classified as average-sized. "That's a very large firm in Ireland," he observes.

Pointing out that in industry, as on the farm, full automation is possible in only a very large operation, Cochrane says that this prospect "in all sectors of the economy in a relatively few years is slim."

Organized labor has been very enthusiastic about the electronics industry in Ireland, and the feeling about microtechnology is one of cautious optimism. Donal Nevin, assistant general secretary of the Irish Congress of Trade Unions, the Irish equivalent of the AFL-CIO, cites the number of jobs electronics has already created and says microcomputing has "enormous potential" for expansion in the service sector.

Nevin says, however, that unions are "apprehensive" about potential long-term effects, particularly on the jobs of women, who make up a large percentage of the work force in electronics. He says organized labor would like to see advances in technology used to increase leisure time "not for its own sake, but to control the widespread unemployment that could result."

Irish unions will probably have a great deal to say in this area, given the high rate of organization among workers.

Nevin concedes that Ireland has a reputation abroad for labor unrest, but contends that most of the problem lies outside the area of private industry. He says that 85 percent of the days lost to strikes in 1979 were in the public sector. A notable example that year was a 19-week postal strike.

"That's not to say we don't have problems in this area," he states, "but they haven't prevented 600 to 800 foreign firms that have come to Ireland over the last 20 years from thriving." ■

—*R.O'C.*

cy on foreign investment has worked well.

"Southern Ireland," he says, "was one of the first relatively less-developed countries to embark on export growth. The main vehicle for that was foreign investment."

The 1960s and early '70s, he says, were a boom period all over the world, but since 1974, "the competition for international mobile investment has increased dramatically.

"In a sense, then, the multinational enterprise is in a very nice position. It's in the position of being able to pick and choose."

He said that the country could "get into a situation where the IDA could well be paying too much for foreign investment."

As for the threat that foreign businesses might exercise political control, he says, "There's no foreign industry playing a dominant role in the country. And most of the plants tend to be rather small by international standards. I don't think people see any danger of their exerting political pressure."

And concerning any fears that an incoming company might have about losing control of its enterprise to the government, the economist said, "Obviously the climate for foreign investment here is quite favorable. There's certainly no danger of expropriation. It's certainly more favorable than in the U.K. or France."

So, regarding the changes that microtechnology will bring, the outlook in Ireland appears to be very promising.

The IDA, which could teach corresponding agencies in the more industrialized countries a few things about business, has laid a solid foundation in the form of a large, varied electronics industry. The government, reflecting a realism common to smaller nations, remains committed to foreign investment. And the Irish people themselves, no longer forced to emigrate en masse, look upon the creation of thousands of jobs as a sign that their children will also be able to stay in Ireland.

The factors that have made Ireland attractive in the American boardroom are likely to continue with a cumulative effect. This country—through its incentives, its attitudes and its commitment to Europe—is likely to exert an ever stronger pull on the U.S. computer industry. In a sense, Ireland already has one foot in the next age. ■

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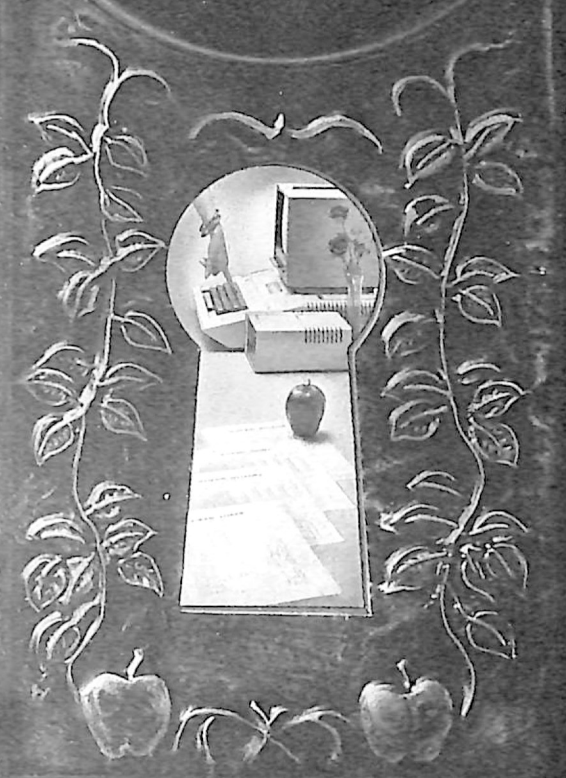

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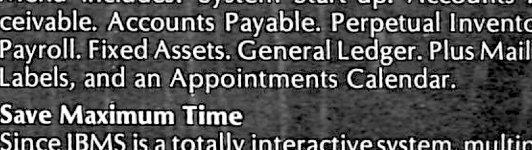

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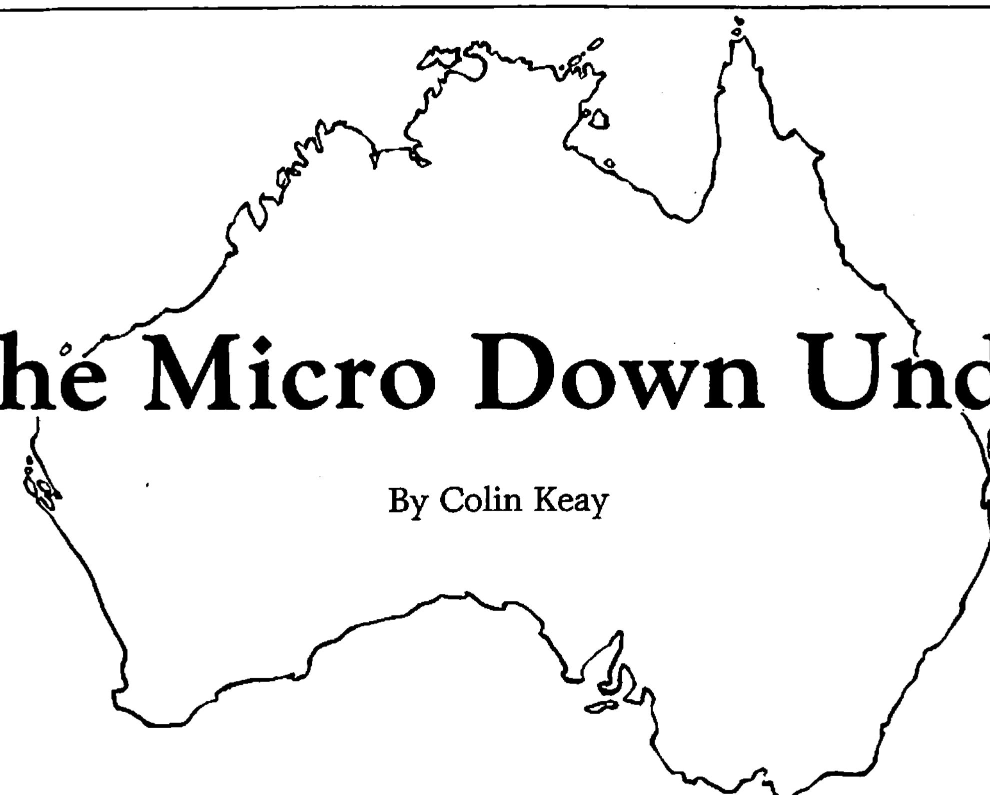


The Micro Down Under

By Colin Keay

The microcomputing scene in Australia most closely parallels that in Canada. It follows the lead of the United States (from whence our tiny tablets of digital power cometh). It severely suffers the tyrannies of taxation and penalties of economics, which the American microcomputer market is spared. And in Australia we have the additional tyranny of distance from the source.

Nevertheless, sales are booming as the mighty micro invades the territory of the minicomputer and conquers virgin fields of its own.

Australia is a land as large as the continental U.S. but with less than one-tenth of the population. So the total market is smaller. But the variety of available micros might even be greater than in the United States. In addition to almost every significant American microcomputer, we also have available some British micros not easily obtainable in America, and a few of our own, such as the Australian Alpha Micro, the AWA Microstar and the Rose Opal/Omega. These are virtually unknown in America.

Such variety tends to keep unit sales low and price high. Good discounts are rare. Then add the 15 percent sales tax, which all nongovernment buyers must pay, and the cost of air-freight across the Pacific (which is almost essential because of the high risks of transoceanic shipping damage and half-year transit delays). The Australian micro buyer pays twice as much, or more, than the U.S. buyer.

I recently bought in Atlanta an S-100 expansion unit at a special discount price of $249. Georgia state tax brought the total to $257 (equal to 226 Australian dollars). It was worth the trouble of carting the unit home as part of my baggage because the Australian purchase price was 575 dollars including taxes (about $633).

Software is, by comparison, much cheaper. No sales tax applies (except for the cost of the medium), and it can be readily duplicated under license in Australia. As a result the dollar cost is often identical. (Ten percent more in real expenditure due to the current rate of exchange.)

As in the United States, a large amount of good software is available to individuals through membership in microcomputer clubs. In the larger state capitals clubs exist for each of the major micros, with not much cross-contact between users of different microcomputers.

On the other hand, Newcastle, Australia's sixth largest city and the largest non-capital city, has a microcomputer club which is open to all. Owners of home-brew systems or uncommon brands can share their experiences and get advice on their problems. The Newcastle Microcomputer Club is based at Newcastle University, where staff members—such as Peter Moylan, Gordon Johnston and Peter McNabb—have done much to introduce novices to the world of microcomputing.

I am bound to be accused of hometown bias when I remark that three graduates of Newcastle University's Physics Department have become nationally recognized figures in Australian microcomputing. Bill Caelli is Australia's Adam Osborne, our guru of the micro. His book *The Microcomputer Revolution*, published by the Australian Computer Society, is now in its third printing. If nothing else, it proves that the computer professionals in Australia are taking the arrival of the micro very seriously. Caelli has recently formed a company to market a device which he has developed to prevent unscrupulous micro owners from gaining access via phone lines to data in commercial computers.

Paul Goldsbrough is a leading educator in microcomputing. Now based at the Canberra College of Advanced Education, he spent some time in America working with the well-known Blacksburg team which produced the 8080 Bugbooks (he wrote

Colin Keay is an associate professor of physics at The University of Newcastle, New South Wales, 2308, Australia.

Bugbook IV on microcomputing interfacing), and he conducts frequent industry seminars on the use of microcomputers.

Our graduate most familiar to the amateur computing fraternity in Australia is John Kennewell, who designed the inexpensive Mini-Scamp, which gave many hundreds of Australians their first taste of microcomputing.

Dick Smith and Others

The Mini-Scamp was marketed by a chain of electronics stores established by a mercurial entrepreneur named Dick Smith. Between chartering Jumbo-jet flights to the Antarctic, Dick Smith has become a multimillionaire by staying at the forefront of electronics marketing in Australia. He is Australian agent for the Exidy Sorcerer and the System 80, the Chinese copy of the TRS-80. His electronics chain is second only to Radio Shack in the number of stores it operates.

Radio Shacks abound everywhere in Australia, with nearly 40 in the city of Sydney alone. As a result the TRS-80 is the number one seller, with Apple in second place. For a time the Sorcerer ran third, but despite Dick Smith's active promotion the troubles besetting the U.S. Exidy Corporation have held back the sales of that fine microcomputer.

The Apple got away to a poor start in Australia through a distributor setting the selling price far too high. Other importers have since brought the price down to the point where the Apple is an excellent value for the money and is becoming the most widely used microcomputer in high schools.

The PET has achieved a better penetration of the college and university market, but it is not yet widely available in the retail market.

Recently a controlling share in Dick Smith Electronics was bought by Woolworths Australia. This development may lead to sales of the Sorcerer and the System 80 at Woolworth's Shopping Centers all around Australia. It is a development which could give Tandy a run for its money on this continent.

Obtaining microcomputing magazines continues to be a problem in Australia. Direct subscription is least expensive, but surface mail from America averages three to four months. In some capital cities computer stores import air-freighted copies of leading U.S. magazines and sell them for $4.50 per issue. But Dick Smith (there's that name again) manages to retail selected journals such as *Byte, 80 Microcomputing* and *Kilobaud Microcomputing* at only $2.95 to those lucky customers within range of a Dick Smith store.

For many years the interests of Australian microcomputerists have been served by *Electronics Australia* ($1.60), under the editorial guidance of Jamieson (Jim) Rowe, who has now switched to a post as Technical Director for the Dick Smith organization. This magazine published many articles featuring mainly 2650 (Signetics) and SC/MP (National Semiconductor) systems. These include John Kennewell's series on his Mini-Scamp and a broad variety of 2650 offerings by Jim Rowe and David Edwards. As a result the Z-80 and 6502 have a much weaker foothold in Australian homebrewing computing than in the United States.

In mid-1980 Australia's first microcomputing journal, *Australian Personal Computer*, was launched. However, it is very obviously a relative of the English magazine *Personal Computer World* and leans on it heavily for content material.

The progress of microcomputing in schools and universities reflects the struggle between the innovative microcomputer enthusiasts and the conservative big-machine advocates. In some places the two attitudes coexist, but generally, the introduction of microcomputing meets opposition from entrenched "real computer—not hobby computer" mentalities.

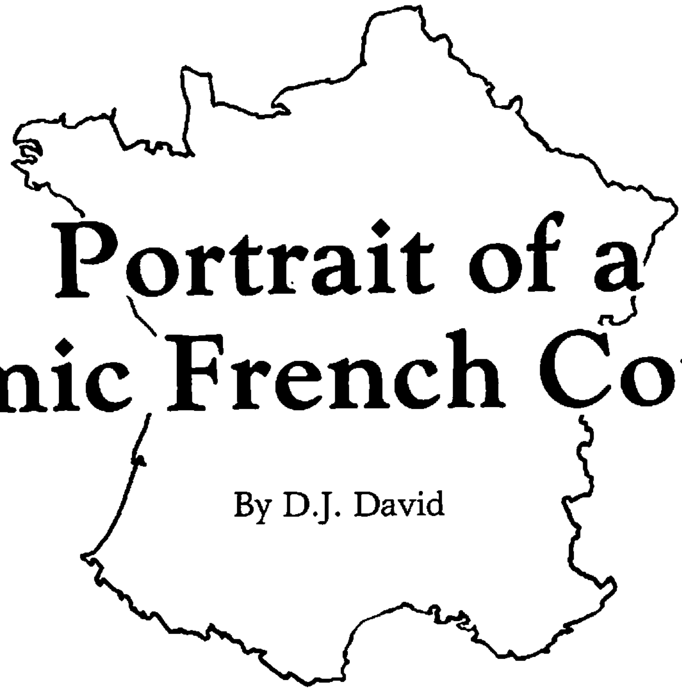
For example, my university has instituted degree courses aimed at producing specialist computer scientists and computer engineers, but a course aimed at educating general scientists in the use of microcomputers (among other things) in their work has been suspended to conserve funds and manpower. But despite negative attitudes and occasional setbacks, the microcomputer is intruding more and more into teaching and research in most university science and engineering departments in Australia.

Schools in Tasmania

On the school scene the state of Tasmania has for the past nine years been following the policy that "every child will have some exposure to interactive computing while at school," with the result that Tasmania now has at least 162 terminals in schools. These are connected to a network of seven computers ranging from PDP-8s up to a VAX 11/780. West Australia is following suit, but the other states of Australia, not having such networks, are embracing the microcomputer to an increasing extent. Unfortunately, there is no coordination, and the results are heavily dependent on the interest and attitude of the teaching staff of each school. Again, Tasmania has been a leader in providing a facility where schools purchasing Apple microcomputers can retrieve useful Apple programs through their statewide computer network.

As far as the training of school teachers in microcomputers is concerned, the facilities in Australia are poor. There is nothing similar to the Laboratory for Personal Computers in Education at the State University of New York at Stony Brook. But the tide is turning, and despite severe financial cutbacks in Australian tertiary education, there is a growing demand by school teachers for courses of training in microcomputing. The teachers are being increasingly embarrassed by pupils who know far more about microcomputing than they do. Imagine the problems they will have if we reach the stage similar to Japan's, where mothers are reportedly buying their children microcomputers so they can keep up with their classmates who already have access to one.

It's quite a taste of future shock to overhear a couple of 12-year-olds arguing the relative merits of eight-bit versus 16-bit processors! ■



Portrait of a Dynamic French Company

By D.J. David

The PET/CBM microcomputers may only be third in the U.S. But in Europe they are number one: by far in Great Britain and Germany, and by a comfortable, if slightly smaller, margin in Holland, Italy and France.

The PET's quality is, of course, a major contributor to its success. But in the case of France, a second factor is the earnestness and activity of Commodore's exclusive importer, the Procep company.

Procep started about five years ago. In those days, the company was very small—three or four people. They imported MOS Technology 6500 family microprocessors, primarily the KIM-1 board.

When Commodore bought MOS, Procep became their importers. Big business began. They have since grown quickly—the company employs 25 people and sells 300 systems a month. These figures will probably double this year.

Quality Service

Despite their growth, Procep offers the same good service. We have 12 PETs and CBMs where I teach, and we've always received fast delivery and thorough documentation. And while we have yet to experience a system breakdown, I've heard that Procep's maintenance service is also good.

Procep controls a full network of distributors and retailers, thus letting customers throughout France take advantage of their services. Distributors are strongly supported by Procep; they are trained in special seminars and receive all the information they need to serve their customers.

Procep offers an excellent documentation service. All Commodore brochures are translated into French. Translations are done as quickly as possible, thus relieving some of the documentation shortage customers have experienced in the past.

Also, Procep offers a whole range of customer seminars. These include an introduction to microprocessors, an introduction to CBM systems use (with emphasis on printers and floppy disks), microprocessor industrial applications (with emphasis on the Sysmod industrial system), Pascal programming, use of the IEEE and the CBM in business applications. Other seminars cover specific profes-

The Euromicro Association (European Association for Microprocessing and Microprogramming) plays an important role in information propagation all over Europe, in the field of microcomputers and related areas. Founding chairman is Dr. Rodnay Zaks. It publishes a journal (*Euromicro Journal*, formerly *Euromicro Newsletter*), which is written on a scientific level. The March 1980 issue contains an interesting special section devoted to microcomputing that features very informative reports on the market for and use of microcomputers in different European countries. People interested can obtain a copy by writing to one of the addresses below.

The second important action of Eucromicro is to organize a congress of more than 500 participants every year. Successive locations have been Nice, France; Venice; Amsterdam; Munich; Goteborg, Sweden; and London (September '80). The next congress will be in Paris in September 1981.

For any inquiries write to D.J. David, c/o Euromicro, 18, rue Planchat, 75020 Paris, France, or to the U.S. correspondent, G.J. Lipovski, Department of Electrical Engineering, University of Texas, Austin, TX 78752.

Daniel J. David teaches business data processing at University of Paris 1. He is a member of the Euromicro and ISMM associations. His articles have appeared in Kilobaud Microcomputing, *and he is a regular contributor to the main French microcomputing magazines,* Microsystemes *and* L'Ordinateur Individuel. *He writes a PET column for the latter. He has authored several books on microcomputers, including* La Decouverte du PET, La Practique du PET/CBM *and* Programmer en Pascal. La Decouverte du PET *(PET's BASICs) is being translated into English and will be published by dilithium Press soon.*

sions, such as teaching or journalism.

Software Support

Procep's earnestness shows most in software. A full team of nearly ten programmers develops programs or adapts already written programs for the French market. Programs cover such areas as text processing, teleprocessing, stock handling and general accounting. The company gives special support to customers who develop programs suitable for a whole branch of interest.

All software developed by Procep is tested and approved by professionals in the target branch before release. This is especially important for the CBM 8000 series, which is more for professionals.

Industrial Support

Procep distributes Sysmod, a system of industrial printed-circuit boards (known as Eurocards) that plugs into a CBM 3000 to permit industrial process control. Also, a CBM with Sysmod constitutes a true development system for the 6500 family. Sysmod boards include a parallel input/output board that features two 6522s, analog input or output boards (eight or 12 bits), a relay board (12 relays), optically isolated input or output boards, an EPROM programmer board, a serial input/output board and a CPU board that permits the customer to use Sysmod in autonomous mode.

Conclusion

In the long run, Procep's attitude will be rewarding. They have saved their customers frustrating and discouraging experiences, and this will help ensure a real development in the field of microcomputing. Procep has thus become an important contributor to the success of Commodore, and more generally of microcomputing in France. ■

The French government, especially the Ministry of Industry, is quite active in the areas of electronic data processing, microelectronics and microcomputing. Their awareness was indicated last year by the organization of a colloquium on "Informatics and Society," which was attended by President V. Giscard d'Estaing.

Under the auspices of the Ministry of Industry, the DIELI (Direction des Industries Electriques et Informatiques) is carrying on several projects.

First, a set of conferences has been organized throughout France to make industrial designers and managers aware of the potentials of microprocessors. In conjunction with this, a number of technical schools, called relay centers, have been established. These centers provide microprocessor seminars and courses in each region, and help companies who want to incorporate a microprocessor in one of their products. They provide consulting engineers and development system facilities, thus saving companies the investment in equipment and qualified engineers.

In education, a project called "10,000 micros dans les Lycees" (10,000 micros in public schools) has provided roughly 1000 machines to schools throughout France. The program is a continuation of one that installed minicomputers in a number of schools. The micros use the LSE language, an intermediate between BASIC and APL with French keywords.

Also, public competitions have been organized to encourage more widespread use of microcomputers in everyday life. In 1980, the second year for the contests, a second competition was organized in the field of computer-aided artistic creation. The prizes are $1000–$20,000 grants to buy microcomputer equipment.

The two categories for competition are future projects and real implementations. Last year, winning projects were related to present worries of the man on the street: energy savings, health, education, security and aid for the handicapped. They include a programmable electronic organ, a programmable rhythm box, a light box, an electronic lock (the key is a printed circuit), graphics creation software, an electronic drill, a heating regulation system, a typing machine for the handicapped, a diabetic assistance system and an obstetrical monitoring system.

—D. J. David

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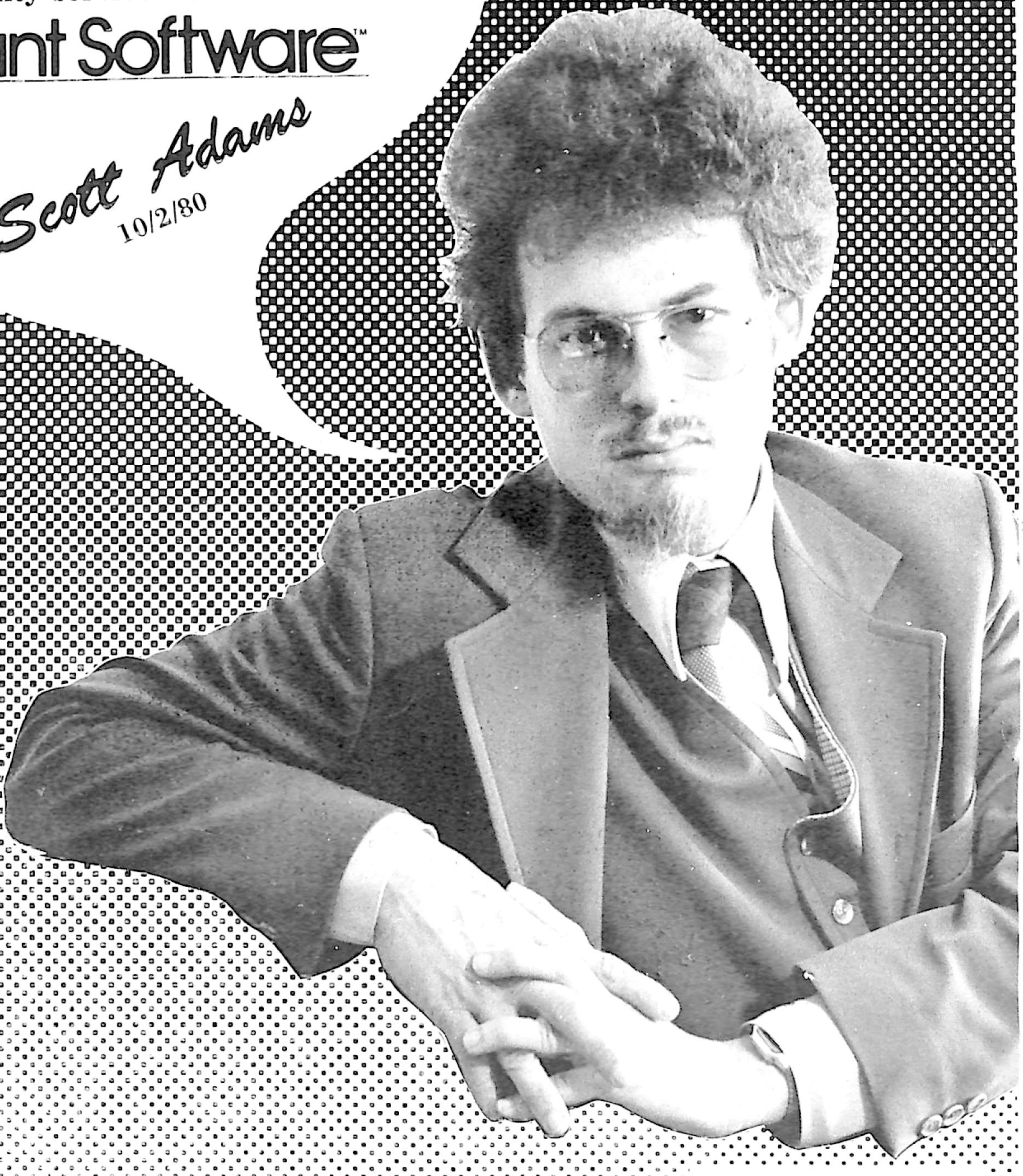

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Been yearning to tackle a major assembly-language project? Part 1 of this article describes a do-it-yourself FORTH interpreter.

Write Your Own FORTH Interpreter

```
; RDSEC - read a sector from the disk
; HL - track to read
; DE - sector to read
; BC - memory area to read to

RDSEC   PUSH    B           ; save memory address
        PUSH    D           ; save sector
        MOV     B,H         ; all subs expect arg in BC
        MOV     C,L
        CALL    SETTRK      ; set track
        POP     B           ; BC gets sector
        CALL    SETSEC      ; select sector
        POP     B           ; BC gets memory address
        CALL    SETDMA      ; set memory address
        CALL    READ        ; READ the sector
        RET
```

Listing 1a. Example assembly-language routine.

```
; RDSEC - read a sector from the disk
; TOP (of stack) - track to read
; TOP-1          - sector to read
; TOP-2          - memory address to read to
; NOTE: This routine won't work because it uses the
; same stack for subroutine calling and parameter
; passing.  It is here only to make a point.

RDSEC   CALL    SETTRK      ; SETTRK uses up top of stack
        CALL    SETSEC      ; SETSEC uses up top of stack
        CALL    SETDMA      ; SETDMA uses up top of stack
        CALL    READ        ; all arguments set, perform read
        RET
```

Listing 1b. Example use of uniform parameter passing on the stack.

```
; RDSEC - read a sector from the disk
; TOP (of stack) - track to read
; TOP-1          - sector to read
; TOP-2          - memory area to read to
; NOTE: This is a threaded code routine.  It uses two
; separate stacks and so will work.

RDSEC   DW      TCALL       ; threaded code CALL
        DW      SETTRK      ;  TCALL SETTRK, set track
        DW      SETSEC      ;  TCALL SETSEC, set sector
        DW      SETDMA      ;  TCALL SETDMA, set memory address
        DW      READ        ;  TCALL READ, read sector
        DW      TRET        ; threaded code RETurn
```

Listing 1c. Sample assembly code compressed into threaded code.

By Richard Fritzson

FORTH has become a popular programming language. It is available for most microcomputers, from a variety of sources, in a variety of forms, under a variety of names. The language is fast and interactive and produces compact code. It also is easy to understand and implement.

To implement the simple version explained in this article, you should be comfortable writing assembly code for microcomputers. Although the examples are all in 8080 assembly language, much of the source presented is written in machine-independent threaded code so everything can be moved to another micro with only a little extra effort.

The FORTH interpreter has three parts: an internal interpreter, an external user interpreter and a compiler. This article covers the implementation of the interpreters.

The Internal Interpreter: Threaded Code

Most programming languages produce either machine code, which is directly executed by a CPU, or interpreter code, an internal representation of the program, which is then interpreted by another program. In the first group are most FORTRANs, PL/M and assembly language. The second group includes nearly all BASICs, LISP and UCSD Pascal.

Richard Fritzson, 25 Callodine Ave., Amherst, NY 14226.

```
                  ; The interpreter's architecture: a program counter and a stack

019D 0000         PC      DW      0       ;a 16 bit pointer into the MIDDLE off
                                          ;the current instruction (not the
                                          ;first byte, but the second)

019F A101         RSTACK  DW      $+2     ;the stack pointer points to the next
                                          ;AVAILABLE stack position (not the
                                          ;topmost occupied position)

01A1                      DS      80H     ;reserved stack space


                  ; RPUSH - push DE on stack
                  ; ENTRY: DE - number to be pushed on stack
                  ; EXIT:  DE - is unchanged
                  ; DESCRIPTION: this code is illustrative of how the
                  ; stack works. However it is not used in the system and
                  ; can be left out.

0221 2A9F01       RPUSH   LHLD    RSTACK  ;get stack pointer
0224 73                   MOV     M,E     ;store low byte
0225 23                   INX     H       ;bump pointer to next byte
0226 72                   MOV     M,D     ;store high byte
0227 23                   INX     H       ;bump pointer to next empty slot
0228 229F01               SHLD    RSTACK  ;restore pointer
022B C9                   RET

                  ; RPOP - pop DE from stack
                  ; ENTRY: No Register Values Expected
                  ; EXIT:  DE - top element of RSTACK
                  ; DESCRIPTION: this code is illustrative of how the
                  ; stack works. However it is not used in the system and
                  ; can be left out.

022C 2A9F01       RPOP    LHLD    RSTACK  ;get stack pointer
022F 2B                   DCX     H       ;drop to first stack position
0230 56                   MOV     D,M     ;get high byte
0231 2B                   DCX     H
0232 5E                   MOV     E,M     ;get low byte
0233 229F01               SHLD    RSTACK  ;restore stack poiner
0236 C9                   RET
```

Listing 2. Sample code showing stack details.

FORTH produces threaded code, which is neither interpreter code nor directly executed by a CPU. It is interpreted, but the interpreters are so much faster (more than ten times the speed of BASIC) and so much smaller (less than 50 bytes) than other interpreters that they are in a class by themselves.

Notice that good assembly-language programs use subroutine calls as often as possible. In fact, they contain code that consists largely of CALL statements; the rest of it is for shuffling parameters in preparation for the next CALL (Listing 1a). If a standard method of parameter passing were used, so that each routine returned its value(s) where the next routine expected to find its arguments, there would be no code at all except the CALL statements.

To implement threaded code, first use the stack to pass all arguments to subroutines and to return all values from subroutines. (This is why FORTH is so stack oriented.)

Once you have eliminated all of the code except the subroutine CALLs (Listing 1b), look at the program. Every third byte of the program is the same. It is the machine-language op code for CALL. This is redundant information and accounts for one-third of the memory occupied by the program.

Eliminate the redundant information. Replace every CALL op code with one special CALL (which I will call TCALL, for threaded CALL). In algebra, this is called factoring.

Listing 1c provides a few details of threaded code. First, the RET instruction has become a special TRET instruction (to match the TCALL). Second, you are no longer writing assembly code. All of the instructions are assembled using the data declaration pseudo-op DW. No machine could execute the code produced by this assembly. Third, the most distinguishing feature of threaded code is that each instruction consists of the address of a subroutine.

Design of the Internal Interpreter

Since this new program cannot be executed directly by the CPU, you need an interpreter. But, because the code has such a close relationship to the machine code from which it is derived, the interpreter's task is easy and the interpreter itself is simple.

Take a closer look at a threaded code routine. Table 1 shows two kinds of subroutine addresses in a threaded code program: addresses of machine-language subroutines and addresses of other threaded code routines. The threaded code routines all begin with the word TCALL, and so are easily recognized. The machine code routines, however, can begin with an arbitrary machine instruction. This makes them hard to recognize.

To remedy this, I introduced a third special word, CODE, which means that the following routine is written in machine language and the interpreter should simply transfer control to it. Notice that each machine-language routine must end by jumping back to the interpreter.

Like the rest of the instructions in a threaded code program, TCALL, TRET and CODE are addresses of subroutines that perform the appropriate tasks for the interpreter. TCALL and CODE, which precede the body of the routine, are often called code words, or type words. You will later see uses for more than just these two types.

SUBRX	DW	TCALL	SUBRB	DW	TCALL	SUBRA	DW	CODE
	DW	SUBRA		DW	SUBRC		LXI	B, 10
	DW	SUBRB		DW	SUBRD		POP	H
	DW	SUBRC		DW	SUBRE		DAD	B
				DW	TRET		PUSH	H
	DW	TRET					JMP	NEXT
Main Program			Threaded Subroutine			Machine-Language Subroutine		

Table 1. Two types of threaded-code subroutines.

You can now design and write a complete interpreter for these routines. To execute a sequence of instructions, the interpreter needs a pointer to keep track of where it is. This is the equivalent of a CPU's program counter (PC) register. To handle the subroutine calling (the TCALL and TRET instructions), it needs a stack.

How you implement these two constructs depends partly on which CPU you are writing for and partly on your own tastes. I use an 8080 and put both the PC register and the stack pointer in memory. This is because the 8080 doesn't have many 16-bit registers; I am not willing to tie one or two of them up with these pointers. The hardware stack pointer, as noted earlier, is already in use for passing parameters. Listing 2 shows some sample code demonstrating the details of the stack.

The entire main loop of the interpreter is shown in Listing 3. (Its name is Next because its purpose is to step to the next instruction. This is not my own idea but seems to be a FORTH implementation tradition.)

Its operation is simple: It increments the program counter to the next instruction (which is the address of a subroutine), picks up the word that the instruction points to (which, being the first word of a subroutine, is either CODE or TCALL) and jumps to it (reminding us once more that CODE and TCALL are addresses of directly executable code).

The routines to handle the special instructions are equally simple. The TCALL instruction (Listing 4a) stores the program counter on the stack and replaces it with the address of the word containing the TCALL instruction (the word currently being executed). When the PC is next incre-

```
                        ; NEXT - main internal interpreter loop
                        ; ENTRY: PC - points into the instruction just completed
                        ; EXIT:  PC - incremented by 2, points to next
                        ;             instruction
                        ;        DE - points to middle of first word of
                        ;             next routine (i.e.  (PC)+1)
                        ; DESCRIPTION: increments the PC; picks up the code
                        ; word of the next routine and jumps to it.

0237 2A9D01     NEXT    LHLD    PC      ;increment program counter
023A 23                 INX     H       ;while loading DE with
023B 5E                 MOV     E,M     ;next instruction
023C 23                 INX     H
023D 56                 MOV     D,M
023E 229D01             SHLD    PC
0241 EB                 XCHG            ;pick up word addressed
0242 5E                 MOV     E,M     ;by next instruction (which
0243 23                 INX     H       ;is CODE, TCALL or some other
0244 56                 MOV     D,M     ;executable address)
0245 EB                 XCHG            ;  and
0246 E9                 PCHL            ;jump to it
```

Listing 3. Main interpreter loop.

```
                        ; TCALL - the threaded call routine
                        ; ENTRY: DE - middle of first word of routine being called
                        ; EXIT:  No Register Values Returned
                        ; DESCRIPTION: pushes the current contents of the PC
                        ; onto the return stack; makes DE the new PC.

0247 2A9D01     TCALL   LHLD    PC      ;get old program counter
024A EB                 XCHG            ;replace with DE
024B 229D01             SHLD    PC
024E 2A9F01             LHLD    RSTACK  ;push old PC on RSTACK
0251 73                 MOV     M,E
0252 23                 INX     H
0253 72                 MOV     M,D
0254 23                 INX     H
0255 229F01             SHLD    RSTACK
0258 C33702             JMP     NEXT    ;back to interpreter
```

Listing 4a. TCALL instruction.

```
                        ; TRET - the threaded code return
                        ; DESCRIPTION: pops the top element of the
                        ; return stack and puts it into the program counter.

025B 5D02       TRET    DW      $+2     ;CODE
025D 2A9F01             LHLD    RSTACK  ;get stack poiner
0260 2B                 DCX     H       ;high byte of top element
0261 56                 MOV     D,M
0262 2B                 DCX     H       ;low byte of top element
0263 5E                 MOV     E,M
0264 229F01             SHLD    RSTACK  ;restore stack pointer
0267 EB                 XCHG            ;store top of stack in PC
0268 229D01             SHLD    PC
026B C33702             JMP     NEXT    ;back to interpreter
```

Listing 4b. TRET instruction.

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```
                ; Simple arithmetic routines
                ; INC - increment the top of the stack
026E 7002       INC     DW      $+2     ;CODE
0270 E1                 POP     H       ;get top
0271 23                 INX     H       ;increment
0272 E5                 PUSH    H       ;restore
0273 C33702             JMP     NEXT

                ; DEC - decrement the top of the stack
0276 7802       DEC     DW      $+2     ;CODE
0278 E1                 POP     H       ;get top
0279 2B                 DCX     H       ;decrement
027A E5                 PUSH    H       ;restore
027B C33702             JMP     NEXT

                ; TADD - add the top two elements of the stack
027E 8002       TADD    DW      $+2     ;CODE
0280 E1                 POP     H       ;first element
0281 D1                 POP     D       ;second element
0282 19                 DAD     D       ;add 'em
0283 E5                 PUSH    H       ;push result
0284 C33702             JMP     NEXT

                ; MINUS - negate top of stack
0287 8902       MINUS   DW      $+2     ;CODE
0289 E1                 POP     H       ;get top
028A CD9102             CALL    MINUSH  ;negate H
028D E5                 PUSH    H       ;push it
028E C33702             JMP     NEXT

0291 2B         MINUSH  DCX     H       ;good ole 2s complement
0292 7C                 MOV     A,H
0293 2F                 CMA
0294 67                 MOV     H,A
0295 7D                 MOV     A,L
0296 2F                 CMA
0297 6F                 MOV     L,A
0298 C9                 RET

                ; TSUB - subtract TOP from TOP-1
0299 4702       TSUB    DW      TCALL   ;threaded code
029B 8702               DW      MINUS   ;negate top
029D 7E02               DW      TADD    ;and add
029F 5B02               DW      TRET
```

Listing 5. Simple arithmetic routines.

```
                ; PeekB - retrieve a byte from memory
                ; ENTRY: TOP    - address
                ; EXIT:  TOP    - byte at address

02A1 A302       PEEKB   DW      $+2     ;CODE
02A3 E1                 POP     H       ;get address
02A4 5E                 MOV     E,M     ;get byte
02A5 1600               MVI     D,0
02A7 D5                 PUSH    D       ;save
02A8 C33702             JMP     NEXT

                ; PeekW - retrieve a word from memory
                ; ENTRY: TOP    - address
                ; EXIT:  TOP    - word at address

02AB AD02       PEEKW   DW      $+2     ;CODE
02AD E1                 POP     H       ;get address
02AE 5E                 MOV     E,M     ;get word
02AF 23                 INX     H
02B0 56                 MOV     D,M
02B1 D5                 PUSH    D       ;save
02B2 C33702             JMP     NEXT

                ; PokeB - store byte in memory
                ; ENTRY: TOP    - address
                ;        TOP-1 - byte to store
                ; EXIT:  No Values Returned

02B5 B702       POKEB   DW      $+2     ;CODE
02B7 E1                 POP     H       ;get address
02B8 D1                 POP     D       ;get byte
02B9 73                 MOV     M,E     ;store
02BA C33702             JMP     NEXT

                ; PokeW - store word in memory
                ; ENTRY: TOP    - address
                ;        TOP-1 - word to store
                ; EXIT:  No Values returned

02BD BF02       POKEW   DW      $+2     ;CODE
02BF E1                 POP     H       ;get address
02C0 D1                 POP     D       ;get word
02C1 73                 MOV     M,E     ;store word
02C2 23                 INX     H
02C3 72                 MOV     M,D
02C4 C33702             JMP     NEXT
```

Listing 6. Peek and Poke instructions.

mented by the interpreter, it will point to the first real instruction of the routine (the one following the TCALL). The TRET instruction (Listing 4b) pops an address off the top of the stack and stores it in the program counter, undoing the work of one TCALL and causing the interpreter to resume execution with the instruction following the last executed TCALL type instruction.

The CODE instruction could point to a routine that transfers control to the word following the CODE instruction. But all it has to do is point directly to the next word. No interpreter routine is needed at all. Thus, the CODE instruction for each machine-language subroutine is different from the rest, but the execution of the system is faster.

A threaded code interpreter does not provide all of the features of a BASIC interpreter, for example. Instead, it provides a flexible framework that you can expand not only with data manipulating instructions (e.g., Add, Multiply, Concatenate), but with interpreter manipulating instructions. (Notice that TRET is just another subroutine; it begins with CODE and ends with a jump back to the interpreter.)

Expanding the Interpreter

Adding new instructions is easy. Listing 5 contains routines for performing simple integer arithmetic. All of these take their arguments from the stack and leave their results there. Listing 6 contains new definitions for reading and writing bytes and words in memory.

PUSH and POP are two useful additions to a language that uses the stack to pass parameters around. Listing 7 contains the code needed to implement these (and some others as well). PUSH takes the word that follows it, pushes it onto the parameter stack and then increments the program counter so that the interpreter doesn't try to execute the constant. This effectively makes PUSH a 32-bit instruction.

Essential to any programming language are instructions that allow you to test conditions. Depending on the results of those tests you can then branch. Listing 8 contains code for implementing an unconditional jump; a jump-if-zero and jump-if-not-zero, which test the top element of the stack; and a jump-if-equal, which tests the top two elements.

Each tests its appropriate conditions and either replaces the PC with the address in the next word if the test is successful or increments the PC (skipping over the next word) if the test fails. You can make these jumps relative (and the code relocatable) by having them add the contents of the next word to the PC instead of replacing the PC.

All other additions to the interpreter are made in the same way. You can experiment with control structures (conditional TRETs, or conditional calls, which take two arguments—one address for true, the other for false). Or you can add more advanced data types such as floating point numbers (each of which takes two or three stack positions) and strings (the stack holds the pointer; you manage the string space).

Constants and Variables

Threaded code interpreters have a special way of dealing with constants and variables. Ordinarily, when you want to reference a number, whether because of its value (a constant) or because of the value it points to (a variable), you could push it onto the stack. This means, however, that you need 32 bits each time you introduce a number into the code.

An alternative is to define a commonly used number as a function that pushes the value onto the stack. For example, when the function ONE is executed, it pushes a 1 on the stack. This reduces the size of the PUSH 1 instruction to one word, but adds a new function to the interpreter (four words). Still, it is worthwhile for frequently used numbers.

Another alternative is to introduce two new types of code words (that is, two new types of subroutine) called Constant and Variable. These replace the TCALL in the function definition. A Constant function has only one word associated with it; when it is executed, it pushes the contents of that word onto the stack.

A Variable function also has one word associated with it, but when executed it pushes the address of that word onto the stack. Listing 9 contains the code for these new function types, along with some commonly used constants. This reduces the size of the new functions to just two words each.

The User's Interpreter: Interactive

Computers should be as easy to use as pocket calculators. This first ver-

```
                    ; Some standard threaded code functions
                    ; TPUSH - push the next word onto the stack

02C7 C902           TPUSH   DW      $+2       ;CODE
02C9 2A9D01                 LHLD    PC        ;get program counter
02CC 23                     INX     H         ;advance to next word
02CD 5E                     MOV     E,M       ;and pick up contents
02CE 23                     INX     H
02CF 56                     MOV     D,M
02D0 229D01                 SHLD    PC        ;store new program counter
02D3 D5                     PUSH    D         ;push word onto param stack
02D4 C33702                 JMP     NEXT      ;continue

                    ; TPOP - drop the top of the parameter stack

02D7 D902           TPOP    DW      $+2       ;CODE
02D9 E1                     POP     H         ;pop one element
02DA C33702                 JMP     NEXT      ;and continue

                    ; SWAP - exchange top two elements of the stack

02DD DF02           SWAP    DW      $+2       ;CODE
02DF E1                     POP     H         ;get one element
02E0 E3                     XTHL              ;exchange
02E1 E5                     PUSH    H         ;put back
02E2 C33702                 JMP     NEXT      ;and continue

                    ; DUP - duplicate the top of the stack
                    ; DESCRIPTION: often used before functions which
                    ; consume the top of the stack (e.g. conditional jumps)

02E5 E702           DUP     DW      $+2       ;CODE
02E7 E1                     POP     H         ;get top
02E8 E5                     PUSH    H         ;save it twice
02E9 E5                     PUSH    H
02EA C33702                 JMP     NEXT

                    ; CLEAR - clear the stack

02ED EF02           CLEAR   DW      $+2       ;CODE
02EF 319D01                 LXI     SP,STACK  ;reset stack pointer
02F2 C33702                 JMP     NEXT
```

Listing 7. Standard threaded-code functions.

```
                    ; Threaded Code Jumps

                    ; All Jumps are to absolute locations
                    ; All Conditional jumps consume the
                    ; elements of the stack that they test.

                    ; JUMP - unconditional jump

02F5 F702           JUMP    DW      $+2       ;CODE
02F7 2A9D01         JUMP1   LHLD    PC        ;get program counter
02FA 23                     INX     H         ;get next word
02FB 5E                     MOV     E,M
02FC 23                     INX     H
02FD 56                     MOV     D,M
02FE EB                     XCHG              ;make it the PC
02FF 229D01                 SHLD    PC
0302 C33702                 JMP     NEXT

                    ; IFZ - jump if top is zero

0305 0703           IFZ     DW      $+2       ;CODE
0307 E1                     POP     H         ;get top
0308 7C                     MOV     A,H       ;test for zero
0309 B5                     ORA     L
030A CAF702                 JZ      JUMP1     ;if yes, jump
030D 2A9D01         SKIP    LHLD    PC        ;else simply skip next word
0310 23                     INX     H
0311 23                     INX     H
0312 229D01                 SHLD    PC
0315 C33702                 JMP     NEXT

                    ; IFNZ - jump if top not zero

0318 1A03           IFNZ    DW      $+2       ;CODE
031A E1                     POP     H         ;get top
031B 7C                     MOV     A,H       ;test for zero
031C B5                     ORA     L
031D C2F702                 JNZ     JUMP1     ;if not, jump
0320 C30D03                 JMP     SKIP      ;else don't

                    ; IFEQ - jump if TOP = TOP-1

0323 2503           IFEQ    DW      $+2       ;CODE
0325 E1                     POP     H         ;get top
0326 CD9102                 CALL    MINUSH    ;negate it
0329 D1                     POP     D         ;get top-1
032A 19                     DAD     D         ;add 'em
032B 7C                     MOV     A,H       ;test for zero
032C B5                     ORA     L
032D CAF702                 JZ      JUMP1     ;if equal,jump
0330 C30D03                 JMP     SKIP      ;otherwise,don't
```

Listing 8. Threaded-code jumps.

```
                    ; Implementation of Constants and Variables in a
                    ; threaded code system

                    ; CONSTANT - code address for constants
                    ; ENTRY: DE - points to middle of code word for
                    ;             constant
                    ; DESCRIPTION: picks up the contents of the word
                    ; following the code word and pushes it onto the stack.

                    CONSTANT
0333 EB                     XCHG            ;HL <- address of code word
0334 23                     INX     H       ;get constant
0335 5E                     MOV     E,M
0336 23                     INX     H
0337 56                     MOV     D,M
0338 D5                     PUSH    D       ;push it on the parameter stack
0339 C33702                 JMP     NEXT    ;return to interpreter

                    ; Some common constants

033C 3303           ZERO    DW      CONSTANT        ;threaded code constant
033E 0000                   DW      0

0340 3303           ONE     DW      CONSTANT        ;threaded code constant
0342 0100                   DW      1

0344 3303           NEGONE  DW      CONSTANT        ;threaded code constant
0346 FFFF                   DW      -1

0348 3303           MEMORY  DW      CONSTANT        ;last available byte
034A FF1F                   DW      8*1024-1        ;8K system

                    ; VARIABLE - code address for variables
                    ; ENTRY: DE - points to middle of code word for
                    ;             variable
                    ; DESCRIPTION: pushes address of word following code
                    ; word onto the stack.

                    VARIABLE
034C 13                     INX     D       ;increment to variable address
034D D5                     PUSH    D       ;store on parameter stack
034E C33702                 JMP     NEXT    ;return to inerpreter
```

Listing 9. Implementing constants and variables.

sion of the external, or user's, interpreter is not going to be the all-purpose, universally useful, interactive computer programming language. In fact, all it's going to be is a calculator, the simplest interactive algorithm you can write for a starting system (Table 2).

The user types in a line containing numbers (arguments) and subroutine names (functions). The system scans the line from left to right; it pushes the numbers on the stack and executes the functions. When it hits the end of the line, it prints the top element of the stack.

Users of Hewlett-Packard calculators will know the input form as reverse Polish notation. The arguments precede the functions that use them. Both the HP calculators and FORTH use RPN for the same reason: The

```
1. READ a line from the console
2. REPEAT
       SCAN for next word
       IF word is a function
       THEN EXECUTE it
       ELSE IF word is a number
            THEN PUSH value of number on stack
            ELSE **ERROR**
     UNTIL END-OF-LINE encountered
3. PRINT the top of the stack
```

Examples of use: (Note: the machine prompts with a hyphen.)

```
 - 6 7 +    (user types)
 13         (machine types, note that 13 stays on stack)
 - 11 +     (user types)
 24         (machine types)
 - 6 -      (user types)
 18
 -
```

Table 2. Algorithm for user's interpreter.

arguments have to be placed on the stack before the functions that use them are executed.

Unlike the calculator, our interpreter is not bound to this form of input. If you don't like typing expressions this way, you can change your scanning routine to go from right to left and type in Polish prefix (or normal Polish) notation. Or you can look up an algorithm for translating algebraic expressions into stack commands and then type those.

Thus, while all FORTH systems use reverse Polish, you don't have to. This external interpreter is independent of the internal, stack-oriented interpreter. Using reverse Polish makes the interpreter simple, but if you want to use this system, why be lazy? You can choose whatever input form you like. You can choose what data types to accept and what function your system will perform. You can have a calculator that handles decimal, octal and hexadecimal numbers, that processes strings (foreign language word translators), that retrieves information from tape or disk, all in response to a few taps of the keys.

Listing 11. Dictionary lookup routine.

```
                    ; LOOKUP - the dictionary lookup routine
                    ; ENTRY: TOP   - pointer to string to be looked up
                    ; EXIT:  TOP   - -1 if string found in dictionary
                    ;                 0 if string not found
                    ;        TOP-1 - pointer to code of found subroutine
                    ;                 or
                    ;               string pointer if not found
                    ; DESCRIPTION: performs a linear search of the
                    ; dictionary. Returns the code address if the string
                    ; is found, or else the string pointer if not found.

038F 4702          LOOKUP  DW    TCALL             ;threaded code
0391 C503AB02              DW    NAMES,PEEKW       ;get top of dictionary

0395 E502A102      SEARCH  DW    DUP,PEEKB         ;get char count of next entry
0399 0503B003              DW    IFZ,FAIL-1        ;if end of dictionary

039D C903                  DW    MATCH             ;else attempt a match
039F 1803B603              DW    IFNZ,SUCCEED-1    ;if succesful match

03A3 E5047E02              DW    FIRST,TADD        ;else skip string
03A7 C70202007E            DW    TPUSH,2,TADD      ;and pointer
03AD F5029403              DW    JUMP,SEARCH-1     ;and try next entry

03B1 D702          FAIL    DW    TPOP              ;drop dictionary pointer
03B3 3C03                  DW    ZERO              ;leave a zero on the stack
03B5 5B02                  DW    TRET              ;and quit

03B7 DD02D702      SUCCEED DW    SWAP,TPOP         ;drop string pointer
03BB E5047E02AB            DW    FIRST,TADD,PEEKW  ;get code pointer
03C1 4403                  DW    NEGONE            ;push a minus one
03C3 5B02                  DW    TRET              ;and return

                   ; Names - address of dictionary names

03C5 4C03          NAMES   DW    VARIABLE          ;threaded code variable
03C7 1906                  DW    NAMEBEG           ;beginning of names

                   ; MATCH - match strings
                   ; ENTRY: TOP   - ptr to string
                   ;        TOP-1 - ptr to another string
                   ; EXIT:  TOP   - -1 if strings are the same
                   ;                 0 if strings do not match
                   ;        TOP-1 - ptr to first string
                   ;        TOP-2 - ptr to second string
                   ; DESCRIPTION: written in assembly to speed things up.

03C9 CB03          MATCH   DW    $+2       ;CODE
03CB E1                    POP   H         ;first string
03CC D1                    POP   D         ;second string
03CD D5                    PUSH  D         ;leave on stack
03CE E5                    PUSH  H
03CF 1A                    LDAX  D         ;get 2nd count
03D0 BE                    CMP   M         ;compare with first
```

The User's Interpreter: The Dictionary

Listing 10 contains the algorithm for interaction translated into the threaded language. Most of its parts are familiar to most programmers. The Readline function is provided by many operating systems. ASCII to binary and binary to ASCII converters are standard parts of most programs, as are print string routines. A "scan for next word" routine is not as common as the others, but it isn't difficult. The dictionary lookup routine, which distinguishes functions from nonfunctions, is the central part of the algorithm.

