No. 48 July-August 1989 $3.95

THE MICRO TECHNICAL JOURNAL

MICRO CORNUCOPIA

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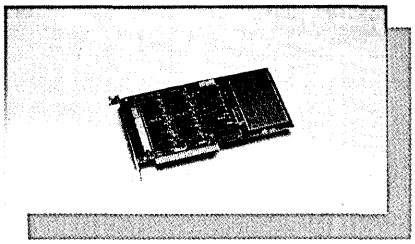

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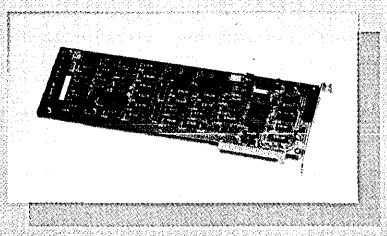

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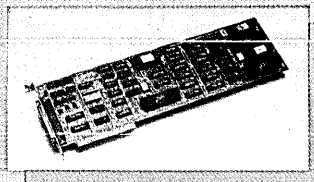

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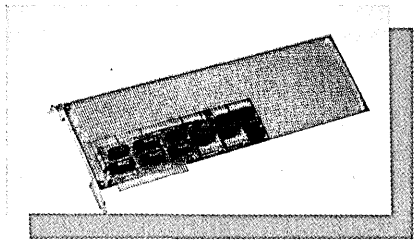

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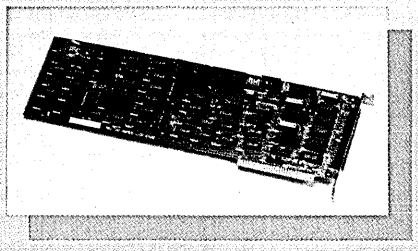

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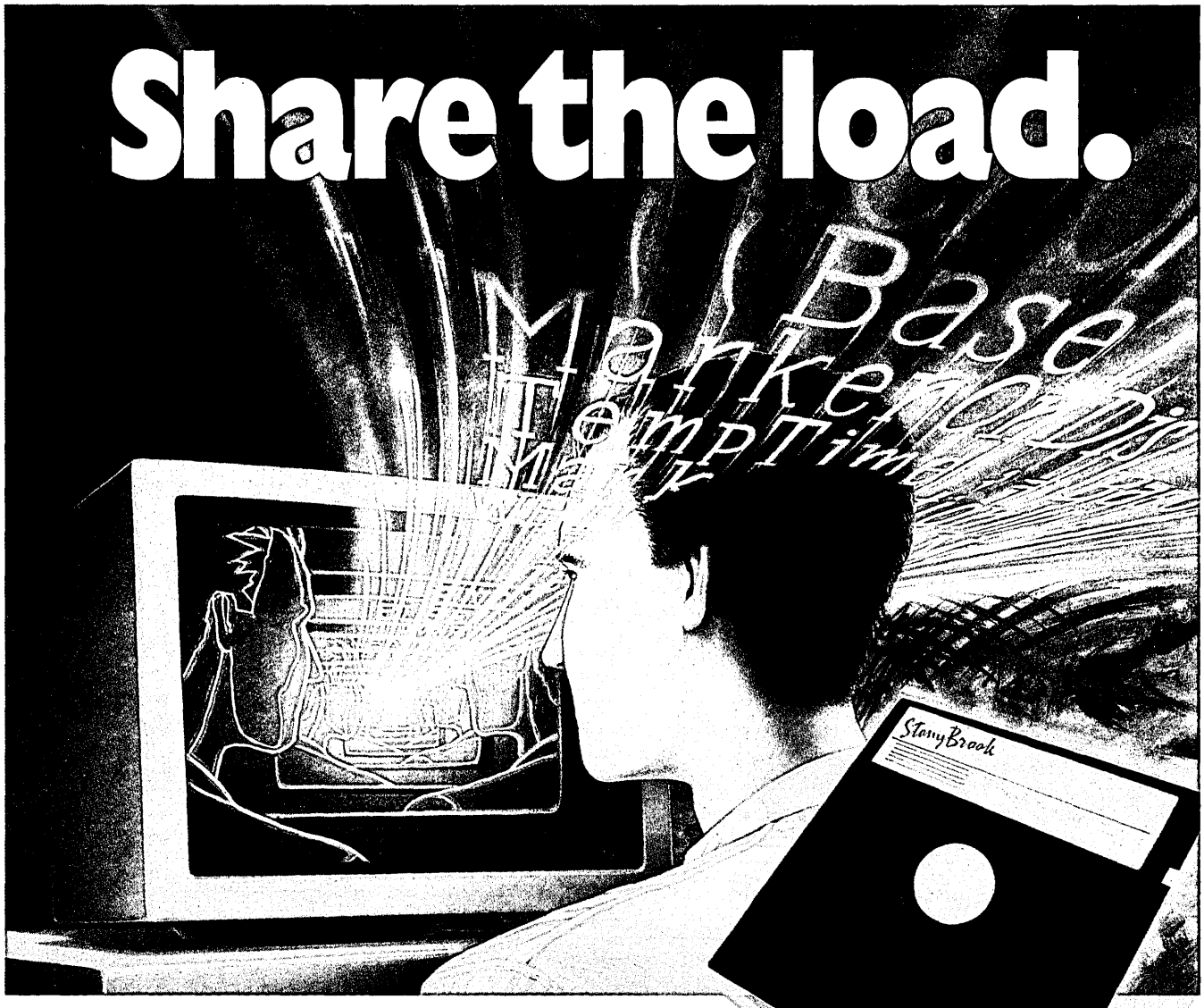

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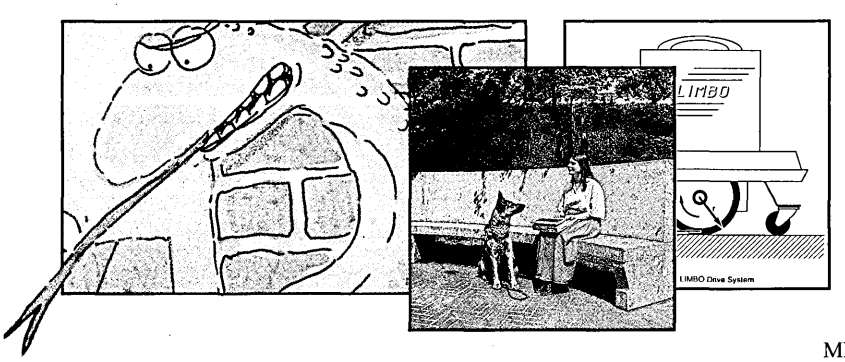

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COVER

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Audit Bureau of Circulations

By David J. Thompson

No Limits!

Computers Shouldn't Be Limitations

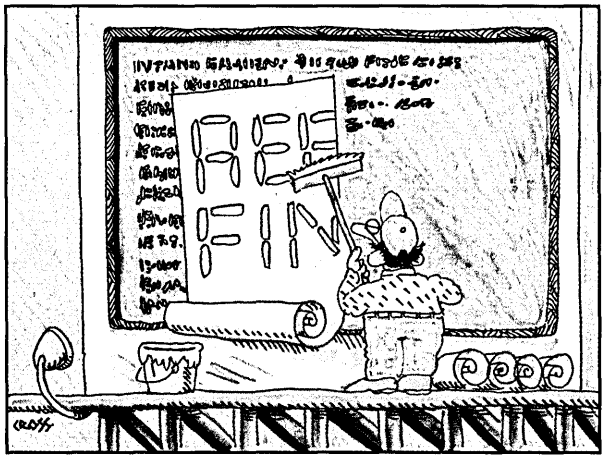
A handicap is a limitation. A limitation is a handicap. At least that's the way it appears. But if you talk to live-wire folks (handicapped or not), you'll find them (ignoring, fighting through, beating, exceeding, straining) their limits.

So the computer (their computer, perhaps the only thing they can use, can communicate with, that doesn't go home at 5 p.m., doesn't get bored, or hoarse, or obnoxious) is very important. And, it better not limit them.

For instance:

I just received a call from a fine lady who's visually impaired (she's lost most of her central vision). She wants to work at home and she's interested in getting a computer so she can do word processing and database projects for businesses in her area. Wonderful idea. However, she can't read normal-sized characters on a 12" screen. (The characters have to be 1.5 times normal before she can read them.)

Then a friend of hers called. The two of them had wandered over to Emerald Microware to see if Brian could locate any 25" displays that would take standard Hercules or EGA output. No luck so far. Then the friend mentioned he might call Jim Button of Buttonware and see if Jim would write special word processor and database packages. The packages would display fewer, larger, characters.



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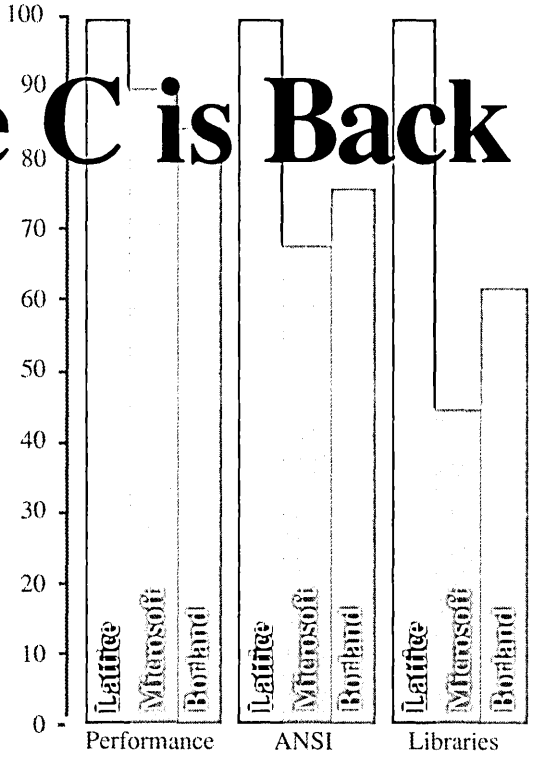
Lattice C is Back on Top!



And the benchmarks show it.

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Lattice C is fully compliant with the ANSI standard. We pass not only the *Computer Language* ANSI Test Suite but 100% of the Plum Hall Test Suite Version 1.09. *Lattice is the compatibility leader.*

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Lattice C includes CodePRobe™, a new full-screen symbolic debugger for DOS and OS/2. CodePRobe has the familiar look of the CodeView, and can be used with a mouse. It also enables you to easily debug family mode programs, Presentation Manager applications, and OS/2 multithread applications. And, for those humongous programs and system killer bugs, CodePRobe can be used remotely from a different PC. *Lattice is the leader in debugging.*

The Leader in Innovation

Lattice has long supported popular language extensions such as *near, far,* and *pascal.* In our previous version, we introduced *align, chip, volatile, interrupt, nopad,* and *pad* to handle important memory management problems in DOS, OS/2, and embedded systems. Version 6 continues this evolution with *critical* and *private. Critical* defines a function that must run as a critical section, and private defines data that must be replicated for each execution thread. Future versions will continue to improve the language for use in cutting-edge environments such as OS/2 and AmigaDOS. *Lattice is the innovation leader.*

The Leader in OS/2

Lattice C includes bindings and header files so that you do not need to buy an expensive OS/2 development kit. The library also supports multithread programming with no built-in limits to the number of threads. The Lattice linker, librarian, editor, debugger and utilities run in DOS, OS/2 and family mode. *Lattice is the OS/2 leader.*

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The Lattice C Development System now includes the utilities that our customers–professional C programmers–use most often. Of course, the system is based upon our C compiler, editor, linker, librarian, and debugger. In addition, we now include our powerful project maintenance tool *lmk*, which is an advanced version of the UNIX *make* utility. *Build, diff, extract, file, splat, touch,* and *wc* enable you to easily maintain your source files, and *cxref* produces comprehensive cross-reference reports. *Lbind* produces family-mode executables that can run under both DOS and OS/2. *Lattice is the productivity leader.*

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Our library has often been praised for its comprehensive and sophisticated features. Now we include *graphics, communications,* and *curses* libraries. The *communications* library supports XMODEM, YMODEM, KERMIT and ASCII protocols. The *graphics* library provides a graphic windowing model. *Curses* provides a UNIX compatible screen manager. *Lattice is the library leader.*

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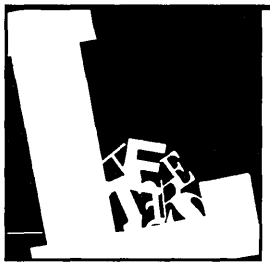


Letters

Interactive Disassembly

My congratulations to Mr. Flusche for his well-written article, "The Art of Disassembly," in Issue #46 of *Micro C*. This is a subject near and dear to me, as well as many of your other readers. My company, C.C. Software, has been marketing the Masterful Disassembler (MD) for many years now, starting with a Z-80 version and then the 80x86.

I have personally disassembled 50,000+ lines of code and can attest that this is not a simple task. But good, *usable*, source code can be generated with the tools we have today.

I realize this was not intended to be a comparison of disassemblers, but only a report on the use of one product (Sourcer). However, a few additional points would be worth mentioning. Mr. Flusche's five-step procedure for disassembly is required only for non-interactive disassemblers. These are the type that require users to examine listings (step 3), edit a "command file" (step 4), and repeat the process (steps 2-5) until you like the result.

Step 3 is the real catch. This is fine only for short programs. When I disassembled the Turbo Pascal compiler (a 21,000 line assembly program), this step would take about four hours on a fast printer. And to repeat this over and over again is prohibitive.

Interactive disassemblers (like MD) replace these steps with a visual display. If you don't like some part of the disassembly, you can change it and immediately see the results on the screen. Video screens are much faster than printers. Also, you don't have to switch over to DEBUG to understand what's happening.

Clark A. Calkins, Owner
C.C. Software
1907 Alvarado Ave.
Walnut Creek, CA 94596

Nasty Language

Periodically I go through old magazines, cut out articles I want, and then throw the mags away. I keep trying to do that with yours, but have been unable to because the magazine has too many useful articles. Consequently, I have no choice but to order another subscription.

However, this subscription is only for one year because you seem to have a fatal disease. If you move quickly you might be able to get help for it, but I don't have high hopes for you doing that. OK, OK. I'll tell you: the dreaded "C" disease.

You are doing just what all too many used-to-be-good magazines have done: You're selling your body and soul out to the C language. How many times did you get dropped on your heads? Or maybe you ran the rapids one too many times and hit your head on a rock.

Oh, what the heck, you probably have six good issues left, notwithstanding the fact you haven't had any good assembly language articles for some time now.

David E. Michener
Custom Computer Service
10525 S.E. Cherry Blossom Dr.
Suite 200
Portland, OR 97216

Editor's note: Let's see. Modula 2, Pascal, 8088 and 68000 assembly, Prolog (oh, and C). You're right; we need to cover more languages. Perhaps Pilot and RPG would be fun. Seriously, we use the language most appropriate for the task. I wouldn't twiddle bits with Pascal any more than I'd write a biorhythm generator in assembly.

New Slant On SEA vs. PKWare

I'd like to add my own two cents to the discussion in *Micro C* Issue #46, regarding the SEA vs. PKWare controversy.

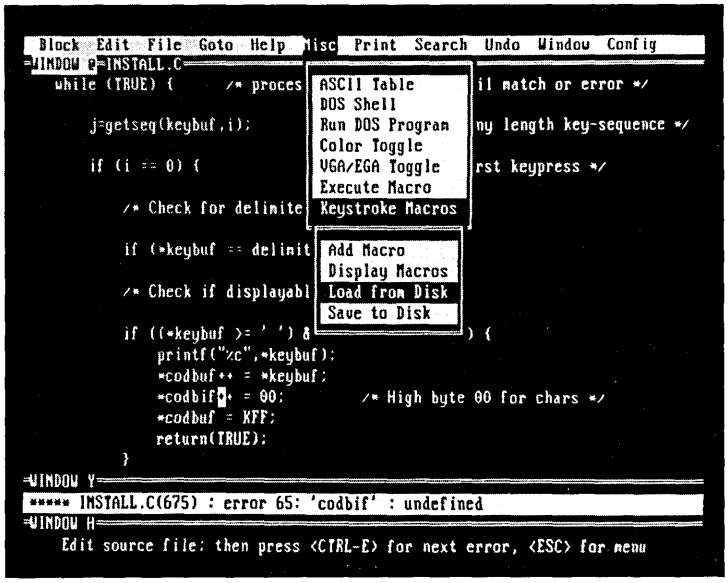
You can copyright the *expression* of an idea, but not the idea itself. If you write a book with the same plot as someone else's book, but you do so in different words, you do not infringe. Even if, by some fluke, your book has exactly the same text as the other book, your book still doesn't infringe if you wrote it independently.

Note the difference here between a copyright and a patent—you can infringe someone's patent even if you invent something totally on your own, with no contact with the outside world. Not so with a copyright.

But there's more: if there is only one reasonable way to express an idea, then you can use the same words as another book and not infringe its copyright, even if you do so with full knowledge of the other book. The reasoning here is that if only one way of expressing the idea exists, then copyrighting this expression would constitute protecting the idea, and that cannot be done by a copyright.

The extension of these ideas from

Continued on page 58



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BENCHMARKS 3 MEG FILE				
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Save and continue	1:05 min	3:23 min	Cannot	Cannot
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Computer Aided Independence

The Adventure Begins

By Dallas Vordahl

13720 E. 26th Ave.
Spokane, WA 99216

When I first spoke with Dallas on the phone, there was no indication that he'd spent days entering the letter proposing this article. It was only later that I found out how much work it had been for him.

But right up front, he made it clear he'd not accept help with the writing (even from his 24-hour live-in aid). So, this article is the product of months of effort by a man who's found INDEPENDENCE in a computer.

In my electric wheelchair, I drove up to the counter at the local Radio Shack and told the salesman I wanted to see a computer. He looked at me rather curiously—wondering, I supposed, what a guy paralyzed from the neck down wanted with a computer. He pointed to a nearby display.

I turned my wheelchair and there, next to a telephone answering machine and a pile of stuffed-toy radios, sat a small gray-and-black television attached to a keyboard. The screen was blank except for "READY" displayed in the upper left corner.

So that's a computer, I thought, rather disappointed. It didn't seem like much. I tried out the keyboard with my mouthstick, making sure I could reach all the keys. All the while the salesman pitched the computer as he would have pitched a stereo or CB radio. He didn't know what 16K RAM was, any more than I did.

I sat there staring at that blank screen, wondering how I could justify $600 for a computer. Ostensibly, I needed it for keeping the books of our three family-run variety stores. Frankly, it was a *computer*, and I *wanted* it.

It was a big decision. Not until later did I realize it was a decision that would completely change my life. I shudder at how easily I could have decided *not* to buy that computer.

It's been ten years since I made that decision—the decision to buy a Radio Shack TRS-80 Model I with 16K RAM and a cassette recorder. Recalling the moment it was first turned on reminds me of the beginning of an adventure... *You are standing at the end of a road before a small brick building. Around you is a forest. A small stream flows out of the building and down a gully.*

Keyboards: The First Barrier

Computer keyboards were designed for people with two hands and ten fingers. I have two hands and ten fingers, but they don't work. So I use a mouthstick.

I can do a lot of things with a mouthstick. I can turn the pages of books and magazines, use a typewriter, pilot a radio-controlled model sailplane and race a radio-controlled model sailboat; dad and I put a lot of time into making them work. The TRS-80 keyboard, however, was beyond us.

Try holding down one key while pressing another. Do it with one finger, and you'll understand the biggest disadvantage of using a mouthstick. So, almost before it began, the adventure had stopped.... *A huge green fierce snake bars the way!*

Adapting the TRS-80 keyboard proved easier than I thought. That keyboard had no Control or Alt keys, only two Shift keys. A computer repair shop installed a mechanical Shift-Lock, and in an astounding flurry it drove the snake away.

The IBM Keyboard

Four years later when I encountered an IBM XT, I found a larger barrier. Imagine disassembling an IBM keyboard and installing a mechanical Control-Lock, Alt-Lock, and Shift-Lock. Not a job for just anyone. I hoped there was a better way.

I wrote to *PC Magazine*, describing the problems of using a mouthstick, and they published my letter. The result was Toggle Key, a TSR program written by Ernest Kraut. His program turns the Control, Alt, and Shift keys into toggle switches and displays their state on the screen.

David Rose of RoseSoft, whom I also asked for help, wrote a "one finger mode" into the following version of ProKey (ProKey is a TSR macro program). He took a different approach to the problem than Kraut.

He kept the Control, Alt, and Shift keys toggled for one keystroke. That saved a keystroke each time I used a single control-key command. (Superkey, by Borland, has a similar feature.)

Other Solutions

PC Magazine readers offered many other solutions ranging from TSR programs, to mechanical arms, to using weights to hold down those keys. The response was terrific, and their help made it possible for me to use IBM-type computers.

However I'm now faced with three-button mice and 101-key keyboards. I can just manage the width of 101-key keyboards with my mouthstick, but mice are simply out of the question—it seems that every advance leaves me farther behind.... *Out from the shadows behind you pounces a bearded pirate! He snatches your treasure and vanishes into the gloom.*

And the problem isn't exclusive to hardware. Programs sometimes use strange key combinations or require a mouse. Worse yet, some programs defeat ProKey and Toggle Key by taking control of the keyboard or other BIOS functions.

There Is Another Way

There are, in fact, many other ways around the standard IBM keyboard. There are keyboards and keyboard emulators designed specifically for the physically disabled: optically controlled, zero pressure, on-screen single-switch scan-

ning, flat membrane, add-on function, calculator style, and voice controlled.

Several years ago I beta tested a Key Tronics voice-controlled keyboard. For someone who can't use a keyboard but has the ability to speak, it would seem a natural solution. It is, but only for rote applications. It wouldn't have, for example, been of much help writing this article. (And when I write that steamy sex scene into my next novel, it wouldn't do to write it out loud.)

The voice-controlled keyboard worked like a macro program, except that spoken words replaced keystrokes as macro names. It could store about 300 words, each word representing one or more keystrokes. By assigning a spoken word to each key and using macros for frequently used commands and text, I could avoid the keys altogether.

However, the voice-controlled keyboard was just too cumbersome; I had to train it to recognize my voice by saying each word at least six times. It was a pain entering and editing long sequences of keystrokes. I mumble a lot. And I don't like wearing a microphone headset.

Someday, I imagine, I will use a voice-input device. That'll happen when: the units become speaker-independent and require no voice-recognition training, when they have built-in and user-defined vocabularies of thousands of words, not hundreds, or when they convert words directly into text.

A better solution might be a keyboard designed for mouthstick users. One such keyboard, The Magic Wand Keyboard, features 96 negligible-force metal keypads contained in a 5.4" x 3" area. This keyboard doesn't force you to press two or more keys simultaneously.

It also features a switch to regulate the sensitivity of the keypads, and has six programmable keys—up to 200 characters per key. Its only drawback is the price: $1,200.... *I am prepared to offer you a hint, but it will cost you points.*

I have not tried The Magic Wand Keyboard, and at $1,200 I probably won't. I'll continue to use my standard keyboard until mouthstick keyboards become affordable or voice-input devices become practical.

Exploring The Cave

After solving the pressing problem of pushing two or more keys simultaneously, I began to explore the TRS-80. It came with only two programs: blackjack and backgammon. I played them, but the fun quickly faded. There remained only one other direction: I moved ... *NORTH* ... into BASIC.

Learning BASIC was at first just something to do. I had no plan or goal—just curious how to tell the computer what to do. My first program simply displayed the word "Hello."

But with that simple program I became more independent; I was controlling something, even if it was only characters on a screen. I had lost most of that kind of control when I became a quadriplegic, confined to a wheelchair, five years earlier. Programming the computer gave me back some control. Still, I didn't see what the computer could do for me.

Keeping Track

At the time, I used a calculator and a typewriter to do my bookkeeping work. It was a hard job, considering the hassle of getting someone else to shuffle through papers and forms and notebooks, filing and finding certain records, and setting them all where I could see them. Then it dawned on me that maybe I could use the computer, and I began to write programs with that in mind.

First I wrote programs to enter and store check stub entries and cash transactions, then general journal entries and payroll records. I wrote a program to bring all that information together and print it out in financial statements. Soon I was able to do my bookkeeping using the computer almost exclusively, with minimum outside help. I even took on a few outside bookkeeping jobs.

Expanding The Horizons

When I bought an IBM XT, its power expanded my options. Its speed, memory, hard disk, and graphics capabilities opened the door to things I never imagined I could do.... *You are in the Hall of the Mountain King, with passages off in all directions.*

With my mouthstick and the XT, I could use a spreadsheet to calculate depreciation, keep payroll records, and chart sales. (Figuring income and payroll taxes and filling out the forms is still a pain, even with a computer.) Using a desktop publishing program, I learned to design and print notices and advertising flyers.

When one of my bookkeeping clients bought a Compaq, I used the skills I learned from writing my own bookkeeping programs to write him a general ledger program. He still uses that program, and so do four other people.

I learned to fly an airplane using Microsoft's Flight Simulator (flying a Cessna 182 with a mouthstick—now *that's* a challenge), and I learned to play games, like Monopoly.

My TRS-80 didn't have a word processing program, and when I bought one for my XT I wondered if I was throwing my money away. Surprisingly, the word processor has become the program I use most. I use it to write everything from fiction to BBS messages to this article; and letters too many to count (now everyone's entitled to my opinion!).

Using my computer, I've learned to do what other people are doing, despite my being paralyzed from the neck down. The computer has changed my thinking; I no longer think about the things I can't do, I think about the things I *can* do.

Taking Inventory

In the ten years I've been using personal computers, I've progressed through a lot of hardware: three computers, three monitors and printers, five floppy and three hard disk drives, five keyboards, and two modems. In the process, my RAM requirements have grown from 16K to 1,664K.

In that steady progression of older hardware to newer hardware, the move from cassette tapes to floppy disks for storage was a big jump, but the 10MB hard disk was magic.... *A hollow voice says "PLUGH."*

No longer did I have to ask someone to switch floppies every time I wanted to change programs, or needed last year's financial records (or to play Frogger, when everyone thought I was hard at work). No single component has given me as much autonomy as the hard disk.

Soon, CD technology may become as important to me as the hard disk is today. I already have a spelling checker and a thesaurus on my hard disk, but a CD-ROM drive would allow me to use a real dictionary and encyclopedia, and a host of other reference materials.

I wouldn't have to ask someone to come pull the dictionary from the shelf and set it up for me. I wouldn't ever have to turn a page (turning from the front to the back of a 1,200 page dictionary using a mouthstick gives me second thoughts of whether I really need to know the meaning of *zymurgy*).

Another piece of hardware, the modem, has also become an important part of my computer system. Beyond its ability to upload and download programs and information from other computers, the modem provides an easy way for me to be a part of society. Society—groups and activities and almost everything else—is geared for people with able bodies, and that often makes it hard for someone in a wheelchair to join in.

On-line computer forums and special

interest groups, and especially BBSs, are groups of people interacting almost solely through their computers. Whether a person is sitting in a wheelchair typing with a mouthstick makes no difference. Without a modem I wouldn't know nearly as much as I do about computers and how to use them, and I'd miss knowing and interacting with a lot of interesting people.

The Hidden Treasure

Most adventures have hidden treasure, but usually they're only *bars of silver* or *sparkling gold nuggets*. In my adventure with computers, however, I found a different and more valuable kind of hidden treasure. It was lying just beyond that "READY" prompt of my first computer... my independence. Not complete independence, not nearly. But a lot more than I had.

Paralysis is not just a loss of movement and feeling in one's arms and legs, paralysis is a loss of independence. That means relying on someone else to do the things you would normally do yourself. It is intensely frustrating being unable to do *anything* for yourself, unable to do anything without the assistance, cooperation, and permission of someone else.

Before I owned a computer, I had only a few ways to relieve that frustration. Today, as I figure the quarterly payroll taxes or land an F-16 on the deck of an aircraft carrier, or write this article—as I press each character with my mouthstick—I am doing it by myself, without the help of anyone. That is independence. That is the hidden treasure.

Forever Lost

There are many paths in this adventure with computers that I have yet to follow. I will explore the technology as far as it allows, taking detours around mice and other devices designed only for people with able bodies.

I imagine computers becoming a part of my life in many other ways. I imagine smart TVs, stereos, and other electronic gear—smart in that they will respond to a voice or a thought or a blink of an eye. I imagine a computer linked to a robot arm that obeys my spoken commands, possibly even a robot capable of moving from place to place. (While mobile robots exist now, they are merely toys.)

Meanwhile, I've used present computer technology to improve almost every aspect of my life: the way I work and play, the way I communicate and interact with other people, and the way I learn and think and challenge my mind. Without a computer, I would be without the most important tool I have for making my life worthwhile.

I haven't scattered bread crumbs along the way or made marks in the walls, nor do I have a map. I don't care, because I'm never going back. I'm forever lost in this computer adventure. And that's just fine.

Products Mentioned

Toggle Key
Ernest A. Kraut
11 Haystack Road
Reading, MA 01867

ProKey 4.10
RoseSoft
P.O. Box 70337
Bellevue, WA 98007

The Magic Wand Keyboard
In Touch Systems
11 Westview Road, Dept. 11
Spring Valley, NY 10977
(914) 354-7431

♦ ♦ ♦

Selecting A Talking Computer For A Blind Friend

It was a real eye-opener for me when Debee demonstrated her vociferous Toshiba laptop at SOG VII. In fact, it was an experience for a lot of us. Though totally blind, Debee can write text and code with the best of us, and she does it all by ear.

When Ray's wife Tina began to lose her vision, Ray decided to get her a talking computer. He found just what he was looking for at the local Computer Heaven. It was IBM PC compatible and included a speech synthesizer with speaker.

Unfortunately, acquisition is easier than implementation. He quickly learned that the "speech synthesizer" was merely a chip. The fact that a speaker was attached didn't mean that the synthesizer had anything to say.

So Ray started writing code. His code made explosive sounds, siren sounds, flying saucer sounds, breaking saucer sounds, rainy weather sounds, and chirpy bird sounds. He even made the synthesizer count from one to ten and made the program menu driven. (The sounds were almost intelligible.) Ray had a wonderful toy, but unfortunately Tina didn't have a talking computer.

Important Points

Ray and Tina's situation is common. Ray could have done much better, if he had known four simple facts—

- Many synthesizers in today's market do create terrific speech.
- A speech synthesizer isn't enough. The blind user needs screen access software—the high level interface between the talking box and the computer's operating system.
- The right word processor, database, or spreadsheet must be purchased. Ease of use for a blind person is much more complicated than it is for the sighted.
- A dealer knowledgeable in the needs of the blind could have guided him to a more appropriate purchase.

Since the IBM PC is "the" business computer, it's the obvious choice if the blind person will use the computer professionally. If the user is a grandfather, a school child, or a housewife, then selecting an IBM PC compatible may not be so important. A few CP/M machines, the Apple II family, and some Radio Shack TRS-80 models can also talk. Several software packages have been written for the Apple II family, especially for children.

Fast & Slow, Up & down

Speech devices don't magically talk any more than printers magically print. Both synthesizers and printers need special software. You must select a synthesizer which will turn ordinary ASCII text into intelligible speech.

Many of the "built-in" speech synthesizers are little more than speech chips—capable of generating simple phonemes. Since hobbyists mainly make up the speech synthesizer market, synthesizers seldom include sophisticated ASCII-to-speech conversion software.

Types Of Speech

Digitized speech can sound very human, but it requires huge amounts of hard disk space, even for a small vocabulary. I don't know of any screen access program which uses digitized speech.

Rule-based speech sounds more mechanical and sometimes mispronounces a word, but it has an unlimited vocabulary. Algorithms make their "best guess" about the pronunciation of each word. The more recent and the more expensive synthesizers usually have better algorithms.

Consistency and phoneme clarity are far more important than a human-like voice and correctness of the English pronunciation. The DECtalk synthesizer has

Debee Norling at her computer work station.

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the most natural-sounding, unlimited-vocabulary speech available. Even though I have a DECtalk, I continued to use my $250 Echo PC for a long time.

I found the Echo's quick response and crisp (although often not very human-sounding) speech more useful than the DECtalk's ponderous, marvelous voice. My primary speech source is now an Aicom Accent. It combines the consistency and quick response of the Echo, with better pronunciation and a large predefined vocabulary. As a technical writer and programmer, I use the Accent for most of my work, but still occasionally use the Echo when writing code. The $4,000 DECtalk continues to gather dust.

In speech synthesis, *there is such a thing as being Too Smart.* Take the letter combination PGUP, for example. A primitive synthesizer will simply spell it out: P G U P. A more sophisticated synthesizer will see the vowel, decide that it must be pronounceable, and make a best guess. The result will be a pseudo-English word, such as "peggup" (or worse).

A speech synthesizer must be able to shut up. To a blind user, quick silence is more important than correct pronunciation. If I look up a phone number in my database, I want to hear the information, then immediately stop the speech. If I have to wait while it reads the entire screen, I'll probably forget the number.

Choose a synthesizer that has several speech rates. A slow speech rate is important for beginners and for carefully studying a complex screen. A fast rate is useful for quickly finding information in a mass of text. As I become more experienced with a synthesizer, I can increase the speech rate.

Editor's note: No kidding. Debee demonstrated her synthesizer at SOG. At the slowest rate, we could understand it after a few minutes, adjusting to some off-the-wall sounds. At her normal rate (probably four times normal speech), the sound was completely unintelligible to our sighted ears.

Speech devices don't magically talk any more than printers magically print. Both synthesizers and printers need special software.

The synthesizer must have a way to change the volume and pitch. A tone control is also desirable.

An easily definable substitution table, often called an exception dictionary, is a nice enhancement, though hardly mandatory. Some synthesizers have a dictionary of correct pronunciations built-in.

Acronym processing is handy, but you should be able to turn it off. I once beta tested a synthesizer which said "New York" every time I typed "F7 n y" for exiting WordPerfect.

Remember—all synthesized speech requires getting used to.

Innies & Outies

Synthesizers are either internal cards or external boxes.

Internal synthesizers are safe from spills and falls and they're less likely to be stolen. There are no power or communications cables to become entangled or unplugged. They also tend to be less expensive than their external equivalents. You don't have to bother with dip switches and baud rates. However, if the computer will contain many cards, an internal synthesizer may create IRQ conflicts.

Some internal cards are designed specifically to fit in some of the popular laptop computers (especially the Toshibas) and run off the laptop's battery.

An external synthesizer has its own power supply and usually communicates with the computer via a serial or parallel interface. A lightweight, durable, external synthesizer is a good choice for someone who must move from computer to computer. Because of its exposure and portability, it's more susceptible to damage or theft than an internal unit. So far, no battery-powered external synthesizer has had a major effect on the market.

A good speech synthesizer still isn't enough. Suppose you send a print screen to your printer. Imagine that you can only read that printout by starting at the first word and reading nonstop to the last word. Do you remember the spelling of the syntax error on line seven and the typo on line three and the faulty indenting on line sixteen? This isn't the best system for a blind operator. He needs a way to conveniently and interactively read selected portions of the screen.

Screen Access Software Is The Key

A screen access package provides a link between the speech synthesizer, the computer, the blind operator, and the mainstream applications program.

I use Video Voice, a TSR utility that watches the keyboard and can speak the keystrokes either character by character or word by word.

Video Voice also checks for the application program's keystrokes and performs various routines based on the user's keypresses. For example, when I press the down cursor, Video Voice monitors the cursor, waits for it to land on the new line, then speaks the text of the line or the character under the cursor. When I press control-left arrow, Video

Voice reads the word that the cursor has moved to. When I press tab, Video Voice speaks either the row and column position of the cursor or the previous word (as in a database prompt).

Video Voice "environments," which are loaded for major application programs, control these actions. Thus I can move rapidly within a document, editing in very much the same way as a sighted person.

Video Voice also watches the screen. Text that's written to the screen using the BIOS video services will be spoken automatically. Because of this, DOS and some programs will talk automatically. Generally, information that's written directly to screen memory cannot be captured by screen access programs.

Video Voice can search for colors, highlighting, underlining, text characters, and IBM extended ASCII. This means that pull-down menus can be useful instead of intrusive and that Video Voice can even cope with multiple pop-up windows.

Video Voice can read a specific range of screen coordinates, say from row 3 column 12 to row 20 column 66. It can also read from a certain line to the bottom, or from the top to a certain line.

It can read six types of text—character, word, sentence, paragraph, row, and screen. For each of these types (except screen), it can read the previous, the current, or what follows. This means that with two keystrokes, I can read the current sentence, the following paragraph, or the previous row.

Furthermore, adding a single keystoke to the sequence will force Video Voice to either spell the selected text letter by letter or to spell it with military phonetics (alpha, bravo, charlie, etc.). The system cursor's position determines the current location.

A screen reading program, such as Video Voice, gives the blind access to Lotus, WordPerfect, dBASE, or just plain old FORMAT and XCOPY. Thanks to Video Voice, I write using QEdit and WordPerfect, program with Turbo C, back up my hard disk with Backit, and use Memory Mate to take notes.

Choosing Applications For The Blind

Finding a workable speech synthesizer and screen reading program doesn't end the project. The applications: compilers, text editors, database handlers ... also must pass the blind test.

There is a big difference between software that "works" with speech and that which is truly usable. Much software will coexist fine with a screen reader loaded in memory. So in the technical sense, the software "works" with speech. However, features which make a program easy to use for the sighted often make it difficult for a blind person.

A program which works well for the blind should have an uncluttered screen. WordPerfect is a good example. When a blind person writes, the only thing on the screen is his document. When he calls up a menu, it completely covers the text underneath. Pop-up windows, menu bars, dialogue boxes, and all those other fancy interfaces are unnecessary complications. If they're created in pixel graphics, they're totally invisible.

A program should keep the system cursor where the action is. Some packages park the system cursor off-screen or in a corner, and use a pseudo-cursor or a reverse video blob to indicate the current item of interest. This makes it very difficult for the blind user to know where she is on the screen. This is currently the biggest single problem in using talking computers with mainstream software. You can't always tell by looking at the screen.

It helps if the program can talk automatically. Most modern software writes directly to screen memory. You can force some programs to use BIOS screen writes. This automatic speech is a mixed blessing. For example, an early version of WordStar forced the blind user to hear the status line repeated with each character typed. On the other hand, installing Procomm Plus to do BIOS screen writes makes it usable.

It's always a good idea to test drive an applications program with speech before you buy it. Remember that program demos are often "slide shows," totally unrelated to how the real program will react with speech. Test the real thing, not a demo.

Choose software with good telephone support. Unless the documentation is on disk, the blind person can't look up information in the manual. Remember your own burnout factor. You won't mind helping your blind friend in the beginning, but you don't want him calling you for support for the rest of your life.

Choosing Your Dealer

A few computer dealers (such as my company, Grassroots Computing) specialize in working with the visually impaired. They know a lot about talking computers and a lot about blind people's needs. They sell quality name-brand equipment, give lots of service, and expect to get paid for it.

Just about every computer store is willing to sell a talking system to a blind person. A few dealers have even made it a regular sideline. They typically know nothing about the blind person's special needs, sell the wrong equipment, and are incapable of providing meaningful support.

A few companies which have specialized in selling other products to the blind (everything from white canes to stereo receivers) have added computers to their product line. Many of these companies are run or owned by blind people. They know little or nothing about computers and sell bottom-end clones at discount house prices. If you can provide all the required support and feel good about no-name clones, these dealers may be a good place to shop because of their familiarity with blind people's needs.

Several companies have grown by developing specialized technology specifically for the blind. They are the only source for exotic equipment such as computer-driven braille embossers, talking 3278 terminals and speaking OCR scanners, etc. One even sells a "photocopy" machine that produces raised line drawings!

Generally, these products tend to be very expensive, and you can only purchase them through their authorized representatives. If you have a specialized need and are willing to pay the price, these companies can help you.

Try Before You Buy

Many local junior colleges have a talking computer in their computer training lab or disabled students center. Some states now have computer training programs for blind clients of their Department of Rehabilitation.

The Commission for the Blind, Independent Living Center, Lighthouse for the Blind, or residential school for the blind in your area might have a talking computer to show you. The local branch of the National Federation of the Blind or the American Council of the Blind might help you find someone with a talking computer. A few dealers who specialize in talking computers produce demonstration tapes for their lines of synthesizers.

Conclusion

Pick a good, intelligible synthesizer. Buy a screen access program. Carefully choose appropriate mainstream software. Purchase from a dealer who will give you the level of support you need. Follow these basic guidelines and your blind friend will enjoy his new talking computer for many years.

♦ ♦ ♦

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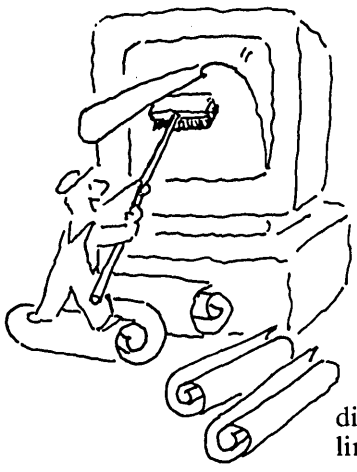

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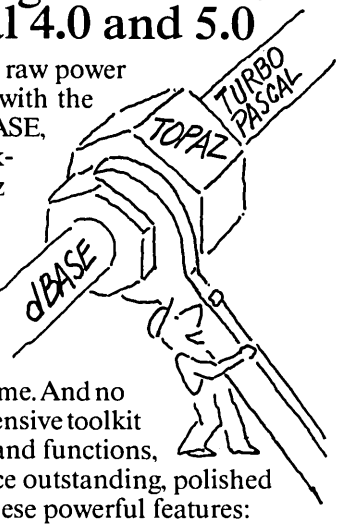

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Writing Software For The Blind

Making It Perfectly Clear

Just as there are ways to optimize menus for the sighted user, there are ways to optimize them for the blind. Debee should know the field well—she writes software and she's blind.