```
                    ; Top Level External Interpreter Version 1.0
                    ;
                    ; This routine reads one line of reverse
                    ; polish notation from the console and executes it.
                    INTERACT
0351 4702                   DW    TCALL             ;threaded code

0353 B904                   DW    PROMPT            ;prompt the user and
0355 F603                   DW    READLINE          ;read a console line

0357 0605           SLOOP   DW    SCAN              ;scan for next word
0359 05037803               DW    IFZ,EXIT-1        ;if end of line, quit
035D 8F03                   DW    LOOKUP            ;else lookup word in dictionary
035F 05036803               DW    IFZ,NUMBER-1      ;if not found, try number

0363 EE03                   DW    EXECUTE           ;else execute it
0365 F5025603               DW    JUMP,SLOOP-1      ;and continue scanning

0369 A705           NUMBER  DW    CONAXB            ;try converting to number
036B 18035603               DW    IFNZ,SLOOP-1      ;if succesful, leave on stack
                                                    ;and continue scanning

036F C7028103               DW    TPUSH,ERRMSG      ;else push error message
0373 C704                   DW    PRINTS            ;and print it
0375 C704                   DW    PRINTS            ;then print string
0377 5B02                   DW    TRET              ;and return

0379 E5025305       EXIT    DW    DUP,CONBXA        ;copy and convert top of stack
037D C704                   DW    PRINTS            ;print it
037F 5B02                   DW    TRET              ;return

0381 0D4E6F7420ERRMSG DB          13,'Not Defined: '
```

Listing 10. Interaction algorithm in threaded language.

FORTH is well known for its dictionary of routines, in which it looks up incoming words. However, every computer language does this. BASIC has a table of reserved words and variable names; assemblers keep symbol tables; and LISP keeps its universal list of all known atoms.

Each of these systems uses a different data structure for its dictionary. These vary in complexity from simple arrays to difficult linked hash tables. We'll look at two relatively easy techniques. One is the traditional FORTH dictionary format and the other is a variation developed for this implementation.

Each entry in a subroutine diction-

```
03D1 C2E703            JNZ     MATCHF   ;if no match
                                        ;else try string matching
03D4 47                MOV     B,A      ;B holds byte count
03D5 23        MATCH1  INX     H        ;next byte
03D6 13                INX     D
03D7 1A                LDAX    D
03D8 BE                CMP     M
03D9 C2E703            JNZ     MATCHF   ;if no match
03DC 05                DCR     B        ;else dec count
03DD C2D503            JNZ     MATCH1   ;if more to compare
03E0 21FFFF            LXI     H,-1     ;else push success
03E3 E5                PUSH    H
03E4 C33702            JMP     NEXT

03E7 210000    MATCHF  LXI     H,0      ;failure
03EA E5                PUSH    H
03EB C33702            JMP     NEXT



06A9 E502        DW            DUP
06AB 0546495253 DB     5,'FIRST'
06B1 E504        DW            FIRST
06B3 00          DB     0               ;end of dictionary
06B3 =         NAMEEND EQU     $-1

009B =         DICSIZE EQU     NAMEEND-NAMEBEG+1      ;dictionary size in bytes

               ; Initialization Code
               ; Executed on start up of system but eventually overwritten by
               ; the expanding dictionary

               ; DICMOVE - moves the dictionary names
               ;           to the top of available memory

06B4 2A4A03    DICMOVE LHLD    MEMORY+2         ;DE <- top of memory
06B7 EB                XCHG
06B8 21B306            LXI     H,NAMEEND        ;HL <- source (end of names)
06BB 019B00            LXI     B,DICSIZE        ;BC <- byte count

                                                ;transfer loop
06BE 7E        DIC1    MOV     A,M              ;get next byte
06BF 12                STAX    D                ;move it
06C0 2B                DCX     H                ;dec source pointer
06C1 1B                DCX     D                ;dec target pointer
06C2 0B                DCX     B                ;dec count
06C3 78                MOV     A,B              ;test for zero
06C4 B1                ORA     C
06C5 C2BE06            JNZ     DIC1             ;not yet

06C8 EB                XCHG                     ;set dictionary variable
06C9 23                INX     H
06CA 22C703            SHLD    NAMES+2

06CD C9                RET
06CE                   END
```

ary has two parts: the name of the subroutine and the code that composes it. If every dictionary entry were the same size, i.e., the same number of bytes, we could simply arrange them in an array. Searching would be as easy as looking at each one in order until you find the word you want or hit the end of the dictionary.

However, since the name of a function and the size of its code both typically vary, there is no way to tell where one entry ends and the next one begins.

The standard solution to the problem is to add a third part to each entry: a pointer to the beginning of the next entry. This makes the dictionary a linked list (Table 3). This solution has some good points. The lookup technique, while slow, is easy to implement. The linked list allows you to add additional structure to the dictionary; many FORTH implementations allow you to define separate vocabularies with the dictionary.

And the dictionary, which grows

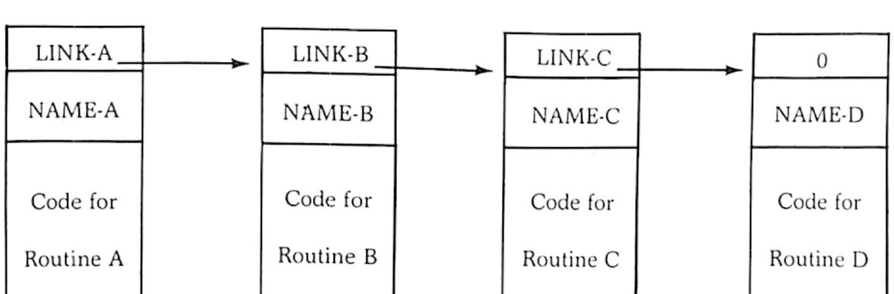

Table 3. Standard linked FORTH dictionary.

dynamically once you have a compiler, is a single data structure that makes storage management easy.

However, I have used a modified version of this technique (Table 4). The name of the function and the code to be executed are stored in two different places. The pointer, instead of connecting one entry to the next, links the name with the code. While this means you have to maintain two different data structures, you get more flexibility for your trouble.

First, you can keep the names in any order you like (perhaps alphabetic), instead of the order in which they were defined. This allows you to reduce searching time.

Also, you can delete the names of functions that you do not need to reference interactively (internal subroutines) and easily reclaim the space for other purposes while leaving the code in the dictionary. This is significant if you like to use long variable and function names in your programs. (Note that you can delete entries from the other dictionary format, but only entire entires, and only in the reverse order from which they were defined.)

Table 5 contains the details associated with this format. Because there are two growing structures to maintain, start one at the lowest point in memory available and the other in the highest, and let them expand toward each other. The function names are stored as strings of characters preceded by byte counts. (This is a second difference between this dictionary and the standard FORTH dictionary. The latter usually stores only a few characters from each name, along with a character count, in order to conserve space. I prefer the full name so that I can later have a function that types out the full text of another function interactively.)

The lookup routine (Listing 11) accepts a pointer to a string (byte count and characters); it returns either the associated CODE address for the routine, or returns the string unchanged if it is not in the dictionary. It is written in threaded code and ought to be understandable if you have gotten this far.

```
                        ; EXECUTE - execute routine at top of stack
                        ; ENTRY: TOP   - address of routine to be executed
                        ; EXIT:  DE - middle of word addressed by top
                        ; DESCRIPTION: The address is of a threaded code
                        ; interpreter routine, so the contents of the
                        ; first word is an executable address. EXECUTE
                        ; gets that address and jumps to it, leaving DE
                        ; in the same state that the main interpreter
                        ; loop (NEXT) would have.

03EE F003          EXECUTE DW      $+2           ;CODE
03F0 E1                    POP     H             ;get address
03F1 5E                    MOV     E,M           ;get first word
03F2 23                    INX     H
03F3 56                    MOV     D,M
03F4 EB                    XCHG                  ;and jump to it
03F5 E9                    PCHL
```

Listing 12. Execute function.

Listing 13. Readline program.

```
                 ; READLINE - fill console buffer
                 ; DESCRIPTION: reads characters from the console, echoing them
                 ; to the screen and storing them in the console buffer,
                 ; beginning in the third character of the buffer.
                 ; Stops on encountering a carriage return and stores a
                 ; final zero after the other characters.
                 ; Takes appropriate action for a backspace character.

                 READLINE
03F6 4702                DW     TCALL              ;threaded code
03F8 3C03                DW     ZERO               ;mark buffer as unscanned
03FA 5204B502            DW     CONBUF,POKEB

03FE 52046E026E          DW     CONBUF,INC,INC     ;push first byte of buffer

0404 E502        RLOOP   DW     DUP                ;duplicate buffer pointer
0406 FA04                DW     CIN                ;get character
0408 E502F104            DW     DUP,COUT           ;echo to screen

040C E502C70208          DW     DUP,TPUSH,08H      ;compare with backspace
0412 23032904            DW     IFEQ,BKSP-1

0416 E502C7020D          DW     DUP,TPUSH,0DH      ;compare with carriage return
041C 23033F04            DW     IFEQ,EOL-1

0420 DD02B502            DW     SWAP,POKEB         ;if neither, store in buffer
0424 6E02                DW     INC                ;increment buffer pointer
0426 F5020304            DW     JUMP,RLOOP-1       ;and keep reading

042A D702D702    BKSP    DW     TPOP,TPOP          ;drop BS and buffer ptr copy
042E 7602                DW     DEC                ;backup pointer
0430 C7022000F1          DW     TPUSH,20H,COUT     ;print a space
0436 C702080OF1          DW     TPUSH,08H,COUT     ;and another backspace
043C F5020304            DW     JUMP,RLOOP-1

0440 D702D702    EOL     DW     TPOP,TPOP          ;drop CR and buffer ptr copy
0444 3C03DD02B5          DW     ZERO,SWAP,POKEB    ;store final zero
044A C7020A00F1          DW     TPUSH,0AH,COUT     ;print a line feed
0450 5B02                DW     TRET               ;and return

                 ; Console Buffer
                 ; DESCRIPTION: First byte contains the scan pointer which
                 ; points to the next byte to be scanned. The remaining bytes
                 ; contain characters read from the console.

0452 4C03        CONBUF  DW     VARIABLE           ;threaded code variable
0454                     DS     101D               ;long enough for most screens
                 ; PROMPT - prompt the user
                 ; DESCRIPTION: clears to a new line and prints a hyphen

04B9 4702        PROMPT  DW     TCALL              ;threaded code
04BB C702C304            DW     TPUSH,PRMSG        ;push prompt message
04BF C704                DW     PRINTS             ;and print it
```

More

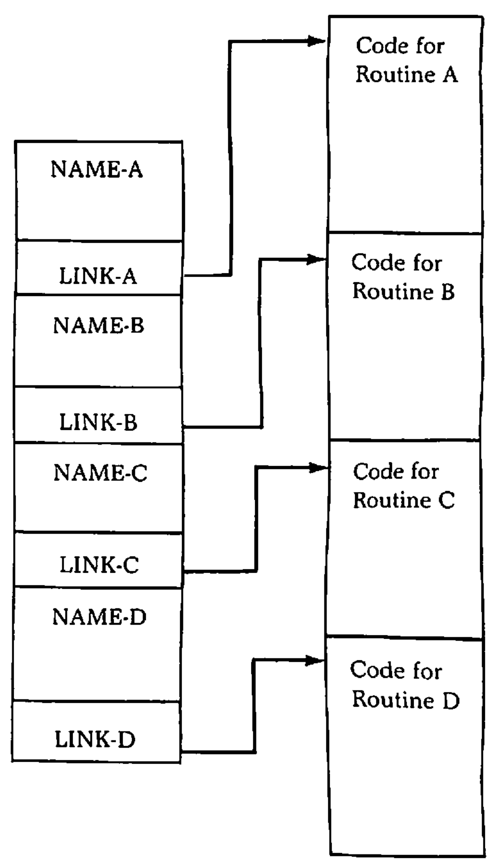

Table 4. Variation of FORTH dictionary.

Listing 13 continued.

```
04C1 5B02              DW      TRET

04C3 030D0A2D  PRMSG   DB      3,0DH,0AH,'-'

               ; PRINTS - prints string
               ; ENTRY: TOP   - points to string
               ; DECRIPTION: Uses first byte of string as a character count.

04C7 4702      PRINTS  DW      TCALL           ;threaded code
04C9 E504              DW      FIRST           ;get count
04CB E5020503DEPRINTS1 DW      DUP,IFZ,PRINTX-1 ;if done return
04D1 DD02E504          DW      SWAP,FIRST      ;else get next character
04D5 F104              DW      COUT            ;print it
04D7 DD027602          DW      SWAP,DEC        ;decrement count
04DB F502CA04          DW      JUMP,PRINTS1-1  ;and keep looping

04DF D702D702  PRINTX  DW      TPOP,TPOP       ;drop count and pointer
04E3 5B02              DW      TRET            ;then return

               ; FIRST - get next byte of string on stack
               ; ENTRY: TOP   - ptr to string
               ; EXIT:  TOP   - first character of string
               ;        TOP-1 - ptr to rest of string
               ; DESCRIPTION: useful for advancing through strings a byte
               ; at a time.

04E5 E704      FIRST   DW      $+2     ;CODE
04E7 E1                POP     H       ;get pointer
04E8 4E                MOV     C,M     ;BC <- character
04E9 0600              MVI     B,0
04EB 23                INX     H       ;bump pointer
04EC E5                PUSH    H       ;restore pointer
04ED C5                PUSH    B       ;add character
04EE C33702            JMP     NEXT    ;continue

               ; COUT - character output routine
               ; ENTRY: TOP - character to print
               ; DESCRIPTION: uses operating system to print character

04F1 F304      COUT    DW      $+2     ;CODE
04F3 C1                POP     B       ;C <- character
04F4 CD0C7E            CALL    7E0CH   ;print it
04F7 C33702            JMP     NEXT    ;return

               ; CIN - character input routine
               ; EXIT: TOP   - character read from console
               ; DESCRIPTION: Uses operating system

04FA FC04      CIN     DW      $+2     ;CODE
04FC CD097E            CALL    7E09H   ;read character
04FF 6F                MOV     L,A     ;HL <- character
0500 2600              MVI     H,0
0502 E5                PUSH    H       ;push on stack
0503 C33702            JMP     NEXT    ;return
```

```
                       TITLE   'Threaded Code Interpreter for 8080'
               ; Richard Fritzson
               ; 29 January 1980        Version 1.0
               ;
               ; This version contains only the basic internal
               ; interpreter and a simple interactive console
               ; interpreter.

0100                   ORG     100H    ;start up address

0100 319D01            LXI     SP,STACK ;initialize parameter stack

0103 CDB406            CALL    DICMOVE ;move dictionary to high memory

0106 210E01            LXI     H,TOP-1 ;set PC to top level loop
0109 229D01            SHLD    PC

010C C33702            JMP     NEXT    ;and start interpreter


               ; TOP - Top Level System Loop
               ; DESCRIPTION: TOP is  an infinite
               ; loop which picks up the contents of the
               ; EXEC variable and executes it.

010F 1901AB02  TOP     DW      EXEC,PEEKW      ;get top level program
0113 EE03              DW      EXECUTE         ;run it
0115 F5020E01          DW      JUMP,TOP-1      ;and loop

               ; EXEC - address of top level routine

0119 4C03      EXEC    DW      VARIABLE        ;threaded code variable
011B 5103              DW      INTERACT        ;address of user interpreter

               ; Reserved Stack Space

011D                   DS      128             ;parameter stack
019D =         STACK   EQU     $
                       PAGE
```

Listing 14. Interpreter program.

The interpreter executes the code address returned by the lookup function using the Execute function (Listing 12), which simulates the action of the internal interpreter.

The User's Interpreter: The Rest of the System

Listing 13 contains a simple version of Readline, written in threaded code. It uses two input/output primitives—character in and character out, both of which use the stack for accepting and returning characters. You can change these to whatever your system requires.

You may have noticed by now that the top-level routine (Interact) is not a loop. It performs its function and then returns. To make the system execute this procedure repeatedly, replace the TRET instruction with JUMPs to the beginning of the routine. However, this locks the system into always executing this one function.

A more flexible alternative (Listing 14) is to make the system's innermost loop repeatedly execute the contents of a variable (initial value: the Interact routine) so that the user can replace the interpreter's main routine with a new one by simply changing the value of a variable. This is useful when you want to change from numeric calculating to a foreign word lookup or text editing.

The rest of the code needed to make the system run is listed in Listing 15. It is a fairly direct 8080 code for handling mundane tasks, such as scanning a line of characters for the next word or performing 16-bit division.

The last two items in this listing are the names portion of the system's dictionary, which contains the names of the available words and the addresses of their associated subroutines; and the system's initialization code, which moves this part of the dictionary to the top of available memory. All of the code here should be easy to understand.

Useful Extensions, Notes about the Code

To put everything together, type the code in the order in which the figures are presented (except for Listing 14, which is actually page one of the program). The order in which the subroutines are entered makes almost no difference; just make the dictionary of names the last permanent routine in the code.

Programmability makes a computer more versatile than a calculator. FORTH is fun to use because of its ability to define new functions interactively. The complier described in the second part of this article allows you to do this. However, you can make a few other improvements before then.

The code presented so far is barebones. If your library of subroutines has substitutes for Readline, number conversions and string printing, they are bound to be better than these. (Notice that the ASCII/binary conversions only handle positive numbers.) Use yours instead of mine.

Also, 16-bit arithmetic is limited. Add double-precision or floating-point routines to the system if you don't have them already. Put all of the arithmetic routines you can find into one version, and make yourself a calculator that is as good as the best. ■

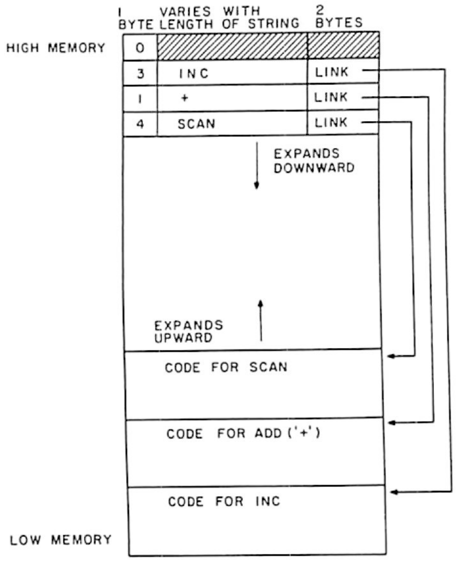

Table 5. Details of dictionary.

Listing 15.

```
                    ; SCAN - Scan for next word
                    ; ENTRY: No Values Expected
                    ; EXIT:  TOP   - -1 if word found, 0 if word not found
                    ;        TOP-1 - ptr to word if found (else nothing)
                    ; DESCRIPTION: first byte of buffer contains a counter of
                    ; characters already scanned. The next word is moved to the
                    ; beginning of the line with a leading byte count.

0506 0805           SCAN    DW      $+2             ;CODE
0508 215404                 LXI     H,CONBUF+2      ;BC <- character count
050B 4E                     MOV     C,M
050C 0600                   MVI     B,0
050E 34                     INR     M               ;test for end of line already
050F CA4705                 JZ      SCANX           ;if yes
0512 23                     INX     H               ;HL <- scanning start point
0513 09                     DAD     B
0514 41                     MOV     B,C             ;B <- character count
0515 23             SCAN1   INX     H               ;increment pointer
0516 04                     INR     B               ;increment count
0517 7E                     MOV     A,M             ;get next character
0518 B7                     ORA     A               ;test for end of line
0519 CA4705                 JZ      SCANX           ;if yes,
051C FE20                   CPI     20H             ;else, check for blank
051E CA1505                 JZ      SCAN1           ;if yes, skip it

0521 115504                 LXI     D,CONBUF+3      ;else begin moving word
0524 0E00                   MVI     C,0             ;C <- size of string
0526 13             SCAN2   INX     D
0527 12                     STAX    D
0528 0C                     INR     C               ;inc word size
0529 04                     INR     B               ;inc scanned char count
052A 23                     INX     H               ;get next byte
052B 7E                     MOV     A,M
052C B7                     ORA     A               ;test for end of line
052D C23405                 JNZ     SCAN3           ;if not,
0530 06FF                   MVI     B,-1            ;else set eol flag
0532 3E20                   MVI     A,20H           ;and change EOL to delimitier
0534 FE20           SCAN3   CPI     20H             ;check for space
0536 C22605                 JNZ     SCAN2           ;if not yet

0539 215404                 LXI     H,CONBUF+2      ;else save scanned char count
053C 70                     MOV     M,B
053D 23                     INX     H               ;and word size
053E 71                     MOV     M,C
053F E5                     PUSH    H               ;and return word pointer
0540 21FFFF                 LXI     H,-1
0543 E5                     PUSH    H
0544 C33702                 JMP     NEXT

0547 3EFF           SCANX   MVI     A,-1            ;hit end of line
0549 325404                 STA     CONBUF+2        ;mark buffer empty
054C 210000                 LXI     H,0             ;return a zero
054F E5                     PUSH    H
0550 C33702                 JMP     NEXT

                    ; CONBXA - convert binary to ascii

                    ; ENTRY: TOP - 16 bit positive integer
                    ; EXIT:  TOP - address of converted ASCII string
                    ; DESCRIPTION: pushes the digits of the number
                    ; on to the stack, least significant digits first.
                    ; Then pops them up and stores them in a local
                    ; buffer.
```

More →

Listing 15 continued.

```
0553 4702         CONBXA  DW      TCALL           ;threaded code
0555 4403DD02             DW      NEGONE,SWAP     ;mark end of string with -1
0559 C7020A00DECONB1      DW      TPUSH,10,DIV    ;divide number by ten
055F DD02                 DW      SWAP            ;put quotient on top
0561 E502                 DW      DUP
0563 18035805             DW      IFNZ,CONB1-1    ;continue until Q = 0

0567 D702                 DW      TPOP            ;then drop quotient,
0569 3C03                 DW      ZERO            ;store zero in first
056B 9B05B502             DW      NBUFR,POKEB     ;byte of buffer,
                                                  ;and store string
056F E5024403     CONB2   DW      DUP,NEGONE      ;test for end of string
0573 23039405             DW      IFEQ,CONB3-1    ;if yes
0577 9B05A102             DW      NBUFR,PEEKB     ;else,increment byte count
057B 6E02                 DW      INC
057D 9B05B502             DW      NBUFR,POKEB
0581 C70230007E           DW      TPUSH,'0',TADD  ;convert digit to ascii
                                                  ;and store in next location
0587 9B05                 DW      NBUFR
0589 9B05A1027E           DW      NBUFR,PEEKB,TADD
058F B502                 DW      POKEB
0591 F5026E05             DW      JUMP,CONB2-1    ;repeat

0595 D702         CONB3   DW      TPOP            ;drop end of string marker
0597 9B05                 DW      NBUFR           ;push return buffer address
0599 5B02                 DW      TRET            ;and return

059B 4C03         NBUFR   DW      VARIABLE        ;threaded variable
059D                      DS      10              ;plenty long enough

                  ; CONAXB - convert ASCII decimal string to binary
                  ; ENTRY: TOP    - pointer to string
                  ; EXIT:  TOP    - -1 if converted to binary
                  ;                  0 if not
                  ;        TOP-1 - value of number if converted
                  ;                 ptr to string if not
                  ; DESCRIPTION: converts only positive, unsigned
                  ; integers. Written in assembly because I had it around
                  ; and didn't want to rewrite it in threaded code.

05A7 A905         CONAXB  DW      $+2       ;CODE
05A9 D1                   POP     D         ;get string pointer
05AA D5                   PUSH    D         ;but leave on stack
05AB 1A                   LDAX    D         ;get byte count
05AC 47                   MOV     B,A
05AD 210000               LXI     H,0       ;starting value

05B0 13           CONA1   INX     D
05B1 1A                   LDAX    D         ;get next character
05B2 FE30                 CPI     '0'       ;test for digit
05B4 DAD705               JC      CONAX     ;if not
05B7 FE3A                 CPI     '9'+1
05B9 D2D705               JNC     CONAX     ;if not
05BC D630                 SUI     '0'       ;convert to binary
05BE D5                   PUSH    D         ;save pointer
05BF 29                   DAD     H         ;multiply current value by 10
05C0 E5                   PUSH    H
05C1 29                   DAD     H
05C2 29                   DAD     H
05C3 D1                   POP     D
05C4 19                   DAD     D
05C5 5F                   MOV     E,A       ;add new binary digit
05C6 1600                 MVI     D,0
05C8 19                   DAD     D
05C9 D1                   POP     D         ;restore pointer
05CA 05                   DCR     B         ;dec count
05CB C2B005               JNZ     CONA1     ;continue until done
05CE D1                   POP     D         ;then drop pointer,
05CF E5                   PUSH    H         ;push number
05D0 21FFFF               LXI     H,-1      ;and -1
05D3 E5                   PUSH    H
05D4 C33702               JMP     NEXT

05D7 210000       CONAX   LXI     H,0       ;failure: push a zero
05DA E5                   PUSH    H
05DB C33702               JMP     NEXT

                  ; DIV - 16 bit divide
                  ; ENTRY: TOP    - divisor
                  ;        TOP-1 - dividend
                  ; EXIT:  TOP    - remainder
                  ;        TOP-1 - quotient
                  ; DESCRIPTION: performs a 32 bit by 16 bit division for
                  ; positive integers only.  The quotient must be resolved
                  ; in 16 bits.

05DE E005         DIV     DW      $+2       ;CODE
05E0 C1                   POP     B         ;BC <- divisor
05E1 D1                   POP     D         ;HLDE <- dividend
05E2 210000               LXI     H,0
05E5 CDED05               CALL    DIV1      ;do division
05E8 D5                   PUSH    D         ;push quotient
05E9 E5                   PUSH    H         ;push remainder
05EA C33702               JMP     NEXT

05ED 0B           DIV1    DCX     B         ;negate BC
05EE 78                   MOV     A,B
05EF 2F                   CMA
05F0 47                   MOV     B,A
05F1 79                   MOV     A,C
05F2 2F                   CMA
05F3 4F                   MOV     C,A
05F4 3E10                 MVI     A,16D     ;iteration count
05F6 29           DIV2    DAD     H         ;shift HLDE
05F7 F5                   PUSH    PSW       ;save overflow
```

More

Listing 15 continued.

```
05F8 EB                   XCHG
05F9 29                   DAD      H
05FA EB                   XCHG
05FB D2FF05               JNC      DIV3
05FE 2C                   INR      L
05FF F1          DIV3     POP      PSW        ;get overflow
0600 DA1206               JC       DIV5       ;if overflow, force subtraction
0603 E5                   PUSH     H          ;else,save dividend

0604 09                   DAD      B          ;attempt subtraction
0605 DA0C06               JC       DIV4       ;if it goes
0608 E1                   POP      H          ;else restore dividend
0609 C31406               JMP      DIV6
060C 1C          DIV4     INR      E          ;increment quotient
060D 33                   INX      SP         ;drop old dividend
060E 33                   INX      SP
060F C31406               JMP      DIV6
0612 09          DIV5     DAD      B          ;force subtraction
0613 1C                   INR      E          ;inc quotient
0614 3D          DIV6     DCR      A          ;decrement count
0615 C2F605               JNZ      DIV2       ;repeat until done
0618 C9                   RET

                 ; The Names in the dictionary
                 ; Notice that the actual printed names are chosen for typing
                 ; convenience and do not necessarily match the internal names
                 ; which must conform to the assembler's rules. Also, not all
                 ; functions have been included here.

0619 =           NAMEBEG  EQU      $
0619 012B          DB     1,'+'
061B 7E02          DW              TADD
061D 012D          DB     1,'-'
061F 9902          DW              TSUB
0621 042F4D4F44    DB     4,'/MOD'
0626 DE05          DW              DIV
0628 0745584543    DB     7,'EXECUTE'
0630 EE03          DW              EXECUTE
0632 05434C4541    DB     5,'CLEAR'
0638 ED02          DW              CLEAR
063A 054D415443    DB     5,'MATCH'
0640 C903          DW              MATCH
0642 064C4F4F4B    DB     6,'LOOKUP'
0649 8F03          DW              LOOKUP
064B 0445584543    DB     4,'EXEC'
0650 1901          DW              EXEC
0652 064D454D4F    DB     6,'MEMORY'
0659 4803          DW              MEMORY
065B 06434F4E42    DB     6,'CONBXA'
0662 5305          DW              CONBXA
0664 03494E43      DB     3,'INC'
0668 6E02          DW              INC
066A 03444543      DB     3,'DEC'
066E 7602          DW              DEC
0670 054D494E55    DB     5,'MINUS'
0676 8702          DW              MINUS
0678 055045454B    DB     5,'PEEKW'
067E AB02          DW              PEEKW
0680 055045454B    DB     5,'PEEKB'
0686 A102          DW              PEEKB
0688 05504F4B45    DB     5,'POKEW'
068E BD02          DW              POKEW
0690 05504F4B45    DB     5,'POKEB'
0696 B502          DW              POKEB
0698 03504F50      DB     3,'POP'
069C D702          DW              TPOP
069E 0453574150    DB     4,'SWAP'
06A3 DD02          DW              SWAP
06A5 03445550      DB     3,'DUP'
06A9 E502          DW              DUP
06AB 0546495253    DB     5,'FIRST'
06B1 E504          DW              FIRST
06B3 00            DB     0                   ;end of dictionary
06B3 =           NAMEEND  EQU      $-1

009B =           DICSIZE  EQU      NAMEEND-NAMEBEG+1     ;dictionary size in bytes

                 ; Initialization Code
                 ; Executed on start up of system but eventually overwritten by
                 ; the expanding dictionary

                 ; DICMOVE - moves the dictionary names
                 ;           to the top of available memory

06B4 2A4A03      DICMOVE  LHLD     MEMORY+2         ;DE <- top of memory
06B7 EB                   XCHG
06B8 21B306               LXI      H,NAMEEND        ;HL <- source (end of names)
06BB 019B00               LXI      B,DICSIZE        ;BC <- byte count
                                                    ;transfer loop
06BE 7E          DIC1     MOV      A,M              ;get next byte
06BF 12                   STAX     D                ;move it
06C0 2B                   DCX      H                ;dec source pointer
06C1 1B                   DCX      D                ;dec target pointer
06C2 0B                   DCX      B                ;dec count
06C3 78                   MOV      A,B              ;test for zero
06C4 B1                   ORA      C
06C5 C2BE06               JNZ      DIC1             ;not yet

06C8 EB                   XCHG                      ;set dictionary variable
06C9 23                   INX      H
06CA 22C703               SHLD     NAMES+2

06CD C9                   RET
06CE                      END
```

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Here's some interfacing information not easily obtained from the Heath manuals.

Getting the Most From Your H8

By Donald Skiff

Flexibility is one of the biggest advantages the Heath H8 has over its new siblings, the H88 and H89. A bare-bones H8 with the minimum 4K of memory and an H8-5 serial and cassette interface board is not only inexpensive (less than $500), but can be used without a terminal for a variety of applications. A beginner can learn the workings of a computer at the machine level, add components when he is ready, and have a full-fledged microcomputer that will compete with the best of them.

The wide range of possible uses makes detailed instructions for using the H8 a little slippery; it's almost as hard to be specific about how to connect the computer to something else as it is to answer the perennial question, "But what can you do with a computer?" Perhaps that's why Heath has been less detailed about interfacing and applications than it has been about assembling the machine. With so many ways to do it, where do you start?

Ever since I built my H8 nearly three years ago, my biggest headaches have been trying to figure out how to connect it to terminals, printers, modems and other computers. It's been a trying experience. Here is some of what I've learned.

PAM-8, the Front Panel Monitor

The front panel of the H8 is a peripheral device, and it is treated by the computer as any other external component.

But the monitor program, PAM-8, uses the panel's switches and display almost continually, and since PAM-8 runs along with user's programs, the panel is frequently involved. I include a discussion of the front panel because it can be accessed through its I/O ports or through PAM-8 routines, separately from its regular PAM-8 functions.

The H8's intelligent front panel makes it different from most other microcomputers. You can examine and alter any register or memory location, load and dump programs on tape and execute programs (even single-step) with a single button.

The front panel keypad and display are not completely dedicated to the monitor program, however. They are accessible through a couple of I/O port locations (360 and 361 octal) to serve nearly any purpose. PAM-8 can handle most of the housekeeping for such operations, making them simple to program whether running machine-language programs or BASIC.

Reading the Keypad—Assembly Language

When GO is pressed, starting execution of a user's program, the keypad is disengaged from the PAM-8 routines, and pressing any single key has no effect unless the user's program checks for it. The two two-key stop operations (RTM/0 and RST/0), however, are connected by interrupt to return control to PAM-8.

Other than these, the program can use almost any key press action. PAM-8 contains a routine that may be called to identify the key pressed. Since there are 16 keys, you can use them for entry of hexadecimal values, for example. Or, in a controller application, pressing a certain key might start a particular process.

The source code for PAM-8 is included in the H8 reference manual. On page 1-56 (in my copy, at least) is the routine RCK—read console keypad. It contains key-bounce and aural feedback routines to indicate when a key is struck, and returns with the identification of the pressed key in the accumulator.

So to detect a key press, simply CALL 003.260 (split octal); then do whatever you want with the contents of the accumulator.

Reading the Keypad—BASIC

It's even easier in BASIC. The statement

X=PAD(0)

will cause the computer to check the keypad for a key press, and set variable X equal to the value of the code for that key (up to 16). It will wait for the key press before continuing.

If, for example, you want to lock your bookkeeping program with a pass code, simply ask for a three-number combination to be entered on the keypad before allowing the program to run.

Controlling the Front Panel Display

PAM-8 normally displays a memory address and its contents or the contents of a pair of 8080 registers, all selectable from the keypad. During a user's program, it will continue to display the location or the register that was there when GO was pressed, updating it if the contents change.

The display can, however, be turned off by the program (BASIC does this), or it can be made to display just about anything, limited only by the arrangement of the LED segments. Any number up to nine digits

Donald Skiff, 7211 Scottwood Ave., Cincinnati, OH 45237.

```
 111111
6      2
6      2
6      2
 000000
5      3
5      3
5      3
 444444
```

Fig. 1.

and nearly all alpha characters can be created.

In Machine Language

Memory location 040.010 contains a control byte used by PAM-8 to operate the front panel display, and that byte can be changed by your program. It is identified in the source code as .MFLAG. Bit 00000010, when set, disables the update process in PAM-8, so that whatever is displayed will remain until that bit is reset. Bit 01000000, when set, will turn the display off. Other bits in this cell serve other functions, so change it carefully.

A nine-byte block of memory (FPLEDS) starting at 040.013 contains the code that PAM-8 translates into the display pattern. Each byte controls one display character, and each bit controls one LED segment in the pattern shown in Fig. 1.

The numbers in the figure represent the bit number for that segment. Bit 7 is the decimal point. In the appropriate byte, any bits that are set will cause the corresponding segment to light, if the .MFLAG display on/off bit is reset.

So, to create any pattern on the front panel display, stop the updating process by PAM-8 and insert appropriate values into the FPLEDS block of memory locations. What appears will remain until you change it, or until your program returns to the monitor.

In BASIC

The statement CNTRL 2,1 will turn the front panel display on, without any update by PAM-8. CNTRL 2,0 will turn it back off.

Any nine numerical values will be displayed when they are inserted into the FPLEDS memory locations. (Since BASIC uses decimal values, the locations start at 8203.) Use the statement

POKE 8203, SEG(X)

to cause the value of X to be shown in the first display location.

The 8251 Mode Byte Bit Configuration

X X X X X X 1 0	Baud rate factor (16 x shown - required)
X X X X 1 1 X X	Character length (8 bit shown - required)
X X 0 0 X X X X	Parity enable (disabled -- not needed)
0 1 X X X X X X	Number of stop bits (1 shown - can be 2)
1 1 6	Octal value of mode byte (216 with 2 stop bits)

The 8251 Command Byte Bit Configuration

X X X X X X X 1	Transmit enable (0 = disable)
X X X X X X 1 X	Data terminal ready output (Interrupt Enable)
X X X X X 1 X X	Receive enable (0 = disable)
X X X X 1 X X X	Send break character on data line
X X X 1 X X X X	Internal error flags reset (if used)
X X 1 X X X X X	Request To send output
X 1 X X X X X X	8251 Internal reset
0 X X X X X X X	(Required)
0 0 5	Octal value of typical command byte

The 8251 Status Bit Configuration

X X X X X X X 1	Transmitter ready for next character
X X X X X X 1 X	Receiver register has character
X X X X X 1 X X	Transmitter empty
X X 1 1 1 X X X	Error flags
X X 0 X X X X X	(always)
1 X X X X X X X	Device ready (DSR) signal received

Table 1.

If you wish to display something other than the numerals 0–9, poke the decimal value of the bit pattern required as described above, instead of using the SEG(X) function.

The H8-5 Serial and Cassette Interface Board

Unless the new H8 owner goes directly into floppy disk program storage, this is apt to be the first peripheral interface purchased. The cassette interface is pretty much a single-purpose device, even though it uses the same control chip—the 8251 USART (universal synchronous-asynchronous receiver-transmitter)—as the serial interface. PAM-8 includes the routines for loading and dumping programs to tape, and few users will need to change the way the device operates.

On the other hand, the serial interface should be used with a system console and is adaptable to a small variety of peripherals. Jumpers on the board configure the port to either RS-232 (or a close approximation of it) or current-loop operation. The Heath instruction manual adequately describes the necessary jumpering and connections for standard terminals. Several connnection points shown on the schematic diagram are not explained.

If you have trouble getting a standard RS-232 terminal to communicate through the H8-5 board, try connecting it to pin 3 of P102 instead of pin 6, and jumper between pins 12 and 13 of IC122. (This bypasses the opto-isolator.)

Serial data transmission can take one of several forms, and the 8251 USART is designed to handle at least some of these. The H8-5, however, incorporates only part of the possible 8251 features. It is intended for asynchronous transmission of eight-bit bytes at a jumper-selected rate of from 110 to 9600 baud (bits per second). It has two device control output lines, but no device status sensing lines (even though these are available on the 8251).

You control the 8251 through a separate I/O port, one number higher than the data port. After reset or upon power-up, the 8251 must be initialized before it can be used. Heath software takes care of this if the interface is being used with the system console. Initialization takes the form of two byte values output to the control port.

The first byte is called the mode byte. It sets the 8251 for synchronous or nonsynchronous operation, character length (five–eight bits), parity handling and the number of stop bits to be used. The Heath manual says that only one mode byte is to be used with the H8-5: 116 octal. This sets the 8251 for asynchronous operation, eight-bit characters, parity check disabled and one stop bit (two stop bits

Main Port (Port + 0)	
1 1 1 1 1 1 1 1	Data port—read and write registers
Interrupt Enable Register (Port + 1)	
X X X X X X X 1	Received data available interrupt enabled
X X X X X X 1 X	Transmitter holding reg. empty int. enabled
X X X X X 1 X X	Receiver line status interrupt enabled
X X X X 1 X X X	Modem status interrupt enabled
0 0 0 0 X X X X	(Required)
Interrupt Identification Register (Port + 2)	
X X X X X X X 1	No interrupt is pending (0 = Yes)
X X X X X 1 1 X	Identification of highest priority int. pending
0 0 0 0 0 X X X	(Required)
Line Control Register (Port + 3)	
X X X X X X 1 1	Word length (8-bit length shown)
X X X X X 0 X X	Number of stop bits (1 shown; 1 = 2 stop bits)
X X 0 0 0 X X X	Parity instructions (no parity shown)
X 1 X X X X X X	Send break character over data line
1 X X X X X X X	Enable access to baud rate set
Modem Control Register (Port + 4)	
X X X X X X X 1	Data terminal ready signal
X X X X X X 1 X	Request to send signal
X X X X X 0 X X	OUT1 signal (CPU can generate interrupt)
X X X X 1 X X X	OUT2 line signal
X X X 0 X X X X	8250 diagnostic signal
0 0 0 X X X X X	(Required)
Line Status Register (Port + 5)	
X X X X X X X 1	Data ready
X X X X 1 1 1 X	Error flags
X X X 1 X X X X	Break signal received
X X 1 X X X X X	Trans. holding reg. empty (ready for next char.)
X 1 X X X X X X	Trans. shift reg. empty (character sent)
0 X X X X X X X	(Always)
Modem Status Register (Port + 6)	
X X X X X X X 1	CTS input has changed since last read
X X X X X X 1 X	DSR input has changed since last read
X X X X X 0 X X	(not relevant on H8-4)
X X X X 1 X X X	RLSD input has changed since last read
X X X 1 X X X X	Clear to send signal received
X X 1 X X X X X	Data set ready signal received
X 1 X X X X X X	(not relevant on H8-4)
1 X X X X X X X	Line signal detect signal received

Table 2. The 8250 register bit configuration.

can be used if needed for a slow terminal, making the mode byte 216 octal). (See Table 1.)

Once received by the 8251, the mode byte need not be sent again unless the USART is reset.

The next byte the 8251 requires is the command byte. This tells the USART whether data is to be transmitted, received or both; whether to reset the internal error flags; and whether to set the device control lines. For ordinary console interfacing, the device control lines are not used. (See Table 1.)

A new command byte can be sent at any time, as long as the 8251 has not been reset. There may be times when its status is not known; if the USART mode has been set, sending it another mode byte (116 octal) will cause it to reset, and a subsequent command byte (005) will be treated as a new mode byte (an invalid one, at that), leaving the port unconfigured and your program confused.

On the other hand, assuming the mode is set when it isn't and sending it a command byte such as 005 will have the same effect. The solution is to send it a byte that will not reset it if it is, and be a valid mode byte if it isn't—either way leaving it set and waiting for a command byte. A 201 octal will do this.

However, 201 will not configure the port correctly; it merely ensures that the USART mode is set. Follow this with a 100 octal, which *will* reset the 8251, and then send the valid mode and command bytes.

The H8-5 has an interrupt system, if your application calls for it. The interrupt jumpers are clearly explained in the manual and the schematic diagram. Heath software doesn't use interrupts, except a modem control package the Heath Users' Group released recently. There isn't space here to do the subject justice, so I'll limit my discussion to the fact that the DTR line from the USART is connected to the interrupt circuits, so that setting DTR will also enable the interrupts, if they are connected. That allows program control over the interrupt handling, perhaps useful in some kinds of controller applications.

If you need a status sensing line, pin 22 of the USART is the DSR input, and it is unconnected. It would be easy to solder a wire to the pad and run it out to the interface terminal strip. A safer method would be through a buffer of some kind, such as a spare AND gate.

The CTS line is tied to ground, where it must be if it is not in use, since the USART transmitter will not send a character unless CTS is low. It might be possible to disconnect it from the ground trace, but that would involve rerouting some circuit paths.

The H8-4 Four-Port Serial Interface Board

Although the H8-5 board can be used for purposes other than the system console, the H8-4 board is much easier to work with. Port and interrupt assignments are handled by jumper plugs (no soldering), and baud rates are software programmable. It has the same capability of interfacing to RS-232 or current loop terminals, and the device control and status sensing lines are (almost) all run out to the interface terminal strip. In fact, each set of connector pins is repeated for each port, with the control and status pins reversed, enabling standard EIA cables to be connected to either one, depending on whether the peripheral is a terminal or a modem.

The Heath instruction manual has some gaping holes. First, it doesn't explain very well the difference between a modem and a terminal connection. For example, it says that "Computers and modems are two types of DCE (Data Communications Equipment); while terminals, printers and most peripherals are DTE (Data Terminal Equipment). Always connect a DTE to a DCE. Never connect two like types together." (Does that mean you can't connect a modem to a computer? No.) But no-where does it explain the real difference, that between two connected units the output lines of one must connect to the input lines of the other. A standard connecting cable has the same numbered pins on both ends connected together. If it is male on one end and female on the other, and the equipment is likewise equipped, there should be no problem connecting them.

But there is a possibility that nonstandard cables and equipment plugs may cause a mix-up in lines. The H8-4 dual connector arrangement is one way to overcome this, but the person connecting the equipment still needs to know exactly what is happening, because it certainly isn't foolproof.

The 8250 ACE (asynchronous communications element) on the H8-4 board is the counterpart to the 8251 USART on the H8-5 board. The greatest advantage of the ACE is not that the baud rate is software controlled (which it is), but that all the control registers can be accessed independently, and in any sequence. There is no risk of sending a command byte or a mode byte at the wrong time, and confusing the poor thing. The baud rate generator is the only register that is accessed through another. Generally, that is done only once in a session, on initial start-up, so it is not a problem. Other controls can be accessed without disturbing the state of the 8250.

What the Heath instruction manual doesn't spell out is that each of these registers (there are seven altogether) is addressed at a different port number. So each channel takes seven ports, instead of two as with the 8251. In setting the address of the channel, only the lowest one (the data port) is set. The others are automatically assigned to the following six port numbers. The manual provides a chart of this relationship, but the chart has been taken from a National Semiconductor publication, and leaves a great deal to one's power of deduction. Table 2 lists the seven ports and the functions of their various bits.

Once you have overcome this hurdle, programming the interface is easy. To initialize the port, output separate bytes to the line control register, the baud rate generator, the line control register again and (if used) the interrupt enable and modem control registers. The settings of these registers may be examined simply by inputting from them. All four device control/status lines (RTS,DTR, CTS,DSR) are available for use, as well as the modem carrier signal detect (RLSD).

The H8-2 Three-Port Parallel Interface Board

The H8-2 parallel board uses the same 8251 USART as the H8-5 serial board. Sound impossible? Well, what the Heath designers did was convert the parallel data from the H8 bus into a serial stream through the 8251, and then feed it into a UART again to convert it back to parallel. Why? My guess is that this arrangement makes both original interface boards (H8-2 and H8-5) look the same to the CPU, and software written for one could be used with the other.

For example, my printer uses a parallel interface. When I run cassette BASIC, I can print with a PORT, 254 statement without having to manually configure that port. BASIC does it for me, because it thinks all ports are alike.

Now that Heath has brought out the H8-4 board, cassette BASIC is probably different from my version, and some configuration is necessary for printers. But the idea was a good one.

Anyway, each of the three ports on the H8-2 provides eight data lines input and eight output (you don't have to program the interface to change them back and forth, as you do with some parallel interface chips), a strobe (take data) line that carries a pulse to the peripheral when something is on the data lines, plus an acknowledge (data taken) line to detect when the peripheral has the data.

This kind of positive, two-way handshaking ensures accurate data transmission, because each byte is accompanied by take data and data taken communication. The handshaking lines are repeated for incoming and outgoing data lines. In addition, each port has a device control output line (RTS) and a device ready input line (DSR) line, controllable at the 8251 USART.

For applications not requiring the handshaking signals, the board has several jumper connections to send or receive data as fast as the interface and CPU can handle it or to control input directly from the CPU. Data output lines can be either polarity, but all handshaking lines are negative-asserting.

Interrupts are available as on the H8-5 board, jumper selected and enabled by the DTR output line. The CTS line into the 8251 is used by the UART to control the serial transmission between them.

Transmission speed is determined by the handshaking signals, up to a rate limited by the clocking circuits running at about 20,000 baud, and the speed of the various chips through which the data passes.

Conclusion

Most of this information is in the Heath manuals. But getting it out is another matter, unless you already know more than the manuals. Trial and error is a long, hard row to hoe. But it's educational. ■

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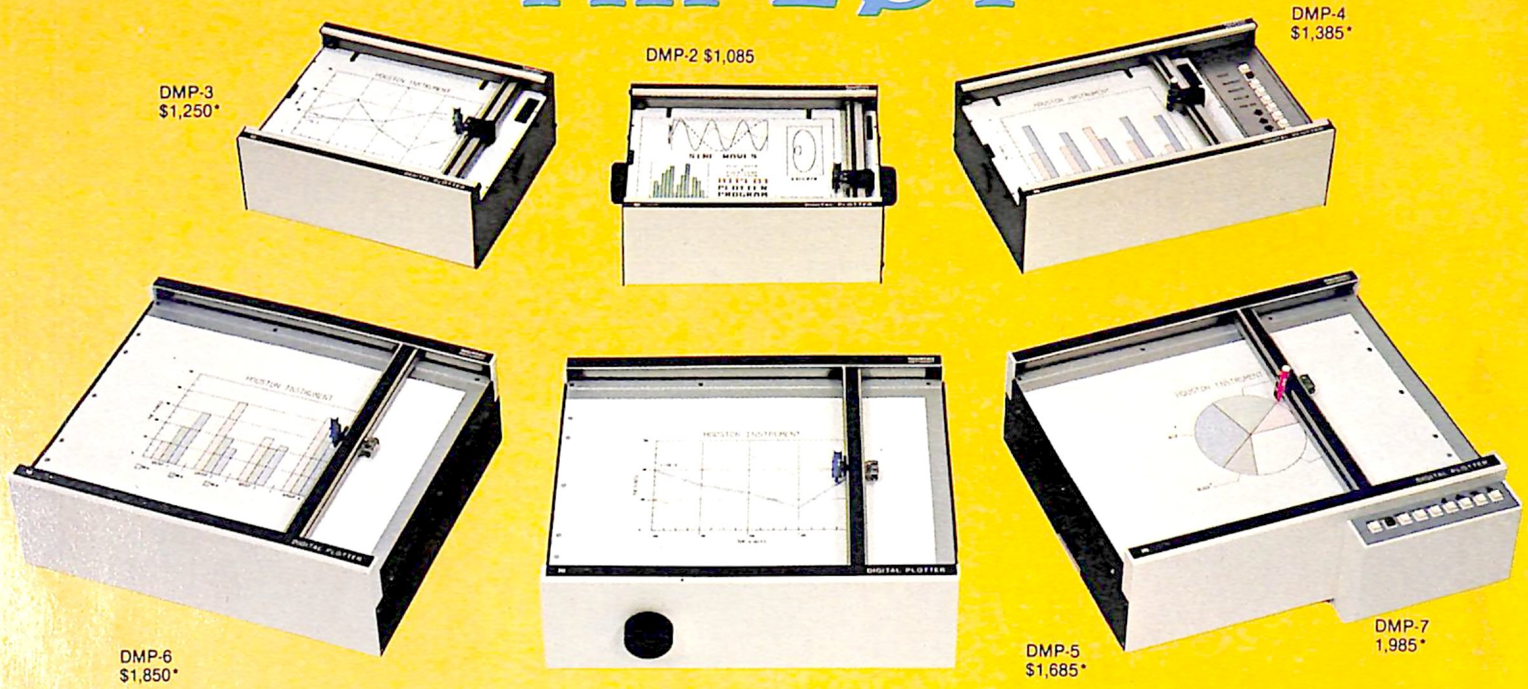

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With the right software, charts and graphs are yours for keeps. . . and in color too.

A High-Stepping Plotter From Houston Instruments

By Kevin Cohan

Charts and graphs are important to businessmen, engineers and scientists who need an easy way to interpret the results of their work or explain statistics to others. Unfortunately, while some small computers provide on-screen plotting capability, the plot is available only as long as the computer is turned on. Furthermore, the color selection and actual resolution leave something to be desired.

Wouldn't it be nice if the microcomputerist could obtain hard copy of these data plots, with detail and options comparable to a large, expensive computer system?

Well, the HiPlot Micro-Plotter from Houston Instruments, (1 Houston Square, Austin, TX 78753), used in conjunction with appropriate software, can provide this hard copy.

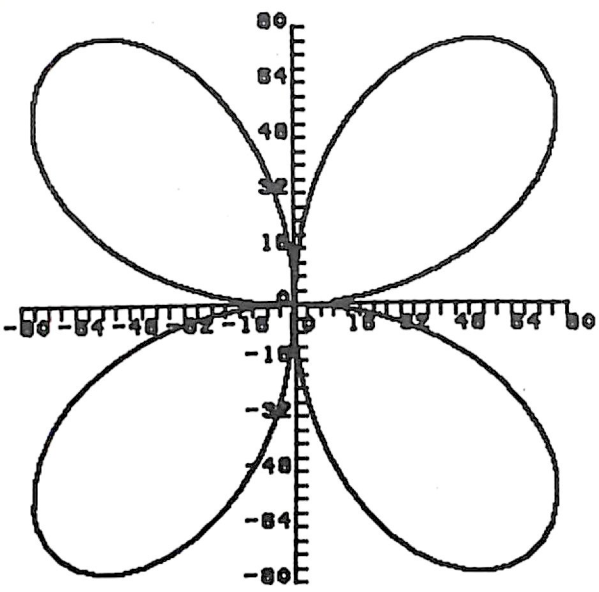
HiPlot is a low-cost, high-resolution flat-bed plotter designed with the microcomputer user in mind. Step size (the amount the plotter moves along the x or y axis for a given input character) is hardware selectable, at either 1/100 or 5/1000 of an inch. In the low-resolution mode (still better resolution than any micro) the maximum step rate, or speed, is 240 steps per second (sps) with 480 sps in high-resolution mode.

The actual plot area measures seven by ten inches. Users may connect the HiPlot to their computer by using either of its built-in interfaces: a six-line TTL-level interface or a hardware-programmable RS-232 serial interface, featuring common baud rates (300–9600). If you use the serial interface, I recommend operating at either 4800 or 9600 baud. Otherwise, the plotter will operate at an annoyingly slow rate, especially when plotting complex graphs.

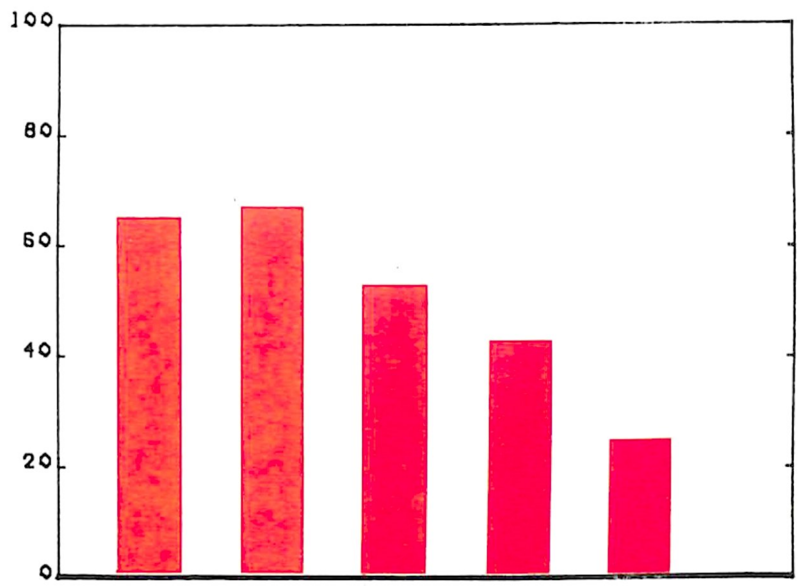
As nice as the HiPlot is, writing your own software for it is quite a chore. I wrote several routines using North Star BASIC. These programs did produce results, but the lines being plotted did not always match up, and the more complex the graph, the greater the error.

However, West Coast Consultants. 1775 Lincoln Blvd., Tracy, CA 95376, has done all the work for you, providing well-done packages designed to make the HiPlot produce precise, top-quality graphical output for PETs, Apples and TRS-80s. Complete

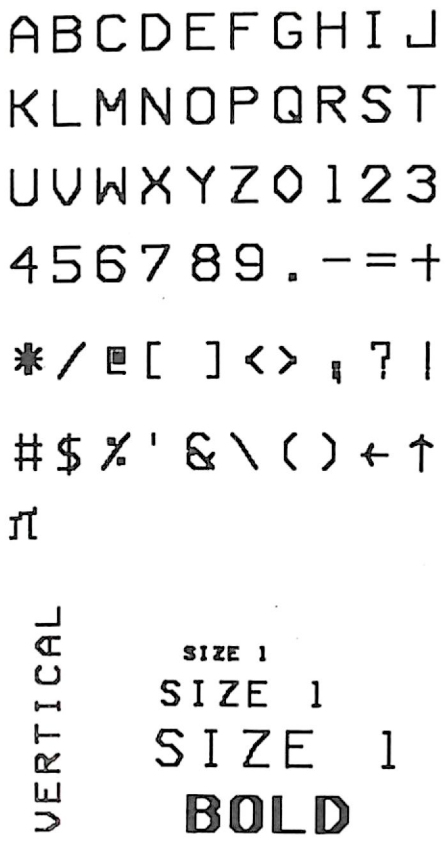
Address correspondence to: Kevin Cohan, Box 411, Peterborough, NH 03458.



Equation plotting with Curve.



Bar graph.



Alphanumerics generated by Curve.

instructions for setting up the necessary hardware interfaces are included with the software. All three computers use the serial interface of the HiPlot.

The software gives you a choice of programs. The first lets you plot equations of various types from a given set of data, while the second lets you create your own plot programs using WCC's standardized set of subroutines, which can be merged with your data generation program.

Curve

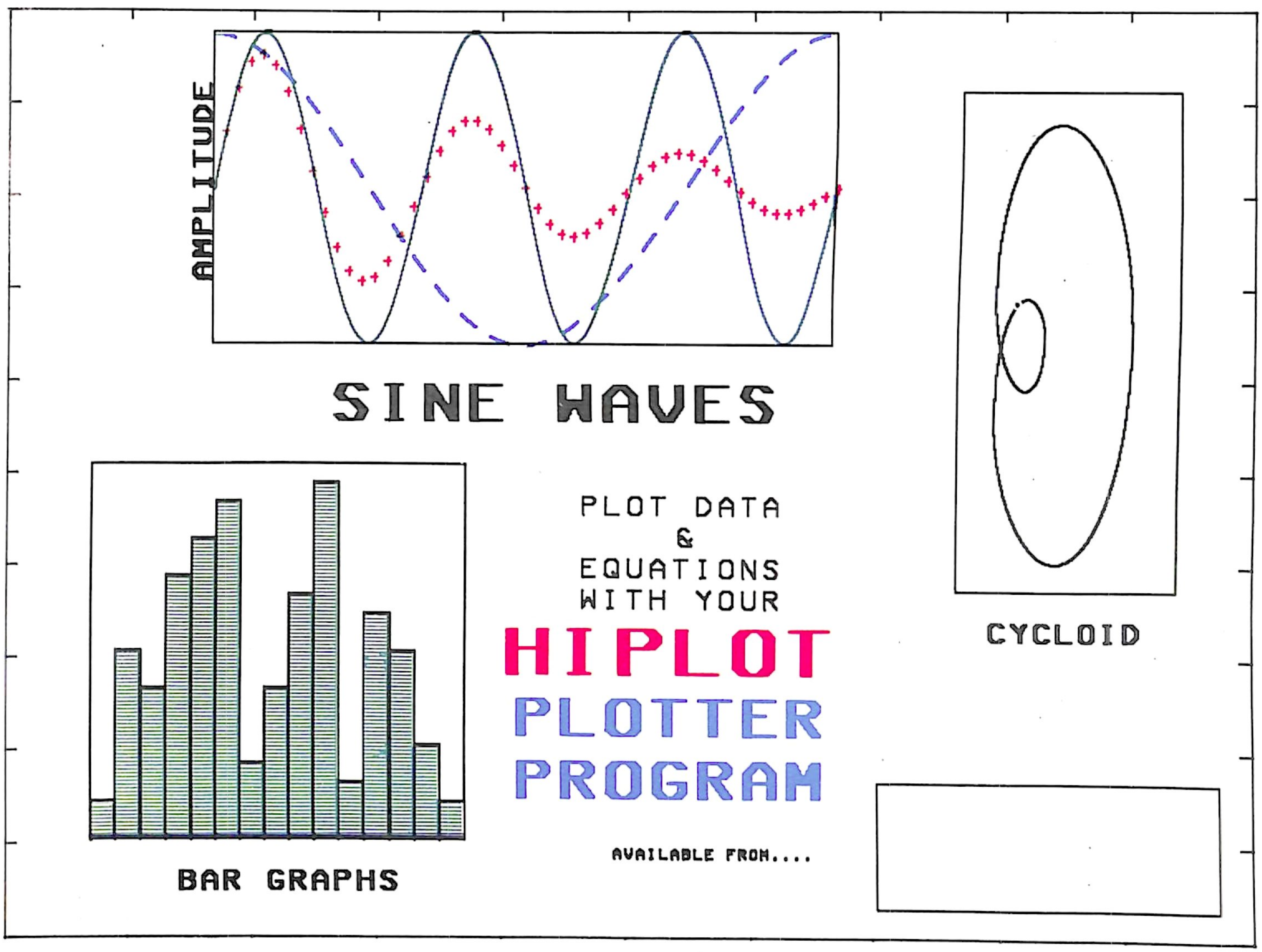
The first program, entitled Curve, lets you plot Cartesian, parametric and polar equations. It also provides the ability to plot individual data points entered from the keyboard, as well as alphanumeric characters. Step-by-step interactive instructions, featuring nice graphics displays on the computer screen illustrating the equipment and procedures, lead you through the routine of plotting these equations. Curve even stops and notifies you when it is time to change pens to plot a different color.

You can define the size of the plotting area, and all subsequent graphs will be adjusted accordingly. The direct data entry points, combined with the labeling and axis generation sections of Curve, will undoubtedly be widely used in many laboratory applications. You can define the axes with either full graph axis, simple lines or simple lines with ticks to indicate the space between graduations, also user defined. The software also provides complete labeling capabilities for any plot generated by the user.

The bar graph capabilities are an interesting feature of this software. You specify the coloring and shading, which can be as coarse as a quarter inch between lines, or as fine as shading the bars with essentially solid color. Each bar can have as many different sections as required.

Curve Subroutines

Curve Subroutines is the title of the second package from WCC. This is a

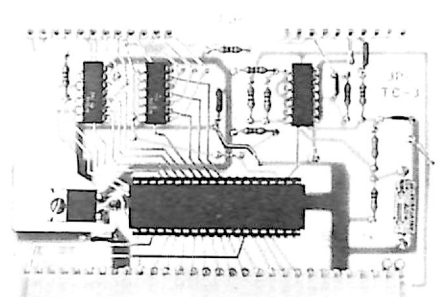


Example of Curve's color capabilities.

set of routines meant to be called from within a program written by the user to generate graphs. They have all the features of the above software, without all the interactive instructions and prepared equation plotting routines. A booklet giving complete descriptions of each module of the subroutine is included, letting you create graphics displays limited only by imagination and programming ability.

This set of subroutines is similar to the standardized groups of subroutines found on many mainframe systems for use with highly complicated and expensive plotting equipment, e.g., Tektronix-style storage display units and associated hard-copy units, or giant X-Y plotters. But expensive and complicated are adjectives not to be associated with the HiPlot-West Coast Consultants combination, though you cannot discern the difference between the graphs produced by this setup and the aforementioned mainframe gear.

This combination of hardware and software is useful to anyone who wants a clear representation of all the work their computer has just performed, from the small businessman to the top executive at DEC, from the smallest scientific statistics analysis to the largest lab application. Statistics will be easily visually represented in multicolor, multishaded plots. When you take into consideration the cost of this hardware and software, its capabilities and the truly professional results, this setup is quite a deal. ■



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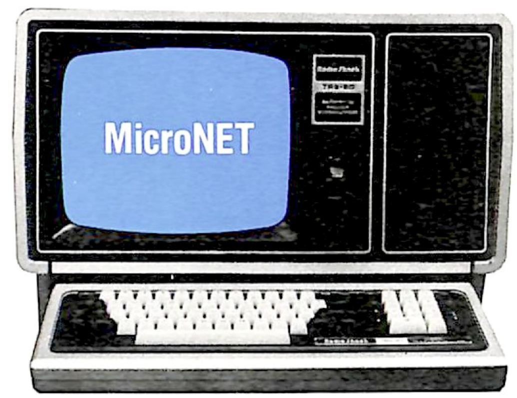

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Microcomputers in Industry

By Bill Barney

I work for a corporation that does custom manufacturing. We're not small—our volume is measured in the millions of dollars. I've worked there for over four years, most of that in production.

Last summer I moved to an office job. My duties included setting the price for each custom order that was received. It dawned on me after just a few days that I had become that most redundant of all creatures—a number cruncher.

As a computer enthusiast, I don't take kindly to being a number cruncher. I've always figured that number crunching was for silicon chips, and not the sort of thing humans should spend their time on.

I had been a computer owner for only a few months, but I had learned a lot. I had consumed every book I could find on the subject, and most magazines. And I knew that the things I was spending my time on could be done better, faster and less expensively by one of today's microcomputers.

Brick Walls

But presenting this information to my employer was going to be a tricky job. Should I simply tell him that I own a TRS-80, and as a result possess infinite wisdom? Unfortunately, when you mention Radio Shack to most people, it conjures up visions of yellow plastic radios, battery cards and "breaker! breaker!" This is hardly the stuff of which industrial revolutions are made.

Neither did I think that presenting to him the benefits a computer could bring to *my* job was a practical approach. Investing eight or ten thousand dollars in a machine to make one person's job a little easier is not an attractive course of action to today's company manager.

Perhaps I should lay before him the problems that exist in the areas that are involved, and thereby demonstrate the need for the machine.

But again, I saw problems. The existing system, with all its faults, was the result of the company manager's best efforts, not to mention several long-time employees. These were the people with whom I had to work every day.

On the other hand, I felt that the presentation had to be made and that I would be doing a real disservice to my employer if I didn't suggest an improvement that I was sure would be in the best interest of the company.

So I developed a plan. I would gather together several magazine articles, book excerpts, manufacturers' information sheets and any other pertinent materials I could find. This should show him what the microcomputer industry could do for him.

Again I hit a brick wall. How much information could I collect for someone who had no familiarity with the field? Especially someone with little, if any, time to spare for reading nonessential materials.

Barry Barney, 1427 2nd St. SE, Puyallup, WA 98371.

The available information falls into two categories. The first is trivial, at least from a business viewpoint: games, personal finance, stamp collection programs and so on. The second includes hopelessly technical material dealing with machine-language programming or hardware modification articles that from the business manager's viewpoint are useless. Even advertisements fall into one of these two areas.

I felt like I had struck out. But I had to say something. So I decided to rely on his open-mindedness and on what I hoped was my ability to talk intelligently on the subject. I sent a memo: "I'd like to see you at your convenience."

I didn't have long to wait. That same day he asked me to come on up to his office. My stomach was jumping and my palms were slick with sweat, but I soon learned that my nervousness was unnecessary.

I briefly explained some of the problems I faced in doing an accurate and consistent job, and pointed out that everyone who had experience with the job voiced the same concerns. I suggested some immediate and projected applications that would benefit the company.

To my surprise, he was agreeable and receptive. In fact, it wasn't long before he was suggesting some applications of his own, all of which were within the realm of current technology. On the whole, it was a very constructive discussion, and out of it a plan of action developed. We are now defining exactly which problems have priority, and are exploring what is available to solve them.

The Lessons

This is the point where I needed to stop and consider the lessons learned. What was it that made this company manager receptive to the idea of a microcomputer?

I don't think any of us who are associated with the field, on any level, can take much of the credit for his willingness to consider this solution. It should mainly go to his being acquainted with the problems within the business that needed solving and his flexibility in considering innovative alternatives.

It certainly isn't due to his familiarity with microcomputers. The company's experience with computers has been limited to mini and small business computers in the \$25–30,000 range. All of the software has been provided by the computer vendor, rather than generated in-house. So, indeed this alternative was innovative.

The experience emphasizes the responsibilities that micro users face if they want to be taken seriously. We need to be aware of the image we have in the eyes of the general public and take advantage of opportunities to improve it. This means being willing to use our computers to help others in whatever ways suit our interests and time.

Those who are involved in the production of hardware and software also need to give attention to their image. Take a look at their advertisements. What's in them that's not in 25 other ads in the same magazine? What new information do they present to the potential business users? And especially, do they present new information in a way that he can immediately understand without having to take a short course in computerese?

Lastly, what about those who are involved in the information business—the magazine and book publishers? What do they offer to the business user? He needs material that is brief and to the point, something that shows him that we are exploring new fields of application. Articles that deal with the configuring of a specific system for a specific problem are interesting, but are they giving us something new? How many data file programs or general ledger systems is the average business going to implement?

This last one comes back to us, the users. If you're participating in a project that has resulted in experiences that could be useful to the rest of us, why not share them? Perhaps we can take a big step towards letting the world know that we're involved in something that can be of immediate and direct benefit to others. ■

✓ Reader Service—see page 194

Apple* Software

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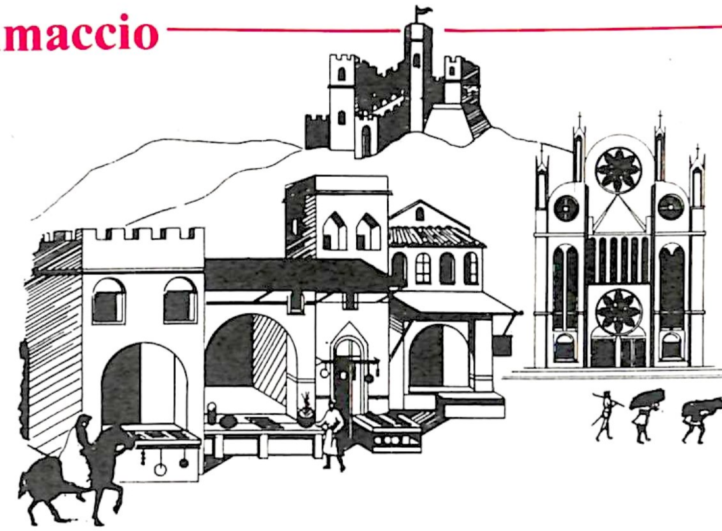

Buon giorno, signore!

Welcome to the province of Santa Paravia. As your steward, I hope you will enjoy your reign here. I feel sure that you will find it, shall we say, profitable.

Perhaps I should acquaint you with our little domain. It is not a wealthy area, signore, but riches and glory are possible for one who is aware of political realities. These realities include your serfs. They constantly request more food from your grain reserves, grain that could be sold instead for gold florins. And should your justice become a trifle harsh, they will flee to other lands.

Yet another concern is the weather. If it is good, so is the harvest. But the rats may eat much of our surplus and we have had years of drought when famine threatened our population.

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Your standing will surely be enhanced by building a new palace or a magnificent *cattedrale*. You will do well to increase your landholdings, if you also equip a few units of soldiers. There is, alas, no small need for soldiery here, for the unscrupulous Baron Peppone may invade you at any time.

To measure your progress, the official cartographer will draw you a *mappa*. From it, you can see how much land you hold. how much of it is under the plow and how adequate your defenses are. We are unique in that here, the map IS the territory.

I trust that I have been of help, signore. I look forward to the day when I may address you as His Royal Highness, King of Santa Paravia. *Buona fortuna* or, as you say, "Good luck". For the Apple 48K.

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✓ Reader Service—see page 194

In some cases, computer communication is easier without a modem.

The Modem Eliminator

By Dennis J. Murray

Have you ever needed to establish communications between two or more computers located near each other?

Did you use modems? If so, why?

Provided all the computers have a standard RS-232C port and are within several hundred feet of each other, there is a simpler, more reliable method: a modem eliminator.

A modem eliminator (or, in some circles, a null modem) consists of nothing more than one RS-232C female connector for each computer and a few passive components. It does not restrict transmission speed, uses little or no power, does not use telephone lines and, in the half-duplex mode, lets you establish a party line with three or more computers on-line.

There are drawbacks. For example, you must have dc continuity on the communication line between computers (called a hard-wired line). Also, the approach won't work with certain sophisticated telecommunication driver programs that look for transitions on modem control lines to indicate terminal response.

But if these problems don't apply to you, then a modem eliminator may be just the thing.

There are two versions: one for full-duplex (Fig. 1) and one for half-duplex (Fig. 2).

A Full-Duplex Modem Eliminator

The full-duplex modem eliminator is simple to build, requiring only two RS-232C female connectors (DB-25S) and a three-wire cable.

Referring to the schematic in Fig. 1, solder a short jumper between pins 4 and 5, and another jumper between pins 6, 8 and 20 of each connector. These jumpers simulate data set ready, carrier detect and clear to send signals normally generated by a modem. Solder one wire of the three-wire cable to pin 7 of connector A, and the other end of the same wire to pin 7 of connector B. This wire establishes a common ground between computers.

Solder one of the remaining two wires to pin 3 of connector A and the other end of the same wire to pin 2 of connector B. Solder one end of the remaining wire to pin 2 of connector A and the other end to pin 3 of connector B. These two wires will now send the transmitted data from each computer to the receive line of the other computer.

The assembly is now complete. All that remains is to put hoods on the connectors and place them in use.

A Half-Duplex Modem Eliminator

Two requisites for a half-duplex transmission are that the transmit signal must be fed back into the receive line, and that only one computer can transmit at a time—the rest must listen.

EIA standards call for the transmit signal to be on pin 2 and the receive signal on pin 3. With no data transmission, both pins should be at the mark level of −3 volts or less. When one computer transmits, it must pull its transmit line to +3 volts or higher to generate a space; otherwise, the line remains at −3 volts or less, indicating a mark condition. The receive line for a modem eliminator must be able to follow the transmitted signal if it is to simulate half-duplex.

Resistor R1 sets the receive bias to a mark level by feeding the transmit signal from pin 2 to the receive line on pin 3 (Fig. 2). Diodes D1 through Dn are reverse-biased. Therefore, when there is no transmit data, all receive lines are at the mark level.

When CPU-B transmits, it pulls its transmit line (pin 2) to the space level (≥+3 volts), forward-biasing the diode, which forces the receive line (pin 3) to follow. Thus, all stations monitoring the receive line will pick up the transmitted data.

Dennis J. Murray, Computech, 1005 Chestnut Drive, Christiansburg, VA 24073.

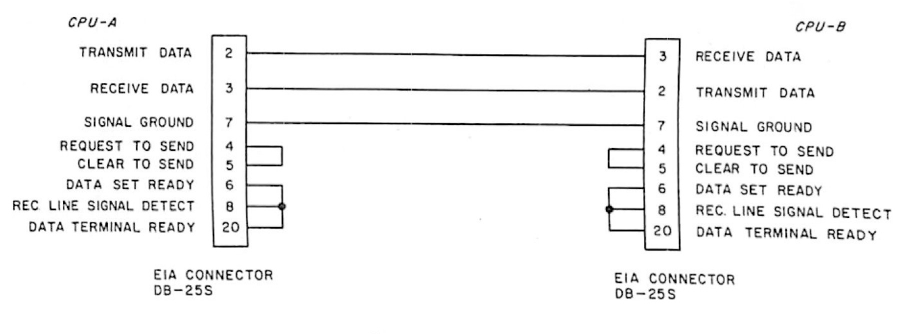

Fig. 1. Full-duplex modem eliminator.

When CPU-A transmits, it pulls its transmit line to the space level. The receive line follows, due to biasing through R1. Since diodes D1–Dn are reverse-biased, all stations will receive data.

To assemble this circuit, you will need one RS-232C female connector for each computer to be in the link, one diode for each computer but the first, one resistor and a two-wire cable. The resistor value is not critical and should be chosen such that it reliably produces a mark state on the receive line with all computers connected. Normally, this will also produce a reliable space condition when CPU-A transmits. If not, the addition of diode Dx will correct the problem.

Solder a jumper between pins 4 and 5 and another jumper between pins 6, 8 and 20 on all connectors. Solder one end of a wire from the two-conductor cable to pin 7 of connector A and the other end of the same wire to pin 7 of the other connectors. Solder one end of the other wire to pin 3 of connector A and the other end of the same wire to pin 3 of the other connectors. This establishes a common ground and receive line for all connectors.

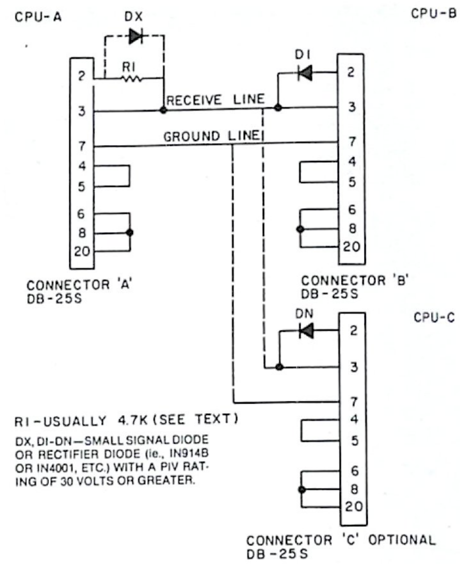

Fig. 2. Half-duplex modem eliminator.

Solder resistor R1 between pins 2 and 3 of connector A. Solder diodes between pins 2 and 3 of the remaining connectors, being careful to observe correct polarity (banded end toward pin 3).

Connect the computers and try communicating. If it works, you're in business. If not, measure the mark level voltage between pins 3 and 7 of connector A. If the voltage is greater than −3 volts, adjust the value of R1 to result in −3 volts or less. If the voltage is OK, diode Dx is needed.

The only restriction placed on the RS-232C interface is that the transmitter must be able to exceed the receiver's space threshold by an amount equal to the forward voltage drop of the diodes used (usually 0.6 volts). This should not be a problem if you are using a commercially available interface or a well-designed homebrew system, since this value is usually far exceeded.

One other potential problem: in rare instances, some computers do not output data terminal ready (pin 20). You may be able to circumvent this by shorting pins 4 and 5 to pins 6 and 8 on that computer's connector, thus using request-to-send to generate all required voltage levels.

Once these problems have been solved, you will find the interface to be reliable and considerably less expensive than modems. The half-duplex model has proven itself in a party line involving up to four computers. ■

TRS-80 gives this old game a new twist.

The Fifteen Puzzle

By William L. Colsher

In 1878, a fellow named Sam Loyd invented a puzzle consisting of a box with fifteen numbered blocks. These blocks were arranged in four rows, each containing four blocks, except for one row which held three blocks and a space. The object of the game is to arrange the blocks in numerical order (see Fig. 1).

This is not as easy as it may seem. Since there are 16 blocks available (15 numbers and a space) there are 20,922,789,888,000 possible starting positions. Some fairly heavy math indicates that half of these positions are impossible to solve. Many of the possible positions will require hundreds of moves to solve. You can see that this is not a trivial game.

The program that this article is based on does more than just gener-

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	0*

*In the old-fashioned physical puzzle this zero is an empty space.

Fig. 1. Final arrangement.

William L. Colsher, 4328 Nutmeg Lane, Apt. 111, Lisle, IL 60532.

Program Listing.

```
10      REM***THE FIFTEEN PUZZLE
20      REM***W. L. COLSHER
30      CLS:IN."DO YOU NEED INSTRUCTIONS (Y=1, N=2)";A:IF A=1 T.GOS.10000
40      CLS:M=0:P."GENERATING THE PUZZLE TAKES A WHILE. PLEASE WAIT."
50      F.I=1TO16:A(I)=0:N.I
60      F.I=1TO16
70      R=RND(16)
80      IFA(R)<>0T.70
90      A(R)=I
100     N.I
110     GOS.5000
120     IF F=1 T.50
130     GOS.6000
140     P." ":IN."YOUR MOVE";X
145     GOS.4000
150     GOS.7000
160     IF F<>0 T.180
170     P."ILLEGAL MOVE, RE-ENTER":F.I=1TO500:N.I:G.130
180     A(X+F)=A(X):A(X)=16
190     G.8000
200     M=M+1:G.130
999     END
4000    REM***CONVERT NUMBER TO LOCATION IN ARRAY
4010    F.I=1TO16
4020    IFA(I)=X T.4040
4030    N.I
4040    X=I
4050    RET.
5000    REM***VERIFY SOLUTION POSSIBLE
5005    F=1
5010    S=0
5020    F.I=1to15
5030    F.J=I+1TO16
5040    IFA(I)>A(J)T.S=S+1
5050    N.J:N.I
5060    F.I=1TO8
5070    READ X
5080    IF A(X)=0 T. S=S+1
5090    N.I
5095    REST.
5100    A=INT(S/2)
5110    IFA*2=S T. F=0
5120    RET.
5130    DATA 2,4,5,7,10,12,13,15
6000    REM***DISPLAY GAME BOARD
6005    C.:L=339:P.A.217,"MOVE  ";M
6010    F.I=1TO4
6015    P.A.L," ";
```

Listing continued.

```
6020   F.J=1T04
6025   N=A((I-1)*4+J)
6028   IF N=16 T. N=0
6030   IF N<10 T.P." ";N;
6038   IF (N=10) * (N<16) T.P.N;
6040   N.J
6050   L=L+64
6060   N.I
6070   RET.
7000   REM***CHECK FOR LEGAL MOVE
7010   F=0
7015   IFX+1>16T.7025
7020   IFA(X+1)=16T.F=1
7025   IFX-1<=0T.7035
7030   IFA(X-1)=16T.F=-1
7035   IFX+4>16T.7045
7040   IFA(X+4)=16T.F=4
7045   IFX-4<=0T.7060
7050   IFA(X-4)=16T.F=-4
7060   RET.
8000   REM***CHECK FOR A WIN
8010   F.I=1T016
8020   IFA(I)<>I T.200
8030   N.I
8040   GOS.6000
8050   P." ":P." "
8060   P."CONGRATULATIONS!!! YOU DID IT IN ONLY ";M;" MOVES!!"
8070   P." ":IN."TO PLAY AGAIN, HIT ENTER.";A$
8090   G.10
10000  REM***INSTRUCTIONS
10010  C.:P.A.18,"F I F T E E N   P U Z Z L E"
10020  P.A.128,"THE OBJECT OF THE 'FIFTEEN PUZZLE IS TO MOVE THE"
10030  P."NUMBERS AROUND SO THAT THEY ARE IN ORDER FROM 1 TO 15. A MOVE"
10040  P."IS MADE BY TYPING IN THE NUMBER (WHICH MUST BE ADJACENT TO"
10050  P."THE ZERO) YOU WISH TO MOVE. THAT NUMBER IS THEN EXCHANGED"
10060  P."WITH THE ZERO.  YOU WIN WHEN THE BOARD LOOKS LIKE THIS:"
10070  P." ":P." ":P." 1  2  3  4":P." 5  6  7  8":P." 9 10 11 12"
10080  P."13 14 15  0"
10090  P." ":IN."HIT ENTER TO PLAY";A$
10100  RET.
```

A	B	C	D
E	F	G	H
	J	K	L
M	N	O	P

1. Let N be a number in position A of the puzzle to be solved. Count how many numbers smaller than N are in positions higher-lettered than A. Count the blank as 16.
2. Do this for all 16 positions (A-P) and add up the count.
3. If the blank square is one of the following: B, D, E, G, J, L, M or O, add one to the sum.
4. There is a solution if the sum is even.
5. There is no solution if the sum is odd.

Fig. 2. Algorithm for 15 Puzzle solvability. *

*Adapted from *Game Playing with Computers* by D. D. Spencer.

ate a puzzle. One of the most important things it does is verify that the randomly generated puzzle is actually solvable. Clearly, this is a nice feature to have. The algorithm used in this section is given by D. D. Spencer in *Game Playing With Computers* (Hayden Book Co., 1975). Fig. 2 illustrates this algorithm in verbal form.

The program checks for legal moves by examining the four (at most) locations that surround a given number (specified during the game by its coordinates). If any one of the locations contains the zero, then the move is legal. Otherwise, an error message is printed and play continues.

Playing the game is really quite simple. The computer will display the game board and then ask you for your move. You then just type in the number you wish to move and hit ENTER, after which the computer will re-draw the game board, making your move. In the event that your move results in a win (not very likely) the computer will congratulate you and ask if you want to play again.■

This "unobtrusive" front panel allows on-the-spot debugging without a debugger program.

Build a Computer System Control and Display Board

By J. C. Hassall

In the early days of personal computing, when front panels were more functional than cosmetic, uninformed (but interested) neighbors, friends and family could be wowed with an impressive array of switches and blinking LEDs. Who wouldn't be impressed by a micro-version of Mr. Spock's computer on the U.S.S. Enterprise?

But those old front panels were useful, too. You could stop the computer simply by flipping a switch, single-step the machine or look into its innermost memory by flipping another switch and observing the LEDs. A sharp operator could do on-the-spot debugging with the front panel. In fact, you had to use the front panel, after power-up, to toggle in the bootstrap program, which let the machine read a better, longer bootstrap program from cassette or paper tape.

As our sophistication grew, our reliance on the front panel dwindled. Firmware became available with the bootstrap in nonvolatile memory. You simply powered up and the machine bootstrapped itself. So front panels were reduced from a functional component to just another pretty face.

OK, but what about program debugging? No longer could the machine be halted in mid-stride. Now another program, called a debugger, had to be loaded into memory. The debugger would then execute the errant program and display interim calculation results, register contents, and so forth on an output device. This is worthwhile, but slow and often aggravating.

Theory of Operation

The circuits shown in the accompanying figures will provide most of the features of the front panel. They'll let you stop the CPU at the end of any machine cycle; observe the contents of the data and address buses; and single-step the CPU manually, one machine cycle at a time.

The circuits will also give you a feature not found on other front panels: the ability to single-step the CPU automatically at an adjustable rate, one machine cycle at a time.

The circuits' features offer numerous advantages. If you do much hardware work, stopping the CPU also freezes the system bus, so that the status of the address and data lines may be observed on the LEDs, or status lines checked with a logic probe. This capability is convenient for checking memory address decoding, I/O port decoding, data errors and so forth.

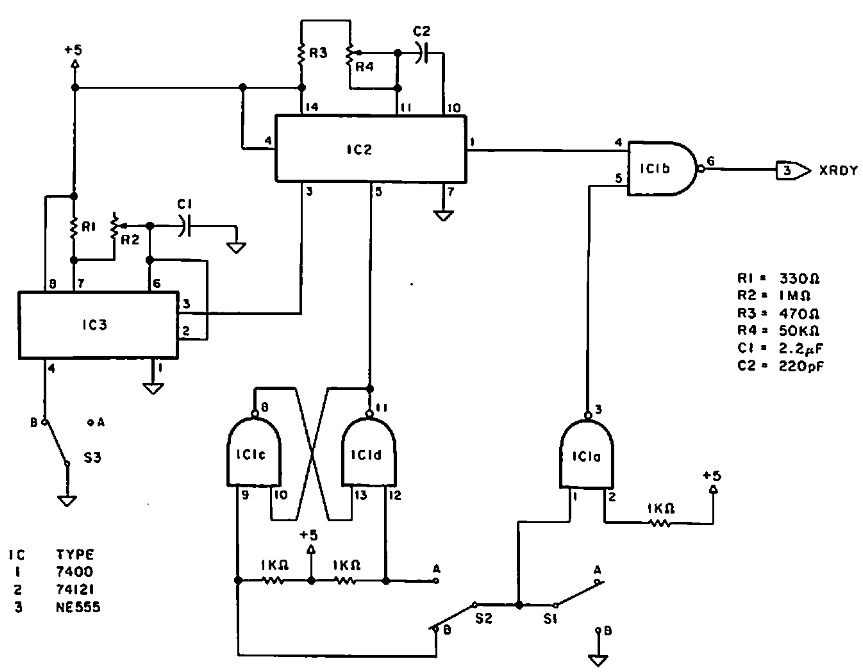

Fig. 1. Single-steps the CPU either manually or at the user-adjusted rate from 20 to 120,000 steps per minute, or allows the CPU to run free.

J. C. Hassall, H & H Enterprises, 1201 Highland Circle, Blacksburg, VA 24060.

A particularly nice feature is that data on the bus may be observed. For example, immediately after an input instruction is executed, the data bus will contain the data from the input port referenced in the instruction. Thus, terminal interface problems can generally be quickly solved by checking terminal data and status lines. Bit errors on memory boards can similarly be quickly traced.

If you're more involved with software than hardware, the circuits let you directly observe data values transferred throughout the program under development without having to load a debugger. The circuits are not intended to replace a debugger, however.

The circuits were developed initially for a home-brew 8080-based system, and then adapted to an S-100 system. The bus signals described are for the S-100 bus, but the circuits will work with any system that has access to the CPU's Ready or Hold pin. Since microprocessors are dynamic devices, they must have a clock to refresh internal registers and maintain synchronization of internal operations. Thus, slowing down the CPU clock to a more human speed would result in internal chaos in the CPU.

All microprocessors have a wait state in which no external operations (e.g., memory access) take place, but internal refresh continues. In essence, the CPU does nothing at full clock speed during the wait state. Upon exiting the wait state, normal operation continues. So the key to stopping the system is to cause the CPU to enter a wait state and stay there until allowed to exit by the operator.

Single-stepping is accomplished in a similar fashion—put the CPU into a wait state, allow it to exit the wait state, execute one machine cycle, then immediately cause it to reenter the wait state.

The term "immediately" is relative to the system clock. To fully understand, you need to look at how the CPU enters and exits a wait state.

At the end of each machine cycle, the status of the active high Ready line to the CPU (XRDY, pin 3, on the S-100 bus) is monitored. If it is at a logic zero, the CPU will enter the wait state for the next machine cycle. At the end of the cycle, the status of the line will again be monitored. The CPU will stay in the wait state until XRDY goes high again. Therefore, the single-step circuitry must hold the XRDY line at logic zero to stop the CPU and provide a clean TTL logic one pulse of the proper duration to the line to allow the CPU to execute the next machine cycle.

The duration of the pulse doesn't really matter, provided that it is shorter than the duration of one machine cycle. The circuit in Fig. 1 will provide a step pulse of 0.114 us to 12.2 us in duration, so it will control an 8080 with an 18.432 MHz or slower crystal. If your system uses a different CPU, compare the duration of its wait cycle (usually specified as T_{wait}) to the times given above. The values have been chosen to cover most CPUs. Adjustment procedures will be covered later.

The control circuit in Fig. 1 can operate in three modes: CPU free-running, CPU single-stepped and CPU single-stepped at an adjustable rate. In the first mode with switch S_1 in position A, pin 1 of IC1a is high, so pin 5 of 1b is low, which causes pin 6 of 1b to be high, and the CPU operates in the free-running mode. Closing S_1 (to

Dialight 555-3007 units can be obtained at the following locations: Philadelphia Electronics, 112 North 12th St., Philadelphia, PA 19107; Newark Electronics, 500 N. Pulaski, Chicago, IL 60646; and Westates Electronics, 20151 Bahama St., Chatsworth, CA 91311. Prices range from $1.22 each, in quantities from one to nine; $1.11, for ten to 24; and $1.01, for 25–99.

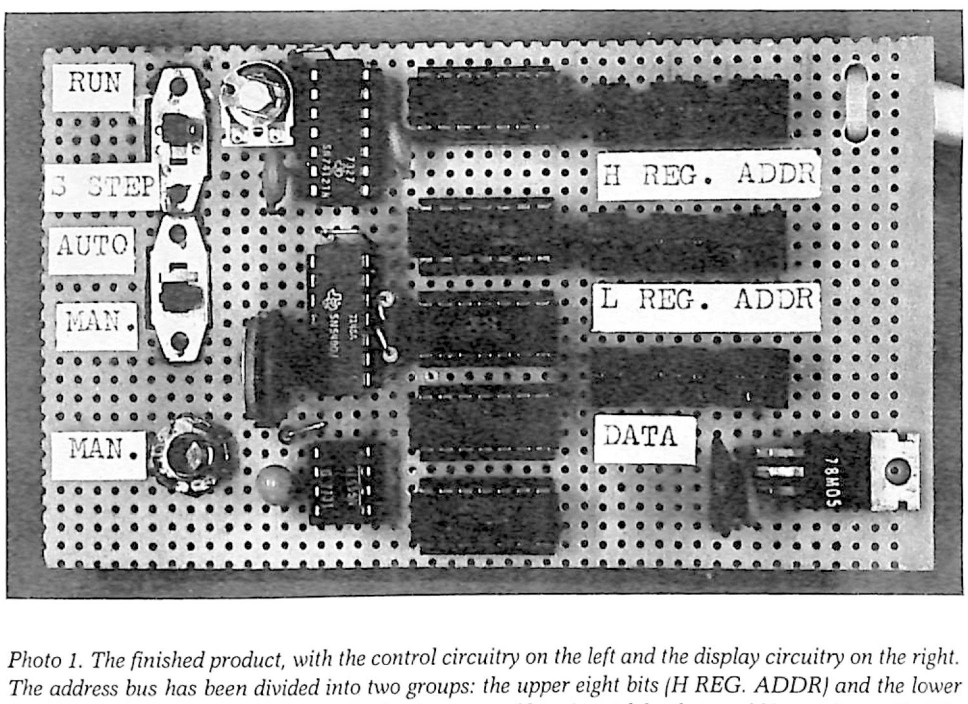

Photo 1. The finished product, with the control circuitry on the left and the display circuitry on the right. The address bus has been divided into two groups: the upper eight bits (H REG. ADDR) and the lower eight bits (L REG. ADDR). The LED display format used here is octal, but hex could be used as easily. The LEDs used are Dialight 555-3007 units. *(Photos by Jan Wellman.)*

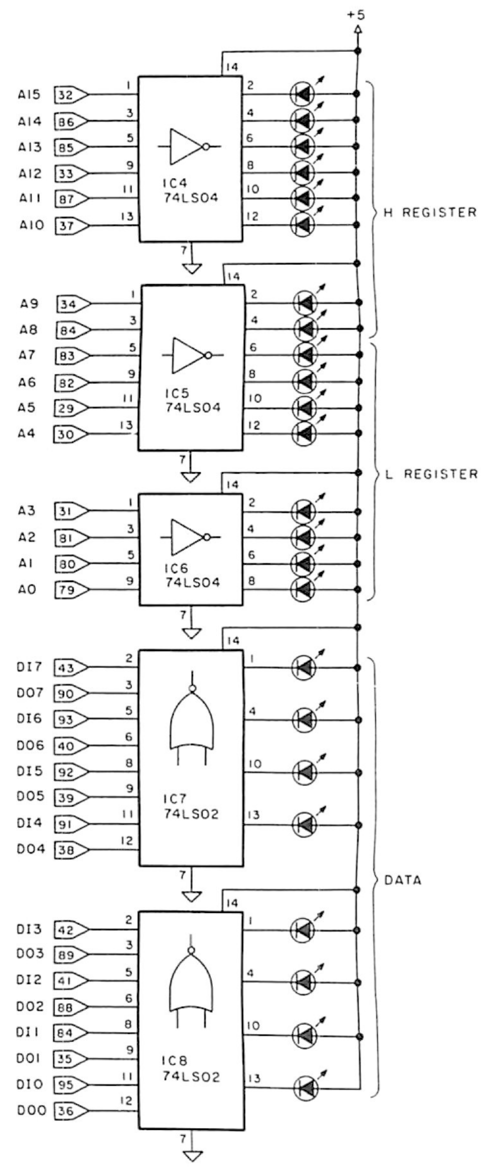

Fig. 2. The display portion of the circuitry. See the text for an explanation of the LEDs.

the B position) causes pin 6 of 1b to go low, putting the CPU in a wait state after completion of the ongoing machine cycle. This is the second mode of operation.

Now assume that S_3 is in the B position. S_2 is an SPDT normally closed, momentary closed type switch. Position B is the normally closed position, in which case the output from the flip-flop formed by 1c and 1d is high. When S_2 is momentarily closed to position A, the flip-flop toggles and the output goes low. The low-to-high transition of pin 4 of IC2 as S_2 is released to position B, causing the $\overline{Q}$ output to pulse from high to low to high. That pulse causes pin 6 of IC1b to go high, allowing the CPU to exit the wait state.

In the third mode of operation, IC3 is allowed to operate as a free-running multivibrator by switching S_3 to position A, thereby allowing the reset line to float high. The high-to-low transition of the output from IC3 will trigger IC2 each time. Since the output duration of IC3 is much shorter than IC2, no retriggering error can result. With S3 in position A, the CPU will automatically be single-stepped at a rate determined by the 1 megohm trimming pot for IC3. The values given allow adjustment from 20 to 120,000 steps per minute. Returning S3 to position A returns to mode 1 operation.

The formulas to determine the pulse duration of IC2 and the pulse train frequency of IC3, should you want to change from the values given, are as follows:

For IC2, the pulse duration time is $T = 0.7C_2(R_3 + R_4)$, where T is in seconds, C_2 is in farads and R_3 and R_4 are in ohms. The pulse train frequency for IC3 may similarly be calculated from $F = 1.44/(R_1 + 2R_2)C_1$, where F is in steps per second and R and C have the same units as above.

The display circuit of Fig. 2 consists simply of three 74LS04s and two 74LS02s, which drive the LEDs. Notice that the LEDs are not drawn with the customary current-limiting resistor in series with the voltage supply. The LEDs I used were Dialight 555-3007 units. Each unit has a current-limiting resistor within the package. The current is limited to 5 milliamps. The internal current-limiting resistor, combined with the fact that they can be mounted on 0.100 inch centers, saves board space and gives a more professional appearance (see photo). Each LED indicates the status of a particular bus line. No provision has been made to isolate the display from the bus during DMA—the LEDs will always display address and data line status. The address lines simply require an inverter to drive the appropriate LED.

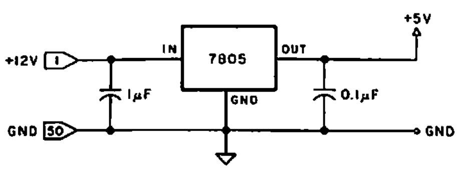

Fig. 3. Can be used to provide the necessary +5 V for the control and display board.

The data lines require a different arrangement, due to the split data bus configuration (Data In and Data Out) used in the S-100 bus. NOR gates are required here, so that when a given Data In or Data Out line is active (high), the appropriate LED will be lit. The only time Data In *and* Data Out are high is during Reset, in which case all LEDs (address and data) are lit. This circuit can be easily altered to work with a bidirectional data bus —simply replace the 74LS02s in Fig. 2 with 74LS04s.

The regulator circuit of Fig. 3 is a standard circuit and requires no description. As seen in the photo, no heat sink is needed for the regulator (assuming a regulator current rating of 1.5A) because current drain for the entire board, with all LEDs on simultaneously, is less than 0.2A. Not shown in any circuit diagram, but advisable in any computer system, are 0.1 uF decoupling capacitors.

Construction and Adjustment

Construction and adjustment is easy. As can be seen from the photo, all components fit nicely on a 2.7 inch by 4.7 inch piece of perforated board. I chose not to use a motherboard slot, but rather to hardwire the board directly to the motherboard. I did this because there is no need to remove the board once installed. It provides maximum flexibility in locating the control and display board in the computer case and gives easier access to the switches, rather than being sandwiched between two closely spaced system boards in the motherboard.

As can be seen in the photo, I have grouped the LEDs according to function (data and address). The address LEDs are split into two groups. The uppermost row in the photo displays the upper eight bits of address (A_{15}–A_8), and the middle row displays the lower eight bits (A_7–A_0). The advan-

Klass Dismissed

Due to extenuating circumstances, *Kilobaud Microcomputing* will be unable to bring you a final article in the Kilobaud Klassroom series as promised in last month's issue. Our appreciation to Peter Stark and George Young who coauthored the series.

Because of reader interest in these articles, the Kilobaud Klassroom series will be made available in book form. Watch for details in upcoming issues of this magazine.

tage of grouping the address LEDs in this fashion will be discussed below.

Additionally, as can be seen in the photo, each group is arranged for octal presentation of information. They could have been grouped for hex just as easily; I would discourage straight binary. While using color-coded wires may not be necessary, I grouped the power, address, data in, data out and XRDY leads by color, then wired the board to the motherboard as the last step. Alternately, wire each lead to the motherboard as it is wired to the control and display board.

Adjustment is easier than construction. Check for proper wiring of all connections before proceeding. There is always a great temptation to power up even before the soldering iron is cold, but checking the wiring takes only a few minutes and pays dividends in troubleshooting (if needed) later.

Before wiring the control and display board to the motherboard, apply power to the control and display board. With the display inputs floating, all LEDs should be lit. With S1 in position A, output XRDY from IC1b, pin 6, should be high. Switching S1 to position B should put XRDY low. Pulsing S2 from position B to A then back to B should create a single low to high to low pulse on XRDY. It is the duration of this pulse that you will have to adjust. Opening S3 to the A position will cause a pulse train at XRDY. Adjust the one megohm timing pot and observe that the pulse train speed changes. The only critical adjustment is for the 50k ohm timing pot for IC2.

After all connections are made to the motherboard, reset the computer system and observe that all LEDs are lit for as long as the reset switch is active. Then put S1 in position B, thereby forcing the CPU into the wait state. Pulse S2 and observe sequential changes of the address LEDs.

Bear in mind that the address lines should increment by one each time. If the address displayed seems to be randomly increasing (by two or three instead of one), adjust the 50k ohm timing pot to a lesser resistance. If you have a listing of the memory to which you reset the system, you should observe the memory contents displayed on the data LEDs.

No distinction has been made as to the source of the data (i.e., going to or coming from the CPU). My main concern was for the contents of the data bus. It will be obvious as you step through a program (with the listing to refer to) where the data originates. Also, the status of the data bus in (PBIN) line can be monitored for determination of data origin.

I suggested above that there is a distinct advantage to grouping the LEDs into either an octal or a hexadecimal format. Presumably the computer is programmed in one format or the other, rather than in straight binary. Use the same format on the control and display board.

Additionally, you will notice in the photograph that I have divided the address display into two groups: the upper-most row is the upper eight bits addressed by the H register, while the middle row of LEDs displays the lower eight bits of the address bus, which is addressed by the

Table 1. Decimal, hexadecimal and octal address equivalents.

ABSOLUTE ADDRESS DEC	HEX	OCTAL	H REG HEX	OCT.	DEC. PAGE	ABSOLUTE ADDRESS DEC	HEX	OCTAL	H REG HEX	OCT.	DEC. PAGE
0	0	0	0	0	0	14336	3800	34000	38	70	14
256	100	400	1	1	0	14592	3900	34400	39	71	14
512	200	1000	2	2	0	14848	3A00	35000	3A	72	14
768	300	1400	3	3	0	15104	3B00	35400	3B	73	14
1024	400	2000	4	4	1	15360	3C00	36000	3C	74	15
1280	500	2400	5	5	1	15616	3D00	36400	3D	75	15
1536	600	3000	6	6	1	15872	3E00	37000	3E	76	15
1792	700	3400	7	7	1	16128	3F00	37400	3F	77	15
2048	800	4000	8	10	2	16384	4000	40000	40	100	16
2304	900	4400	9	11	2	16640	4100	40400	41	101	16
2560	A00	5000	A	12	2	16896	4200	41000	42	102	16
2816	B00	5400	B	13	2	17152	4300	41400	43	103	16
3072	C00	6000	C	14	3	17408	4400	42000	44	104	17
3328	D00	6400	D	15	3	17664	4500	42400	45	105	17
3584	E00	7000	E	16	3	17920	4600	43000	46	106	17
3840	F00	7400	F	17	3	18176	4700	43400	47	107	17
4096	1000	10000	10	20	4	18432	4800	44000	48	110	18
4352	1100	10400	11	21	4	18688	4900	44400	49	111	18
4608	1200	11000	12	22	4	18944	4A00	45000	4A	112	18
4864	1300	11400	13	23	4	19200	4B00	45400	4B	113	18
5120	1400	12000	14	24	5	19456	4C00	46000	4C	114	19
5376	1500	12400	15	25	5	19712	4D00	46400	4D	115	19
5632	1600	13000	16	26	5	19968	4F00	47000	4E	116	19
5888	1700	13400	17	27	5	20224	4F00	47400	4F	117	19
6144	1800	14000	18	30	6	20480	5000	50000	50	120	20
6400	1900	14400	19	31	6	20736	5100	50400	51	121	20
6656	1A00	15000	1A	32	6	20992	5200	51000	52	122	20
6912	1B00	15400	1B	33	6	21248	5300	51400	53	123	20
7168	1C00	16000	1C	34	7	21504	5400	52000	54	124	21
7424	1D00	16400	1D	35	7	21760	5500	52400	55	125	21
7680	1E00	17000	1E	36	7	22016	5600	53000	56	126	21
7936	1F00	17400	1F	37	7	22272	5700	53400	57	127	21
8192	2000	20000	20	40	8	22528	5800	54000	58	130	22
8448	2100	20400	21	41	8	22784	5900	54400	59	131	22
8704	2200	21000	22	42	8	23040	5A00	55000	5A	132	22
8960	2300	21400	23	43	8	23296	5B00	55400	5B	133	22
9216	2400	22000	24	44	9	23552	5C00	56000	5C	134	23
9472	2500	22400	25	45	9	23808	5D00	56400	5D	135	23
9728	2600	23000	26	46	9	24064	3E00	57000	5E	136	23
9984	2700	23400	27	47	9	24320	5F00	57400	5F	137	23
10240	2800	24000	28	50	10	24576	6000	60000	60	140	24
10496	2900	24400	29	51	10	24832	6100	60400	61	141	24
10752	2A00	25000	2A	52	10	25088	6200	61000	62	142	24
11008	2B00	25400	2B	53	10	25344	6300	61400	63	143	24
11264	2C00	26000	2C	54	11	25600	6400	62000	64	144	25
11520	2D00	26400	2D	55	11	25856	6500	62400	65	145	25
11776	2E00	27000	2E	56	11	26112	6600	63000	66	146	25
12032	2F00	27400	2F	57	11	26368	6700	63400	67	147	25
12288	3000	30000	30	60	12	26624	6800	64000	68	150	26
12544	3100	30400	31	61	12	26880	6900	64400	69	151	26
12800	3200	31000	32	62	12	27136	6A00	65000	6A	152	26
13056	3300	31400	33	63	12	27392	6B00	65400	6B	153	26
13312	3400	32000	34	64	13	27648	6C00	66000	6C	154	27
13568	3500	32400	35	65	13	27904	6D00	66400	6D	155	27
13824	3600	33000	36	66	13	28160	6F00	67000	6E	156	27
14080	3700	33400	37	67	13	28416	6F00	67400	6F	157	27

L register. This method has the advantage of subdividing each 1K of memory into four blocks. A 256-byte group corresponds to incrementing the H register by one. Increment the H register four times, and you have gone through 1K bytes (one page) of memory.

Using Table 1, with address equivalents in decimal, hexadecimal and octal, greatly facilitates determination of memory location in decimal, hex, octal or decimal page, as well as memory addresses as a function of H register contents. Calculation of memory offsets, relative jump locations, amount of memory used by a program and so on is now almost trivial. When used in conjunction with the memory address display, Table 1 tells you at a glance exactly where you are in memory, whether you use hex or octal in your programming.

Conclusion

No longer do you need to put up with the shortcomings of a computer with a functionless front panel. By using the control and display board described here, on-the-spot debugging will be a reality. The board will give you the capabilities of stopping the CPU, manually single-stepping the CPU and observing address and data in/data out bus contents. It also includes a feature not offered on other front panels: single-stepping the CPU automatically at an operator-adjusted rate. While S-100 pin numbers have been used in the circuit diagrams, this circuitry is adaptable to any other system. ■

ABSOLUTE ADDRESS			H REG		DEC
DEC	HEX	OCTAL	HEX	OCT	PAGE
28672	7000	70000	70	160	28
28928	7100	70400	71	161	28
29184	7200	71000	72	162	28
29440	7300	71400	73	163	28
29696	7400	72000	74	164	29
29952	7500	72400	75	165	29
30208	7600	73000	76	166	29
30464	7700	73400	77	167	29
30720	7800	74000	78	170	30
30976	7900	74400	79	171	30
31232	7A00	75000	7A	172	30
31488	7B00	75400	7B	173	30
31744	7C00	76000	7C	174	31
32000	7D00	76400	7D	175	31
32256	7E00	77000	7E	176	31
32512	7F00	77400	7F	177	31
32768	8000	100000	80	200	32
33024	8100	100400	81	201	32
33280	8200	101000	82	202	32
33536	8300	101400	83	203	32
33792	8400	102000	84	204	33
34048	8500	102400	85	205	33
34304	8600	103000	86	206	33
34560	8700	103400	87	207	33
34816	8800	104000	88	210	34
35072	8900	104400	89	211	34
35328	8A00	105000	8A	212	34
35584	8B00	105400	8B	213	34
35840	8C00	106000	8C	214	35
36096	8D00	106400	8D	215	35
36352	8E00	107000	8E	216	35
36608	8F00	107400	8F	217	35
36864	9000	110000	90	220	36
37120	9100	110400	91	221	36
37376	9200	111000	92	222	36
37632	9300	111400	93	223	36
37888	9400	112000	94	224	37
38144	9500	112400	95	225	37
38400	9600	113000	96	226	37
38656	9700	113400	97	227	37
38912	9800	114000	98	230	38
39168	9900	114400	99	231	38
39424	9A00	115000	9A	232	38
39680	9B00	115400	9B	233	36
39936	9C00	116000	9C	234	39
40192	9D00	116400	9D	235	39
40448	9E00	117000	9E	236	39
40704	9F00	117400	9F	237	39
40960	A000	120000	A0	240	40
41216	A100	120400	A1	241	40
41472	A200	121000	A2	242	40
41728	A300	121400	A3	243	40
41984	A400	122000	A4	244	41
42240	A500	122400	A5	245	41
42496	A600	123000	A6	246	41
42752	A700	123400	A7	247	41
43008	A800	124000	A8	250	42
43264	A900	124400	A9	251	42
43520	AA00	125000	AA	252	42
43776	AB00	125400	AB	253	42
44032	AC00	126000	AC	254	43
44288	AD00	126400	AD	255	43
44544	AE00	127000	AE	256	43
44800	AF00	127400	AF	257	43
45056	B000	130000	B0	260	44
45312	8100	130400	B1	261	44
45568	B200	131000	B2	262	44
45824	B300	131400	B3	263	44
46080	B400	132000	B4	264	45
46336	B500	132400	B5	265	45
46592	B600	133000	B6	266	45
46848	B700	133400	B7	267	45
47104	B800	134000	B8	270	46
47360	B900	134400	B9	271	46
47616	BA00	135000	BA	272	46
47872	BB00	135400	BB	273	46
48128	BC00	136000	BC	274	47
48384	BD00	136400	BD	275	47
48640	BE00	137000	BE	276	47
48896	BF00	137400	BF	277	47
49152	C000	140000	C0	300	48
49408	C100	140400	C1	301	48
49664	C200	141000	C2	302	48
49920	C300	141400	C3	303	48
50176	C400	142000	C4	304	49
50432	C500	142400	C5	305	49
50688	C600	143000	C6	306	49
50944	C700	143400	C7	307	49
51200	C800	144000	C8	310	50
51456	C900	144400	C9	311	50
51712	CA00	145000	CA	312	50
51968	CB00	145400	CB	313	50
52224	CC00	146000	CC	314	51
52480	CD00	146400	CD	315	51
52736	CE00	147000	CE	316	51
52992	CF00	147400	CF	317	51
53248	D000	150000	D0	320	52
53504	D100	150400	D1	321	52
53760	D200	151000	D2	322	52
54016	D300	151400	D3	323	52
54272	D400	152000	D4	324	53
54528	D500	152400	D5	325	53
54784	D600	153000	D6	326	53
55040	D700	153400	D7	327	53
55296	D800	154000	D8	330	54
55552	D900	154400	D9	331	54
55808	DA00	155000	DA	332	54
56064	DB00	155400	DB	333	54
56320	DC00	156000	DC	334	55
56576	DD00	156400	DD	335	55
56832	DE00	157000	DE	336	55
57088	DF00	157400	DF	337	55
57344	E000	160000	E0	340	56
57600	E100	160400	E1	341	56
57856	E200	161000	E2	342	56
58112	E300	161400	E3	343	56
58368	E400	162000	E4	344	57
58624	E500	162400	E5	345	57
58880	E600	163000	E6	346	57
59136	E700	163400	E7	347	57
59392	E800	164000	E8	350	58
59648	E900	164400	E9	351	58
59904	EA00	165000	EA	352	58
60160	EB00	165400	EB	353	58
60416	EC00	166000	EC	354	59
60672	ED00	166400	ED	355	59
60928	EE00	167000	EE	356	59
61184	EF00	167400	EF	357	59
61440	F000	170000	F0	360	60
61696	F100	170400	F1	361	60
61952	F200	171000	F2	362	60
62208	F300	171400	F3	363	60
62464	F400	172000	F4	364	61
62720	F500	172400	F5	365	61
62976	F600	173000	F6	366	61
63232	F700	173400	F7	367	61
63488	F800	174000	F8	370	62
63744	F900	174400	F9	371	62
64000	FA00	175000	FA	372	62
64256	FB00	175400	FB	373	62
64512	FC00	176000	FC	374	63
64768	FD00	176400	FD	375	63
65024	FE00	177000	FE	376	63
65280	FF00	177400	FF	377	63

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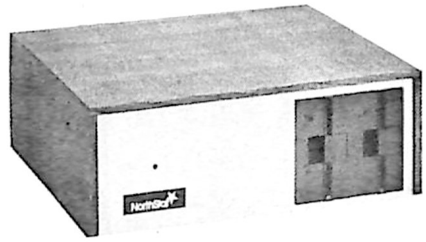

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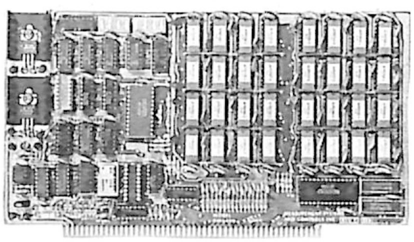

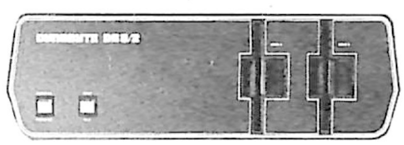

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S.D. Sales' 80-Column Video Board

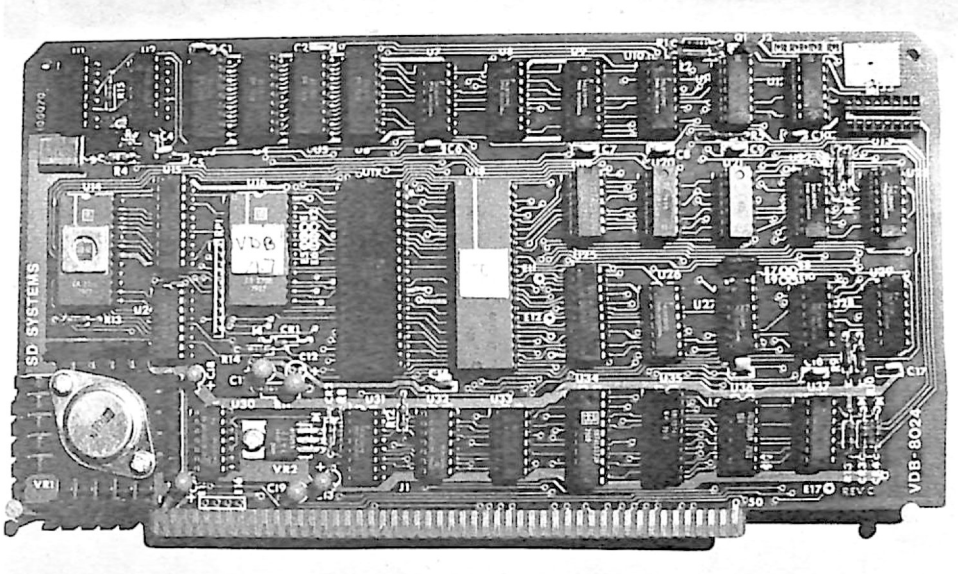
By Ernie G. Brooner

You can always get an argument about terminals vs mapped memory video.

The terminal occupies no memory, and the mapping technique permits, even in its simplest form, more access to character manipulation. Mapping is faster and more flexible, but it occupies memory space. A 64-column board (the commonest kind) requires dedication of 1K, and an 80-column board requires 2K of memory space.

Some of the more sophisticated models now try to combine the best features of both systems—complete software control of the screen and I/O port addressing. The S.D. Sales 8024 is one such device. The secret is an on-board Z-80 processor.

In the January 1980 issue of *Microcomputing*, I described the construction of a 64-column memory-mapped board by Ithaca Intersystems ("A Video Board from Ithaca Intersystems," p. 50). I was satisfied in every way, and in fact am still using it. But I got carried away by the excitement of the West Coast Computer Faire in March 1980, and bought the S.D. kit from one of the exhibitors. The going price for this item is just over $300 in kit form, and nearly $500 assembled and tested. Boards of this price range are intended for business use or the very serious hobbyist.



The S. D. Sales 8024.

What It Does

One is justified in asking what can this item do that cannot be done by the many available 64-column boards, at one-third to one-half the price. Either a great deal, or very little, depending on your point of view.

First, of course, it has 24 lines of 80 columns, or twice the display of the 64-column board. This is important only if you are going to be using software that requires a display that wide; if you write your own software, you don't need it. And if you use an 80-column printer, you will be able to display the same lines on both the terminal and printer.

How important is this feature? To me, not very. My most stringent requirement is the Word Star word processor that I use in my writing chores. Word Star formats the entire document on the screen before printing. But most documents are printed on standard 8-1/2 inch paper, and the Selectric I use as a printer is 10 pitch. Allowing for normal margins, therefore, I print only 60 columns to each line. The 64-column board accommodates this nicely, and still has room for the editing display at the end of each 64-column line on the CRT.

What else will an 80-column board do? It allows 24 lines of display, and I do miss that on my home system, but I can live without it.

Now to some particular advantages of the board being discussed. The most significant, from a design point of view, is the on-board processor and its associated software in ROM. The software is quite extensive, run-

Ernie G. Brooner, Box 236, Lakeside, MT 59922.

ning to around 2K. This is much more than you could conveniently dedicate to an in-computer software driver for a memory-mapped board. (Existing operating systems usually leave anywhere from one-fourth to one K available for this purpose.) This software in ROM recognizes a great many more control characters than would otherwise be possible, and can perform such activities as causing specified fields to blink, to reverse, to be underlined or to do combinations of these things. The cursor is also completely controlled by the calling program at all times. The Z-80 processor, and the ROM software, function only during the CRT retrace time and do not disturb the display in any way.

The displayable characters are stored in another ROM, as they customarily are in any video display device, mapped or otherwise. The specific advantage offered by this unit is a provision for an additional complete set of alternate characters, which can be designed and programmed into a ROM by the user, if he has the capability for programming ROMs.

The user manual explains how to design the characters. Briefly, each character is made up of a dot matrix of eight bytes. With this feature, you can conceivably have, for example, both English and Hebrew alphabets available, and switch from one to the other at will by simply including the appropriate control characters in the information being sent to the screen.

Construction

This is not a difficult kit, although the board is very densely populated. The instructions rightfully caution that it is not for beginners. I would add that it's not for advanced builders, either, unless they already understand how this kind of circuitry works and have on hand the necessary test equipment and access to chips and other spare parts that this kit uses. If you really need such a board and can afford it, buy it assembled.

Kits are becoming scarcer in this industry, and I suspect that this is at least partly due to manufacturers not wanting to fuss with builders' errors.

This kit has fair documentation with one exception: those of us who think like engineers and technicians never quite trust a schematic we can't see well enough to read, and this is a prime example. A complex diagram has been reduced to fit a standard page and is useless.

To make a long story shorter, my 8024 board failed to work at first testing and had to be sent to the S.D. factory for help. This was followed by the usual hassle in trying to get it repaired and returned.

When the board was finally returned (in good working order, incidentally), the explanation was that the builder (me) had installed a couple of diodes backwards. I have serious doubts about this. A trace had been cut and a previously unused section of a hex inverter had been inserted into the clock line to the character generator. Since my original diagnosis had been that the characters were not being clocked into memory, I will always wonder just who should have paid for the help I needed. In reality, I did.

The previous paragraphs touch on both documentation and manufacturer support, so these subjects will not be elaborated. Briefly, my entire experience with S.D. Sales has been worse than with some others, better than most, and somewhat less satisfactory than I would wistfully hope for.

Summary

Although the S.D. 8024 is described as a video board, think of it as a terminal and evaluate it in that way. There is an on-board keyboard port, and because of this, the board replaces all of a terminal, with the exception of the CRT monitor. As with a terminal, it is addressed by port number and does not consume any of the computer's memory. It is hardwired to be port 1 for data and 0 for status, so you might have to readdress some of your other peripherals.

The cost does seem a bit excessive, but on the other hand it is comparable in performance to a good terminal. The on-board software permits many more features than are found in the average terminal. The hardware quality is excellent, and the most serious criticism I have concerns the problem of getting it going for the first time.

I am aware of only one other, slightly more expensive, board in the same category available to hobbyists. If advertising can be trusted, it has an integral graphics capability that this board (and most boards) lack. If paying this amount again for a video board, I would be willing to go a bit further for either more features or a complete stand-alone terminal. ■

✓ Reader Service—see page 194

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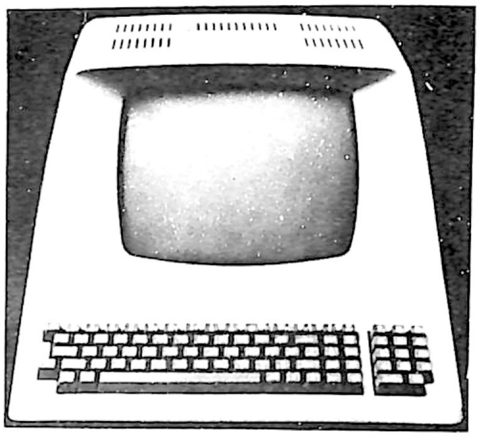

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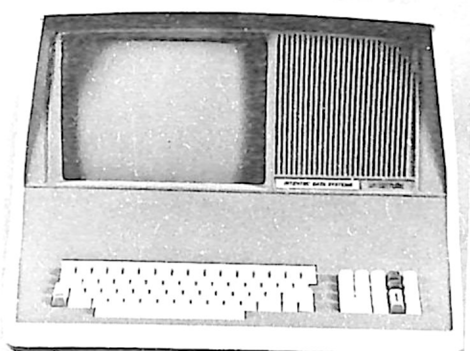

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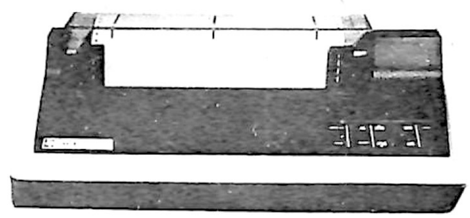

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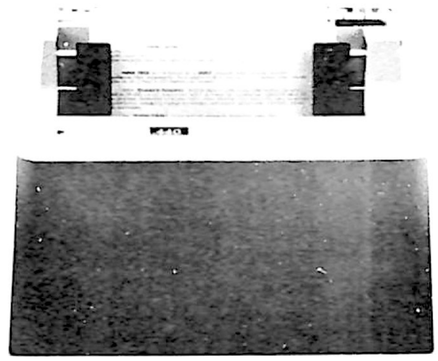

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Turn Your Smart Computer Into a Dumb Terminal

By Marc I. Leavey, M.D.

The Computer Bulletin Board System (CBBS) is an actively growing part of microcomputerdom. All you need is a terminal and a modem, to be in touch with systems all over the world via the telephone line.

However, this setup has several major problems. First, you have no facilities to save material accessed on the system. Second, individuals without terminals (such as the GMXBUG-VDM system I recently upgraded to) are out in the cold. Finally, all of that computer power is sitting idly by while you are on line.

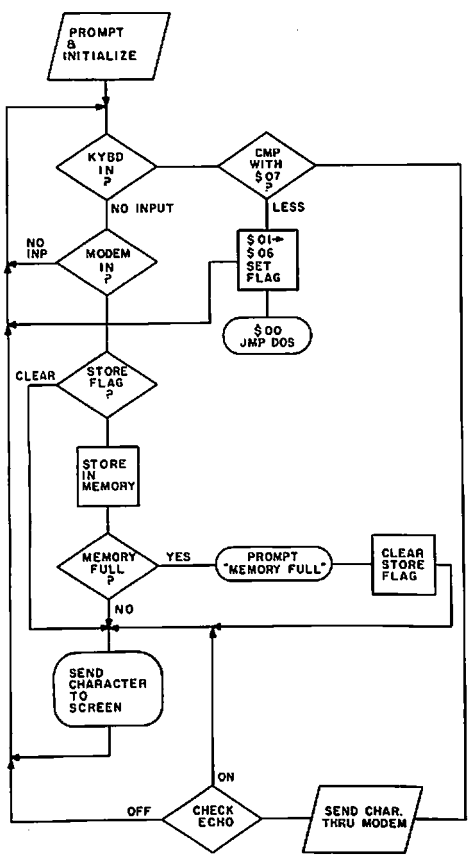

Fig. 1. Flowchart of TERM.$.

This set of programs will overcome these problems. It allows a 6800-based computer, with a GMXBUG-3.0 monitor and GIMIX VDM, to simulate a full- or half-duplex terminal for connection to a modem. Internal commands let you store incoming data in memory and view it on the screen. A new DOS command, written for SSB DOS68.51C, lets you save the textual material directly to disk for later use. Alternatively, nondisk users can use a simple outputting routine to save the region to tape. Thus, received data can be examined with the editor, or programs in BASIC can be used directly.

I developed a second version of the terminal routine for users of non-VDM systems. Monitors such as SWTBUG or SMARTBUG, which support terminals through ACIA ports, may use this version. The function is identical to the GMXBUG version, although it is a few bytes longer due to the inclusion of routines not needed with the video-based monitor.

The flowchart in Fig. 1 describes both versions of the terminal program. A loop continually scans for input from either the keyboard or modem. Keyboard input, when present, is first checked for control characters $01 (control-A) through $06 (control-F), which are used as internal terminal commands to set or clear flags.

In the absence of a control character, the byte is passed to the modem output, and the input loop is reentered. The character may or may not be echoed to the terminal, depending on the setting of one of those flags. This allows either full-duplex (no internal echo) or half-duplex (echo enabled) operation.

When the loop detects modem input, the character may first be stored in memory, depending on another flag. If the character is stored, a check sees if the storage memory is full. If so, the program issues a STORAGE MEMORY FULL prompt and aborts further attempts at storage. Regardless, the terminal displays the character, and the input loop is again reentered.

For the GMXBUG-based system, the keyboard is on the standard PIA on port 4, and the modem is connected to an ACIA on port 0. This lets you use the TAPOUT and TAPEIN routines in the monitor to conveniently provide input and output.

A modified version for SMARTBUG supports the standard ACIA for the terminal on port 2. The modem ACIA is connected to port 3. Simply changing the terminal ACIA to port 1 ($8004) would make this program SWTBUG-compatible, since no routines unique to SMARTBUG are used. Because an ACIA is assumed, however, MIKBUG would not be

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able to run this program without rewriting the input and output routines.

To use this program, run it from disk. I save it as a transient (TERM.$), so that merely typing TERM while in DOS executes the program. Nondisk users may, of course, load the program from tape and jump to the starting address.

After the opening banner is displayed, the terminal is configured and running in full-duplex, storage-mode-off operation. Typing any control character command, even while receiving, will alter the appropriate flag and action.

The Commands

A rundown of the various commands may be helpful. Briefly, they are:

Control-A. Initiates storage of incoming data. Any data coming in over the modem port is stored sequentially in RAM. The parity bit is masked. Data typed on the keyboard is not stored, unless echoed by the remote computer or modem.

Control-B. Stops storage. Pointers remain where they are, and when and if storage is resumed, data will be placed immediately following whatever is already there.

Control-C. Clears the pointer to the end of data. This has the effect of wiping out all stored data, although it is really still there if it has not been overwritten. Clearing the pointer resets storage whether or not the storage mode is on. It will even reset while receiving, but who knows where you will be then!

Control-D. Dumps the contents of storage memory to the screen.

Control-E. Enables internal echo. Note that although what you type is on the screen, it still is not stored in memory. It has to be coming into the modem port to do that.

Control-F. Enables full-duplex mode. This way, what you type does not mess up what you receive. The system you are talking to must tell you what you say. This is the way many CBBS systems like it.

Break. Null, or break, is $00. It executes a jump to $D283, which is the warm start address of Smoke Signal DOS. If you want to go somewhere else, like to the monitor ($E0E3), just change the jump address.

The Dump Command

Here is some more on the dump command. After typing a control-D,

SMARTBUG storage terminal program.