In some ways, writing user-friendly software for an audience that includes users with visual impairments isn't all that different from writing user-friendly software for everyone else. In general—

- Keep modes to a minimum.
- Keep the screens consistent.
- Keep the keystrokes consistent.
- Keep the messages simple.

In some ways, however, writing user-friendly software for the blind is quite different. Remember that the blind can't take in a whole screen at once. Even when the blind have the best screen access packages (which verbalize character attributes), highlighting and screen formatting can become distractions.

It's important to keep the screen as simple as possible. Blind people must always know where to find the most important piece of information.

How Blind People "See"

Basically, a blind person can access a computer screen three ways—

- Speech access consists of a speech synthesizer and a screen reading program which lets the blind person interactively review portions of the screen.
- Braille displays consist of rows of pins which rapidly rise and lower to create a changing pattern of dots. The braille window is usually only 20 characters long (a few are 40). The window must be moved about on the screen to take in the information.
- Large-print screen display software enlarges a portion of the screen (for partially sighted). This enlarged window must be moved in order to see the whole screen.

Debee and Duchess.

Cursors & Pseudo-Cursors

Virtually all screen reading programs know where the system cursor is; they usually query the BIOS. My screen access program, Video Voice, queries the 6845 video controller directly.

Screen access software has a more difficult time finding a pseudo-cursor or moving highlight bar. These screen programs tend to depend on the system cursor to indicate the user's current screen location.

For example, if you ask Video Voice to read the previous sentence, it must first determine the location of the current sentence. It does this by scanning both ways from the cursor, searching for the current sentence's start and end. If a blind user asks his screen reading package to read the current line, "current" is determined by the line where the cursor rests.

Unfortunately, modern software tends to park the cursor up on row 1 column 1, destroying any opportunities for the blind person to find his "current" place. Even worse are those programs which move the cursor off the screen, say to row 26.

Figure 1 shows a C program which can turn off the blinking cursor so that sighted folk won't see it move. Call this routine and, with the cursor invisible, continue to use it to point to the user's current location on the screen. For example, put the cursor after the "Enter your choice" prompt. In a database, put it at the beginning of the data entry field.

If you don't have a specific screen coordinate defined as the "current" location and you use a reverse video blob or color highlighting to indicate a variable size pseudo-cursor, move the system cursor to the first character within the highlighted area.

If you turn the blinking cursor off, use the method in Figure 1 to disable the cursor. Don't use ANSI.SYS as that just moves the cursor to row 26. Don't use the technique in Robert Jourdain's book, which positions the cursor offscreen. Instead, turn it off by calling the BIOS function to set cursor size, and set bit 5 of the scan lines, signaling the BIOS to make the cursor invisible.

Keep the cursor invisible, but let it shadow your pseudo-cursor. Screen access software will find the system cursor, even when you have made it invisible.

Screen Layout

When formatting your screens, remember that the simpler they are, the easier they'll be for the visually impaired to read. Think about the placement of columns, the layout of windows, and the organization of menus. Above all, remember that displaying trivia is especially frustrating for the blind user, he can't avoid (listening to) it.

By Debee Norling
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Berkeley, CA 94701

Figure 1—Turning Off The Cursor

```
/* Call with the parameter off set to TRUE (1) or FALSE (0). The
parameters high and low are for top and bottom scan lines of the
cursor. We actually turn off the cursor by calling a routine
in the BIOS to change its size.*/

#include <dos.h>


int setcursor (off,high,low)
int off;
int high;
int low;
{
    union REGS inregs,outregs;            /* General registers   */

    if (off)                             /* Set bits 4 and 5 if  */
       high |= 0x0030;                   /* turning cursor off   */
    inregs.h.ah = 1;
    inregs.h.ch = (unsigned char) high;
    inregs.h.cl = (unsigned char) low;
    int86(0x10,&inregs,&outregs);

    return(off);
}


This program will turn off the cursor and leave it in the
same location so that screen access software will correctly find
it but sighted folk won't see it move or blink.

Note that the cursor can be turned off without being repositioned.
Most software authors don't realize that, so they park the cursor
on row 26 to make it invisible.

Even if the cursor is on the screen, the system cursor is often
parked in the wrong place. Software which uses the system cursor
(even if invisible) works much better with speech, since the blind
user always knows where he is.
```

♦ ♦ ♦

Avoid Multiple Columns

When possible, avoid displaying data in several columns. If you must use columns, space them as widely apart as possible so that screen access software can tell where each column ends.

Don't Overlap Windows

Avoid overlapping windows. If you must have a previous window peeking out from underneath the current window, make sure you display it in a different color, or surround it by IBM extended ASCII frame characters. You must give the screen access program something to find.

Though Video Voice can find the graphics frame and box drawing characters, some other screen review programs aren't as sophisticated. If your window is within a frame, or in a color not used elsewhere on the screen, Video Voice can find it.

If a frame consistently resides in a specific screen location, then virtually all screen access software can be configured to find it. But the best way for the blind is to have menus à la WordPerfect. These overlay the whole screen, obscuring anything behind it, never sharing the stage with other actors.

Be Consistent, Be Consistent

If you display hunks of information repetitively, try to display each category in its own screen location. For example, if the user always knows that error messages are on row 24, then he can check that row periodically. Turbo Lightning is hard for blind novices because it doesn't always pop up its information in the same place. Few screen-access programs can dynamically locate pop-up boxes.

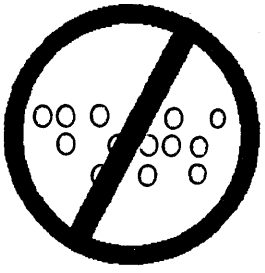
If your program puts text (such as a status line) on a certain row, keep it there. Don't let the information get pushed around the screen by pull-down windows, pop-up boxes, and error messages. The blind user will lose track of his information if it drifts aimlessly from one screen location to another. The best place for a status line is the very bottom row. The second best is the top row. Find a safe place to put your messages, then keep them there.

If you use colors, use them consistently. Red can always indicate errors, blue the current choice, and magenta the status line. Screen access programs can search for specific attributes, and then read only that information. Thus, if a blind person hears a beep, she can search for red just to get the error message, without having to read the entire screen.

Give the user a way to reassign the colors of each type of information. If you use drop shadows, provide a way to disable them.

Menu Dos & Don'ts

Menus which display the "trigger" character in an attribute different from the rest of the word are difficult for the blind. They are usable if the trigger character is always the first character of the choice. If the trigger is embedded within the choice, the screen gets confusing.



Look Ma, No Dots

Communicating, Dot To Dot

What about Braille? Unfortunately, only a small percentage of the blind population reads braille. The world's largest circulation magazine for the blind has only 4,600 braille subscribers, even though the subscription is free.

Since so few people use braille, the market for braille devices is quite small. Nevertheless, through grants and goodwill, there's a plethora of braille equipment.

Braille has some definite advantages. Unlike speech, which often mispronounces and sometimes misinterprets, braille is accurate—the blind person can "see" every character. It's a marvelous tool for proofreading.

Braille has some disadvantages, too. It's hard to utilize interactively. Using a hard-copy embosser as your primary access is like having to print your document every time you want to see your screen. Using a soft braille device requires you to move your hands to the braille display. However, your hands also need to remain on your keyboard for typing.

Braille embossers must punch the dots into very heavy paper, typically 100# card stock. This makes a lot of noise.

Paper braille output is bulky and expensive. The standard braille page is 11" x 11.5", yet it holds only about a third of the text of an 8.5" x 11" printed page. A standard desktop dictionary sold by a major agency takes 72 volumes; it requires about 24 feet of oversized shelving.

Soft-braille devices have a display composed of pins which move rapidly up and down to create a changing dot pattern. These devices "show" only 20 or 40 characters at a time. The blind user is obliged to move this braille "window" around in screen memory in order to get a "feel" for the whole screen.

Soft-braille devices have too many moving parts. A standard 40-cell braille display has 240 pins to move up and down, plus the actuators to move the pins, thousands of minute parts, each of which must be machined to a fine tolerance and protected from damage.

Braille devices are very expensive, and there's no mass market to amortize development costs. A very desirable "photocopy" machine that makes raised line drawings has sold fewer than 100 units since it was invented several years ago, despite a constant sales effort.

The cheapest embosser on the market costs a little under $2,000 for a kludged rework of a daisy-wheel printer that puts out barely readable braille. There are several embossers in the $3,500 to $4,500 range. The user must also purchase text to braille translation software.

Among the cheapest soft-braille displays is a unit which costs around $1,000. It is so sensitive to damage that if you don't protect the pins with plastic wrap, you void the warranty. A very nice soft-braille device that attaches to the computer's serial port has recently been introduced for about $4,000.

Meanwhile, you can obtain a speech synthesizer with screen access software, a usable tool, for as little as $500. No wonder speech, despite its potential for error, is more popular.

♦ ♦ ♦

Let's use the following menu line as an example:

```
Add Delete eXit
```

Assume that the text is normal white on black and that the A, D, and X are in bright yellow, except that the current choice (A) is in green. Read white says "dd elete e it." Read yellow says "d x." Read green says "a." The information is there, but it takes a lot of keystrokes to get to it.

Put the cursor at the first character of the current choice so "read current word" can speak the current choice. Or write part of the text of the prompt in the same color as the screen background.

That way, this sort of menu:

```
Print Save Exit
```

can speak without interfering with the visual aesthetics. I add an "invisible" trigger letter and equals sign before each menu choice. On the screen the real menu looks like this:

```
P=Print S=Save E=Exit
```

Light bar menus, especially reverse video ones, are generally easy enough to use, so long as there is nothing else of the same color on the screen.

Keep your borders simple. Sighted people tend to underestimate how tedious repetitive speech can become. Instead of using hyphens and vertical bars, which are spoken, use the line draw characters of the IBM extended ASCII character set.

Screen access software either doesn't read graphics characters or lets you optionally turn graphics off.

Runs of alternating characters, such as "-*-*-," are extremely tedious, since each character gets spoken. A continuous run of any single character can be sensed and counted. Thus, most modern screen access packages pronounce a row of "equals" signs something like: "counted 40 equals signs." Not great, but definitely acceptable. However, remember that a box framed with characters other than the IBM extended ASCII character set won't be seen as such by a screen access program.

"Helping"

Don't misspell words so the synthesizer will pronounce them correctly. There are many speech synthesizers popular with blind users. Each has different pronunciation rules. Some pronounce better than you think.

Use sound effects sparingly and make sure they can be disabled. When you change modes, a sound is helpful. Blinking characters or an enlarged cursor warn the sighted user of a mode change. How I long for a text editor which would make a squishing noise whenever I accidentally turn off insert mode. I'd like to hear those little characters squeal as I type over them by mistake.

Procomm Plus uses a distinctive rising tone to indicate when a window opens onscreen and a descending tone as the window closes. Backit uses a pretty flute-like warble to prompt for a new disk.

As an example of incorrect use of sounds, I have a notetaker which beeps whenever it finds a search string or gets a disk or printer error. Since it uses the same beep to indicate success and to announce an error, it "cries wolf" too many times, and I ignore its warning.

Make the important obvious, and get rid of the trivial. When I log on to a BBS, it invariably greets me with a gabble of tedious statistics. I don't care that I am caller number 3,465, that I have logged on 20 times before, and that I have downloaded 14 files and uploaded 2.

If I wanted statistics, I'd ask for statistics. Unlike the sighted user who can skip over that which he doesn't care to see, I'm forced to sit through a cacophony of data just to find out if I have any electronic mail.

Heard But Not Seen

Your software can talk by writing to the screen via the BIOS. When you call a BIOS screen service using interrupt 10 hex, screen readers watching that interrupt can intercept the data and send a copy to the synthesizer.

I use an interesting trick to make my software talk while keeping my screen displays fast. First I write the entire screen directly to video memory. Then I repaint it using the BIOS. If I only want part of the screen spoken, I just repaint that part. There's no flicker and the screens snap into place as rapidly as if I weren't doing any BIOS screen writes at all.

Summary

Avoid multitudinous modes, screen clutter, and overlapping windows. Use consistent screen locations, consistent colors, consistent layouts, consistent messages, and consistent keystrokes. Enhance the information with well-thought-out sounds. Try some little tricks to improve your screen's listenability. Most importantly—don't banish the cursor!

◆ ◆ ◆

File Transfer Via The Parallel Port

And An XT Controller Update

You've perhaps heard about these parallel file transfer packages that pass data at the speed of light. Pretty fancy, with all that file handling. Right? Well, Bruce's is just as fancy and it's a lot cheaper. (Free.)

Ready? This time I'll show you how to transfer files (very quickly) via the parallel printer port. I've successfully transferred files at speeds of 1/4 megabyte per second between a 10 MHz XT and a 6 MHz AT. So with a couple of cheap printer cards ($20 each from MicroSphere) and a little rewiring on a cable, you can create a 2-node tiny LAN (well, the file transfer part of a LAN, anyway).

This article temporarily diverts from my "turn your XT into a controller" series (although I could try to slide it in under the auspices of "communicating with a controller"). In the meantime, I do have an update on the XT controller project which should keep you happy until next time, when I return to the series.

XT Controller Project Update

Your response to the XT Controller series has been great. I guess a lot of you realize that "XTs don't die, they just get cheaper." DOS is the most powerful development environment around for the price, so why roll your own hardware when you can use an XT?

In one of the upcoming projects in this series, I'll look at modifying the ROM BIOS. This is fundamentally important to making an XT controller. It's the ROM BIOS which requires a keyboard, a monitor, RAM, and all those other doodads you may not want on your controller. I plan to look at this problem from several angles. The simplest angle will involve disabling the keyboard and monitor check routines, so you can run your controller as a standalone box, but still boot from a floppy disk.

The most involved angle will be rewriting the ROM to use static RAM instead of dynamic RAM (eliminating the RAM refresh interrupts) and executing a program in EPROM instead of looking for a floppy disk.

For those of you who have to know how to do it *now*, I've received a couple of excellent leads which should get you going.

Laine Stump (who's back in Turkey by now) has written several BIOSes for PC Tech. He suggested the following: get an EPROM burner which can read *and* write (you can find these for the PC at under $150), and suck the contents out of your XT ROM BIOS. Then find the power-on reset vector and change that to an adjacent ROM socket in your XT (there are usually several).

Blow the modified ROM BIOS contents into a new EPROM, and put it back into the original socket. After figuring out where the entry points to the various ROM BIOS routines live (more about that in a minute), you write your own code in C, which picks and chooses from the routines in the ROM BIOS. This is much easier than rewriting (and—*ugh*—redebugging) the ROM BIOS from scratch.

If you have to build the ROM BIOS from scratch, don't: I found two guys in San Diego who have done all the work for you! John Foster & John Choisser have created a small, friendly (they answer the phone "this is John," although I can't tell which one), Micro C style company which puts out very interesting, self-published books and products for getting into the guts of the PC.

One of their products is a little handbook called *The XT-AT Handbook for Engineers, Programmers, and Other Serious PC/XT and PC/AT Users*. It's a brief summary of all the hardware and low-level software facts and features of your XT or AT. It includes the bus, memory map, I/O map, hardware interrupts, DMA channels, power-on error signals, switch settings, DOS & BIOS summaries (including the BIOS entry point addresses), AT CMOS memory, programming information about the important chips on the motherboard, etc.

It also has one small, fascinating page called "User ROM Scan," which starts like this: "The BIOS provides a means whereby builders of adapter cards may hook into the power-on initialization sequence." Hmmm, very intriguing.

A warning: this booklet assumes you already know what you're doing. Don't get it expecting to learn the basics. If you do know something about the inside of an XT or AT, though, it's a wonderful summary, and a good jumping-off point if you are delving into a particular mystery.

They also create some very reasonable kits for modifying the low-level software inside your computer. One of these, the PromKit (which I haven't seen yet), promises to "put anything into PROM that you can put on a disk—even DOS."

The other, which I have, but haven't used yet, is the XT BiosKit which—get this—is the whole XT BIOS rewritten in C! You can modify it to your heart's content, burn it into an EPROM, and you're done! Boy, I'm glad *somebody* did this, because I sure wasn't looking forward to it. The price is incredibly reasonable ($99, with a $2 production royalty) and they have one for the AT ($199, with a $4 production royalty).

My only criticism of John & John is that they've done too much pioneering work and put too little of it down on paper! The XT BiosKit has a brief introduction which gives you the bare necessities (the rest of the manual contains the C source listings), and the *XT-AT Handbook* is really a large summary card. It's obvious these two know a lot about the insides of the PC, and I think they should write about it. Come on, you two—get busy.

I'll be giving the details of BIOS modi-

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fications (including How To Put Programs Into EPROM) in the future (once I figure it out!).

John Foster & John Choisser
Annabooks
12145 Alta Carmel Ct., Ste. 250-262
San Diego, CA 92128
(619) 271-9526

Parallel Port File Transfer

When I began the controller series, I used the parallel printer port that came with the cheap Hercules imitation card on my XT clone. After a few experiments, the card mysteriously stopped working. Knowing what I did about the parallel printer card, I was certain there was no way the printer port could be damaged.

Upon further investigation, I discovered that the circuit used for the parallel printer port on Hercules clone cards (and, I assume, the original Hercules card) is very different from the hardy TTL parallel printer cards you can buy so cheaply.

The printer port consisted of one chip! And the chip was CMOS, which can be fragile (especially when exposed to static electricity). So I tried to replace the chip (attempting to blow it up again with the same circuit, thus proving the destructive nature of the circuit, or at least the destructive nature of the experimenter).

But after a long search I found that only one company manufactures the chip, and an obscure one at that. I'm not sure if it's even possible to buy this chip through regular channels. Perhaps the designers of the card expect you to throw it away if you break it.

So I've come to this conclusion—if you want to build this project, you should buy two cheap printer cards, the kind that are about $20 and chock full of TTL chips. I've had success with these, and if you have an accident, you'll probably only damage one chip, which you can easily and cheaply replace.

So I've come to this conclusion—if you want to build this project, you should buy two cheap printer cards, the kind that are about $20 and chock full of TTL chips.

The cheap printer cards also have a full set of address jumpers, so you can place the card anywhere in the PC's I/O space instead of just LPT1: or LPT2:. More expensive cards use DIP switches and restrict your choices.

I've found it convenient to put the printer cards for both machines in an unused I/O area so they won't interfere with normal operations. (See Chapter 7 of my book *Computer Interacing With Pascal & C* for details about changing the address jumpers.)

One of the most useful places you might use this program is to transfer files between your laptop and your desktop computers. Alas, I don't know what kind of circuit they use for the parallel printer port in a laptop, so I don't know if it's safe to use this scheme. However, there are several packages on the market that appear to use the parallel port to transfer files, so it's probably safe. Don't hold me to it, though.

Cabling

The hardware portion of this project is quite simple: it consists of wiring a cable. Both ends of the cable are male DB-25 connectors, which plug into the parallel printer cards of each machine.

You can approach the cabling in two ways. The easy (but more expensive) way is to buy two DB-25 ribbon cable connectors, and a length of ribbon cable long enough to connect your two machines. Ribbon cable is convenient because it keeps all the wires in order for you. Use a vise to clamp the connectors onto the cable, cross a few wires, and you're done.

If you want a hard (but cheap) way, buy a printer cable with a male DB-25 connector at each end, slice it open, and switch some wires around. You'll need to trace each wire with a continuity checker. DB-25 connectors usually have some kind of numbering next to the pins; some connectors only number one or two pins and some connectors number all the pins. Building your cable this way is more tedious, but it will keep your mind off real work.

The Circuit

Figure 1 shows the cable connections. This circuit uses the fact that each parallel printer card has 8 lines which are output only, 5 lines which are input only, and 4 lines which can be configured with software to be inputs or outputs. It uses the 8 output-only lines to send information from the card to the remote computer, and it uses the 5 input-only lines and 3 of the bidirectional lines to receive information from the remote computer.

It uses the remaining bidirectional line as a handshake, to see when a byte is available during receiving or to indicate a byte is ready during sending.

The handshake line is configured to send or receive depending on whether you run the program in send mode or receive mode. You must make the determi-

nation when you start up the program, by a flag on the command line which indicates "send" or "receive." Figure 1 shows the line configurations when the machine on the left is sending and the machine on the right is receiving.

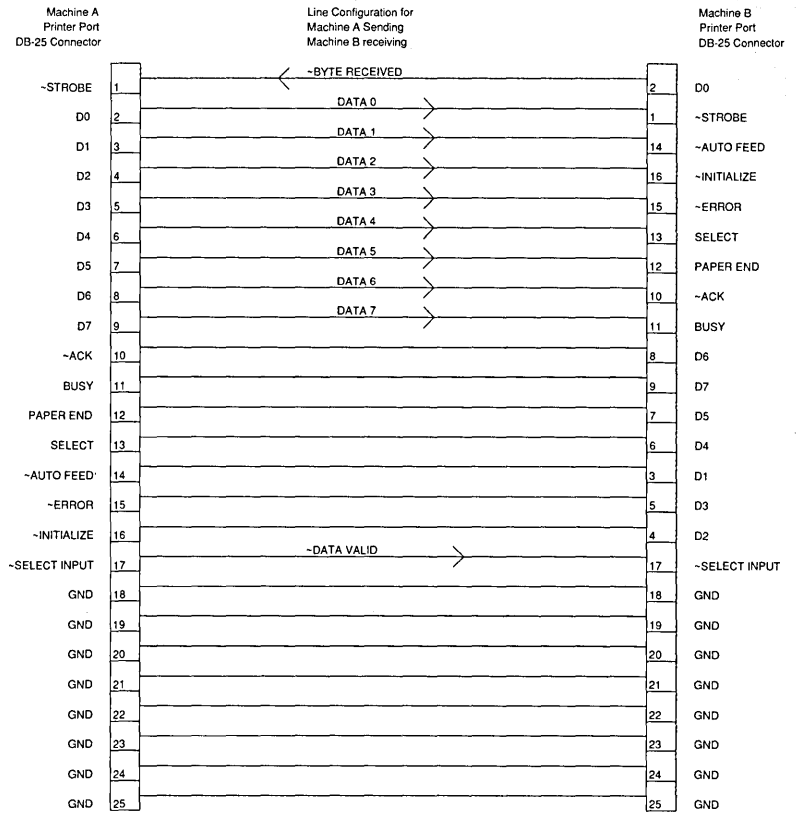
The byte organization of the printer card lines guided the selection of most of the wires. I attempted to minimize the bit-twiddling necessary to reconstruct a byte from the data on the wires. However, the handshake line had to be a bi-directional line, so the handshake signal could flow in either direction. The handshake line is the printer port's SELECT INPUT line, pin 17. Notice that pin 17 and the ground wires are the only lines left undisturbed from the original cable configuration.

It uses an additional signal to indicate that the receiving computer has read the byte. This signal, however, doesn't need to be bidirectional. The receiving computer uses the D0 line to signal the sending computer (via the sending computer's STROBE line) that it has received a byte. Note that the receiving computer doesn't need its data lines, so they're available.

The byte-transfer sequence goes like this: the sending computer places a byte on its printer data port (D0 - D7), and lowers its SELECT INPUT line to indicate that data is valid. The receiving computer sees that data is valid, reads the byte, and lowers its D0 line to indicate it has successfully received the byte.

The sending computer sees this, raises its SELECT INPUT line to acknowledge that the receiving computer got the byte, and waits for the receiving computer to lower its D0 line. When the receiving computer lowers its D0, the cycle is completed, and a new byte transfer can begin.

Figure 1—Parallel Port Transfer Cabling



File Transfer Protocol

Now that bytes can be transferred, we need a way to transfer entire files. This program uses a very simple file transfer protocol, which you might want to improve with some error checking (i.e., a checkvalue at the end of each file), particularly if you're in a noisy environment. (See Figures 3 through 6 for all the code.)

A file transfer goes like this: when the program starts on the receiving computer (established by the -r flag), it sets its printer port to "idle" and waits for the sending computer to say something. You have to start the program on the receiving computer before you start the program on the sending computer.

When the sender (established by the -s flag) starts up, it too sets its printer port to "idle." The sender begins each file transfer with a block of information, called a control block. A control block begins with the ATTN character (established by a #define in the header file—an ASCII "escape" is used here), which gets the receiver's attention.

The word "filename" and several pieces of information about the file follow the ATTN. There are only two pieces in this program: the file's name and its size in bytes. Each piece of information is called a "control message." If you want to add more information (a checkvalue, etc.), simply add more control messages. A control message can be any length and is delimited by the characters LDELIMIT ("{" used here) on the left and RDELIMIT ("}" used here) on the right.

When the receiver gets a complete control block, it opens a file and starts putting bytes into it. It counts each byte until it reaches the size specified in the control block, then it closes the file. At this point, the receiver looks for another ATTN followed by a new control block. This can be information about the next file (so you can send a batch of files) or the special string "end of transaction."

The sender can be told, with the -h flag in the command line, to leave the receiver "on hold" after the last file is transferred. This way you can send a batch of files, move to another subdirectory, send some more files, etc. Try changing the program so you can send messages to the receiver and make it change directories, too (and even make new ones!).

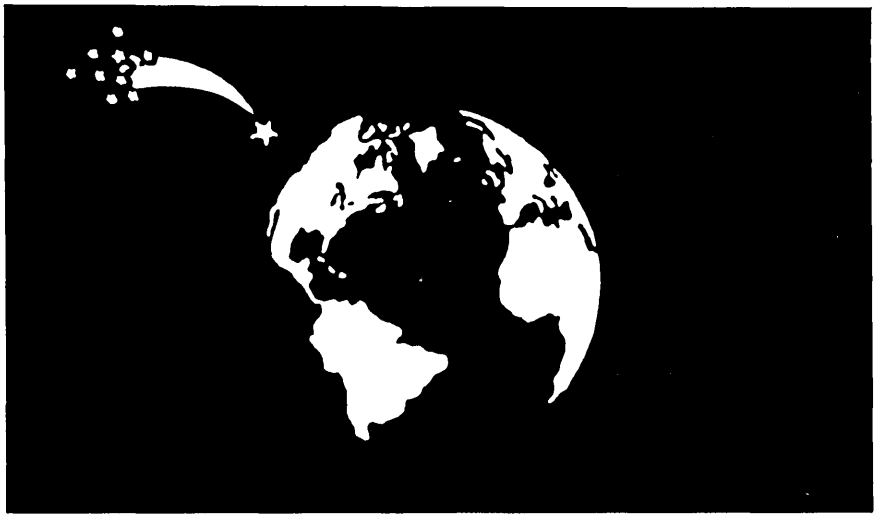
Software In Turbo C

To understand the code, you'll need to study Figure 2, the map of the bytes on the parallel printer card. You can see the pin numbers on the DB-25 connector shown in the cells representing the bits.

The I/O location of the bytes is relative to a value called BASE, which the jumper selections on your printer card established. The byte at BASE is the printer data port, which you can write and read, although on an unmodified card you can only read what you've written. BASE + 1 is read only. BASE + 2 can be read or written. If you want to read bits 0 through 4, you must write a 0 to bits 0, 1 and 3, and a 1 to bit 2.

I know it sounds a bit like voodoo economics, but you'll have to stare at the circuit for the printer card (in *Computer Interfacing In Pascal & C*) if you really want to understand how it works. Or

You Asked for Precision...



And **Tele**™ *created a World of Possibilities*

Berry Computers presents The Tele Toolkit — a complete Operating Systems Kernel

Need to get all possible performance from your embedded controller? Using tele will save you a lot of work. Tele measures all tasks with better than 1 usec precision. Tele is an operating system requiring the Intel 8086 instruction set.

Tele is designed to be efficient and precise. It's most important features for controlling equipment are multitasking and windows. **Full C source code is provided, including diagnostic programs to verify operation.**

The multitasking scheduler is preemptive. Tasks are scheduled by an initiator task that automatically reschedules itself. **It is easy to customize one or more initiators for specific scheduling algorithms.**

The scheduler can easily be locked out, allowing high speed experimental data to be collected during interrupt service. Another task, running under control of the scheduler, can merge the data with that from other experiments or store it for later analysis. **Multitasking often simplifies program design by reducing or eliminating communication and synchronization issues.**

On a 10 MHz processor with 16 bit bus, the Tele task scheduler requires 5.2% of processor cycles. Because that represents a fixed number of instructions, Tele's overhead is inversely proportional to the processor clock speed. Therefore it takes 2.6% at 20 MHz. Tele also runs on the original PC.

Tele uses overlayed windows to allow independent tasks to share a common display screen. Each task can create any number of virtual displays. The operating system then maps rectangles from selected virtual displays to the console. **Tele's scheme is over 5 times as efficient as the standard BIOS display driver- and the BIOS doesn't do windows.**

An MS-DOS file system is also available, but that is a story for another advertisement. Tele is available in the following components:

Demo Diskette	**$ 5** (refundable with purchase)
SK system kernel	**$50** (multitasking)
CD console display	**$40** (windows, requires SK)
FS file system	**$40** (MS-DOS media, requires SK)

Telephone support is freely available.

The Tele Toolkit is available from:

Crosby Associates
P.O. Box 248
Sutter Creek, California
95685

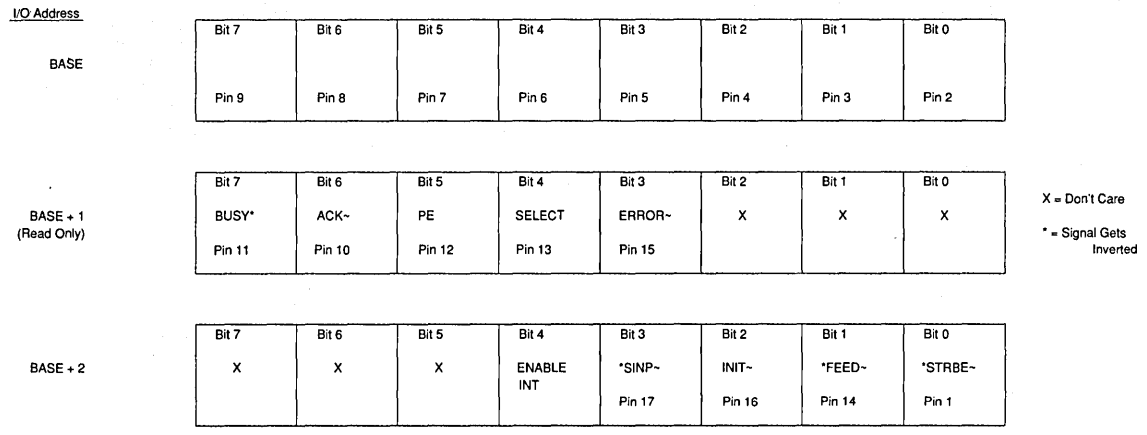
CALL NOW TO ORDER:
(209) 267-0362

Visa, Mastercard, American Express & Discover Card accepted.

MS-DOS is a trademark of Microsoft Corporation.

Reader Service Number 147

Figure 2—Printer Port Registers



you can just trust me.

The software is broken up into functions: receive_byte() and send_byte() create receive_files() and send_files(), which are in turn incorporated into main(). It's straightforward except for the bit twiddling, which you'll just have to stare at until it makes sense (at least, that's what they told me when I was 16 and learning to rebuild the transmission on my MG...).

A problem might arise—what if you tell the remote machine to create a file, and it can't? I've added one more control line—"Abort"—going from the receiver back to the sender (Data bit 1). The receiver can assert this line if it's having problems and call the whole transaction off. Check the code to see how it's used.

Faster, If You Have MASM

I found that the C code for byte transfers was a bit slow. If I had an optimizing compiler, perhaps I could have saved myself some trouble, but instead I wrote the time-critical routines in Turbo C inline assembly.

These routines move a block at a time, instead of a byte at a time. The fast transfer times are achieved with the assembly routines receive_block() and send_block(). Unfortunately, you must have MASM to make them work. If you don't, you'll just have to use the C routines.

Nails & Glue

To finish the program, main() must handle an arbitrary number of files and allow wildcards in the command line. Main() uses the Turbo C library functions findfirst() and findnext() to expand the command line arguments.

The code comes with a makefile. To build it, simply type "make" (assuming you've installed Make with Turbo C).

A Design Alternative

With a slight modification to the board (shown in Chapter 7 of *CIWP&C*), you can turn the 8-bit output-only port on the printer card into an 8-bit I/O port. Then you can use any cable without changing it, and rewrite the software to control the direction of both 8-bit I/O ports and use pins 1, 14, 16 & 17 as handshaking lines.

You could even designate one computer as the "server," and the other as the "client," and use the parallel port interrupt (or modify the board to use a different interrupt). So the client can let the server know it has a request. And the request can be either to send a file or receive a file (since you have more than one handshake line now). This is much tougher, but for those of you who love a challenge and have time on their hands....

If you make improvements (or, unthinkable as it might sound, bug fixes), please post them on the Micro C BBS for all to share.

Future Shocks

I plan to design a board to handle many interrupts using 8259 interrupt controllers (like the one on the motherboard of the XT). All these interrupts will be fed into a single interrupt line on the XT bus. The C++ software will make adding a new interrupt almost effortless. You just tie a wire to the board, do a little software configuration and a little plain C programming, and voilà—you'll have a new interrupt!

Now here's where I need some reader feedback. I'm considering creating a printed circuit board so this project will be easy to build. I suspect there'll be a lot of interest, but I need a show of hands before I sink my hard-earned money into something like this. The board will include a complete manual, parts list, and assembly instructions (including those for soldering, if you haven't done that before), as well as the software and test programs on disk.

Please call Micro C or write me. I need to know who you are. Do you want to do this project? If so, are you the "do everything yourself" type who wants to build things from scratch, or do you want a circuit board and instructions? If you want the board, do you want the board, all the parts, and the instructions, or just the board all assembled and tested?

Get in touch. I need to make an educated guess about whether to leap or not.

Acknowledgement

Thanks to OrCAD for their excellent circuit drafting program.

Editor's note: Bruce often refers to articles in previous issues. You can get a book of his hardware articles, Computer Interfacing with Pascal & C, *and a disk of source code by sending a check for $30 to Micro Cornucopia, P.O. Box 223, Bend, OR 97709, or phoning (800) 888-8087 with Visa/MC.*

♦ ♦ ♦

C CODE FOR THE PC

source code, of course

	MS-DOS File Compatibility Package (create, read, & write MS-DOS file systems on non-MS-DOS computers)	$500
	Bluestreak Plus Communications (two ports, programmer's interface, terminal emulation)	$400
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NEW!	Code Base (database manager, dBase and Clipper compatibile indes & data files; Version 4.0)	$260
	Greenleaf Data Windows (windows, menus, data entry, interactive form design; specify compiler)	$220
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NEW!	AT BIOS Kit (roll your own BIOS with this complete set of basic input/output functions for ATs)	$160
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	OS/88 (U••x-like operating system, many tools, cross-development from MS-DOS)	$150
	ME Version 2.1 (programmer's editor with C-like macro language by Magma Software; Version 1.31 still $75)	$140
	Vmem/C (virtual memory manager; least-recently used pager; dynamic expansion of swap file)	$140
	Turbo G Graphics Library (all popular adapters, hidden line removal)	$135
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Updated!	Install 2.1 (automatic installation program; user-selected partial installation; CRC checking)	$120
	TE Editor Developer's Kit (full screen editor, undo command, multiple windows)	$105
	Minix Operating System (U••x-like operating system, includes manual)	$105
NEW!	HyperText Viewer (simple hypertext system; multi-file documents; includes Tiny Curses)	$100
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	Tele Operating System (TeleKernel, TeleWindows, TeleFile, & TeleBTree by Ken Berry)	$100
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	QC88 C compiler (ASM output, small model, no longs, floats or bit fields, 80+ function library)	$90
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	MultiDOS Plus (DOS-based multitasking, intertask messaging, semaphores)	$80
NEW!	eval() (C function to evaluate ASCII infix expression string; 17 built-in functions)	$75
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	Professional C Windows (lean & mean window and keyboard handler)	$70
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NEW!	SYSKIT (rommable or TSR debug/monitor; easily expandaded)	$60
	Quincy (interactive C interpreter)	$60
NEW!	Symtab (general-purpose symbol table construction and management package)	$60
	PTree (general-purpose parse tree construction and management package)	$60
NEW!	Backup & Restore Utility by Blake McBride (multiple volumes, file compression & encryption)	$50
	SuperGrep (exceptionally fast, revolutionary text searching algorithm; also searches sub-directories)	$50
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	Polyglot TSR Package (includes reminder, bookmark, virus catcher, cache manager, & speech generator)	$50
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	Multi-User BBS (chat, mail, menus, sysop displays; uses Galacticomm modem card; Version 4.1.1)	$50
	Make (macros, all languages, built-in rules)	$50
	Coder's Prolog (inference engine for use with C programs)	$45
	Virtual Memory Manager by Blake McBride (LRU pager, dynamic swap file, image save/restore)	$40
	Heap I/O (treat all or part of a disk file as heap storage)	$40
	Biggerstaff's System Tools (multi-tasking window manager kit)	$40
	OOPS (collection of handy C++ classes by Keith Gorlen of NIH; Version 2.2)	$35
	Bison & PREP (YACC workalike parser generator & attribute grammar preprocessor; now includes documentation)	$35
	PC-XINU (Comer's XINU operating system for PC)	$35
	CLIPS (rule-based expert system generator, Version 4.2)	$35
	Tiny Curses (Berkeley curses package)	$35
	Polyglot RAM Disk (change disk size on the fly; includes utilities)	$30
	SP (spelling checker with dictionary and maintenance tools)	$30
	Clisp (Lisp interpreter with extensive internals documentation)	$30
	Translate Rules to C (YACC-like function generator for rule-based systems)	$30
	6-Pack of Editors (six public domain editors for use, study & hacking)	$30
	Crunch Pack (14 file compression & expansion programs)	$30
	Pascal P-Code Compiler & Interpreter or Pascal-to-C Translator (Wirth standard Pascal)	$25
	ICON (string and list processing language, Version 7.5)	$25
	FLEX (fast lexical analyzer generator; new, improved LEX; Version 1.1)	$25
	LEX (lexical analyzer generator; an oldie but a goodie)	$25
	AutoTrace (program tracer and memory trasher catcher)	$25
	Data Handling Utilities in C (data entry, validation & display; specify Turbo C or Microsoft)	$25
	Arrays for C (macro package to ease handling of arrays)	$25
	A68 (68000 cross-assembler)	$20
	List-Pac (C functions for lists, stacks, and queues)	$20
	XLT Macro Processor (general purpose text translator)	$20
	C/reativity (Eliza-based notetaker)	$15
	Data	
Updated!	GenBank DNA Sequences (Release 59.0; includes demo disk of Pearson FAST/A programs)	$150
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NEW!	Smithsonian Astronomical Observatory Subset (right ascension, declination, & magnitude of 258,997 stars)	$60
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The Austin Code Works
11100 Leafwood Lane
Austin, Texas 78750-3409 USA
acw!info@uunet.uu.net
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Figure 3 — Make File for PXFER.EXE

```
# PPXFER.EXE transfers files between computers via
# parallel ports, using a special cable configuration.
# Copyright Bruce Eckel. For non-commercial use only.

.c.obj: tcc -IC:\TURBOC -c $*.c
ppxfer.exe: ppxfer.obj block.obj
    tcc -LC:\TURBOC -eppxfer ppxfer.obj block.obj
ppxfer.obj: ppxfer.c ppxfer.h
block.obj: block.c ppxfer.h
print: +print ppxfer.h  block.c ppxfer.c
```

♦ ♦ ♦

Figure 4 — PPXFER.H

```
#define MASM   /* comment this if you don't own masm */
#define TIME /* program generates timing information */
 /* Base addr for my modified parallel printer card: */
#define SPECIAL 0x270
#define LPT1
#define LPT2
#define HERC 0x3bc
#define MGA HERC
#define BASE SPECIAL
typedef unsigned char dbyte;
#define ATTN  27   /* "attention" character (escape) */
#define LDELIMIT '{'  /*left delimiter for cntrl msgs*/
#define RDELIMIT '}' /*right delimiter for cntrl msgs*/
#define BUFSIZE 1000

#ifdef MASM
/* assembly-language routines in block.c. These send
   blocks of dbytes quickly for fast file transfers */

/* Send a block of dbytes. Send "count" dbytes, located
   in "buffer" */
void send_block(dbyte * buffer, unsigned int count);

/* Receive exactly "count" dbytes; place in "buffer" */
void receive_block(dbyte * buffer, unsigned int count);
#endif MASM
```

♦ ♦ ♦

Figure 5 — PXFER.C

```
#include <io.h>
#include <stdio.h>
#include <string.h>
#include <fcntl.h>
#include <sys/stat.h>
#include <stdlib.h>
#include <errno.h>
#include <dir.h>
#include <time.h>          /* to calc transfer speeds */
#include "ppxfer.h"          /* header file with defs */

dbyte base_plus_two;        /* global so output value at
            BASE+2 doesn't accidentally get changed */
#define RAISE_HANDSHAKE
        (outportb(BASE+2, base_plus_two &= ~(1 << 3)))
#define LOWER_HANDSHAKE
        (outportb(BASE+2, base_plus_two |= (1 << 3)))
#define TESTKEY  if (kbhit()) break

/* Prints a byte in binary (for testing): */
void print_binary(dbyte c) {
  int i = 7;
  do printf("%c",c & (1 << i) ? '1' : '0'); while(i--);
}

/* Set the channel to the "idle" state: */
void idle(void) {
  outportb(BASE,0xff);  /* all lines high */
  /* initialize for all inputs (handshake is high): */
  outportb(BASE+2,  (base_plus_two = 0x04));
}

dbyte receive_byte(void) {
  dbyte data;
  while( ! (inportb(BASE+2) & (1<<3)))
    ;
  data = (inportb(BASE+1) & 0xf8) |
         (inportb(BASE+2) & 0x07);
  outportb(BASE, 0xfe);  /* send BYTE RECD signal */
  data ^= 0x83;  /* flip "inverted" bits */
  while( (inportb(BASE+2) & (1<<3)))
    ;
  outportb(BASE, 0xff);   /* de-assert BYTE RECD sig */
  return data;
}

void send_byte( dbyte data) {
  outportb(BASE, data);
  LOWER_HANDSHAKE;
  while( ! (inportb(BASE+2) & 1)) {
    if (inportb(BASE+2) & 2) {
      puts("aborted by receiver");
      exit(1);
    }
    TESTKEY;
  }
  RAISE_HANDSHAKE;
  while ( inportb(BASE + 2) & 1) {
    if (inportb(BASE+2) & 2)
      { puts("aborted"); exit(1); }
    TESTKEY;
  }
}

void send_string( char * string) {
  while(*string) {
    send_byte(*string);
    string++;
  }
}

void usage(char * msg) {
  puts("\nusage: ppxfer -s file1.ext ...");
  puts("     to send files through the parallel port \
      using the special");
  puts("     cable configuration, (the list of files \
      can be any length;");
  puts("     wildcards may be used in the file name) \
      or:");
  puts("ppxfer -sh file1.ext ...");
  puts("     to send files and leave the receiver on \
      hold so other");
  puts("     files may be sent, or:");
  puts("ppxfer -r");
  puts("     to receive files.");
  puts(msg);
  exit(1);
}

void send_file(char * unambiguous_name) {
  int i, infile;
  unsigned long filesize, readsize;
  char buf[30];
  dbyte filebuf[BUFSIZE];
  long secs_start, secs_end;  /* for timing */

  if ((infile = open(unambiguous_name,O_RDONLY |
       O_BINARY )) < 0 ) {
    puts("cannot open file to send:");
    puts(unambiguous_name);
    exit(1);
  }
  filesize = lseek(infile, 0L, 2); /* find file size */
  lseek(infile, 0L, 0);   /* reset file ptr to start */
  ultoa(filesize,buf,10);
  idle();
  send_byte(ATTN);  /* send an escape */
  send_string("filename"); send_byte(LDELIMIT);
  send_string(unambiguous_name); send_byte(RDELIMIT);
  send_byte(LDELIMIT);
  send_string(buf); send_byte(RDELIMIT);
  printf("sending %-15s  size: %s bytes:  ",
         unambiguous_name, buf);
#ifdef TIME
  time(&secs_start);
  printf("starting time: %d\n", secs_start);
#endif TIME
  while((readsize = read(infile,filebuf,BUFSIZE)) > 0)
```

```
#ifdef MASM
    send_block(filebuf, readsize);
#else MASM      /* without MASM, do it the slow way: */
  for (i = 0; i < readsize; i++)
    send_byte(filebuf[i]);
#endif MASM
  close(infile);
#ifdef TIME
  time(&secs_end);
  printf("ending time: %d\n", secs_end);
  printf("%f Kbytes/sec\n",
        (filesize/1000)/(secs_end - secs_start));
#endif TIME
}

void receive_files(void) {
  char c;
  int i,j, outfile;
  unsigned long incr, filesize, bytecount, readsize;
  char buf[30], filename[30];
  dbyte filebuf[BUFSIZE];

  idle();
  while(1) {
    while ( receive_byte() != ATTN )
      if (kbhit()) if (getch() == 27) exit(1);
      /* hunt for ESC from the port or the keyboard */
    for (i=0; (c = receive_byte()) != LDELIMIT; )
      buf[i++] = c;
    buf[i] = 0;  /* end of control string */
    if (strcmp(buf,"end of transaction") == 0) {
      puts("end of transaction");
      exit(0);
    }
    if (strcmp(buf,"filename") == 0) {
      for (i=0; (c = receive_byte()) != RDELIMIT; )
        filename[i++] = c;
      filename[i] = 0;
      for (i=0; (c = receive_byte()) != LDELIMIT; )
        ; /* throw away chars until left delimiter */
      for (i=0; (c = receive_byte()) != RDELIMIT; )
        buf[i++] = c; /* store until right delimiter */
      buf[i] = 0;
      filesize = atol(buf);
      printf("receiving %-15s  size: %s bytes\n",
            filename, buf);
      if ((outfile = open(filename, O_WRONLY |
          O_BINARY|O_CREAT, S_IREAD|S_IWRITE)) < 0) {
        puts("cannot open output file");
        outportb(BASE,0xfd);  /* set "abort" line */
        switch(errno) {
          case ENOENT:
            puts("path or file name not found"); break;
          case EMFILE:
            puts ("too many open files"); break;
          case EACCES:
            puts ("permission denied"); break;
          case EINVACC: puts("invalid access code");
        }
        exit(1);
      }
      for (incr = (signed)(filesize - BUFSIZE) > 0 ?
        BUFSIZE : filesize, bytecount = 0;
        bytecount < filesize;
        bytecount += incr,
        incr = filesize-bytecount > BUFSIZE ? BUFSIZE
        : filesize - bytecount ) {
          receive_block(filebuf,incr);
          write(outfile, filebuf, incr);
      }
      close(outfile);
    }
  }
}

void main(int argc, char * argv[]) {
  struct ffblk file_block;
  int i, done;

  if (argv[1][0]!='-'||(argv[1][1]!='s'&&argv[1][1] !=
      'r')) usage("use '-s' or '-r'");
  /* receive files: */
  if (argv[1][1] == 'r')
    receive_files();
  /* send files using wildcards: */
  if (argv[1][1] == 's' ) {
    if (argc < 3) usage("not enough arguments");
    for(i = 2; i < argc; i++) {
      done = findfirst(argv[i],&file_block,0);
      while (!done) {
        send_file(file_block.ff_name);
        done = findnext(&file_block);
      }
    }
    if (argv[1][2] == 'h')
      {puts("receiver ready for more files"); exit(0);}
    send_byte(ATTN);
    send_string("end of transaction");
    send_byte(LDELIMIT);
  }
}
```

♦ ♦ ♦

Figure 6 — BLOCK.C

```
#pragma inline
#include "ppxfer.h"
#define SVE asm push AX; asm push BX; asm push CX;\
            asm push DX; asm push F;
#define RST asm pop AX; asm pop BX; asm pop CX;\
            asm pop DX; asm pop F;

void receive_block (dbyte * buffer,unsigned int count){
    _CX = count;
    _BX = buffer;
    _DX = BASE + 2;
wait1: asm in AL,DX;
    asm test AL, 00001000B;
    asm jz wait1;       /* wait for handshake to drop */
hshake_lo: asm dec DX;                    /* BASE + 1 */
    asm in AL,DX;
    asm and AL, 11111000B;  /*mask off pertinent bits*/
    asm mov AH,AL;                        /* stash it */
    asm inc DX;                           /* BASE + 2 */
    asm in AL,DX;
    asm and AL, 00000111B;           /* rest of byte */
    asm or AL,AH;                  /* combine the byte */
    asm xor AL, 10000011B;   /* flip "inverted" bits */
    asm mov byte ptr [BX], AL;   /* store the result */
    asm inc BX; /* move pointer to next mem location */
    _DX = BASE;
    asm mov AL, 11111110B;
    asm out DX,AL;          /* lower "byte recd" line */
    _DX = BASE + 2;
wait2: asm in AL,DX;
    asm test AL,00001000B;
    asm jnz wait2;      /* wait for handshake to rise */
    _DX = BASE;
    asm mov AL, 11111111B;
    asm out DX, AL;          /* De-assert "byte recd" */
    _DX = BASE+2;
    asm loop wait1;
}

void send_block (dbyte * buffer, unsigned int count) {
    _CX = count;
    _BX = buffer;
    _DX = BASE;
send: asm mov AL,byte ptr [BX];/* get a byte to send */
    asm inc BX;
    asm out DX,AL;
    _DX = BASE + 2;
    asm mov AL, 1100B              /* lower handshake */
    asm out DX,AL;
wait3: asm in AL,DX; /*wait for "byte recd" to go low*/
    asm test AL,1;
    asm jz wait3;
byterecd: asm mov AL, 0100B;       /* raise handshake */
    asm out DX,AL;
wait4: asm in AL,DX;
    asm test AL,1;  /* wait for byte recd to go high */
    asm jnz wait4;
    _DX = BASE;
    asm loop send;
}
```

♦ ♦ ♦

LIMBO Motors On

Gentlemen, Gather Your Parts

If you'd like to build the ultimate maze machine, does Bob have a project for you. This is Part 2, continuing the design.

Robots are cantankerous creatures, lord love 'em. Robotic Behavior is constrained by the sweaty physical world in ways no respectable micro could long endure. Micros sit safely on the desk, gentle breezes fanning their warm parts—while robots grub about the floor dodging dust bunnies and Twinkie wrappers.

Micros dreamily contemplate the fractalness of the Mandelbrot set—while robots bumble about the room, sometimes finding their goal, sometimes finding the basement instead. (Any robot can go down stairs. Coming back up is harder.)

Micros live forever, ending their useful days resting contentedly on a high closet shelf—while robots' lives are constantly threatened by vibration, power spikes, and disrespectful puppies.

Designing A 'Bot

Designing a robot from scratch is not a linear, top down process. Hierarchical system specifications make pretty pictures, but lousy robots. Yes, I believe in structured programming, and I try not to use global variables on Sundays. I just don't think structured design works very well in motion.

Unlike well-written procedures, the subsystems of a robot interact through the hairiest global variable of all, the real world. Motors affect batteries, batteries affect electronics, electronics affect motors, and 'round you go.

At the same time, you have to begin somewhere. The iterative design approach I use is more like a conversation than a hierarchical list.

I "talk" to my robot by adding or changing a subsystem. The robot replies by working or not. I try to keep the iterations short and frequent.

The first thing to ask an unborn robot is, "What's your function?" Most times I get a murky answer. With the LIMBO robot, the answer was a crystal clear, "Running mazes faster than Murphy."

With the function known, I settled down with a copy of the Robots Thru the Maze rules (for a copy, contact the Seattle Robotics Society or see it on the Issue #48 disk or the Micro C BBS, 503-382-7643 24 hr. N, 8, 1).

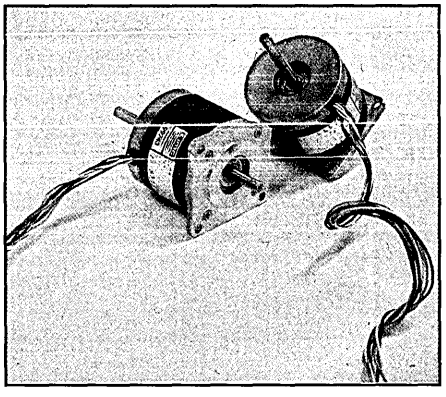
Dimensions

As a rule of thumb, LIMBO's widest point should be no more than about 2/3 of the passage width, or 14.5". (The passages are 22".) Its turning radius should be less than 11", half of the passage width.

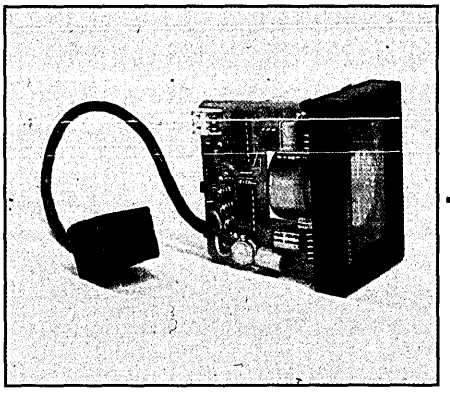
My observations of other robots in maze contests told me that LIMBO should be circular (as viewed from above) with no projections to hang up. The mechanical bumpers would have to fit smoothly into LIMBO's body, be rugged, and be easy to build.

After a few weeks of searching, I found that plastic trays used to catch water leaking from flower pots were ideal. The tray I chose for LIMBO is a "Super Pot" with the "TerraPot" brandname. The diameter of this tray is about 13.5", perfect for the maze. The tray is also sufficiently flexible to allow the bumpers to bend quite a bit without damage (and soak up shocks that the electronics would otherwise have to absorb).

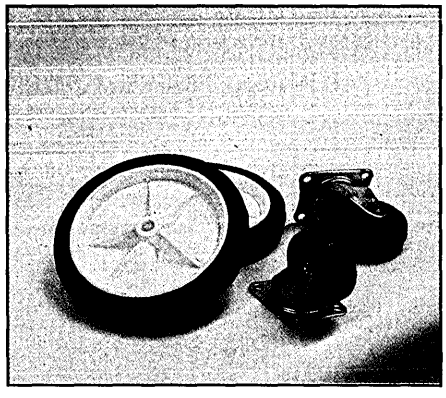
I found this brand tray in three different garden supply departments of discount stores in Seattle for under $2. I got several because I knew LIMBO would tell me that I cut the first tray wrong.



Surplus IMC Magnetic Steppers.



Flux-gate Magnetometer Compass.



Training Wheels and Swivel Castors.

By Bob Nansel
816 North 105th St.
Seattle, WA 98133

When you plan on making mistakes, you stand a fair chance of correcting them.

Now I had basic dimensions and some fine flower pots. The next step was to select a motor drive.

Stepper Motors

I chose stepper motors for the convenience of open loop operation. A look through catalogs of new motors quickly showed that this convenience would be expensive. Okay, how about the surplus market?

I found a likely motor in the C&H Sales catalog, an IMC Magnetics #023-2024-12. This stepper is a 5V, four phase unit with 200 step/rev. The catalog listed running torque as 35 oz.-in. and the holding torque as 53 oz.-in. with a current draw of 1 amp per phase. The dimensions are 2.25" dia. x 2.05" deep, plus two 1/4" shafts, front shaft .7" long, rear shaft 1.55" long, for a total length of 4.3". Two of these beauties would easily fit within the 13.5" bumper contact skirt. Price: $22.50.

But how well would these motors work driving LIMBO around the maze? That would depend on how much robot they would have to move. This is the first of many times in the robot design process that you must make a few informed guesses.

> Unlike well-written procedures, the subsystems of a robot interact through the hairiest global variable of all, the real world.

I reckoned by guess and by golly that LIMBO would weigh in somewhere around eleven pounds. Five pounds of that would be stepper motors and structures; most of the rest could be allotted to the battery. I arrived at these figures by considering power consumption versus battery life required for a day at the races.

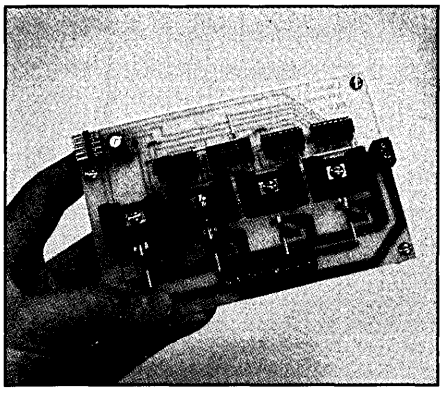
Batteries

Lead/acid gelled electrolyte cells have an energy density of about 16 watt-hours per lb. Two phases of each stepper would be energized at any one time, for a current draw of 4 amps. The electronics could be expected to add another amp, for a total of 5 amps. This current multiplied by the time LIMBO could spend wandering through the maze would give the required amp-hr. rating (hence weight) of the battery.

With each run limited to 10 minutes, three runs would be half an hour at 5 amps, or 2.5 amp-hr. Choosing a 6 volt battery system for the sake of the 5 volt steppers, that meant a minimum battery weight of about one lb. (6V x 2.5 amp-hr. = 15 Watt-hr.). But, each contestant would get three runs through the maze, so more battery mass would be required.

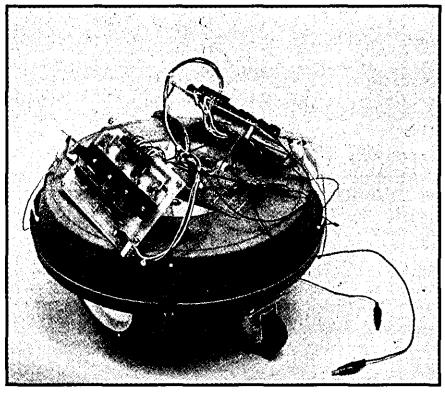
Panasonic makes a 6 volt, 10 amp-hr. rated battery, which would give two hours total running time. This allows four contestants to complete three maximum time limit runs each before LIMBO would pass out with a drained battery. The Digi-Key catalog lists this battery (#P170) as weighing 3.86 lbs. and priced at $19.35.

I decided for the sake of cost to use



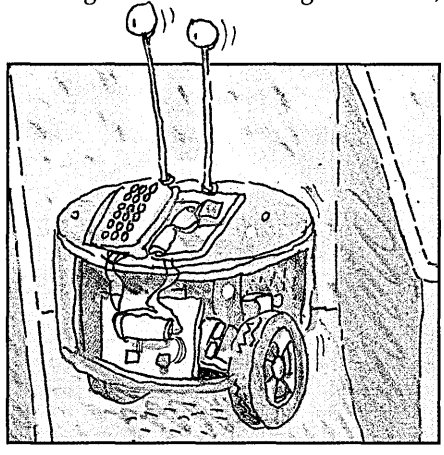
Prototype of Driver Board.

+



Test Set-up in Dangling Wire Stage.

=



LIMBO

just one of these batteries. LIMBO contestants would be advised to provide their own fully-charged batteries during the competition to assure adequate power reserves for the inevitable pre- and post-contest fiddling and demonstrations. After sensors and software, batteries are the weakest link in robotics. (Now about that cold fusion...)

A Moving Moment (Of Force)

Would the steppers move an 11 lb. LIMBO? By Newton's formula, F=ma, the force required to accelerate a mass is given by that mass times the acceleration of the mass. A good sports car will accelerate at half a gee, about 16 ft./sec.^{2}. To keep from spinning its wheels and getting lost in the maze (despite the "LIMBO" name), it would be better if LIMBO accelerated at a more sedate 1/10 gee, 3.22 ft./sec.^{2}.

To calculate the force required to accelerate 11 lbs. at 3 ft./sec.^{2}, you need to first convert the 11 lb. weight to a mass. In the English system of units, mass is measured in the unfortunately named unit, the "Slug," which is just the weight divided by 1 gee (32.2 ft./sec.^{2}).

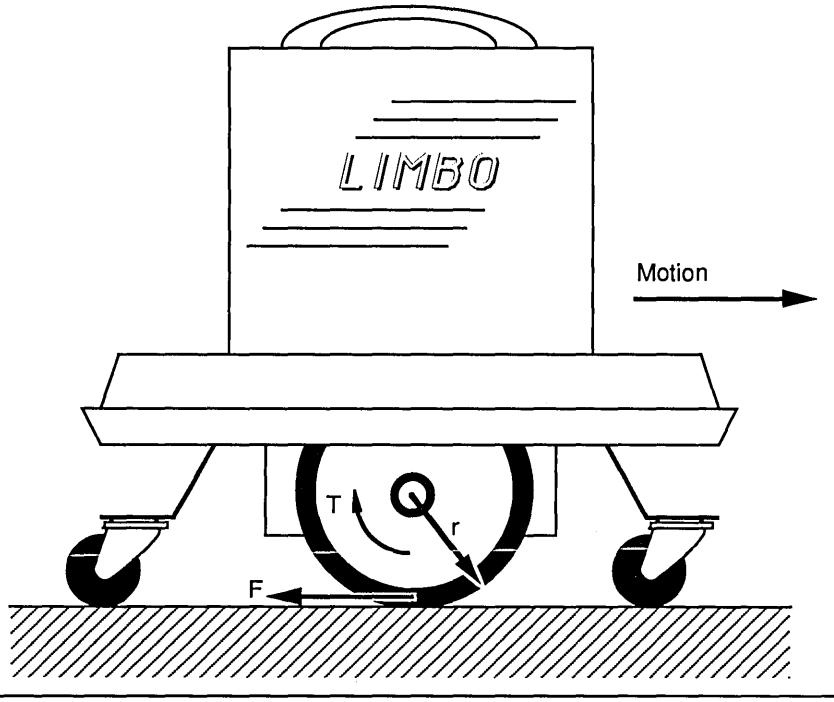
An 11 lb. weight corresponds to a mass of 0.342 slug, and the force required to accelerate it is F=ma=0.342 slg x 3.22 ft./sec.^{2}: 1.10 lb. I prefer to use SI units because, like most right-minded people in the Pacific Northwest, I hate slugs: F = 5 Kg. x .981 m/sec.^{2} = 4.9 Newtons (round up to 5 N). I like Newtons better (except for the new apple flavor...).

Fine. Push it with a pound of force, and LIMBO will accelerate at 1/10 gee. But what does that mean in terms of motors? Now we talk torque.

The relevant torque here is the stepper motor holding torque. This is the torque developed by the stepper when the rated DC currents flow continually to two of the phases of the four phase motor. The holding torque happens to be the maximum torque of the stepper, 53 oz.-in. here (0.374 N*m).

But torque alone can't move LIMBO. There has to be a way to translate that rotational torque into a linear force, and wheels are the simplest answer. The size wheel to use should be about 1/3 the maximum diameter of LIMBO; 4" would work well, but 5" wheels are easier to come by.

Figure 1—LIMBO Drive System



The linear force developed by the wheel at the ground is F=T/r. "T" is the torque, "r" is the radius of the wheel (see Figure 1). Plug in the values for torque and wheel radius, and you get F=(53 oz.-in.)/(2.5 in.) = 21.2 oz. for each motor/wheel combination. Since LIMBO uses two such motor/wheel combos, each will contribute 21.2 oz. of force, for a total of 42.4 oz., or 2.65 lbs.

It looks as if our motors are more than adequate. To be sure, we need to make the same series of calculations using the Running Torque, which is less than the holding torque (after all, we do want

LIMBO to move around). A few strokes of the calculator will reveal that the force produced by the two wheels acting under this torque is 28 oz., or 1.75 lbs., which still gives us plenty of margin.

Training Wheels

I've found injection molded plastic training wheels work best for maze robots (especially young robots). These are available in any K Mart for under $8 a pair, so you don't have to steal from your kid's bike. The utility wheels normally sold in hardware stores and garden supply centers are too big (the smallest are usually 6" dia.) and have ball bearings, which make it impossible to drive them directly from the shaft of a motor. The training wheels require a 3/8" shaft, but the shafts on the motor are only 1/4", so we'll have to build up the diameter of the motor shaft.

Another thing: these wheels are made-in-Taiwan specials, so examine several pairs closely before buying. You'll want to select the truest, most uniform pair you can find, but there will still be variations between wheels which software will have to compensate for. (I didn't say this would be easy, just fun).

Back To The Design

Now that we have a better idea of the size, shape, and motive power of LIMBO, we can skip back up to a higher, more abstract level of design. LIMBO consists of seven subsystems (see Figure 2):

(1) Bumper contact sensor array
(2) Battery power supply
(3) Drive system
(4) Flux-gate magnetometer compass
(5) Infrared range-finder array
(6) Status console
(7) Controller

Since this is a computer-oriented magazine, you may think it odd that I list the controller last. Surely the controlling intelligence of the robot should be first on the list?

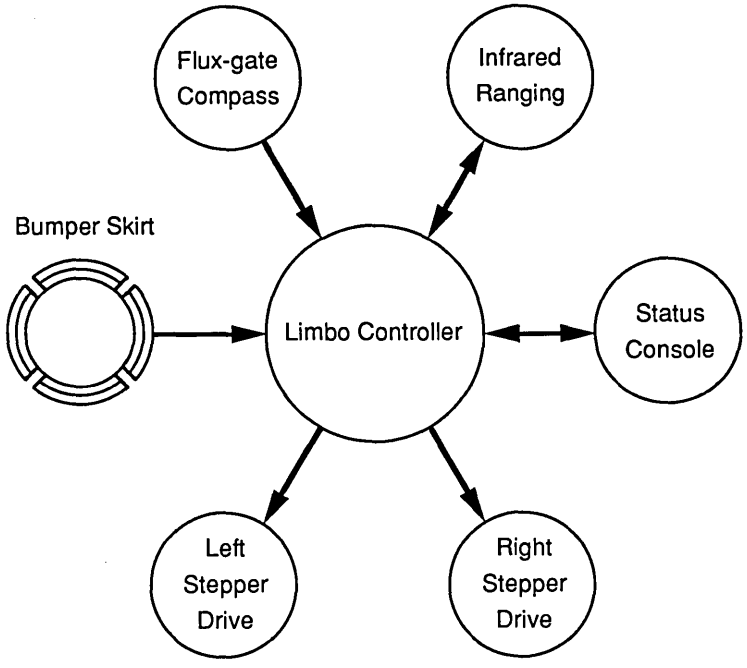
I purposely leave the controller until last because it, among all the subsystems, is the least affected by the gritty environment a robot lives in. In effect, I design robots from the outside in, sensors and motors first, controlling electronics and software last. It works.

The bumper contact system consists of a bumper skirt (the flower pot tray) and eight snap-action microswitches, plus some supporting structure. The battery power supply includes the battery, power conversion circuitry, distribution wiring and fuse protection. The drive system consists of one stepper motor and one wheel each for left and right, as well as swiveling castors, front and back, mounted on a simple suspension.

The flux-gate magnetometer compass will either be a modified unit available from Radio Shack or a home-brew version. (I'm still evaluating cost vs. performance between these two options.)

The presence of ferrous materials such

Figure 2—LIMBO Subsystems



as pipes, conduits, and rebar in concrete naturally affects magnetic sensors. To minimize the affects of local distortions in the Earth's magnetic field, the flux-gate coil will be mounted on a central mast so that it will be at least 36" from any ferrous objects in the floor or maze walls.

Further, to guard against magnetic distortions caused by very large steel structures, the compass should only be used for relative heading readings when making turns.

As long as LIMBO turns about its own center, relative change in heading is sufficient to make accurate turns—the absolute heading indicated by the compass is unimportant. Unless the contest area is known to be free from distortions, though, don't try to maintain an absolute heading while the robot is in linear motion.

Infrared Range

I described the IR range-finders last time, but it wouldn't hurt to review. The idea is to measure reflected IR with two sensor/emitter pairs a known distance apart (see Figure 3a).

The two sensor/emitter pairs are aimed roughly along the same line of sight, so the sensor closest to the object will receive the strongest signal. The equation in the figure shows that the ratio of the fourth power of the received signal strengths determines the distance to a diffusely reflecting object.

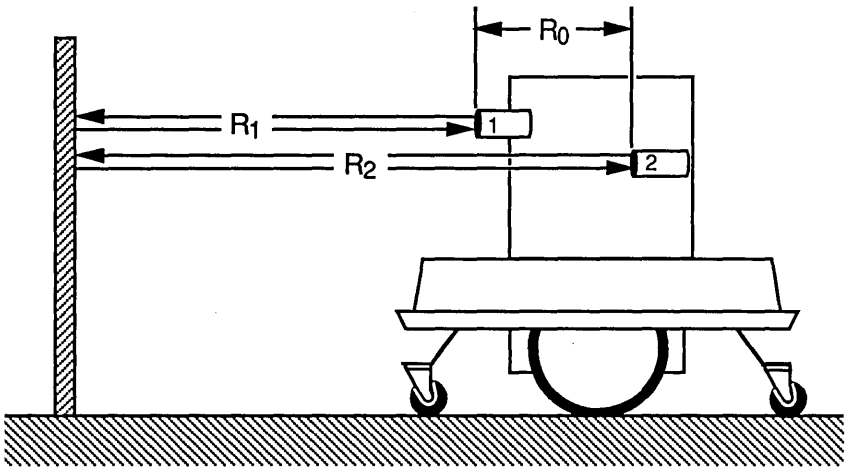
Unfortunately, signal intensity varies as the inverse fourth power of the distance from the wall giving at least a 3-decade dynamic range for distances from 0-22".

On the controller side of things, it would be nice to digitize this signal with a cheap 8-bit converter. (You see, I do think a little about the controller at this stage; like I said, this is not a linear process). But 8-bits is clearly not enough resolution to digitize signals accurately with more than a 1:1000 dynamic range. I haven't even mentioned the necessary math routines. What to do?

An elegant solution presents itself. Remember those peculiar tables in the back of high school algebra texts, those log-a-rhythms? (This is not the name of a dirt band, really.) If I take the log of a signal, it's the same as compressing the dynamic range of that signal. I can do this with a logarithmic amplifier. Once in the logarithmic domain, I'll perform multiplication or division by adding or subtracting the logarithms of the numbers I'm so keenly interested in.

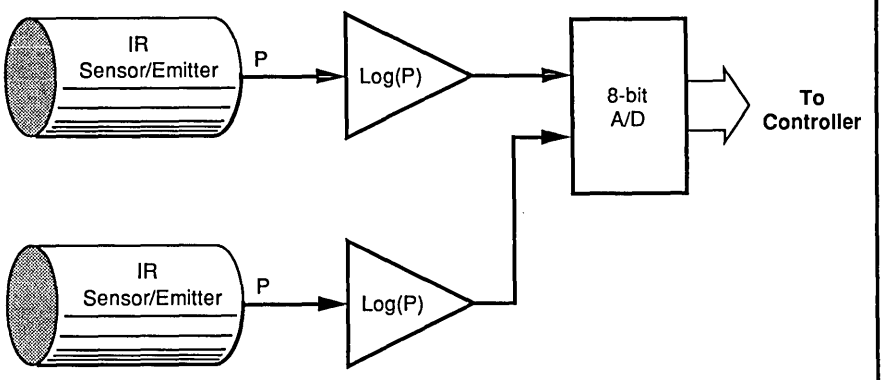
Powers and roots are found almost as

Figure 3a—Range Equation



$$\frac{(R_1+R_0)^4}{R_1{}^4} = \frac{P_1}{P_2} \Rightarrow R_1 = \frac{R_0}{\sqrt[4]{\frac{P_1}{P_2}} - 1}$$

Figure 3b—Logarithmic Signal Compression.



$R_1 = F(\text{Log}(P_1) - \text{Log}(P_2))$

easily with single multiplications or divisions. In order to get the full benefit of using logarithms, however, I should use a different form of the equation (see Figure 3b). With this equation, a simple algorithm leaps forth:

(1) Read converted values for log(P1) and log(P2).

(2) Subtract the second from the first.

(3) Use the above result to index into a lookup table of ranges.

Even I can understand a program like that. But I get ahead of myself.

The next subsystem to consider is the Status console. A 7-segment display shows the current operating status of LIMBO: "r" for "Ready"; "S" for "Stopped"; "L" for "Locked"; "b" for low battery. Digits 1 through 3 show the number of runs executed through the maze.

"Ready" denotes that LIMBO is ready to start a run through the maze. "Stopped" shows after a completed run, and "Locked" indicates the keylock switch is in the "Locked" position.

This last is essential when the robot is in a public maze contest because everyone wants to touch a "real robot." The keyswitch interlock allows said touching without such embarrassments as resetting system memory, changing run number, or sending LIMBO tumbling off the table.

Besides the keyswitch, "Start," "Stop," and "Reset" switches are part of the console, performing the functions of starting a run, stopping a run, and resetting LIMBO for a new series of runs.

The Controller

The last subsystem, the controller, is a single board computer expressly designed for LIMBO. It uses a 10 MHz HD64180 CPU from Hitachi, 64K CMOS static RAM, 64K CMOS system EPROM, and a 28-pin ZIF socket for the competitor's firmware.

There are 48 bits of parallel I/O, 22 of which are available for expansion. A Counter/Timer chip generates the pulses to drive the left and right stepper motors, so the CPU needn't spend time twiddling bits just to run the motors. An 8-bit A/D chip with 16-channel MUX handles the flux-gate compass, 8 IR sensor/emitter pairs, and battery voltage and battery temperature sense (very important).

Although there are extra I/O lines available, most of the expansion will probably be via the high speed multidrop RS-485 port. This will facilitate multiprocessing, and will encourage the development of modular subsystems (vision, anyone?).

On a more mundane level, I've included an RS-232 port for debugging from a terminal. Finally, the software will include a monitor running under a multitasking real-time operating system. I'll have a lot more to say about the controller in future issues.

Next time, LIMBO stops looking so much like a garage sale and more like a robot when we build stepper drive boards (PC layouts included) and assemble the motor box. We'll also fabricate the bumper contact skirt, wire the switches, and more.

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PCX Compatibility

Trying To Create A Graphics File Standard

When is a standard a standard? When there are many incompatible versions running around. When is a standard an impediment? When it outgrows its intended use. How does the PCX file format fit into this picture? Read on.

In the PC world there's a plethora of "standards" for storing graphics images. The most popular standards are TIFF (Tagged Image File Format), GIF (popular on CompuServe and BBSs), and PCX. The PCX format has emerged as a de facto industry standard, largely because of the wide range of software packages and hardware device drivers that support it.

ZSoft Corporation originally developed the PCX format for its PC Paintbrush family of products. Most desktop publishing programs (such as Aldus PageMaker and Xerox Ventura), paint and scanning software, fax boards, clip art, and file conversion programs can read it. Although ZSoft makes the format of PCX images known, developers (like myself) have had to start from scratch when writing PCX routines.

So you won't have to reinvent the wheel, I developed a PCX toolkit which allows you to manipulate PCX images from within almost any program. While developing the toolkit, I uncovered some interesting information about PCX images which I'd like to share.

Some History

Mark Zachmann, ZSoft's founder and president, invented PCX and PCC. He chose the name "PCX" because it sounded like "PICTURE." In early development, PCX was an uncompressed format. But at the eleventh hour, as ZSoft was about to release PC Paintbrush 1.0 in 1983, Zachmann decided to adopt a run-length compression algorithm.

The extension "PCC" designated a "cutout" (smaller than the screen) file. When Zachmann decided to implement his compression algorithm, he intended to only compress PCX images. Eventually, he compressed both, and PCC and PCX images are now in the same format.

Since then, the PCX format has become a widely-supported graphics standard—partly because major OEM hardware vendors, such as Tecmar and Microsoft, bundle PC Paintbrush with their video boards and mice.

ZSoft has also managed to support hundreds of display adapters, printers, scanners, and drawing devices—making PCX a very widely-used format for storing bit-mapped images.

Device Dependence

PCX is a "device dependent" format—meaning that an image created on a CGA will only look right on CGA (or CGA mode). Likewise, a picture created using a VGA 16-color mode can't be displayed on a CGA (i.e., 2-color or 4-color mode). This causes some problems for developers who want to support Hercules, CGA, EGA, VGA, and extended VGA modes with one image file. Put simply, you can't support all modes with one file.

One way around the problem is to draw two copies of every image—one for CGA and one for EGA/VGA modes. Another is to use only black and white images which can be displayed on any adapter. But black and white alone won't solve the problem since the display's aspect ratio will distort the image, elongating circles...

To achieve device *independence*, you must use a graphics primitive package. This means you must create the image with lines, circles, squares, etc., then redraw it later on the screen. You've seen this method used in CAD/CAM packages and programs like Micrografx Designer.

Unfortunately, the types of drawings you can create with programs like these (which create vector-mapped images) are limited. And sometimes you *need* the bit-mapped images generated by programs like PC Paintbrush. (As far as I know, no toolkits exist for displaying vector-mapped images from within your applications. So a vector-mapped project starts by reinventing the wheel.)

As long as we have different video modes, we'll have problems with graphics applications. I don't want to sound unsympathetic, but I'd like to encourage developers to move their support to higher resolutions (EGA and VGA) instead of CGA. Programs that try to support the lowest common denominator are forever penalizing the users of higher resolution monitors. I think EGA should be the new bottom end.

The Format

A PCX file is identified by a PCX or PCC extension, and a 0AH (10 decimal) as the first byte of the file. The PCC extension merely identifies the image as a partial screen image, or cutout. The first 128 bytes of any PCX or PCC file consists of an image file header. This header defines the width and depth of the image, the number of planes, the bits per pixel, and other information necessary for re-creating the image (see Figure 1).

Run-Length Encoding

After the header comes the image data. An uncompressed CGA screen takes 16K, an EGA 112K, a VGA 154K, and some extended VGA screens can be as large as 480K or more. A scanned, 8 1/2" x 11" 300 dpi 8-bit grayscale image would require 8.5 MB! Fortunately, a method called Run-Length Encoding (RLE) compresses PCX image data.

In RLE, any repeating data is stored as a count byte and a data byte. If, for example, 60 bytes of the image repeat, only 2 are stored instead of 60. This will save (here) 97%.

By Chris Howard

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Figure 1 — PCX File Header

```
typedef struct pcxheader {
        char        manuf;      /* Always =10 for Paintbrush    */
        char        hard;       /* Version information          */
        char        encod;      /* Run-length encoding (=1)     */
        char        bitpx;      /* Bits per pixel               */
        unsigned    xl;         /* Picture dimensions (incl)    */
        unsigned    yl;
        unsigned    x2;
        unsigned    y2;
        unsigned    hres;       /* Display horiz resolution     */
        unsigned    vres;       /* Display vert  resolution     */
        char        clrma[48];  /* Pallete                      */
        char        vmode;      /* (ignored)                    */
        char        nplanes;    /* Number of planes (ver 2.5=0) */
        unsigned    bplin;      /* Bytes per line               */
        unsigned    palinfo;    /* Palette Info (1=col, 2=gray) */
        unsigned    shres;      /* Scanner resolution           */
        unsigned    svres;      /* Scanner resolution           */
        char        xtra[54];   /* Extra space (filler)         */
} PCXHEADER;
```

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Here's the pseudo-code for data uncompression—

```
For each byte read X,
  if top 2 bits of X are 1, then
    repeatcount=(6 low bits of X)
    data = (next byte after X)
  else
    repeatcount = 1
    data = X
  end if
```

The data compression algorithm is exactly the opposite—

```
For each byte read Y,
  if byte Y = next byte, then
    repeatcount = repeatcount+1
  else
    if (repeatcount = 1), then
      if top 2 bits of Y are 1
        set top 2 bits of...
        ...repeatcount on
        write count byte
      end if
      write data byte
    else
      set top 2 bits of...
      ...repeatcount on
      write count byte
      write data byte
    end if
  end if
```

For a compression scheme, the PCX format is as straightforward as they come. It could be used to encode almost any kind of data—but is really only effective where bytes repeat, such as image data.

Finding The Data

You might assume that you'd display an image by reading a byte, testing it, writing it to the display, etc., until you reach the end of the file. But this method has a serious problem—data isn't always contiguous.

Sometimes you may include extra data at the end of each scan line, to round the number of bytes per line to an even word boundary. You may also include extra data at the end of the file, either to round the number of lines up to a multiple of 16, or for additional palette data.

What's A Palette, Anyway?

Display palettes have always been a bit of a mystery but they're conceptually simple, analogous to a painter's palette (where the term comes from). Although the painter may have thousands of jars of paint on his shelf, he can only fit a limited number of colors on his palette.

On an EGA, you can choose 16 colors for your palette, out of 64 possible colors (or jars). The VGA can display 256 colors out of thousands.

CGA

The first byte of the CLRMA array is the CGA background. The top four bits of the byte represent a background color between 0 and 15. The fourth byte of the array is the CGA foreground palette. The upper 3 bits control the palette settings as follows—

```
bit 7: Color burst    0 = color
                      1 = mono
bit 6: Palette        0 = yellow
                      1 = white
bit 5: Intensity      0 = dim
                      1 = bright
```

EGA/VGA 16 color

The palette is stored as 16 triples. A triple is a three-byte value representing RGB—one byte of red, one of green, and one of blue. On the EGA and VGA, there are four levels of Red, four of Green, and four of Blue. Divide each byte by 4 to get the appropriate level, as follows—

Divided Byte	Level	Xx
0 - 63	Level 0	00
64 -127	Level 1	01
128-192	Level 2	10
193-254	Level 3	11

To format this as a BIOS palette value, which expects a byte formatted as 00RGBrgb, takes some bit manipulation. Use the Xx value above to match the

level to the appropriate bit values. For instance, a Red level of 2, a Green of 1, and a Blue of 0 yields a byte of 00100010.

VGA 256-Color

The VGA palette format for 256-color modes won't fit in the CLRMA array, since it takes 768 bytes. For awhile, ZSoft didn't support the 256 color palette. It then started storing the palette in the separate PATTERNS file, at the end of the patterns.

In the PCX Programmer's Toolkit, we chose to extend the format by storing the palette at the end of the encoded image data. The palette was identified by the same 0AH (10 decimal) as the PCX ID byte, by preceding the palette with the ID byte. The format of the palette is BIOS compatible (RGB triples).

The latest versions of PC Paintbrush now also store the palette at the end of the file. However, they shift each byte left two bits to match their internal palette format. We requested that the ID byte be different so that the toolkit could automatically identify and compensate for the palette differences transparently. The ID byte for the new format is 0CH (12 decimal). The toolkit can read either palette format but now only writes new images in the new format.