```
                          NAM    SMARTBUG STORAGE TERMINAL PROGRAM
                 * PROGRAM TO CONVERT SMARTBUG-6800 SYSTEM
                 * INTO A TERMINAL THAT STORES INPUT INTO
                 * MEMORY - FOR LATER SAVE TO DISK
                 *
                 * VER 2.0 - 10 MAY 80
                 *
                 * MARC I. LEAVEY, M.D.
                 *
                          OPT    NOG
                          OPT    NOS
                 *
0D0A             CRLF     EQU    $0D0A
E07E             PSTRNG   EQU    $E07E
D283             ZWARMS   EQU    $D283
E0C8             OUT4HS   EQU    $E0C8
8008             PORT2    EQU    $8008         TERMINAL PORT
800C             PORT3    EQU    $800C         MODEM PORT
E1D1             OUTEE    EQU    $E1D1
                 *
A100                      ORG    $A100
A100 CE A1DD     STORTM   LDX    #PROMPT
A103 BD E07E              JSR    PSTRNG
A106 F6 8008     TERM     LDA B  PORT2
A109 54                   LSR B
A10A 25 33                BCS    SNDCHR
A10C F6 800C     RCVCHR   LDA B  PORT3
A10F 54                   LSR B
A110 24 F4                BCC    TERM
A112 B6 800D              LDA A  PORT3+1
A115 84 7F                AND A  #$7F
A117 7D A1DC              TST    STRFLG
A11A 27 17                BEQ    NOSAVE
A11C FE A1DA              LDX    ATADDR
A11F A7 00                STA A  0,X
A121 08                   INX
A122 FF A1DA              STX    ATADDR
A125 BC A1D8              CPX    TOADDR
A128 26 09                BNE    NOSAVE
A12A CE A347              LDX    #FULPMT
A12D BD E07E              JSR    PSTRNG
A130 7F A1DC              CLR    STRFLG
A133 F6 8008     NOSAVE   LDA B  PORT2
A136 57                   ASR B
A137 57                   ASR B
A138 24 F9                BCC    NOSAVE
A13A B7 8009              STA A  PORT2+1
A13D 20 C7                BRA    TERM
A13F B6 8009     SNDCHR   LDA A  PORT2+1
A142 84 7F                AND A  #$7F
A144 81 07                CMP A  #$7
A146 2F 1B                BLE    COMAND
A148 F6 800C     MODLUP   LDA B  PORT3
A14B 57                   ASR B
A14C 57                   ASR B
A14D 24 F9                BCC    MODLUP
A14F B7 800D              STA A  PORT3+1
A152 7D A1CB              TST    ECHOFG
A155 27 0A                BEQ    SNDXIT
A157 F6 8008     ECHLUP   LDA B  PORT2
A15A 57                   ASR B
A15B 57                   ASR B
A15C 24 F9                BCC    ECHLUP
A15E B7 8009              STA A  PORT2+1
A161 20 A3       SNDXIT   BRA    TERM
A163 81 01       COMAND   CMP A  #$01
A165 27 17                BEQ    START
A167 81 02                CMP A  #$2
A169 27 18                BEQ    STOP
A16B 81 03                CMP A  #$3
A16D 27 19                BEQ    CLEAR
A16F 81 04                CMP A  #$4
A171 27 1D                BEQ    DUMP
A173 81 05                CMP A  #$5
A175 27 4A                BEQ    ECHOON
A177 81 06                CMP A  #$6
A179 27 4B                BEQ    ECHOOF
A17B 7E D283     EXIT     JMP    ZWARMS
A17E B7 A1DC     START    STA A  STRFLG
A181 20 83       ISLAND   BRA    TERM
A183 7F A1DC     STOP     CLR    STRFLG
A186 20 F9                BRA    ISLAND
A188 FE A1D6     CLEAR    LDX    FMADDR
A18B FF A1DA              STX    ATADDR
A18E 20 F1                BRA    ISLAND
A190 FE A1D6     DUMP     LDX    FMADDR
A193 BC A1DA     DMPLUP   CPX    ATADDR
A196 27 08                BEQ    DUNDMP
```

More

Listing continued

```
A198 A6 00               LDA A 0,X
A19A BD E1D1             JSR   OUTEE
A19D 08                  INX
A19E 20 F3               BRA   DMPLUP
A1A0 CE A365    DUNDMP   LDX   #FMPMPT
A1A3 BD E07E             JSR   PSTRNG
A1A6 CE A1D6             LDX   #FMADDR
A1A9 BD E0C8             JSR   OUT4HS
A1AC BD A1CC             JSR   PCRLF
A1AF CE A379             LDX   #TOPMPT
A1B2 BD E07E             JSR   PSTRNG
A1B5 CE A1DA             LDX   #ATADDR
A1B8 BD E0C8             JSR   OUT4HS
A1BB BD A1CC             JSR   PCRLF
A1BE 7E A106             JMP   TERM
A1C1 B7 A1CB    ECHOON   STA A ECHOFG
A1C4 20 BB               BRA   ISLAND
A1C6 7F A1CB    ECHOOF   CLR   ECHOFG
A1C9 20 B6               BRA   ISLAND
A1CB 00         ECHOFG   FCB   0
A1CC CE A1D3    PCRLF    LDX   #CRLFST
A1CF BD E07E             JSR   PSTRNG
A1D2 39                  RTS
A1D3 0D 0A      CRLFST   FDB   CRLF
A1D5 04                  FCB   4
A1D6 00 00      FMADDR   FDB   $0000
A1D8 5F FF      TOADDR   FDB   $5FFF
A1DA 00 00      ATADDR   FDB   $0000
A1DC 00         STRFLG   FCB   $00
A1DD 0D 0A      PROMPT   FDB   CRLF
A1DF 53                  FCC   /SMARTBUG - 6800 TERMINAL PROGRAM/
A1FF 0D 0A               FDB   CRLF
A201 20                  FCC   /   BY: MARC I. LEAVEY, M.D./
A21C 0D 0A               FDB   CRLF
A21E 0D 0A               FDB   CRLF
A220 43                  FCC   /COMMANDS:/
A229 0D 0A               FDB   CRLF
A22B 43                  FCC   /CONTROL-A = START STORAGE OF REMOTE INPUT/
A254 0D 0A               FDB   CRLF
A256 43                  FCC   /CONTROL-B = STOP STORAGE OF REMOTE INPUT/
A27E 0D 0A               FDB   CRLF
A280 43                  FCC   /CONTROL-C = CLEAR STORAGE POINTERS/
A2A2 0D 0A               FDB   CRLF
A2A4 43                  FCC   /CONTROL-D = DUMP STORED DATA TO SCREEN/
A2CA 0D 0A               FDB   CRLF
A2CC 43                  FCC   /CONTROL-E = ENABLE TERMINAL ECHO (HALF DUPLEX)/
A2FA 0D 0A               FDB   CRLF
A2FC 43                  FCC   /CONTROL-F = DISABLE TERMINAL ECHO (FULL DUPLEX)/
A32B 0D 0A               FDB   CRLF
A32D 43                  FCC   /CONTROL-G = EXIT TO DOS/
A344 0D 0A               FDB   CRLF
A346 04                  FCB   4
A347 0D 0A      FULPMT   FDB   CRLF
A349 3E                  FCC   />> STORAGE MEMORY FULL <</
A362 0D 0A               FDB   CRLF
A364 04                  FCB   4
A365 53         FMPMPT   FCC   /STORAGE STARTS AT $/
A378 04                  FCB   4
A379 53         TOPMPT   FCC   /STORAGE ENDS AT   $/
A38C 04                  FCB   4
                *
A100                     END   STORTM
```

the contents of storage memory, beginning at $0000, are output in ASCII to the terminal. Nothing is sent or received via the modem during this output, and you should think of the terminal as being off-line. Keyboard input, with the exception of one character, is also ignored.

At the conclusion of the dump, the starting and ending address of data in storage is displayed. These limits are useful if the data is to be saved to disk or tape. The SVTEXT command saves the text as a disk file. You may use conventional Kansas City Standard or other tape techniques, just as with any other program or data. Because you might not want to view a long dump, especially at 300 baud or less, type an escape character ($1B) to terminate the dump in progress and jump directly to the display of boundaries.

The TERM.$ program is shown assembled at $A100, below my DOS, in a convenient location of vacant memory. If this is not practical for you, you can place it within the first 32K block of memory, preferably on the high side of whatever memory you have. Change the high limit of storage, TOADDR, to protect the new location.

The SVTEXT Command

After you've gone on line with a CBBS and stored data in RAM, you now want to save what you've stored to disk. "Simple," I hear you say, "I'll just type SAVE, give it a name and use the dump boundaries as my starting and ending addresses."

Just one problem, bunky. The save command saves binary files, not text. If you try to save text, you will end up with all kinds of addressing information inserted indiscriminately therein. It takes hours to clean up, and you still will miss one or two. So the solution is the SVTEXT command, shown here.

The syntax of this command is identical to the save command, except, of course, for the absence of a transfer address, which is not executable, since the data being saved is text. So, if the dump delimiters are, for example, $0000 and $17B2, and the file to be created on disk drive 1 is CBBS.TXT, you would enter DOS by typing BREAK, and then typing:

SVTEXT,1:CBBS.TXT,0,17B2

After creation, the file may be examined with the view command, or

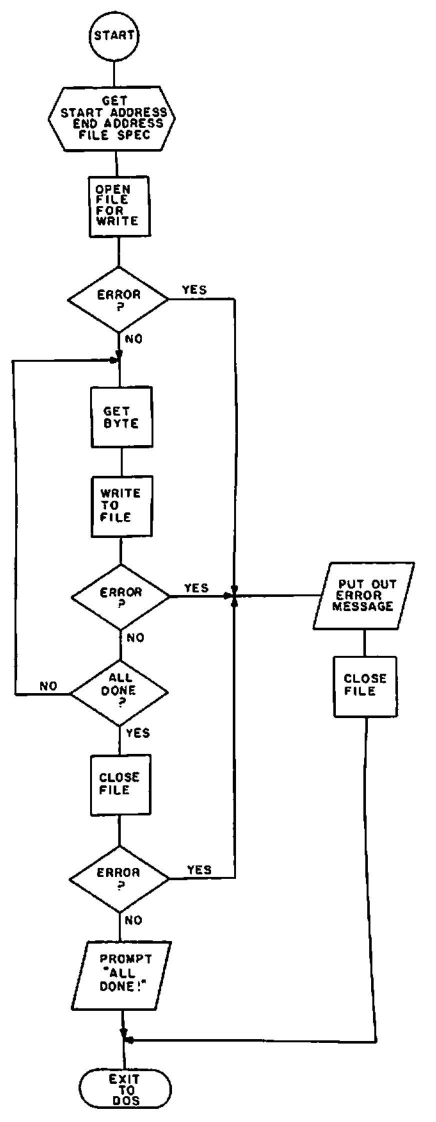

Fig. 2. Flowchart of SVTEXT.$.

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9511-cc-2m	9½x11" 2 part—Carbonless	750	30.70
9511-cc-3m	9½x11" 3 part—Carbonless	500	31.91
1411-15-1m	14⅞x11" 1 part—15# Stock	1500	29.50
1411-cc-2m	14⅞x11" 2 part—Carbonless	750	42.55
1411-cc-3m	14⅞x11" 3 part—Carbonless	500	45.40
1411-cc-4m	14⅞x11" 4 part—Carbonless	375	46.32
1411-20-1	14⅞x11" 1 part—20# Stock	2700	56.75
1285-18-1	12x8½" 1 part—18# Stock (Form is 11"x8½"—Torn Apart)	2900	48.28
33-1L	15/16x3½" 1-up Stock Labels	5000	20.00
33-2L	15/16x3½" 2-up Stock Labels	10000	35.00
33-3L	15/16x3½" 3-up Stock Labels	15000	48.00
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worked upon with the editor. If the format is proper, it could even serve as a BASIC data file or a BASIC program.

The SVTEXT program is diagrammed in Fig. 2. If you've never written a disk command you might find it frightening, but reading from or writing to a disk file is no more complicated than addressing an I/O device. What makes it so simple is the disk file management (DFM) routine in the DOS. After obtaining the unit number, file name and delimiters, the DFM allows one byte, placed in the A accumulator, to be written to the disk by calling the DFM as a subroutine. This is analogous to outputting the character through OUTEEE. Thus, the file created will be an exact image of what is in memory. ■

Storage terminal program in assembly language.

```
                  NAM   STORAGE TERMINAL PROGRAM
             * PROGRAM TO CONVERT GMXBUG-6800 SYSTEM
             * INTO A TERMINAL THAT STORES INPUT INTO
             * MEMORY - FOR LATER SAVE TO DISK
             *
             * VER 2.0 - 8 MAY 80
             *
             * MARC I. LEAVEY, M.D.
             *
                  OPT   NOG
                  OPT   NOS
             *
001B         ESC     EQU   $1B
000A         CRLF    EQU   $0D0A
3F11         OUTCHR  EQU   $3F11
3F12         TAPEIN  EQU   $3F12
3F13         TAPOUT  EQU   $3F13
3F14         PSTRNG  EQU   $3F14
3F16         PCRLF   EQU   $3F16
3F26         INKEY   EQU   $3F26
D283         ZWARMS  EQU   $D283
E0C8         OUT4HS  EQU   $E0C8
             *
A100                 ORG   $A100
A100 CE A1B4 STORTM  LDX   #PROMPT
A103 3F 14           FDB   PSTRNG
A105 3F 26   TERM    FDB   INKEY
A107 26 27           BNE   SNDCHR
A109 F6 8000 RCVCHR  LDA B $8000
A10C 54              LSR B
A10D 24 F6           BCC   TERM
A10F 3F 12           FDB   TAPEIN

A111 7D A1B3         TST   STRFLG
A114 27 16           BEQ   NOSAVE
A116 FE A1B1         LDX   ATADDR
A119 A7 00           STA A 0,X
A11B 08              INX
A11C FF A1B1         STX   ATADDR
A11F BC A1AF         CPX   TOADDR
A122 26 08           BNE   NOSAVE
A124 CE A30D         LDX   #FULPMT
A127 3F 14           FDB   PSTRNG
A129 7F A1B3         CLR   STRFLG
A12C 3F 11   NOSAVE  FDB   OUTCHR
A12E 20 D5           BRA   TERM
A130 81 06   SNDCHR  CMP A #$6
A132 2F 0B           BLE   COMAND
A134 3F 13           FDB   TAPOUT
A136 7D A1AC         TST   ECHOFG
A139 27 02           BEQ   SNDXIT
A13B 3F 11           FDB   OUTCHR
A13D 20 C6   SNDXIT  BRA   TERM
A13F 81 01   COMAND  CMP A #$01
A141 27 17           BEQ   START
A143 81 02           CMP A #$2
A145 27 18           BEQ   STOP
A147 81 03           CMP A #$3
A149 27 19           BEQ   CLEAR
A14B 81 04           CMP A #$4
A14D 27 1D           BEQ   DUMP
A14F 81 05           CMP A #$5

A151 27 4F           BEQ   ECHOON
A153 81 06           CMP A #$6
A155 27 50           BEQ   ECHOFF
A157 7E D283 EXIT    JMP   ZWARMS
A15A B7 A1B3 START   STA A STRFLG
A15D 20 A6           BRA   TERM
A15F 7F A1B3 STOP    CLR   STRFLG
A162 20 A1           BRA   TERM
A164 FE A1AD CLEAR   LDX   FMADDR
A167 FF A1B1         STX   ATADDR
A16A 20 99   ISLAND  BRA   TERM
A16C FE A1AD DUMP    LDX   FMADDR
A16F BC A1B1 DMPLUP  CPX   ATADDR
A172 27 0F           BEQ   DUNDMP
A174 A6 00           LDA A 0,X
A176 3F 11           FDB   OUTCHR
A178 3F 26           FDB   INKEY
A17A 27 04           BEQ   NOINTP
A17C 81 1B           CMP A #ESC
A17E 27 03           BEQ   DUNDMP
A180 08      NOINTP  INX
A181 20 EC           BRA   DMPLUP
A183 3F 16   DUNDMP  FDB   PCRLF
A185 CE A32B         LDX   #FMPMPT
A188 3F 14           FDB   PSTRNG
A18A CE A1AD         LDX   #FMADDR
```

More →

Listing continued

```
A18D BD E0C8            JSR   OUT4HS
A190 3F 16              FDB   PCRLF
A192 CE A33F            LDX   #TOPMPT
A195 3F 14              FDB   PSTRNG
A197 CE A1B1            LDX   #ATADDR
A19A BD E0C8            JSR   OUT4HS
A19D 3F 16              FDB   PCRLF
A19F 7E A105            JMP   TERM
A1A2 B7 A1AC    ECHOON  STA A ECHOFG
A1A5 20 C3              BRA   ISLAND
A1A7 7F A1AC    ECHOFF  CLR   ECHOFG
A1AA 20 BE              BRA   ISLAND
A1AC 00         ECHOFG  FCB   0
A1AD 00 00      FMADDR  FDB   $0000
A1AF 5F FF      TOADDR  FDB   $5FFF
A1B1 00 00      ATADDR  FDB   $0000
A1B3 00         STRFLG  FCB   $00
A1B4 0C         PROMPT  FCB   12
A1B5 47                 FCC   /GMXBUG - 6800 TERMINAL PROGRAM/
A1D3 0D 0A              FDB   CRLF
A1D5 20                 FCC   /   BY: MARC I. LEAVEY, M.D./
A1F0 0D 0A              FDB   CRLF
A1F2 0D 0A              FDB   CRLF
A1F4 43                 FCC   /COMMANDS:/
A1FD 0D 0A              FDB   CRLF
A1FF 43                 FCC   /CONTROL-A = START STORAGE OF REMOTE INPUT/
A228 0D 0A              FDB   CRLF
A22A 43                 FCC   /CONTROL-B = STOP STORAGE OF REMOTE INPUT/
A252 0D 0A              FDB   CRLF
A254 43                 FCC   /CONTROL-C = CLEAR STORAGE POINTERS/
A276 0D 0A              FDB   CRLF
A278 43                 FCC   /CONTROL-D = DUMP STORED DATA TO SCREEN/
A29E 0D 0A              FDB   CRLF
A2A0 43                 FCC   /CONTROL-E = ENABLE ECHO (HALF-DUPLEX)/
A2C5 0D 0A              FDB   CRLF
A2C7 43                 FCC   /CONTROL-F = DISABLE ECHO (FULL-DUPLEX)/
A2ED 0D 0A              FDB   CRLF
A2EF 4E                 FCC   /NULL OR BREAK = EXIT TO DOS/
A30A 0D 0A              FDB   CRLF
A30C 04                 FCB   4
A30D 0D 0A      FULPMT  FDB   CRLF
A30F 3E                 FCC   />> STORAGE MEMORY FULL <</
A328 0D 0A              FDB   CRLF
A32A 04                 FCB   4
A32B 53         FMPMPT  FCC   /STORAGE STARTS AT $/
A33E 04                 FCB   4
A33F 53         TOPMPT  FCC   /STORAGE ENDS AT   $/
A352 04                 FCB   4
                *
A100                    END   STORTM
```

Save text command.

```
                        NAM   SAVE TEXT COMMAND
                        OPT   NOS
                        OPT   NOG
                *
                * COMMAND TO STUFF CONTENTS OF MEMORY INTO
                * A SEQUENTIAL FILE ON DISK
                * COMMAND FORMAT: SVTEXT,<FILE SPEC>,<START ADDR>,<END ADDR>
                *
                * VER 1.00 - 24 APR 80
                * MARC I. LEAVEY, M.D.
                *
                * DOS EQUATES AND DFM CODES
CD80            TCA     EQU   $CD80
D283            ZWARMS  EQU   $D283
D291            ZFLSPC  EQU   $D291
D2A0            ZGETHN  EQU   $D2A0
D2A6            ZOUTST  EQU   $D2A6
D2A9            ZTYPDE  EQU   $D2A9
D783            CDFM    EQU   $D783
D786            DFM     EQU   $D786
0000            XFC     EQU   0
000C            XFT     EQU   12
0001            QSO4W   EQU   1
0002            QSWRIT  EQU   2
0003            QSWC    EQU   3
0001            FTCS    EQU   1
                *
CD80                    ORG   TCA
CD80 CE CDF8    SVTEXT  LDX   #FCB
CD83 BD D291            JSR   ZFLSPC
CD86 BD D2A0            JSR   ZGETHN
CD89 FF CDDF            STX   FMADDR
```

More →

Listing continued

```
CD8C BD D2A0              JSR   ZGETHN
CD8F FF CDE1              STX   TOADDR
CD92 CE CDF8              LDX   #FCB
CD95 86 01                LDA A #QSO4W
CD97 A7 00                STA A XFC,X
CD99 86 01                LDA A #FTCS
CD9B A7 0C                STA A XFT,X
CD9D BD D786              JSR   DFM
CDA0 26 1F                BNE   ERROR
CDA2 86 02      FILOPN    LDA A #QSWRIT
CDA4 A7 00                STA A XFC,X
CDA6 FE CDDF              LDX   FMADDR
CDA9 FF CDE3    FILLUP    STX   ATADDR
CDAC A6 00                LDA A 0,X
CDAE CE CDF8              LDX   #FCB
CDB1 BD D786              JSR   DFM
CDB4 26 0B                BNE   ERROR
CDB6 FE CDE3    OKSAVE    LDX   ATADDR
CDB9 BC CDE1              CPX   TOADDR
CDBC 27 0C                BEQ   DONE
CDBE 08                   INX
CDBF 20 E8                BRA   FILLUP
CDC1 BD D2A9    ERROR     JSR   ZTYPDE
CDC4 BD D783              JSR   CDFM
CDC7 7E D283              JMP   ZWARMS
CDCA CE CDF8    DONE      LDX   #FCB
CDCD 86 03                LDA A #OSWC
CDCF A7 00                STA A XFC,X
CDD1 BD D786              JSR   DFM
CDD4 26 EB                BNE   ERROR
CDD6 CE CDE5              LDX   #OKPMPT
CDD9 BD D2A6              JSR   ZOUTST
CDDC 7E D283              JMP   ZWARMS
CDDF            FMADDR    RMB   2
CDE1            TOADDR    RMB   2
CDE3            ATADDR    RMB   2
CDE5 44         OKPMPT    FCC   /DATA SAVED TO DISC/
CDF7 00                   FCB   0
CDF8            FCB       RMB   165
CD80                      END   SVTEXT
```

Sophisticated software to help you maximize rentals and minimize inventory.

Computerize Your Rent-All Store

By Charles W. Prather and Hawthorne A. Davis

We supply businesses with custom-programmed microcomputers. Through a local rental equipment company, we became aware of the need for a specialized package of programs to help manage rent-all businesses.

The company had seven store locations serving eastern North Carolina, and the combined inventory included thousands of equipment items. The firm wanted to maximize profit by controlling equipment distribution among the stores according to demand.

In addition, management wanted to determine the profitability of each rental item, to identify which ones should be added to or subtracted from the equipment pool. Profitability by store location would also help pinpoint where more local advertising effort was needed.

These and other objectives were met with the software package we developed which we call ARM-1000 (for Automated Rental Management).

Rental Equipment Business

The American Rental Association (ARA) has developed an equipment classification scheme in which categories of rental items are assigned a unique number. For example, ARA number 9104 identifies all motor-driven trenchers that dig a three-foot deep by six-inch wide trench. In addition, each trencher owned by the business carries its own separate inventory number so each specific one can be identified.

Rental companies also rent bulk equipment. Like the regular equipment, bulk equipment is identified by an ARA number, but the entire lot, rather than each piece, carries a single inventory number. Examples of this type of equipment are scaffolding and party glasses.

Standard printed contracts are executed for each rental showing equipment rented, dates and dollar amounts. These rental contracts become the data source to keep the entire system current.

Many rental firms consist of a headquarters store and a number of other stores in nearby towns and communities. Though ARM-1000 was originally written for a seven-store chain, it can easily accommodate more.

```
1—MAINTAIN, ADD TO AND UPDATE NUMBERED INVENTORY
2—MAINTAIN, ADD TO AND UPDATE BULK INVENTORY
3—MANAGE NUMBERED INVENTORY
4—MANAGE BULK INVENTORY
5—MAINTAIN VENDOR REFERENCE FILE
6—MAINTAIN ARA DESCRIPTION FILE
7—MAKE BACKUP COPY OF DATA DISK
8—FINISHED USING SYSTEM
WHICH ONE?
```

Sample 1. Master menu display.

Software Overview

We replaced the CCP (console command processor) of CP/M with our main menu program, so that whenever the reset button on the computer is pressed, the system comes up displaying the main function menu (Sample 1). To perform a function, you just type its number.

This main menu program also executes whenever any operating program ends and the system reboots. It can be disabled by pressing the escape key; then, access to any of the usual CP/M functions is possible. The menu drives seven principle programs, which do the major tasks of entering data, processing, generating reports and making backup copies of data and program diskettes.

Three utility programs were not included in this menu because they are used less frequently. They initialize the system, initialize new diskettes and locate errors in file contents. These hidden (nonmenu) programs are run by pressing the escape key and entering the program's name.

Following are the menu-driven programs and their functions:

MANAGE generates all the reports. This is the main rental management program, which locates, summarizes and presents data in selected ways for the standard and the bulk inventoried equipment items as described below.

FMAINT maintains the main inventory data file, allows data entry

Charles W. Prather and Hawthorne A. Davis, Southern Digital Systems, Inc., Suite 806-A, Vernon Park Mall, Kinston, NC 28501.

from rental contracts and automatically updates the financial and rental/repair history for each inventoried item each month. A separate but similar maintenance program is used for bulk inventoried equipment.

VENDOR builds and maintains a file of vendors and manufacturers.

ARAMAINT builds and maintains a file of ARA numbers and names. It also cross-correlates VENDOR.DAT and ARADESC.DAT files to rapidly find the favored vendor for any specified ARA number.

COPY allows automatic menu-directed copying of data and program diskettes. Verifies the diskette track by track.

Four data files are used, and they contain the following data:

INVENTORY.DAT, the main data file, contains 21 data fields describing item and vendor and maintaining rental income, repair and rate structure information. This file also contains a moving window record of the last 12 months' rentals and rental income for each item.

VENDOR.DAT contains the vendor's name, address and two telephone numbers.

ARADESC.DAT correlates the ARA number with a word description of the item and the favorite vendor. The ARADESC.DAT file cross-references each ARA number with a 50-character description string and a preferred vendor number. This file is also kept sorted according to ARA number and is binary-searched by the MANAGE program to give the word description of any item when its inventory number is entered.

The maintenance program for this file can locate a preferred vendor when the ARA number is entered in typically three seconds. This maintenance program also provides alphabetically and numerically sorted lists of those ARA items stocked.

INVIND.DAT correlates ARA number with inventory data file pointer. This index file is automatically kept sorted by the MANAGE program.

We selected Microsoft's Fortran-80 and 8080 assembly language over other popular microcomputer languages because their execution speed, especially for sorting and locating items, is considerably faster, and we judged the increased system performance would be well worth the extra programming work involved. Our judgment proved to be right; routinely sorting the INVIND.DAT data file containing 4000+ items requires only a few seconds, and locating a single item by ARA number requires less than half a second. The system response is practically instantaneous.

The key to fast system response is to maintain a sorted index of ARA numbers referenced to inventory numbers in RAM during program execution. Locating the correct inventory number after entering an ARA number is fast because only RAM is searched and no long disk reading is involved. The inventory number is arranged so that it is also a file pointer to the proper record in the INVTORY.DAT data file, allowing the disk to immediately find the record and read it.

Because the ARA index is maintained in RAM, about 7000 items can be on line at any one time. Rental businesses can manage groups of items separately (for example, homeowner and contractor equipment), so

PROFITABILITY REPORT
12 MONTHS ENDING 10/79
** LOCATION(S) SELECTED

ARA#	COP	ARA#	COP	ARA#	COP	ARA#	COP	ARA#	COP
1004/	0	1220/	0	1267/	0	1306/	0	1323/	0
2623/	0	3932/	0	3995/	0	4192/	0	4351/	0
4722/	0	4724/	0	5003/	0	5044/	0	5064/	0
5072/	0	5102/	0	5170/	0	5812/	0	5817/	0
5828/	0	6016/	0	6046/	0	7208/	0	7328/	0
7426/	0	7431/	0	7943/	0	8339/	0	8575/	0
8996/	0	9800/	0	3229/	44	4601/	56	1229/	61
5602/	63	3863/	66	8317/	67	7209/	103	1411/	107
8340/	114	8223/	117	7857/	121	4175/	144	6357/	149
6002/	155	8564/	156	1236/	157	3238/	159	6010/	170
7216/	200	8743/	200	1213/	203	3814/	208	3260/	230
3852/	252	6539/	267	1327/	278	3213/	279	6718/	296
3822/	304	6444/	308	6328/	328	4350/	333	1278/	342
4638/	345	1406/	351	4913/	353	6008/	358	7071/	358
7218/	366	3626/	372	3244/	380	4965/	392	9355/	397
3264/	401	8718/	401	384/	418	6044/	421	8634/	423
1203/	429	6590/	429	1251/	432	2700/	440	3202/	474
5664/	474	1260/	476	7240/	480	8307/	482	5144/	483
9054/	484	3236/	491	5066/	495	1408/	500	8900/	512
5831/	517	8137/	521	5146/	525	2012/	526	1218/	536
3217/	536	1007/	554	7858/	565	5184/	568	7845/	582
8524/	595	3259/	630	3319/	631	7419/	644	6446/	646
7432/	652	8635/	658	5024/	672	8978/	689	4923/	704
3032/	706	5136/	713	5147/	722	9324/	725	5142/	738
3230/	743	1225/	750	5000/	751	5157/	760	1212/	770
5114/	771	7464/	780	7423/	802	5143/	808	6837/	812
1404/	817	8544/	817	6320/	831	2656/	835	8901/	843
1277/	857	7888/	868	1252/	889	5042/	891	6348/	901
3721/	908	3239/	918	8640/	926	5130/	929	3232/	946
6552/	991	1264/	1000	3228/	1000	5148/	1009	4624/	1032
7440/	1055	4950/	1076	1718/	1084	1262/	1120	4939/	1129
1312/	1154	3275/	1154	5138/	1160	1324/	1169	3242/	1201
8338/	1221	1223/	1227	5026/	1261	8358/	1261	3954/	1270
8335/	1293	8514/	1325	7865/	1327	7104/	1355	5611/	1375
5169/	1380	8552/	1386	6333/	1407	2714/	1435	8574/	1457
8502/	1476	3280/	1477	5036/	1483	1006/	1487	6812/	1491
2240/	1500	1326/	1501	6811/	1575	5067/	1580	2612/	1595
9360/	1616	1414/	1622	1216/	1625	3955/	1716	6810/	1725
5052/	1772	4912/	1849	9004/	1873	5062/	1984	8344/	1989
5613/	2043	3712/	2057	6809/	2103	3998/	2172	4619/	2265
7485/	2344	5113/	2400	1358/	2577	7400/	2635	3025/	2710
1266/	2750	4914/	3017	3996/	4627	1261/	5882		

Sample 2. Profitability report by ARA category. COP stands for coefficient of performance and is ROI × 1000.

ARA# 9054

INV#	LOC	SINCE	CURRMO RENTS	$	12-MO RENTS	$	LAST:RTD	REP	COST
151	L2	11/79	0/	0	28/	392.	9/28/79	7/99	1118.23
152	L2	7/99	0/	0	3/	34.	10/29/79	7/99	15.00
158	L2	7/79	0/	0	2/	28.	7/15/79	7/99	54.25
163	L2	7/99	0/	0	23/	358.	9/ 7/79	7/99	54.25
164	L2	7/99	0/	0	13/	172.	2/ 4/79	7/99	90.65
575	L7	7/99	0/	0	0/	0.	7/ 4/70	7/99	70.00
576	L7	7/99	0/	0	0/	0.	7/ 4/70	7/99	70.00
577	L4	7/99	0/	0	0/	0.	7/ 4/70	7/99	70.00

Sample 3. Tweleve-month rental history for each specific item in ARA category #9054 for all store locations.

that each group could consist of over 7000 items, which is large enough to satisfy the requirements of most any rental store chain.

The INVENTORY.DAT file consists of unformatted records that are 104 bytes long. However, Microsoft's Fortran-80 requires fixed length records of 128 bytes. We did not want to waste this extra space on the diskettes, so we developed a special file handler for Fortran-80 which permitted using random file records of any length. The file handler is included with ARM-1000, but we are also marketing it separately.

Software Function

Initial data entry for all rental equipment items is time-consuming because of the number of items (typically 1000 per store location) and because 21 data fields are entered for each item. We streamlined the data entry process so that all 21 data fields can be entered in 45–60 seconds. Once the initial data has been entered, the system is easy to keep current because the rental dates and dollar values are entered directly from the rental contracts. New items are entered and obsolete items are dropped using the efficient file maintenance options on the master menu. Deleted inventory numbers are automatically reused when additional items would have exceeded the available disk storage capacity.

Output is obtained on the CRT display or on a printer. Reports are:

Profitability report—ARM-1000 computes percent return on investment (ROI) for each ARA equipment category (Sample 2). The heading COP stands for coefficient of performance and is equal to the ROI× 1000. The profitability report can be obtained for the items at any one store or at all stores combined. The reports are printed beginning with the least profitable and ending with the most profitable, making it easy to single out the group of least- and most-profitable items.

Performance reports by ARA number—Two performance reports can be produced for any ARA-numbered equipment category. The first is a report showing the detailed 12-month rental history for each specific inventory item in the selected ARA category. This report shows data for all store locations (Sample 3). The second summarizes the last 12-month rental activity for the selected ARA category for all store locations (Sample 4). These reports allow a direct item-by-item and store-by-store performance comparison.

Comprehensive report by inventory number—Upon entering any inventory number, a comprehensive report is displayed on the CRT showing descriptive information, recent performance, month-by-month performance over the past year, repair record and more for a specific piece of equipment (Sample 5).

Equipment transfers and rental rate changes—Reports are printed automatically whenever equipment items are moved from one store location to another or whenever the rental fees are changed on any item. These reports help remind employees that these important changes have occurred.

Inventory number and descriptions/

```
                     SUMMARY BY LOCATION
                     12 MONTHS AVERAGED
                         ARA#  9054

              CURRENT MONTH              PERIOD  CHOSEN
 LOC  NUM  RENTALS       INCOME          RENTALS       INCOME     COP

  L1    5   0/   0.0     0./     0.0   0/   0.0     0./      0.0 0.000

  L2    5   0/   0.0     0./     0.0  69/  13.8   984./    196.8  .739

  L4    1   0/   0.0     0./     0.0   0/   0.0     0./      0.0 0.000

  L5    2   0/   0.0     0./     0.0   0/   0.0     0./      0.0 0.000

  L7    2   0/   0.0     0./     0.0   0/   0.0     0./      0.0 0.000
```

Sample 4. Summary of 12-month rental history by ARA category for all locations.