The Hard Part

The hard part is programming the video hardware. To compress the image data, you must read and access video memory and align it in a linear format. This varies with almost all display modes. For instance: CGA memory is interleaved, EGA memory is planar, VGA is planar, Hercules is interleaved (different from CGA), and extended VGA modes ... well, there is no standard.

To get a better handle on the hard part, I recommend the following books—

- *Programmer's Guide to the PC and PS/2 Video Systems*, by Richard Wilton, published by Microsoft Press.
- *Programmer's Guide to the EGA and VGA Cards*, by Richard Ferraro, published by Addison-Wesley.
- *Programmer's Guide to the Hercules Graphics Cards*, by David Doty, published by Addison-Wesley.

In general, a planar image is stored one scan line at a time, one plane after the other. For instance, start at line 1 and encode the Red plane, the Green plane, the Blue plane, then the Intensity plane for that line. Then store line 2 RGBI, line 3 RGBI, etc.

Maintaining A Standard

When anything claims to be a standard, we generally infer that it's well-defined, accepted, and supported. With PCX, the format meets two of those three: it's accepted and supported, but it's not well-defined.

In other words, there's no outline (in my opinion) for future revisions, and no way for developers to know which revision of the PCX format they're dealing with. There is a version byte in the header (which references a PC Paintbrush version), but this version byte hasn't changed.

Take, for example, the 256-color modes. Granted, it was impossible to predict (in 1983) we'd be supporting huge palettes when at the time there were only CGA and Hercules adapters. But it's not excusable for the company controlling the standard to issue a "temporary" work around (i.e., storing the 256-color palettes in the Paintbrush PATTERNS file), and then finalize on a format six months later.

Developers who went ahead and supported the pattern file format were left out in the cold, since Paintbrush now doesn't even support the separate palette in current versions.

I'm not finding fault with ZSoft, but raising a question—how do you maintain a standard so that it's expandable and allows for future innovations, while allowing other developers to support it?

This happens time and again in the computer industry. A program stores information in its own private format, and then without the vendor's permission, the format becomes widely supported. The original vendor gets locked in, no longer having control. He's now responsible not only for maintaining his own products, but for maintaining "The Standard."

Some Suggestions

Although I don't have the whole solution for this kind of problem, I do have some suggestions for developers who find it necessary to create a new format:

(1) Uniquely identify the file. Don't rely on extensions for identifying files. Maintain an ID byte, usually the first byte of the file. Multi-byte IDs are better.

(2) Maintain a version field. Always put a version number in the header. However, this *must* be other than the ID field—don't encourage developers to key on it, but encourage its use as a "features supported" number. New versions of the format must be backward compatible, with new features available if the software supports it.

(3) Design an expandable header. Fixed length headers may be easy to write, but lead to dead ends. The fields always remain constant (i.e., at the same locations) at the top of the header. One of the fields is, of course, a "header length" field. This allows for header expansion at any time (say, to accommodate that 1024 color palette...) for new fields. Programs that support previous formats wouldn't use the new fields. They'd automatically skip over them.

(4) Variable field placement. Keep in mind that field locations should vary without causing problems. By this I mean that the header field can hold an OFFSET to the actual data. The offset field has a fixed position, but the data can be located anywhere in the file. This works well with variable length data (such as palettes) and string information.

(5) Allow "information areas." Put optional fields in there for file information strings, copyright areas, etc.

(6) Backward Compatibility. The format must *always* be backward compatible.

(7) Maintain a Format Specification. A format specification guarantees consistent support in not only your own programs, but in other software vendors' programs. Never release an "intermediate" version. If the format must change in a way that's not backward compatible, solutions must be made available to developers supporting the format.

(8) Release a Toolkit. A toolkit serves both the format developer and other supporting developers. It makes it easy for other vendors to support your files, and it also allows you to change the format transparently and consistently without affecting everyone adversely.

Conclusion

In summary, the PCX format is a powerful way to break your graphics application into the myriad of software packages that now support PCX. The easiest and most reliable way of doing this is through the PCX Programmer's Toolkit, since it handles the PCX support issues for you automatically, ensuring backward compatibility.

If you decide to implement your own standard, keep the above design points and issues in mind. You may be the only one using the format at first; but by looking ahead and allowing expansion, you can avoid being "locked in" to a dead-end format. This will also encourage developers to standardize on your format, without the worry of needless or spontaneous changes.

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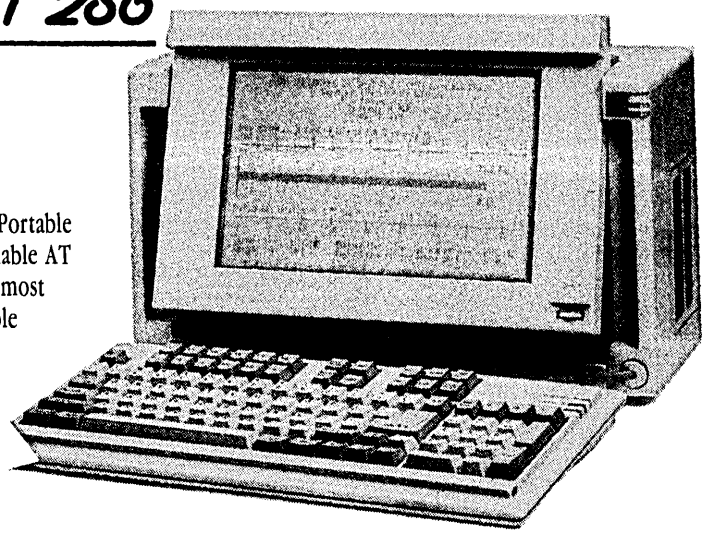

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A 68000-Based Multitasking Kernel

Or, How To Fix A Perfectly Good Singletasking System

Well, here it is, multitasking, Micro C style. Karl shows us how he's written a multitasking supervisor for his truly unique 68000 system. (And guess what he's working on—a 68000-based embedded controller for around $30! Great robot guts.)

As I'm writing this, my surplus 68000 system is running three tasks simultaneously; the SK*DOS operating system, my ROM monitor, and a simple LED blinker. No collisions, no crashes, no muss, no fuss. All made possible by a tiny, home-brew multitasking kernel called MTASK.

Tasks And Scheduling

Multitasking uses two types of programs: tasks, and task schedulers. Any program, whether ROM or RAM based, qualifies as a task. A scheduler program controls the switching of tasks. The programmer defines tasks to the scheduler using a table of parameters, appearing in memory as a block of data.

Each task definition block (or TDB) must contain (as a minimum) the execution address of the task, the task's stack pointer and some form of validation flag. The flag gets checked by the scheduler prior to task startup, protecting the system against corrupted TDBs. Additional TDB information may be provided for controlling I/O and system resources, assigning task priority, and aiding intertask communication.

CPU control passes periodically to the scheduler. The scheduler shuts down the previous task, checks for the next task, and transfers control to it. As each task gets switched on or off, the scheduler updates the appropriate TDB.

The signal that interrupts a task and activates the scheduler defines the type of multitasking kernel used. Two main types of kernels exist: the interrupt-driven, and the cooperative.

The Usual Way...

Most often, multitasking refers to an interrupt-driven task switching system. Here, hardware routinely interrupts a task's operation and control passes to the scheduler.

This is usually a simple system to implement. You need a source of periodic interrupt signals (such as a 555 timer or a divider circuit driven by the CPU's clock) and an interrupt handler program to pass control to the scheduler when the interrupt occurs. Of course, you also need the scheduler.

The main drawback to this system lies in the hardware interface. The hardware design and the software design must play together perfectly. The software must know where the interrupts come from, how often they will occur, and how they can be controlled. Thus, the scheduler design is unique for each hardware design.

An Alternative

The cooperative multitasking system uses a different approach for passing control to the task scheduler. Here, each task voluntarily abdicates to the scheduler, which then wakes up the next task. There are no hardware-induced interrupts. Each task knows precisely where it will give up control to another task and precisely where it will regain control.

This technique requires no special knowledge of the system's hardware. It is necessary, however, to know how it handles low-level I/O. Developing a cooperative kernel involves blending these I/O calls with the scheduler code.

The major drawback to the cooperative system lies in its name. Each task must release control to the scheduler properly and in a timely manner, or other tasks won't be run. Generally, the cooperative system forces release of the CPU by embedding the scheduler transfer inside an I/O call.

Whenever a task transfers data to a console device or serial port, the scheduler gets activated instead. It temporarily suspends the I/O request and activates the next task. Eventually, the original task comes up for scheduling again, at which time the I/O request gets handled.

Some computationally-intensive tasks (such as fractal calculations) would not release the CPU for a long time. For these cases, a special routine provides a forced scheduler call. Obviously, the programmer must imbed such calls at key points in the program if the cooperative system is to work smoothly.

If you want to play with a truly elegant implementation of a cooperative multitasking system, try the public-domain Forth-83 system (check your local BBS).

For an elegant description of how the F83 scheduler and multitasking system work, consult the book *Inside F83* by Dr. C. H. Ting. This superb explanation of F83's internal workings may be ordered from Mountain View Press.

More On Cooperation

The cooperative system usually relies on I/O calls to trigger the scheduler. This means that the scheduler must somehow intercept each I/O request, yet it must also complete the I/O request properly. This I/O interception can be handled in various ways.

If a system uses software interrupts to trigger an I/O request, the scheduler can simply overlay a transfer to itself into the interrupt vector location. For example, if a 68000 system relies on TRAP 0 for processing I/O requests, the scheduler would simply write its own entry address into location $80. I/O requests would then be routed through the scheduler, which would eventually direct them to the original I/O code.

If, however, a system uses explicit calls to I/O subroutines, the scheduler must insert a hook into those subroutines. This is not normally a problem,

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as any self-respecting DOS uses RAM-based I/O routines. In this case, you'll need to know precisely how these I/O routines behave. Calls to the scheduler then overlay the entry points, providing the needed interception.

Even if the machine uses ROM-based I/O modules, you can still create a cooperative multitasking system. In my case, all I/O requests pass through a RAM-based vector before returning to the ROM for processing. This RAM vector gives me an intercept point.

About MTASK

The program MTASK, written in 68000 assembly language, provides a simple multitasking kernel. (See Figure 1 for listing.) It is capable of considerable power—in fact, it gives two users full access to my ROM monitor. This simple multi-user capability results from careful monitor design.

But this discussion deals with MTASK as a multitasking kernel. MTASK contains several modules: the I/O overlays, the startup sequence, the scheduler routine and a special program for displaying information about scheduled tasks.

Development of MTASK started even before I got SK*DOS running on my system. The design seems rather schizophrenic because I changed vital system details in midstream. For example, SK*DOS requires all programs to be position independent, able to run properly regardless of load address. I wrote 99% of MTASK that way, simply out of habit.

However, it was impossible to provide the execution address of tasks to the scheduler if I didn't know what they were going to be. For test purposes only, I ORGed MTASK to run at location $3D000. This locks the internal entry points into place, allowing me to give actual addresses to the scheduler routine.

This means that MTASK, in its current form, will *not* run properly under SK*DOS. That doesn't concern me right now, as SK*DOS' file control system does not support multi-user operation anyway. In the future, I will probably imbed MTASK (or son of MTASK) in ROM and add system service routines to support external control of task assignments. This would get around the position-independence imposed by SK*DOS.

> Each task knows precisely where it will give up control to another task and precisely where it will regain control.

For now, I have to work around SK*DOS to run MTASK. This involves changing SK*DOS' end of memory pointer (MEMEND) to $3CFFF, then loading MTASK into RAM at its default origin of $3D000. This sequence prevents SK*DOS from loading a program on top of MTASK.

I then transfer control to my ROM monitor from SK*DOS. Finally, I use the monitor's GO command to start up MTASK. To return to SK*DOS with MTASK still running, I then GO to SK*DOS' warm-start entry point, $1006.

Inside MTASK

Six entry points support the low-level I/O functions for the two serial ports on my system. INV0 and INV1 handle incoming characters from ports 0 and 1, respectively. OUTV0 and OUTV1 take care of outgoing characters. KEYV0 and KEYV1 check for a pressed key on the corresponding terminals. Tasks may use either serial port for I/O; the entry points placed into a task's TDB by the programmer determine which port gets used.

The scheduler writes the selected three low-level entry points into the monitor's RAM vector locations before switching tasks. Thus, each task gets its own set of I/O handlers. In an expanded version of MTASK, these vectors may not even point to the ROM-based I/O routines; instead, they might point to a queue handler or other special-purpose subprogram.

Transfer to MTASK occurs when the program first executes. MTASK builds up a TDB for task 0. This consists of writing the channel 0 I/O vectors into the RAM links and putting an initial stack pointer address into the TDB. MTASK then pushes the monitor entry point onto the stack and jumps to the monitor using an RTS instruction.

PAUSE does the task scheduling; I gave it the same name as the F83 task scheduler. Though PAUSE seems short, a great deal takes place here. (Refer to Figure 1 for the following discussion. Bear in mind that the stack pointer used by PAUSE upon entry seldom matches the stack pointer upon exit. This can get quite confusing as you go through the code. It might help to grab a pencil and paper.)

PAUSE first pushes all registers, including the stack pointer, onto the current task's stack. It then generates a pointer to the TDB of the current task, where it tucks away the current stack pointer for later use.

Next, PAUSE determines the number of the next potential task and generates a pointer to that TDB. The validity flag is checked and, if not okay, the routine repeats the procedure with the next task.

After arriving at a valid user and TDB, PAUSE checks the task status bits.

Figure 1—68000 Multitasking Kernel

```
* This program serves as a cooperative-type multitask
* controller for the Mini-Frame. It provides an
* appropriate set of I/O routines, until those routines
* can be installed in ROM.

GETC0    EQU     $800032    GET CHAR FROM CHANNEL 0
GETC1    EQU     $800038    GET CHAR FROM CHANNEL 1
PUTC0    EQU     $800044    WRITE CHAR TO CHANNEL 0
PUTC1    EQU     $80004A    WRITE CHAR TO CHANNEL 1
KEY0     EQU     $800056    CHECK FOR KEY ON CHANNEL 0
KEY1     EQU     $80005C    CHECK FOR KEY ON CHANNEL 1
WARMS    EQU     $80000E    WARM START ENTRY TO MONITOR
PRINTF   EQU     $800020    PRINTF ENTRY POINT

         ORG     $3D000     PROTECT FROM SK*DOS

START    BRA     MTASK      START THE MULTI-TASK SYSTEM
         BRA     PSTAT      PRINT STATS ON ALL TASKS

* The following equates are offsets into the task
* description block.

STKPTR:   EQU    0          STACK POINTER (LONG)
VALID:    EQU    4          VALID FLAG (2 BYTES)
STARTS:   EQU    6          STARTUP ADDRESS (LONG)
INV:      EQU    10         VECTOR FOR CHAR IN (LONG)
OUTV:     EQU    14         VECTOR FOR CHAR OUT (LONG)
KEYPRSDV: EQU    18         KEYPRESSED VECTOR (LONG)
STATUS:   EQU    22         STATUS BYTE (1 BYTE)
TEMP1:    EQU    23         RESERVED (1 BYTE)
COUNT:    EQU    24         ACTIVATION COUNT
TEMP2:    EQU    28         RESERVED (LONG)
NAME:     EQU    32         TASK NAME (8 BYTES)
STKSIZE:  EQU    $200       ROOM FOR EACH TASK'S STACK

TASK0SP   EQU    $3E000           TASK 0 STACK POINTER
TASK1SP   EQU    TASK0SP+STKSIZE  TASK 1 STACK POINTER
TASK2SP   EQU    TASK1SP+STKSIZE  TASK 2 STACK POINTER

* The following equates may need to be adjusted if the
* ROM routines change.

GETCRAM2 EQU     $E00+2     RAM VECTOR FOR GETC
PUTCRAM2 EQU     $E06+2     RAM VECTOR FOR PUTC
KEYRAM2  EQU     $E0C+2     RAM VECTOR FOR KEYPRSD

INV0:
        BSR      KEYV0      CHECK FOR KEY PRESSED
        BCC      INV0       LOOP UNTIL CHAR AVAILABLE
        JSR      GETC0      GO GET THE CHAR
        RTS                 AND RETURN

INV1:
        BSR      KEYV1      TEST FOR CHAR
        BCC      INV1       LOOP UNTIL CHAR AVAILABLE
        JSR      GETC1      GO GET THE CHAR
        RTS                 AND RETURN

OUTV0:
        BSR      PAUSE      TIME FOR A SLICE
        MOVE.W   4(A7),-(A7) PUSH THE CHAR AGAIN
        JSR      PUTC0      SEND CHAR TO PORT
        ADDQ.L   #2,A7      POP THE CHAR AND RETURN
        RTS


OUTV1:
        BSR      PAUSE      GUESS WHAT?
        MOVE.W   4(A7),-(A7) PUSH THE CHARACTER AGAIN
        JSR      PUTC1      SEND CHAR TO PORT
        ADDQ.L   #2,A7      POP THE CHAR AND RETURN
        RTS

KEYV0:
        BSR      PAUSE
        JSR      KEY0       GO LOOK AT KEYBOARD
        RTS

KEYV1:
        BSR      PAUSE
        JSR      KEY1       GO LOOK AT KEYBOARD
        RTS

* MTASK - This routine starts the multitask kernel:
*   It prepares task 0 for activation.
*   It jumps to the execution address in the TDB to
*   start task 0.

MTASK:
    LEA      CURRENT(PC),A0     POINT TO CURRENT TASK
    CLR.W    0(A0)              SHOW TASK 0
    MOVE.L   #TASK0SP,A7        SET UP TASK 0 STACK PTR
    LEA      INV0(PC),A0        GET INPUT VECTOR
    MOVE.L   A0,GETCRAM2        OVERWRITE MONITOR'S LINK
    LEA      OUTV0(PC),A0       DO OTHER VECTORS
    MOVE.L   A0,PUTCRAM2
    LEA      KEYV0(PC),A0
    MOVE.L   A0,KEYRAM2
    MOVE.L   #WARMS,-(A7)       PUSH ENTRY TO ROM MONITOR
    RTS

* PSTAT - Print statistics on all tasks to the current
* I/O device.
*
* It is designed to be called from monitor with a GO
* command. The RTS at the end of the code will return
* user to the monitor.

PSTAT:
    PEA      HEADING(PC)        AIM AT HEADING MESSAGE
    JSR      PRINTF
    ADDQ.L   #4,A7
    LEA      RAMTBL(PC),A0      AIM A0 AT RAM TABLE
    CLR.W    D1                 START WITH TASK 0

PSTAT1:
    MOVE.W   #BLKSIZE,D0        GET SIZE OF CONFIG BLOCK
    MULS     D1,D0              GET OFFSET INTO ARRAY
    MOVE.L   INV(A0,D0.W),D2    GET INPUT VECTOR
    CMP.L    #INV0,D2           IS HE USING PORT 0?
    BNE      PSTAT2             BRANCH IF NOT
    PEA      PORT0(PC)          PUSH PORT 0 STRING
    BRA      PSTAT4
PSTAT2:
    CMP.L    #INV1,D2           IS HE USING PORT 1?
    BNE      PSTAT3             BRANCH IF NOT
    PEA      PORT1(PC)          PUSH PORT 1 STRING
    BRA      PSTAT4
PSTAT3:
    PEA      PORTX(PC)          UNKNOWN PORT
PSTAT4:
    MOVE.L   COUNT(A0,D0.L),-(A7)  PUSH ACTIVATION CNT
    MOVE.L   STKPTR(A0,D0.L),-(A7) PUSH STACK POINTER
    LEA.L    NAME(A0,D0.L),A1   POINT TO NAME IN BLOCK
    LEA      NAMESTR(PC),A2     POINT TO LOCAL NAME STR
    MOVEQ    #8,D2              LOAD A COUNTER
PSTAT5:
    MOVE.B   (A1)+,(A2)+        COPY A BYTE
    SUBQ.L   #1,D2              COUNT THIS BYTE
    BNE      PSTAT5             LOOP UNTIL DONE
    CLR.B    (A2)               CLEAR TERMINATING BYTE
    PEA      NAMESTR(PC)        PUSH NAME STRING
    PEA      STATMSG(PC)        SHOW THE STAT MESSAGE
    JSR      PRINTF
    ADD.L    #20,A7
    ADDQ.W   #1,D1              GO TO NEXT TASK
    CMP.W    #LASTTASK,D1       SEE IF ALL DONE
    BLE      PSTAT1             KEEP PRINTING UNTIL DONE
    PEA      FINALMSG(PC)       PRINT FINAL MESSAGE
    JSR      PRINTF
    ADDQ.L   #4,A7
    RTS


HEADING:
        DC.B     $0D,$0A,$0A
        DC.B     '          '
        DC.B     'Stack     '
        DC.B     'Activation '
        DC.B     '          '
        DC.B     '          '
        DC.B     $0D,$0A
        DC.B     'Name      '
        DC.B     'Pointer   '
        DC.B     'Count     '
        DC.B     'I/O device '
        DC.B     '          '
        DC.B     $0D,$0A
        DC.B     '-----------'
```

Continued on page 42

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```
        DC.B    '----------'
        DC.B    '----------'
        DC.B    '----------'
        DC.B    '----------'
        DC.B    $0D,$0A
        DC.B    0
STATMSG:
        DC.B    '%-11s%-11X%-11X%-11s'
        DC.B    $0D,$0A
        DC.B    0
FINALMSG:
        DC.B    $0D,$0A
        DC.B    0
PORT0:
        DC.B    'CHNL 0'
        DC.B    0
PORT1:
        DC.B    'CHNL 1'
        DC.B    0
PORTX:
        DC.B    'UNKNOWN'
        DC.B    0

* PAUSE - The heart of the multitask controller. It
* switches tasks each time it is invoked. Normally, it
* is invoked automatically each time an I/O request is
* made. Additionally, it may be invoked explicitly by a
* routine to force a task switch (in the interest of
* fairness).

PAUSE:
    MOVEM.L D0-D7/A0-A7,-(A7) SAVE ALL REGISTERS
    LEA     CURRENT(PC),A0    POINT TO CURRENT TASK
    MOVE.W  0(A0),D0          PUT IN D0
    MOVE.W  D0,D2             SAVE CURRENT TASK IN D2
    LEA     RAMTBL(PC),A0     POINT TO RAM TABLE
    MULS    #BLKSIZE,D2       MAKE A BLOCK POINTER
    ADD.L   D2,A0             POINT A0 AT TASK'S BLK
    MOVE.L  A7,STKPTR(A0)     SAVE CURRENT STACK PTR

PAUSE0:
    CMP.W   #LASTTASK,D0      IS THIS THE LAST TASK?
    BNE     PAUSE1            BRANCH IF NOT
    CLR.W   D0                GO BACK TO TASK 0
    BRA     PAUSE2
PAUSE1:
    ADDQ.W  #1,D0             GO TO NEXT TASK
PAUSE2:
    LEA     CURRENT(PC),A0    POINT TO CURRENT TASK
    MOVE.W  D0,0(A0)          SAVE CURRENT TASK
    MOVE.W  D0,D2
    MULS    #BLKSIZE,D2       LEAVE D2 AS A BLOCK PTR
    LEA     RAMTBL(PC),A0     GET ADDRESS OF TASK TABLE
    ADD.L   D2,A0             PNT A0 AT NEW TASK TABLE
    CMP.W   #'VL',VALID(A0)   IS THIS A VALID TASK?
    BNE     PAUSE0            IF NOT, GO TRY NEXT ONE
    MOVE.B  STATUS(A0),D1     GET STATUS OF NEW TASK
    BTST.B  #ACTIVE,D1        CHECK THE ACTIVE BIT
    BEQ     PAUSE0            INACTIVE, TRY AGAIN
    BTST.B  #STARTUP,D1       HOW ABOUT STARTUP BIT?
    BEQ     PAUSE3            NO, MUST BE FULLY ACTIVE
    MOVE.L  STKPTR(A0),A7     PUT NEW STACK PTR INTO A7
    MOVE.L  STARTS(A0),-(A7)  PUSH THE STARTUP ADDRESS
    MOVEM.L D0-D7/A0-A7,-(A7) PUSH ALL REGS (DUMMY)
    BSET.B  #ACTIVE,D1        SHOW THIS TASK AS ACTIVE
    BCLR.B  #STARTUP,D1       SHOW THIS TASK AS STARTED
    MOVE.B  D1,STATUS(A0)     SAVE NEW STATUS
    BRA     PAUSEX            GO GET HIM STARTED


PAUSE3:
    MOVE.L  STKPTR(A0),A7     GET THE NEW STACK POINTER

PAUSEX:
    ADDQ.L  #1,COUNT(A0)      INCREMENT ACTIVATION CNT
    MOVE.L  INV(A0),GETCRAM2
    MOVE.L  OUTV(A0),PUTCRAM2
    MOVE.L  KEYPRSDV(A0),KEYRAM2
    MOVEM.L (A7)+,D0-D7/A0-A7 RESTORE ALL REGISTERS
    RTS                       TRANSFER TO NEW TASK

* BLINKER - This is a simple test program to verify
* that the multitask activity is taking place.

BLINKER:
    BSR     PAUSE             GIVE OTHER GUY A SHOT
    LEA     RAMTBL(PC),A0     POINT TO RAM TABLE
    MOVE.W  #2,D0             GET TASK # (CHEATING)
    MULS    #BLKSIZE,D0       D0 POINTS TO OUR TASK BLK
    MOVE.L  COUNT(A0,D0.L),D0 GET CURRENT ACTIV. COUNT
    BTST.L  #12,D0            LOOK AT A SPECIAL BIT
    BNE     BLNK_ON           IF SET, TURN LIGHT ON
    MOVE.L  #$3F00,$450000    NOT, SO TURN LED OFF
    BRA     BLINKER           LOOP FOREVER
BLNK_ON:
    MOVE.L  #$3E00,$450000
    BRA     BLINKER

* Following EQUs are bit patterns used in status byte

ACTIVE:    EQU     0          BIT 0, TRUE = ACTIVE
STARTUP:   EQU     1          BIT 1, TRUE = NOT STARTED
ACTIVE_ST:       EQU   $01    STATE = ACTIVE, STARTED
UNSTARTED_ST:    EQU   $03    STATE = ACTIVE, UNSTARTED
SLEEP_ST:        EQU   $00    STATE=INACTIVE, UNSTARTED

* Following table is initialized version of task tables

RAMTBL:
* TASK 0
    DC.L    TASK0SP           STACK POINTER, TASK 0
    DC.B    'V','L'           VALID FLAGS
    DC.L    WARMS             STARTUP ADDRESS
    DC.L    INV0              INPUT VECTOR
    DC.L    OUTV0             OUTPUT VECTOR
    DC.L    KEYV0             KEYPRESSED VECTOR
    DC.B    ACTIVE_ST         STAT BYTE-ALREADY ACTIVE
    DC.B    0                 RESERVED
    DC.L    0                 ACTIVATION COUNT
    DC.L    0                 RESERVED
    DC.B    'TASK_0',0,0

BLKSIZE EQU       40          NUMBER OF BYTES IN BLOCK

* TASK 1
    DC.L    TASK1SP           STACK POINTER, TASK 1
    DC.B    'V','L'           VALID FLAGS
    DC.L    WARMS             STARTUP ADDR (ROM MON)
    DC.L    INV1              INPUT VECTOR
    DC.L    OUTV1             OUTPUT VECTOR
    DC.L    KEYV1             KEYPRESSED VECTOR
    DC.B    UNSTARTED_ST      STAT BYTE-ACTIVE,UNSTRTED
    DC.B    0                 RESERVED
    DC.L    0                 ACTIVATION COUNT
    DC.L    0                 RESERVED
    DC.B    'TASK_1',0,0

* TASK 2 (Dummy activity to show multitask activity)
    DC.L    TASK2SP           STACK POINTER, TASK 2
    DC.B    'V','L'           VALID FLAGS
    DC.L    BLINKER           STARTUP ADDRESS
    DC.L    0                 INPUT VECTOR
    DC.L    0                 OUTPUT VECTOR
    DC.L    0                 KEYPRESSED VECTOR
    DC.B    UNSTARTED_ST      STAT BYTE-ACTIVE,UNSTRTED
    DC.B    0                 RESERVED
    DC.L    0                 ACTIVATION COUNT
    DC.L    0                 RESERVED
    DC.B    'BLINKER',0

LASTTASK:   EQU   2           NUMBER OF LAST LEGAL TASK

* RAM area used by the multi-user system.
CURRENT:
        DC.W    0             NUMBER OF CURRENT TASK
NAMESTR:
        RMB     10            RESERVED FOR STAT ROUTINE

        END     START
```

♦ ♦ ♦

If the status bits show the task as inactive, PAUSE skips the task and resumes the search for another valid task and TDB. If the task's status bits show it's not yet started, PAUSE resets the bits to show the task as active and proceeds with startup.

Starting a task requires updating the current user number, incrementing the task's activation count (contained in the TDB), and loading the task's I/O vectors into RAM. Finally, PAUSE pulls the task's stack pointer from the TDB, reloads all registers (including the stack pointer) and executes an RTS, returning control to the now-active task.

PSTAT provides a visual check of the multitasking kernel. Executing PSTAT gives a short display of all tasks defined by the TDBs. Information supplied by PSTAT includes the task name, stack pointer, activation count, and current I/O device assigned. The activation count, contained in each TDB, is simply the number of times PAUSE has started that task. It allows external programs to monitor a task's progress and trigger other events based on the count.

Finally, BLINKER demonstrates that the multitasking system works. It turns a status LED on and off at a two-second rate. Because BLINKER's status bits are initially set to active and not started, it will start the first time it becomes a candidate task.

Improvements, Anyone?

MTASK offers considerable power, but you can always add features. The first upgrade that comes to mind concerns communication with the scheduler. Currently, changing values inside a TDB requires a rewrite and reassembly; hardly a robust procedure. Better would be a set of routines directly supporting manipulation of the TDBs. This would permit external programs to start and stop tasks, determine status of the tasks, or alter task parameters.

An obvious way to provide this communication lies with the TRAP instruction. I might choose a presently unused TRAP vector (such as 7) and write into it the address of a dedicated program for servicing scheduler requests. To invoke a scheduler service request, a program could load A0 with a service request code, load A1 with a pointer to a block of data, and execute a TRAP 7.

Another possible way to handle scheduler service requests could be via a vector in the monitor ROM. Since MTASK doesn't have to be in RAM (only the TDBs and a few support variables need to be changeable), burning MTASK into EPROM might make sense. Programs needing scheduler support could then enter the service routine via a ROM vector.

Uses For MTASK

Even in its present form, MTASK can handle such jobs as data collection, data buffering, monitoring of external conditions, and anything else not directly involving SK*DOS. Because of my ROM monitor design, I can even hook two serial terminals to my Mini-Frame and have two users running my ROM monitor simultaneously. In fact, the TDB for task 1 in the listing shows how to set this up.

To demonstrate MTASK's power, I once wrote an assembly language program for a two-player hunt-the-battleship game. The program lets each user run in real-time, entering commands and seeing the results immediately. The program made quite an impression at our computer club meeting.

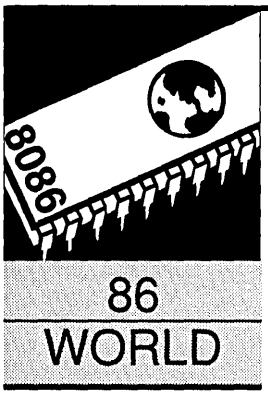
Even though SK*DOS does not (presently) support multiple users, I can use MTASK to run SK*DOS as the primary task, with a secondary task running my monitor from another serial port. The BLINKER task and both serial ports behave perfectly; SK*DOS never even knows other programs are running.

The problem of SK*DOS overwriting MTASK can be solved one of two ways. MTASK could be burned into EPROM, as I discussed above, or you could hide a section of memory from SK*DOS (using SK*DOS' DOSPARAM command). Then MTASK could be loaded into this area. You could write a .BAT file to handle this.

In Conclusion

MTASK offers considerable power in only 1K of code. I believe that the cooperative nature of MTASK will permit others to easily stage it on their 68000 systems. MTASK serves as an excellent tool for exploring multitasking. If any readers add to MTASK, please share your efforts with the rest of us.

♦ ♦ ♦



Debugging A Processor

Or: You Can't Always Execute An Address

By Laine Stump
% Redhouse Press
Merkez PK 142
34432 Sirkeci
Istanbul, Turkey

If you've had an itch to get into debuggers—C debuggers, assembly debuggers, TSR debuggers, smart debuggers, and not-so-smart debuggers, then park your flea and read on. (Laine's not starting from scratch.)

Here I am, back at the threshold of Anatolia again. Time to unpack my bags and make sure the Bactine didn't leak all over the PostScript books. Time to unroll the boat and check for rot. Time to renew all my old contacts in Istanbul and Ankara. Time to dredge through all those things I did at PC Tech and find something to fill in this column in place of my planned topic (which I left, along with my common sense, somewhere in the passenger's lounge at JFK International...).

A Little Trick

A while back, I was helping out with the debugging of a PC Tech design based on a new NEC processor (sorry, but I'm not sure how much I'm supposed to say, so I won't say much). As with most new hardware products, this one seemed to be branching off to Never Never Land at random times. Of course, we were a bit curious about it.

The first step was to make an interrupt service routine that would intercept all the "bad" interrupts and print a register dump. Then we could look at CS:IP and see what caused the problem. The interrupt service routine (or "trap") was written in assembly language and assembled into a TSR (Terminate and Stay Resident) program, which installed itself at system startup.

Coprocessor Exception

The TRAP program was useful for figuring out a few problems. For example, this particular NEC processor would generate a "Coprocessor Exception" interrupt when it encountered an 8087 instruction. The same facility is available on the 186, 286, and 386, and it can be selectively enabled/disabled by software. It turned out, however, that the NEC processor had this feature permanently turned on.

Since nearly every program written these days executes an 8087 instruction to see if an 8087 is present, we couldn't run any software without the machine crashing.

By trapping the Coprocessor Exception interrupt, we discovered that an exception was occurring. So we wrote a more permanent interrupt service routine which incremented IP (the Instruction Pointer) past the offending instruction and any possible operands, and returned. This mimics the operation of an Intel processor with no 8087: all 8087 instructions are treated as NOPs.

Since Intel processors (or any of the NEC processors you've ever heard of) don't need this facility, I haven't included that part in the example program. Too much clutter causes confusion. (I think.)

Invalid Opcode Exception

Another "bad" interrupt we trapped was the "Invalid Opcode" interrupt. This interrupt is generated whenever the processor encounters an instruction it does not recognize. (The same interrupt is also available on the 186, 286, and 386).

It turned out that some of the crashes resulted from attempts to execute invalid instructions. Being able to see when this happened helped, but it didn't show us why. After all, the software we were running was all debugged. Something earlier was causing the machine to jump to a nonsense location and execute nonsense opcodes which, eventually, meant an invalid instruction. In fact, the machine bombed at the same location somewhere down in low memory every time.

Then Earl (at PC Tech) had an idea: the most common cause of jumping to nonsense locations is an uninitialized pointer. The most common value of an uninitialized pointer is 0000:0000. "Go into SYMDEB and type 'g=0:0'," he said.

I tried it. Sure enough, up came the "Invalid Opcode Encountered" message. At the *same address*! Now I knew that, somehow, someone was trying to execute code at 0:0. The next step was to backtrack and find out why.

Divide By 0 Exception

Location 0:0 is the base of the 80x86 (and compatibles) interrupt vector table. This is an array of long pointers to interrupt service routines. The first entry, at 0:0, contains a pointer to the interrupt service routine for a "Divide by 0" exception. When a program attempts to execute a divide instruction with a divisor of 0, this service gets called.

On the other hand, when a program tries to execute code at 0:0 (usually by jumping or calling indirectly through a pointer), it ends up interpreting the pointer to the Divide by 0 interrupt service routine as opcodes. Obviously, this creates complete gibberish. Eventually the machine works its way into a state which causes some kind of exception. Usually, in the process, the processor obliterates all evidence of where it's been.

Here I am, back at the threshold of Anatolia again. Time to unpack my bags and make sure the Bactine didn't leak all over the PostScript books.

To detect execution at 0:0 immediately, we must make the first byte at 0:0 some known opcode which branches to a known place. The first opcode that comes to mind is opcode CCh, the breakpoint instruction which causes a branch to the interrupt 3 handler. Debugging programs use INT 3, though, so it would be more convenient to use something else.

I came up with the solution to put a 66h at 0:0. This is an invalid opcode (on the 186 and 286, but not the 386), and causes execution to branch to the Invalid Opcode interrupt handler. The handler for invalid opcodes can then check to see if the opcode in question is at 0:0, and prints a message accordingly.

What about the pointer to the Divide by 0 routine? That should be at 0:0, after all. And we just trashed it!

The solution to that problem is to force the address of the divide by 0 interrupt handler to an address such that the byte at 0:0 is guaranteed to be 66h. Simple enough, since 0:0 contains the least significant byte of the interrupt handler address. So, we put an ORG xx66h just before the start of the Divide by 0 handler.

Now we can report both a Divide by 0 and an attempt to execute at 0:0!

A potential problem with making our own Divide by 0 trap is that COMMAND.COM installs the default one. It prints a message and then terminates the current program. The behavior of TRAP's Divide by 0 is slightly different, but this will only show up with buggy programs, anyway. The information given is so much more useful that it's worth any inconvenience.

TRAP

The resulting program (see Figure 1) is installed from the DOS command line. It traps out and reports: (1) execution of invalid opcodes; (2) attempts to execute at 0:0; and, (3) divide by 0 exceptions.

When encountering one of these conditions, it prints a message and register dump, along with a few bytes of the code at the last known CS:IP. Then, after waiting for a key to be pressed, it executes an INT 3. The idea is that you can run the program in question under DEBUG or SYMDEB, then use the debugger to examine the area of the program in question after the crash.

Computers For The Blind

Talking computers give blind and visually impaired people access to electronic information. The question is how and how much?

The answers can be found in "The Second Beginner's Guide to Personal Computers for the Blind and Visually Impaired" published by the National Braille Press. This comprehensive book contains a Buyer's Guide to talking microcomputers and large print display processors. More importantly it includes reviews, written by blind users, of software that works with speech.

This invaluable resource book offers details on training programs in computer applications for the blind, and other useful information on how to buy and use special equipment.

Send orders to:

National Braille Press Inc.
88 St. Stephen Street
Boston, MA 02115
(617) 266-6160

$12.95 for braille or cassette, $14.95 for print. ($3 extra for UPS shipping)

NBP is a nonprofit braille printing and publishing house.

Figure 1 — TRAP.ASM

```
;*********************************************************************
;** 4/17/89 *   TRAP.ASM        *   Version 0.00                      *
;*********************************************************************
;*                                                                   *
;*  Invalid Opcode, Divide by 0, and attempt to execute at 0:0 Trap  *
;*                                                                   *
;*********************************************************************
;* Copyright (c) 1989, PC Tech, Inc.   All Rights Reserved           *
;* Permission granted for use, but not for sale.                     *
;*                                                                   *
;* PC Tech                      tel: 612-345-4555                    *
;* 907 North 6th St.            fax: 612-345-5514                    *
;* Lake City, MN 55041                                               *
;*                                          written by Laine Stump   *
;*********************************************************************
;*                                                                   *
;* TRAP is a TSR (Terminate Stay Resident) program that traps all    *
;* Invalid Opcode Exception interrupts and Divide by 0 interrupts,   *
;* then displays stack dump, register dump, and dump of the code at  *
;* the point that caused the bad interrupt.                          *
;*                                                                   *
;*********************************************************************
;*      assemble with MASM 5.1, LINK, and EXE2BIN (use MAKE.BAT)     *
;*********************************************************************
ReportToPrinter equ 0   ;0 to screen, 1 to LPT1:

        .186
        .MODEL  SMALL,C
CODE    segment PUBLIC 'CODE'
        assume  cs:code
FIRSTBYTE       equ     this byte ;between here&LASTBYTE remains res.
        ORG     100h
START:  JMP     MAIN    ;init code is at end so we can get rid of it.