```
                          INV#   15 DESCRIPTIVE
                          ---------------------
   ARA DESCRIPTION: BED 3/3 SINGLE ROLLAWAY
   MODEL# 1231                   SERIAL# 0                ARA#   4624
   MANUFACTURER LEGGET AND PRATT
   VENDOR LEGGET AND PRATT
                                      HISTORY
                                      -------
   PURCHASED  2/76             COST     64.75         IN SERVICE  7/76
   LOCATION L2                 SINCE  7/76
   LIFE-DATE:    20 RENTALS    173.00 INCOME    0 REPAIRS      0.00 REP-COST

                                 RECENT RECORD
                                 -------------
   RATE STRUCTURE:  750 MIN    0 HR     0 DAY    7.50 WK     22.00 MO
   THIS MONTH:     0 RENTALS      0 INCOME

        11/78 12/78  1/79  2/79  3/79  4/79  5/79  6/79  7/79  8/79  9/79 10/79
 RENTALS    0     0    10     0     0     0     0     0     0     0     0     0
 INCOME     0     0    82     0     0     0     0     0     0     0     0     0
   LAST: RENTED  7/17/99             REPAIRED  7/99 PAUSE "RET"
```

Sample 5. Comprehensive report by inventory number.

ACTIVE ARA CODES, DESCRIPTIONS AND
PREFERRED VENDOR CODES

ARA	DESCRIPTION	VEN	REC
1406	BABY CRIB REGULAR	0	3
1411	BABY PLAY PENS MESH TYPE	0	5
1414	BABY STROLLERS	0	6
1408	BABY HIGH CHAIRS	0	4
1404	BABY CRIB PORTA-CRIB TYPE	0	2
4624	BED 3/3 SINGLE ROLLAWAY	0	14
7208	BICYCLE EXERCISE STANDARD	0	15
7209	BICYCLE ACTION BIKE	0	16
8223	CHAIRS ITEM NOT IN BOOK	0	20
9367	COLOR TV SET 15.5 INCH	120	24
7888	COT PLASTIC METAL	0	19
3230	FLOOR POLISHER 13 TO 15 INCH DIAM	92	8
3213	FLOOR MACHINE 13 INCH POLISHER	92	7
1225	I DON'T KNOW	4	9
9347	NOT LISTED	0	22
3319	REFRIGERATOR SMALL SIZE	0	13
7218	ROLLER MASSAGE	0	17
8344	SANDER BELT 3 IN W/VAC	0	21
9360	TV SET 16 INCH B/W	120	23
3260	VACUUM SMALL 3 GAL	0	11
3259	VACUUM 6 GAL	0	10
3264	VACUUM UPRIGHT	0	12
7240	VIBRATORS BELT STANDING	0	18

Table 1. Inventory number, description and vendors.

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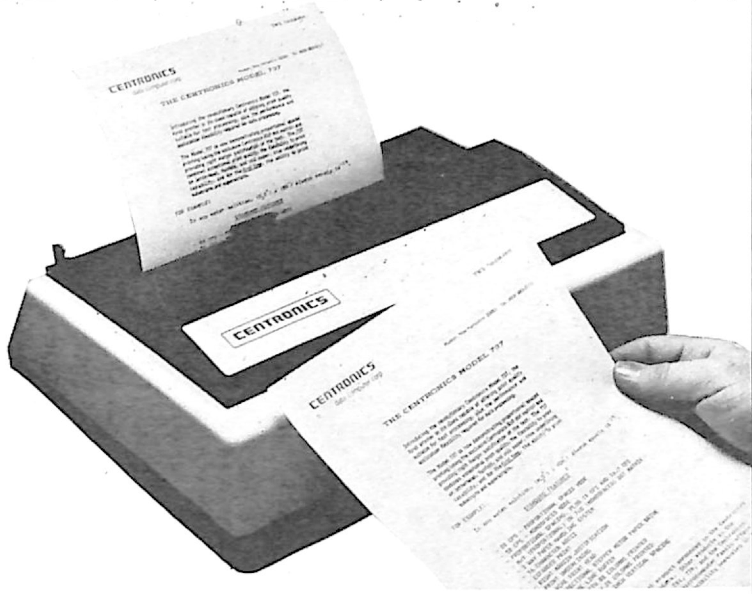

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11	ALAN MFG. CO.
184	ALDRIAGE POWER CO
4	ALL MAKES MACHINE CO.
161	ALLISON AND ERWIN CO
243	ALLIS
223	AME
7	AMERICAN HARDWARE&EQUIPMENT CO
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15	BERGER INSTRUMENTS
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264	BILCO INDUSTRIES
213	BINKS
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16	BLUE BIRD INTERNATIONAL
17	BOSCH(ROBERT CORP)
159	BROOKS SERVICE CO
160	BROOKS AND BROOKS LIMITED
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18	BURGESS, INC
21	BURLINGTON COMPRESSOR SERVICE, INC
211	BURTON IND/SAA
94	C A NASH & SON CO
200	CAL-VAN

Table 2. Alphabetical vendor list with file numbers.

vendors—Equipment items, along with their associated ARA numbers, are listed and referenced to the preferred vendor (Table 1). This list can be sorted both alphabetically and numerically by ARA number.

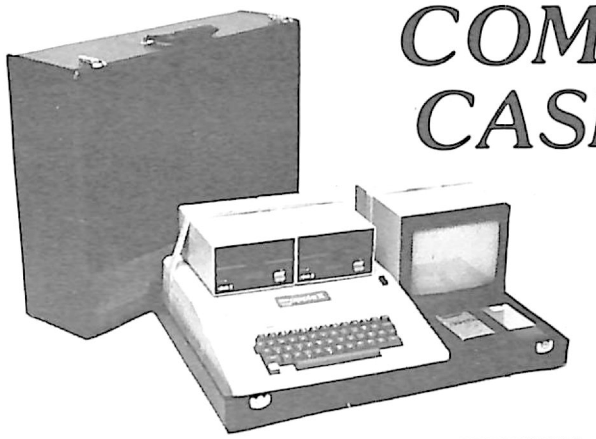
Vendor list—Vendors are listed alphabetically along with their associated file numbers (Table 2).

Hardware Requirements

Hardware is typical; nothing special is required. Diskettes are eight-inch single or double density, soft sectored. Because of the size and complexity of the programs and the data stored in memory during program execution, 64K RAM is required. If the single density format is used, three eight-inch disk drives are needed, but with double density two drives are adequate.

Our specific hardware configuration included a Tarbell disk interface, a TEI 3p+3s I/O Board (one printer and one CRT port), a TEI 8080 CPU, Central Data Corp. 64K Dynamic RAM, Shugart or Siemens eight-inch disk drives, a Soroc IQ-120 terminal and a serial or parallel printer.■

COMP CASE



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- AP103M Apple, 9 inch Monitor and Double Drive 129
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- P402 Line Printer II-Centronics 730 89
- CC90 Matching Attache Case 75

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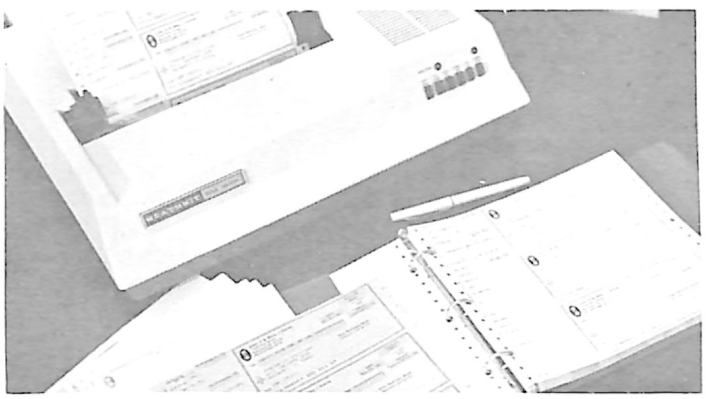

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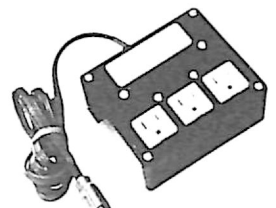

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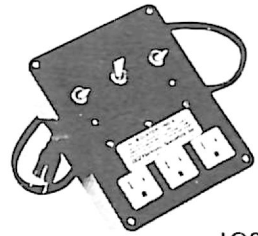
ISO-1A	-3 individually filtered sockets	$ 56.95
ISO-4	-6 individually filtered sockets	96.95
ISO-2	-2 filtered banks; 6 sockets	56.95
ISO-5	-3 flitered banks; 9 sockets	79.95



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Part 2 of this music synthesis article explores the computation of data for waveform tables and describes an experimental KIM-based synthesis system.

Simulation of Musical Instruments

By Hal Chamberlin

In Part 1 we devised a method of synthesizing multiple tones with any waveform desired. The question now becomes, "How do you determine what samples to put into a waveform table?"

Perhaps the simplest method is to draw one cycle of the waveform on graph paper and then laboriously read off 256 sample values and enter them into the table. The drawn shape could come from an oscilloscope photo of a musical instrument sound or from imagination. The drawn shape must span exactly 256 grid lines in exactly one cycle to be valid. You could also make use of a light pen or graphic digitizer in conjunction with a drawing program to do the same thing with much less effort.

The biggest problem when using imagination is that there is no simple relation between the appearance of the drawn shape and the resulting timbre. Thus, if a particular shape produces a sound that is close to what is desired, there is no way to know what must be changed to make it sound even closer.

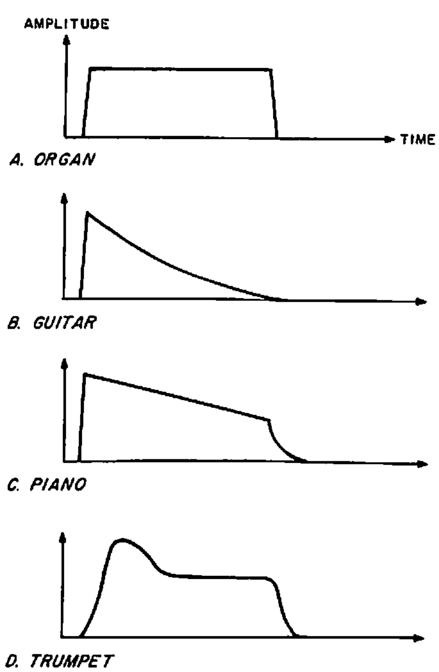

Fig. 1. Typical instrument amplitude envelopes.

Filling the Waveform Tables

Probably the best way to fill waveform tables is to write a program that accepts harmonic specifications, computes the corresponding waveshape and automatically enters it into memory. There is a very definite correlation between the harmonic makeup of a tone and its timbre. You can also occasionally find published harmonic analyses of musical instrument tones, particularly organ pipes.

Listing 1 shows a very simple BASIC program that can be used to create waveform table data and poke it directly into memory. The statements starting at line 3000 first amplitude-normalize the waveform, convert the samples into integer form in the range of 0 to 63 (to avoid overflow when four are added up) and then poke them into memory.

The biggest advantage of using harmonics to specify waveforms is that alias distortion can be readily avoided. Alias distortion occurs whenever any frequency component of a waveform exceeds one-half of the sampling frequency. This can easily happen with high notes using waveforms rich in harmonics.

For example, if you attempt to play high C (523 Hz) using a waveform with ten significant harmonics through an 8 kHz sample rate system, the eighth, ninth and tenth harmonics will alias, since they will be 4184, 4707 and 5230 Hz, respectively, all above four kHz. Aliasing means that intended frequencies are altered and usually produces an objectionably harsh sound. Thus, waveform tables used to play high notes should have their upper harmonics restricted, while those for low notes may have dozens of significant harmonics if desired.

Musical Instrument Synthesis

After some experimentation with different waveforms and types of music, you will discover that a wide variety of tone colors is possible, but the tones always sound like an organ. Of course, the organ is the most versatile of conventional musical instruments, but digital synthesis should be able to do better. One of the reasons for an organ-like sound is that only continuous, sustained tones can be generated by simple waveform table scanning. In other words, the amplitude envelope is rectangular, as shown in Fig. 1a. Many instruments have other shapes, such as those in Figs. 1b, 1c and 1d.

The standard method of adding an amplitude envelope to a sound is to pass it through a variable-gain amplifier and vary the gain in accordance with the desired envelope shape. In digital synthesis this is equivalent to multiplying the samples representing the sound by an amplitude factor that changes as the note progresses. The

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```
1000 REM WAVEFORM TABLE FILL PROGRAM
1001 REM ENTER HARMONIC NUMBER FOLLOWED BY RELATIVE AMPLITUDE
1002 REM HARMONIC NUMBER=0 FILLS THE TABLE AND EXITS
1010 DIM W(256): Z=6.283185/256
2000 FOR I=0 TO 255: W(I)=0: NEXT I
2010 PRINT "ENTER HARMONIC NUMBER ";: INPUT N
2020 IF N=0 GOTO 3000
2030 PRINT "ENTER RELATIVE AMPLITUDE ";: INPUT A
2040 FOR I=0 TO 255: W(I)=W(I)+A*SIN(N*I*Z): NEXT I
2050 GOTO 2010
3000 M=0
3010 FOR I=0 TO 255
3020 IF ABS(W(I))>M THEN M=ABS(W(I))
3030 NEXT I
3040 PRINT "ENTER ADDRESS OF WAVEFORM TABLE ";: INPUT A
3050 FOR I=0 TO 255
3060 POKE A+I,INT(31.5*W(I)/M+32)
3070 NEXT I
9999 STOP
```

Listing 1. Waveform Table Fill program in BASIC.

series of amplitude factors could come from an envelope table that is scanned just like the waveform table but much more slowly.

Adding overall envelope control certainly improves the variety of sounds available and is frequently enough to give reasonable simulations of common musical instruments. However, rather than spending a lot of time explaining how overall envelope control can be added to a table-scanning digital synthesis system (which mainly involves methods for eliminating time-consuming multiplication), let's go all the way and include timbre envelopes as well.

To some extent the sound of all instruments changes its waveform during the course of a note. Consider, for example, the "waaahhh" of a muted trombone or the "twaanng" of a guitar. The change in character of the sound during the notes is what makes these instrument sounds so distinctive. In terms of synthesizing these and similar sounds, it is the harmonic composition, as well as the overall amplitude, of the waveform that changes gradually.

The standard method of adding a timbre envelope to a sound is to pass it through a variable filter and vary the cutoff or center frequency and Q factor in accordance with the desired effect. In digital synthesis you have to use a digital filter, which involves several multiplications per sound sample. This is just not practical in a real-time microcomputer-based system, so some other method must be found. But first we need a way to visualize timbre envelopes so that they can be specified.

Fig. 2a shows a simplified decaying waveform of a plucked string. The overall amplitude envelope is quite similar to that of Fig. 1b, but the waveform itself also changes shape.

At the very beginning, the second harmonic is actually stronger than the fundamental. The second harmonic is responsible for the crook in the waveform near the baseline. However, as the waveform decays, the second harmonic decays faster than the fundamental and thus the crook gradually disappears. Eventually, the second harmonic fades out completely, leaving just a decaying sine wave. This is reasonable behavior for a plucked string because high-frequency vibrations encounter greater losses in strings than low-frequency ones do.

Fig. 2b shows one way of representing this behavior in meaningful terms. The solid line shows the amplitude envelope of the fundamental, while the dotted line shows the envelope of the second harmonic. We can find out the harmonic composition of the tone at any point in time by erecting a vertical scale at that point and reading off the amplitude of each harmonic as shown. The same idea will work for any number of harmonics.

Now, how can we modify the tone generator routine described last month for varying waveforms? The secret is to arrange for the waveform table address bytes, which are normally constant, to change while the table scanning is taking place. Thus, while the tone is sounding, the synthesis program is actually switching through a sequence of waveform tables. If the switching is fairly rapid and the contrast between adjacent waveform tables is small, the audible effect is that of a smooth transition. The idea is not unlike that of a sequence of image frames giving the illusion of smooth motion in a movie.

Fig. 3a illustrates this concept by showing the resulting stair-step approximation to the smooth harmonic envelopes in Fig. 2b. In this example only eight waveform tables are used; in a practical situation it is common to use between 15 and 30 of them. Fig. 3b shows the resulting waveform, which even for this coarse example bears a remarkable resemblance to the ideal case in Fig. 2a.

In the actual implementation of waveform table switching, the concept of a waveform sequence table is introduced. The waveform sequence table is nothing more than a table of waveform table addresses. This extra level of indirection is very little problem in a microprocessor such as the 6502, and it has many benefits.

While a note is sounding, a pointer scans through the sequence table at uniform speed just as the waveform pointer scans through the waveform table, but more slowly. In the program implementation, the time

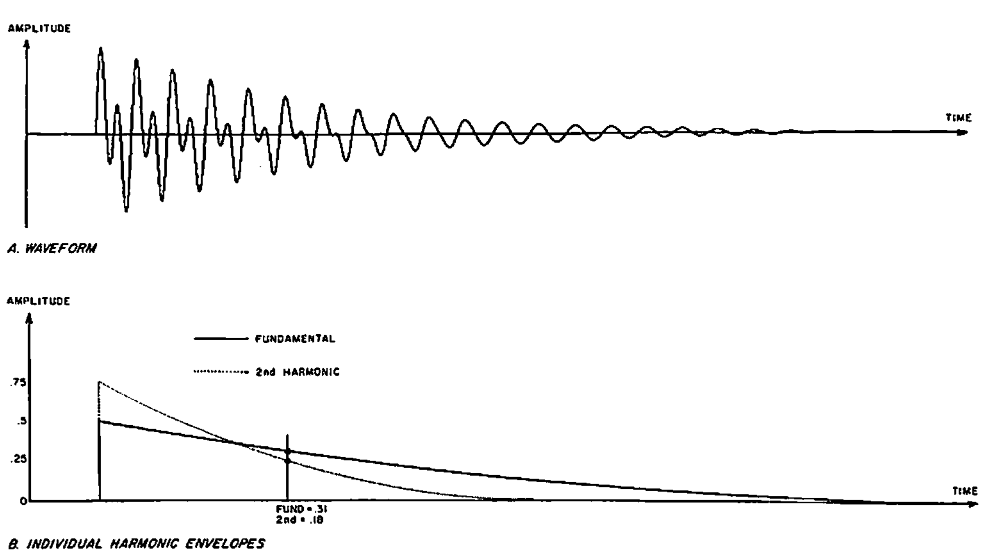

Fig. 2. Simplified characteristics of a plucked string.

```
031E 650E           ADC   V2IN
0320 8503           STA   V2PT
0322 A504           LDA   V2PT+1
0324 650F           ADC   V2IN+1
0326 8504           STA   V2PT+1
0328 A506           LDA   V3PT      ; VOICE 3
032A 6510           ADC   V3IN
032C 8506           STA   V3PT
032E A507           LDA   V3PT+1
0330 6511           ADC   V3IN+1
0332 8507           STA   V3PT+1
0334 A509           LDA   V4PT      ; VOICE 4
0336 6512           ADC   V4IN
0338 8509           STA   V4PT
033A A50A           LDA   V4PT+1
033C 6513           ADC   V4IN+1
033E 850A           STA   V4PT+1
0340 CA             DEX             ; DECREMENT & CHECK TEMPO COUNT
0341 D008           BNE   TIMWAS    ; BRANCH TO TIME WASTE IF NOT RUN OUT
0343 C614           DEC   DUR       ; DECREMENT & CHECK DURATION COUNTER
0345 F00C           BEQ   ENDNOT    ; JUMP OUT IF END OF NOTE
0347 A615           LDX   TEMPO     ; RESTORE TEMPO COUNT
0349 D0B9           BNE   PLAY1     ; CONTINUE PLAYING
034B D000  TIMWAS:  BNE   .+2       ; 3  WASTE 12 STATES
034D D000           BNE   .+2       ; 3
034F D000           BNE   .+2       ; 3
0351 D0B1           BNE   PLAY1     ; 3  CONTINUE PLAYING
0353 60    ENDNOT:  RTS             ; RETURN
                                    ; TOTAL LOOP TIME = 115 STATES = 8695 HZ
```

Remainder of core sound-generation routine from Part 1.

equalization instructions are replaced with instructions to move four pointers through their respective waveform sequence tables at a rate of one increment each time register X (TEMPO) times out.

One advantage of using a sequence table is that waveform switching can be rapid when there is rapid change in the harmonic envelopes and less rapid at other times, thus cutting down on the number of waveforms needed and memory usage. Another advantage is that waveforms do not have to be stored in memory in the order that they are used. This allows such tricks as playing through the attack sequence backwards for the decay sequence to save on memory.

Another trick is to cycle through a few waveforms during the sustain of a note to impart a sort of warble effect on notes. A strumming effect can also be created in this manner. You can even construct several sequence tables for the same set of waveforms to take care of differences in duration and articulation from note to note.

The results of adding waveform table sequencing to the earlier synthesis routine, which was done primarily by Frank Covitz, are astounding. Attempts at simulating plucked string sounds result in a real plucked sound, and you can easily tell the difference between a plucked string and a struck string (not possible without timbre envelopes). Blown instruments sound blown, and bowed instruments sound bowed. You can even get reasonably nice-sounding bells, even though true bell tones are decidedly inharmonic and therefore cannot be duplicated by simple waveform table scanning.

Many of the instrument definitions (sets of harmonic envelopes) that have been experimented with are based on computer analyses of musical instruments published in the *Computer Music Journal* by James A. Moorer (see references).

One particularly successful instrument simulation done by Cliff Ashcraft has been a piano. To cover the wide range of the piano, it is necessary to define several instruments, one for each octave. This is because the quality of piano sound varies in different pitch ranges due to differences in string construction and the fact that the sounding board has a finite mass. Music played with his piano definitions is amazingly realistic, just like a real piano in the next room. Consult the references for a full description of the system.

This article is not primarily concerned with simulating existing musical instruments with a microcomputer. The real interest, and future of computer music synthesis, is in dreaming up entirely new instrumental sounds and composing scores that complement them.

Tone color as a musical variable is just as important as pitch and rhythm and may become more so, since pitch and rhythm composition has been experimented with for centuries, whereas timbre composition has only recently been possible. Convincing simulation of existing musical instruments is an important milestone because most conventional musical instruments produce very complex sounds. Doing a good job on them implies the capability to begin exploring timbre space without a lot of restrictions.

Delayed-Playback Digital Synthesis

While you can do amazing things with real-time software digital synthesis on a microcomputer, the compromises, shortcuts and relatively low sample rates necessary leave something to be desired in the area of fidelity. The faster microprocessors that are beginning to appear (both higher clock frequency standard units and the new 16-bit units) will certainly improve the capability of real-time software synthesis. A 6502 running at 3 MHz, for example (which is currently available), could produce eight voices at a 12 kHz sample rate

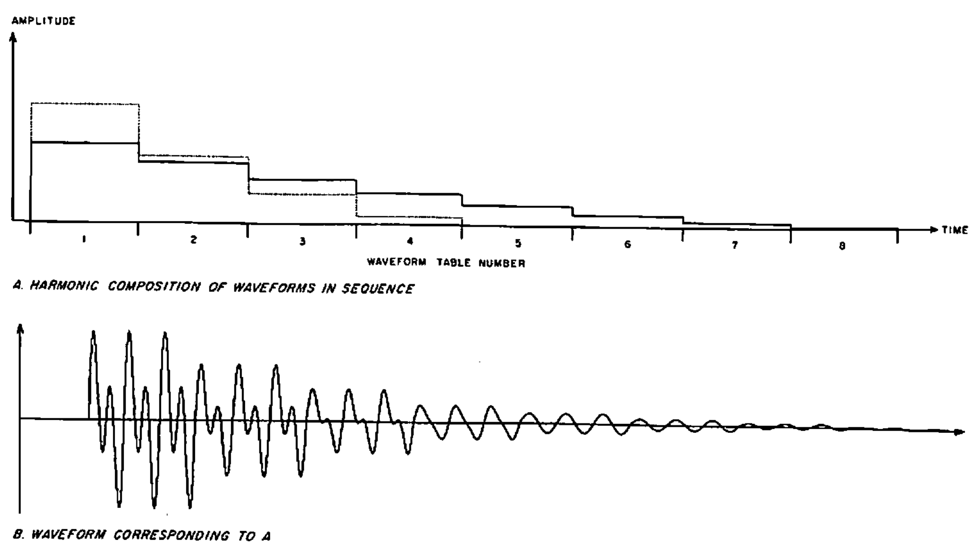

Fig. 3. Example synthesis of a plucked string.

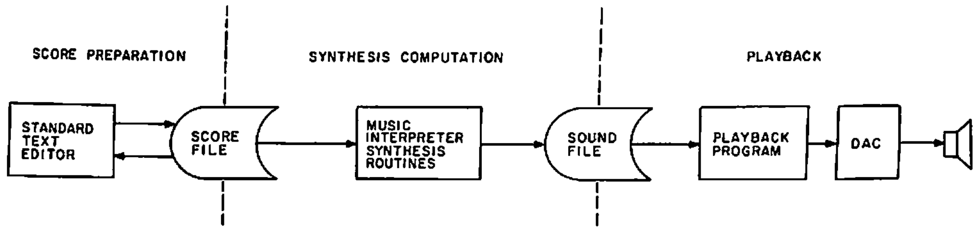

Fig. 4. Delayed-playback software synthesis system.

for fidelity similar to good AM radio reception. However, there are still a number of musical features missing which are needed for a truly versatile system for interest to the majority of musicians and listeners.

For example, bending notes (gradually changing their pitch), true vibrato, percussion instrument synthesis and singing voice synthesis are all needed to penetrate the contemporary music idiom (perhaps this is why Bach is so often performed with computers). With delayed playback, any or all of the compromises may be eliminated, the sample rate and DAC accuracy may be increased to true hi-fi levels, and any desired musical feature that can be defined can be implemented.

Fig. 4 shows a block diagram of a delayed-playback software synthesis system as it might be implemented on a microcomputer. Playing a musical selection is actually a three-step process.

In the first step a machine-readable score is entered or edited from a previous run. Typically, the score file on disk is just a standard ASCII text file, so a standard text editing program is sufficient. In advanced systems other methods of score entry, such as graphical input with a light pen, joystick or digitizer or even direct input from a music keyboard, are possible. In any case, the result of the first step is an integrated score and instrument definition file on disk.

In the second step, a music interpreter program, which also contains all of the synthesis routines, reads the score file, carries out the indicated synthesis operations and writes a sound file on disk. While the majority of your work is spent creating and editing the score file, the vast majority of machine work is spent computing the sound file.

Computing a minute of final sound may take anywhere from five minutes to whatever CPU time you can tolerate, depending on the sample rate, number of simultaneous voices playing and the sophistication of the synthesis techniques. Most of this time is spent in arithmetic subroutines, so a microprocessor with automatic multiply (such as the 6809, 9900 and all of the new 16-bit units) is a distinct advantage.

In the playback step, a highly specialized program reads the sound file from disk and sends the sound samples to the DAC at a uniform rate. When high-resolution DACs (ten bits or more) are used, the uniformity of sample rate becomes critical to minimize jitter distortion. In order to achieve such uniformity while the program is also handling data readback from the sound file, the DAC must generally be equipped with its own sample clock and at least one level of data buffering.

A Delayed-Playback System

I implemented an experimental delayed-playback software digital synthesis system and demonstrated it at the PC '80 computer show in Philadelphia this fall. It runs on the 6502-based KIM-1 microcomputer equipped with 16K of RAM and a Micro Technology Unlimited (MTU) disk controller, which adds another 16K. Two Siemens eight-inch floppy disk drives are used, and the double-density capability of the MTU controller is utilized.

An experimental 12-bit digital-to-analog converter with an additional three bits of gain control is used to get a theoretical dynamic range equivalent to a 16-bit DAC. The gain control is not yet utilized by the software, however. An important feature of the experimental DAC is a 256 sample first-in-first-out buffer which allows the sample stream from the computer to be interrupted for milliseconds at a time without affecting the smooth flow of data to the DAC itself.

When floppy disks are used to hold the sound file, the disk format is an important determinant of the maximum playback data rate. While the normal CODOS disk operating system software (which is used to prepare the score file) uses the standard

IBM disk format of 26 sectors of 256 bytes each, the total diskette capacity is only about 512K bytes.

A different format consisting of 16 sectors of 512 bytes is used for the sound file and gives 630K bytes per disk, a 23 percent increase in potential data rate and capacity. In order to read through the sound file at high speed, it is mandatory to be able to read all of the sectors on a track in one revolution of the disk. In addition, you must be able to step to the next track without waiting for a whole revolution before reading again. Staggering the sector numbers by three on adjacent tracks is utilized to accomplish this. The resulting sustained average data rate from the disk can approach 40K bytes per second.

The actual playback program currently uses a 20 kHz sample rate with 12-bit samples for a total data rate of 30K bytes per second. At this data rate, an eight-inch diskette holds about 21 seconds of sound. Going to double-sided disks would double the capacity to 42 seconds. Minidisks have about half the capacity, but more important, only half the maximum data rate.

The synthesis and computation phase of a performance is relatively straightforward on the experimental system. The score file is read from drive 0 using CODOS, and the sound file records are written onto drive 1 using a set of specialized disk driver routines. When a sound disk is filled up, the synthesis program waits for a new disk to be inserted into drive 1.

When the playback program is called in, CODOS is disabled and the operator is expected to put the first sound disk in drive 0 and the second one in drive 1. When playback starts, the first 21 seconds of sound are read from drive 0 and then an immediate, inaudible switchover to drive 1 is performed. During the next 21 seconds, the operator must remove sound disk 1 from drive 0 and insert disk 3 to be read when disk 2 is exhausted. You can switch back and forth like this indefinitely for music of any duration; the performance at the PC '80 show required 23 disks for eight minutes of sound.

The problem in using this system is not the disk jockeying required during playback but the changing of disks during computation. With the music selected for performance, a new disk was required about every 15 to 30 minutes, which means that the computation cannot be left to run

✓Reader Service—see page 194

overnight with any degree of benefit. Clearly, a 10 megabyte hard disk would be advantageous here.

The experimental delayed synthesis program does about the same things as the real-time synthesis program mentioned earlier. The major differences are an essentially unlimited number of voices, interpolation between waveform table entries and interpolation between adjacent waveform tables in the sequence rather than sudden switching. It won't be considered complete until the musical features described previously are implemented.

The Future

While these developments may seem exciting now, the future is likely to see many more exciting things happen in the field of music synthesis on microcomputers. The sophisticated programmable synthesizer boards will undoubtedly become more sophisticated and gradually come down in price. Today's square-wave synthesizer chips will probably be supplemented by programmable waveform synthesizer chips that use direct memory access to automatically scan waveform tables in memory.

The most exciting prospects are in the software synthesis area, however. The processors used in personal systems will gradually get faster at the machine-language level, which will increase the capability and fidelity of real-time software synthesis. Even a simple step up to 16 bits, which is inevitable, will nearly double the speed of the core sound routine, giving both more voices and a higher frequency range. Because of the very low cost of including a DAC in the circuitry of a computer, most future systems will probably contain built-in DACs.

On the delayed-playback front, experimental systems such as the one just described will reach full development and make it possible to produce significant music of commercial value with microcomputers. Even the very general and powerful MUSIC-11 system (truly the ultimate in sound synthesis flexibility) has already been implemented on the LSI-11 microcomputer (used in the Heath H11 and Terak systems), and it is only a matter of time before it is available for the more common microcomputers. The decreasing cost and increasing capacity of small hard disks will also make using a delayed-playback type of system much more convenient and increase the fidelity even further. ■

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5. Chamberlin, Hal, *Musical Applications of Microprocessors*, Hayden Book Co., Rochelle Park, NJ.

The two real-time digital synthesis programs described in this article, along with the necessary digital-to-analog converter, may be obtained from Micro Technology Unlimited, Box 12106, Raleigh, NC 27605.

Simplify operator effort and save disk space, too.

A Print Utility for CP/M

By Ken Barbier

If only I had a dollar for every time I have entered
PIP LST: = FILENAME.PRN
and gotten a garbage printout of an assembly-language program listing because I forgot to include [T8] on the end of the command line!

The peripheral interchange program (PIP) supplied with the CP/M operating system can perform a host of functions, including formatting of output to a line printer, but it insists that you tell it to expand the tabs. Forget the [T8], and your listing will be all jammed together. And I *always* forget.

In addition to amnesia, I also suffer from laziness. Every unnecessary keystroke on a computer terminal is an insult to humanity (I dare you to ask me what I think of Pascal). Since I can't remember all the magic words required by PIP, I wrote the Print program shown in Listing 1.

Operating Print

Now when I want a printout of a file named (in this example) FILENAME.PRN, I simply have to enter
PRINT FILENAME
and out comes a listing, with tabs expanded to eight spaces, and with form feeds for each page and for the end of the listing.

Lacking one of the exotic word processors, I often use the ED program of CP/M to write letters, notes, operating instructions, product data sheets and similar examples of short texts. I usually need more than one copy of such items and use a PRINT command to produce multiple copies (up to 255). Simply enter
PRINT FILENAME 5
and out come five copies of FILENAME.PRN. If the file to be printed has a file type other than PRN, it can be specified in the usual manner:
PRINT FILENAME.TYP
where .TYP agrees with the file type specification in the disk directory.

Print Program Features

The program is most useful on a single disk drive CP/M system but is fully compatible with multi-drive systems. When loaded, the program will pause and prompt the operator to place the read disk in the drive. This lets you print a file that is not on the same disk as the PRINT.COM file.

Ken Barbier, Borrego Engineering, PO Box 1253, Borrego Springs, CA 92004.

Listing 1. Assembly-language Print program.

```
                  ************************************************
                  *                                              *
                  *     A PRINT UTILITY FOR CP/M    6 MARCH 80   *
                  *                                              *
                  ************************************************

                  ; THIS PROGRAM PERMITS THE SIMPLE ENTRY OF "PRINT FILENAME N"
                  ; TO PRODUCE N COPIES OF THE NAMED .PRN FILE.  IF N IS NOT
                  ; SPECIFIED. IT DEFAULTS TO 1.
                  ; OTHER FILE TYPES MAY BE SPECIFIED IF DESIRED.  TABS ARE
                  ; EXPANDED TO 8 SPACES. AND A FORM FEED IS OUTPUT EACH 60 LINES
                  ; AND AT THE END OF THE FILE.

                  *  CP/M BDOS ADDRESSES

0000 =            RBOOT   EQU     0              ; RE-BOOT CP/M
0005 =            BDOS    EQU     5              ; BDOS CALL ENTRY
005C =            FCB     EQU     5CH            ; DEFAULT FILE CONTROL BLOCK
007C =            FCBN    EQU     FCB+32         ; RECORD COUNT
0065 =            TYPE    EQU     FCB+9          ; FILE TYPE
006D =            QTY     EQU     FCB+17         ; NUMBER OF COPIES
0080 =            INBUF   EQU     80H            ; DEFAULT DMA ADDRESS

                  *  CP/M BDOS FUNCTIONS

0001 =            READF   EQU      1             ; READ CONSOLE INTO (A)
0002 =            TYPEF   EQU      2             ; WRITE CONSOLE FROM (E)
0005 =            LISTF   EQU      5             ; WRITE LIST DEVICE FROM (E)
000B =            INTRF   EQU     11             ; TEST CONSOLE INTERRUPT
```

After printing is complete, the program again pauses, allowing another swap of disks before reloading the CP/M operating system. These pauses make life with a single disk drive system a little easier, but can be patched out of the program if not needed.

The minimum size of any file on a CP/M system is 1K bytes, and PRINT fits easily within 1K. This lets you include operator prompts and error messages that are fully spelled out and easily understood.

For example, if a read checksum error is encountered when the file to be printed is being loaded into the computer memory, the program displays

READ ERROR! ENTER X TO ABORT
CR TO IGNORE _

and pauses, giving you the option of entering "X" to return to the operating system or entering a carriage return to ignore the error and print the data as read.

Other types of errors which are not recoverable are also flagged on the console, and a pause lets you swap disks before returning to the operating system.

If the file to be printed is larger than the available memory in the computer, it will be read into memory and printed in segments. Multiple copies are still possible with large files, since the file is rewound at the end of each printout.

All disk operations and I/O are handled through the CP/M standard BDOS call, which is vectored through a jump instruction at memory location 5, so the program as listed should be compatible with any version of CP/M.

Add a Program and Gain 5K

In "CP/M for Single-Drive Systems" (*Kilobaud Microcomputing*, September 1980, p. 94), I listed a Filecopy program for use on single disk drive CP/M systems. With such a system—typically consisting of a computer, one terminal, one printer and a single disk drive—there is little need for most of the features provided by PIP. Adding Filecopy and Print to your systems disk can eliminate the need for PIP, which takes up 7K bytes of disk space. Each of the new programs fits in 1K, so erasing PIP results in a net gain of 5K bytes. On a single-density minifloppy system, this provides an increase of more than 10 percent in the available user workspace! ■

Listing 1 continued.

```
000F =              OPEN    EQU     15              ; OPEN FILE
0011 =              FIND    EQU     17              ; FIND FILE IN DIRECTORY
0014 =              READ    EQU     20              ; READ FILE

                    * CONTROL CHARACTERS AND CODES

007F =              RUB     EQU     7FH             ; RUBOUT CHARACTER
001A =              EOF     EQU     1AH             ; END OF FILE IN BUFFER
0009 =              TAB     EQU      9              ; TAB CHARACTER
000C =              FFEED   EQU     0CH             ; FORM FEED CHARACTER

0100                        ORG     0100H           ; TPA PROGRAM START ADDRESS

0100 C30C02                 JMP     START           ; GO TO PROGRAM START

                    *  CONSOLE I/O THROUGH BDOS CALL

0103 E5             CI      PUSH    H               ; SAVE REGISTERS
0104 D5                     PUSH    D
0105 C5                     PUSH    B
0106 0E01                   MVI     C.READF         ; READ FUNCTION
0108 CD0500                 CALL    BDOS            ; RETURN CHAR IN <A>
010B C1                     POP     B               ; RESTORE OTHER REGISTERS
010C D1                     POP     D
010D E1                     POP     H
010E C9                     RET

010F E5             CO      PUSH    H
0110 D5                     PUSH    D
0111 C5                     PUSH    B
0112 5F                     MOV     E.A             ; PRINT CHAR TO <E>
0113 0E02                   MVI     C.TYPEF
0115 CD0500                 CALL    BDOS
0118 C1                     POP     B
0119 D1                     POP     D
011A E1                     POP     H
011B C9                     RET

011C E5             LO      PUSH    H
011D D5                     PUSH    D
011E C5                     PUSH    B
011F 5F                     MOV     E.A
0120 0E05                   MVI     C.LISTF
0122 CD0500                 CALL    BDOS
0125 0E0B                   MVI     C.INTRF         ; LOOK FOR OPERATOR
0127 CD0500                 CALL    BDOS            ; INTERRUPT
012A E601                   ANI     1               ; IN LS BIT
012C CA3701                 JZ      LOX
012F CD0301                 CALL    CI              ; IS IT A RUBOUT?
0132 FE7F                   CPI     RUB
0134 CAE801                 JZ      EXIT            ; YES. QUIT
0137 C1             LOX     POP     B
0138 D1                     POP     D
0139 E1                     POP     H
013A C9                     RET

013B 3E0D           CCRLF   MVI     A.0DH           ; CR LF TO CONSOLE
013D CD0F01                 CALL    CO
0140 3E0A                   MVI     A.0AH
0142 C30F01                 JMP     CO

0145 3E0D           LCRLF   MVI     A.0DH           ; CR LF TO LIST DEVICE
0147 CD1C01                 CALL    LO
014A 3E0A                   MVI     A.0AH
014C C31C01                 JMP     LO

014F E1             MSGXP   POP     H               ; OUTPUT MESSAGE AND RETURN
0150 7E             MSGX1   MOV     A.M             ;  THROUGH <H.L>
0151 FE00                   CPI     0               ; TEXT TERMINATOR = 0
0153 CA5D01                 JZ      MSGEX
0156 CD0F01                 CALL    CO
0159 23                     INX     H
015A C35001                 JMP     MSGX1
015D 23             MSGEX   INX     H               ; POINT TO TEXT + 1
015E E9                     PCHL                    ; AND RETURN THERE

                    * PRINT UTILITY CONSOLE MESSAGE SUBROUTINES

015F CD3B01         RDMSG   CALL    CCRLF           ; PROMPT FOR READ DISC
0162 CD4F01                 CALL    MSGXP
0165 5245414420             DB      'READ DISC IN DRIVE. THEN CR '
0181 00                     DB      0
0182 CD0301         RDMS1   CALL    CI              ; GET RESPONSE
0185 FE58                   CPI     'X'             ; ALLOW EXIT
0187 CA0000                 JZ      RBOOT           ;  BACK TO CP/M
018A FE0D                   CPI     0DH             ; ACCEPT CR ONLY
018C C28201                 JNZ     RDMS1
018F CD3B01                 CALL    CCRLF           ; ACKNOWLEDGE
0192 C9                     RET                     ; AND RETURN

0193 CD3B01         RDERR   CALL    CCRLF           ; SHOW READ ERROR
0196 CD4F01                 CALL    MSGXP
0199 5245414420             DB      'READ ERROR!  ENTER X TO ABORT '
01B7 0D0A                   DB      0DH.0AH
01B9 2020202020             DB      '                CR TO IGNORE '
01D9 00                     DB      0
01DA CD0301         RDER1   CALL    CI              ; ACCEPT CR OR X
01DD FE58                   CPI     'X'
01DF CAE801                 JZ      EXIT
01E2 FE0D                   CPI     0DH
01E4 C8                     RZ                      ; RETURN MEANS IGNORE
01E5 C3DA01                 JMP     RDER1           ;  READ ERROR

01E8 CD4F01         EXIT    CALL    MSGXP
```

More

Listing 1 continued.

```
01EB 0D0A                 DB     0DH,0AH
01ED 4241434B20           DB     'BACK TO CP/M?
01FB 00                   DB     0
01FC CD0301      EXIT1    CALL   CI              ; WAIT FOR CR OR X
01FF FE0D                 CPI    0DH
0201 CA0000               JZ     RBOOT
0204 FE58                 CPI    'X'
0206 CA0000               JZ     RBOOT
0209 C2FC01               JNZ    EXIT1           ; AS ONLY LEGAL RESPONSE

020C AF          START    XRA    A               ; CLEAR CONTINUATION AND
020D 32DA03               STA    CONTD           ;  RELOAD FLAGS
0210 32DB03               STA    RELOD
0213 3C                   INR    A               ; DEFAULT PRINT QTY = 1
0214 32DC03               STA    COUNT
0217 216500               LXI    H,TYPE          ; SET FILE TYPE TO .PRN
021A 7E                   MOV    A,M             ;  IF NOT SPECIFIED
021B FE20                 CPI    ' '
021D C22802               JNZ    STAR1
0220 3650                 MVI    M,'P'
0222 23                   INX    H
0223 3652                 MVI    M,'R'
0225 23                   INX    H
0226 364E                 MVI    M,'N'
0228 216D00      STAR1    LXI    H,QTY           ; GET PRINT QUANTITY
022B 7E                   MOV    A,M             ;  IF ANY
022C FE20                 CPI    ' '
022E CA5802               JZ     PRNIN           ; ELSE CONTINUE
0231 D630                 SUI    30H             ; STRIP ASCII
0233 32DC03               STA    COUNT           ; AND SAVE QUANTITY
0236 23                   INX    H
0237 7E                   MOV    A,M             ; ANOTHER DIGIT?
0238 FE20                 CPI    ' '
023A CA5802               JZ     PRNIN           ; NO, CONTINUE
023D CDCB03               CALL   MULTI           ; YES, COUNT * 10 > (C)
0240 7E                   MOV    A,M             ; ADD NEW LS DIGIT
0241 D630                 SUI    30H
0243 81                   ADD    C
0244 32DC03               STA    COUNT           ; FOR TOTAL
0247 23                   INX    H
0248 7E                   MOV    A,M             ; GET LAST DIGIT
0249 FE20                 CPI    ' '             ;  IF ANY
024B CA5802               JZ     PRNIN
024E CDCB03               CALL   MULTI
0251 7E                   MOV    A,M
0252 D630                 SUI    30H
0254 81                   ADD    C
0255 32DC03               STA    COUNT

                 * INPUT THE PRINT FILE

0258 CD3B01      PRNIN    CALL   CCRLF           ; SIGN ON MESSAGE
025B CD4F01               CALL   MSGXP
025E 43502F4D20           DB     'CP/M PRINT UTILITY  V80.0  6 MAR 80'
0281 0D0A                 DB     0DH,0AH
0283 00                   DB     0
0284 CD5F01               CALL   RDMSG           ; PROMPT FOR READ DISC
0287 115C00               LXI    D,FCB           ; LOOK FOR FILE
028A 0E11                 MVI    C,FIND          ;  BEFORE GOING AHEAD
028C CD0500               CALL   BDOS
028F FEFF                 CPI    255             ; DOES FILE EXIST?
0291 C2B302               JNZ    PRNI1           ; YES, READ IT
0294 CD3B01               CALL   CCRLF           ; NO, GIVE UP
0297 CD4F01               CALL   MSGXP
029A 46494C4520           DB     'FILE DOES NOT EXIST!
02AF 00                   DB     0
02B0 C3E801               JMP    EXIT
02B3 210000      PRNI1    LXI    H,0             ; ZERO LINE AND
02B6 22D803               SHLD   DSAVE           ;  CHAR COUNTERS
02B9 21DD03               LXI    H,BUFFR         ; INITIALIZE POINTER
02BC 22D603               SHLD   HSAVE           ;  INTO BUFFER
02BF 115C00               LXI    D,FCB           ; USE FILE CONTROL BLOCK
02C2 0E0F                 MVI    C,OPEN          ;  AND OPEN THE FILE
02C4 CD0500               CALL   BDOS
02C7 FEFF                 CPI    255             ; ERROR?
02C9 C2E802               JNZ    PRNI2
02CC CD3B01               CALL   CCRLF           ; YES, SHOW IT
02CF 554E41424C           DB     'UNABLE TO OPEN FILE! '
02E4 00                   DB     0
02E5 C3E801               JMP    EXIT            ; AND ABORT
02E8 115C00      PRNI2    LXI    D,FCB           ; READ A RECORD
02EB 0E14                 MVI    C,READ
02ED CD0500               CALL   BDOS
02F0 FE00                 CPI    0               ; GOOD READ?
02F2 CAFD02               JZ     PRNI3           ;  YES, STORE IT
02F5 FE01                 CPI    1               ; OR END OF FILE?
02F7 CA2303               JZ     RDEND           ; YES
02FA CD9301               CALL   RDERR           ; NO, SHOW ERROR
02FD 2AD603      PRNI3    LHLD   HSAVE           ; STORE THE RECORD
0300 118000               LXI    D,INBUF
0303 0E80                 MVI    C,80H
0305 1A          PRNI4    LDAX   D
0306 77                   MOV    M,A
0307 23                   INX    H
0308 13                   INX    D
0309 0D                   DCR    C
030A C20503               JNZ    PRNI4
030D 22D603               SHLD   HSAVE           ; AND NEXT ADDRESS
0310 3A0700               LDA    7               ; ANY MEMORY LEFT?
0313 3D                   DCR    A
0314 BC                   CMP    H
0315 C2E802               JNZ    PRNI2           ; YES, KEEP READING
0318 AF                   XRA    A               ; NO, SET FLAGS
0319 2F                   CMA
```

More

Listing 1 continued.

```
031A 32DA03            STA     CONTD          ;  AND
031D 32DB03            STA     RELOD
0320 C32A03            JMP     RDEN1          ;   PRINT PARTIAL FILE

0323 AF        RDEND   XRA     A              ; CLEAR CONTINUED
0324 32DA03            STA     CONTD          ;  FLAG
0327 327C00            STA     FCBN           ; REWIND THE FILE
032A 2AD603    RDEN1   LHLD    HSAVE          ; FLAG END OF FILE
032D 361A              MVI     M,EOF

               * PRINT THE FILE

032F 2AD803    PRNOU   LHLD    DSAVE          ; (E) = POSITION ON LINE
0332 EB                XCHG                   ; (D) = LINE COUNT ON PAGE
0333 21DD03            LXI     H,BUFFR        ; OUTPUT THE BUFFER
0336 7E        PRNO1   MOV     A,M            ; GET A CHARACTER
0337 23                INX     H              ; AND POINT TO NEXT
0338 FE1A              CPI     EOF            ; ALL DONE?
033A CA6703            JZ      PRNEX
033D FE0A              CPI     0AH            ; IGNORE LINE FEEDS
033F CA3603            JZ      PRNO1
0342 FE0D              CPI     0DH            ; CARRIAGE RETURN?
0344 CA5803            JZ      NXTLN
0347 FE09              CPI     TAB            ; TAB CHARACTER?
0349 CAAF03            JZ      TABBR          ; YES, SKIP AHEAD
034C FE1F              CPI     1FH            ; NON-PRINTING?
034E DA5203            JC      PRNO2          ; YES, DONT COUNT IT
0351 1C                INR     E              ; NO, COUNT
0352 CD1C01    PRNO2   CALL    LO             ; WRITE THE CHARAACTER
0355 C33603            JMP     PRNO1

0358 CD4501    NXTLN   CALL    LCRLF          ; CR AND LF
035B 1E00              MVI     E,0            ; ZERO CHAR COUNTER
035D 14                INR     D              ; COUNT LINE
035E 7A                MOV     A,D            ; TO END OF PAGE
035F FE3C              CPI     60
0361 CCC303            CZ      FORMO          ; THEN FORM FEED
0364 C33603            JMP     PRNO1          ; AND CONTINUE

0367 EB        PRNEX   XCHG                   ; SAVE COUNTERS
0368 22D803            SHLD    DSAVE
036B 3ADA03            LDA     CONTD          ; FILE CONTINUED?
036E B7                ORA     A
036F CA7B03            JZ      PRNE1          ; NO, COUNT IT
0372 21DD03            LXI     H,BUFFR        ; YES, READ MORE
0375 22D603            SHLD    HSAVE
0378 C3E802            JMP     PRNI2
037B 3E0C      PRNE1   MVI     A,FFEED        ; FEED OUT LAST PAGE
037D CD1C01            CALL    LO
0380 210000            LXI     H,0            ;  AND ZERO COUNTERS
0383 22D803            SHLD    DSAVE
0386 3ADC03            LDA     COUNT          ; COUNT THIS PRINTOUT
0389 3D                DCR     A
038A 32DC03            STA     COUNT
038D C2A103            JNZ     PRNE2          ; AND DO MORE TIL
0390 CD4F01            CALL    MSGXP          ; ALL DONE
0393 414C4C2044        DB      'ALL DONE! '
039D 00                DB      0
039E C3E801            JMP     EXIT
03A1 3ADB03    PRNE2   LDA     RELOD          ; HAVE TO RELOAD FILE?
03A4 B7                ORA     A
03A5 CA2F03            JZ      PRNOU          ; NO, PRINT IT AS IS
03A8 AF                XRA     A              ; YES, CLEAR THE FLAG
03A9 32DB03            STA     RELOD
03AC C3B302            JMP     PRNI1          ; AND RE-OPEN THE FILE

03AF 7B        TABBR   MOV     A,E            ; GET POSITION
03B0 E607              ANI     07             ; MASK 3 LS BITS
03B2 4F                MOV     C,A            ; FOR TAB SPACING
03B3 79        TABB1   MOV     A,C            ; DONE?
03B4 E608              ANI     8
03B6 C23603            JNZ     PRNO1          ; YES, NEXT CHARACTER
03B9 3E20              MVI     A,' '
03BB CD1C01            CALL    LO             ; NO, OUTPUT A SPACE
03BE 1C                INR     E              ; COUNT IT
03BF 0C                INR     C
03C0 C3B303            JMP     TABB1          ; AND LOOP

03C3 3E0C      FORMO   MVI     A,FFEED        ; OUTPUT A FORM FEED
03C5 CD1C01            CALL    LO
03C8 1600              MVI     D,0            ; ZERO LINE COUNT
03CA C9                RET

03CB 3ADC03    MULTI   LDA     COUNT          ; COUNT TIMES TEN
03CE 4F                MOV     C,A
03CF 07                RLC
03D0 07                RLC
03D1 07                RLC
03D2 81                ADD     C
03D3 81                ADD     C
03D4 4F                MOV     C,A            ; INTO (C)
03D5 C9                RET

               * RAM BUFFERS

03D6           HSAVE   DS      2              ; BUFFER ADDRESS STORE
03D8           DSAVE   DS      2              ; COUNTERS STORE
03DA           CONTD   DS      1              ; CONTINUED FLAG
03DB           RELOD   DS      1              ; RELOAD FILE FLAG
03DC           COUNT   DS      1              ; NUMBER TO PRINT
03DD           BUFFR   DS      1              ; START OF RAM BUFFER

03DE                   END
```

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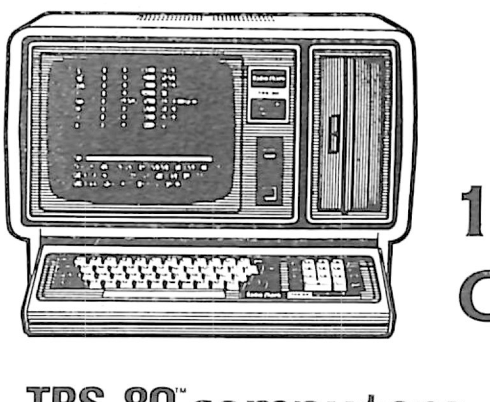

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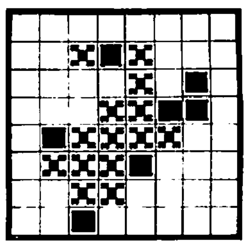

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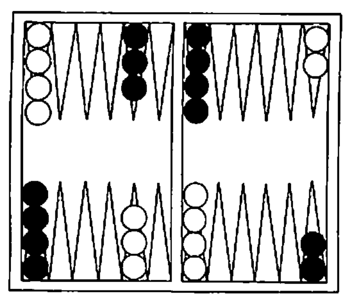

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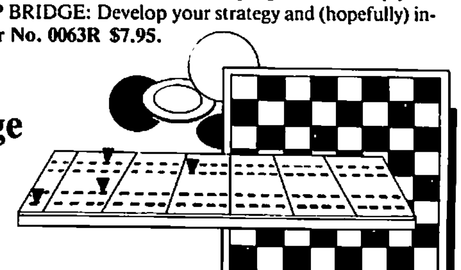

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Apple**

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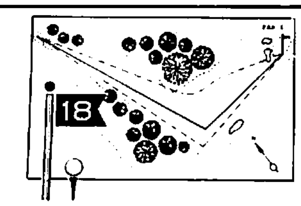

GOLF—Without leaving the comfort of your living room you can enjoy a challenging 18 holes of golf with a complete choice of clubs and shooting angles. Now, you need never cancel your game because of rain. One or two players can enjoy this game on your Apple II with Applesoft and 32K. **Order No. 0018A $7.95**

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Load and save machine-language programs with consummate ease.

Autoloader Program For the C1P and Superboard II

By David W. Kammer

As an owner of OSI's Superboard II, I eventually became tired of writing programs in BASIC and started machine-language programming with the ROM monitor.

The documentation carefully explains how to program from the keyboard and mentions how to load machine language from cassette directly to memory. However, it doesn't say how to generate machine-language tapes in the first place. This program lets you produce self-loading tapes that will load a machine-language program anywhere in memory.

The program is in 6502 machine language and is located in the highest memory of an 8K machine. It uses many of the subroutines in the ROM monitor and BASIC.

To use the program, type in the machine-language program that you want to save anywhere in RAM memory except between \$00F0–\$0220 and \$1EC0–\$1FFF. The program must end with the three illegal op codes 93 93 93 as an end flag. Put the monitor in the address mode, enter the address of the autoloader program (1EC0) and type G. Then type in the hexadecimal address of the program to be saved after the prompt.

Put the cassette recorder in record mode and touch the space bar. The address will be updated on the screen as the program is recorded, and the computer will jump to the monitor in the address mode when finished. The first program you should put on tape is the autoloader program itself.

To load a machine-language program from tape, go to the monitor in the address mode, start the cassette recorder in playback and type L. You don't need to type in the address of the program; the monitor will automatically load the program starting at the correct address. When the program is finished loading, the computer is back to keyboard control, but in the data mode. To run the program, type a period (.), the entry address of the program and G.■

David W. Kammer, Department of Physics, Albion College, Albion, MI 49224.