 INCLUDE ROMCALLS.INC
 INCLUDE DOSCALLS.INC
 INCLUDE SUBROUTS.ASM

;*********************************************************************
; Trap for Invalid Opcodes - also checks for attempt to execute at 0:0
;
InvOpTrap:
  pusha
  mov   bp, sp
  push  ds
  push  es
  mov   es, PALL_CS[bp]
  mov   di, PALL_IP[bp]
  mov   ax, es  ;check for attempt to execute at 0:0
  or    ax, di
  jnz   @f

  ;an attempt was made to execute at 0:0
  call  IP_StringOut
  db "Attempt to Execute at 0:0 Exception",cr,lf,0
  jmp   short CI_10

@@: ;normal invalid opcode
  call  IP_StringOut
  db "Illegal OpCode Exception",cr,lf,0
;*  jmp CRASHIT

CRASHIT: ;print exception, then do int 3 (Debugger Breakpoint)
; enter with message to print in cs:si, interrupt # in DX,
; exception address in es:di

  mov   ax,es
  call  HexWord
  mov   al,':'
  call  Putc
  mov   ax,di
  call  HexWord
  call  Space
  call  Space
  sub   bx, bx
  mov   cx, 8
@@:
  mov   al, es:[di+bx]  ;dump opcodes bytes at CS:IP
```

```
    call  HexByte
    call  Space
    inc   bx
    loop  @b
    call  CRLF
CI_10:
    call  DumpRegs        ;dump registers at time of exception
    call  DumpStack       ;stack at time of exception
    RomCall       Keyboard, GetKey
    pop   es
    pop   ds
    popa
    int   3               ;break out to debugger (if running)

;*********************************************************************
;       DIVIDE BY 0 EXCEPTION HANDLER
;
;  The divide by 0 exception handler is org'ed at a special
;  address so that an attempt to execute at 0:0 (where the divide
;  by 0 exception vector is stored) will cuase an easily identifiable
;  exception.
;
;  This was done because a program running wild very often ends up
;  at location 0:0. This can happen because of a jump or call indirect
;  through an uninitialized long pointer, or (very commonly) by
;  executing an INT xx for an interrupt whose vector has not been
;  initialized (and is therefore 0:0.
;
;  Remember that COMMAND.COM sets its own Divide by 0 interrupt, so
;  if you install this one from ROM before DOS boots, it will be
;  overwritten. Runtime libraries of many languages also set up their
;  own Divide by 0 interrupt. This means if you want to catch this
;  kind of bug (attempt to execute at 0), you must be careful about
;  when you initialize the vector, and what programs you run.
;
;  Even though the actual exception for an attempt to execute at
;  0:0 will be for an Invalid Opcode exception, the Invalid Opcode
;  exception handler differentiates it by noticing that CS:IP is 0:0
;  when the exception occurs
;
ORG     266h    ;assure the byte at 0:0 is 66h (invalid instruction)
                ;so it will cause an INT 6. Watch that this doesn't
Div0Trap:       ;cause earlier code to be overwritten!!!!
    pusha
    mov   bp, sp
    push  ds
    push  es
    mov   es, PALL_CS[bp]
    mov   di, PALL_IP[bp]
    call  IP_StringOut
    db    "Divide by 0 Exception",cr,lf,0
    jmp   CRASHIT

;*********************************************************************
;  Display a dump of registers as they were at time exception occurred
;
DumpRegs:
    call  IP_StringOut
    db " AX   BX   CX   DX   DI   SI   BP   SP"
    db "   CS   DS   ES   SS   IP  Flag",cr,lf,0
    mov   ax,pall_ax[bp]
    call  HexWord
    call  Space
    mov   ax,pall_bx[bp]
    call  HexWord
    call  Space
    mov   ax,pall_cx[bp]
    call  HexWord
    call  Space
    mov   ax,pall_dx[bp]
    call  HexWord
    call  Space
    call  Space
    mov   ax,pall_di[bp]
    call  HexWord
    call  Space
    mov   ax,pall_si[bp]
    call  HexWord
    call  Space
    call  Space
```

Continued on page 48

Possible uses of TRAP are to detect invalid opcodes in long strings of "inline" code of the Turbo Pascal variety, find the source of that pesky Divide by 0 bug, or figure out which long pointer to a subroutine wasn't initialized.

Load TRAP before you start up the debugger! (It's a TSR, remember?)

I used MASM 5.1 to assemble TRAP. You could probably twitch it around to work with earlier versions, but I would recommend just upgrading to 5.1 and getting it over with. Trap uses a few subroutines for printing numbers and strings which, though not listed in the magazine, are available on the Micro C BBS or on the Issue #48 disk.

8088s

Sorry about this, all you 8088 users, but TRAP just won't work on an 8088 or 8086 system. They don't have the facilities to trap out invalid opcodes. It will work on the V20, V30, 186, and 286. It won't work as is on the 386, since 66 is a real live opcode. With all the hardware debugging options of the 386, though, that shouldn't be much of a problem.

Of Mice And Me

Every year when I leave Istanbul, someone wants to buy my mouse. Since mice are quite expensive on the local market (although rats can be had dirt cheap—I know, I had a kitchen full of them), I am usually willing to oblige. I have always bought Logitech mice, and have always been happy with them, as have the people I sold them to.

This year when I was packing up to go, I was planning on just getting another one of the standard, 200 dpi, boxy square Logitech mice. Then I saw an ad for their new "ergonomic" model. I immediately began to salivate. (Love those little miceys, Miceys what I love to eat....)

I have now used the new Logitech mouse for three weeks, and I can say that everything in the ads is true. The new shape fits my hand perfectly. The "ballistic" control of mouse movement (faster movement causes greater changes in position) really works. Placing the ball further forward gives more fingertip control of the mouse pointer. Finally, their new punk logo and bone-white color give my desk that decadent, graffiti-esque look we all strive for.

I think I'll keep this one.

The same mouse can be plugged into either an RS-232 port, or the mouse port of an IBM PS/2. This will never become an issue with me (unless PC Tech de-

cides to put a PS/2 mouse port on one of their designs), but it may be useful information to those of you closer to the "mainstream."

By the way, the books indicate that the "ballistic" control is the result of the new mouse driver software, *and* that it works on the older mice as well. I know absolutely nothing about Logitech's upgrade policy for mouse drivers, but you might give them a call, if you're interested.

The Logitech Mouse $139
Logitech
6505 Kaiser Drive
Fremont, CA 94555
(800) 231-7717
(800) 552-8885 (in Calif.)
++41-21-869-9656 (in Europe)

Zortech Debugger

Since Scott Ladd said in his last column that he might talk about the new Zortech Debugger (ZTCDB) this issue, I won't spend a lot of time on the subject. There are a few things that I just can't bear not to mention, though.

The first thing a CodeView user will notice about ZTCDB is how many windows there are. There is a window for the source, of course. But it also has a window that shows all global data items, one that shows all automatic data items (local variables), one with a directory listing, one that lists all functions in the program, and several others. Things difficult to impossible to see with CodeView are simple with ZTCDB.

For example, you don't have to spend the time typing in all the variables you want to watch. They're already there, in the Data or Auto window. If you want to dereference a pointer, just hit the *Ins* key (the same trick shows the members of a structure, or items in an array).

Also, the debugger recognizes that the compiler places some variables in registers, so these can be properly monitored.

There is a Functions window, too, which gives the name of all functions in your program. You can bring the source code of any function up on the screen by moving the cursor to the function name and typing Enter.

ZTCDB handles breakpoints much easier, too. There are several commands to set breakpoints on; for example, all lines of a function, the first line of all functions, and all lines of the program. This is much more powerful than CodeView's BP command, which only

```
  mov   ax,pall_bp[bp]
  call  HexWord
  call  Space
  lea   ax, PALL_FLAGS[bp+2]    ;this is value before INT
;*  mov ax,pall_sp[bp]          ;this is junk value in middle of PUSHA
  call  HexWord
  call  Space
  call  Space
  mov   ax,pall_cs[bp]
  call  HexWord
  call  Space
  mov   ax,pall_ds[bp]
  call  HexWord
  call  Space
  mov   ax,pall_es[bp]
  call  HexWord
  call  Space
  mov   ax,ss
  call  HexWord
  call  Space
  call  Space
  mov   ax,pall_ip[bp]
  call  HexWord
  call  Space
  mov   ax,pall_flags[bp]
  call  HexWord
  call  Space
  call  CRLF
  ret

;*********************************************************************
;  Display a dump of the stack as it was when exception occurred
;

DumpStack:
  call  IP_StringOut
        db "Stack Dump: ",cr,lf,0
  lea   si, PALL_FLAGS[bp+2]
  mov   cx, 8
DST_00:
  push  cx
  mov   ax,ss
  call  HexWord
  mov   al,':'
  call  Putc
  mov   ax,si
  call  HexWord
  call  Space
  mov   cx, 8
@@:

  mov   ax,ss:[si]
  call  HexWord
  call  Space
  add   si,2
  loop  @b
  call  CRLF
  pop   cx
  loop  DST_00
  ret

;****************************************

LASTBYTE        equ     this byte
; Below this point is used only during initialization, then discarded.
;
IntInfo STRUC
  IntNo         DB      ?
  IntVector     DW      ?
IntInfo ENDS
;
;  table of new interrupt vectors to install

NewIntTable \
  IntInfo       ,Div0Trap
  IntInfo       ,InvOpTrap    ;Intel Invalid Opcode exception
  IntInfo       ,0            ;END OF TABLE
;*********************************************************************

        assume  ds:code
```

```
MAIN    PROC NEAR          call    IP_StringOut
        DB 'PC Tech Invalid Opcode & Divide by 0 Exception Trap',CR,LF
        DB '    Copyright (c) 1989, PC Tech, Inc.',CR,LF,0
        SUB     SI,SI
MAINLOOP:
        MOV     AL,NewIntTable[si].IntNo
        MOV     DX,NewIntTable[si].IntVector
        OR      DX,DX
        JZ      DONE
        DOS     SET_VECTOR
        ADD     SI, size IntInfo
        JMP     MAINLOOP
DONE:   MOV     PrinterFlag, ReportToPrinter
        MOV     DX,(LASTBYTE-FIRSTBYTE+15)/16
        MOV     AL,0
        DOS     KEEP_PROCESS
MAIN    ENDP

CODE    ends
        end     START
```

♦ ♦ ♦

allows a single breakpoint at a time.

You can select eight different "conditional" breakpoints in the same way. A conditional breakpoint will be taken only if an expression you supply evaluates to TRUE. This can be useful for pinpointing the spot where a certain variable is modified, or where a boundary condition is reached.

ZTCDB also has the ability to set Tracepoints. A tracepoint is a breakpoint which, instead of halting execution, increments a counter and continues. With this tool, you can profile the execution of your program and decide which portions you should spend time optimizing.

For example, I ran the DISKEDIT program from the last issue after setting a tracepoint on every line of the program. I learned that, as I had expected, the program was spending about 80 times as much time in the procedures cprintf() and Write16Bytes() as in any other part of the program. If more speed concerned me, I would rewrite these functions in assembly.

Finally, in the breakpoint department, ZTCDB saves all your breakpoints in a configuration file so you can use them the next time you debug the program.

Negatives

As with any good program, there are still a few distracting problems with ZTCDB. There are always the little "taste" and "preference" kinds of things, of course. One example is that I don't exactly like the mouse interface. I can't pin down why, though. I guess it's just because of the differences between ZTCDB mouse commands and MS Word mouse commands (especially the method of scrolling). Also, I sorely miss having a simple mouse command that says "execute up to this line."

I would also much rather see the assembly language listings in the source window in upper case instead of lower case. This helps to visually separate the C source code from the assembly language it was compiled into.

Something completely missing from ZTCDB is the ability for a breakpoint to trigger execution of a list of debugger commands. CodeView makes this available, and it can be very useful.

And I like CodeView's register display format much better.

Those are just details, though. I can live without them. I guess.

My first real complaint, as with almost every program on the market, is a lack of TRUE support for large screens. ZTCDB does handle 43 line EGA and 50 line VGA displays, but it doesn't know what to do with a 66 line display. I was able to fool it into thinking that my 34010 Mono board was a VGA, and got 50 lines out of it. But then it kept switching back to 25 lines every time I stepped through a DOS or BIOS call. (This doesn't happen with a real VGA, though).

Tracing through ZTCDB's code (I was debugging ZTCDB with SYMDEB, but that's another story), I also noticed that a screen width of 80 columns is hardcoded into several places. That means that I can't use the right half of my new double page monitor on the new 34010 Mono II board.

I shouldn't complain about this too much, since neither Earl nor I could coax CodeView to do anything over 25 lines reliably. Someday developers will all have huge displays; then programmers will write programs to run on huge displays. If they would just figure out that all they had to do was look to 40:4Ah for number of columns, and 40:84h for number of rows (-1), and forget about all those stupid VGA equipment checks.

No Assembly

The biggest problem, with the current version of ZTCDB anyway, is that it is restricted to debugging C programs (and C++ in a limited fashion). I tried several different attacks and could never get it to accept an assembly language module. No assembly is a big minus for me. After all, at least two-thirds of all my work is in assembly language. This is disappointing, since it means I will have to keep at least two different debuggers on my machine.

ZTCDB has already replaced CodeView as my debugger for C programs. If Zortech makes it compatible with MASM, and if CodeView doesn't get off its tail and make some drastic improvements, I think I will switch over completely.

And if they make it support a screen that is 160 columns by 66 lines? I might just die of ecstasy.

Footnote

Keep in mind, no matter how advanced all these hot new debuggers get, they can still never replace SYMDEB. At least not for me. Although I've been using CodeView for over a year now, and ZTCDB for the last month, I still use SYMDEB at least as often as the other two together.

Why? Because I can run SYMDEB without giving it a program name to debug. I spend a lot of time just looking at interrupt tables and ROM BIOS code and playing with internals. The power of the new debuggers brings with it a more stringent form, which doesn't exist in the free and easy "do what you like, but be prepared for the consequences" world of SYMDEB and DEBUG.

I suppose I'll always be a rebel at heart.

♦ ♦ ♦

Searching For A File

And Not Just Any File

By Scott Robert Ladd
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Gunnison, CO 81230
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We all use a directory program of one sort (sorry) or another, but the generic packages usually don't do everything. Every time my 20 meg drive gets full, I'm forced to run through all my directories, looking for duplicates and temp files. How about a directory search routine that digs these out? Well, Scott has the answer.

It's springtime in the Rockies, and I'm beginning to have a bad case of "exploration fever." Symptoms include a distinct distaste for four walls, an urge to saddle up the mountain bike, and a strong desire to head for the hills. Moving to Gunnison has been an enlightening and entertaining experience. Just like writing for and reading *Micro C*.

Micro C is a truly unique magazine, as I'm sure you're aware. I feel somewhat privileged to write for this bimonthly tome of wit and wisdom. The May/June issue was especially interesting to me, although the reasons for my reaction have nothing to do with computers. Larry's article on Creativity (with a capital C) parallels many of my own feelings on the subject.

A walk among the aspen and pine really loosens up the creative juices. There are few sights more extraordinary than the flight of a red-tailed hawk as it glides over the fields (unless, of course, you're a rodent!). I also enjoy watching deer graze in a mountain meadow. And, of course, the sight of mountains reflected in a high-altitude lake takes my breath away. (Now Dave knows why my columns are always late!)

There is more to life than computers and technology. SOG exemplifies this attitude. It's a technical conference for people who want to get away from technology. By the end of SOG VII in Bend, Maria and I felt that we had spent a weekend with a group of friends. That's a feeling I've never had at other technical conferences.

When Dave announced that Micro C was not going to hold another SOG, Maria and I decided we had to keep it going. Thus was born Rocky Mountain SOG. Something as special as SOG cannot be allowed to expire; this is evidenced by the number of other people who want to hold SOGs in their own areas.

By the time you read this, Maria's and my first child will have been born. No technology or science has the potential of a newborn baby. It is remarkable how the bringing of a new life into the world changes one's perspective.

There is more to life than computers...

(Editor's new product announcement: Elora Marjorie Ladd was born April 17th. An "absolutely perfect" child according to papa Scott.)

Of course, a person's perspectives have to keep changing if they are to grow as a human being. This is one thing which sets us apart from computers: humans always have the potential to better themselves and the world around them.

All that aside, this is a technical column, so I suppose I had better say something technical. After all, I've got these creative juices flowin'....

TOOLBOX

Due to the length of C EXPLORATIONS this issue, I've dropped the TOOLBOX section. After all, C EXPLORATIONS has gotten short shrift in the past; I've found that parts of this column argue with each other if they're not treated fairly. So, you're not reading this since it doesn't exist.

C EXPLORATIONS

It's been a while since I presented a significant piece of code in this column. So I began looking through my pile of programs, seeking an interesting and educational piece of code. What I found were my standard library functions for doing file searches. While that may

Figure 1 — FILESRCH.H

```
/*
     Header:      FileSrch (File Search)
     Version:     1.00  02-Apr-1989
     Language:    ANSI C with MS-DOS extensions

     This module will search subdirectories for files to be deleted.
     It can query the user as to which files should be deleted.

     Written by Scott Robert Ladd. No rights reserved.
*/

#if !defined(FILESRCH_H)
#define FILESRCH_H 1

#if defined(_MSC) || defined(_QC) || defined(__WATCOMC__)
    #pragma pack(1)
#endif

typedef
  struct
    {
    char     reserved[21];
    char     attrib;
    unsigned time;
    unsigned date;
    long     size;
    char     name[13];
    }
  FILE_DATA;

#if defined(_MSC) || defined(_QC) || defined(__WATCOMC__)
    #pragma pack()
#endif

/* attribute bit masks */

#define ATTR_READONLY   0x01 /* read only */
#define ATTR_HIDDEN     0x02 /* hidden */
#define ATTR_SYSTEM     0x04 /* system */
#define ATTR_VOLABEL    0x08 /* volume label */
#define ATTR_DIRECTORY  0x10 /* directory */
#define ATTR_ARCHIVE    0x20 /* archive */
#define ATTR_ALL        0x3F /* all files */

/* prototypes */

void sub_find(char * spec,
              char attrib,
              char * top_dir,
              void (* handler)(char * dir, FILE_DATA * fd));

int wild_match(char * name, char * tmpl);

int find_first(char * spec, char attrib, FILE_DATA * fd);

int find_next(FILE_DATA * fd);

#endif
```

♦ ♦ ♦

seem old-hat, this module presents some often overlooked ideas.

MS-DOS provides four INT 0x21 services for directory searches. Services 0x11 and 0x12 are outmoded file-control block (FCB) functions. They appear complicated and restricted when compared to the recommended 0x4E and 0x4F services (introduced in MS-DOS v2.x).

Services 0x11 and 0x12 force you to load an FCB with file information. In versions of MS-DOS prior to 3.0, they do not support the " * " wildcard character. Services 0x4E and 0x4F use a file specification stored in a standard NUL-terminated (C-type) string, and fully support the standard wildcard characters.

Service 0x4E, known as FIND FIRST, sets up the directory search and retrieves information on the first file (if any) which matches the given specification. Subsequent calls to service 0x4F (entitled FIND NEXT) will return data on additional files which match the specification.

A location known as the data transfer address (DTA) holds the data on the file. The initial location of the DTA is at offset 0x80 within the PSP of the present program. Service 0x2F (called GET DTA) retrieves the current address of the DTA, and service 0x1A (named SET DTA) sets the DTA to a new address.

While it is possible to use the default DTA, it's better to create a buffer and set the DTA to point to it. This lets you define a structure for the incoming information, and also prevents conflicts with other MS-DOS services which may be using the default DTA.

There is one other point in favor of providing your own DTA. The file information retrieved contains data used by ensuing calls to FIND_NEXT. By using multiple DTA buffers of your own creation, you can have several different file search operations going simultaneously.

Most C compilers provide a pair of functions which use FIND FIRST and FIND NEXT to retrieve file information. Unfortunately, there are several prob-

lems with the "free" function provided by C compiler vendors. First, the vendors do not coordinate, so that Turbo C's findfirst() and findnext() are slightly different from Microsoft C's equivalent functions, _dos_findfirst() and _dos_findnext().

Some compilers provide only simplified access to these functions. For example, WATCOM's opendir() and readdir() do not allow the specification of file attributes. Zortech's findfirst() and findnext() cannot be used for simultaneous searches, since they use a static buffer for the DTA.

The hierarchical directory structure of MS-DOS (borrowed from UNIX) is one of its best features. With a properly organized tree of directories, it is theoretically much easier to control your files. I have more than 2,500 files on my 386 system, and you can imagine the chaos that would result if they were all in the drive's root directory! Unfortunately, the MS-DOS directory services only look in one directory at a time. So we have to write our own functions for multi-directory file searches.

With all this in mind, I wrote FILESRCH. FILESRCH.H (see Figure 1) is the header containing data definitions

Continued on page 54

Figure 2 — FILESRCH.C

```
#if defined(__TURBOC__)
    #include "dir.h"
#else
    #include "direct.h"
#endif
#include "dos.h"
#include "stddef.h"
#include "stdlib.h"
#include "string.h"
#include "filesrch.h"

#if defined(M_I86SM) || defined(M_I86MM) || defined(__TINY__) ||
          defined(__SMALL__) || defined(__MEDIUM__)
    #define SMALL_DATA_PTRS
#endif

#define MAX_SPEC 128

/* global data */

static char * orig_spec;
static char   srch_attr;
static void (* file_func)(char * dir, FILE_DATA * fd);
static union  REGS  regs;
static struct SREGS sregs;
static unsigned old_dta_seg;
static unsigned old_dta_off;

/* local function prototypes */

static void sub_find_work(char * dir_spec);
static void set_dta(void * new_dta);
static void reset_dta(void);

/* actual program code! */

void sub_find(char * spec,
              char attr,
              char * dir,
              void (* handler)(char * dir, FILE_DATA * fd))
    {
    char * start_dir;
    char * orig_dir;

    if (spec != NULL)
        orig_spec = strdup(spec);
    else
        orig_spec = "*.*";
    srch_attr = attr;
    file_func = handler;
    if (dir != NULL)
        {
        orig_dir = malloc(MAX_SPEC);
        getcwd(orig_dir,MAX_SPEC);
        start_dir = strdup(dir);
        }
    else
        {
        orig_dir = NULL;
        start_dir = malloc(MAX_SPEC);
        getcwd(start_dir,MAX_SPEC);
        }
    sub_find_work(start_dir);
    if (orig_dir != NULL)
        {
        chdir(orig_dir);
        free(orig_dir);
        }
    free(start_dir);
    }

static void sub_find_work(char * dir_spec)
    {
    typedef struct dir_entry
        {
        char * direct;
        struct dir_entry * next;
        }
        DIR_ENTRY;
    DIR_ENTRY * first_dir, * temp_dir, * cur_dir;
    char * dir_buf, * work_dir;
    FILE_DATA file;
    int res;
```

Continued on page 54

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and function prototypes, and must be #included into any program which uses the functions defined in FILESRCH.C (see Figure 2). While FILESRCH primarily focuses on searching for files, the module illustrates several other interesting facets of C programming in the MS-DOS environment.

The first functions I wrote were those for accessing FIND FIRST and FIND NEXT. Oddly enough, I named these functions find_first() and find_next(). Since, as I stated earlier, some compilers already have functions of this type, it may seem strange that I would "reinvent" the wheel. My purpose was twofold: to provide portable directory search functions; and to furnish these functions for compilers such as WATCOM and Zortech which did not have built-in functions.

find_first() accepts three parameters: the file specification (which may contain standard wildcards); the file attributes desired; and a pointer to a file information buffer. You can assign attributes manually, or with the defined ATTR_xxxx constants in FILESRCH.H. The header file also defines the format of the file information buffer.

It is particularly important that you compile this module, and any which call it, with byte alignment in structures. The FILE_DATA structure, like most MS-DOS structures, aligns some information on odd-byte boundaries. A pragma takes care of the problem for Microsoft and WATCOM compilers; Turbo C defaults to byte alignment, and Zortech C requires the -a compiler option when compiling the module.

I prefer the way Microsoft and WATCOM handle this situation: with the pack pragma, only the structure needing byte alignment compiles that way; everything else compiles in the default mode. Not only does this make it harder for the programmer to miscompile the module, it also avoids problems with modules compiling with different alignments.

First, find_first() calls a function to set the DTA to the location of the user-supplied buffer. It then calls FIND FIRST, saves the value of the carry flag, calls a function to reset the DTA, then returns the stored value of the carry flag as an error indicator.

find_next() is much simpler. It accepts only one parameter, a pointer to a FIELD_DATA structure already initialized by find_first(). It sets the DTA to point to the buffer, calls FIND_NEXT, and then resets the DTA to its former location. As with find_first(), find_next()

```
    work_dir = malloc(MAX_SPEC);
    first_dir = malloc(sizeof(DIR_ENTRY));
    cur_dir = first_dir;
    cur_dir->next = NULL;
    chdir(dir_spec);
    getcwd(work_dir,64);
    res = find_first("*.*",0xFF,&file);
    while (!res)
        {
        if (wild_match(file.name, orig_spec) &&
           (file.attrib & srch_attr))
            {
            file_func(work_dir,&file);
            }
        if (((file.attrib & 0x10) == 0x10) && (file.name[0] != '.'))
            {
            cur_dir->direct = strdup(file.name);
            cur_dir->next   = malloc(sizeof(DIR_ENTRY));
            cur_dir         = cur_dir->next;
            cur_dir->next   = NULL;
            }
        res = find_next(&file);
        }
    dir_buf = malloc(MAX_SPEC);
    cur_dir = first_dir;
    while (cur_dir->next != NULL)
        {
        chdir(work_dir);
        chdir(cur_dir->direct);
        getcwd(dir_buf,128);
        sub_find_work(dir_buf);
        temp_dir = cur_dir;
        cur_dir  = cur_dir->next;
        free(temp_dir->direct);
        free(temp_dir);
        }
}

int wild_match(char * name, char * tmpl)
    {
    strupr(name);
    strupr(tmpl);

    while ((*name && *name != '.') || (*tmpl && *tmpl != '.'))
        {
        if ((*name != *tmpl) && (*tmpl != '?'))
            {
            if (*tmpl != '*')
                {
                return 0;
                }
            else
                {
                while (*name && *name != '.')
                    name++;
                while (*tmpl && *tmpl != '.')
                    tmpl++;
                break;
                }
            }
        else
            {
            name++;
            tmpl++;
            }
        }
    if (*name == '.')
        name++;
    if (*tmpl == '.')
        tmpl++;
    while (*name || *tmpl)
        {
        if ((*name != *tmpl) && (*tmpl != '?'))
            {
            if (*tmpl != '*')
                return 0;
            else
                return 1;
            }
        else
            {
            name++;
            tmpl++;
            }
        }
    return 1;
```

Continued on next page

```
    }

int find_first(char * spec, char attrib, FILE_DATA *
fd)
    {
    unsigned res;

    set_dta(fd);
    regs.h.ah = 0x4E;
    regs.x.cx = (unsigned)attrib;
    #ifdef SMALL_DATA_PTRS
        regs.x.dx = (unsigned)spec;
        intdos(&regs,&regs);
    #else
        segread(&sregs);
        sregs.ds  = FP_SEG(spec);
        regs.x.dx = FP_OFF(spec);
        intdosx(&regs,&regs,&sregs);
    #endif
    res = regs.x.cflag;
    reset_dta();
    return res;
    }

int find_next(FILE_DATA * fd)
    {
    unsigned res;

    set_dta(fd);
    regs.h.ah = 0x4F;
    intdos(&regs,&regs);
    res = regs.x.cflag;
    reset_dta();
    return res;
    }
```

```
static void set_dta(void * new_dta)
    {
    regs.h.ah = 0x2F;
    intdosx(&regs,&regs,&sregs);

    old_dta_seg = sregs.es;
    old_dta_off = regs.x.bx;
    regs.h.ah = 0x1A;
    #ifdef SMALL_DATA_PTRS
        regs.x.dx = (unsigned)(new_dta);
        intdos(&regs,&regs);
    #else
        sregs.ds  = FP_SEG(new_dta);
        regs.x.dx = FP_OFF(new_dta);
        intdosx(&regs,&regs,&sregs);
    #endif
    }

static void reset_dta(void)
    {
    segread(&sregs);