Autoloader program in machine language.

```
         MACHINE
ADDRESS  CODE       LABEL     MNE   OPERAND     COMMENT

1ECØ                * = $1ECØ
1ECØ                ADR = $FE
1ECØ                STP = $FØ

1ECØ     A9 ØØ      START     LDA   #Ø          INITIALIZE STOP FLAG
1EC2     85 FØ                STA   STP
1EC4     A9 65                LDA   #$65        INITIALIZE CURSOR POSITION
1EC6     8D ØØ Ø2             STA   $Ø2ØØ
1EC9     A2 ØD                LDX   #13         PRINT OUT "CASSETTE WRITE"
1ECB     BD CE 1F   LOAD1     LDA   TEXT1,X
1ECE     2Ø 2D BF             JSR   $BF2D
1ED1     CA                   DEX
1ED2     1Ø F7                BPL   LOAD1
1ED4     A9 ØD                LDA   #$ØD        CR AND LF
1ED6     2Ø 2D BF             JSR   $BF2D
1ED9     A9 ØA                LDA   #$ØA
1EDB     2Ø 2D BF             JSR   $BF2D
1EDE     A2 Ø7                LDX   #7          PRINT OUT "PGM ADD?"
1EEØ     BD DC 1F   LOAD2     LDA   TEXT2,X
1EE3     2Ø 2D BF             JSR   $BF2D
1EE6     CA                   DEX
1EE7     1Ø F7                BPL   LOAD2
1EE9     2Ø BØ 1F             JSR   KEYB        GET STARTING ADDRESS FROM KEYBOARD, DISPLAY
1EEC     ØA                   ASL   A           IT, CONVERT TO HEX AND STORE IN $FF AND $FE
1EED     ØA                   ASL   A
1EEE     ØA                   ASL   A
1EEF     ØA                   ASL   A
1EFØ     85 FF                STA   ADR+1
1EF2     2Ø BØ 1F             JSR   KEYB
1EF5     18                   CLC
1EF6     65 FF                ADC   ADR+1
1EF8     85 FF                STA   ADR+1
1EFA     2Ø BØ 1F             JSR   KEYB
1EFD     ØA                   ASL   A
1EFE     ØA                   ASL   A
1EFF     ØA                   ASL   A
1FØØ     ØA                   ASL   A
1FØ1     85 FE                STA   ADR
1FØ3     2Ø BØ 1F             JSR   KEYB
1FØ6     18                   CLC
1FØ7     65 FE                ADC   ADR
1FØ9     85 FE                STA   ADR
1FØB     2Ø AC FE             JSR   $FEAC       DISPLAY STARTING ADDRESS
1FØE     A9 ØD                LDA   #$ØD        CR AND LF
1F1Ø     2Ø 2D BF             JSR   $BF2D
```

More

Listing continued

```
1F13   A9 ØA              LDA   #$ØA
1F15   2Ø 2D BF           JSR   $BF2D
1F18   A2 1Ø              LDX   #16          PRINT OUT "TO LOAD HIT SPACE"
1F1A   BD E4 1F   LOAD3   LDA   TEXT3,X
1F1D   2Ø 2D BF           JSR   $BF2D
1F2Ø   CA                 DEX
1F21   1Ø F7              BPL   LOAD3
1F23   2Ø ØØ FD   SPC     JSR   $FDØØ        WAIT FOR SPACE KEYBOARD ENTRY
1F26   C9 2Ø              CMP   #$2Ø
1F28   DØ F9              BNE   SPC
1F2A   A9 2E              LDA   #$2E         "." TO CASSETTE (ADDRESS MODE)
1F2C   2Ø B1 FC           JSR   $FCB1
1F2F   A5 FF              LDA   ADR+1        STARTING ADDRESS TO CASSETTE
1F31   2Ø BF 1F           JSR   HXAH
1F34   2Ø B1 FC           JSR   $FCB1
1F37   A5 FF              LDA   ADR+1
1F39   2Ø C3 1F           JSR   HXAL
1F3C   2Ø B1 FC           JSR   $FCB1
1F3F   A5 FE              LDA   ADR
1F41   2Ø BF 1F           JSR   HXAH
1F44   2Ø B1 FC           JSR   $FCB1
1F47   A5 FE              LDA   ADR
1F49   2Ø C3 1F           JSR   HXAL
1F4C   2Ø B1 FC           JSR   $FCB1
1F4F   A9 2F              LDA   #$2F         "/" TO CASSETTE (DATA MODE)
1F51   2Ø B1 FC           JSR   $FCB1
1F54   2Ø AC FE   PGMD    JSR   $FEAC        DISPLAY CURRENT ADDRESS
1F57   AØ ØØ              LDY   #Ø
1F59   B1 FE              LDA   (ADR),Y      LOAD PROGRAM BYTE
1F5B   C9 93              CMP   #$93         STOP CHARACTER?
1F5D   DØ Ø4              BNE   HERE2        NO, INITIALIZE STOP FLAG
1F5F   E6 FØ              INC   STP          YES, INCREMENT STOP FLAG
1F61   DØ Ø4              BNE   HERE3
1F63   A2 ØØ      HERE2   LDX   #Ø
1F65   86 FØ              STX   STP
1F67   2Ø BF 1F   HERE3   JSR   HXAH         CONVERT TO ASCII
1F6A   2Ø B1 FC           JSR   $FCB1        DUMP HIGH NIBBLE TO CASSETTE
1F6D   B1 FE              LDA   (ADR),Y
1F6F   2Ø C3 1F           JSR   HXAL         CONVERT TO ASCII
1F72   2Ø B1 FC           JSR   $FCB1        DUMP LOW NIBBLE TO CASSETTE
1F75   A9 ØD              LDA   #$ØD         CR TO CASSETTE
1F77   2Ø B1 FC           JSR   $FCB1
1F7A   A6 FØ              LDX   STP          END OF PROGRAM?
1F7C   EØ Ø3              CPX   #3
1F7E   FØ Ø9              BEQ   END          YES, EXIT
1F8Ø   E6 FE              INC   ADR          INCREMENT PROGRAM ADDRESS
1F82   DØ DØ              BNE   PGMD         AND GET NEXT BYTE
1F84   E6 FF              INC   ADR+1
1F86   4C 54 1F           JMP   PGMD
                ; CHANGE TO KEYBOARD CONTROL
1F89   A9 2E      END     LDA   #$2E         "." TO CASSETTE
1F8B   2Ø B1 FC           JSR   $FCB1
1F8E   A2 Ø3              LDX   #3           OUTPUT ADDRESS $ØØFB TO CASSETTE
1F9Ø   BD F5 1F   HERE4   LDA   TEXT4,X
1F93   2Ø B1 FC           JSR   $FCB1
1F96   CA                 DEX
1F97   1Ø F7              BPL   HERE4
1F99   A9 2F              LDA   #$2F         "/" TO CASSETTE
1F9B   2Ø B1 FC           JSR   $FCB1
1F9E   A9 3Ø              LDA   #$3Ø         ASCII Ø TO CASSETTE
1FAØ   2Ø B1 FC           JSR   $FCB1
1FA3   A9 3Ø              LDA   #$3Ø         ASCII Ø TO CASSETTE
1FA5   2Ø B1 FC           JSR   $FCB1
1FA8   A9 ØD              LDA   #$ØD         CR TO CASSETTE
1FAA   2Ø B1 FC           JSR   $FCB1
1FAD   4C 43 FE           JMP   $FE43        JUMP TO MONITOR
                ; KEYBOARD INPUT SUBROUTINE
1FBØ   2Ø ØØ FD   KEYE    JSR   $FDØØ        INPUT CHARACTER FROM KEYBOARD
1FB3   2Ø 2D BF           JSR   $BF2D        DISPLAY IT
1FB6   2Ø 93 FE           JSR   $FE93        CONVERT TO HEX
1FB9   1Ø Ø3              BPL   RETN         LEGAL CHARACTER?
1FBB   4C CØ 1E           JMP   START        NO, TRY AGAIN
1FBE   6Ø         RETN    RTS
              ; HEX TO ASCII SUBROUTINE
1FBF   4A         HXAH    LSR   A            SHIFT TO RIGHT 4 TIMES
1FCØ   4A                 LSR   A
1FC1   4A                 LSR   A
1FC2   4A                 LSR   A
1FC3   29 ØF      HXAL    AND   #$ØF         CONVERT TO ASCII
1FC5   C9 ØA              CMP   #1Ø
1FC7   9Ø Ø2              BCC   ASCZ
1FC9   69 Ø6              ADC   # 'A - '9 - 2
1FCB   69 3Ø      ASCZ    ADC   # 'Ø
1FCD   6Ø                 RTS
           ; TEXT DATA
1FCE   45         TEXT1   .BYTE 'ETTESSAC ETIRW'
1FCF   54
1FDØ   54
1FD1   45
1FD2   53
1FD3   53
1FD4   41
1FD5   43
1FD6   2Ø
1FD7   45
1FD8   54
1FD9   49
1FDA   52
1FDB   57
1FDC   3F         TEXT2   .BYTE '?DDA MGP'
1FDD   44
```

More

Listing continued

```
1FDE   44
1FDF   41
1FE0   20
1FE1   4D
1FE2   47
1FE3   50
1FE4   45        TEXT3     .BYTE 'ECAPS TIH DAOL OT'
1FE5   43
1FE6   41
1FE7   50
1FE8   53
1FE9   20
1FEA   54
1FEB   49
1FEC   48
1FED   20
1FEE   44
1FEF   41
1FF0   4F
1FF1   4C
1FF2   20
1FF3   4F
1FF4   54
1FF5   42        TEXT4     .BYTE 'BF00'
1FF6   46
1FF7   30
1FF8   30
1FF9   93                  ;             STOP FLAGS
1FFA   93
1FFB   93
```

C1P ROM subroutines and locations.

$BF2D	Prints character in accumulator (A register) to screen offset by cursor. The cursor position is in $0200. This subroutine also processes a CR ($0D) and LF($0A) and increments the cursor positon after every print to screen.
$FEAC	Takes address stored in $FE (low) and $FF (high) and displays on screen.
$FD00	Returns ASCII character from keyboard in accumulator.
$FCB1	Outputs byte in accumulator to cassette.
$FE93	Converts byte in accumulator to hexadecimal. Returns $80 if not a legal hexadecimal character.
$FE43	Entry into address mode of monitor.

Gives new meaning to the word portability.

Introducing the TRS-80 Pocket Computer

By Nat Wadsworth

Some seven years ago I was involved in the design and manufacture of one of the first microcomputer systems made expressly for personal computerists.

The SCELBI-8H included an 8008 CPU chip, was typically supplied with 4096 bytes of memory and used machine-language programming. A separate interface and keyboard input the data, and another special unit let the computer display messages on the face of an oscilloscope tube.

The whole package, complete with 5 amp power supply, weighed in at some 30 pounds and took up two cubic feet of space. The system sold for about $2500.

The other day I walked into a local Radio Shack store and bought the new TRS-80 Pocket Computer.

It comes complete with an integrated alphanumeric keyboard and display. It has considerably more memory (including a BASIC interpreter and operating system in read only memory) than the pioneering SCELBI-8H. It is programmable using high-level BASIC language.

The complete unit is 1/2 inch thick, 2-3/4 inches wide and 7 inches long. It tips the scales at a featherweight six ounces.

Like the SCELBI-8H, this machine is a pioneering personal computer, the first pocket computer to be made commercially available. It truly heralds, I do believe, the coming of the personal computer revolution for everybody.

Orders of Magnitude

The TRS-80 Pocket Computer (PC) has the features and abilities that I would have liked to design into the SCELBI-8H seven years ago. Namely, it is highly portable, highly functional and capable of being highly personalized.

In just seven years technology has permitted computer system designers to improve performance by orders of magnitude (that is, powers of 10, when dealing with the decimal numbering system). Let's take a look at some of the areas where these vast improvements have been made. I'll start by recapping some of the above figures.

The TRS-80 Pocket Computer, taking up about ten cubic inches of space, is roughly 1/345 the size of the early personal computer. That represents a difference in magnitude of order two-plus. The PC is about 1/80 the weight of many desk-top systems. That is, again, almost two orders difference in magnitude.

The early 8H system needed about 25 watts; the TRS-80 runs on four watch batteries and consumes 11 milliwatts when in the operating mode. The order of magnitude difference for power consumption exceeds three! (Twenty-five watts is some 2272 times more power than 11 milliwatts.)

Incidently, at those power levels the manufacturer claims some 300 hours of operating time on a set of batteries. At an hour or two actual operating time per day, that comes to a six to nine month period between battery changes. (By the way, it retains its memory contents when not being used at just a fraction of its normal power level.)

Nat Wadsworth, PO Box 232, Seymour, CT 06483.

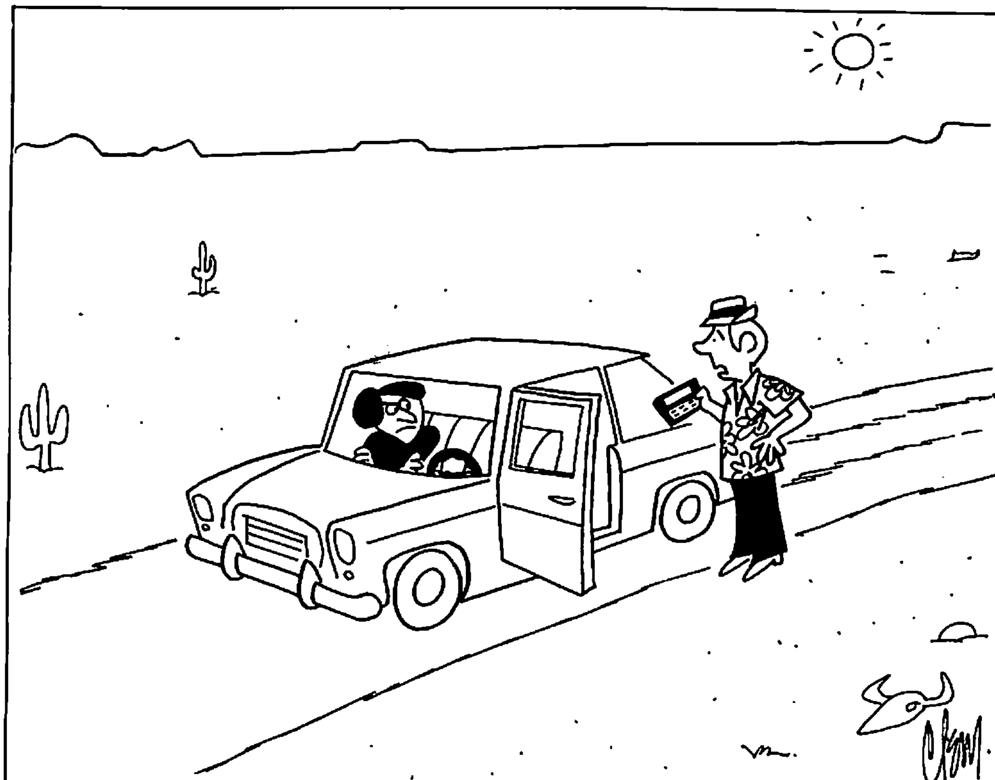
The TRS-80 Pocket Computer programs in BASIC language. As a minimum, that is at least an order of magnitude more convenient than programming in machine language.

Real Capability

The TRS-80 Pocket Computer is not a toy. It is a genuine computer by all formal standards and as proved by practical application.

The machine comes equipped with a BASIC operating system built into its ROM memory and the equivalent of 1424 bytes of user memory. This might not seem like much read and write storage to people used to running with 64K and dual eight-inch disks, but it is considerably more than you might expect, because the interpreter performs tokenizing and program packing tricks, and the computer reserves extra data memory not included in the above count for use by program variables.

First things first. For starters, the TRS-80 Pocket Computer can serve purely as a multifunction calculator by operating in the direct execute mode. You don't have to do any programming; simply type in your formulas using algebraic notation and press the enter key.



"That's funny. . . according to this, we shouldn't have run out of gas for another 36.7832 miles."

Do you want transcendental functions such as sine, cosine, log, natural logarithms or exponentiation? Just type them in. All those functions and more are provided in ready-to-use format. Parentheses in your formulas? You can use up to 15 levels of them if you want.

But you aren't going to buy a real pocket computer just so that you can have a fancy calculator, so let's get on to the good stuff.

Four Operation Modes

First there is the regular PRO, or program, mode. This is the mode you use to enter and edit a program. This machine has complete editing ability. You can access any line or group of lines in a program using the LIST command (shortened to L to save keying strokes). When you reach the appropriate line, cursor control lets you skip over words and characters to get to the part of the line that you want to deal with.

The display shows up to 24 characters at a time. However, you can roll the display right or left along a full 80-character line. (Yes, you can have multiple BASIC statements on a line.) Naturally, you can also scroll the display up or down.

Remember, I said full editing abilities. You can do all the standard editing operations such as inserting or deleting characters and new lines.

You can use line numbers from 1 to 999 when creating a program. A special feature lets you assign alphanumeric labels to lines.

For language, you have the standard selection of BASIC statements including LET, INPUT, PRINT, PAUSE, PRINT USING, IF. . . THEN, GOTO, GOSUB, RETURN, FOR. . . STEP, NEXT, STOP, END and CLEAR. There is even a little audio beeper (BEEP) built into the unit for audible signals when programs need input or to announce other types of pertinent events.

Need to know how much program memory you have left? Just ask for the info with the MEM command.

Variables? You can use the 26 letters of the alphabet as numeric or string variables, although the string variables are limited to seven characters per string.

If you're disappointed because I only mentioned letters as variables through subscripting, don't be. You can assign up to 204 variables through subscripting. Of course, there is a trade-off here. As in any BASIC, the more variables you assign (beyond the 26 letters of the alphabet in this case), the less memory you will have available for program storage. The 26 letter-of-the-alphabet assignments, though, are memory-free on the Radio Shack PC. Memory for these variables is provided as part of a fixed memory area that is not used for program storage.

Once a program or programs (you can have a whole bunch of different programs in memory at the same time) are in memory, you must switch to the RUN mode to execute them. You can use the RUN (shortened to R.) if you just have a single program in the unit. If you want to select a particular routine from a group residing in the machine, you can use the RUN (line number) format. However, as I will explain, programs can be executed in other ways.

But suppose your program doesn't work correctly right off the bat? Well, you just shift right into debugging with the DEBUG command; the computer will enter a break condition immediately after each instruction is executed. You can then inspect the values of variables, step to the next line in the program, continue debugging in a fast modality or resume normal program operation.

The PC can operate in two more modes. The DEF mode lets the operator define any one of a group of keys as invoking the operation of a particular program or routine. You can designate any program or routine in memory as a defined operation by assigning a label to the first line in the program. The label assigned must be the symbol for the selected key. The selected key is one that the user wants to designate for invoking a particular action.

The DEF mode thus enables programs or parts of programs to be executed or accessed more conveniently than by using the RUN command followed by a line number. This is particularly true if the key selected to perform a programmed operation is mnemonically related to the activity. Thus, the I key might be defined by a user as the one to use when the interest portion of a financial calculation was to be performed.

By the way, a couple of removable templates are provided. You can write on these templates and fit them around the special keys used in the define mode. They slip off the unit and can be stored in the computer's carrying case.

Finally, there is the so-called RESERVE mode of operation, which lets you to assign statements, functions or commands to various keys within a group of designated keys. There is a limitation in this mode; the operation cannot exceed 48 program steps. The practical intent of this mode is to let you execute frequently used functions or operations with a single key.

For instance, in your line of work you might repeatedly need to refer to the quadratic formula. If so, you could place the steps necessary to solve that formula in memory with the computer operating in the RESERVE programming mode. You would then assign a particular key to that operation. Perhaps you might use the F key to represent formula. Thereafter, whenever you needed to solve a quadratic problem, you would just switch your TRS-80 to the run mode and punch the F key.

Or, suppose you are working on debugging a complex program. You needed to frequently check the values of three variables. You could use the RESERVE mode to put in a short routine that would display those values each time you struck, say, the V key.

In essence, the RESERVE mode lets you customize or tailor the PC to your specific needs. It is an extra feature that lets the machine be personalized to each user's unique requirements.

"It's a new course at the University called The Healthy Computerist."

Benchmarks

From time-to-time, *Kilobaud Microcomputing* has run articles on benchmarking the various popular microcomputers. I recently hauled out the June 1977 issue and took a look at some benchmarking routines worked up by Tom Rugg and Phil Feldman ("BASIC Timing Comparisons," p. 66).

I modified their Benchmark Program 1 to appear as shown here:

```
300 PAUSE "START"
400 FOR X=1 TO 100
500 NEXT X
700 PAUSE "END"
800 END
```

The PAUSE statements on the TRS-80 Pocket Computer are similar to PRINT statements. The difference is that messages are just briefly displayed (for about a second); the program then continues automatically. (The PRINT statement on the PC requires that the entry key be depressed before program operation continues. This option makes sure you won't miss any vital directives.)

The FOR loop was ended at a value of 100 instead of 1000 as in the original benchmark. The trial times I obtained were then multiplied by 10 for comparison with the microcomputers discussed in the benchmarking article.

Why was the FOR loop value cut to 100 for the test? Primarily because the PC limits the FOR range to a maximum of three digits or 999. This is a limitation of the machine, but not a serious one; it can be circumvented by factors inside the loop or by using nested loops.

The above limitation might make you wonder if the TRS-80 Pocket Computer is an integer BASIC machine. No, it is not. It has full floating-point capability to ten significant digits and plus or minus the 99th power. This is what it normally uses for calculations. But the variable value of FOR. . .NEXT loops must be integer values in the range 1 to 999, as must any specified STEP value. (The value 1 is assumed for a STEP value if none is specified.)

So, if you want to perform a calculation on a variable over the range of, say, 10 to 9990 in steps of size 10, you need to do the following type of procedure: Have the FOR. . .NEXT variable go from 1 to 999 with a step size of 1. Multiply those values by 10 inside the loop, using a different variable name to obtain the range actually desired.

I also used X as a variable in the benchmark program, instead of the variable K used in Rugg's and

Feldman's tests.

Why mention such a seemingly trivial alteration? Because it makes a difference. Because of the manner in which variables are stored, ones symbolized by the letters W, X, Y and Z can be looked up faster than those labeled A, B, C and so forth. Using the variable symbol X in the benchmark tests instead of the variable symbol A results in about a 20 percent better performance.

So how did Benchmark Program 1 stack up? The test for 100 loops ran in 18.5 seconds. This figure must be multiplied by 10 to get a comparison figure to use against the machines timed by Feldman and Rugg. So the time for 1000 loops would be approximately 185 seconds. That is about 90 times, or close to two orders of magnitude, slower than the typical two seconds that many microcomputers take to perform such an operation.

Yes, the machine is considerably slower than most microcomputers. But it still does floating-point operations a lot faster than you can do them in your head!

The speed is roughly comparable to that of an 8008-based machine. But let's keep in mind one other significant factor. The pocket computer is only pulling 11 milliwatts of power. As the old saw goes, "It takes power to obtain speed." You have to make some sort of sacrifice in a machine of this size. When you have a machine that can give six to nine months of typical daily operation on a set of four wristwatch batteries, you can't expect it to set blazing speed records.

Other Benchmark Tests

Let's take a look at how the machine fared in a few other benchmark tests.

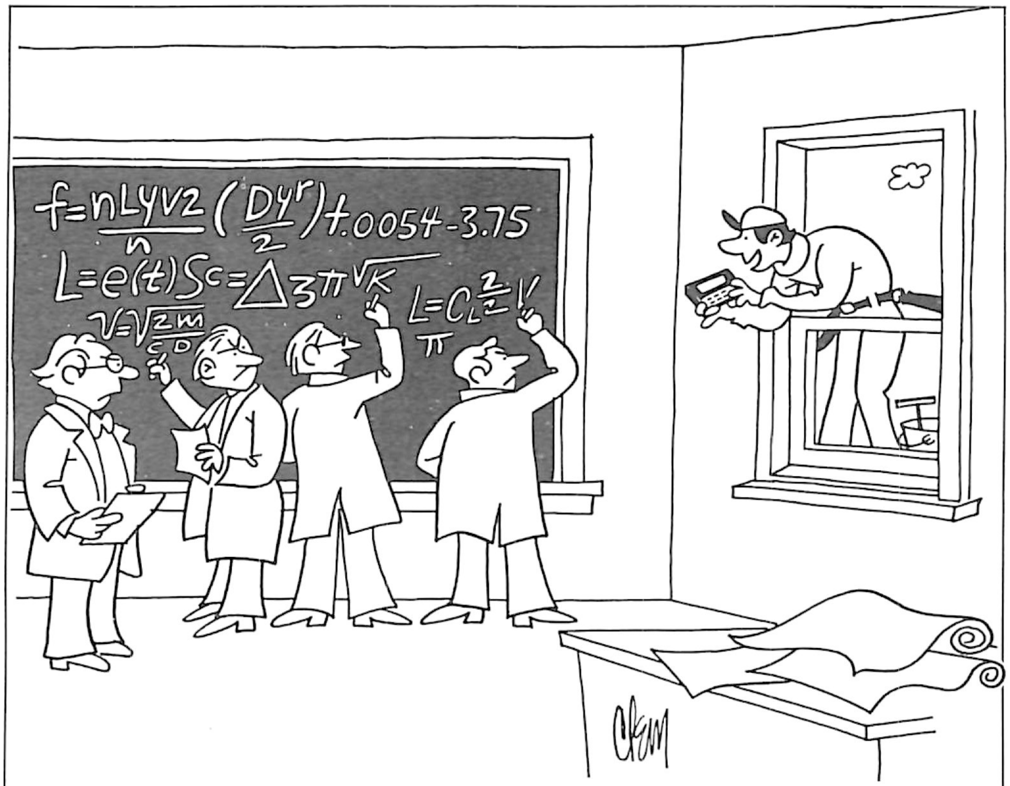
Benchmark Program 2, adapted from Feldman and Rugg, contained:

```
300 PAUSE "START"
400 X=0
500 X=X+1
600 IF X<100 THEN 500
700 PAUSE "END"
800 END
```

This test ran in 33 seconds. Multiplying by 10 yields 330 seconds, as opposed to ten seconds by other micros. Note now that the speed ratio is down from about 90:1 to about 33:1.

Benchmark Program 5 in the "BASIC Timing Comparisons" article was altered slightly so that it read:

```
300 PAUSE "START"
400 X=0
500 X=X+1
510 A=X/2*3+4-5
520 GOSUB 820
600 IF X<100 THEN 500
700 PAUSE "END"
800 END
820 RETURN
```



"Say, can I give you fellows a hand?"

This one executed in 78 seconds. That makes the benchmark 780 seconds when adjusted for a loop of 1000 instead of 100. Typical microcomputers run the program in about 30 seconds. Note that the performance ratio is now down to about 26:1. It appears that as the benchmarking programs are given a larger variety of operations, the disparity between the time required by the PC and its bigger cousins becomes smaller. In light of these three tests, I would guess that the PC pays a heavy time price during FOR...NEXT loops. You can easily make up your own benchmarks to confirm or deny this hypothesis.

All in all, considering its size, I am favorably impressed with the TRS-80 Pocket Computer's speed. It may not set any records, but I can tolerate waiting a few seconds while a machine does my work for me.

What Next?

Now that I've proven to my own satisfaction that the TRS-80 Pocket Computer is indeed a real computer—and a rather impressive performer at that—I'm ready to put it to good use.

As a professional programmer, I have wanted just such a machine in my pocket to quickly verify algorithms that I might dream up at any time, on or off the job. This is the area in which I think the PC will be handiest for me.

Others might find it valuable for entirely different uses. The TRS-80 Pocket Computer is designed to be highly adaptable, and will thus have a special appeal to each individual. This personalization is the essence of personal computing.

I like the machine's size and portability. It fits comfortably in a shirt or jacket pocket, a purse or a briefcase. This ability to literally put a computer in your pocket and take it with you, operate it any time you want—while you're on a plane, a bus, in a car, standing on a street corner, sitting in your office or in your living room—is going to make a big difference in the way people perceive and respond to this tool of the brain.

Some people will use the PC as a daily appointment reminder. Engineers will use it to solve routine application problems, the kinds of problems that are a pain to solve with pencil and calculator but not worthy of putting on a large computer. Students of virtually any subject can quickly adapt this little unit to present material and drill them on it in a personal fashion. The businessperson will find it invaluable for performing countless types of financial calculations and analysis.

One of this machine's enjoyable challenges will be in the development of compact and efficient programs. The art of creating compact coding has been dropping by the wayside as the price of memory declines.

Many things are coming for the TRS-80 Pocket Computer. You can already get a tape cassette interface so that you can store programs on an audio cassette. A number of application programs are being developed and marketed by Radio Shack.

Before I close, let me point out one more "order of magnitude" comparison. The early SCELBI-8H microcomputer with input/output devices sold for about $2500. The TRS-80 Pocket Computer retails for less than $250. ■

If you have some compact routines for the TRS-80 Pocket Computer or have learned some new tricks and capabilities of the machine that others might enjoy, why not drop me a letter and tell me about it. Perhaps we can get some sort of user's forum started to ease the path of those who will be following in our footsteps.

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- For video categories, send 5×7 inch glossy prints of the artwork as it appears on your video display.
- For the hard-copy categories, send full-size originals.
- While you don't need to submit programs with your entries, they must be available on request.
- No minis or mainframes allowed.
- Entries become the property of *Microcomputing* magazine, and cannot be returned.
- Address entries to **Graphics Contest, Kilobaud Microcomputing Editorial Dept., Peterborough, NH 03458.**

LITTLE BITS

By Richard Fritzson

Assembly-Language Coding

A subroutine that ends with the instructions:

```
CALL     SUBR
RET
```

can be optimized to end with:

```
JMP     SUBR
```

because the routine SUBR will return "over" the calling routine to the proper address. On an 8080-type CPU, this trick saves one byte of memory in the assembled code and about eight microseconds each time it executes (one less RET and a JMP instead of a CALL). It also makes the code less readable.

The following trick, similar to the above, has similar advantages and improves readability.

Example 1 is the standard assembly-language coding of the IF-THEN-ELSE construct, taken from a floppy disk controller. The code is awkward. It has one forward GOTO for each CALL; it has two unnecessary labels; it has a test for nonzero just before the CALL to READ (executed when the test fails) and three lines away from the CALL to WRITE, which is called when the test succeeds.

You can achieve the same function by introducing an extra "switching" subroutine (see Example 2). The resulting code is one JMP instruction shorter—three bytes saved on an 8080; only one byte saved on a Z-80 where the eliminated JMPs were relative—and executes in the same time. More important, it eliminates the two forward JMPs and their labels L1 and L2 and the right test next to the right routine's name. As long as the new subroutine is on the same page as the calling code, no new readability problems are introduced. If you follow the rule of never making an assembly-language routine more than one page long, this is no trouble.

A little thought, and examination of old assembly-language routines, should convince you that this is not a special-case solution, but an alternative way to code IF-THEN-ELSEs on any occasion. ■

```
        LDA     IOFLAG  ; Get R/W indicator
        ORA     A
        JNZ     L1      ; if not zero, write
        CALL    READ    ; else read
        JMP     L2
L1:     CALL    WRITE
L2:     STA.    ERR     ; save error flag
        .
        .
        .
```

Example 1.

```
        CALL    XFER    ; do transfer
        STA     ERR     ; save error flag
        .
        .
        .
        ----    ------
XFER:   LDA     IOFLAG  ; get R/W flag
        ORA     A
        JZ      READ    ; if read
        JMP     WRITE   ; else write
```

Example 2.

Richard Fritzson, Metagram, 5048 Lakeshore Rd., Hamburg, NY 14075.

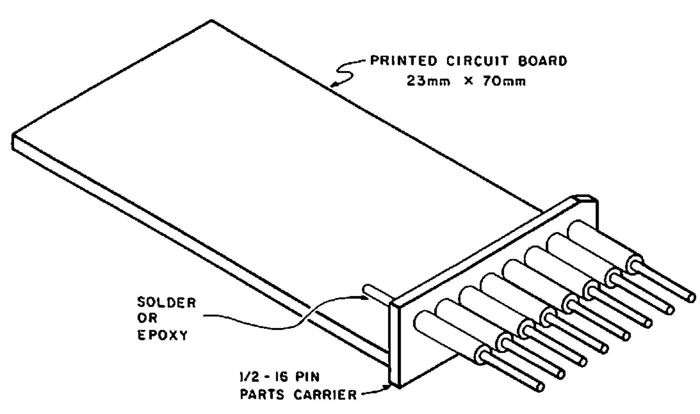
By John M. Franke

Exercise Your Socket Contacts

New or unused socket contacts are overly stiff until a chip has been inserted and removed a few times. Many people will inadvertently bend pins on 24-, 28- or 40-pin integrated circuits when trying to insert them. I have designed a simple contact exerciser tool to solve this problem.

I split a 16-pin parts carrier lengthwise and soldered or epoxied it to a handle made from a piece of printed circuit board. The tool permits me to exercise any pin number socket quickly and has completely eliminated bent pins. ■

John M. Franke, 1006 Westmoreland Avenue, Norfolk, VA 23508.



Socket contact exerciser tool.

By D. C. Shoemaker

Heath Commands Revealed

Version 1.6 of the Heath Disk Operating System (HDOS), along with the earlier Version 1.5, includes several new features and commands, as well as an improved operating manual. But two useful commands remain undocumented. These allow the user to reset (replace) the disk containing the operating system with another disk, one that doesn't have to include all the HDOS files, using the same type of reset command you would use in PIP, "RESET SY0:." These two commands take the following form.

CAT/JGL—presumably named for the chief architect of HDOS, Gordon Letwin—can be used to catalog a disk to determine what's on it. This command sets a standard catalog listing with all the normal flags (S, W, L) plus one other (C).

The C files are the ones that are interesting—HDOS requires them to operate in the stand-alone mode. They must reside on the disk (or in memory) for the operating system to function. Normally, they are on the SY0: disk, where they are kept when not required for an operation.

The other command—SET HDOS STAND-ALONE—allows you to enter the stand-alone mode. When executed, this command transfers all files flagged with a C into memory, letting the SY0: disk be removed completely. Any other disk may then be mounted on SY0:, regardless of whether or not it is a SYSGENed disk. The command may be reset by typing SET HDOS NO-STAND-ALONE.

The stand-alone mode has several applications. Changing disks in the midst of a long program or one requiring several disks of data is easier. Also, it gives you the ability to remove a disk that you don't want tampered with later.

A word of caution: for some reason, Heath left these functions undocumented. Always expect the unexpected when dealing with some undocumented aspect of a system. I recommend you practice on nonessential disks before trying this technique out on an irreplaceable program or data.

Some features of an operating system are left undocumented because they may sometimes produce "strange" results. This can apply to any system, from an IBM 370 to a Heath H8. It's entirely possible that a bus may exist in Level IV that Heath wants to correct in Level V before issuing the documentation.

I'm indebted to Dave Kobets of the Kansas City Heathkit Electronic Center for first drawing my attention to the existence of these commands. ■

D.C. Shoemaker, 2000A Foxridge, Blacksburg, VA 24060.

By Jim Porter

Don't Freq. Out

Every now and then I need a lower frequency than my breadboard 555 clock can deliver; I need a simple divide by 2, 4, 8 or more circuit. A 74163 is fast and simple to use. Connect +5 V and ground; put the clock input on pin 2; and get one-half frequency on pin 14, one-fourth on pin 13, one-eighth on pin 12 and one-sixteenth on pin 11. I can use one output or all four. If one-sixteenth the frequency isn't enough, then cascade the output to another input. It's simple! ■

Jim Porter, PO Box 12842, Memphis, TN 38112.

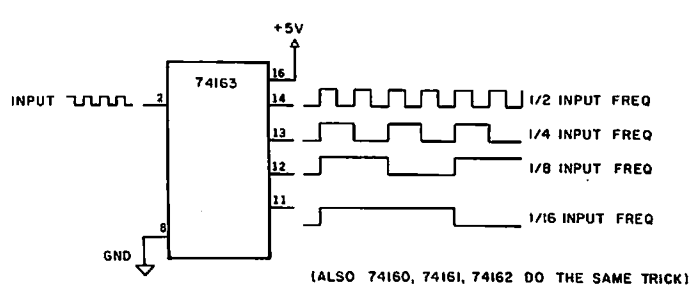


Fig. 1. Lowering the frequency.

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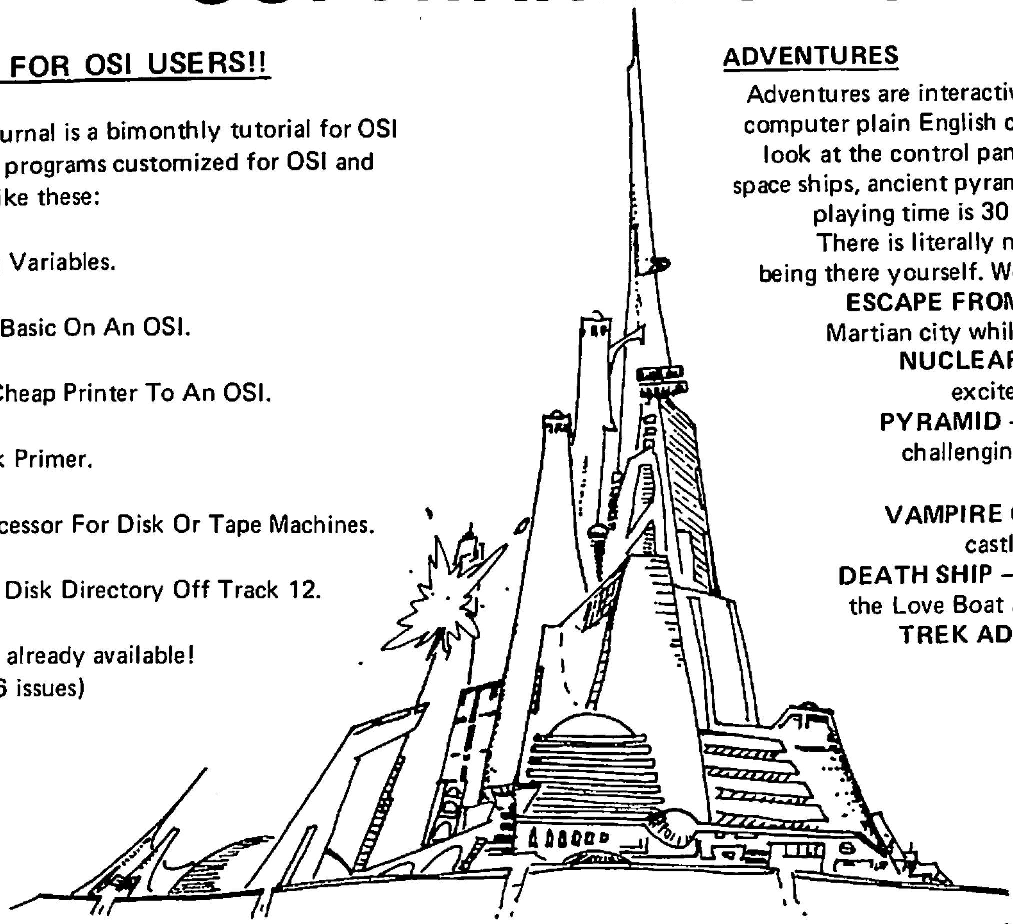

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C1E/C2E for C1/C2/C4/C8 Basic in ROM machines.
This ROM adds full screen editing, software selectable scroll windows, keyboard correction (software selectable), and contains an extended machine code monitor. It has breakpoint utilities, machine code load and save, block memory move and hex dump utilities. A must for the machine code programmer replaces OSI support ROM. Specify system $59.95

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These programs all allow the editing of basic lines. All assume that you are using the standard OSI video display and polled keyboard.

C1P CURSOR CONTROL – A program that uses no RAM normally available to the system. (We hid it in unused space on page 2). It provides real backspace, insert, delete and replace functions and an optional instant screen clear.
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C2/4 CURSOR. This one uses 366 BYTES of RAM to provide a full screen editor. Edit and change lines on any part of the screen. (Basic in ROM systems only.)

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CALENDAR

West Coast Computer Faire

The 6th West Coast Computer Faire will be held in San Francisco, April 3–5, 1981. Manufacturers and distributors will exhibit low-cost systems for small-business, school and home. The speakers program will feature topics on computers in education, electronic prosthesis for the physically impaired, computer art, exotic games, information utilities, legal aspects of computing and biomedical applications. Contact Computer Faire, 345 Swett Road, Woodside, CA 94062, 415/851-7075.

Albion, MI, Microcomputer Fair

Albion College will be hosting the second annual Albion Microcomputer Fair on Feb. 21, 1981, from 9 AM to 4 PM in the Science Complex. For further information, contact D. W. Kammer, Dept. of Physics, Albion College, Albion, MI 49224, 517/629-5511, ext. 261.

Papers for EUROMICRO '81

A call for papers has been issued for the EUROMICRO Symposium to be held in Paris, Sept. 8–10. Authors should submit six copies of original papers on recent and novel developments in all aspects of microprocessing and microprogramming by March 15 to EUROMICRO, 18 rue Planchant, 75020 Paris, France.

Computer Game Festival

The 4th Annual PACS Computer Games Festival, sponsored by the Philadelphia Area Computer Society and the LaSalle College Physics Dept., will be held March 14, 1981, from 10 AM to 5 PM in the LaSalle College Ballroom, 20th and Olney, Philadelphia, PA 19141. For further information, contact Stephen A. Longo, Physics Dept., La Salle College, Philadelphia, PA 19141. Phone: 215/951-1255.

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Wanted: used cassette software for Apple II & books on computing. Send list for my offer. Ray Gabriel, PO Box 175, Madison, OH 44057.

For Sale: SWTPC CT-64 terminal, 16 × 64 × 2 & features. Needs monitor. $225 or best. Also 2400-baud cassette I/O board & software, $20. William Lee, 337 E. Naples, Chula Vista, CA 92011, 714-697-3176.

Tel-It message and inventory computer system. Z-80 based terminal with 16 char. readout (no CRT). Built-in tape drive, real-time clock. Will interface to printer. Cost $900, asking $500; call Bob Loveless at 714-689-7800.

Diablo Hytype I Model 1200. Letter quality "Daisy Wheel" printers. Brand new units w/platen and print wheel. EIA RS-232C/CCITT interface kit, $75. Power supplies, $100. New printer, $650. There is no better buy anywhere. For Apple, TRS-80 & CP/M systems, interface info available. After 7 PM. Scott Priester, 211 White Water Ct., Greer, SC 29651. 803-268-0678.

Wanted: CPU board for SWTP 6800 computer. Write Garth Fisher, Department of Industrial Technology, Walla Walla College, College Place, WA 99324.

SWTPC M6800 computer, 36K memory, expandable to 64K with 4116s. Cassette interface, 2 serial I/O brds., keyboard and video interface. All documentation and software. $700. SSB disk drive and controller brd. DOS versions 3.1, 4.3 and 5.1. $500. T. Southworth: 313-281-0233 after 5 PM.

I/O sale: Centronics P-1, $250; SWTPC CT-64 terminal, $250; Hitachi 9" video monitor, $75; SWTPC AC-30 tape I/O, $75. 10% down on COD, cash orders ppd. C. D. Shilling, Box 18014, Ft. Worth, TX 76118.

Printer—Texas Instruments Silent 700-Model 755. Receive only thermal printer and data terminal (RSR-232). Exc. condition. $495. 212-224-2448 (eve.).

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Heath H89 computer w/32K extra memory. Still in boxes, $1600 or assembled, $2200. Savings of $250–600! Steve Larson, 1525 S. Lansing St., Aurora, CO 80012. 303-752-3768.

Teletype ASR-33 complete w/stand, paper, tape and manuals. Just refurbished by Teletype. Works perfectly. $400 or best offer by March 1st. Steve Larson, 1525 S. Lansing St., Aurora, CO 80012. 303-752-3768.

For Sale: PDP 11/03 or Heath H-11 32K RAM and I/O card. Both 1/2 board cards, working, factory assembled with manuals. Best offer. Write PO Box 16692, Portland, OR 97216.

For Sale: Heath H9 video term., $200; Cherry Pro Keybd w/encl., internal pwr sup., $130. H9 prints lwr case input from Cherry/computer. H9 avail w/o mod. I ship. George Sullivan c/o Dr. P. Petcher, Chatom, AL 36518. 205-847-2262.

For Sale: Teletype KSR-33 very good condition. With cart and base; will include TRS-232 interface and cables (ready to go when you plug it in). Asking $425—Make offer. Mark Engelhardt, 274 Mainzer, St. Paul, MN 55118. Phone: 612-457-8911.

For Sale: Base 2 printer. Brand new. Business forces me to get daisy wheel. Tractor feed & single sheets. Must sacrifice, $395. Willing to ship COD. D. Keen, RD 1, Box 432, CMCH, NJ 08210.

Diablo Hytype I Mod 1200 daisy wheel printer; new pin feed fric. platen & print wheel; white 'RO' cover; new Boschert switch supply; interface cable, service manual—$1000. Barry: 415-228-6211.

Texas Instruments 16-bit University Module computer, complete with power supply, increased RAM, RS-232 wiring, and all manuals; $250. A. A. Schwartz, 6454 Camino Teatro, La Jolla, CA 92037.

For Sale: New 16K RAMs from scrapped computer boards. Tested, 200 ns 4116s. High rel. ceramic, $25 for 8, $45 for 16. Doug Gennetten, 4425 Goshawk Drive, Fort Collins, CO 80526. 303-226-1395.

MICRO QUIZ

(from page 16)

Answer: 47

I=1=>S=0+(5/1)
I=2=>S=5+(20/2)
I=3=>S=15+(15/3)
I=4=>S=20+(60/4)
I=5=>S=35+(60/5)

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Sarasota, FL

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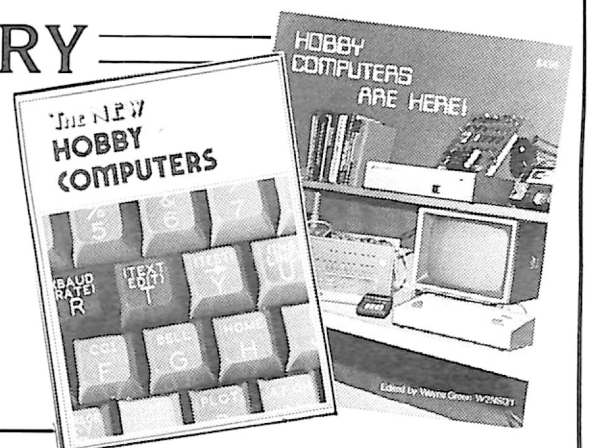

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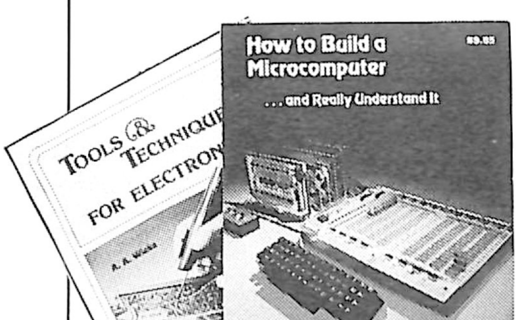

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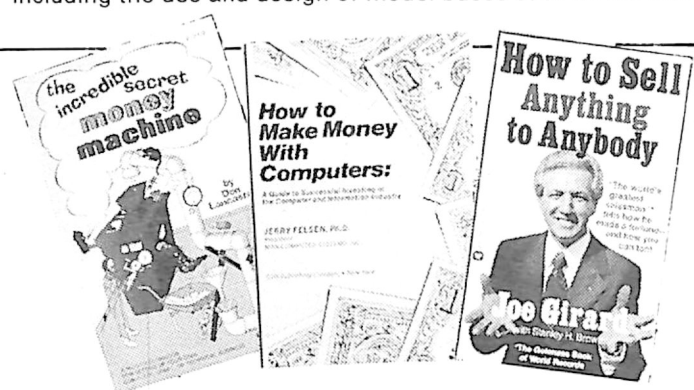

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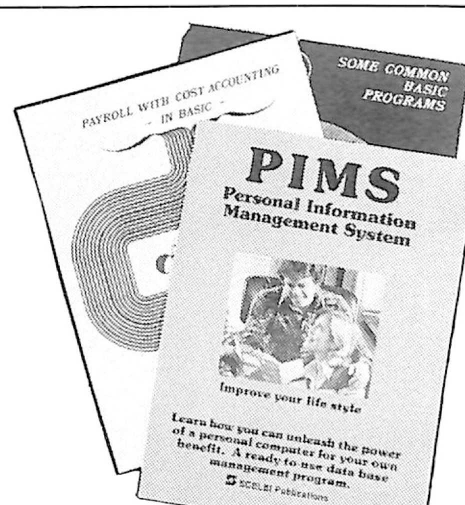

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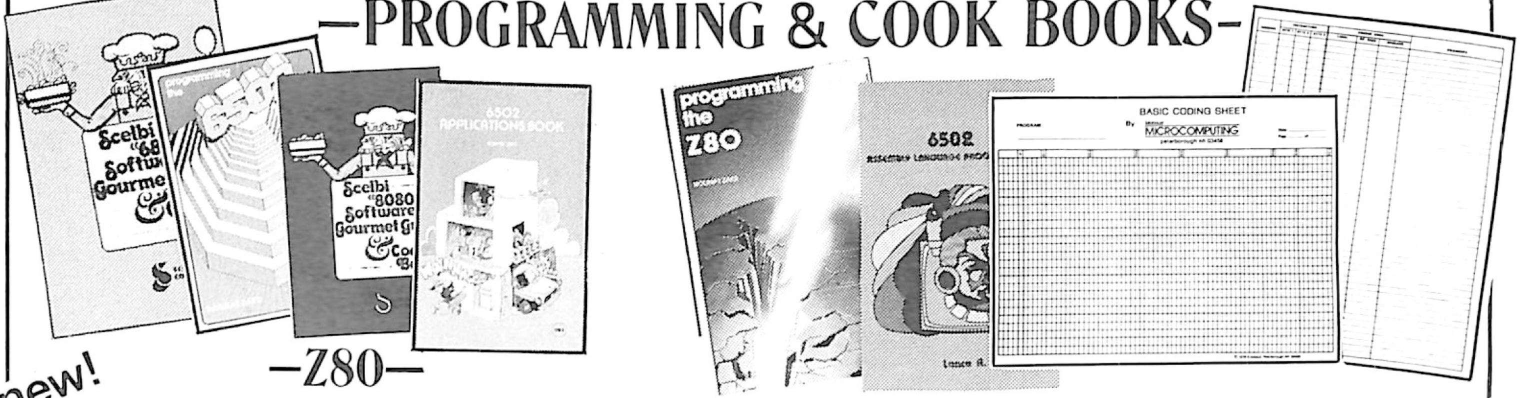

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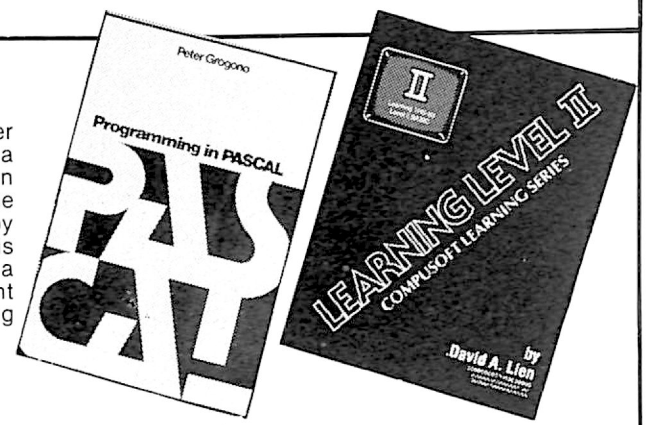
BASIC AND PASCAL



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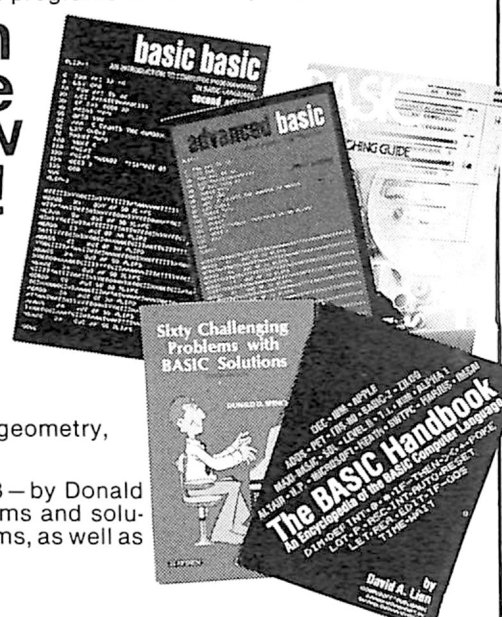

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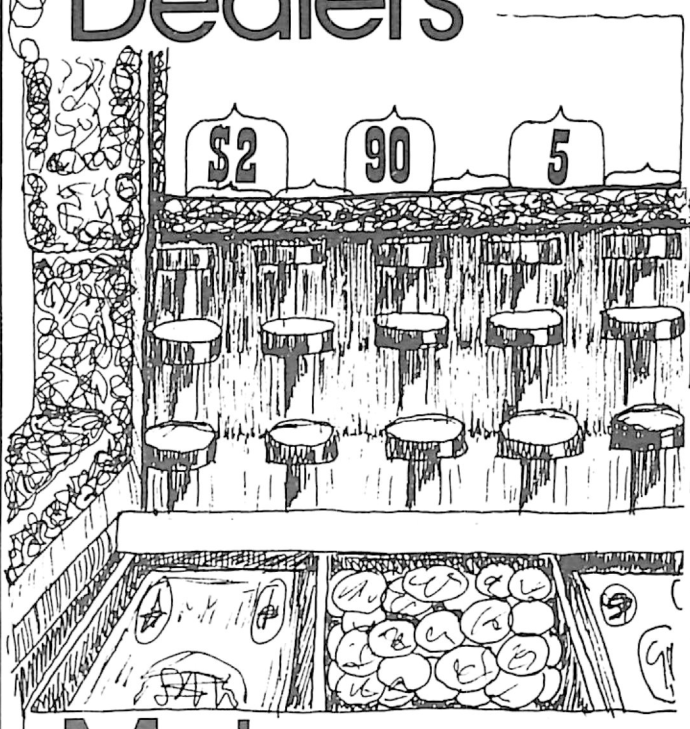

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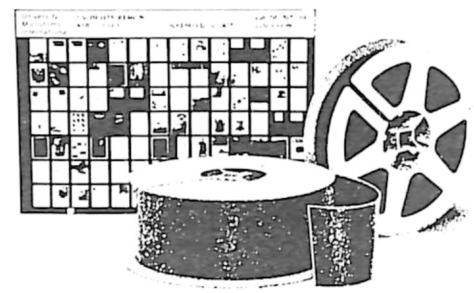

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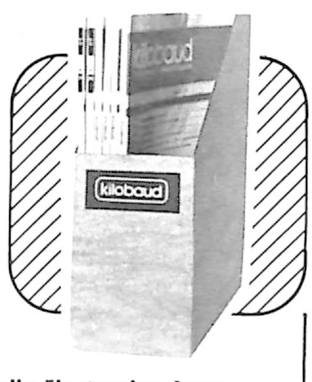

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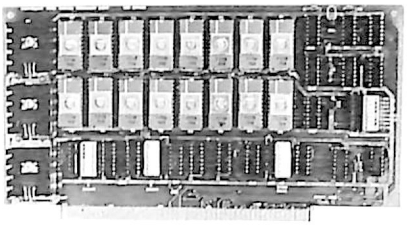

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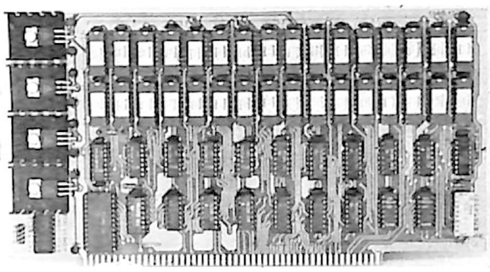

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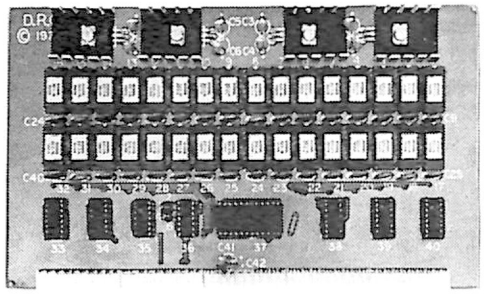

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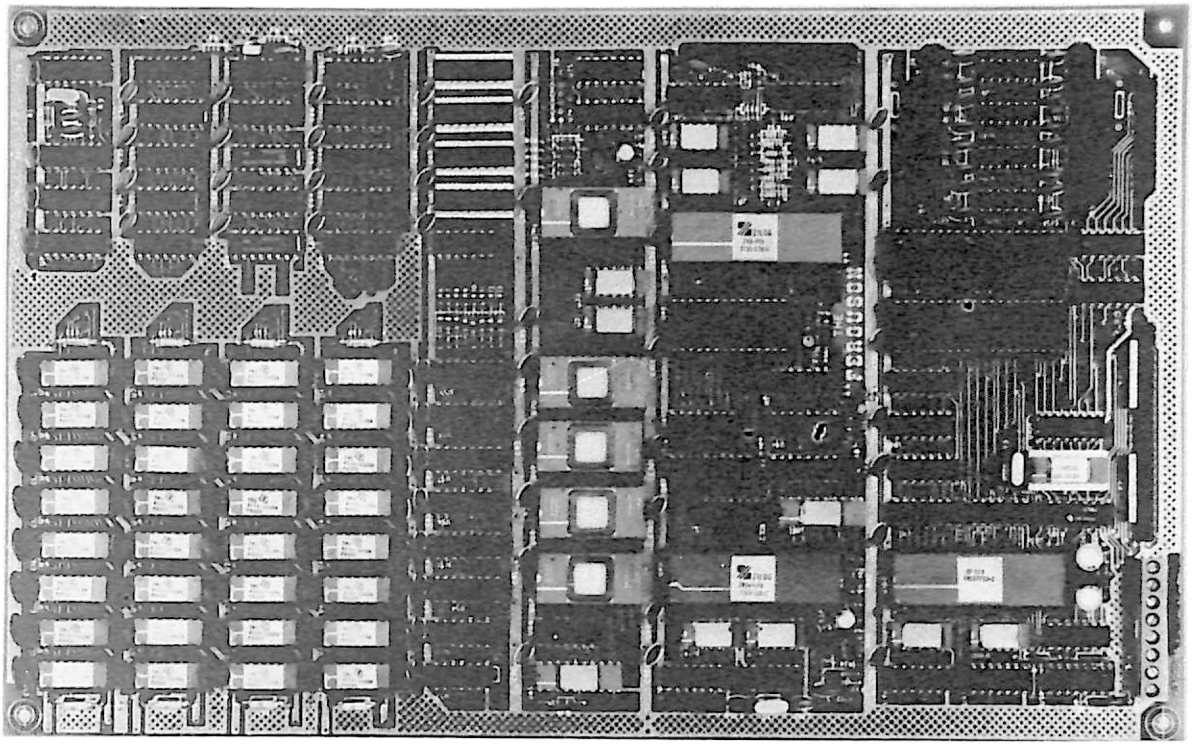

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8T23	3.10
8T24	3.50
8T25	3.20
8T26	1.69
8T28	2.75
8T97	1.69
8T98	1.69

MOS/MEMORY RAM

2101-1	2.85
2102-1	95
2102AL-4	1.45
2102AN-2L	1.65
2104A-4	4.95
2107B-4	3.75
2111-1	3.75
2112-2	3.95
2114	3.75
2114L 300ns	4.25
2114L 450ns	4.00
4116 200ns	5.50
8/4116 200ns	35.00
MM5262	40
MM5280	3.00
MM5320	9.95
MM5330	5.94
PD411D-3	4.00
PD411D-4	5.00
P5101L	8.95
4200A	9.95
82S25	2.90
91L02A	1.50
HD0165-5	6.95
MM57100	4.50
GIAY38500-1	9.95
MCM66751A	9.95
9368	3.50
410D	10.00
416	16.00

CLOCKS

MM5311	5.50
MM5312	3.90
MM5314	3.90
MM5369	2.10
MM5841	14.45
MM5865	7.95
CT7010	8.95
CT7015	8.95
MM5375AA/N	3.90
MM5375AG/N	4.90
7205	16.50
7207	7.50
7208	15.95
7209	4.95
DS0026CN	3.75
DS0056CN	3.75
MM53104	2.50

MICROPROCESSOR

6502	10.95
6504	9.95
6522	9.95
6800	6.95
6802	11.95
6820	4.95
6850	5.95
8080A	5.95
8085	12.95
8086	75.00
Z80	9.95
Z80A	11.95
8212	2.90
8214	3.95
8216	2.90
8224	3.45
8228	4.95
8251	6.95
8253	15.00
8255	5.75
8257	10.95
8259	14.95
1802CP plas	13.95
1802DP plas	17.95
1861P	9.50
CDP1802CD	28.95
CDP1802D	35.00
CDP1816P	7.95

UART/FIFO

AY5-1013	5.50
AY5-1014	7.50
3341	6.95

PROM

1702A	4.95
2708	7.30
2716T1	18.00
2716 5 Volt	13.50
8/2716 5 Volt	89.00
2732	55.00
2758	19.50
8741A	55.00
8748	55.00
8748-8	55.00
8755A	55.00
N82S23	2.95
N82S123	6.50
N82S126	3.75
N82S129	8.50
N82S131	8.50
N82S136	8.75
N82S137	8.75
DM8577	2.90
8223	2.90

CONNECTORS

30 pin edge	2.50
44 pin edge	2.75
86 pin edge	4.00
100 pin edge	4.50
100 pin edge WW	5.25

IC SOCKETS

Solder Tin Low Profile

PIN	1 UP	PIN	1UP
8	15	22	30
14	14	24	35
16	16	28	42
18	27	36	58
20	29	40	57

2 level 14 pin ww 20

WIRE WRAP LEVEL 3

PIN		PIN	
14	32	24	86
16	33	28	1.00
18	57	40	1.23

CRYSTALS

1 MHz	4.50
2 MHz	4.50
4 MHz	4.25
5 MHz	4.25
10 MHz	4.25
18 MHz	3.90
20 MHz	3.90
32 MHz	3.90
32768 Hz	4.00
1.8432 MHz	4.50
3.5795 MHz	1.20
2.0100 MHz	1.95
2.097152 MHz	4.50
2.4576 MHz	4.50
3.2768 MHz	4.50
5.0688 MHz	4.50
5.185 MHz	4.50
5.7143 MHz	4.50
6.5536 MHz	4.50
14.31818 MHz	4.25
18.432 MHz	4.50
22.1184 MHz	4.50

KEYBOARD ENCODERS

AY5-2376	$12.50
AY5-3600	17.95
AY5-9100	10.50
AY5-9200	16.50
74C922	5.50
74C923	5.50
HD0165-5	6.95
AY5-9400	10.50

D Connectors RS232

DB25P	3.62
DB25S	5.20
Cover	1.67
DE9S	1.95
DA15P	2.10
DA15S	3.10
Complete Set	9.50

Hickok 3½ Digit LED multimeter	89.95
Stopwatch Kit	26.95
Auto Clock Kit	17.95
Digital Clock Kit	14.95

8K/16K Eprom Kit (less PROMS)	$89.00
Motherboard	$39.00
Extender Board	$15.00

RESISTORS ¼ watt 5%

10 per type	.03
25 per type	.025
100 per type	.015
1000 per type	.012
350 piece pack 5 per type	6.75

½ watt 5% per type .05

Televideo Terminal

Model 912	$845.00
Model 920	$945.00

Tiny Basic Experimentors Kit $10.00

KEYBOARDS

56 key ASCII keyboard kit	$67.50
Fully assembled	77.50
53 key ASCII keyboard kit	60.00
Fully assembled	70.00
Enclosure Plastic	14.95
Metal Enclosure	29.95

LEDS

Red T018	15
Green, Yellow T018	20
Jumbo Red	20
Green, Orange, Yellow Jumbo	25
Cliplite LED Mounting Clips	8/$1.25

(specify red, amber, green, yellow, clear)

CONTINENTAL SPECIALTIES in stock
Complete line of breadboard test equip.
MAX-100 8 digit Freq. Ctr. $149.95

OK WIRE WRAP TOOLS in stock
Portable Multimeter $18.00
Complete line of AP Products in stock

SPECIAL PRODUCTS

MM5865 Stopwatch Timer with 10 pg. spec	9.00
PC board	7.50
Switches Mom. Pushbutton	27
3 pos. slide	25
Encoder HD0165-5	6.95
Paratronics 100A Logic Analyzer	$475.00
Model 10 Trigger Expander Kit	$229.00
Model 150 Bus Grabber Kit	$369.00
Clock Calendar Kit	$23.95
2.5 MHz Frequency Counter Kit	$37.50
30 MHz Frequency Counter Kit	$47.75

TRANSFORMERS

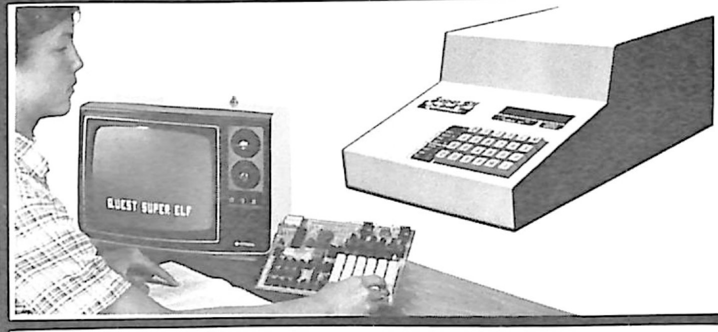
6V 300 ma	3.25
12 Volt 300 ma transformer	1.25
12.6V CT 600 ma	3.75
12V 250 ma wall plug	2.95
12V CT 250 ma wall plug	3.75
24V CT 100 ma	3.95
10V 1.2 amp wall plug	4.85
12V 6 amp	12.95
12V 500 ma wall plug	4.75
12V 1 amp wall plug	6.50
10.15 VAC 8.16 VA wall plug	9.75

DISPLAY LEDS

MAN1	CA	270	2.90
MAN3	CC	125	39
MAN72/74	CA/CA	300	1.00
DL704	CC	300	1.25
DL707/DL707R	CA	300	1.00
DL727/728	CA/CC	500	1.90
DL747/750	CA/CC	600	1.95
FND359	CC	357	70
FND500/507	CC/CA	500	1.35
FND503/510	CC/CA	500	90
FND800/807	CC/CA	800	2.20
3 digit Bubble			60
10 digit display			1.25
7520 Clairex photocells			39
TIL311 Hex			9.50
MAN3640	CC	30	1.10
MAN4610	CA	40	1.20
MAN4640	CC	40	1.20
MAN4710	CA	40	95
MAN4740	CC	40	1.20
MAN6640	CC	56	2.95
MAN6710	CA	60	1.35
MAN6740	CC	60	1.35

MA1002A, C, E	8.95
MA1012A	8.95
102P3 transformer	2.25
MA1012A Transformer	2.25

BSR Controller $39.95
Connect your computer to the BSR Home Control System. Computer controlled ultrasonic transmitter for your BSR. Software for 1802 user



RCA Cosmac 1802 Super Elf Computer $106.95

Compare features before you decide to buy any other computer. There is no other computer on the market today that has all the desirable benefits of the **Super Elf** for so little money. The Super Elf is a small single board computer that does many **big** things. It is an excellent computer for training and for learning programming with its machine language and yet it is easily **expanded with additional memory, Full Basic, ASCII Keyboards, video character generation, etc.**

Before you buy another small computer, see if it includes the following features: ROM monitor; State and Mode displays; Single step; Optional address displays; Power Supply; Audio Amplifier and Speaker; Fully socketed for all IC's; Real cost of in warranty repairs; Full documentation.

The **Super Elf** includes a **ROM** monitor for program loading, editing and execution with **SINGLE STEP for program debugging** which is not included in others at the same price. With **SINGLE STEP** you can see the microprocessor chip operating with **the unique Quest** address and data bus displays **before, during** and **after** executing instructions. Also, CPU mode and instruction cycle are decoded and displayed on 8 LED indicators.

An RCA 1861 **video graphics** chip allows you to connect to your own TV with an inexpensive video modulator to do graphics and games. There is a **speaker system** included for writing your own music or using many music programs already written. The speaker amplifier may also be used to drive relays for control purposes.

A 24 key **HEX keyboard** includes 16 HEX keys plus **load, reset, run, wait, input, memory protect, monitor select** and **single step**. Large, on board displays provide output and optional **high and low address**. There is a 44 pin standard connector slot for PC cards and a 50 pin connector slot for the Quest Super Expansion Board. Power supply and sockets for **all** IC's are included in the price plus a detailed 127 pg. instruction manual which now includes over 40 pgs. of software info. including a series of lessons to help get you started and a music program and graphics target game. Many schools and universities are using the Super Elf as a course of study. OEM's use it for training and R&D.

Remember, other computers only offer Super Elf features at additional cost or not at all. **Compare before you buy. Super Elf Kit $106.95, High address option $8.95, Low address option $9.95. Custom Cabinet** with drilled and labelled plexiglass front panel **$24.95.** All metal Expansion Cabinet, painted and silk screened, with room for 5 S-100 boards and power supply **$57.00. NiCad Battery Memory Saver Kit $6.95.** All kits and options also completely assembled and tested.

Questdata, a software publication for 1802 computer users is available by subscription for $12.00 per 12 issues. Single issues $1.50. Issues 1-12 bound $16.50.

Tiny Basic Cassette **$10.00,** on ROM **$38.00,** original Elf kit board **$14.95. 1802 software;** Moews Video Graphics **$3.50.** Games and Music **$3.00,** Chip 8 Interpreter **$5.50.**

Super Expansion Board with Cassette Interface $89.95

This is truly an astounding value! This board has been designed to allow **you** to decide how you want it optioned. **The Super Expansion Board comes with 4K of low power RAM** fully addressable anywhere in 64K with built-in memory protect and a **cassette interface**. Provisions have been made for all other options on the same board and it fits neatly into the hardwood cabinet alongside the **Super Elf.** The board includes slots for up to 6K of **EPROM** (2708, 2758, 2716 or TI 2716) and is **fully socketed.** EPROM can be used for the monitor and Tiny Basic or other purposes.

A IK Super ROM Monitor $19.95 is available as an on board option in 2708 EPROM which has been preprogrammed with a program loader/editor and error checking multi file cassette read/write software, (relocatable cassette file) another exclusive from Quest. It includes register save and readout, block move capability and video graphics driver with blinking cursor. Break points can be used with the register save feature to isolate program bugs quickly, then follow with single step. If you have the **Super Expansion Board** and **Super Monitor** the monitor is up and running at the push of a button.

Other on board options include **Parallel Input and Output Ports** with **full handshake.** They allow easy connection of an ASCII keyboard to the input port. **RS 232 and 20 ma Current Loop** for teletype or other device are on board and if you need more memory there are two **S-100** slots for static RAM or video boards. Also a 1K Super Monitor version 2 with video driver for full capability display with Tiny Basic and a video interface board. **Parallel I/O Ports $9.85, RS 232 $4.50, TTY 20 ma I/F $1.95, S-100 $4.50. A 50 pin connector set** with ribbon cable is available at $15.25 for easy connection between the **Super Elf** and the **Super Expansion Board.**

Power Supply Kit for the complete system (see Multi-volt Power Supply).

Quest Super Basic V5.0

A new enhanced version of **Super Basic** now available. Quest was the first company worldwide to ship a full size Basic for 1802 Systems. A complete function **Super Basic** by **Ron Cenker** including floating point capability with scientific notation (number range $\pm .17E^{38}$), 32 bit integer ± 2 billion; multi dim arrays, string arrays; string manipulation; cassette I/O; save and load, basic, data and machine language programs; and over 75 statements, functions and operations.

New improved faster version including **renumber** and essentially **unlimited variables.** Also, an exclusive user expandable command library.

Serial and Parallel I/O included.

Super Basic on Cassette $55.00.

PROM Eraser

assembled. 25 PROM capacity **$37.50** (with timer **$69.50**). 6 PROM capacity OSHA/UL version **$69.50** (with timer **$94.50**).

Z80 Microcomputer

16 bit I/O, 2 MHz clock, 2K RAM, ROM Breadboard space. Excellent for control. Bare Board **$28.50.** Full Kit **$99.00.** Monitor **$20.00.** Power Supply Kit **$35.00. Tiny Basic $30.00**

S-100 Computer Boards

8K Static Godbout Econo IIA Kit	149.00
16K Static Godbout Econo XIV Kit	269.00
24K Static Godbout Econo XX-24 Kit	414.00
32K Static Godbout Econo XX-32 Kit	537.00
16K Dynamic RAM Kit	289.00
32K Dynamic RAM Kit	328.00
64K Dynamic RAM Kit	399.00
Video Interface Kit	**$139.00**

80 IC Update Master Manual $39.00

Comp. IC data selector, 2700 pg. master reference guide. Over 51,000 cross references. Free update service through 1980. Domestic postage $3.50.

Modem Kit $60.00

State of the art, orig., answer. No tuning necessary. 103 compatible 300 baud. Inexpensive acoustic coupler plans included. Bd. only $17.00.

LRC 7000+Printer $389.00

40/20 column dot matrix impact, std. paper. Interface all personal computers.

64/40/32/20 version **$405.00.** Optional cables available.

LRC 7000 printer interface cable for Super Elf with software $26.00

NiCad Battery Fixer/Charger Kit

Opens shorted cells that won't hold a charge and then charges them up, all in one kit w/full parts and instructions. **$7.25**

Rockwell AIM 65 Computer

6502 based single board with full ASCII keyboard and 20 column thermal printer. 20 char. alphanumeric display, ROM monitor, fully expandable. **$375.00.** 4K version **$450.00.** 4K Assembler **$85.00,** 8K Basic Interpreter **$100.00.**

Special small power supply for AIM65 assem. in frame **$54.00.** Complete AIM65 in thin briefcase with power supply **$499.00.** Molded plastic enclosure to fit both AIM65 and power supply **$47.50.** Special Package Price: 4K AIM, 8K Basic, power supply, cabinet **$599.00**

AIM65/KIM/VIM/Super Elf 44 pin expansion board; 3 female and 1 male bus. Board plus 3 connectors **$22.95.**

60 Hz Crystal Time Base Kit $4.40

Converts digital clocks from AC line frequency to crystal time base. Outstanding accuracy.

Video Modulator Kit $9.95

Convert TV set into a high quality monitor w/o affecting usage. Comp. kit w/full instruc.

Multi-volt Computer Power Supply

8v 5 amp, ±18v .5 amp, 5v 1.5 amp, −5v .5 amp, 12v .5 amp, −12v option. ±5v, ±12v are regulated. Basic Kit **$29.95.** Kit with chassis and all hardware **$43.95.** Add $4.00 shipping. Kit of hardware **$14.00.** Woodgrain case **$10.00.** $1.50 shipping.

Gremlin Color Video Kit $69.95

32 x 16 alpha/numerics and graphics; up to 8 colors with 6847 chip; 1K RAM at E000. Plugs into Super Elf 44 pin bus. No high res. graphics. On board RF Modulator Kit **$4.95**

Elf II Adapter Kit $24.95

Plugs into Elf II providing Super Elf 44 and 50 pin plus S-100 bus expansion. (With Super Expansion). High and low address displays, state and mode LED's optional **$18.00.**

1802 16K Dynamic RAM Kit $149.00

Expandable to 32K. Hidden refresh w/clocks up to 4 MHz w/no wait states. Addl. 16K RAM **$63.00**

Super Elf 44 pin expansion board; 3 female and 1 male bus. Board plus 3 connectors **$22.95**

Tiny Basic Extended on Cassette $15.00 (added commands include Stringy, Array, Cassette I/O etc.)

S-100 4-Slot Expansion	**$ 9.95**
Super Monitor VI.I Source Listing	**$15.00**

Super Color S-100 Video Kit $129.95

Expandable to 256 x 192 high resolution color graphics. 6847 with all display modes computer controlled. Memory mapped. 1K RAM expandable to 6K. S-100 bus 1802, 8080, 8085, Z80 etc.

Editor Assembler $25.00 (Requires minimum of 4K for E/A plus user source)

1802 Tiny Basic Source listing	**$19.00**
Super Monitor V2.0/2.1 Source Listing	**$20.00**

TERMS: $5.00 min. order U.S. Funds. Calif residents add 6% tax.
$10.00 min. BankAmericard and Master Charge accepted. $1.00 insurance optional.
Postage: Add 5%. C.O.D. $10.00 min. order.

FREE: Send for your copy of our NEW 1980 QUEST CATALOG. Include 48¢ stamp.

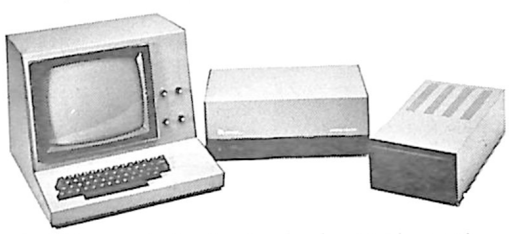
Start learning and computing for only $129.95 with a Netronics 8085-based computer kit. Then expand it in low-cost steps to a business/development system with 64k or more RAM, 8" floppy disk drives, hard disks and multi-terminal I/O.

THE NEW EXPLORER/85 SYSTEM

Special! *Full 8" floppy, 64k system for less than the price of a mini! Only* **$1499.95!**

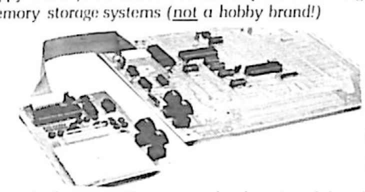
(Also available wired & tested, $1799.95)

Imagine — for only $129.95 you can own the starting level of Explorer/85, a computer that's expandable into full business/development capabilities — a computer that can be your beginner system, an OEM controller, or an IBM-formatted 8" disk small business system. From the first day you own Explorer/85, you begin computing on a significant level, and applying principles discussed in leading computer magazines. Explorer/85 features the advanced Intel 8085 cpu, which is 100% compatible with the older 8080A. It offers onboard S-100 bus expansion, Microsoft BASIC in ROM, plus instant conversion to mass storage disk memory with standard IBM-formatted 8" disks. All for only $129.95, plus the cost of power supply, keyboard/terminal and RF modulator if you don't have them (see our remarkable prices below for these and other accessories). With a Hex Keypad/display front panel, Level "A" can be programmed with no need for a terminal, ideal for a controller, OEM, or a real low-cost start.



Full 8" disk system for less than the price of a mini (shown with Netronics Explorer/85 computer and new terminal). System features floppy drive from Control Data Corp., world's largest maker of memory storage systems (not a hobby brand!)

Level "A" is a complete operating system, perfect for beginners, hobbyists, industrial controller use. $129.95



Level "A" With Hex Keypad/Display.

LEVEL "A" SPECIFICATIONS

Explorer/85's Level "A" system features the advanced Intel 8085 cpu, an 8355 ROM with 2k deluxe monitor/operating system, and an advanced 8155 RAM I/O . . . all on a single motherboard with room for RAM/ROM/PROM/EPROM and S-100 expansion, plus generous prototyping space.

PC Board: Glass epoxy, plated through holes with solder mask. • **I/O:** Provisions for 25-pin (DB25) connector for terminal serial I/O, which can also support a paper tape reader . . . cassette tape recorder input and output . . . cassette tape control output . . . LED output indicator on SOD (serial output) line . . . printer interface (less drivers) . . . total of four 8-bit plus one 6-bit I/O ports. • **Crystal Frequency:** 6.144 MHz. • **Control Switches:** Reset and user (RST 7.5) interrupt . . . additional provisions for RST 5.5, 6.5 and TRAP interrupts onboard. • **Counter/Timer:** Programmable, 14-bit binary. • **System RAM:** 256 bytes located at F800, ideal for smaller systems and for use as an isolated stack area in expanded systems . . . RAM expandable to 64K via S-100 bus or 4k on motherboard.

System Monitor (Terminal Version): 2k bytes of deluxe system monitor ROM located at FØØØ, leaving ØØØØ free for user RAM/ROM. Features include tape load with labeling . . . examine/change contents of memory . . . insert data . . . warm start . . . examine and change all registers . . . single step with register display at each break point, a debugging/training feature . . . go to execution address . . . move blocks of memory from one location to another . . . fill blocks of memory with a constant . . . display blocks of memory . . . automatic baud rate selection to 9600 baud . . . variable display line length control (1-255 characters/line) . . . channelized I/O monitor routine with 8-bit parallel output for high-speed printer . . . serial console in and console out channel so that monitor can communicate with I/O ports.

System Monitor (Hex Keypad/Display Version): Tape load with labeling . . . tape dump with labeling . . . examine/change contents of memory . . . insert data . . . warm start . . . examine and change all registers . . . single step with register display at each break point . . . go to execution address. Level "A" in this version makes a perfect controller for industrial applications, and is programmed using the Netronics Hex Keypad/Display. It is low cost, perfect for beginners.

HEX KEYPAD/DISPLAY SPECIFICATIONS

Calculator type keypad with 24 system-defined and 16 user-defined keys. Six digit calculator-type display, that displays full address plus data as well as register and status information.

LEVEL "B" SPECIFICATIONS

Level "B" provides the S-100 signals plus buffers/drivers to support up to six S-100 bus boards, and includes: address decoding for onboard 4k RAM expansion selectable in 4k blocks . . . address decoding for onboard 8k EPROM expansion selectable in 8k blocks . . . address and data bus drivers for onboard expansion . . . wait state generator (jumper selectable), to allow the use of slower memories . . . two separate 5 volt regulators.

LEVEL "C" SPECIFICATIONS

Level "C" expands Explorer/85's motherboard with a card cage, allowing you to plug up to six S-100 cards directly into the motherboard. Both cage and card are neatly contained inside Explorer's deluxe steel cabinet. Level "C" includes a sheet metal superstructure, a 5-card, gold plated S-100 extension PC board that plugs into the motherboard. Just add required number of S-100 connectors.

Explorer/85 With Level "C" Card Cage.

LEVEL "D" SPECIFICATIONS

Level "D" provides 4k of RAM, power supply regulation, filtering decoupling components and sockets to expand your Explorer/85 memory to 4k (plus the original 256 bytes located in the 8155A). The static RAM can be located anywhere from ØØØØ to EFFF in 4k blocks.

LEVEL "E" SPECIFICATIONS

Level "E" adds sockets for 8k of EPROM to use the popular Intel 2716 or the TI 2516. It includes all sockets, power supply regulator, heat sink, filtering and decoupling components. Sockets may also be used for 2k x 8 RAM IC's (allowing for up to 12k of onboard RAM).

DISK DRIVE SPECIFICATIONS

- 8" CONTROL DATA CORP. professional drive.
- LSI controller.
- Write protect.
- Single or double density.
- Data capacity: 401,016 bytes (SD), 802,032 bytes (DD), unformatted.
- Access time: 25ms (one track).

DISK CONTROLLER/ I/O BOARD SPECIFICATIONS

- Controls up to four 8" drives.
- 1771A LSI (SD) floppy disk controller.
- Onboard data separator (IBM compatible).
- 2 Serial I/O ports
- Autoboot to disk system when system reset.
- 2716 PROM socket included for use in custom applications.
- Onboard crystal controlled.
- Onboard I/O baud rate generators to 9600 baud.
- Double-sided PC board (glass epoxy.)

DISK DRIVE CABINET/POWER SUPPLY

- Deluxe steel cabinet with individual power supply for maximum reliability and stability.

ORDER A COORDINATED EXPLORER/85 APPLICATIONS PAK!

Beginner's Pak (Save $26.00!) — Buy Level "A" (Terminal Version) with Monitor Source Listing and AP-1 5-amp Power Supply: (regular price $199.95), now at SPECIAL PRICE: **$169.95** plus post. & insur.

Experimenter's Pak II (Save $53.40!) — Buy Level "A" (Hex Keypad/Display Version) with Hex Keypad/Display, Intel 8085 User Manual, Level "A" Hex Monitor Source Listing, and AP-1 5-amp Power Supply: (regular price $279.35), all at SPECIAL PRICE: **$219.95** plus post. & insur.

Special Microsoft BASIC Pak (Save $103.00!) — Includes Level "A" (Terminal Version), Level "B", Level "D" (4k RAM), Level "E", 8k Microsoft in ROM, Intel 8085 User Manual, Level "A" Monitor Source Listing, and AP-1 5-amp Power Supply: (regular price $439.70), now yours at SPECIAL PRICE: **$329.95** plus post. & insur.

ADD A TERMINAL WITH CABINET, GET A FREE RF MODULATOR: Save over $114 at this SPECIAL PRICE: **$499.95** plus post. & insur.

Special 8" Disk Edition Explorer/85 (Save over $104!) — Includes disk-version Level "A", Level "B", two S-100 connectors and brackets, disk controller, 64k RAM, AP-1 5-amp power supply, Explorer/85 deluxe steel cabinet, cabinet fan, 8" SD/DD disk drive from famous CONTROL DATA CORP. (not a hobby brand!), drive cabinet with power supply, and drive cable set-up for two drives. This package includes everything but terminal and printers (see coupon for them). Regular price $1630.30, all yours in kit at SPECIAL PRICE: **$1499.95** plus post. & insur. Wired and tested, only **$1799.95.**

Special! Complete Business Software Pak (Save $625.00!) — Includes CP/M 2.0, Microsoft BASIC, General Ledger, Accounts Receivable, Accounts Payable, Payroll Package: (regular price $1325), yours now at SPECIAL PRICE: **$699.95.**

Please send the items checked below:

- ☐ **Explorer/85 Level "A" kit** (Terminal Version) . . . **$129.95** plus $3 post. & insur.
- ☐ **Explorer/85 Level "A" kit** (Hex Keypad/Display Version) . . . **$129.95** plus $3 post. & insur.
- ☐ **8k Microsoft BASIC** on cassette tape, **$64.95** postpaid.
- ☐ **8k Microsoft BASIC in ROM kit** (requires Levels "B", "D" and "E") . . . **$99.95** plus $2 post. & insur.
- ☐ **Level "B" (S-100) kit** . . . **$49.95** plus $2 post. & insur.
- ☐ **Level "C" (S-100 6-card expander) kit** . . . **$39.95** plus $2 post. & insur.
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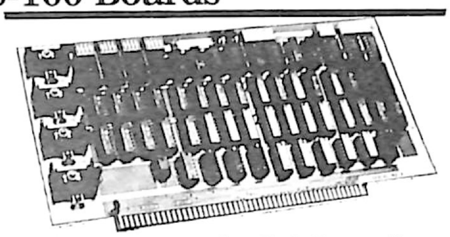

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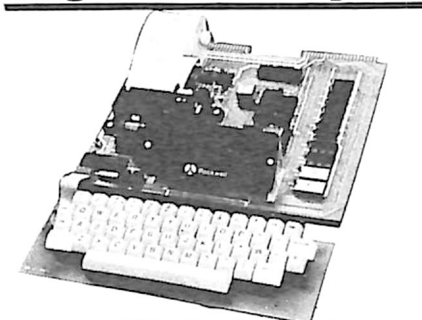

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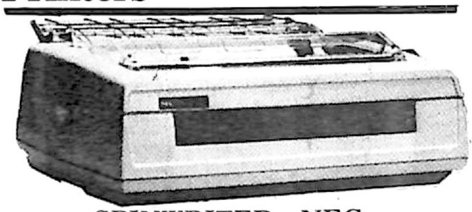

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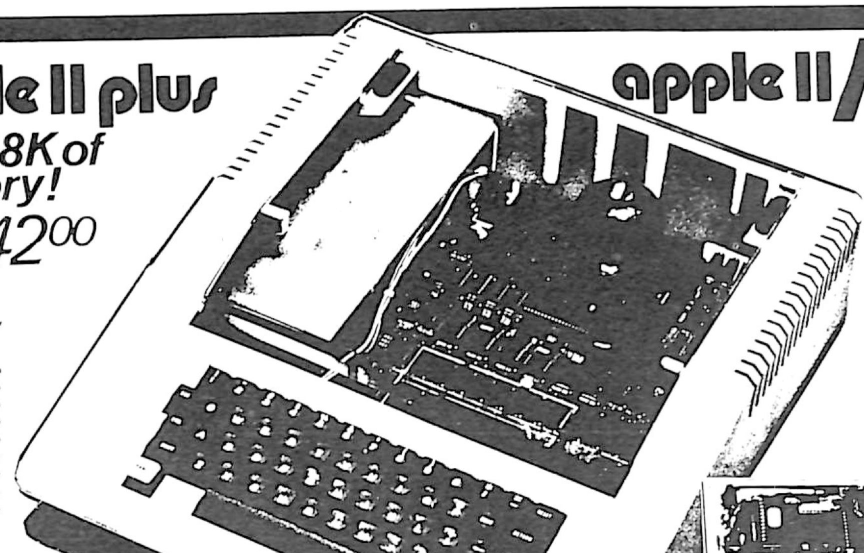

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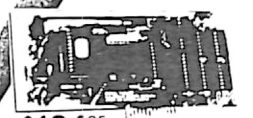

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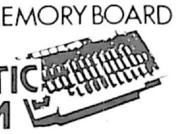

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74LS26	.49
74LS27	.26
74LS30	.28
74LS32	.32
74LS38	.32
74LS42	.65
74LS48	.78
74LS51	.25
74LS54	.35
74LS74	.38
74LS75	.60
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74LS86	.95
74LS90	.69
74LS93	.69
74LS107	.45
74LS112	.38
74LS113	.48
74LS122	.48
74LS123	.95
74LS126	.69
74LS138	.69
74LS151	.44
74LS153	.44
74LS155	1.15
74LS158	.75
74LS160	.95
74LS161	.85
74LS162	.95
74LS163	1.60
74LS164	.65
74LS165	.65
74LS170	1.75
74LS174	.75
74LS175	.75
74LS190	.75
74LS193	.95
74LS195	.95
74LS196	.85
74LS221	1.40
74LS240	1.65
74LS241	1.65
74LS243	1.45
74LS244	1.45
74LS245	2.25
74LS253	.95
74LS257	.95
74LS258	.95
74LS259	2.85
74LS279	.44
74LS283	1.00
74LS293	1.85
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Global Specialties

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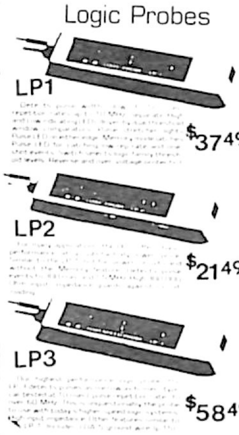
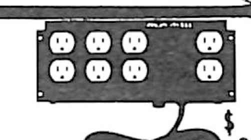


LP1 $37.49

LP2 $21.49

LP3 $58.49



$87.50

No "Glitches", Surges Or Interference

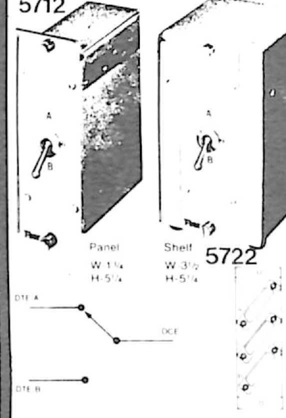
The MPD 117 is the low-cost solution to your power distribution problems. The MPD 117 has a high performance EMI filter, built in circuit breaker, two direct and six switched outlets, illuminated "on/off" switch for switched outlets, and is built with rugged UL approved components and housing in an all steel chassis with convenient mounting flanges.

MSM5832 MICROPROCESSOR REAL-TIME CLOCK/CALENDAR $7.45

GENERAL DESCRIPTION

The MSM5832 is a monolithic metal-gate CMOS integrated circuit that functions as a real time clock/calendar for use in bus-oriented microprocessor applications. The on chip 32,768 Hz crystal controlled oscillator time base is counted down to provide addressable 4-bit I/O data of SECONDS, MINUTES, HOURS, DAY-OF-WEEK, DATE, MONTH, and YEAR. Data access is controlled by 4-bit address, chip select, read, write and hold inputs. Other functions include 12H/24H format selection, leap year identification and manual ±30 second correction.

5712



Panel W-1¾ H-5¼ Shelf W-3½ H-5¼ 5722

Connector Layout

$145.00 $155.00

Description
The **RS-232C Compatible Digital Transfer Switch** is designed to switch modems between front end processors. All 24 pins of the connector are switched, with Pin 1 wired to ground.

T-bar INCORPORATED

EPROMS

2708	1K×8	$5.95 (8 for $40)
2716	2K×8	10.95 (8 for $80)
2732	4K×8	39.95 (2 for $75)

SINGLE 5VOLT FOR 2716 & 2732

TRS 80 16K Memory Add On **$43.95** KIT CONTAINS DIP SWITCHES AND DETAILED INSTRUCTIONS

SN7400N	.20	SN7482N	1.05
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SN7404N	.22	SN7493N	.48
SN7408N	.24	SN7495N	.60
SN7410N	.22	SN7496N	.70
SN7412N	.28	SN74122N	.39
SN7413N	.35	SN74136N	.95
SN7414N	.49	SN74141N	.69
SN7416N	.29	SN74151N	.65
SN7417N	.29	SN74153N	.65
SN7423N	.28	SN74154N	1.25
SN7425N	.25	SN74155N	.80
SN7430N	.23	SN74157N	.69
SN7437N	.29	SN74160N	.95
SN7438N	.24	SN74161N	.65
SN7440N	.22	SN74163N	.85
SN7442N	.57	SN74164N	.87
SN7443N	.78	SN74165N	.87
SN7445N	.78	SN74174N	.95
SN7451N	.20	SN74175N	.69
SN7454N	.20	SN74180N	.75
SN7474N	.32	SN74181N	1.15
SN7475N	.32	SN74393N	1.69

video 100

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MODEL 800B IMPACT PRINTER
- Dot resolution graphics in six densities
- 1920 character buffer
- Fully adjustable tractors to 9-1/2

$649.00

base 2 inc.

TMS2716 E-PROM REQUIRES THREE $8.50 POWER SUPPS.

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50-99	4.00
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250-499	8.00
500-999	10.00
1000 up	inquire

VOLTAGE REGULATORS

NEGATIVE	POSITIVE
7905 5V	7805 5V
7908 8V	7806 6V
7915 15V	7808 8V
7918 18V	7812 12V

95¢

MC1330AIP	$1.60
MC1350P	1.15
MC1358P	1.50
LM380N	1.75
NE565N	1.25
MC1458P	.50

555 TIMER 27¢

APPLE EXPANSION KIT 16K Memory Add-On $39.00
MEMORY ADD-ON KIT INCLUDES INSTRUCTIONS

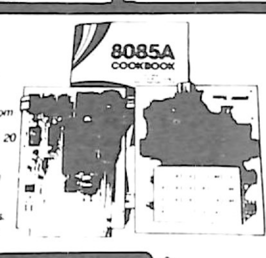
S-100 16K ADD-ON BARE BOARD WITH DOCUMENTATION AND DETAILED INSTRUCTION BOOK $28.95

8038C VCO Waveform Gen w/sine $2.65

SCR's & Triacs
10 Amp. 400 Volts Isolated Tab TO-220 Pkg
IS410 95¢ IT410 95¢

2114L 1024 x 4 Static RAM
300nsec $3.99
200nsec 4.75

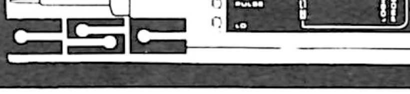
COMPLETE 8085A BASED **MICRO-COMPUTER** *AND MICROPROCESSOR TRAINING UNIT*
YOU GET:
- *Fully assembled and tested 8085A Microcomputer with 1K RAM, 1K PROM & 1K EPROM Programmable I/O, Keyboard unit, CPU card, 20 ma Asynchronous serial port, Display and Operating system*
- *8085A Cookbook 362 pages takes you from basic concepts to actual design*
- *8080/8085A Software Design Book 1 with detailed examination of all 244 instructions. 336 pages include sample programs using all basic instructions and typical assembly language*



PACCOM $295.00

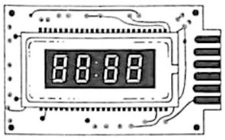
SOROC TECHNOLOGY, INC.

IQ120 $689



CSC $17.95 LOGIC PROBE KIT

National Semiconductor Clock Modules



12VDC AUTOMOTIVE/ INSTRUMENT CLOCK

APPLICATIONS:
- In-dash autoclocks
- After-market auto/ RV clocks
- Aircraft-marine clks.
- 12VDC oper. instru.
- Portable/battery powered instrumnts.

Features: Bright 0.3" green display. Internal crystal timebase. ±0.5 sec./day accur. Auto. display brightness control logic. Display color filterable to blue, blue-green, green & yellow. Complete—just add switches and lens.

MA1003 Module $16.95

MA1023	.7" Low Cost Digital LED Clock Module	8.95
MA1026	.7" Dig. LED Alarm Clock/Thermometer	18.95
MA5036	.3" Low Cost Digital LED Clock/Timer	6.95
MA1002	.5" LED Display Dig. Clock & Xformer	9.95

National Semiconductor RAM SALE

MM5290N-4 (MK4116/UPD416) .. $4.95 each
16K DYNAMIC RAM (250NS)
(8 EACH $39.95) (100 EACH $450.00/lot)

MM5290J-2 (MK4116/UPD416) .. $6.95 each
16K DYNAMIC RAM (150NS)
(8 EACH $49.95) (100 EACH $550.00/lot)

MM5298J-3A .... $3.25 each
8K DYNAMIC RAM (LOW HALF OF MM5290J) 200NS
(8 EACH $23.95) (100 EACH $250.00/lot)

MM2114-3 .... $5.95 each
4K STATIC RAM (300NS)
(8 EACH $43.95) (100 EACH $450.00/lot)

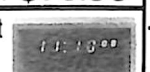
MM2114L-3 .... $6.25 each
4K STATIC RAM (LOW POWER 300NS)
(8 EACH $44.95) (100 EACH $475.00/lot)

EPROM Erasing Lamp

- Erases 2708, 2716, 1702A, 5203Q, 5204Q, etc.
- Erases up to 4 chips within 20 minutes.
- Maintains constant exposure distance of one inch.
- Special conductive foam liner eliminates static build-up.
- Built-in safety lock to prevent UV exposure.
- Compact — only 7-5/8" x 2-7/8" x 2"
- Complete with holding tray for 4 chips.

UVS-11E $79.50

Jumbo 6-Digit Clock Kit



- Four .630"ht. and two .300"ht. common anode displays
- Uses MM5314 clock chip
- Switches for hours, minutes and hold functions
- Hours easily viewable to 30 feet
- Simulated walnut case
- 115VAC operation
- 12 or 24 hour operation
- Includes all components, case and wall transformer
- Size: 6¾" x 3-1/8" x 1¾"

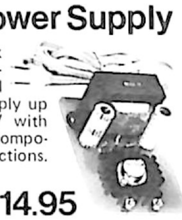
JE747 .... $29.95

6-Digit Clock Kit

- Bright .300 ht. comm. cathode display
- Uses MM5314 clock chip
- Switches for hours, minutes and hold modes
- Hrs. easily viewable to 20 ft.
- Simulated walnut case
- 115 VAC operation
- 12 or 24 hr. operation
- Incl. all components, case & wall transformer
- Size: 6¾" x 3-1/8" x 1¾"

JE701 .... $19.95

Regulated Power Supply



Uses LM309K. Heat sink provided. PC board construction. Provides a solid 1 amp @ 5 volts. Can supply up to ±5V, ±9V and ±12V with JE205 Adapter. Includes components, hardware and instructions. Size: 3½" x 5" x 2"H

JE200 .... $14.95

ADAPTER BOARD —Adapts to JE200— ±5V, ±9V and ±12V

DC/DC converter with +5V input. Toriodal hi-speed switching XFMR. Short circuit protection. PC board construction. Piggy-back to JE 200 board. Size: 3½" x 2" x 9/16"H

JE205 .... $12.95

MICROPROCESSOR COMPONENTS

8080A/8080A SUPPORT DEVICES

INS8080A	CPU	6.50
DP8212	8-Bit Input/Output	3.25
DP8214	Priority Interrupt Control	5.95
DP8216	Bi-Directional Bus Driver	3.49
DP8224	Clock Generator/Driver	3.95
DP8226	Bus Driver	3.49
DP8228	System Controller/Bus Driver	4.95
DP8238	System Controller	5.95
INS8243	I/O Expander for 48 Series	9.95
INS8250	Asynchronous Comm. Element	16.95
DP8251	Prog. Comm. I/O (USART)	7.95
DP8253	Prog. Interval Timer	14.95
DP8255	Prog. Peripheral I/O (PPI)	9.95
DP8257	Prog. DMA Control	19.95
DP8259	Prog. Interrupt Control	14.95
DP8275	Prog. CRT Controller	49.95
DP8279	Prog. Keyboard/Display Interface	19.95
DP8300	Octal Bus Receiver	6.95
DP8303	System Timing Element	6.95
DP8304	8-Bit Bi-Directional Receiver	3.95
DP8307	8-Bit Bi-Directional Receiver	3.95
DP8308	8-Bit Bi-Directional Receiver	3.95

6800/6800 SUPPORT DEVICES

MC6800	MPU	14.95
MC6802CP	MPU with Clock and RAM	19.95
MC6810AP1	128x8 Static RAM	4.95
MC6821	Peripheral Inter. Adapt (MC6820)	7.49
MC6828	Priority Interrupt Controller	10.95
MC6830L8	1024x8-Bit ROM (MC68A30-8)	14.95
MC6850	Asynchronous Comm. Adapter	6.95
MC6852	Synchronous Serial Data Adapter	6.95
MC6860	0-600bps Digital MODEM	10.95
MC6862	2400bps Modulator	12.95
MC6880A	Quad 3-State Bus. Trans. (MC8T26)	2.25

MICROPROCESSOR CHIPS

Z80 (780C)	CPU (MK3880N) (2MHz)	13.95
Z80A (780-1)	CPU (MK3880N-4) (4MHz)	15.95
CDP1802	CPU	19.95
2650	MPU	16.95
IDM2901ADC	CPU—4-Bit Slice (Com. Temp. Grade)	19.95
MC56502	MPU w/Clock (65K Bytes Memory)	11.95
INS8035N-6	MPU—8-Bit (6MHz)	16.95
INS8039N-6	CPU—Sgl. Chip 8-Bit (128 bytes RAM)	19.95
INS8040N-6	CPU (256 Bytes RAM)	24.95
INS8070N	CPU—64 Bytes RAM	24.95
INS8073N	CPU w/Basic Micro Interpreter	29.95
P8085	CPU	19.95
INS8900	CPU—16-Bit	29.95
TMS9900JL	MPU—16-Bit	49.95

SHIFT REGISTERS

MM500H	Dual 25-Bit Dynamic	.50
MM503H	Dual 50-Bit Dynamic	.50
MM506H	Dual 100-Bit Static	.50
MM510H	Dual 64-Bit Accumulator	.50
MM1402	256-Bit Dynamic	3.95
MM5013	1024-Bit Dynamic/Accumulator	1.95
MM5016H	500/512-Bit Dynamic	.89
MM5034N	Octal 80-Bit	9.95
MM5035N	Octal 80-Bit	9.95
2504V (1404A)	1024-Bit Dynamic	3.95
2518N	Hex 32-Bit Static	4.95
2522V	Dual 132-Bit Static	2.95
2524V	512-Bit Dynamic	.99
2525V	1024-Bit Dynamic	2.95
2527V	Dual 256-Bit Static	2.95
2528V	Dual 250-Bit Static	4.00
2529V	Dual 240-Bit Static	4.00
2532N	Quad 80-Bit Static	2.95
3341PC	Fifo (Dual 80)	6.95

DATA ACQUISITION

AF100-1CN	Universal Active Filter 2.5%	5.95
AF121-1CJ	Touch Tone Low Pass Filter	19.95
AF122-1CJ	Touch Tone Low Pass Filter	19.95
LM308AH	Super Gain Op Amp	1.00
LM334Z	Constant Current Source	1.30
LM335Z	Temperature Transducer	1.40
LF356N	JFET Input Op Amp	1.10
LF398N	Sample & Hold Amplifiers	3.95
LM399H	Temp. Comp. Prec. Ref. (.5ppm/C°)	4.95
ADC0804LCN	8-Bit A/D Converter (1 LSB)	4.95
DAC0806LCN	8-Bit D/A Converter (0.78% Lin.)	2.25

DATA ACQUISITION (CONTINUED)

ADC0809CCN	8-Bit A/D Converter (8-Ch. Multi.)	5.25
ADC0817CCN	8-Bit A/D Converter (16-Ch. Multi.)	10.95
DAC1000LCN	10-Bit D/A Conv. Micro. Comp. (0.05%)	13.95
DAC1008LCN	10-Bit D/A Conv. Micro. Comp. (0.20%)	8.95
DAC1020LCN	10-Bit D/A Converter (0.05% Lin.)	8.49
DAC1022LCN	10-Bit D/A Converter (0.20% Lin.)	5.95
DAC1222LCN	12-Bit D/A Converter (0.20% Lin.)	9.95
CD4051N	8-Channel Multiplexer	1.19
AY-5-1013	30K BAUD UART	5.95

RAM'S

1101	256x1 Static	1.49
1103	1024x1 Dynamic	.99
2101 (8101)	256x4 Static	3.95
2102	1024x1 Static	1.75
21L02	1024x1 Static	1.95
2111 (8111)	256x4 Static	3.95
2112	256x4 Static MOS	4.95
2114	1024x4 Static 450ns	5.95
2114L	1024x4 Static 450ns Low Power	6.95
2114-3	1024x4 Static 300ns	7.49
2114L-3	1024x4 Static 300ns Low Power	7.95
2117	16,384x1 Dynamic 550ns (house marked)	4.95
4116 (UPD416)	16K Dynamic 250ns	4.95
MM2147J	4096x1 Fast 70ns	19.95
5101	256x4 Static	7.95
MM5261	1024x1 Dynamic Fully Decoded	.99
MM5262	2Kx1 Dynamic	.25
MM5280/2107	4096x1 Dynamic	4.95
MM5290J-2(4116)	16K Dynamic 150ns (UPD416)	6.95
MM5298J-3A	8K Dyn. 200ns (lower ½ of MM5290J)	4.95
7489	16x4 Static	1.75
UPD414/MK4027	4K Dynamic 16-pin	4.95
TMS4044-45NL	4K Static	14.95
TMS4045	1024x4 Static	14.95

PROMS/EPROMS

1702A	2K UV Erasable PROM	5.95
2708	8K EPROM	9.95
TMS2716	16K EPROM (-5V, +5V, +12V)	19.95
2716Intel(2516)TI	16K EPROM (Single +5V)	17.95
2732Intel(2532)TI	32K EPROM	49.95
2758	8K EPROM (450ns) (Single +5V)	7.95
5203	2048 PROM	14.95
82S23(74S188)	32x8 PROM (Open Collector)	4.95
82S115	4096 Bipolar PROM	19.95
82S123(74S288)	32x8 Tri-State Bipolar PROM	4.95
82S185	8K PROM	29.95

ROM'S

2513(2140)	Character Generator (Upper Case)	9.95
2513(3021)	Character Generator (Lower Case)	9.95
2516N	Character Generator	10.95
MM5230N	2048-Bit Read Only Memory	1.95

NMOS READ ONLY MEMORIES

MCM66710P	128x9x7 ASCII Shifted w/Greek	13.50
MCM66740P	128x9x7 Math Symbol & Pictures	13.50
MCM66750P	128x9x7 Alpha. Control Char. Gen.	13.50

MICROPROCESSOR MANUALS

M-Z80	User Manual	7.50
M-CDP1802	User Manual	7.50
M-2650	User Manual	5.00

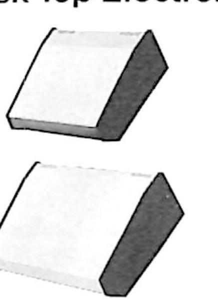
SPECIAL FUNCTION

DS0025CN	Dual MOS Clock Driver (5MZ)	3.50
DS0026CN	Dual MOS Clock Driver (5MZ)	1.95
INS1771N-1	Floppy Disc Controller	24.95
INS2651N	Communication Chip	19.95
MM58167N	Microprocessor Real Time Clock	8.95
MM58174N	Microprocessor Compatible Clock	11.95
COP402N	Microcontroller with 64-Digit RAM and Direct LED Drive	6.95
COP402MN	Microcontroller with 64-Digit RAM & Direct LED Drive w/N Buss Int.	7.49
COP470N	32-Seg. VAC Fluor. Driver (20-pin pkg.)	3.25

TELEPHONE/KEYBOARD CHIPS

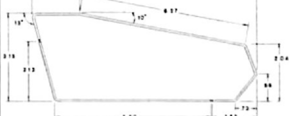
AY-5-9100	Push Button Telephone Dialer	14.95
AY-5-9200	Repertory Dialer	14.95
AY-5-9500	CMOS Clock Generator	4.95
AY-5-2376	Keyboard Encoder (88 keys)	11.95
HD0165-5	Keyboard Encoder (16 keys)	7.95
74C922	Keyboard Encoder (16 keys)	5.49
74C923	Keyboard Encoder (20 keys)	5.75
MM53190N	Push Button Pulse Dialer	7.95
MM57499N	96/144-Key Serial Keyboard Encoder	8.95

DESIGNERS' SERIES
Blank Desk-Top Electronic Enclosures



- High strength epoxy molded end pieces in mocha brown finish.
- Sliding rear/bottom panel for service and component accessibility.
- Top/bottom panels .080 thk alum. Alodine type 1200 finish (gold tint color) for best paint adhesion after modification.
- Vented top and bottom panels for cooling efficiency.
- Rigid construction provides unlimited applications.

CONSTRUCTION:
The "DTE" Blank Desk Top Electronic Enclosures are designed to blend and complement today's modern computer equipment and can be used in both industrial and home. The end pieces are precision molded with an internal slot (all around) to accept both top and bottom panels. The panels are then fastened to ¼" thick tabs inside the end pieces to provide maximum rigidity to the enclosure. For ease of equipment servicing, the rear/bottom panel slides back on slotted tracks while the rest of the enclosure remains intact. Different panel widths may be used while maintaining a common profile outline. The molded end pieces can also be painted to match any panel color scheme.



Enclosure Model No.	Panel Width	PRICE
DTE-8	8.00"	$29.95
DTE-11	10.65"	$32.95
DTE-14	14.00"	$34.95

$10.00 Min. Order — U.S. Funds Only
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Postage — Add 5% plus $1 Insurance

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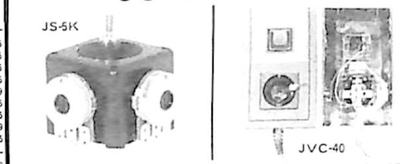


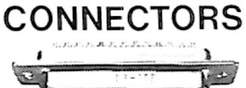
JS-5K	5K Linear Taper Pots	$5.25
JS-100K	100K Linear Taper Pots	$4.95
JVC-40	40K (2) Video Controller in case ...	$5.95

AC and DC Wall Transformers

Ideal for use with clocks, games, power supplies or any other type of AC or DC application.

Part No.	Input	Output	Price
AC 250	117V/60Hz	12 VAC 250mA	$3.95
AC 500	117V/60Hz	12 VAC 500mA	$4.95
AC 1000	117V/60Hz	12 VAC 1 amp	$5.95
DV9200	117V/60Hz	9 VDC 200mA	$3.25
DC 900	120V/60Hz	9 VDC 500mA	$3.95

CONNECTORS



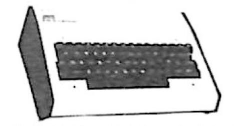
DB25P	D-Subminiature Plug	$2.95
DB25S	D-Subminiature Socket	$3.50
DB51226	Cover for DB25P/S	$1.75
22/44SE	P.C. Edge (22/44 Pin)	$2.95
UG88/U	BNC Plug	$1.79
UG89/U	BNC Jack	$3.79
UG175/U	UHF Adapter	$ .49
SO239	UHF Panel Recp.	$1.29
PL258	UHF Adapter	$1.60
PL259	UHF Plug	$1.60
UG260/U	BNC Plug	$1.79
UG1094/U	BNC Bulkhead Recp.	$1.29

TRS-80
16K Conversion Kit

Expand your 4K TRS-80 System to 16K.
Kit comes complete with:
★ 8 ea. MM5290 (UPD416/4116) 16K Dyn. Rams (*NS)
★ Documentation for Conversion

TRS-16K2 •150NS $49.95
TRS-16K4 •250NS $39.95

JE610 ASCII
Encoded Keyboard Kit



The JE610 ASCII Keyboard Kit can be interfaced into most any computer system. The kit comes complete with an industrial grade keyboard switch assembly (62-keys), IC's, sockets, connector, electronic components and a double-sided printed wiring board. The keyboard assembly requires +5V @ 150mA and −12V @ 10 mA for operation. Features: 60 keys generate the 126 characters, upper and lower case ASCII set. Fully buffered. Two user-define keys provided for custom applications. Caps lock for upper-case-only alpha characters. Utilizes a 2376 (40-pin) encoder read-only memory chip. Outputs directly compatible with TTL/DTL or MOS logic arrays. Easy interfacing with a 16-pin dip or 18-pin edge connector. Size: 3½"H x 14½"W x 8¾"D

JE610/DTE-AK (as pictured above) ... $124.95
JE610 Kit 62-Key Keyboard, PC Board, & Components (no case)..... $ 79.95
K62 62-Key Keyboard (Keyboard only) ... $ 34.95
DTE-AK (case only — 3¼"Hx11"Wx8¾"D) $ 49.95

JE600
Hexadecimal Encoder Kit

FULL 8-BIT
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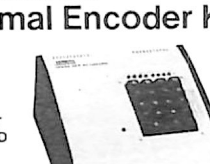

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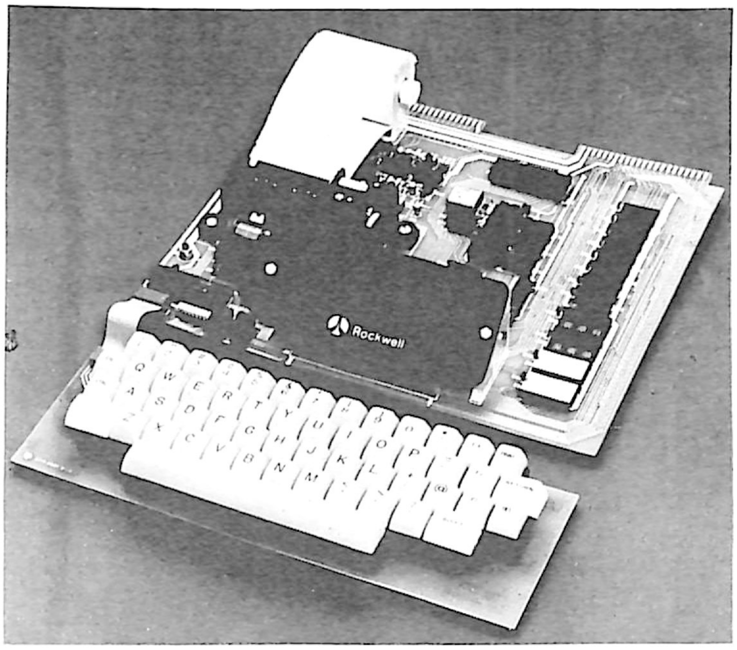

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BLACKBOARD

(from page 10)

ship is not inherent in the computer. Students should also realize that repeated runs of this program will produce different results, just as the real-world situation would produce different results. This very simple program is a valid simulation of a real situation.

Listing 2 contains a program that tosses two dice 3000 times and counts the number of times a sum of seven occurs. This is an example that can be understood at an elementary level, but is also an example that can be used to demonstrate to more mature students some of the dangers of incorrect simulations.

The program correctly simulates the tossing of two dice. Each die is represented by a random integer 1, 2, 3, 4, 5 or 6. The two numbers are then added, and the sum is compared to the desired value of 7. However, when used as an assignment or eye-opening illustration for those with no training in probability or statistics, this program often produces a notable incorrect result. Line 30 is frequently written as IF RND(12) = 7 THEN S = S + 1, or more cleverly as IF RND(11) + 1 = 7 THEN S = S + 1. Both of these are incorrect! In the first case the program is choosing a random integer between 1 and 12 inclusive to represent the sum of the two dice. The more clever case chooses the integer between 2 and 12 inclusive.

Using either of these incorrect commands for line 30 will, however, produce consistent results when the program is run. Those with little or no background in mathematics are quite content that they have a valid simulation of rolling two dice. And that contentment represents the real danger of simulations. A simulation can be no more valid or accurate than the accuracy and validity of the model used to produce the simulation. In this case we have a valid program that incorrectly models the real world we tried to simulate.

As simulations become very large and complex, the engineer or doctor who needs and helps design the simulation is not the same person who programs the simulation. The designer and the programmer must both be sure they fully understand each other and each other's work before either should have any faith in the simulation. As a simulation's complexities increase, so does the number of people who work on the simulation, and hence so will the dangers of it containing an incorrect representation of the real world.

Now consider several additional problems that might be used to introduce simulation ideas at the middle school and high school level. For example, the coin-tossing simulation can be modified to answer many different questions. What is the average number of flips that occur before obtaining five consecutive heads? After two consecutive heads are obtained, what is the probability of obtaining a tail on the next flip?

The coin-tossing problem can also be presented in a more disguised form. Most students have heard of the gambling strategy that suggests betting \$1 the first bet. If you win, you're \$1 ahead. If you lose, then make the second bet \$2. If you win, you're \$1 ahead. If you lose, again double your bet. Continue this pattern until you win just one time, and then you're \$1 ahead. At that time begin betting as though it's your first bet.

Sounds pretty good, doesn't it? You always win because you always keep doubling your bet until you win. Try writing a simulation of this method—bet on whether a tossed coin will land as heads or tails. Still look like a good method? If it does, then you ignored an important aspect from the real world. You ignored the reality of an initial, finite bankroll.

A simulation that requires a few additional programming skills is to replicate the child's game of looking for license plates with the same last two digits. The game is played while driving down the highway and noting the last two numeric digits on the license plate of each car passed. The question is to determine how many cars will be passed before finding two cars whose license plates have the same last two digits. To do this students must first write a simulation, then run the simulation a sufficient number of times to develop confidence in their answer. A discussion of and experience in determining how many runs are required for a sufficient answer is an important step in learning about simulations.

Secondary school mathematics teachers can use the next idea in any one of several courses. Given a quadratic equation $Ax^2 + Bx + C = 0$, where $A \neq 0$ and A, B and C are positive integers 0, 1, 2, . . . , 25, what is the probability that the roots will be imaginary; rational and equal; rational and unequal; or irrational? A program that represents this question and calculates the results should be readily completed by any student of first-year algebra.

If you object to considering this a simulation, you could probably produce some valid points to defend your position. Rather than debate, describe it as a quasi-simulation of a student actually solving the 16,900 different equations to determine the answer. Your results might make you wonder why so much time and emphasis is spent factoring quadratic equations in first- and second-year algebra classes. When suggesting problems such as this, try to add additional questions that better students can also address. How, for example, does the answer to the previous question change if A, B and C vary from 0 to 10 or from 0 to 50? Can you predict the results for other ranges of A, B and C?

Teachers can often make up a situation that fits a particular topic and then ask students to write a simulation program to represent that situation. The following teacher-produced situation is an excellent example of this type of contrived situation.

As part of a conservation and ecology project, a group of biology students has designed the following controlled experiment:

A small pond is polluted with several common types of waste material. Exactly 100 male fish are then introduced to the previously fish-free pond. Each day the students carefully net exactly ten fish. All ten fish are caught simultaneously and at the same time each day. After the netted fish are examined for signs of gill disease, their tails are dyed, and they are returned to the pond. The dye used is harmless and completely disappears after 15 full days in the water. If a netted fish is already dyed, it is dyed again so that it will remain dyed for the next 15 days. The experiment continues until each of the fish netted on any one day all have dye on their tails.

What is the average number of marked fish in the pond on a given day? How many days should the students allow to permit a reasonable chance for successful completion of this experiment?

Writing a simulation to represent this experiment is a highly instructive exercise for secondary students. Using their simulation to answer the first question regarding the average number of fish is relatively straightforward. However, defining a "reasonable chance" is a subjective task over which students will enthusiastically debate.

Once again, a small simulation can demonstrate an important aspect of far more significant simulations. When simulations were written to determine the most reasonable choice for reactor shutdown and cleanup, there were still major decisions that computers could not make. People also had to define "reasonable chance" in that situation. Hopefully, those working on the nuclear reactor were more conservative in their definition of reasonable than would be the average biology student considering the completion of just one assignment.

Both the importance of simulations and the role of the computer in support of simulations have increased remarkably. Understanding the nature of simulations should be part of the background of all educated people. The simulations suggested in this article are offered as possible initial steps that might be taken when students are introduced to this important concept. ■

Correspondence concerning this column should be addressed to Walter Koetke, Putnam/Northern Westchester BOCES, Yorktown Heights, NY 10598.

Saddling Apple Routines; In Search of Satisfied Customers

Saddling Apple Routines

Terry Phillips' "Whoa, Apple" (October 1980) routines were very useful, but I discovered that Apple DOS users cannot use them in their present forms. The problem arises because the print routine pointers can't be changed while DOS is active. You can get around this by loading either of the machine-language routines and running this short program:

```
10 PR#0 : IN#0 : REM TURN DOS OFF
20 POKE 54,299 : POKE 55,2 : REM SET POINTERS
30 CALL 976 : REM RESTART DOS
```

While tracking down this problem, I also found that the routine for halting a program listing is already built into Applesoft BASIC. As in the software approach, entering a CTRL-S stops the listing and a CTRL-Q restarts it.

Robert L. Hurt
Greensboro, NC

Terry Phillips' article was informative and accurate. However, the routines will not work when listing a program while in DOS. The routines, as presented, will work in DOS only if they are called from a program already running.

To use the routines with DOS, the RTS instruction at address 2E4 should be changed to JMP 03EA. The JMP instruction contains two more bytes than the RTS, so to keep the entry address the same, the routines should be typed in beginning at address 2DA instead of 2DC. This change allows DOS to pick up the address of the display control routines and tuck it away in DOS's own I/O registers. A rather meager explanation of all this can be found in the Apple DOS 3.2 manual on p. 105.

Tracy L. Shafer
MacDill AFB, FL

Response:

These suggestions perform exactly as intended, allowing the routines contained in the article to operate in a DOS environment. They are indeed a high-level and low-level approach to the same problem. The first solution, offered by Robert Hurt, simply turns DOS off to allow the routines to work and then reactivates DOS. Although this approach is functional, it's probably not as versatile as that suggested by Tracy Shafer, in which the routines are integrated into the DOS I/O.

Robert Hurt also made the statement that the CTRL-S, CTRL-Q output control software is already built into Applesoft BASIC, which I believe to be incorrect. Mr. Hurt probably has an Apple II-Plus or an Apple with an Auto-start ROM, which does have a similar CTRL-S, CTRL-Q control capability.

Terry Edward Phillips
Columbia, MD

In Search of Satisfied Customers

Your editorial straightforwardness about the lamentable state of the industry and word processing (November 1980, pp. 6–7) is remarkable for its courageous lack of the usual magazine sycophancy towards potential advertisers.

I am in the middle of a continuing quest for a word-processor-capable microcomputer. The capabilities, the promise of this device excite me. The industry, or more accurately, the computer retailers, dampen my ardor at every turn. Not an hour before I read your editorial, I inquired of the proprietor of a large computer outlet here about when I could obtain the Apple III. His smooth, sophisticated response to me was, and I quote, "Don't hold ya breath, fella!" Such couth. Such reassurance. Such incentive to press several thousand dollars into his fist. At one fell swoop, the untold fortune shelled out by manufacturers at the recent Toronto Computer Show was thrown to the wind.

When I first set out on my quest for a word processor, I was anxious, eager, impatient. Now, it has become something of a running gag. No longer am I in a frenzy of purchase. It'll be a while before I make the buy, even though I know what I want. Eventually, I'll buy the unit I want, despite the efforts to put me off by the very industry itself. In the meantime, the industry could profit by listening to you.

Sidney Allinson
Scarborough, Ontario

Your experience in the editorial "Word Processor Woes" (November 1980, p. 7) mirrors that of many of our now satisfied customers: They bought an add-on word processing software package for a general-purpose micro or mini, rather than going to a dedicated word processor manufacturer.

There will never be a word processor that's "as easy to use as a typewriter." But intelligent design that realizes human needs are superior to technical sizzle will always find a welcome home in the business world. And when that philosophy is backed up by person-to-person training and on-going support, you've got a winning combination.

Robert A. Fuire
Director of Marketing
Lexitron Corporation
Chatsworth, CA

To clear up an obvious misunderstanding: The system I used was put together by a dedicated word processor manufacturer and was not an add-on software package. They did use components from several other firms as part of their system, adding their software and special keyboard to it. I still found it cumbersome to use and ill-fitted for most of my work. I do hope that some of your happy users will find the time to write me and tell me of their experiences with your system—Wayne.

Violating the Code

The cardinal rule of computer programming has been violated in Dick Lutz's article "A Humanist's Approach to Computer Programming" (October 1980, p. 202). Professional programmers live by strict adherence to the rule: "Not one line of code may be entered into the machine until the program has been entirely defined, designed, coded, documented and desk-checked."

The article provides a BASIC program, PRGMBASE, to assist programmers by providing a shell from which they can work. One gathers from the article that Lutz encourages his readers to write their programs as they enter them into the terminal. To quote his own words, "I load it (PRGMBASE) whenever I begin writing a program in Microsoft BASIC. It not only imposes form on what I write, but it also helps me as I write."

Though well-intentioned, he is advocating very poor programming practices. The methodology of the experienced programmer does not allow for "writing" a program while perched in front of the terminal. The design and coding phases must be completed before the program is keyed into the computer. In essence, the program is finished before the programmer ever sits down at his terminal. When entering the program, the programmer should simply be typing from his coding form. No programmer who follows this procedure needs the tool Lutz provides to "impose form" on what he is entering.

Lutz's suggestions are an amateurish attempt to solve problems created by sloppy programming techniques. His cry for good documentation is worth noting, but it should be part of the larger process of a procedural programming methodology.

John Dalbey
Pacific Grove, CA

Response:

You're right. Programs definitely should be thought through before they are run. Nonetheless, macros are a strong and proud tradition in programming, and I put PRGMBASE in that category. If you've ever saved a group of subroutines to use in a future program, you've done much the same thing.

A programming language does that, too. It gives you a set of capabilities and limitations within which you work. Yet only the most versatile of us would forsake our language of usual choice because of a dogma that insists that no parameters be accepted before a program is fully thought out.

Nobody who types at multiples of his handwriting speed would take seriously an insistence that he stay away from a keyboard while writing a program. Thought, yes. Flowcharts, yes. Diagrams, yes. Doodles and notes, yes. But for writing, my medium of choice is the keyboard connected to the editing capabilities of my computer.

Lastly, I plead guilty to the "amateurish" charge. Let's just say I'm trying to retain my standing.

Dick Lutz
Pittsburgh, PA

Buy the Computer Before the Book

In the book review section of the September 1980 issue of *Microcomputing*, there is a fine review of *PET/CBM Personal Computer Guide*. The review does give one bad piece of advice to prospective PET owners in the last sentence: "Whether you're a PET owner or a prospective owner, this book is for you." I am not questioning the value of the book, but rather why should a prospective owner spend $15 on the book when Commodore will give you one free? The strings attached are that you must buy a *new* PET or CBM computer.

Commodore's district sales office in Norristown, PA, told me that, indeed, the book is being included with new computers, and that if a buyer of a *new* computer does not receive a copy with the computer, he should contact either the selling dealer or Commodore.

My advice to *prospective* owners of *new* PET/CBM computers: Save $15, wait until you buy the computer for your copy of the book. Also, for very recent buyers, if you did not receive a copy, question the dealer or Commodore—you may have one coming to you.

Myron D. Miller
Indianola, PA

The following is a response to the letter written by Jack Browne and Steve Sparks of Motorola published in our November 1980 issue—Editors.

Then and Now

At the time I wrote and submitted my article to *Microcomputing*, Motorola was promising only evaluation samples of the 68000, to be delivered early in 1980. I'm sure that Motorola is delivering in volume now, but that certainly wasn't true at the time the article was written.

Secondly, at the time the article was prepared, no one outside Motorola knew for sure what kind of design problems they were having with their pre-production versions of the 68000. I made the mistake of passing on a rumor that was making its way through the industry, and I apologize for not naming it for what it was.

As for my other "many incorrect statements," they were errors of omission. The article didn't pretend to cover every detail of the 68000, nor did every aspect of the 8086 and Z8000 get mentioned. Perhaps I should have left the 68000 out of the article, since the device wasn't in production at the time I wrote the article. But, I thought the readers of *Microcomputing* might like to have a little advance information. If I've badly misled anyone about the 68000, I apologize. I'm sure Mr. Browne or Mr. Sparks could clear up any questions you have.

Martin Moore
Aloha, OR

Encoding and Decoding Data

I enjoyed your November issue on computer security. Walter McCahan's article "Software Security" (p. 24) was a good overview on the whole subject. The one weakness is that anyone who determines a way to list the program can find the key necessary to get access to the program.

Alan Sclawy's article "CP/M Encryption Prescription" (p. 42) was excellent in showing an effective method of encoding data. The method is advantageous in being easy to apply but developing a coded text that is very difficult to decode without the key. To keep the keys to this method from being generally available, they are not included in the program.

Alan Sclawy did mention that there is another method of coding data that uses the public-key system. The 1979 August issue of *Scientific American* has an article "The Mathematics of Public-Key Cryptography" by Martin Hellman which describes some methods of encoding data that use a technique called the trap door function.

Another source of information is from the Massachusetts Institute of Technology's Laboratory for Computer Science. They published an understandable publication "A Method of Obtaining Digital Signature and Public-Key Cryptosystems" by Ronald Rivest, Adi Shamir and Len Adleman (code identifies MII/LCS/TM-82).

The public-key system works because knowing how to encode a text does not mean you know how to decode that same text. This technique uses modulo arithmetic. You can have a key in a program, as Walter McCahan did, but getting access to a program would not let the person discover the key. The key in the program would be encoded already.

There is little, if any, advantage of the public-key method over Alan Sclawy's use of the Gilbert Vernam XOR method. While the Gilbert Vernam method requires that the keys be kept secret, the public-key method must have its decoding factor kept secret. The biggest advantage of the public-key method is that it is mathematically more difficult to break than the Vernam method. I would have to be very desperate before I would try to break the code that Alan Sclawy generated. Good luck to anyone else who might try.

Robert C. Fruit
Hinsdale, IL

Chip In

One problem with Ohio Scientific Systems (most notably C2) has been their inability to utilize the 6502 IRQ and NMI commands from a BASIC program via USR routines. The problem originates from the fact that the reset vectors for these commands, contained in the system ROM, point to an area of memory that is heavily used by BASIC (i.e., 01XX). Thus, it is impossible to field either of these interrupts because BASIC rapidly destroys any service routine.

A proposal to OSI suggests that a new ROM be produced, identical to the old one in all respects except for the IRQ and NMI reset vectors. These would be changed to point to a part of memory that is "stable" (e.g., D0XX or E0XX). However, for such a new ROM to be produced, it must be financially feasible to do so. All interested OSI users should drop a quick note to Ohio Scientific Computers (attn: Customer Relations, 1333 South Chillicothe Road, Aurora, OH 44202) expressing interest. If enough replies are received, we may well see a new monitor chip.

Shaun D. Black
University of Michigan
Ann Arbor, MI

Edited by Dennis Brisson

Heath Color Graphics Board
Direct-Connect Modems
Apple Voice Entry Terminal
6809 Single-Board Micro

Direct-Connect Modems

The Microperipheral Corporation, PO Box 529, Mercer Island, WA 98040, has just introduced a new line of direct-connect modems, called Microconnections. All units feature Bell-103-compatible operation in the originate or answer mode. A direct connection to the telephone line eliminates the problems associated with acoustic-coupled modems and provides high sensitivity low-error rates and noise-free performance. Designed to interface most popular computers and terminals to the telephone network, Microconnections are available for the TRS-80, Atari, Apple and RS-232 serial I/O. Prices start at $199.95.

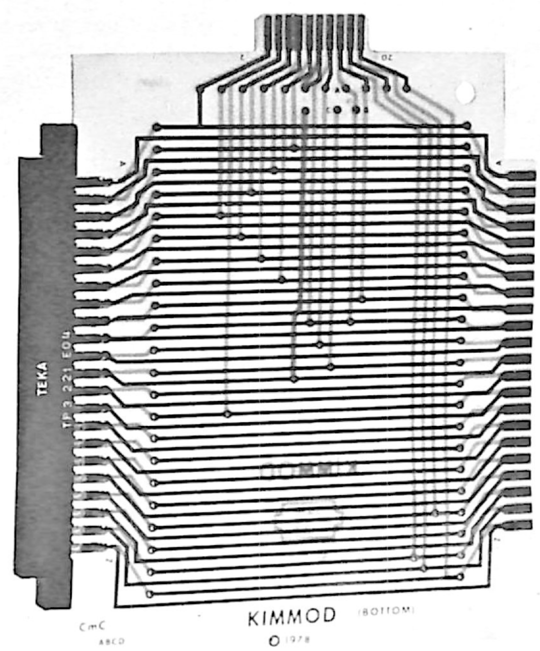
The Autodial/Autoanswer module ($79.95) permits automatic connection to other computers via the telephone network, with unattended data transfer such as message sending and retrieval. Another option allows the Microconnection to be used with European systems ($29.95); tone frequencies are set to CCIR standards. Smart terminal programs such as Dow Jones Connection and Mailgram Connection are also available. Reader Service number 494.

The Microperipheral Corporation's Microconnection.

KIM A/D Conversion System

KIMSET1, an analog to digital conversion system for KIM microcomputers, provides 16 channels of analog input, each with a resolution of eight bits. Consisting of a KIMMOD, AIM16 analog input module, connecting cable, MANMOD1 manifold module, POW1 power supply, software and instructions, the KIMSET1 allows the KIM to process such real-world variables as temperature, velocity, pressure, dB, pH, acceleration, humidity and light and fluid levels. The KIMMOD plugs into the KIM at the applications port and provides the computer user with both another applications port and a port for connecting the AIM16 module. The MANMOD1, which plugs into the AIM16, provides screw terminals for ground, reference and analog inputs. Price is $285.

Connecticut Microcomputer, Inc., 150 Pocono Road, Brookfield, CT 06804. Reader Service number 487.

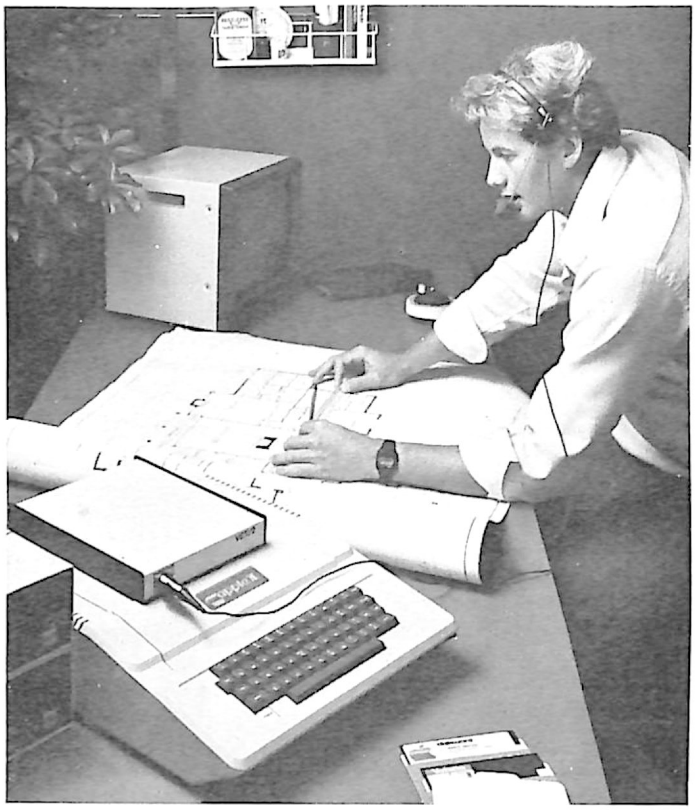


Connecticut Microcomputer's KIMSET1.

Heath's Color Graphics

A color graphics board for Heath computer systems has recently been introduced by Heath Company, Benton Harbor, MI 49022. The HA-8-3 Color Graphics Board, designed for use with Heath's H8 and All-In-One Computers, uses the advanced TI-9918 Color Video Display Generator from Texas Instruments and an AY-3-8910 Programmable Sound Generator.

Eight channels of analog-to-digital conversion can handle up to four X-Y joystick consoles (not included). Each console has four bits of parallel I/O for switches or LEDs. A socket is also provided for the AMD-9511 Arithmetic Processor Chip (not included), which permits rapid floating point, trigonometric and transcendental computations. The chip can also perform hardware multiplication/division



VET/2 voice entry terminal.

of both integer and floating-point numbers. The HA-8-3 connects to the video input of most video monitors. Price is $395. Reader Service number 489.

Apple Voice Entry Terminal

The VET/2 voice entry terminal from Scott Instruments, 815 North Elm, Denton, TX 76201, interfaces directly with any 48K Apple II microcomputer and gives the Apple truly integrated speech recognition capability. The 1-1/4 × 8 × 10 inch unit plugs into any slot in the Apple II and is linked functionally to the keyboard, allowing you to choose keyboard input or voice input at any time. Price is $895. Reader Service number 492.

6809 Single-Board Microcomputer

The QCB-9 is a single-board microcomputer based on the 6809 eight-bit microprocessor from Logical Devices, Inc., 1525 N.E. 26th St., Ft. Lauderdale, FL 33305. It incorporates an onboard floppy disk controller, handling up to three single-sided, single-density minifloppy drives. Since up to 24K bytes of EPROMs or 6K bytes of RAM can be configured on the board, it requires no additional memory boards and can thus perform many functions ranging from word processing and software/hardware development to industrial control. Jumper options allow a variety of EPROMs to be used, as well as providing flexibility in memory and I/O addressing. Additional features include an RS-232C serial communication interface, two eight-bit parallel ports and on-board power regulation. Price is $395. Reader Service number 488.

H89/Z89 Connection

Now you can add the Centronics Model 737 high-density matrix printer to your H89/Z89 computer with the interface package from FBE Research Company, Inc., Box 68234, Seattle, WA 98168. The interface circuit board (with integral six-foot printer cable) plugs into either internal H89/Z89 bus. The HDOS device driver, CT, is provided in object and source formats. The driver provides full access to all of the printer's features, including underscoring; elongated, proportional, condensed or standard print fonts; subscripting and superscripting; backspace; and half or full, forward or reverse line feeds. The interface board and driver cost $64.95, or $14.95 for driver only and $54.95 for interface only. Reader Service number 491.

6809 Processor for The Apple II

The Mill, a plug-in processor board for the Apple II, brings the world of 6800 software to the Apple II community. Installed in any Apple II peripheral slot, the Mill supercharges the stock Apple II microcomputer with the Motorola 6809E processor, a high-speed device optimized for real-time data acquisition, stack-type languages such as FORTH and Pascal and concurrent programming tasks. You can run existing 6502 programs or use software developed for the Motorola 6800 processor; the assembler for the Mill's 6809 will readily compile 6800 instructions into 6809 object code.

The 6809E is hardware compatible with the Apple's existing processor, thus allowing external circuitry such as bus drivers, timing and control circuitry to be kept simple and reliable. Communications between the two processors is easily accomplished with commands, and you can also simply recode sections of 6502 programs into 6809 machine language for high-speed operations. Price is $275.

Stellation Two, PO Box 2342, Santa Barbara, CA 93120. Reader Service number 490.

Address Correction

The address of E. A. Elliam Associates as published in our December issue ("The Master Catalog System for CP/M Users," p. 188) was incorrect. The company's correct address is 24000 Bessemer St., Woodland Hills, CA 91364

Edited by Dennis Brisson

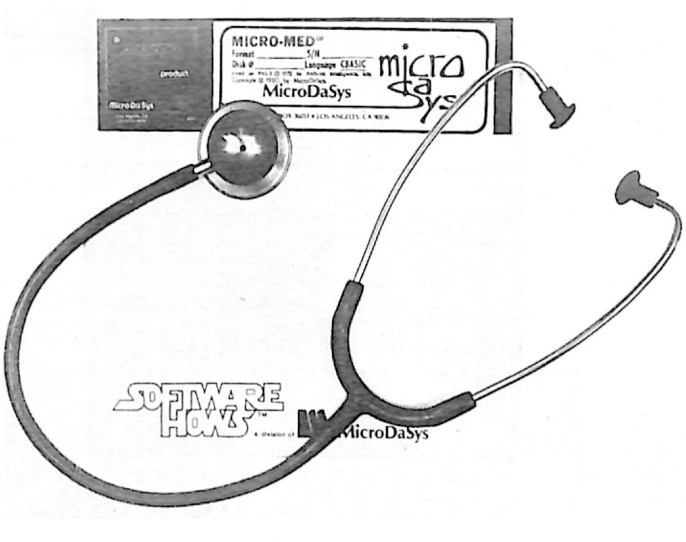
Word Processors for Apple and CBM
Medical Billing System
8080 Tax Program
TRS-80 Cribbage

Patient Billing System

MicroMed version 1.65 is a floppy- and/or hard-disk-based medical billing system that will automate your billing procedure, improve turnaround of insurance form processing and provide mail-list and information processing for your patient records. It keeps track of services rendered, bills patients and/or insurance organizations and prepares statements. It handles any number of insurance form types. You can quickly and easily modify the formats that are used in the system if new forms are added or existing forms are altered.

You can elect to assess service charges on past due accounts and can sort through patient information and prepare a mailing list using 15 sort criteria keys. With a form letter merge utility such as the SoftwareHows DataMerge package, you can send personalized form letters, dunning messages or notices to selected patients. MicroMed also performs patient appointment recall. Available in disk formats for CP/M-based systems, MicroMed costs $1500.

MicroDaSys, PO Box 36275, Los Angeles, CA 90036. Reader Service number 481.



MicroDaSys' MicroMed medical billing system.

Word Processing for The Apple

The Programma WP system, designed with the user in mind, has over 150 commands in its two linked programs: Apple Pie (Programma Improved Editor) and Format, the text formatter.

Pie is a free-form, screen-oriented editor for creating and editing the text for processing. You can enter or alter text anywhere on the screen. It features page scrolling, character or line insert and delete, splitting and joining of lines, string searches and global replacement. It allows use of a lowercase adapter and will work with or without an 80-column board.

Format uses simple codes to format letters, documents, manuals, catalogs or scripts to any specification. Centering, underlining, margin justifications, indentation, paragraphing and filling and automatic pagination are included. It allows spelling corrections or copy revisions before printing, as well as major changes to a document's final appearance. Available on minifloppies for $129.95.

Programma International, Inc., 2908 N. Naomi St., Burbank, CA 91504. Reader Service number 484.

6800 Diagnostics and Disk Repair

A memory diagnostics and disk repair package for the 6800 microprocessor is now offered by Technical Systems Consultants, Inc., PO Box 2570, 1208 Kent Ave., West Lafayette, IN 47906. The memory diagnostics package includes a zeroes and ones test, random pattern test, walking bit tests, dynamic RAM dropout test and a convergence test. The disk repair portion includes three diagnostic utilities which report unreadable sectors and structural inconsistencies among the files on the diskette, two utilities for recovering data when the directory on the diskette is not readable, a utility to remove bad or intermittent sectors from the free space, a program to retrieve deleted files from the diskette free chain, a single-sector read/write/modify routine and a copy utility which ignores CRC errors. The utilities operate on a Flex-formatted diskette. Price is $75 for a five- or eight-inch diskette. A comparable package for the 6809 microprocessor is also available. Reader Service number 476.

8080 Tax Program

A tax preparation package that processes an average return in less than 30 minutes on an 8080-compatible microcomputer is now available from Lifeboat Associates, 1651 3rd Ave., New York, NY 10028. Designed for accountants and tax services that prepare more than 100 tax returns annually, Master Tax eliminates the need for input sheets, questionnaires and outside computer services. All data entry sequences are entirely form oriented. Printing can be done on preprinted continuous forms, overlays or on computer-generated IRS-approved forms. The program also maintains client history files.

Master Tax incorporates 1 percent and 3 percent medical limitation, checks for FICA over-withholding, calculates earned income credit calculation, carries over city sales tax to schedule A and types the tax preparer's Federal ID and employee's social security

numbers on 1040s. The program requires an 8080/Z-80/8085-based system with 48K of memory, two disk drives and a video terminal with an 80 character by 24 line display with direct cursor positioning capability. Price is $995. Reader Service number 475.

CP/M File Transfer Program

SENDFILE and RECVFILE, written in CP/M 8080 assembler code, let you transfer files to and from a micro with similar programs. You can transfer files between 8-inch disk systems and 5-1/4-inch disk systems or any systems having different disk formats. The two micros must communicate via I/O ports, possibly over a modem.

All terminal and disk I/O is via standard CP/M interface calls, with the exception of the I/O ports, which are normally not a part of CP/M and thus are coded directly. These I/O and Status bit assignments are tailored to your system via four simple Equates at the beginning of the programs. After these modifications, they may be assembled and loaded as CP/M COM files. The programs are available in source form on 8-inch IBM 3740 format for $25 or on 5-1/4-inch North Star format for $20. Source listings are $15.

Kester Consulting, 3416 Braddock St., Dayton, OH 45420. Reader Service number 486.

TRS-80 Accounts Payable System

AP, an accounts payable system for the TRSDOS Model II, is designed to keep track of current and aged accounts payable. The system incorporates programs to maintain a complete record for each vendor, helps determine which vouchers to pay by due date or discount date, or within certain cash requirements, and prints checks automatically. You can often increase discounts taken and reduce the cash tied up, and hence allow smoother cash flow of your company. AP uses a full 80-column screen and requires 64K memory and dual disk systems. Price is $129.

Micro Architect, Inc., 96 Dothan St., Arlington, MA 02174. Reader Service number 477.

Word Processor for CBM 8032

Wordcraft 80 is a word-processing system designed for the Commodore 8032 business system.

Features include variable page layouts up to 117 characters by 98 lines; screen display of finished format document; tabs, indentations, decimal tabs and columns; and automatic centering and right margin justification. Wordcraft 80 also handles automatic page numbering, headers and trailers; and the deletion/insertion of characters, words and paragraphs. Price is $395.

Commodore Business Machines, Inc., 950 Rittenhouse Road, Norristown, PA 19403. Reader Service number 478.

Lawtech Software

The following two programs from The Lawtech Company, PO Box 1523, La Grande, OR 97850, were written for a 16K TRS-80 with Level II BASIC. Price is $15 separately or $25 for both.

Intoxitron estimates a subject's blood alcohol content and degree of intoxication, based on sex and weight, as well as the number and strength of drinks and the time since the first drink.

Inc. minimizes attorney error in the area of corporate cumulative voting provisions. It explains cumulative voting, performs all calculations necessary to understand and allocate shareholder voting and contains a checklist of pitfalls and bibliography. Reader Service number 480.

TRS-80 Cribbage

Now you can test your card-playing skills against your micro with Cribbage Master, a program for the 16K TRS-80 Level II. The program scores every hand and crib with lightning speed and without

Interface Technology's Micro Commander package.

errors. The player's cards are shown on the computer's screen in card-shaped rectangles, moving from the player's hand to the table as they are played. The program plays a strong game, pegging its own points in play. All entries are made with a single keystroke. Price is $12.95.

Manhattan Software, Box 35, Pacific Palisades, CA 90272. Reader Service number 483.

Apple II Word Processor

A professional word processing software system for the Apple II has recently been announced by Computer Solutions, 6 Maize Place, Mansfield, Q. 4122, Australia. It allows upper and lowercase for the Apple and features full mail-merge facilities. The software and manual cost $295. Reader Service number 482.

Micro Commander

The Micro Commander is a software-driven interface for your microcomputer and the BSR X-10 system to remote-control lights and appliances (motors, TV, stereo, heaters, alarms, fans, pumps, etc.) in your home or office. Because the Micro Commander is a direct interface to the ac power line, you do not need to purchase the BSR command console. You can have direct computer control of up to 256 separate lights and appliances. You can connect it to a TRS-80 or S-100 bus micro. The manual includes a 14K TRS-80 BASIC program listing and 8080/Z-80 assembly-language listing. Price is $59.95.

Interface Technology, PO Box 383, Des Plaines, IL 60018. Reader Service number 479.

68XX Information Service

A 6800 through 68000 software/hardware information service has recently been formed by Computer Publishing Incorporated (CPI), 3018 Hamill Road, Hixson, TN 37343. CPI has compiled a comprehensive file of development and applications software for the 68XX series of computers, including the S-50-bus configuration. This file lists specialized software and/or hardware currently available, including several new multi-user, multitasking disk operating systems for the 6809 and 68000. Reader Service number 485.

Attention, Clubs

Kilobaud Microcomputing wants to hear from clubs with announcements of their meetings or special events. Include your club's name, the name and address of a contact person, the date and address of the regular meeting schedule, membership requirements, publications and club objectives.

8080 Microcomputer Experiments
Transducer Experiments and Applications
S-100 Bus Handbook
Z-80 Design Projects

8080 Microcomputer Experiments, 2nd Edition

By Howard Boyet,
dilithium Press, 1978
396 pp., $15.95

Dr. Boyet is a Professor of Electrical Engineering at Pratt Institute in Brooklyn, NY, and brings classroom and laboratory experience to the book. He feels that far more learning is done through hands-on work than from simply reading, and he brings this conviction to *8080 Microcomputer Experiments*. Just about half of its 396 pages are devoted to software and hardware experiments that motivate the student to become truly involved. A quarter of the book is devoted to expository material that prepares the student for the experiments, and the remaining quarter contains useful reference data.

The experiments are geared for the 8080 microprocessor, and the address and instruction codes are expressed in octal. While this certainly makes it more convenient for those with an 8080 machine and for those who use octal, the concepts are the same with other microprocessors, and the 8080 instruction set is given in both hex and octal in appendix B. The experiments are performed specifically on the E & L Instruments MMD-1 8080 trainer, but they can, for the most part, be done on any other 8080 system as long as the data and address buses are accessible. Detailed requirements for other 8080-based systems are given in appendix H.

Chapters 1 and 2 are intended to provide sufficient theory to allow the student to perform the experiments with complete understanding. But while Boyet says that no previous experience is necessary, chapter 1 covers binary and octal numbers in only four pages, and then goes on to cover gates, flip-flops, latches, decoders, registers, Tri-states, register transfers and encoders in 14 more pages. It certainly helps if the reader has a bit of previous knowledge of these things, and failing that, it might be a good idea for him to do some introductory reading. Chapter 2 covers microcomputer architecture and data flow and bus structure briefly but adequately.

In chapter 3 the book begins to shine. The experiments in this chapter deal only with software and programming. They start out with a program that demonstrates that 377 (octal) + 1 = 000 and that 000 − 1 = 377 (octal), thereby using the computer to repeat, via a program, exactly what was learned in theory in chapter 1. This is pedagogy at its best. Other experiments help the reader understand, among other things, storage and retrieval of data from memory, time delays, port displays, the use of push and pop instructions, flags, conditional jumps, calls and returns, and the very important relationships between binary and BCD.

Chapter 4 deals with single-stepping, which is the key to seeing what is really happening inside the computer. Single-stepping lets the operator examine the status of the computer cycle by cycle, and observe the changes that are occurring at each step of the program. It is the ultimate debugging tool. The chapter starts with single-stepping a simple binary addition program, and includes more and more instructions in the programs as the chapter progresses.

Chapter 5 discusses interfacing the computer to an I/O device and interacting with it. The experiments relate to selecting the device, outputting control signals to it, outputting data to it, inputting data from it, jamming and interrupt requests, status bits and so on. In the words of the book, "chapter 5 puts it all together."

Appendices A through L cover some important ICs and their pin configurations, the 8080 instruction set (in hex and octal), vendors, references, the Intel 8085, etc. Appendix K is particularly noteworthy—it presents 25 additional software and interfacing experiments, whose contents range from counting and keyboard control to further work with interrupts and jamming.

Many books are available today that try to educate and clarify in the field of microprocessors and microcomputers. Many of them are excellent; a few don't quite measure up. Within this reviewer's experience, most do not go the route of education through experimentation. It is too easy with an explanatory work to absorb what is easy to follow and gloss over what is more difficult, with the thought of returning to it "some day." Much of the book's value is thereby lost.

In a book filled with experiments, that is more difficult. Boyet has come up with an approach that, although not at all unusual for a textbook, is a bit off the beaten path for a semipopular work in the microcomputer field. He has produced a book that takes the reader to the heart of the matter and motivates him to get inside and see what is happening, and having seen, understand.

In the author's words, "it is the purpose of this book to present a concise, hard-hitting, significant and motivating group of experiments covering the basic and fundamental essentials of the microprocessor-microcomputer." He did just that, and in so doing he produced an excellent book that should be read by everyone interested in understanding software, hardware and how they work together.

Alfred A. Adler
Tucson, AZ

Instrumentation Transducers, Experimentation, and Applications

Roger W. Prewitt and Stephen W. Fardo
Howard W. Sams & Co., Inc.
Softcover, 219 pp., $11.95

Microcomputers not only play games and balance your checkbook, but can also monitor and record the temperature, humidity, light level or anything else in the physical environment. They do so with a transducer, which takes the physical variable and converts it into an analog signal that can be digitized into a format compatible with the computer.

Since the analog output is only as good as the transducer that generates it, the user needs to know how they work and what their limitations are. This book introduces the beginner to some of the more common transducers and their possible applications.

The authors study transducers for six physical variables: temperature, humidity, light level, pressure, displacement and pH. They present their material in a unique format—removable worksheets make it more of a workbook than a text. The book includes a discussion of each transducer, some experiments dealing with it and a list of questions. The experiments illustrate important principles of transducer operation.

I like the manner in which this book deals with each class of transducer. But some important transducers were neglected. The authors did not mention the pH probe, and the section on pH was poorly done and too short.

But overall, the book is useful for explaining the theory and operation of common transducers. It would be a good text for an introductory course in instrumentation, but is also a good self-teaching guide for the hobbyist.

George D. Dooley
State College, PA

The S-100 Bus Handbook

Dave Bursky
Hayden Book Company, Inc.
Rochelle Park, NJ, 1980
Softbound, 280 pp., $12.95

I dislike writing a negative review of a book because I know how much work goes into writing and publishing one. However, I feel it is important that I give an honest opinion if my review is to be meaningful.

I'm a confirmed S-100 bus devotee, and I went after this book as soon as I heard about it. I was looking for information on bus signals, interfacing and associated software but, unfortunately, I didn't find much. *The S-100 Bus Handbook* is a rehash of material that is mostly out of date or irrelevant. The microcomputer novice might find some interesting information here, but I don't think that the hardware hacker who wants to build or modify S-100 circuit boards is going to find much that he can use.

The text starts out with chapters on history, binary math, Boolean algebra, introductory electronics and logic functions. Anyone who is interested in the hardware aspects of the S-100 bus is already past that. The next chapter lists the bus pins and describes their functions a little, but not nearly enough. This should be one of the main chapters in the book, but it is only seven pages.

The chapter on computer memory systems gets a few more pages, but they are mostly pictures of boards and blown-up micro chips. Next come I/O interfaces and peripheral storage devices, and here the author goes into a little more detail using some boards which are no longer available as examples. The information presented is still valid because there isn't that much difference between the major manufacturers since they all use basically the same chips.

The chapter on 8080 programming uses up pages and pages to list and describe all of the 8080 assembly-language instructions. This is unnecessary for the user who is already programming the 8080 and not really sufficient for the novice trying to learn.

The text ends at page 148 with some useful information on interfacing to the real world and troubleshooting. This is slightly over half the book. The rest is devoted to appendices. These include lists of books and publications, lists of TTL and CMOS chips, manufacturers and 90 pages of schematic diagrams of various S-100 bus circuit boards.

These latter have a certain relevance if you have the experience to figure out what the original designer had in mind. But again, except for a few boards, all of these are no longer available, and the chances are pretty good that you would have the schematics if you already had any of these boards.

Maybe I was expecting too much, and that's why I'm disappointed in *The S-100 Bus Handbook*. But whatever I was looking for, I didn't find it here. Maybe it's because the text is too general or too simplified. The rapid changes in the microcomputer industry and the length of time it takes to research, write and publish a book make an up-to-date text difficult, but my main objection is the approach used. All I can say is let the buyer beware. Look it over before you put out your money.

Rod Hallen
Washington, DC

Z-80 Microcomputer Design Projects

William Barden, Jr.
Howard W. Sams & Co., Inc.
Indianapolis, IN, 1980
Softcover, 208 pp., $12.95

While there are frequent articles about Elf computers and entire magazines devoted to the KIM/SYM/AIM computers, small-scale (read cheap) applications of the Z-80 are rare. It's almost as if a chip specification indicates that the Z-80 was designed for "real" computing applications in large, expensive packaged systems.

Fortunately for those interested in a Z-80 equivalent to the KIM, William Barden has written a book detailing the design, construction and programming of just such a project. Dubbed the EZ-80, this single-board computer was designed with economy and simplicity in mind.

The first 50 pages give the reader an overview of the hardware and programming involved. Although the material here is adequate for the completion of the project, a more thorough treatment can be found in the author's earlier book, *The Z-80 Microcomputer Handbook*.

Design Projects assumes the reader has limited programming experience and wisely avoids an exhaustive examination of the instruction set. The reader is encouraged to investigate the advanced instructions after mastering the simpler codes.

In contrast, the hardware chapters deal first with the requirements of a section of the computer and then introduce the specific device chosen. Most of the parts are industry workhorses and readily available.

The second quarter of the book deals with the actual construction of the EZ-80 computer and a simple EPROM programmer. Both wire-wrap and printed circuit approaches are discussed, including wiring lists and PC board patterns in an appendix. Barden treats all phases of the construction process in some detail, and includes checkout procedures to eliminate expensive errors. A diagnostic program offers further support.

The real fun begins in the second half of the book. Nine applications of the EZ-80 are detailed in terms of the EPROM program and operating instructions, followed by hardware notes where necessary. There is also a brief description of how the program works. To avoid typesetting errors, all programs are printed the way they came off the printer.

The actual applications are traditional. They activate relays (a burglar alarm and a telephone dialer), count and make noises (a music "synthesizer" and two Morse code generators).

The final chapter, "Blue Sky Projects," gives suggestions for more ambitious projects, including distributed processing using several Z-80 computers.

This book was written to detail the construction of a single-board Z-80 computer to the point where even a neophyte can succeed, and on that basis there can be no complaints. The few reservations I have concern the design rather than the book itself. (Why a 12-key instead of a hex keyboard? Why not a larger memory?)

I recommend this book to anyone interested in learning about the Z-80 or single-board computers.

R. Tyler Sperry
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PERSPECTIVES

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enough to prove useful on projects that return more money than micro-based business applications projects. Such a shortage has proven to be quite long-lasting for minicomputer vendors in the small business applications arena.

Some Solutions

But all is not gloom and doom. Some mitigating measures, and possibly some solutions, are at hand.

If you are a businessman convinced that computer power is just what you need, you have every right to ask micro vendors about their design and implementation control methods. Ask to see something on paper. If you get a blank stare or a waffle and are still determined to do business, haul out this article and use the outline presented here as a checklist.

I am not associated with CIBAR (except as a satisfied customer), but I have a question for the industry: Micro hardware manufacturers, where are your professional enrichment programs for your dealers? Individual vendors can't afford seminars from high-powered (and high-priced) outfits such as CIBAR, but seminars (and other programs) sponsored and partly subsidized by you, the manufacturer, for your dealers would be a good investment in both your futures. Certainly these badly needed programs are affordable at some level in the industry.

Question number two is like the first: Producers of standard components (both hardware and software) for final delivered systems, where are your implementation kits, configuration checklists, interview aids and so forth?

I am not talking about documentation, the supposed dearth of which is too often blamed for results actually due to inexperience or downright incompetence. I am also not talking about glossy, professional-looking (whatever that is) product or sales brochures which seem to be perceived by every component producer as essential, and which often do the dealer and the potential customer little good.

I'm talking about the sort of thing an insurance salesman comes equipped with when he sits down with a prospect. I mean the sort of graphic and textual aid that casts the customer in the role of a person with a problem to be solved and the vendor in the role of the professional here to help with a solution, and then helps step both parties through the problem to a solution.

Obviously, to actually be useful to the vendor, such a thing would have to be prepared with consideration to how the range of capabilities of your components relates to some coherent view of the entire solution. The system life cycle concept provides such a view.

As well as equipping the vendor to handle the component product as it might be handled by a computer engineer, systems analyst or software engineer, the component producer should equip the vendor to sell solutions. The accountant has standard audit worksheets, the lawyer has standard contract forms. The micro vendor also needs something to go by. ■

By David Carew

A Crisis Of Craftsmanship

Why Micros Too Often Fail Small Business

Small businesses and the micro industry are faced with a serious crisis: a crisis of craftsmanship.

If you've been around, you've heard the other caveats and warnings. The message is either that micro hardware capability, reliability, service support and documentation has not yet arrived, or that micro vendors have yet to understand the needs of the small business market. These chestnuts, as richly detailed and variegated as any piece of folklore or myth, have been around the industry for years.

But they are bunk, or, at best, platitudes.

In 1964 machines of scarcely more capability and considerably less reliability than today's micros were launching mankind into space. We will have cheap machines rivaling the hardware that controlled the moon shot in 1969 long before people stop using platitude A to explain commercial system fiascoes.

As for platitude B, there is nothing so abstruse about the situation of the typical small businessman as to be incomprehensible to the typical micro vendor. Indeed, such a vendor is often himself a small businessman.

The point I have to make is perhaps a bitter pill for the industry to swallow. To understand it fully, some background is necessary.

The System Life Cycle

The life of a typical system passes through a number of phases. Ideal system development and implementation is structured around the system life cycle. Understanding this concept and the typical stages or phases of the system life cycle is crucial to a real grasp of what seems an obvious truth: systems are implemented and delivered one at a time.

The hardware and software components of the automated portion of the system for Joe's Corner Shoe Store may well be mass-produced, but at some level crucial to Joe, the system must be unique to Joe's specific situation.

A breakdown of the system life cycle was devised by CIBAR Systems Institute in a comprehensive management tool called the Project Notebook. CIBAR is engaged in making the high-flown theories of the computer scientist useful to the solution of everyday problems facing the practicing DP person. Each system passes through phases, as outlined in Table 1. A detailed expansion of items and concerns within each stage is shown in Table 2.

As can be seen, computer systems (micro and otherwise) are essentially handcrafted products, built one at a time, and the microcomputer industry faces a shortage of the right sort of craftsmen. Joe's system will not design or implement itself just because it is largely composed of off-the-shelf components.

I hesitate to say that the average computer shop employee wouldn't know an integration test specification or a stimulus flow diagram if one crawled up and lodged its teeth in his ankle. But I will say that many of those in the micro business who are responsible for a complete and final system product are unaware that they face a challenge complex enough, deep and rich enough to be worthy of professionalism, care, and specific control, a craft worthy of study to be perfected by a mastery of tools and techniques.

The craftsman shortage may well prove chronic. The system design and analysis skills involved are general

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System Life Cycle Phases

I.	Definition of the problem or need
II.	Logical design
III.	Physical design
IV.	Construction
V.	Implementation
VI.	Operation
VII.	Evaluation and maintenance

Table 1.

I. Definition
- 1.1 Problem statement
- 1.2 User correspondence
- 1.3 Survey and analysis of existing system
- 1.4 Project plans
- 1.5 Cost benefit analysis
- 1.6 System requirements statement
- 1.7 Project objectives
- 1.8 Management memos, status and review reports
- 1.9 Functional analysis and decomposition

II. Logical Design
- 2.1 Data dictionary entries
- 2.2 Data flow diagrams
- 2.3 Process and control flow diagrams
- 2.4 Data structure diagrams
- 2.5 External functional specifications

III. Physical Design
- 3.1 Hardware configuration
- 3.2 Data base definition
- 3.3 Memory usage
- 3.4 Input formats
- 3.5 Output formats
- 3.6 Screen formats
- 3.7 Program definitions
- 3.8 Program interface definitions
- 3.9 System design specification

IV. Construction
- 4.1 Module definitions
- 4.2 Module documentation index
- 4.3 Module interface definitions
- 4.4 Macro or preprocessor definitions
- 4.5 Unit test specifications
- 4.6 Operators manual
- 4.7 Users manual

V. Implementation
- 5.1 Integration plan
- 5.2 Test plan
- 5.3 Integration test specification
- 5.4 Requirements matrix
- 5.5 Conversion plan
- 5.6 Training plan
- 5.7 Stimulus flow diagrams
- 5.8 Acceptance scenario

VI. Operation
- 6.1 Change control plan
- 6.2 Backup procedures
- 6.3 Run time documentation

VII. Maintenance and evaluation
- 7.1 Discrepancy reports
- 7.2 Action requests
- 7.3 Performance evaluation
- 7.4 Project evaluation
- 7.5 System evaluations

Table 2.

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