    regs.h.ah = 0x1A;
    sregs.ds  = old_dta_seg;
    regs.x.dx = old_dta_off;
    intdosx(&regs,&regs,&sregs);
    }
```

♦ ♦ ♦

Reader Service Number 37

returns the carry flag as an error indicator.

The implementation of these functions deserves some comment. Because of the existence of multiple memory models in MS-DOS C compilers, pointers come in different sizes (see *Micro C* #41 for my discussion of memory models). MS-DOS services work with far, or 32-bit, pointers. This is fine when working with the large or compact models, but causes problems in the small and medium models, where data pointers are only 16-bit offsets in the data segment.

FILESRCH handles this problem. All MS-DOS C compilers define macros to indicate which memory model it uses for the current compilation. When FILESRCH detects that it's using a memory model which has near (16-bit) data pointers, it defines a macro called SMALL_DATA_PTRS. The find_first() and set_dta() functions then know what type of pointer they are working with, and can adjust themselves at compile-time.

This is an excellent example of how you can use the C preprocessor to make one source file handle multiple situations. The preprocessor is the C facility I miss most when working with other compilers.

We now have functions to handle simple directory searches. The next problem is to create a function to search a directory tree. The sub_find() function, and its workhorse slave function, sub_find_work(), handle this problem. sub_find() is lazy; it receives the information from the caller, then makes sub_find_work() do all the work.

The parameters for sub_find() are: a pointer to a file specification (once again, it can include wildcards); a byte containing the file attributes being searched for; a pointer to the name of the directory in which the search should start; and a function pointer. This last parameter points to a function which will be called with file information each time a file is found.

sub_find() begins by checking to see if the file specification is a NULL pointer. If so, it assumes that we want to search for all files (*.*). Whatever the file specification turns out to be, a global variable stores it. Next, sub_find() saves the attribute and function pointer parameters in global variables.

If the directory parameter is NULL, it assumes the search should begin in the current directory; otherwise, it uses the given directory. Once it determines the starting directory, it calls sub_find_work(). After sub_find_work() is done, sub_find() cleans up after itself and returns.

Why do I use several global variables, instead of passing information on the sub_find_work() as arguments? sub_find_work() is recursive so globals reduce stack overhead. The search specifications which don't change (file spec, attributes, and handler function pointer) would merely waste stack space if they had to pass as arguments every time sub_find_work() got called.

Placing this constant data in global variables also makes it accessible. (I used the static qualifier on the global items so they wouldn't be visible outside the scope of FILESRCH.)

sub_find_work() does two things. First it reads file data for all the files in the directory specified by the dir_spec parameter. Your own handler function can then process those files which have names and attributes matching those passed to sub_find(). If a file is a directory, it gets stored in a linked list.

Second, after all files in the directory are processed, sub_find_work() calls itself (recursively) for each directory. Thus, it reads the file data for the directory specified and all subdirectories thereof.

You may want to refine and expand on these functions. They provide a basis for developing programs which can access files in multiple directories. And, they show several aspects of working around and with MS-DOS.

All memory models of Borland Turbo C 2.0, Microsoft C 5.10 and QuickC 2.0, WATCOM C 7.0, and Zortech C 1.07 have tested FILESRCH.C. It should work with any MS-DOS C compiler which supports intdos() or another similar function.

NEWS AND REVIEWS

Here's a shocker: not much is happening this month in the world of C. At least I'm not aware of anything. But don't worry, things are just getting going for 1989. Microsoft is busily at work on C 6.0, and it looks *very good*. I can't say much now, but I think Microsoft is about to provide programmers with a quantum leap in development environments.

Zortech has finally released their C debugger. I haven't had much time to work with it, but it looks good. I have noticed some minor problems. You can't look at the value of local static variables, for instance. It also requires using both the /CO (CodeView info) and /LI (line number info) options when linking. This seems strange, since the /LI option is a subset of the /CO option, according to Microsoft's documentation.

The biggest disappointment is that it does not truly support C++. They are releasing a version which does. Soon. With a little refinement, Zortech will have one of the top debuggers available for MS-DOS.

RESOURCES

Rocky Mountain SOG, of course, will be a great resource. It excited people in Denver so much that they merged the Micro Assembly conference (which I've mentioned in past columns) into Rocky Mountain SOG! Check the SOG ads in this issue for more details on what will be the best SOG ever!

As for books, I highly recommend one called *Concrete Mathematics* by Ronald Graham, Donald Knuth, and Oren Patashnik (1989, Addison Wesley, ISBN 0-201-14236-8). Its subtitle, *A Foundation for Computer Science*, describes the contents of the book quite succinctly.

Have you ever wondered how algorithms are analyzed and created? This is the book for you. Fun to read, it even has graffiti in the margins. The graffiti was taken from used copies of the textbook (this is Stanford graffiti, folks).

WRAP-UP

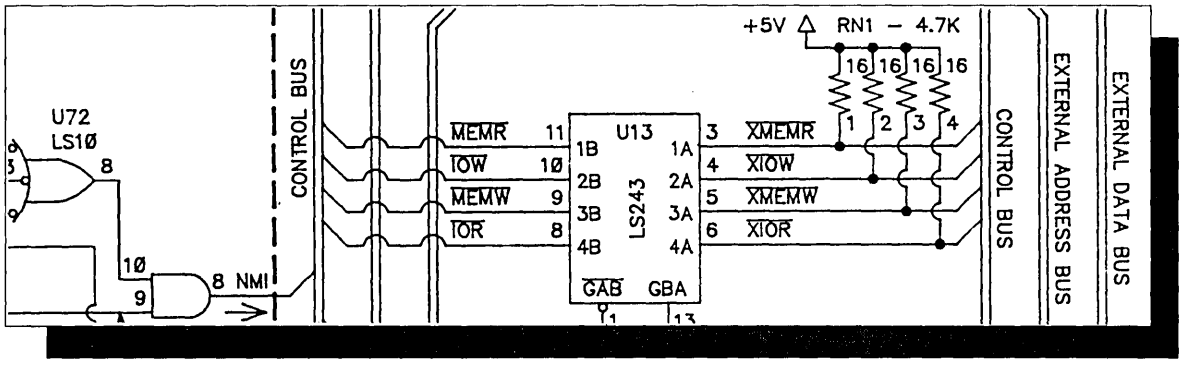
Another issue, another column! I have definite plans for the next three. In September/October (#49), I'll present ways of doing very accurate calculations—by showing methods of generating pi to hundreds and thousands of digits.

Following that, in issue #50, I'm entering Larry's realm to talk about using fractal geometry to generate alien landscapes and planets. Finally, we'll go a little further afield as I submit a star chart generator for your pleasure in issue #51. And as always, I'll update you on what is happening in the world of C.

We hope to C you at Rocky Mountain SOG in July. Until we next meet, good luck!

♦ ♦ ♦

MICRO CORNUCOPIA **XT SCHEMATIC**



At last you can plumb the mysteries of your computer with this single sheet schematic of the IBM XT's main board. A wealth of information for both True Blue *and* clone owners.

Need to know just how a non-maskable interrupt occurs (and how to mask it)? Is your keyboard dead (or do you just want to know how to disable it)? A trip through our schematic will answer your questions.

Although clones use slightly altered board layouts and different chip location names, they're close enough to the original for this schematic to be very useful. As an example — you have a dead clone. Lil sucker won't even beep. A look at the schematic shows the location of parallel port A. You know that the power-on self test loads a checkpoint number into port A before each test. So now all you have to do is read port A with a logic probe to see how far the system went before it puked.

We include these checkpoints and other trouble shooting information with the schematic.

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CP/M KAYPRO SCHEMATICS

Of course, we still provide a complete schematic of the processor board in your CP/M Kaypro. It's logically laid out on a single 24'' by 36'' sheet and comes complete with an illustrated theory of operation that's keyed to the schematic. You get detailed information available nowhere else.

For instance, those of you with the 10 and newer 84 systems get a thorough run down of the processor board's video section complete with sample driver routines. All packages contain serial and parallel port details and programming examples. Also coverage of the processor, clock, I/O, and disk controller (information that's not even available in Kaypro's own dealer service manual!).

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Kaypro 10 (without modem) $20.00

Kaypro 2, 4, and 10 (84 series) $20.00

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Continued from page 6

books to software still requires time to be completely defined, but it would appear that some of the arguments, which were given in *Micro C* as being offered by SEA against PKWare, contradict these established principles.

For example, on page 61 is a statement that SEA asserts PKWare "...would be in violation of copyright law even if [they] hadn't copied *any* of SEA's code. ...Henderson argues that Katz's admission of seeing SEA's program code ... establishes a presumption of infringement...."

Although there exists a court settlement between SEA and PKWare which, according to your article, appears in SEA's favor, please note that a settlement does not indicate who is right or wrong. The matter was not judged by a judge or jury; a settlement merely indicates a compromise between the parties.

Sometimes (as in the GEM suit between Microsoft and Digital Research) a larger opponent can force a smaller opponent into an unfavorable settlement under threat of a costly court process. It would be presumptuous of us to judge who is right or wrong in the SEA vs. PKWare case merely by the terms of the settlement.

If you want to see how the courts view program copyrights, look at the four-year-old legal battle between Intel and NEC, which was just recently settled. Intel claimed that NEC copied their microcode, and that NEC's programmer "all but admitted in court" that he had used disassembled Intel code in writing NEC code.

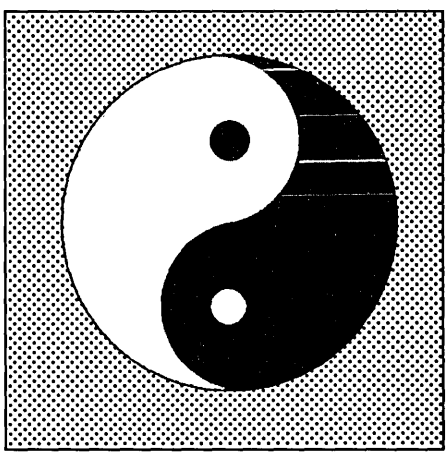
U. S. District Judge William Gray concluded that, because of a technicality, Intel's copyright was invalid. But even if it had been valid, he held that NEC still would not have infringed. He agreed that there were routines which were "substantially similar," but pointed to some "in which close similarity in approach is not surprising." He further stated that some similarities were unimportant because NEC was forced into the use of certain routines to achieve a required result.

In his decision, Judge Gray also quoted an article in a UCLA law journal, which stated that "courts do not allow the accused work to be dissected into pieces, and the pieces isolated as if each stood alone." One criterion he used was whether "an ordinary observer, considering the accused microcode as a whole, would ... recognize it as having been taken from the copyrighted sources."

Here is a clear case where: (1) except for some improvements, the NEC code was clearly designed to achieve the same result as the Intel code; (2) because it did the same job, it had many similarities; (3) NEC apparently had disassembled Intel code; (4) NEC had even copied a part of the code which was required to overcome a hardware problem. And yet the court found that NEC did not infringe.

Obviously there is more to the story than SEA says. The only way to decide copyright infringement is to examine the actual code. Even then, when the code implements the same algorithm or procedure—which is not copyrightable—and there is a particular way in which any reasonably skilled programmer would implement that algorithm, code similarity does not prove infringement.

Peter A. Stark
P.O. Box 209
Mt. Kisco, NY 10549



In Support Of New Paths

I've stumbled along for quite a while wondering whether there were other people out there who shared a combination of interests that don't appear too obvious on the surface—computers and what I guess I'll call self-actualization.

My house guests are fascinated to find *Micro C* underneath a book on meditation. Imagine my surprise to open the last issue and find your little manifesto. (See the Editorial in Issue #47.) Congratulations on the new course you've found for yourself, and for affirming it in print.

I began taking yoga classes a little over a year ago, and I'm completely hooked. Apparently, something pushed me into a bit of an identity crisis then (my job at the fire department, no doubt), and I got busy looking for ways to figure out who I really am.

Yoga was one of several, and I continue to be amazed at what it does for me. I think you'll find that it will keep paying big dividends over a period of time if you stick with it.

In the East (Asia, not Kansas), the path towards self-knowledge is regarded as an intensely spiritual one. It also tends to be pretty exclusive. You choose a path and stick to it, often dictated by the culture you live in. We westerners are more eclectic; we have a menu-oriented approach to life.

Who knows where you'll end up. It may not be such an exotic experience. You sound like you've already found something that has you moving in the direction you want, and there are risks in dabbling in too many things at once.

We have a more compulsive left brain to keep happy than the average Burmese or Nepali, though, so it really helps to have some reading to keep the deductive circuits pacified. I have a few suggestions, but the only one that will definitely be pertinent is to use your own intuition. The people who have something for me are usually the ones who offer it with no strings, hoping that I'll find what I need and grow with it. So pitch what doesn't feel right, or file it for later.

I've found that Buddhism offers me something that turns out to be nicely complimentary to the yoga. You can read about Buddhism in *Buddhist America.* (By Don Moreale, perhaps best ordered direct from him at 1220 1/2 E. 20th, Denver, CO 80205, $12.95.)

Chop Wood, Carry Water: A Guide to Finding Spiritual Fulfillment in Everyday Life has been another good one for me. (By Rick Fields and others. Jeremy Tarcher, Inc., 9110 Sunset Blvd., Los Angeles, CA 90069. $11.95 and often on the shelf at B. Dalton.)

It is nice to know that there are kindred souls out there. You'll find 'em around you, too. Oregon's not exactly a desert in this regard. Life doesn't al-

ways seem easier once you get started with this stuff, but it is fuller and more meaningful. Once started, it's hard to stop.

Loren Marshall
1705 Bartlett Dr.
Anchorage, AK 99507

A Skeptical Response

I was somewhat intrigued by your comments on your search in the May-June *Micro C.* Each person must ultimately choose his own belief system. However, I felt the need to comment on common traps in logic, frequently committed in pursuit of things mystical; I feel these show through in your editorial.

One of the most fertile aspects of the human mind (and also one of the most tricky) is the ability to map symbols onto events or conditions. This of course is at the heart of literature and art and creative thinking, but also very easily misleading when trying to solve a problem.

Many things, such as astrology, psychic readings, Tarot cards, etc., are testable, at least to a degree, by objective approaches. But this is often overlooked by devotees. A classic example is astrological prediction, which in general is flexibly interpreted by the receiver of the prediction. This has been repeatedly shown through simple tests: give a large group of people their horoscopes, except mix up some of them and not others. Neither the person distributing the charts nor the recipients know if they have the correct one.

Repeatedly, tests like these have shown that those with the wrong charts have found their charts "true" as often as those with the correct charts. (A recent study in Germany in which the personality profiles of more than 2,500 people were statistically compared with their full horoscopes—not just sun signs—failed to show a statistically significant correlation. This test, incidentally, was performed by an astrologer in an attempt to provide scientific validation for his beliefs.)

This same result often accompanies Tarot and other psychic readings, except that here the personal feedback between reader and subject can strongly enhance the apparent power of the result. Your anecdote is a prime example. The original statement simply identified you as some kind of teacher. Most people can quickly map this to themselves (professional teachers, parents, those who help co-workers learn jobs, people active in churches or community groups, clubs, etc.)—pretty much a sure-fire hit.

Quite possibly, other statements were made by the reader which generated less of a personal match and so are less likely to be recalled by the subject (you). But now you hit a train of thought: you revealed your occupation, narrowing the subject by orders of magnitude. The next comment contains a couple of guaranteed hits: "write quite a bit..." and "...dedicated loyal audience." It's hard to imagine anyone interested in his/her editing work that would score this as a miss.

And, "will write a book." Pretty straightforward extension for a person already a professional writer. I think I would bet on that prognostication without any belief in the system.

When properly tested, these approaches have not shown themselves to stand up statistically. However, to the extent that people are willing to believe, then they will appear to work.

Anyhow, I enjoy your magazine and your free-wheeling approach that allowed this discussion in the editorial.

P.S. Feel free to drop into the Skeptical Inquirer conference on Compuserve science forum—last Tuesday of the month, 9:30 Eastern time. This is an informal open discussion (scientific, not witch-hunting) of these and all sorts of other controversial fields (UFOs, faith healing, creationism, etc).

Jay Holovacs
95 King George Rd.
Warren, NJ 07060
CIS 74756,413

You Are What You Eat

As a licensed psychotherapist, I have been very concerned about NutraSweet (Aspartame) since its introduction to replace saccharin. One of my areas of specialization is Mood Disorders. Your comments regarding flying apply to many other areas of our mental health.

Every container with NutraSweet says that it contains: "Phenylketonurics: contains Phenylalanine." Phenylalanine is one of the chemicals (an amino acid) that the body uses to produce Serotonin. Serotonin is one of four major chemicals that help send signals around the brain.

This increase in Serotonin has the same effect as most prescribed antidepressant medications. These powerful, mood-altering medications should be used under close psychiatric supervision.

Research on the wide use of NutraSweet has shown definite side effects in people of all ages. These side effects are similar to those of people taking an inappropriate medication: dry eyes; dry mouth; sedation; agitation; irritability; excitability; change in sleep, appetite, sexual functioning or interest; loss of equilibrium and coordination; blurred vision; constipation; headaches, and many more. Ask your doctor or read the package insert regarding the side effects of Tricyclic Antidepressants. Properly supervised, the side effects of these medications are minimized.

So, companies have removed or reduced some chemicals (salt, caffeine, sugar and saccharin) and, in their place, added a new one. I think the new warning label should read:

"Warning: The Surgeon General has determined that this product contains a powerful mood-altering chemical."

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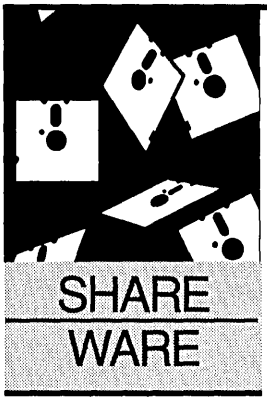
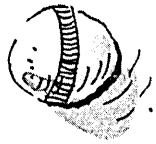
6275 Canterbury Dr., #204
Culver City, CA 90230

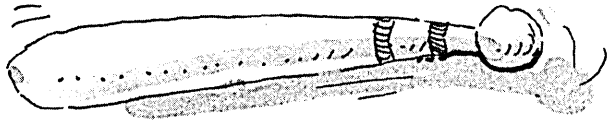
Editor's note: Boy, put a message like that on all the diet pop and you'd double the consumption by teenagers.

♦ ♦ ♦





Juggling Files And Editing Text



Anthony Barcellos
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Davis, CA 95617-2249
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Data: (916) 758-1002

Tony describes a file handling utility, a text editor, and the latest in the ARC wars. Speaking of ARC, you might want to zip right down to the end of this column.

Although MS-DOS may be the most popular microcomputer operating system in the known universe, it doesn't get much respect. Often called a "mere file loader" or a "CP/M clone" ("CP/M"?), DOS continues to frustrate users.

Almost everyone has advice for Bill Gates and company on what is wrong with DOS, but few actually *do* something about it. This time I'll talk about two examples. Both address DOS's limitations in file handling and text editing.

Almost everyone has advice for Bill Gates and company on what is wrong with DOS, but few actually *do* something about it.

Helpware's Director 1.0

Dan Baumbach created the Director file management utility because he was dissatisfied with DOS's file-handling abilities and disappointed with the numerous alternatives.

Don't be misled by the 1.0 in Director's name. It's a fairly mature product that recently began to sport a new name. Actually a pair of programs called DL and DB, the double utility reached version 2.5 before Baumbach repackaged them under a single name and reset the version counter. The components of Director have reached version 3.0.

DL, which is probably short for "Directory List," continues to be Director's mainstay. It displays a directory tree and lets you highlight the subdirectory you're interested in. When you press ENTER you see the subdirectory's files in sorted order.

The default order is alphabetical, but you can choose date, size, extension, or unordered (the order in which the directory stores the files). Press enter on a highlighted filename and DL displays the file's contents — there's a hex option so you can view binary files in hexadecimal.

You can do practically anything within DL: copy, delete, rename, move (to another directory), print, change attributes, or run (in executable files). If you want to operate on several files, DL lets you mark them for batch operations. Another DL feature allows you to "shell out" to a text editor to work on a highlighted text file.

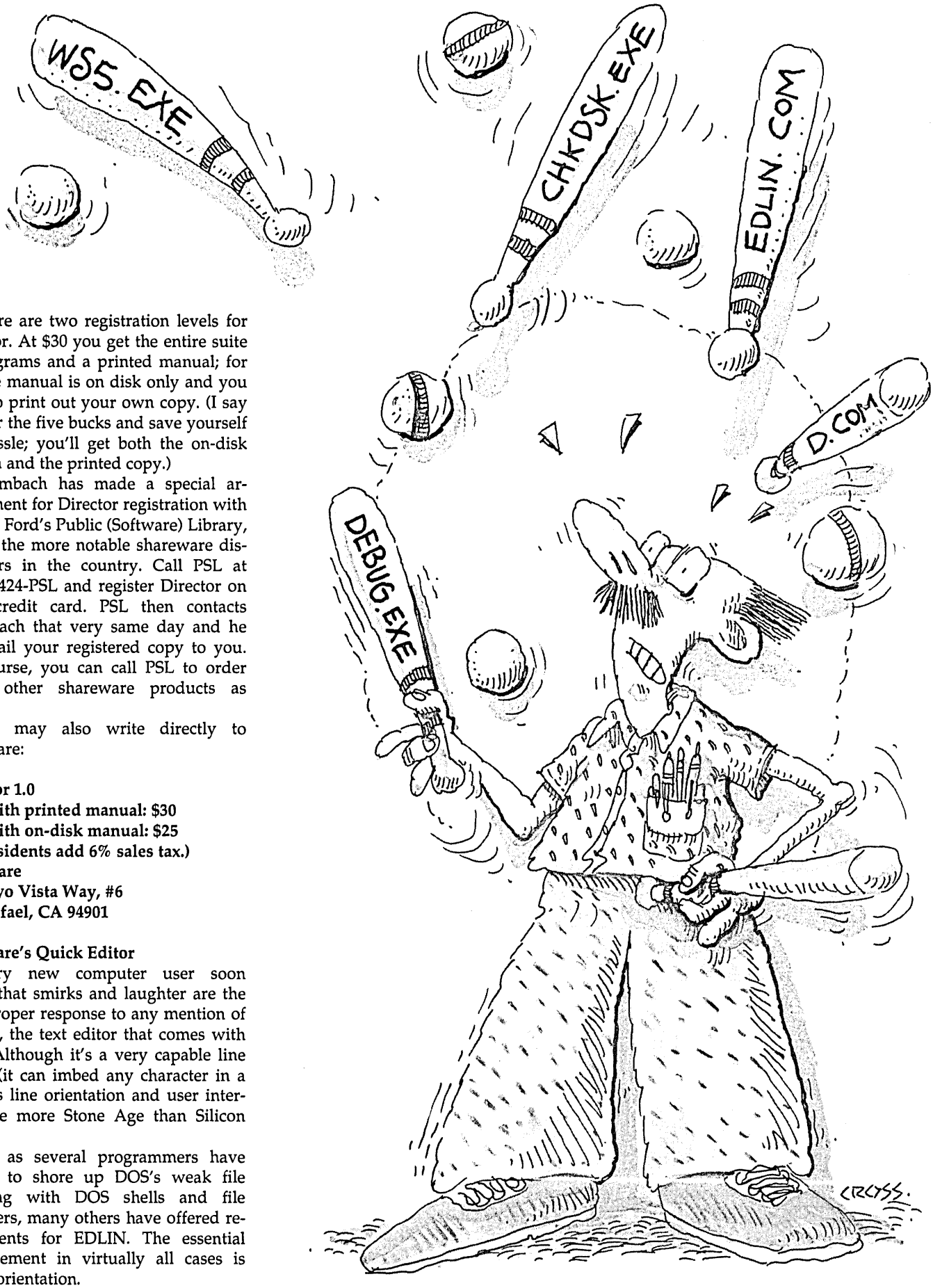
Since a file manager needs to keep an eye on its working space, DL monitors your hard disk and will share the information with you at the press of a key.

Sometimes roaming about your hard disk and poking into various subdirectories might not interest you. If you plan on a file-fiddling session that will be confined to a single directory, Director includes the pared-down DB program (which stands for "Dan Baumbach?").

DB saves some time and memory since it can ignore the directory structure and go directly to the local files. Baumbach says, "Most of the time, I used DB instead of typing DIR, to see what's in a directory and be able to scroll through it and view files."

Baumbach has continued to polish Director and added configuration programs to customize the features of DL and DB. To assist impatient users (are there any other kind?), he has written a "quick start manual" that gets right into the program.

His 45-page user manual takes a more leisurely approach, describing each feature in detail, providing a shareware registration form, and giving a plug to the Association for Shareware Professionals.



There are two registration levels for Director. At $30 you get the entire suite of programs and a printed manual; for $25 the manual is on disk only and you have to print out your own copy. (I say pop for the five bucks and save yourself the hassle; you'll get both the on-disk version and the printed copy.)

Baumbach has made a special arrangement for Director registration with Nelson Ford's Public (Software) Library, one of the more notable shareware distributors in the country. Call PSL at (800) 2424-PSL and register Director on your credit card. PSL then contacts Baumbach that very same day and he will mail your registered copy to you. (Of course, you can call PSL to order many other shareware products as well.)

You may also write directly to Helpware:

Director 1.0
Reg. with printed manual: $30
Reg. with on-disk manual: $25
(CA residents add 6% sales tax.)
Helpware
100 Bayo Vista Way, #6
San Rafael, CA 94901

SemWare's Quick Editor

Every new computer user soon learns that smirks and laughter are the only proper response to any mention of EDLIN, the text editor that comes with DOS. Although it's a very capable line editor (it can imbed any character in a file), its line orientation and user interface are more Stone Age than Silicon Age.

Just as several programmers have striven to shore up DOS's weak file handling with DOS shells and file managers, many others have offered replacements for EDLIN. The essential improvement in virtually all cases is screen orientation.

If you're not an old-timer in the mi-

crocomputer business (if, say, you got started after 1981), you might not even know the difference between line editors and screen editors. EDLIN and its kin require you to specify the line you want to work on, and there's no simple cursor movement to get you to the line above or below. Full-screen editors let you move your cursor around freely and edit where you will.

QEdit is one of the best known and most popular shareware text editors. The good folks at SemWare are now at version 2.07 of this small but powerful program.

For example, QEdit is perfectly happy in only 128K (meaning that you can run it on a PCjr), although it will take advantage of a full 640K. A single disk drive suffices, since QEdit requires only 50K on disk.

Okay, so QEdit is tiny. What can a program that small do? Plenty:

- Load as many different text files as your computer's memory can hold.
- Open up to 8 windows; each can display a different file or a different part of the same file.
- You get 99 scratch buffers for dumping or retrieving chunks of text.
- You can even customize the keyboard.
- It lets you create macros by either recording keystrokes or writing macro scripts in a text file.
- Shell out to DOS from within the editor.
- Customize screen colors and default format settings.
- Modify the Help screen to contain your own tips and notes.
- Invoke "C mode" for automatic indenting of source code.

Is that enough? There's more. This "Quick Editor" both lives up to its name and travels light, unencumbered by companion files. Even the extensive customization is accomplished in a "patch area" of the executable Q.EXE file. Once you've used the QCONFIG.EXE utility to patch Q.EXE, the Q.EXE file is all you need to run QEdit with all your special features. Only macros or key redefinitions create external files.

QEdit is the brainchild of Sammy Mitchell. A professional programmer, Mitchell has worked with both mainframes and micros.

SemWare distributes Mitchell's QEdit in two forms. The $54.95 registration package includes a nicely printed spiral-bound 100 page manual. The $44 package contains just the QEdit disk, with the user's manual in a text file. SemWare accepts credit card orders by phone, or you can write to them.

QEdit 2.07
Reg. with printed manual: $54.95
Reg. with on-disk manual: $44.00
(GA residents add 4% sales tax.)
SemWare
730 Elk Cove Court
Kennesaw, GA 30144-4047
(404) 428-6416

The Infinite Loop

Taking advantage of a lull in the ARC wars, we peek out of the bunker and what do we see: strange new utilities roaming the battle-scarred landscape.

Phil Katz (PKWare) has released PKZIP and PKUNZIP. They represent his attempt to launch a new standard for file compression and conflation. (I would have said "archiving," but Katz scrupulously avoids the word.)

Naturally mindful of the trouble caused by the legal battles of the ARC wars, Katz is trying to make his new ZIP format attractive by issuing the following declaration:

"The file format of the files created by these programs, which file format is original with the first release of this software, is hereby dedicated to the public domain. Further, the filename extension of '.ZIP,' first used in connection with data compression software on the first release of this software, is also hereby dedicated to the public domain, with the fervent and sincere hope that it will not be attempted to be appropriated by anyone else for their exclusive use, but rather that it will be used to refer to data compression and librarying software in general, of a class or type which creates files having a format generally compatible with this software."

Obviously, PKWare hopes to claim the high ground in the battle for market share by disavowing any interest in making ZIP a proprietary format or process. However, do PKZIP and PKUNZIP have any other features that will help them compete with SEA's ARC?

The speed edge that characterized PKARC and PKXARC is no longer a consideration since SEA's ARC and QARC (Quick ARC) now offer comparable performance. (The court settlement between ARC and PKWare resulted in SEA's acquisition of the

PKARC and PKXARC source code. In addition, SEA is optimizing the ARC code.)

However, the ZIP utilities have a brand-new directory storage feature. That is, you can create a ZIP file that not only stores and compresses your files, it also remembers the directory structure and the location of the files therein. Upon unzipping a ZIP file, the PKUNZIP utility will recreate the directory tree for you and place the files in their appropriate subdirectories. This is a nifty addition.

As with PKARC and PKXARC, the ZIP programs come with a utility (called PKSFX) to create a self-unzipping file. *Editor's note: It's not what it sounds like, really it isn't.* This lets you distribute a program and its companion files in an .EXE file that unzips itself upon execution. Phil Katz distributes his new utilities in a file called PKZ090.EXE. The version number, 0.90, indicates that this is a new venture. You should see release 1.00 shortly; in fact it may be out by the time you read this.

I don't know whether the ZIP format can carve a niche in the market. While Katz won the sympathy of many BBS operators during the ARC wars, there's a natural reluctance to convert all those existing ARC files. Though the UCLA PC Users Group has gone over to ZIP wholeheartedly, HAL-PC's BBS requests that you not upload ZIP files. Yet another battle has begun.

A full registration of the ZIP utilities is $47, which includes a disk that contains the files and their user manuals. Corporate rates and distribution arrangements are also available from PKWare; call them for details.

PKZIP, PKUNZIP, and PKSFX, v 0.90
Registration: $47
PKWare, Inc.
7545 N. Port Washington Rd.
Glendale, WI 53217-3442
(414) 352-3670 Voice
(414) 352-7176 BBS

The Original

As previously noted, SEA created the original ARC program. Once nearly elbowed aside by the high-performance PKWare alternatives, SEA's program is now out in a faster version called 5.32. For even greater speed, they now also offer QARC.

To enhance their public image in the wake of the legal scuffle with Katz, SEA has launched a newsletter called *Making Waves!*. (It appears to be a quarterly.) Call SEA for more information on their products and the new newsletter.

System Enhancement Associates
21 New Street
Wayne, NJ 07470
(201) 473-5153

Cloud On The Horizon?

PKWare's ZIP format is not the only contender for ARC's market. A new entrant called LHARC has just started to appear on the bulletin boards. While it is not as fast as PKZIP or QARC, LHARC's claim to fame is that it couples decent performance with extraordinarily effective compression—beating its competitors by 30 percent or more. That could produce major savings in disk space.

I haven't had a chance to try LHARC to evaluate its claims or examine its compatibility with the existing ARC standard. Watch for more news next time. Things are getting interesting all over again.

♦ ♦ ♦

I AM A RADIO

A while back Nate logged on to Micro C's bulletin board with an unusual problem. I don't know that we were able to help him, but at least he found a couple thousand sympathetic modems.

2431 To: ALL From: NATHAN ENGLE

Hey, I'm a radio! I was playing around with op-amps tonight and I hooked up a speaker to the thing. While I was twiddling with the wires on the protoboard, I suddenly found that I was tuned in to some AM radio station. The signal only comes through when I touch the + input on the op-amp, so I guess I'm the antenna....

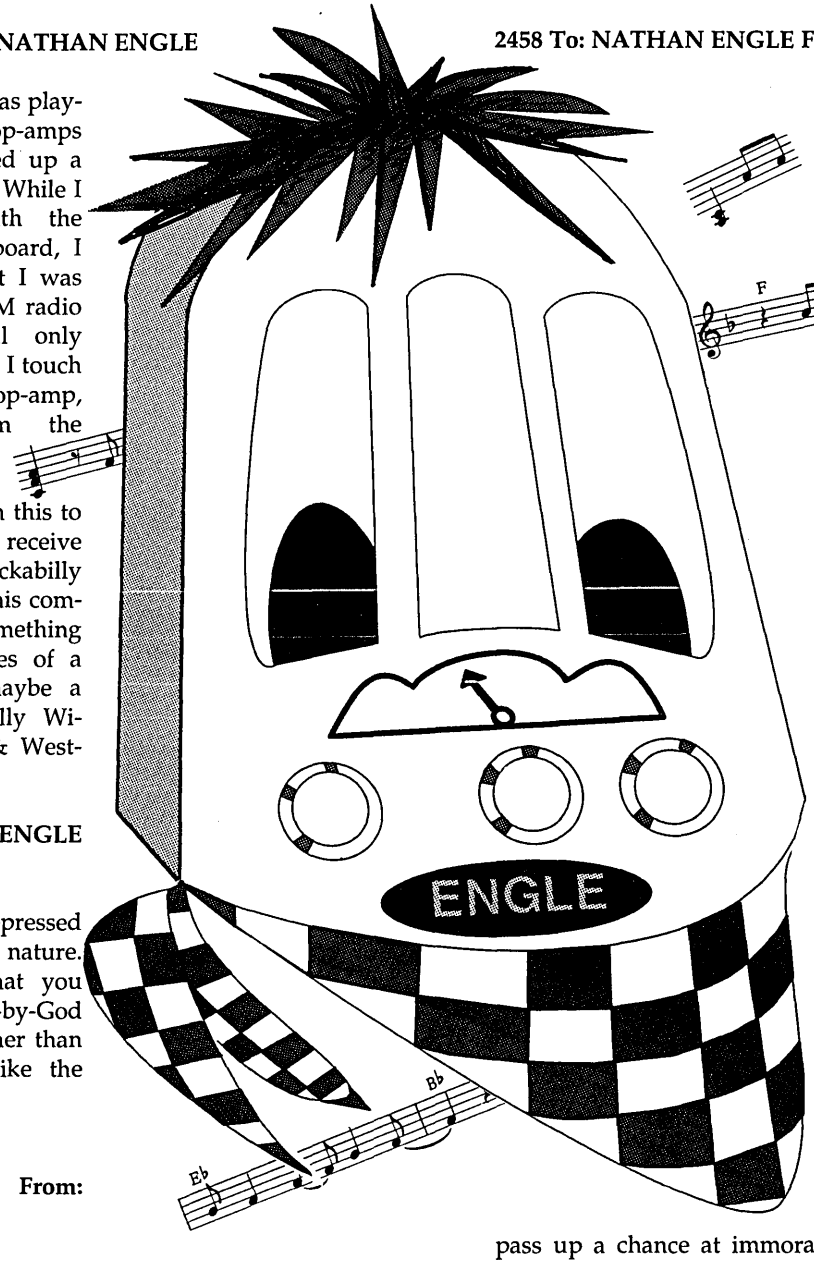
Can anybody explain this to me? I appear to receive some sort of Rockabilly Country station. Is this common? I expected something more along the lines of a quiet Mozart or maybe a Celtic band like Silly Wizard, but Country & Western?

2449 To: NATHAN ENGLE From: SYSOP

Obviously you've repressed your true musical nature. Just be thankful that you heard honest-to-by-God American music rather than some punk band like the Dead Milkmen.
Larry.

2452 To: SYSOP From: NATHAN ENGLE

Well, yeah, there is always that ... still it was a shock. I listen to Public Radio most assiduously; don't even own a TV. It was kind of a shock to realize that I'm receiving that Country & Western muck all the time. I think it's gotta be bad for me. By the way, I've discovered that my toolbox also tunes to this particular station so maybe it just comes from the neighborhood.



2458 To: NATHAN ENGLE From: SYSOP

You may be on to something here. Why don't you have some fun with it and upload a submission for the Culture Corner? Fame and fortune await. (Well, infamy anyway.)
Larry

2462 To: SYSOP From: NATHAN ENGLE

An article about my unfortunate condition? I think I'll hold off for a while. I've been listening to this station (my station?) for a couple of days. Yesterday a guy gave a sort of pseudoscientific explanation of the Black Hole at the center of the Milky Way which this guy had identified as Satan. There are a lot of truckin' and "you-done-me-wrong" songs as well.

This religious stuff is what re ally stymies me. I'm the original secular humanist (well, me and Carl Sagan...) and if it got around that I'm actually a radio antenna for a Christian rock-a-billy country station.... My prestige would suffer a blow, let me tell you.

2488 To: NATHAN ENGLE From: SYSOP

Nathan, I'm surprised. You'd pass up a chance at immorality? (Pardon me, immorTality.) How about a collection of these messages. I'll do all the work and you can take the credit.
Merry Christmas, Larry

By Nathan Engle
6465 Piping Rock Lane #30
Indianapolis, IN 46254

2489 To: SYSOP From: NATHAN ENGLE

Well, Larry, I've been thinking about it and I may be taking the wrong attitude going into the closet like I had planned. It just doesn't seem to be in keeping with the spirit of Open Disclosure in this age of Enlightened Media. I've been listening to this station a lot recently and it may be affecting my thinking, but it seems to me that if we can get to the root of this, if we can save one single child from the same dread fate.... Well, darn it! You put it that way, I don't see how I could refuse. Only I'm not doing any posters.

Oh, by the way, a very merry holiday to everyone at Micro C. You have helped make this a banner year for me. When I was a kid my father used to take me to art fairs where he had a display. It was an overwhelming experience more than once, camping out in central Kentucky with a gang of the most bohemian artists and musicians you ever saw.

That's a long way away now, some of those people have died, many have changed, but those are my kind of people. I can't help but feel that *Micro C* people (writers and readers alike) are like that, too. People with passions always are, whether it's for flying old planes, running fast computers, or playing five string banjo.

Thanks for keeping the fires burning. Sol Libes going out of business and Steve Ciarcia leaving *BYTE* have really hit home with me this year, and made me more nostalgic than usual....

2495 To: NATHAN ENGLE From: SYSOP

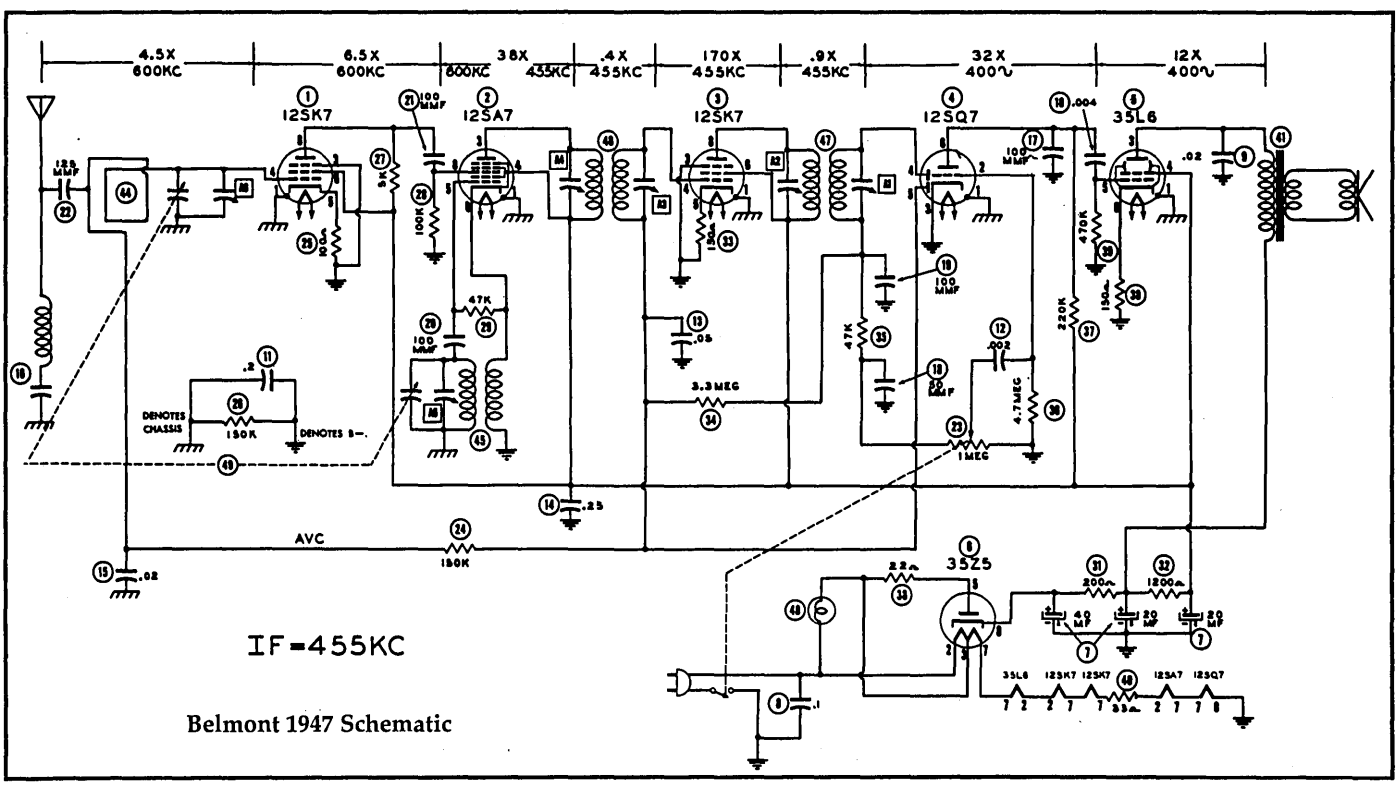
Thanks Nathan! I do wish you'd reconsider your poster decision. (We'll even let you keep your clothes on...) Larry

2503 To: SYSOP From: NATHAN ENGLE

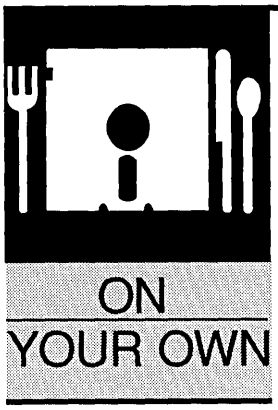
I just don't go onto posters very well. People keep on mistaking me for a 19th century European statesman and it confuses them. "Why have they put Mr. Gladstone in a poster? I'm confused."

We'd have to have a big label identifying me as a 20th century poster child instead, and that might tend to spoil the effect. Anyway, I'm glad you've taken up the cause. Save the children!

♦ ♦ ♦



Belmont 1947 Schematic



Growing A Software Business

Succeeding Without Venture Capital And Other Impediments

By Patrick O. Conley
President
Abraxas Software, Inc.
7033 SW Macadam Ave.
Portland, OR 97219

Occasionally someone expresses an opinion in Micro C. I know that sounds strange, especially for those of you who join me "Around The Bend," but it happens. You'll find that Pat has a few opinions—opinions that I share.

How I wound up talking to Pat the first time, I don't recall, but I distinctly remember feeling I'd connected with an entrepreneur's entrepreneur. So I proposed an "On Your Own."

"But I don't write," Pat countered.

"I'll interview you on the phone," I offered.

"Better than that, send me the questions via fax and I'll jot down some answers and return them the same way," he said.

That same afternoon I sent half a page of questions, and within 24 hours our little fax was spitting out the longest single page ever transferred. (Guinness, are you listening?) What follows is that page.

You have been working for yourself for quite a while. How did you wind up starting Abraxas Software?

In our system, the lack of control an individual has over his own life has always frustrated me. I realized at an early age that if I were going to be free, I had to own my own business. Simple things like what time I get up, how much vacation I take, how I spend my time, and where I live are really important.

In 1983, during the venture capital rage, I left a good paying job as a software engineer designing graphics systems and started a company building graphics boards for the PC. Venture capital came very easily, and within one month my partner and I had a business. I learned my first lesson: venture capitalists are the worst bosses in the world. Taking money from them is like taking money from the devil.

Second, I learned what Howard Hughes said is true: "Partners are dead weight." In a small business, you can only have one person in charge. The advantage small businesses have over the big companies is that they react quickly. However, if you have to spend all your time in meetings, you might as well kiss your business good-bye. In working with venture capitalists, the partners must stick together—but like all strategists, the venture folks know how to divide and conquer.

During 1981-1983, I designed graphics controllers at Tektronix, Metheus, and then Microfield. I learned my third lesson. At Tektronix, forty of us developed a system. What a mess—all the group wanted to do was sit in meetings and eat croissants; the project took two years. At Metheus, four people did the same thing in half the time.

Finally, at Microfield, one person did it in six months. The lesson: one person can do a heck of a lot; Alexander the Great taught this to his men. Well, it wasn't long before the venture-some bought me out of Microfield. I used that cash to start Abraxas in 1984.

I printed business cards, sold my house (zero gain), got rid of my car payment, and for the next two years I lived on $500 a month. I made $5,000 a month at Metheus.

The first year and a half I did royalty work, and in the end averaged about fifty cents an hour. Then I tried consulting, and my income rose to over $100K a year.

When I was designing graphics controllers, I used YACC to build C compilers for Bit Slice engines. I realized at Microfield that the PC market needed a YACC for professionals. In 1987 I brought out Abraxas' first product, PC-YACC.

(Important note: If you can't get through the first two years of poverty, don't even think about starting a business. It's called paying your dues; and unless you go through it, you'll never learn to do great things with very little.)

Tell Us About Abraxas Software....

Right now we sell PCYACC, MACYACC, and PCYACC/2 for OS/2. Later this summer we'll have some exciting products that will solve portability and maintainability problems. Our products sell because of their value and depth. There are over ten man-years in PC-YACC, and for $395 that's an incredible value for someone serious about language design.

We publicize our products via press releases and advertising. We support our users by help-

ing them solve problems with the program. We don't teach people how to use PCYACC. In fact, the only reason we charge $395 is so we don't have to deal with amateurs. At $99, our customers would drive us crazy.

I once spent an hour with a customer only to find that he had the disk upside down in his drive. Believe me, that can generate strange results if you're debugging floppy disk drivers over the telephone.

Our $139 personal version of PCYACC generates two percent of sales, yet accounts for eighty percent of the support. If I were smart I wouldn't even sell the product, but I don't want to lock the students and the little guy out.

In the future, the best innovations will come from the guy in some room somewhere in the middle of nowhere. Don't believe Microsoft when they say that gone are the days of opportunity for the little guy; this simply isn't true. In truth, the big guys are terrified of entrepreneurs.

I assume that our customers are smarter than we are; you can't fool them. We give inexpensive or free upgrades. Almost every suggestion from a customer gets implemented.

One thing that bothers me about our industry is what I call pet rock software. That's junk software that just sits on people's shelves. A lot of people think they can spend three months on a program, sell it, and rake in the dough. Well, the joke's on them. Remember,

I learned my first lesson: venture capitalists are the worst bosses in the world. Taking money from them is like taking money from the devil....

the average software entrepreneur doesn't even pay for his PC, let alone make any money.

Where do you see the company going (literally and otherwise) in the next few years?

Abraxas is committed to developing high quality software development tools for DOS, OS/2, Mac, Sun, Aix, VMS, and NeXT. We want all our tools to be portable to every platform. In the 90s, the most important thing will be portability. No longer will firms invest millions of dollars on systems that support only one platform. The dinosaurs who don't see this will simply become extinct.

Sometime in the future, I'll move Abraxas to a smaller and more livable town. The politicians are now trying to sell Oregon and make it more like California (in terms of L.A.), so we'll probably move to Eastern Oregon. Note, we are not a software publishing company; we are a software development company.

How well is it doing financially?

In the last question I mentioned that we're a software development company. I believe that only publishers can make money on software. To be a publisher, you need to be doing at least five million dollars a year. Otherwise, you don't have the economy of scale to do mass mailings, cheap advertising, and low cost duplication and printing.

Money comes in and money goes out. I still only pay myself $500 a month—after all, I learned

how to live on that. About 75% of our revenue goes towards advertising. A publisher probably spends about 15-20% on advertising. So, we're staying in business, but nobody is getting rich. If you want to be rich, become a publisher.

At the level we advertise, print, and duplicate, we have to pay top dollar. A special mention regarding advertising: the big companies get great breaks that big magazines claim don't exist. I think that crossing this advertising cost wall is the biggest obstacle to becoming a big company.

However, at this point I want to keep Abraxas small, because small companies are fun and you get to work with the customer. In a big company you spend all your time dealing with financial and managerial problems.

Why is it financially successful?

We're not trying to rip anyone off. We sell quality products that we use ourselves. Every product I'll ever sell will be something that I need to solve a software engineering problem.

Let me clarify something. Success cannot be measured financially. Money is simply the blood of a business. If the patient is low on blood, he dies. Too much money is not good, either. The politicians would take your blood if they could; they will take your money. Furthermore, if you're rolling in cash, some company like Microsoft will come and take your business away before you know what happened.

There are probably a hundred times as many companies out there who would rather copy products than innovate, and they have full-time people just looking for fat little niches. Finally, the purpose of this business is to stay in the game. If you run out of revenue, you're out. Playing the game is fun if you like to travel, meet people, and have full control of your life.

But there's more to success....

The real reason for starting the business is vacation time. Two weeks a year is ridiculous. From the very beginning, I have taken at least two months of vacation a year. I take very inexpensive trips, but I go all over the world.

I try to go mountain climbing every weekend, I ride my bicycle to work, and I do martial arts in the evening. Another thing I like most about my business: buying new toys. I just bought an Apple SE/30—it's a beautiful machine. My next machine will be a NeXT.

One new exciting thing about business: as an entrepreneur you can do something. Give your money away. Yvon Chouinard of Patagonia gives away ten percent of his company profits and the rest goes back into the business. He donates this money to environmental causes. He will not relocate his business to a town that accepts strip malls. If we had more people like this, America would be a place to live instead of a place to work.

There's this copying tendency we have as Americans. You are rewarded in school for behaving the same.... So, when most people start a business, they copy big business. A big mistake. You must start lean and mean and never leave that path.

There's a book called *Growing a Business*; please read it. This book describes many things entrepreneurs can do to make this a better world. Currently I'm involved in supporting National Public Radio, boycotting EXXON, and saving our environment.

It sounds like your company is surviving because you've avoided the traps.

There's this copying tendency we have as Americans. You are rewarded in school for behaving the same. To be popular, you must dress and act acceptably.

So, when most people start a business, they copy big business. A big mistake. You must start lean and mean and never leave that path.

I've seen small companies spend their first $100,000 in venture capital on furniture. Two years later, they still don't have a product. If you get caught up in your ego and fancy car, and all the garbage that goes with being an "entrepreneur," you will fail!

The first few years, you must work long and hard for no return. All things in life are this way. Like mountain climbing and martial arts, the paths are long but the rewards are great.

The second reason is lack of patience and commitment. There is no quick way to get rich. If that's what you want, become an investment banker and steal legally. You must be committed, burn your bridges, quit your comfortable job. Make your business the most important thing (second only to the people) in your life.

Many people are afraid to do things alone so they bring a friend. We usually spend less time picking a partner than picking a lover; but remember, partners must spend more time together. When the relationship fails, the business fails. Also, most people are afraid to go alone. Misery loves company, and most people do not like to suffer alone.

Also, never announce vaporware, and don't ship a product with bugs. It only takes one mistake, one message that you are a flaky company, and that's it. No ifs, buts, or anything. It's the old story, "If you don't have time to do it right the first time, where are you going to get time the second time?" I see this over and over. If you ever make this mistake, go back to square one and rename your company, because the public will never forgive you.

Finally, pet rock software—I've seen gobs of stupid software. The public isn't stupid. If you can't spend the time to develop an excellent product, then don't bother. If you develop a high quality, useful piece of software that solves real problems, really works, and doesn't create more problems, you can't fail.

You use remote programmers. Why? Tell us about them.

When I started my business, I knew I didn't want to build a home for orphan programmers. I have known so many "programmers" who spend their day reading the UNIX Net or playing computer games, I just didn't want to be a baby-sitter. Remote programmers, by their very nature, must be disciplined or they don't eat.

I prefer to hire first generation immigrants. They are the hardest workers. They understand that, in terms of starting their own business, America is without limits.

Since I'm on this subject, I want to mention that most PCYACC sales come from northern Europe. Here we have one of the most technical products available for the PC, and only disciplined North European developers buy it. This tells me that, in the near future, Europe will blow us away.

I work with a programmer in New Mexico who has a wonderful lifestyle in an enchanting village. He's an incredible producer. When he isn't programming for profit, he's teaching his five-year-old son theoretical physics. He has developed an asteroid game that teaches Lorentz transformations, Euclidean geometry, general relativity, and astrophysics, all on a Macintosh. He also has developed technology that allows the Mac to be an inhouse bird sanctuary by playing songs and displaying real birds.

Any more suggestions for other entrepreneurs?

Work hard. Be original and ask yourself every day, how badly do I want this? Don't abandon the people you love. And in the end you're doing it all for only one person, yourself.

Play hard and work hard. Don't quit playing, because if you do you'll lose your sense of value, and then you have nothing. Give away your best ideas. Being selfish with your products and talent will only hurt you in the end.

Every three years, take everything you've learned and throw it away. Today, DOS is hot. Eight years ago it was CP/M. In two years, OS/2 will be *hot*. Learn the NeXT. Its hardware theme will be the basis of the 90s. Become a registered developer for all the hardware people, such as IBM, Apple, HP, SUN, NeXT, and DEC. This way you'll be in the same league as the big guys in terms of information and prices on new technology.

How about keeping a successful startup going?

My experience with our customers is that when they first come out with a great product, it sells well. They pay for their advertising, and everything is great. Then about six months after introduction, they start spending all their time doing support. They never get back to upgrading the product and the revenue drops. Now they're trapped.

They have no time to develop new products. They get squeezed and die.

I've seen this happen to many companies in the industry. It is simply bad planning. First, most products have a life of only a couple years. So it makes sense that you should develop new products all the time. Also, if you have a small customer base, you need to sell upgrades to maintain your cash flow. You need, at the least, two people: one to market and one to implement.

Marketing is a full-time job. I spent one year and $150K of my own money marketing PCYACC. I mean, that's all I did. Press releases and more press releases. Surveys, talking to customers, solving problems. So you can see what happens when you have one person who tries to do it all.

To succeed, you must be able to develop, market, and support concurrently. Otherwise you will fail. I have no solutions. This is a hard problem. I got around it by hiring programmers to work on new ideas while I was spending my time announcing PCYACC.

This reminds me of what Mitch Kapor once said: "All you need to start a software company is a garage, a computer, and five. million dollars." It's really not hard.

Back to reality. There are ways to market without spending money. Simply assume you have none. Solutions will manifest themselves because hunger really puts the old brain in gear.

I suspect it's best to publish your own software. To a point, it really depends on your resources and the product target. It would be ridiculous, for instance, for a small company to bring out a better word processor. License it to the big company that needs one for their product mix.

In general, it's better for small companies to go after new niches. The people I know who do the best have their own niche sewed up solid.

But you don't have to market your own software.

There are three ways to get paid when someone else markets your product: stock, royalty, or cash. Stock is a joke 99% of the time. It's worthless. Royalty is good only if your product is published by a sincere publisher who will market your product and nothing else that season. Cash is always the best. Have you ever noticed? That's what lawyers, doctors, and accountants take.

Companies only offer royalties for one reason. They can't afford to front the cash. If they really believed in the product, they would never offer royalties, because that's their profits. If the product does sell well, they'll do everything possible to void the royalty contract and to keep the money.

Summarize your experience.

I believe most people want to be in business for the form and not substance. When I see people start a business, they're forever haggling over business cards, stationery, going public, titles, offices, furniture, autos, travel, expense accounts, and clothes. Note that I haven't mentioned product.

Most people, I've found, are simply interested in the "image" of business. To be successful, you must be product-oriented. Every moment must be spent on product improvement and sales. Every dollar must be spent to improve sales. Every minute during the day, I ask myself Townsend's question (he rescued AVIS in the sixties): "If you're not doing it for fun or profit, then what the hell are you doing it for?"

As for incorporating your business, it doesn't help your profits so don't worry about it. Worry about making your business real. Create a good product.

If you were starting over....

I absolutely would not do royalty work unless the publisher committed to marketing my software. Also, the publisher would have to guarantee to spend at least three times my guaranteed royalties on advertising.

I had to learn for myself never to take anyone else's money. If you do, the business is not really yours, even when you do all the work. I learned my lesson quickly and even got some cash out of the deal.

Life is full of lessons. You can learn from them or repeat them. (If you're smart, you'll even learn from other people's lessons.) Good Luck.

♦ ♦ ♦

Continued from page 4

Great idea. Except.... She would be limited to that word processor and that database package.

If they could find the monitor, there'd be no limitations. She'd be able to use any word processor, any database package, any spreadsheet, any game, and anything else that the rest of us use. As far as the computer world was concerned, she wouldn't be handicapped at all.

They're still looking.

(Take a look at Debee Norling's article, "Writing Software For The Blind," for one solution to this problem.)

But Graphics May Be Handicapped

We had fun putting together the last issue. We used to get graphics on paper. Sandy would redraw everything with pen and ink. It took hours. Two years ago we were just getting into Ventura and we could see that the computer would be the way to do graphics.

One year ago Sandy was taking the papered illustrations from authors and entering them in AutoCad or Publisher's Paintbrush. Occasionally, she'd scan something and then edit it. (Getting AutoCad to speak something that Ventura could reproduce *properly* took hours and hours and hours.)

Now we're starting to see illustrations on disk rather than paper. In the last issue Gary sent PCX files for his "Last Page." Okay. PCX has never been a problem so we just sucked them into Ventura. No luck. We tried loading them into Publisher's Paintbrush, no luck. We tried using Reflection to convert them to TIFF or something and then convert them back to PCX. They converted, sort of, but the TIFF file wouldn't convert back. (Reflection bailed back to the system and the system announced it couldn't find COMMAND.COM.)

Gary started investigating and, no doubt, you'll be hearing more about this whole thing from him. A PCX file is not necessarily a PCX file even though it was generated by the same version of the same program from the same manufacturer. The only package that would display Gary's new PCX format was Sam Azer's.

No wonder Sam's article on the PCX format was so popular. (I understand it was required reading at several graphics houses.)

Meanwhile

I've mentioned that we're trying out Gem Artline. Powerful package. Gem Artline runs under Gem (Does this sound like déjà vu all over again?) so it says it's completely compatible with Ventura. Unfortunately, it's not completely compatible with any Ventura prior to 2.0, unless you install the newest GEM.

We installed the newest GEM on one of our desktop machines so we could properly display and print Artline illustrations. (Never do your experiments on your main machine, it's a guaranteed way to shut down your operation.)

Unfortunately, no one's willing to use the machine with the new Gem. For instance, to get into Ventura the old way, you entered:

```
VP <CR>
```

Now you enter:

```
Gem <CR>
```

and then you have to make three mouse selections among zillions of unreadable little boxes. Wonderful. Exiting out of Ventura (and Gem) is even more fun because once you're out, the screen doesn't work. (Why should I want to use the screen except to select a little box?)

Maybe it's time to concentrate on the Arts & Letters Editor. It runs under windows. (Unfortunately Carol has discovered Editor and she's hogging the machine.)

"Hey Dave, you ought to try this Arts and Letters package, it does some really incredible things ... and it's fun."

What can I say?

Under Windows

However, Windows isn't the cleanest of packages either. Though Arts & Letters works well under its runtime windows, and our scanner software Eyestar Plus works fairly well under its runtime windows, we have real problems with one after installing the other.

We install Arts & Letters and Eyestar Plus won't run. We reinstall Eyestar Plus and usually neither runs. They're in separate directories, but that doesn't seem to make a difference. I need to reformat the drive anyway. So afterwards I'll get out CRC.COM, do the reinstalls, and see what gets tromped on. (On second thought, I'll put them on different systems.)

Speaking Of Hard Drives

I'm reformatting the drive because I formatted it last with Spinrite (the old nondestructive format on an XT trick). I did the same thing on another drive (using Disk Technician) and soon it had trouble booting. After it began showing errors, I ran the exhaustive monthly Disk Technician test. The test found half a dozen soft errors, none of them even close to track 0. I replaced the drive.

So I'll be doing a low level, destructive reformat the old-fashioned way. (DEBUG, FDISK, FORMAT.) Boy, just when you think you've found something new, you find out it doesn't work. (Both packages work fine on ATs, however.)

Around the Bend

SuperCalc 5

Occasionally we do real work at Micro C. For spreadsheets and the like, Sandy's been using SuperCalc 4. Great package, absolutely dependable. Then she purchased the upgrade to 5. She expected truly marvelous things like laser printer output, a selection of fonts, more graphics....

Unfortunately, it appears they didn't test their fancy new printing routines before shipping the product.

Outputting to a dot matrix printer is frustrating. For instance, if you're outputting regular text, it outputs properly if you select "carriage return, no linefeed."

If you're outputting condensed text to the same printer, you must select "carriage return and linefeed." Otherwise it prints everything on a single line.

Okay, that's no worse than an adventure game. Except, Sandy needed regular text followed by condensed text. So she either got double-spaced regular text or all the condensed text on a single line. So she tried outputting on our laser printer. However, outputting to either a Laserjet or PostScript printer turned out to be an even bigger adventure.

Sometimes she'd get the first page (never any following pages). But usually, she wouldn't even get the first page. Even after she'd successfully output the first page, she couldn't output that same page again.

Often, just selecting the print option would hang the system. (We've tried it on a 186, 286, and 386 system.)

Sandy has spent hours trying all the permutations. Fortunately there's tech support. Unfortunately, tech support doesn't know much.

"Gee, did you select the PostScript printer in the setup menu...?"

"Yes. And I'm doing it again."

"It should work now."

"Yes, it should."

While she was talking, I trapped the output to see what the program was sending to the printer. What I found was raw text, no PostScript header, no PostScript line information, no PostScript end of page command. She told the guy there was no PostScript header.

"Are you sure your printer is connected to the computer?"

Dumb, dumb, dumb, dumb....

Sandy finally discovered how to get the program to speak PostScript (there's an additional, carefully hidden menu, not documented by man or manual). But the program still didn't run dependably until she selected the default printer port rather than specifying LPT1. Seems that the program sends a reset to the printer (after each page) if you specify a port from their menu. Now the program works though it still occasionally paints random jagged lines across the screen.

Despite these initial frustrations, Sandy really likes the program. (She's liked all the previous incarnations of SuperCalc.) Plus, the graphics generated by this version (jaggies aside) are pretty incredible.

Cheap Logic Analyzer

Larry had spent a week, on and off, trying to debug our disk copier. It's a custom copier designed around the Z80-based Little Board. The copier has worked well. In fact, outside of needing a new set of drives occasionally, it's been flawless.

Flawless, that is, until a few weeks ago. After Larry had spent his week, he decided it was time to take a vacation. On the way out the door he reminded me that someone really had to fix the copier.

Larry had checked supply voltages, they were fine. He had also substituted another supply just to make sure. No change. He had disconnected the drives to see if one might be dragging down the system. Nope. He even mentioned replacing the processor.

As he left, he wished me luck. I got out the scope and started looking for the obvious:

System clock? Check.

Address lines wiggling? Check.

Data lines wiggling? Check.

Control lines wiggling? Check.

Usually when the address and data lines are moving, you can assume the kernel is running. That means the clock, processor, ROM, and ROM select logic are all working. That means I could write some diagnostic code, burn it into ROM, and let the Z80 find the problem.

However, as I dug around for the materials to assemble Z80 code and burn a ROM, I realized that creating even a simple diagnostic ROM would be a two-week project. Not an attractive prospect.

Well, I did have the source for the current ROM. If only I knew how far it was getting into the code, I might have a clue

about what was hanging up the system. I needed a logic analyzer.

Fortunately, at that very moment John Worman walked in the door; and even more fortunately, he'd just finished building a Heathkit logic analyzer. Three hours later I was hooking the new, untested analyzer into my old, cranky copier.

The Heathkit logic analyzer is not exactly competition for Tektronix's super collider. Instead of 500 MHz, the Heathkit maxes out at 10 MHz. Instead of 128 channels, it supports 16. I mean, it's your basic minimum machine, and it's really the minimum for even an 8-bit processor.

For instance, how do you look at address and data at the same time? The Z80 has 16 address lines and 8 data lines. That's not counting the control signals such as CAS, MUX, read, and write.

Fortunately this processor was running ROM code, and fortunately the initialization routine lay in the first 256 bytes. I hooked up 8 channels to the ROM's lowest 8 address lines. I hooked up the other 8 to the data bus.

I hooked one of the analyzer's qualifier leads to the power line, and made it active high. Then I hooked the other qualifier to the ROM's write enable line and turned on the copier. Blam, I had the low order addresses and data from the first 2048 ROM accesses.

At startup the processor begins by loading the instruction at address 0000.

```
00 C3
01 29
02 00
```

Well, a C3 is a jump, so the processor knew it should load the following two bytes to see where to jump to. It loads the low order byte first (29) followed by the high order byte (00). (The first three bytes in my printed listing were C3, 29, 00 so things were fine so far.)

I looked at the next ROM access:

```
2D E3
```

Oops. The processor was supposed to jump to address 0029 but went to 002D instead. I quickly dug through the schematic to see if there was something between the processor and the ROM (something that might misread the processor's address selection). Nope.

So it must be the processor. Right? However, it couldn't be the Z80, Larry had mentioned replacing it. But I stuck in a new processor and surprise, surprise, everything worked.

Then, just for argument's sake, I grabbed new data. Things were hunky dory.

```
00 C3
01 29
02 00
29 F3
```

Some details about the Heathkit Logic Analyzer.

```
Data Width.....16 bits
Data Depth.....2046 words
Clock Input.....Rising or falling edge
Clock Qual. ..... Two (logic high or low)
Clock Period ..... 100 ns minimum
Displays ..... ASCII/Hex/Octal or Timing
Delay Range ..... 2 to 50,000 clocks
Trigger Word ..... Selectable H,L, Don't care

Logic Analyzer Model IC-1001 ..... Price $279.95, kit
Heath Company
Benton Harbor, MI 49022
(616) 982-3411 (Good Luck)
```

By the way, when Heath says it's a kit—it's a kit. You even assemble the three-ring binder (with two nuts and two screws) before you insert the pages. Don't worry, however, they're famous for their clear manuals and their knowledgable support.

The Toshiba T1000

I've been dragging around a Kaypro 2000 for a couple of years and it's really spoiled me. Now I feel naked if I don't have a computer with me. (The king has no computer.)

After all, there's no way to know when an idea's going to jump out at me or I'm going to dig up some juicy gossip. Plus, we all know that paper's for cave dwellers. Unfortunately, the 2000 hasn't been very dependable, or very lightweight, or very easy to haul around, or easy to fix. The 2000 is a kludge.

However, I had the 2000 and I kept futzing with it (inter-

mittent main board, flaky drive, dead battery...) until I saw the little Toshiba T1000.

The T1000 isn't a killer computer (4.77 MHz 8088, 512K, unlit LCD screen, single 720K drive), but it has some very redeeming features. It's light (just over 6 lbs. versus 11 for the 2000), and it runs 5 hours on a charge (versus 3). It has built-in serial and parallel ports, built-in CGA interface, MS-DOS 2.11 and DOS utilities in ROM, and an LED that glows red 10 minutes before the batteries expire. It's silent, the screen is more readable than the Kaypro's, and it's small enough to fit in a briefcase.

For me, it's perfect. Weight and size are most important (so I can go even farther up in the mountains to write my editorials). Operating time away from power is also significant (some portables won't run 2 hours), and any machine I own must have at least one drive.

I spent one frustrating vacation tapping away on one of Radio Shack's imitation laptops. No drive, limited memory. Boy, not having a drive made me nervous and really limited the time I could be away from a real computer.

Toshiba has fancier machines with backlit screens (very nice), two floppies (handy), faster processors, more memory (you can add memory to the 1000), expansion slots, hard drives, etc. These features are wonderful if you need them, but they all add weight and none of these souped up systems runs 5 hours between charges. So the basic 1000 is optimum for me.

The only thing I miss about the Kaypro laptop is the keyboard. That keyboard had an absolutely wonderful touch—better than any portable, laptop, or desktop.

The Search

Thanks for all the cards, letters, calls, and messages on the BBS regarding my search (Yoga, rolfing, psychic readings...). I haven't had a chance to get back to all of you, but I thank you for your help and support. (Also see Letters, this issue.)

Some of you wondered how you could locate a national or regional new age support group. You shouldn't have to look beyond your own community. People who are doing this are like folks running CP/M—they're there, they're just not advertising.

Usually you can find a bookstore that specializes in new age material. Stop in when you have some time to browse and chat. Pay special attention to their message board. Or, your local college may offer evening classes on Yoga, Eastern Religions, or meditation; give the instructor a call.

Also check with alternative health professionals such as rolfers, reiki healers, or even massage therapists and Naturopaths. Any of these should be able to put you in touch with local support groups.

I'd avoid the local paper, especially the little ads that read: "Psychic Reader Tells All. Special Introductory Prices."

Also be cautious—if something or someone doesn't feel right to you, then step back a bit. Stay away from anyone who has all the answers (especially one who has the only answers).

Staying Balanced

Most people seem to plug along in the middle, never really comprehending the scientific world (left brain) and never connecting with the psychic or spiritual world (right brain).

The rest of us seem to go either left or right and hang out there. We usually reserve our serious talk for folks who've been properly initiated (who already understand us).

However, I'm finding a surprising number of people who have been very connected with the scientific (my) side but have begun to investigate the spiritual—and I'm finding some spiritual types who are now soaking up the physical side. (I'm talking about C classes and hardware design labs.) The two sides are not mutually exclusive. In fact, if you put them together, you get an interesting balance.

Books

Now for some light (and not so light) reading.

The book that got me started in this search is *The Magic Of Conflict*. I know, it doesn't sound very interesting, but the subtitle snagged me: *Turning A Life Of Work Into A Work Of Art.*

Author Thomas Crum thinks of life as a playground, especially when you're doing what you should be doing. It's really about feeling good about yourself. I found this a most readable and fascinating book. (Keep it at your bench.)

The Magic Of Conflict By Thomas F. Crum
Touchstone Press
252 pages $9.95 paperback
ISBN 0-671-66836-6

Another paperback, *The Tao of Physics*, provides an overview of the connection between Eastern philosophy and Western science. This is an interesting book and a good one to begin

with if you're not ready to feel good about yourself. Unfortunately, I found Fritjof Capra's writing a bit cumbersome. Prepare yourself to work at this one. (He's probably never written an editorial.)

The Tao Of Physics By Fritjof Capra
Bantam
346 pages $4.95 paperback
ISBN 0-553-26379-X

Of course, I have to include three other authors: Carl Sagan, Carlos Castaneda (the adventures of Don Juan), and Richard Bach (*Jonathan Livingston Seagull* is his classic). These authors aren't particularly metaphysical, just interesting thinkers and excellent writers.

And For A Definite Change Of Pace

The books I've mentioned so far have been authored in a very normal way. Someone comes up with an idea, takes keyboard in hand, and writes. In my search, I've also stumbled onto a whole different style of book—untouched by human mind.

These are channeled books, the words dictated by spirits. Whether you're comfortable with the idea or not, these books make interesting reading (of course you can pick your spirit just as you'd pick any other author).

Seth and Lazaris are two of the most famous spirit authors. You can breeze right through Lazaris' books while Seth takes work. But Seth will challenge and stretch your ideas about life, the universe, and everything. I started with the volume called *Seth Speaks*.

Both Seth and Lazaris have become so popular that even the mall bookstores carry them. (And if you're thinking of writing science fiction, Seth would make a wonderful jump start.)

The Lazaris Books
Concept Synergy, Publisher
279 S. Beverly Dr., Suite 604
Beverly Hills, CA 90212

The Seth Books
(Jane Roberts, Channeler)
Bantam Books

And that's "Around The Bend"

David Thompson Editor & Soothsayer

CP/M NOTES

CP/Miscellany

Whither STM

Not too long ago, a friend gave me an old CP/M machine called the Pied Piper, manufactured by a company called STM Electronics Corp. This company was either from Mountain View or Menlo Park (both in California), and appears to have gone out of business.

Another friend suggested I write to see if you can suggest where I may find some information on it. I have all the manuals but am trying to find the ROM BIOS listings and schematics. I'm also looking for information on some of its optional accessories, such as the RS-232 board.

When companies go out of business, is the information passed on to some other organization or is it lost? Is there a user group around for this product?

Thomas B. Lerman
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Fair Oaks, CA 95628

Editor's note: Information on products from dead companies just dissipates into the electronic ether, quite literally. Your best resources will be the closets and garages of other Pied Piper users. Any closet Pied Pipers out there who can help Thomas?

Kaypro II Fix

I use an old Kaypro II-83 as a Z80 and Z8601 development system. I installed double-sided drives and the Pro 8 monitor ROM in 1984; the monitor version was 2.2.

After a longer than average programming effort, the B drive started generating bad-sector errors. Formatting and disk exercising programs confirmed that all tracks beyond number 40 had bad sectors. After opening the case, my eagle-eyed son noted that the B drive was double-stepping when it should have been single-stepping. A call to Micro C got a new monitor ROM on the way and some suggested tests to perform.

At this point, the Kaypro II was apparently fully operational, but it could not read the last 40 tracks on drive B. Normally, on warm boot, both drives were read by the monitor ROM and set to the appropriate drive configuration. Drive B should have been set for DSDD disks on a DSDD drive. However, the ROM assumed it had DSDD disks in a *quad* drive. This was the reason that it double-stepped when formatting. When the machine was forced to look at drive B by asking for its directory, it then recognized the drive as DSDD and the system worked fine.

The initial cause for the problem was thought to be the monitor ROM and it was replaced with a newer version (3.3). However, then the system would not boot at all. The old ROM was reinstalled and a new cause was sought.

U49, an 8-bit buffer (74LS241) that fed low order addressing to the monitor ROM, was checked, found to be good, and replaced anyway. The problem was solved.

Evidently, the LS241 had weakened over time and the monitor ROM was getting the wrong addressing information. The LS241 still appeared to be working, but not well enough to properly address the ROM. The monitor simply bypassed part of its own code and went merrily on its way.

So, if this problem ever comes up again, or if your system ever has problems booting, check U49 carefully. Try swapping it with U62 (another LS241). At $1 each (or less), you might want to replace both.

John Konopacki
Analytical Detectors Co.
P.O. Box 1024
Stafford, TX 77477

More CP/M Suppliers

After running Samuel Vincent's list of CP/M vendors in Issues #45 and #46, we received several tips on other companies catering to CP/Mers:

Derby, W. S.
P.O. Box 2041
Livermore, CA 94550
General utilities
SASE for information

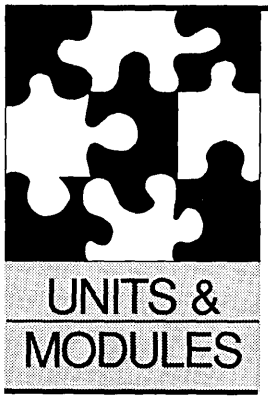
Elliam Associates
P.O. Box 2664
Atascadero, CA 93423
(805) 466-8440
All manner of public domain and commercial software.
Most CP/M disk formats supported
Catalog — $1

Quinsept, Inc.
P.O. Box 216
Lexington, MA 02173
(800) 637-ROOT or (617) 641-2930
Genealogy software
Also for MS-DOS, Apple, Commodore Mac, and TRSDOS.
Information available

Plu*Perfect Systems
Current Address :
410 23rd St.
Santa Monica, CA 90402
(213) 393-6105
ZCPR, system tools

Micro C Staff

♦ ♦ ♦



Compression Routines

Putting The Squeeze On Data

By Michael S. Hunt
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Data compression doesn't have to be dull. In fact, it might be just the thing for your next party. "Step this way Mom, step this way Dad, and I'll show you how to get rid of repeating characters." (Who knows, they might get the hint.)

This month I'm talking about data compression. Before I get started, I should state that I have seen neither SEA's nor PKWare's source code. The source code listed here is entirely of my own design. I am solely responsible for its content, which is not copyrighted in any way.

I release the following programs to the public domain. You are encouraged to use them, change them, and include them in programs you sell for profit (or loss).

Editor's note: I'm sure you can also use them for party favors.

Data Compression

One of the simplest forms of data compression is to replace spaces with tabs. Another form of compression, run-length encoding (RLE), replaces any repeating character with three bytes: a flag, the character, and a count. Since the compressed sequence requires three bytes, there is no need to compress any sequence less than four bytes.

The compression flag must be a byte value that does not occur in the data you're compressing. For most text, a byte value of 255 works well. Some COM and EXE files, however, contain 255, and I found that 236 works for these.

To check this, I wrote a small utility to count the number of occurrences of each byte value. It's included with the Modula-2 version on the Micro C Issue #48 disk.

Variable Typecasting

The unit contains compression and decompression routines for both files and memory buffers. (See Figure 1.) To avoid repeating myself (let me say that again), I will refer to both the file and memory buffers as buffers. A generic routine to compress or decompress any kind of variable structure can present data type problems. Turbo Pascal 5.0, and perhaps 4.0, provide for variable typecasting. This technique allows us to view and operate on a data type as if it were some other type.

Because of the variable typecasting, there is no way to determine the size of the buffers dynamically. The untyped parameters src and dest must be passed by reference, so they are pointers to the buffers. Since the type of buffers is unknown, the function SizeOf() cannot be used. The variable typecasting allows a type to be declared that defines how we will view the typecast variable. (Ouch, that one tied my tongue!)

The RleDComp unit declares the type bytes. It is an array of 65535 bytes. This is the largest buffer that the compression routines can handle. The input buffer now appears to be an array [1..srcSize] of byte. You assume the output buffer to be an array [1..srcSize+1] of byte.

In Modula-2, this can be avoided by declaring the buffers as array of byte in the parameter list and using the HIGH function to determine the size of the array passed.

Encoding

The compression flag is passed to the compression routine. Since the flag character can change depending on the type of file, I also make it the first character in the output buffer.

The srcSize parameter specifies the size of the input buffer or the amount of data in the buffer. I assume the output buffer will be large enough to hold the compressed data. Because of the addition of the compression flag to the beginning of the output buffer, the worst case size for the output buffer is srcSize + 1.

DestSize returns the size of the output data in the dest buffer so you can use that value as the scrSize in the decompression. You could alternately store the destSize as the second byte in the output buffer.

The encoding sequence first outputs the compression code. We then consider three criteria to determine if the repeat counter can be bumped. First, we must make sure we are not at the end of the buffer. Second, the current byte must equal the current byte plus 1; and

third, the repeat counter must not be at its maximum.

Short-Circuit Your Boolean

If you look closely at the if statement in RleCompBuff, you may notice a potentially illegal array reference. If sPos was set to the last element in the array, the bytes(src)[sPos+1] reference would generate an out-of-range error. You can instruct the Turbo Pascal compiler, and others, to generate code that will stop evaluation or short-circuit the expression once the outcome is known.

The file-based routines can handle the largest files that Turbo Pascal can accommodate.

Since the if statement ANDs three expressions, only one has to fail to render the entire expression false. The (sPos < srcSize) subexpression will always evaluate false when there is a danger of out-of-range error. Because I relied on the short-circuit, this code must be compiled with the Turbo compiler flag {$B-} (default).

If any of the above three conditions fail, we are ready to output data. If the repeat count is greater than three, we output the compression flag, followed by the repetitive byte and the repeat counter. If the repeat count is less than or equal to three, no compression is necessary and we output the raw bytes.

Two variables, sPos and dPos, contain the current position in the src and dest buffers. When sPos equals srcSize, the encoding terminates. dPos maintains the count returned in destSize.

Decoding

The decoding sequence is very simple. The first byte of the input buffer contains the compression flag. After the compression flag is identified, a byte is read from the input buffer.

If it is not the compression flag, it is written to the output buffer. If it is the compression flag then another byte, the repeated byte gets read, and the program grabs the count. It executes a loop that writes out count number of the re-

Figure 1 — Data Compression and Decompression Routines

```
unit RleDComp;

(*
   Author: Michael S. Hunt        Date: April 3, 1989
   this source code is released into the public domain
*)

interface

procedure RleCompBuff (var src, dest;
                       repeatCode : byte;
                       srcSize : word;
                       var destSize : word);

procedure RleDecompBuff (var src, dest;
                         srcSize : word);

procedure RleCompFile (var sFil, dFil : file ; repeatCode : byte);

procedure RleDecompFile (var sFil, dFil: file);

implementation

type  bytes = array [1..65535] of byte;

procedure RleCompBuff (var src, dest;
                       repeatCode : byte;
                       srcSize : word;
                       var destSize : word);
var   sPos, dPos : word;
      k, repeatCount : byte;
begin
  repeatCount := 1;
  sPos := 0;
  dPos := 2;
  bytes(dest)[1] := repeatCode;
  repeat
    sPos := sPos + 1;
    if (sPos < srcSize) AND (bytes(src)[sPos] = bytes(src)[sPos+1])
                        AND (repeatCount < 255) then
      repeatCount := repeatCount + 1
    else
      if repeatCount > 3 then
        begin
          bytes(dest)[dPos] := repeatCode;
          bytes(dest)[dPos+1] := bytes(src)[sPos];
          bytes(dest)[dPos+2] := repeatCount;
          dPos := dPos + 3;
          repeatCount := 1
        end
      else
        begin
          for k := 1 to repeatCount do
            bytes(dest)[dPos+k-1] := bytes(src)[sPos];
          dPos := dPos + repeatCount;
          repeatCount := 1
        end;
  until sPos = srcSize;
  destSize := dPos - 1
end; (* RleCompBuff *)

procedure RleDecompBuff (var src, dest;
                         srcSize : word);
var   dPos, sPos : word;
      j : byte;
begin
  sPos := 2;
  dPos :=1;
  while sPos <= srcSize do
    begin
      if bytes(src)[sPos] = bytes(src)[1] then
        begin
          for j := 1 to bytes(src)[sPos+2] do
            bytes(dest)[dPos+j-1] := bytes(src)[sPos+1];
          dPos := dPos + bytes(src)[sPos+2];
          sPos := sPos + 3
        end
      else
```

```
        begin
          bytes(dest)[dPos] := bytes(src)[sPos];
          dPos := dPos + 1;
          sPos := sPos + 1
        end
    end
end; (* RleDecompBuff *)

procedure RleCompFile (var sFil, dFil : file; repeatCode : byte);
var   bytesRead : word;
      k, repeatCount, curByte, repeatByte, nextByte : byte;
begin
  repeatCount := 1;
  BlockRead (sFil, curByte, 1, bytesRead);
  if bytesRead > 0 then
    BlockWrite (dFil, repeatCode, 1);
    repeat
      BlockRead (sFil, nextByte, 1, bytesRead);
      if (curByte = nextByte) AND (repeatCount < 255)
                              AND (bytesRead = 1) then
        repeatCount := repeatCount + 1
      else
        if repeatCount > 3 then
          begin
            BlockWrite(dFil, repeatCode, 1);
            BlockWrite(dFil, curByte, 1);
            BlockWrite(dFil, repeatCount, 1);
            repeatCount := 1
          end
        else
          begin
            for k := 1 to repeatCount do
              BlockWrite(dFil, curByte, 1);
            repeatCount := 1
          end;
      curByte := nextByte
    until bytesRead = 0
end; (* RleCompFile *)

procedure RleDecompFile (var sFil, dFil: file);
var   bytesRead : word;
      repeatByte, repeatcode, repeatCount, curByte, i : byte;
begin
  BlockRead (sFil, repeatCode, 1, bytesRead);
  if bytesRead > 0 then
    begin
      BlockRead (sFil, curByte, 1, bytesRead);
      while bytesread > 0 do
        begin
          if curByte = repeatCode then
            begin
              BlockRead (sFil, repeatByte, 1, bytesRead);
              BlockRead (sFil, repeatCount, 1, bytesRead);
              for i := 1 to repeatCount do
                BlockWrite(dFil, repeatByte, 1)
            end
          else
            BlockWrite(dFil, curByte, 1);
          BlockRead (sFil, curByte, 1, bytesRead);
        end
    end
end; (* RleDecompFile *)

begin
end.
```

♦ ♦ ♦

petitive byte to the output buffer. The cycle repeats until the program has processed the entire input file.

File Vs. Buffer

The file-based routines can handle the largest files that Turbo Pascal can accommodate. The buffer-based routines are limited to 65535 bytes. If you wanted to compress a VGA screen, you would have to compress one-fourth of it at a time. Depending on the bit plane mapping, video memory can be a prime candidate for RLE because typical screens contain large identical areas. You must remember to reset or rewrite the files used by the file compression routines with a record size of 1.

Example:

```
reset(srcFile, 1);
rewrite(destFile, 1);
RleCompFile(srcFile,destFile,255);
```

The file routines are slow because they aren't buffered. The buffer routines can be called repetitively to compress file fragments that are reassembled on disk. An example of this will be on the Issue #48 disk.

Next Time

I recently started working for Micron Technology, Inc. One of my new toys at work is a Digital VAX cluster running the VMS operating system. In the next few issues, I will explore some of the system routines available to the VMS programmer.

The first one is a sorting routine that maintains multiple sorts in memory. You can define the number and type of keys for each sort. After all the data has been passed for a particular sort, it retrieves the data one record at a time in sorted order. Next time, I will present my PC-based sort routines that model this concept. Good logic to you.

References

Held, Gilbert, *Data Compression*
(New York:John Wiley & Sons,1987)
ISBN 0 471 91280 8

♦ ♦ ♦

The Really Early Days Of Computing

Or, How I Delayed VisiCalc

This is the beginning of the "Bits From Your Past." In future issues we'll be running excerpts from many of the letters we received from all you wonderful folks. But to kick it off, here's a "bit" I just couldn't take apart. Jack even describes my experiences with the early calculators—right down to the rat-a-tat-tat.

For some of you young folks, this may seem hard to believe, but it's true:

We haven't *always* had PCs! There was a time when we had no computers at all to play with. Computing had to be done by *hand*!

Days Of Logarithms

We had three tools in high school: a table of logarithms, a set of trig tables, and a pencil. Adding and subtracting we did by hand, the old-fashioned way. For multiplication and division, it was easier to add and subtract the logarithms, then take the antilog.

I spent a good portion of my high school algebra class learning how to read and interpolate a table of logarithms. The trig books had tables of the trig functions, giving both their value and its logarithm. We used the latter most, because trig functions tend to multiply things. The tables were typically given to the nearest tenth of a degree, enough for anybody.

Solving a relatively simple trig problem was not a simple matter ... it took lots of time and patience, and it was easy to make errors. Calculating the points in a single 3-D drawing would have been overwhelming.

We had another approach to problems like that: graphics. A drafting class was required for any technical career. In that class we learned how to handle T-squares and triangles, and how to keep our pencils needle-sharp without breaking them (you use sandpaper).

The Slide Rule

A lot of that changed when I went to college. I'll never forget that first day in the college bookstore, where I was outfitted for a career in engineering. I watched, bug-eyed, as the clerk stacked up my standard-issue equipment: a set of drafting instruments, a drafting board, T-square, triangles and french curves, and—that most wonderful of all calculating instruments—the *slide rule.*

For me, the slide rule was magic. No more log tables, no more trig tables. The K & E slide rule had all that inscribed in 10" of porcelained bamboo. To multiply, divide, take square roots (or any other root or power, for that matter), you had only to manipulate the slider and hairline "cursor" on that magic instrument. The trig functions were there, too.

My first technical class in college covered slide rules—those silent calculators that never left our sides, housed as they were in scabbards hanging from our belts.

Unfortunately, the slide rule could not add or subtract. For that we still had to do things by hand, although in graduate school I got a neat little pocket adding machine that helped immensely.

As a sidelight, I entered a sports car rally as a navigator (the "sports car" was a custom '41 Chevy). We won, thanks to the invincible computing power of my slide rule and adding machine.

As the years progressed, so did my proficiency with the slide rule. My grades depended on it, and I studied it earnestly. Before a quiz, I would carefully adjust it, like a soldier cleans his rifle before a battle.

Those three strips of bamboo had to be spaced just right to slide freely but still stay where I put them. I actually lubricated them with talcum powder for maximum speed without overheating(!). I could always tell the guys who were serious about their grades—they had talcum powder stains on their shirts.

Hi-Res Graphics

Our skills in graphics were sharpened, too. In those days, the worth of an engineer depended just as much on his ability to draw a straight line or to plot a graph as on his "book-larnin."

We solved many problems in those days with graphs and nomograms that we now do by computer. One of my favorite courses was Descriptive Geometry. There we learned to do all kinds of magical things with a pencil and T-square. We solved real-life geometry problems like estimating the volumes of highway cuts and fills, or the distance by which a power cable would miss a hillside.

One day, our prof gave us the four sets of coordinates defining two skewed straight lines. The problem was to find the miss distance between them. We did this by generating projections of the lines onto different planes until one of them appeared end-on, as a point.

While I was working diligently on the problem, Francis, who was smarter and faster than the rest of us, announced that the distance was zero; the lines intersected.

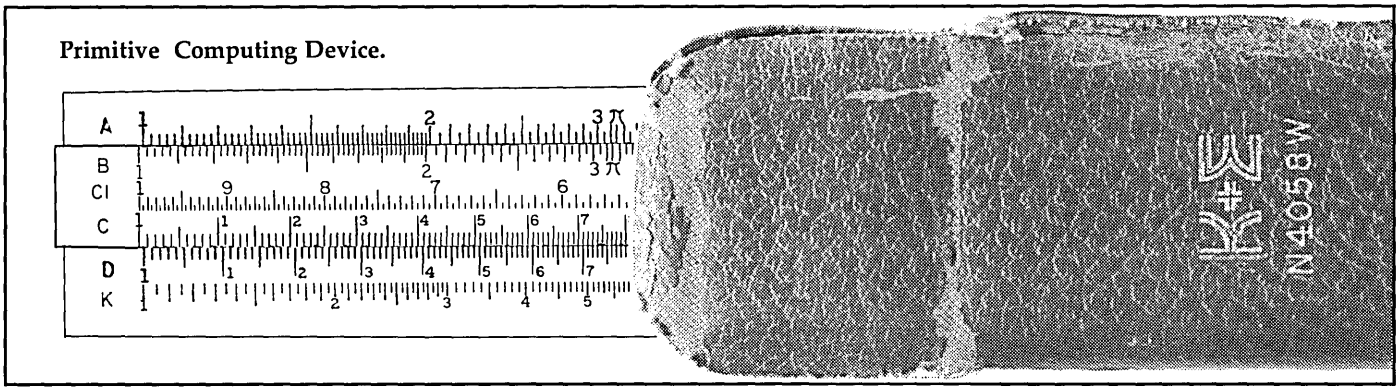
"That's impossible," said the prof. "I picked those points at random. Do you realize what the odds are that I would pick a pair of lines that intersect, at random? The distance may be small, but it can't be zero. Go back and do it again."

Now Francis was smart, but he wasn't a politician. He said, "I don't care what the odds are. I did it right the first time, and the lines *intersect*!"

As the conversation got more and more heated, it was clear that Francis was in deep trouble. He was winning the argument but losing the war, and the prof's face was getting redder and redder.

As the two elevated the argument to a shouting match, they were too engrossed to notice that, all over the classroom, the rest of us were carefully erasing the lines

By Jack W. Crenshaw, Ph.D.
1220 E. Idlewild Ave.
Tampa, FL 33604



Primitive Computing Device.

that we, too, had by this time found to intersect. One of the nice features of solving things graphically was that you could always move the lines a bit when it seemed prudent.

Into The Space Age!

After college, I went to work for NASA. I was going to help put men on the moon (which I did). My first day, I received the two tools of my trade: an 18", government-issue slide rule, and a book of 5-place trig tables.

See, NASA figured that the three-digit accuracy of the standard 10" slide rule just wouldn't cut it for space travel. Generally, to get one more digit of accuracy, you increased length 10 times. It just happened that the 10" rule could *almost* get four digits (it could, over part of its range). Increasing the length to 18" was just enough to get that precious extra digit.

Even more exciting, NASA had real desktop *calculators*! There were several such machines around. Ours were the Fridens. About the size of an AT, they weighed much more. They worked much like the adding machines used for businesses, only these would multiply and divide, as well.

The keyboard had twelve columns of ten keys each, and a carriage like a typewriter. On the carriage spun numbered wheels. You typed a number in by punching (that's the right word—no electronics or power-assist here) one key in each column, and then punching the "go" key.

To the accompaniment of considerable noise, the carriage slewed, the wheels spun, and in a matter of Decaseconds, your answer appeared. Division was quite a sight to behold. On those few machines that could do square roots, the noise level rose alarmingly as more and more wheels got into the act.

Most of us didn't have access to the square root machines, and a measure of your proficiency was how quickly you could find a square root on a non-square-root Friden. There was a neat algorithm for it that I've never forgotten (no, it's not Newton's method). I also learned the famous "Friden March," a calculation that caused the carriage to chunk along in a neat, "rah, rah, rah-rah-rah" rhythm.

The big advantage of the Friden, other than its tendency to get the right answer, was that it was accurate to as many as *twelve* digits, unheard of until then. But most of our calculations were done to only five digits or so, because that's as many as we had in the trig tables. Later I managed to get a book of six-place tables. It was a *big* book.

When you think about the space race and the high-tech things that go on there, it helps to remember that, at least through projects Mercury and Gemini, it was mostly done with Fridens.

Graphs

As in college, a lot of our output in those days were graphs. Again a large part of our skill was our ability to plot microscopic dots at the right places on a piece of log-log paper, and then draw a smooth curve through them.

> My first technical class in college covered slide rules—those silent calculators that never left our sides, housed as they were in scabbards hanging from our belts.

Back in college, we plotted graphs with from three to seven points, but NASA needed much more accuracy. A lot of our time went into calculating the data for plotting the many points. That's where I learned about spreadsheets.

These were the *original* spreadsheets, of course—real sheets of 14" x 17" paper, ruled into rows and columns. We organized the "input" data into one or more columns, then we worked down the list, calculating each new column as we went.

For simple problems with not too many entries, we used the good ol' 18" slide rule. For more complex problems, we used the Friden.

For long problems, we would turn the thing over to Donna, our secretary. Donna supported some seven engineers, and had the patience of Job. She would sit there all day, day after day, crunching out those numbers, which we would then plot up and analyze. Donna prided herself on using 12-digit accuracy for everything, even if the input data was only good to three digits. If there were any errors, they certainly weren't going to come from her.

One day I got a *really* big problem—too big for Donna. I asked one of the old hands, "What do you do with problems that are too big for Donna?" He said, very matter of factly, "Oh, you take them to the Computer Room."

You should have seen my eyes light up. I'd read all about the "Giant Brains"—had even learned to program one in college, though I never saw it (the school didn't actually have one).

I couldn't wait to see how the folks in the Computer Room dealt with my problem. Eagerly I got directions from my colleague, prepared my data, and rushed over to the building he described. Following his directions, I walked down the hall until I arrived at a set of double doors with a large sign proclaiming, sure enough, "Computer Room." Holding my breath, I eased open the door.

It was a *huge* room. There must have been 300 desks, all arranged neatly in rows. At each desk sat a woman, and on each desk was a Friden. The *women* were the computer! I kid you not. I found out later that their official job description was "GS-2, Computer."

Once I had gotten over the shock, I approached the "head computer." She explained to me how things worked. First, you filled out the spreadsheet with all the input data. Then at the top of each remaining column, you wrote some operation, such as:

```
(3) = (1) * (2)
```

where each number referred to a column number. In effect, you wrote a program. It was no different from defining the formula for Lotus or Excel. After defining all the calculations, you turned things over to the computers, who filled in the numbers.

The foreperson assigned different parts of the job to different women, depending on the load. For a *big* job, she would keep several parts running in parallel. Most likely the first multitasking, multiprocessing computer system.

It all went quite smoothly. The computers rarely made mistakes. They also had independent verification, so any mistakes were always caught. They would even plot the results up for me, although I rarely used that service since I found that I could plot more accurately.

Progress Is Wonderful

Well, things didn't stay that way for long. We eventually did get real computers—the 701, followed by the 704, 709, 7094, etc. By this time I had a different job, had learned how to program in FORTRAN and other peculiar languages, and was building a bit of a reputation as a computer expert. I had written some slick simulation programs and we were flying imaginary spacecraft all around a simulated moon.

The number of computations we performed in a day would have taken those lady computers their whole lifetimes, multiprocessing or not. It was an exciting time. I still had my slide rule (the 10" one—NASA took back the 18" one and the 6-place tables). I even had a 6" rule for my shirt pocket, and a 1-1/2" one as a tie clasp (strictly for emergencies). But the slide rule got used less and less as better ways came along.

A Real Spreadsheet

One day a colleague, whom I'll call John, came to see me. He said, "Jack, I've come up with a neat computer program that I'd like you to take a look at."

"Okay, John," said I. "What does it do?"

"Remember the good old days when we had to do computing by hand? Remember the way we used to make up those spreadsheets, and turn them over to the computer ladies?" he asked.

"Well, I've developed a computer program that works the same way. All you have to do is to define the formulas for each column of the spreadsheet and give the data. The computer does the calculations just like the lady computers used to, and gives you a printout that looks just like a spreadsheet. I think it'll be just the ticket for those people who don't know how to program in FORTRAN. It will open up the use of computers to lots more people."

I thought about it for thirty seconds, and said, "John, that's the dumbest idea I've ever heard."

There was a moment of silence as John absorbed what I had just said. The sparkle in his eyes dimmed a bit. Finally, he whispered, "Why?"

Now, in my defense you have to understand: in those days we were taught that computer time was precious—$600 per hour, in a time when $600 would buy more than a ticket to a rock concert. It was important, we were told, to keep the CPU busy in productive work at all times. It was better to spend engineer's time than computer time.

So I explained, "John, now that we have electronic computers, we have to learn to do things their way. Anybody who plans to be an engineer in the 60s is going to have to learn to speak to computers in their language.

"You and I have learned to program so we can do that. What you're trying to do is to let the computer make up for the deficiencies of the engineer. You're forcing the computer to do extra work, just because the engineer is too lazy or too dumb to learn the computer's language. You're never going to sell an idea that uses a computer so inefficiently!"

As I spoke, I could see John slowly fall apart. His jaw fell slack, his shoulders slumped, and he seemed to age by years, right before my eyes. That sparkle of excitement in his eyes dimmed and went out. Finally he turned and left, a beaten and broken man.

I never saw John again. He sent me an example of the output of his program. (I recall that it could do automatic graphing of its results, which was quite an innovation at the time.) I promptly filed it under "dumb ideas." I heard through the grapevine that he kept trying for a while, halfheartedly, to interest someone in it. As I had predicted, he was never able to do so, and he faded into obscurity, along with his program.

And that's why we had to wait 15 more years for VisiCalc, Lotus 1-2-3, and Excel.

♦ ♦ ♦

'89 ▪ micro ▪ REGIONAL ▪ SOG's

BCSOG

July 7 & 8 — Port Alberni, Canada

If SOG's your attempt to get away from it all, then the BC SOG is your spot. Vancouver Island's Port Alberni is about as far from anywhere as you're going to get by car, plane, or boat. (195 highway miles northwest of Victoria, British Columbia.)

This lumbering and fishing community of 18,500 lies at the end of a fjord-like saltwater inlet. Famous for its salmon fishing, its sheltered islands and inlets, this is a popular area for kayaking, canoe camping, boating.

Port Alberni has an excellent sport sockeye salmon season. You have an opportunity to book a spot—results are not guaranteed, but you can pretty well bet on getting a fish.

For family excursions the M.V. Lady Rose, a Scottish Coaster, steams down Alberni Inlet and into Barkley Sound to Bamfield or through the Broken Groups Islands to Ucluelet and returns in late afternoon. A tour can be set up for 11 or more at $39 each.

Other activities in the area are scuba diving, hiking, museums, the new Harbour Quay, and much, much, more!

The community sports twelve motels, six bed and breakfasts, and lots of campsites and trailer spaces. With the registration kits the BC organizers will tell you more about accomodations.

Talks are scheduled on Friday and Saturday at North Island College. The facility will open Thursday evening, the 6th, for early arrivals. They'll also have a space for the traditional all-night technical forums-the Jolt SIG.

Special events include a planned mini-maze competition put on by the Seattle Robotics Society and a fresh salmon BBQ scheduled for Friday evening. There is a 50 person maximum limit on barbeque, if you are planning to attend get your reservations now.

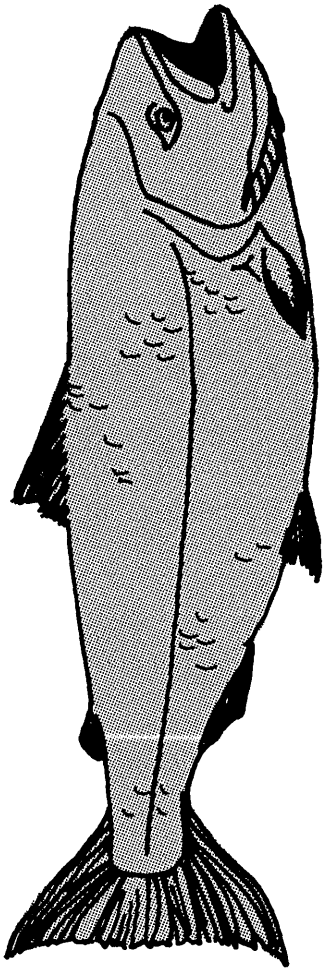
Sponsors David Stern & Randy Young ask that you pre-register by June 15.

If you're a vendor, swapper, or hacker, bring your wares, the meeting and display area will be open from Thursday-Saturday evenings. Eight foot tables are only $10.00 each.

Prices:

Registration:..... $10 (per family)
BC SOG T-shirt:..... $10 (specify size)
Salmon Barbeque: $10
.....($5.00 12 and under)
(All prices in Canadian dollars.)

Contact:
David Stern
4403 8th Ave.
Port Alberni, BC Canada
V9Y 4S6
(604) 723-5917 or (604)724-2019
(Randy Young)



'89 ▪ micro ▪ REGIONAL ▪ SOG's

ROCKY MOUNTAIN SOG

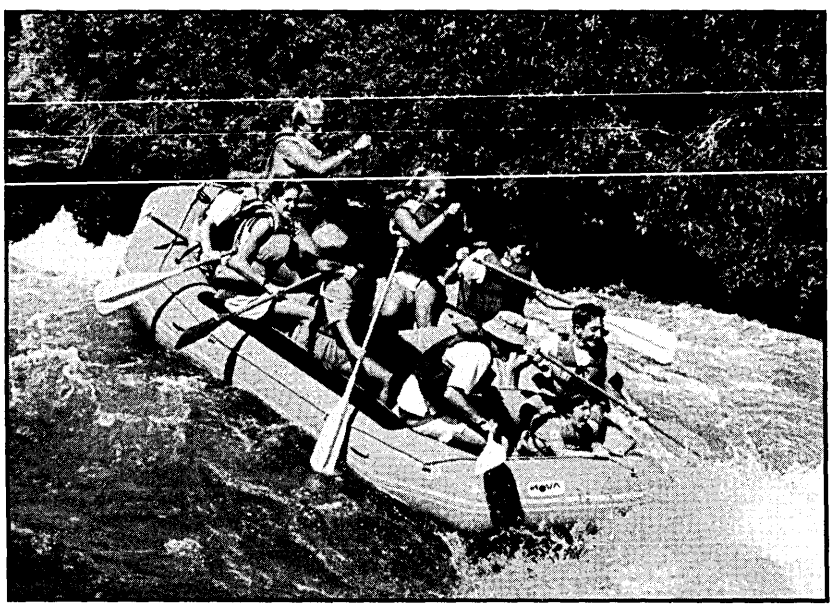
July 27-29, 1989 — *Gunnison, Colorado*

Rocky Mountain SOG kicks off on Thursday the 27th with a traditional SOGgy favorite: white-water rafting. Friday and Saturday will be filled with workshops and presentations, followed by a banquet Saturday night. (Scott's arranged an all-night room for the Jolt SIG.)

Gunnison, population 6,500, lies nestled in the Rockies along the Gunnison River. Raft trips in Gunnison offer both a full and a half-day excursion, with plenty of excitement.

Besides white-water rafting, you'll find horseback riding, hiking and great fishing are recreational opportunities to explore. Gunnison County has some of the most beautiful wilderness in the country.

Rocky Mountain SOG will be held during the same weekend as nearby Crested Butte's Aerial Weekend, which features parachuting, hang-gliding, and hot-air balloon rides and races. This will be a family vacation as well as an educational experience.



When you register, they'll send you a packet. In that packet you'll find information on activities ranging from tours of the Black Canyon to ghost town excursions. You'll also receive hotel and airport information. Both Continental and United Airlines service Gunnison's airport.

The Keynote speaker for the Saturday Night Banquet will be Walter Bright, author of Zortech's C++.

Prices:

Conference registration:
$25 in advance,..... $30 at the door
RM SOG Tee-Shirt .....$10 (specify size)
1/2 day raft trip..... $35
Full-day raft trip..... $50
Saturday night Banquet..... $15
Thursday night Barbeque $10
Cafeteria Lunches (Fri/Sat) $10 ($5 each)

Registration Info:

Please register as soon as possible. If you preregister, please do so before July 1. Make checks payable to "Rocky Mountain SOG." Include names, addresses, and phone numbers of everyone you're paying for, and list what each is ordering.

Contact:

Rocky Mountain SOG
302 N. 12th Street
Gunnison, CO 81230
(303) 641-6438

'89 ▪ micro ▪ REGIONAL-SOG's

SOG EAST

September 7&8

York, Pennsylvania

Nestled in York, Pennsylvania, this SOG will bring the best of the West to the East.

In York you'll find antiques, Penn-Dutch cooking, crafts, and more. Historic Gettysburg is only 30 minutes away.

York is 25 minutes from the Harrisburg airport, and about 60 miles from Baltimore/Washington International.

Tentative Schedule:

Wednesday Night (4pm-9pm) Twilighter Railroad Excursion. Steam train ride and dinner trip, $25. A special trip just for SOG attendees and families.

Thursday- Meetings, Speakers.

Thursday Supper- Volleyball, frisbee, BBQ (Penn-Dutch style) outdoors, $15 per person.

Thursday Evening- Rooms available all night for talking, JoltSIG,etc.

Friday- Speakers.

Friday- The York County Fair begins-largest livestock and agricultural show on the East coast. Lots of food, free show entertainment.

Saturday Morning- Another train ride-Saturday's trip is open to the general public so you'll need to make reservations early.

There'll be space to display your treasures to because to bring along anything you'd like to sell.

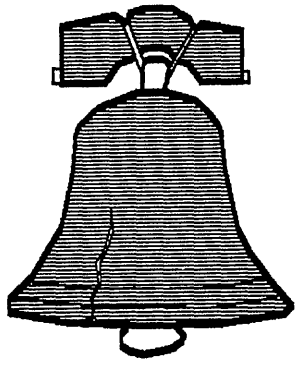
They'd like verbal reservations as soon as possible so they can reserve the train, rooms, etc. Please get your money in by August 1. Also, speakers and exhibitors (tables, $35), please call right away. Free admission for speakers (call early so they can schedule you.)

Registrants will receive lodging and transportation information by return mail. Make checks payable to The CDS Group.

Prices:

SOGEast registration **$25**
SOGEast T-shirt ..... **$10 (specify size)**
Wednesday Train & Dinner **$25**
Thursday BBQ Picnic **$15**

Contact:
John Ribar
The CDS Group
3161 Honey Run Dr.
York, PA 17404
(717) 792-5108 (8-12pm Eastern)
(717) 854-3861 (Weekdays, 8-9am Eastern)
You can also talk to Carol Park at this number: Compuserve 73577,1652.



LONGHORN SOG

October 13, 14, 15 1989

Dallas, Texas (Info Mart)

The Dallas computer club has over 4,000 members in some 15 user groups. Dallas weather should be marvelous this time of year. So plan to come and enjoy the southern sun and hospitality. If you'd like to speak, you should contact Stuart immediately.

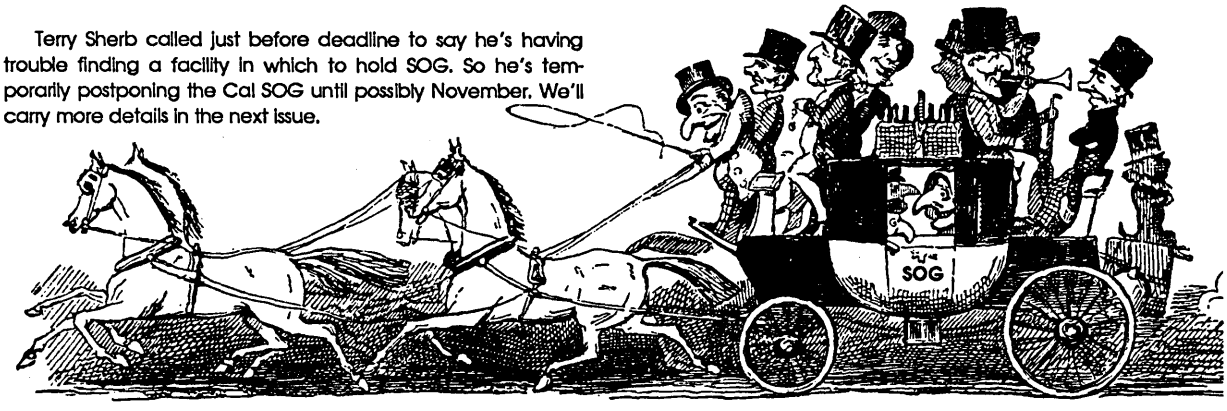
Contact:
Stuart Yarus
The Computer Council of Dallas 1950
Stemmons Fwy., Box 277
Dallas, TX 75207
(214 867-8012 (evenings)

CAL SOG

See You All Soon!

November???

Terry Sherb called just before deadline to say he's having trouble finding a facility in which to hold SOG. So he's temporarily postponing the Cal SOG until possibly November. We'll carry more details in the next issue.



Faith In Numbers:

Chaos In Chaos

By Gary Entsminger
1912 Haussler Dr.
Davis, CA 95616

This issue, Gary may appear to be a bit chaotic; but that's because this is only an approximation of a column. Fortunately he rounds it off with references.

Chaos theory attempts to show the problems that can occur in the modeling of dynamic systems which include a nonlinear factor. The simplest of these, the logistic equation—

```
(1) Nextx = RX(1-X)
```

has been studied extensively, and is known to exhibit unpredictable behavior when iterated (or "fed back" into a feedback loop). In a feedback loop, the value of X in one generation determines the value of X in the next. For more information about feedback loops, see "The Last Page, Strange Attractors, Order In Chaos," *Micro C* #47.

The take-home message of the theory is: these models behave unpredictably because they're extremely sensitive to initial conditions. Nearby values of X in one state (or generation) may lead to values (of Nextx) which are far apart in the next state.

For example, in the logistic equation, a slight change in value of X far from the decimal point, say—

```
0.999999999949
```

versus the rounded off value of

```
0.99999999995
```

would be enough to produce far apart (i.e., unpredictable) Nextx values in succeeding generations (or states).

It doesn't matter where you round the decimal; eventually, the round off error will work its way left. In general, the farther from the decimal point you round, the longer it takes for the error to show up.

I created two sets of numbers by iterating equation (1) using Turbo C floats (11 or 12 significant digits). (See Figure 1.) The first set rounds X =.999999999949 up to .99999999995. The second does not.

By comparing the two sets, you can see the error accumulate. By the 20th iteration, the values are very far apart, and by the 25th iteration, they will be at opposite ends of the range. Similar behavior occurs regardless of where we round. A Turbo C double precision real, for example, exhibits virtually identical behavior by the 30th iteration or so. (More on the 0 to 1 range and compiler precision later.)

To see this "chaotic" behavior, play with the *Strange Attractor* program I wrote for last issue (it's on Micro C issue disk #47).

In short, chaos theory looks at mathematical models (or representations) of physical systems and determines that these representations are unpredictable.

Let me emphasize "representations" and explain why.

Representations & Models

When we model a dynamic system, we use an equation, or equations, to describe how the system changes from state to state. In the logistic equation, for example, we say that the Nextx (or the next state of X) is determined (or described) by the current X, times a rate of change constant (R), times some other factor (1-X, in this case).

Many different kinds of scientists and engineers use nonlinear equations like this one to model dynamic systems.

Consider a simple biological system where we want to describe how a population (the number of wolves, for example) changes from season to season. Equations like (1) above "model" these changes. X represents some value between 0 and 1 (where 1 represents the largest possible number of wolves), and Nextx represents number of wolves in the next generation.

What exactly is the largest possible number of wolves? Well, if we were counting wolves, it would be the most we could count (a finite number).

So a Nextx = 0.5 says, in effect, we have half the possible number of wolves. And 0.55, says we have slightly more than half the possible number of wolves. And 0.555 says we

Figure 1 — Round-off Error Accumulation

```
x(0.99999999995)                    x(0.999999999949)
x(4.0000447398E-11)                 x(2.0000445744E-11)
x(0.00000000016000178959)           x(8.0001782974E-11)
x(0.00000000064000715825)           x(0.00000000032000713187)
x(0.000000025600286313)             x(0.000000012800285271)
x(0.000000010240114499)             x(0.000000051201141017)
x(0.000000040960457577)             x(0.000000020480456302)
x(0.0000001638418236)               x(0.000000081921823531)
x(0.00000065536718702)              x(0.00000032768726728)
x(0.00000262146703)                 x(0.0000013107486396)
x(0.000010485840632)                x(0.0000052429876861)
x(0.000041942922716)                x(0.000020971840789)
x(0.00016776465403)                 x(0.000083885603883)
x(0.0006709460362)                  x(0.00033551426835)
x(0.0026819834704)                  x(0.0013416067941)
x(0.01069916174)                    x(0.0053592275413)
x(0.042338758714)                   x(0.021322024886)
x(0.1621847529)                     x(0.083469584563)
x(0.5435234353)                     x(0.30600965206)
x(0.99242284232)                    x(0.84947097963)
x(0.030078977454)                   x(0.51148013759)
```

♦ ♦ ♦

have slightly more than.... Specifically, we're not counting wolves, we're representing wolves with an "infinite" number of real numbers, *not integers*, and there's the rub.

Real Problems

A real number (like a columnist) can be rational or not. A rational number is a number which meets either of the following requirements:

- is reducible to an integer;
- expressible as a terminating decimal fraction;
- expressible by a non-terminating fraction of which one or more figures repeat themselves periodically, without end.

Any integer, fractions (like 53/8), or decimals like 3.923076923076... qualify as rational numbers.

The number pi (3.1416...) and the square root of 2 (1.144213...), for examples, do not.

Now consider how a computer *represents* real numbers. In normalized scientific notation, a real number is represented by a sign (+ or -) and a fraction multiplied by 10^N—

```
Realx = +- F * 10^N
```

In binary (or computer terms) this becomes—

```
Realx = +- F * 2^N
```

Using 48 bits we might represent a real as—

```
sign of real number     1 bit
normalized mantissa    32 bits
sign of exponent        1 bit
exponent               14 bits
total                  48 bits
```

(This is how Turbo Pascal does it.)

The representation varies among systems, depending on memory and other computer resources. But in every system, every real number has a known range of significance.

In Turbo Pascal, real numbers use 6 bytes (48 bits) of memory and range from 2.9×10^{-39} to 1.7×10^{38} with 11 or 12 significant digits—equivalent to a Turbo C float.

If you're using a math coprocessor, you can improve—from 3.4×10^{-4932} to 1.1×10^{4932} with 19 or 20 significant digits—equivalent to a Turbo C long double.

In Turbo Prolog, reals range from 1.7×10^{-308} to 1.7×10^{308}, with 15 or 16 significant digits— equivalent to a Turbo C double.

An HP 11c scientific calculator gives about 5 significant digits.

What does all this talk about significance mean? Well, for starters, each of these compilers (and the calculator) will quickly produce *very different values* for Nextx when used to iterate equations like (1).

Chaos In Chaos

Consider what happens when a computer (or calculator) encounters an irrational number or a rational number that has more digits than it can represent accurately.

It rounds off the number. What else can it do? One irrational number heading off toward infinity would distract a computer for an infinite length of time.

Editor's note: However, with a math coprocessor, an infinite length of time doesn't take nearly as long.

In many calculations, of course, rounding is no big deal. Engineers and statisticians thrive on limits and approximations. But in chaos theory, rounding is in fact *a very big deal*, since the theory's principal claim is that values (numbers) very close together in one state can lead to results very far apart in future states.

If we use the logistic equation and

examine each Nextx calculation carefully, we find that usually within the first three or four calculations, the computer rounds X off, and feeds the *rounded* X back into the equation.

The rounded X (Nextx) is again rounded within three or four iterations (at most). Each successive round off goes back into the equation. Eventually, through round off error alone, two very close X values will lead to very far apart Nextx values.

The claim made by chaos theorists that iteration of nonlinear equations, or models like (1), will lead to unpredictable Nextx values in succeeding generations is certainly true; but not necessarily true, because the system is unpredictable. It's necessarily true because the real number representation of the system is unpredictable (creating the conditions as it calculates the conditions it attempts to demonstrate).

Attempts to untease the problem (separate "real number errors" from what's "really happening" in the system) seem doomed (I think), since no system is capable of maintaining real number accuracy to an unlimited significance. And even if it could, it would surely encounter at least one irrational number during the process, which it would have to round off.

Chaos theory demonstrates a flaw (or error) in nonlinear models by *using the error to demonstrate it*. In other words, violating the requirement for independence, or in simpler terms, begging the question.

Summa

Interestingly enough, mathematical demonstrations and representations of chaos have been principally a computer (or calculator) created phenomenon. Try multiplying a few 16 digit reals by hand and you'll see why. But even hand-derived calculations will eventually succumb to an irrational number.

Also, interestingly enough, when modelers iterate the logistic equation using R values in the mid-range of the equation (say 2 to 3, where the range of R is 0 to 4), the results are much more consistent, in fact often at equilibria.

Chaotic behavior is most pronounced near the equation's maximum.

Values of X in chaotic states then oscillate, farther and farther apart, over and under some possible state of equilibrium. We can't tell if the system is or isn't at equilibrium since we can't get 'round the real number problem.

In particular, at the maximum range of the model (at values nearing R = 4, in the logistic equation), chaos is greatest.

Cheney & Kincaid, in their book, *Numerical Mathematics And Computing*, have shown that round off errors are extremely great in subtractions where the values (being subtracted) are very close together. They suggest programming around subtraction in these cases, if possible, to reduce (but of course not eliminate) loss of significance.

Look again at the logistic equation. When the value of X approaches 1, we subtract values that are closer and closer together. We would then expect greater round off error to occur, which it does.

I suggest that one explanation for the strangeness in chaos belongs to the error inherent in any system which uses real numbers to represent countable values.

In other words, representations, being only approximations, are limited in what they can say about the nature of approximations.

And that's Tidbits.

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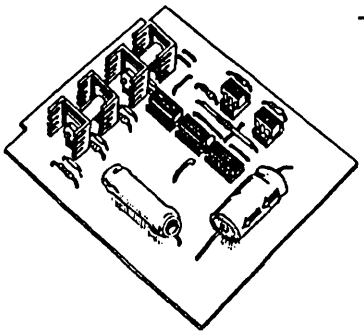
Techna-Kit



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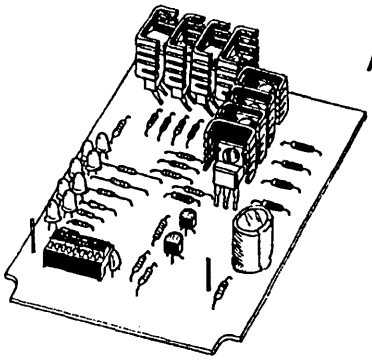

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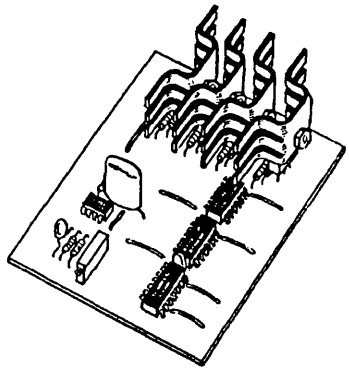

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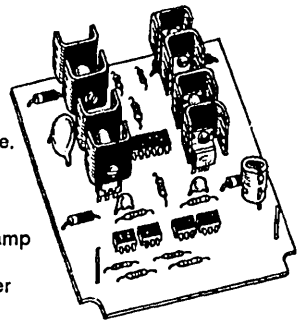

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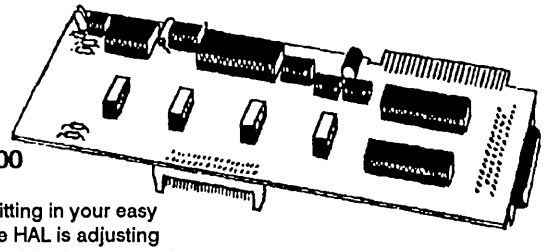

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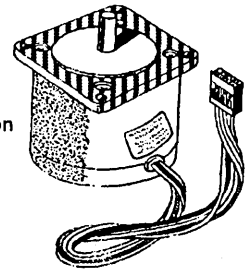

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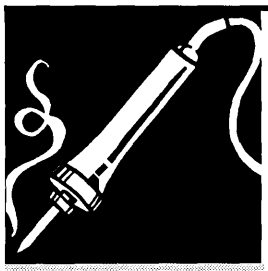


TECHTIPS

Of Mice And Bugs

NEC HD Laptop Tips

I have a little info on the NEC HD laptop (20 Meg hard drive). Figure 1 shows how to build your own spare battery pack for about $35. (NEC gets $100 for theirs.) Figure 2 covers the pinout for an external 5 1/4" drive (360K).

NEC's documentation on the pinout was incomplete, and their tech support people were unable to help. (They want you to buy their expensive external drive.) I'm running a Canon drive on mine, but almost any drive should work. The 5 1/4" drive must have its own power supply.

I had a lot of trouble with the NEC at first. Their built-in software conflicted with many of my utilities (dBASE III, WordStar, MASM 5.1, and others). I got garbage in large dBASE and WordStar files and sometimes the machine would just lock up.

CRCs confirmed that something was wrong, and a manual check of the data confirmed it. Many long distance calls to NEC (with the usual 15 minute delay to get a technician) finally resulted in a solution.

It turns out that you have to kill all their built-in software (actually, you can't get rid of all of it). If you run KILL640R and right after it run KILLPOP, most of the problems will disappear.

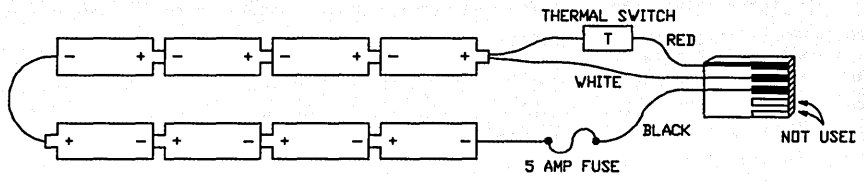
There is a better solution: use DOS 3.3. No problems, runs perfectly without a glitch. If you do this, the machine will come up running in low speed (4.77 MHz). Run a program from the NEC BBS (312-860-2602), called LV9SPEED.COM, to switch to high speed (9.54 MHz). Save your NEC DOS (3.2) in case you need to change start-up settings (screen attributes, etc.).

One other note: NEC's BACKUP utility is garbage, totally useless. The machine ate up part of a FAT a while back, and my backup disks (two sets) were unusable. (RECOVER didn't recognize them.) Cute, considering that BACKUP reported no errors and, naturally, I reformatted the hard drive before I found out that the disks were no good. BACKUP and RECOVER in DOS 3.3 work perfectly.

I am pleased with the NEC now that the bugs have been appeased. For a time I was ready to trash it. Weight-wise it's a little heavy, keyboard is good, screen very readable, runs about an hour and a quarter on a battery pack, 2400 baud modem (extra), power supply too bulky (I built my own). I travel a lot and always take it along; I'm becoming very dependent on it.

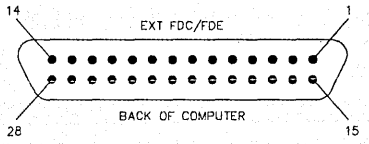
Lynn Smith
3051 Shirley Dr.
Newbury Park, CA 91320

Figure 1—NEC Battery Pack (9.6v).




```
Notes: Use 1.8 ah ni-cads with solder tabs (factory = 2.2 ah)
    Thermal switch normally closed; open @ 70°C. Good
    substitute is ECG 8063 (thermal fuse). Place thermal switch
    inside battery pack.
    red = charge path     white = +9.6 volts     black = ground
```

Figure 2—NEC HD Drive Pinout.



1	PC/EXT
2	Ready
3	Drive select 2
4	Motor enable 2
5	n.c.
6	Index
7-10	n.c
11	Direction
12	Step pulse
13	Write data
14	Write enable
15	Track 0
16	Write protect
17	Read data
18	Side select
19	n.c.
20	Ground
21	(NEC didn't know)
22-28	Ground

NOTE: Order of pins is reverse of what you might expect. Pins are not numbered. Ground pins 1 and 21 in the external drive through 3.9K. This is how the NEC knows the external drive is there.

Power Hungry Mouse Solution

Regarding Rod Morimoto's technical tip, "Logitech/Zenith Compatibility," in *Micro C* issue #41: I too had the problem with interfacing a Genius Mouse GM-6 Plus with a Zenith 181-92 laptop computer. The problem is that the open circuit output voltage of the laptop's RS-232 port is less than 4 volts, but the mouse requires more than 5 volts at about 10 milliamps.

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Rod's unimplemented suggestion is doable, but unduly complex. My solution was to stick a standard $5 RS-232 junction box between the computer and the mouse as shown in Figure 3.

I got the two 2-cell AAA battery holders (59¢ each) from a Radio Shack and glued them to the top of the junction box. I wired the batteries in series (for 6 volts) and threaded the plus and minus leads into the junction box. (Disconnect the mouse when not in use to conserve battery energy.)

This simple circuit has been successfully operating for some time. However, the mouse will only work in Microsoft mode, at the 6 volt level.

On another subject, does anyone know how to interface a 3.5" 1.44 MB floppy disk and/or a hard disk to this model Zenith?

Sidney Epstein
140 Cadman Plaza West, Apt. 17G
Brooklyn, NY 11201

Video Attribute Control

I would appreciate help with a problem. Since I have cataracts and retinitis pigmentosa, I see a great deal of glare when large areas of the screen are displayed as reverse video (in monochrome systems) or bright colors.

Although many programs have an installation which allows color selection or the use of underline instead of reverse video, many others do not. Does anyone know:

(1) how reverse video can be changed or defeated on monochrome CRTs?

(2) how colors can be changed to dark background and light characters?

An example of software that gives me the problem is Eight-in-One, which has a large part of the screen in bright reverse video. I would hope that when the application software controls the colors, there is a way to override and reset colors by using a special EGA card or monitor.

Maybe the problem is easier in the CGA display. In monochrome displays, maybe certain driver cards could accept a change to reverse video showing it as underlined text, like WordStar allows in its installation procedure. At present I have an AT compatible with a Quad EGA+ board and Hercules compatible monochrome graphics board. Thanks for any ideas.

Carl H. Schmitt
3201 Coquelim Terrace
Chevy Chase, MD 20815

Figure 3—Zenith Laptop/Genius Mouse Interface.

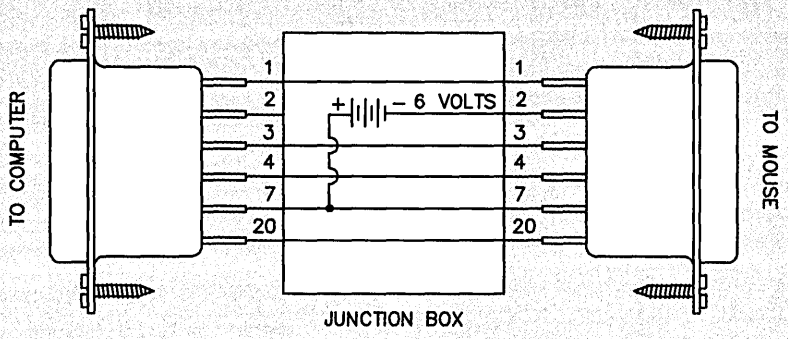

Figure 4—Short Program to Locate Attributes On Video Adapter

```
PROGRAM FindAtr; { Toggles an attribute repeatedly until a keystroke.
                   Configured here to find the reverse video attribute
                   on a CGA card. }

CONST
  Normal  = $07;                              { normal video attribute }
  Reverse = $70;                              { reverse video attribute }
  VidBase = $b800;                  { base address for CGA text memory }

VAR       { use ABSOLUTE to force this array to overlay video memory }
  Screen: ARRAY [0..3999] OF Byte ABSOLUTE VidBase:0;


PROCEDURE SetAttribute (Attrib: Byte);

VAR
  I: Integer;

BEGIN                             { set all characters to one attribute }
  FOR I := 0 TO 1999 DO
    Screen [2*I + 1] := Attrib;
END;  { SetAttribute }


BEGIN  { MAIN }
  WHILE NOT Keypressed DO
    BEGIN
      SetAttribute (Reverse);           { turn attribute on and beep }
      Write (^G);
      Delay (1000);
      SetAttribute (Normal);           { turn attribute off and beep }
      Write (^G);
      Delay (1000);
    END;  { WHILE }
END.
```

♦ ♦ ♦

Editor's note: I dug out a few video boards at Micro C, did a little digital vivisection, and came up with a few very general tips on attributes. (Don't let anyone tell you differently; R&D really stands for "Ruin and Devastate.")

The one byte attribute associated with each character controls reverse video, underline, blink, intensity, and foreground and background color. Be aware that available attributes vary a bit from Hercules to CGA to VGA, etc. Our mission (should we decide to accept it) is to intercept the attributes before they get combined with character data to form the final dot stream. It turns out to be easy (sorta).

The video controller reads one character/attribute pair at a time and stuffs 'em into buffers. We just have to figure out which chip buffers the attribute byte. Often, octal flip-flops like the '273 and '374 perform this function.

So here's the drill. Run a little program (like the one in Figure 4) that toggles the attribute you want to control. Make it beep every time the attribute changes. Now start

digging around on the video board with a logic probe or volt meter. Look for a pin (or pins) that goes high and low with the same frequency as the beep. (A board extender to bring the video card up out of the bowels of your computer will make life immeasurably easier. Available for $20 or so from Jameco and others.)

Once you've found the appropriate pin (be sure it's an input to the chip, not an output), just pull the chip, bend out the pin so it doesn't contact the socket, tie it high or low (through a 1K resistor), and plug the chip back in. I used this method to defeat a single attribute (reverse video). But you should be able to gain more complete control.

Find all 8 bits of the attribute (probably 8 inputs on the same chip) and tie them high through a DIP switch to 5 volts. Now you can set any attribute by simply changing the DIP switch setting. Careful though, the attribute will apply to the entire screen. (I find a blinking, reverse video display to be most restful, but that may not be appropriate for all users.)

Larry Fogg
Micro C Staff

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Editor's note: An application form, more general information, and a list of computer related titles resides on the Micro C BBS under the name CBFB.ARC. The impressive list of titles even includes an offering from Peter Norton. (I wonder if that one comes on a pink disk?)

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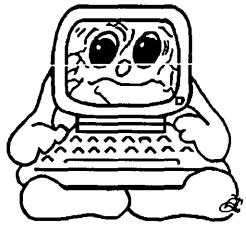

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Issue 48

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By Gary Entsminger
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A PCX Toolkit For Publishers & Programmers

If you think desktop publishing has solved the graphics file compatibility issues, you should have been around here last issue (but, we hope, not this issue).

I like it when someone writes a program I can use right now. Genus Microprogramming, down in Houston, sent me a set of PCX tools I can use *right now* and with every issue. Thanks guys.

For you joining late, Mark Zachmann, founder and president of ZSoft, invented the compressed graphics file format, .PCX, in 1983. Now, most important desktop publishing programs (Ventura, PageMaker, Word Perfect 5, etc.) and most good graphics programs read and import some form of the .PCX format. "Some form," since .PCX isn't yet all that standard. Inventor Zachmann has changed it during revisions of his program, PC Paintbrush. (See the PCX article in this issue.)

Two utilities in the Genus toolbox help clear up the nonstandard mess.

The Publisher's Toolkit

pcxHdr displays the .PCX header information—the original display resolution of an image, its width, depth, palette, version number, encoding mode, and more. If an image isn't making sense, the pcxHdr display might tell you why.

pcxFix goes a step farther; it fixes images in the latest .PCX format it knows. Specifically, pcxFix makes the latest version (whichever one that is) of PC Paintbrush the standard. The toolkit utilities expect to see the latest format, so they recognize "the fix standard."

pcxShow displays an image or a group of images.

pcxPrint prints an image (but only supports two devices: HP LaserJets and compatibles, and IBM or Epson dot-matrix and compatibles).

pcxCut lets you cut an image (or trim the parts you don't want). You define a box, and pcxCut scissors off everything outside the box. Cuts are identified by the .PCC file extension (a .PCX file in disguise). You can do anything to a .PCC file you can to a .PCX.

pcxLoc lets you identify specific pixel coordinates (100,200, for example). Some input devices need this "enumerated" information.

pcxLib lets you create and manipulate libraries of images.

pcxGrab is a screen grabber with a clever twist—it grabs text *and* graphics screens. In graphics mode, pcxGrab saves the image as a .PCX. In text mode, it saves the image as an .SCR, and you take a second step.

You run the utility, *pcxTrans*, to translate the text to a .PCX image file. You can then import this file into Ventura, Word Perfect, etc., and manipulate it as you would any .PCX image.

The Programmer's Toolkit

Anyone can do everything I've mentioned so far by using the .EXE versions of the utilities. But programmers can do a lot more.

The utilities come in two forms: executable files, and object libraries. So C, Pascal, BASIC, Assembly Language, Fortran, and Clipper programmers can call any toolbox function from their own programs. Functions are available for saving, creating, and manipulating images, displays, libraries, etc.

Each package includes all the libraries, along with several programming examples to get you going. It took me at most a couple of minutes to write a C program which displayed an image.

And no royalties, as long as you do something new with the toolbox (i.e., don't just repackage and sell it).

The manual is well-written, clear, and includes many useful discussions about adapters, images, and the programming details of the PCX format.

The help (and detailed information) I received from programmer Chris Howard (at Genus) also impressed me.

At one point, while working on a "page," I tried unsuccessfully to translate a "grabbed" text image into a .PCX image which I could show on my portable CGA AT-Rabbit.

Chris insisted that the toolbox worked perfectly with CGA. (After all, displaying an image using the CGA is child's play compared to displaying images in the 11 extended VGA modes, up through 800x600x256, that the Toolbox supports.)

"Sorry, Chris," I said, "but I'm getting garbage."

We duplicated our efforts; my CGA produced garbage, his "emulation" worked great.

"Emulation?"

"I'm using multi-sync, and ... hmmmm," he added, "that's the problem. Your 'real' CGA adapter doesn't load the IBM extended character set. My CGA, EGA, VGA emulator does."

"But wait a minute," I said. "I can run a whole bunch of nifty graphics programs with my CGA, and no problems (well, only a few). What about Borland's BGI? It works great."

"The BGI creates its own extended character set," he responded. "So do many other packages. We don't.

"We decided to use the character set that's there (in EGA, VGA, and emulator ROM); the 'real' CGA doesn't have it. You have to create your own or load it (with DOS)."

So I ran GRAFTABL (Load Graphics Table), included on the DOS disk, and lo and behold, a perfect image.

Case closed. If you're in the publishing or programming biz, consider this package.

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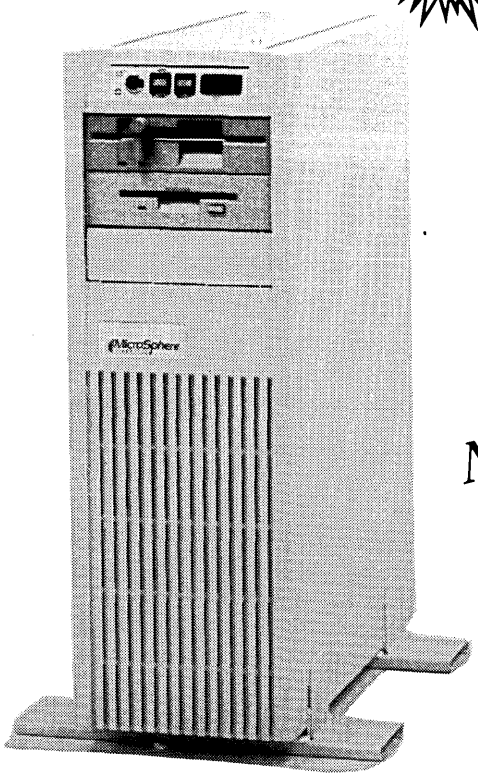

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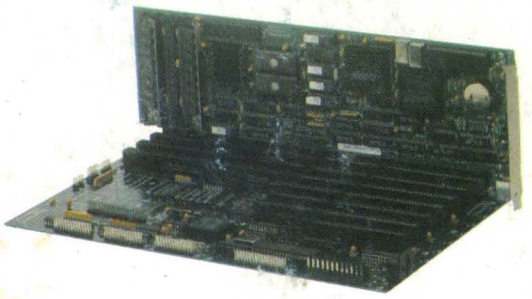

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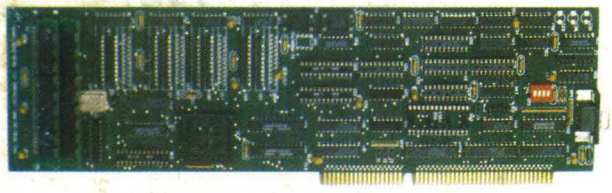

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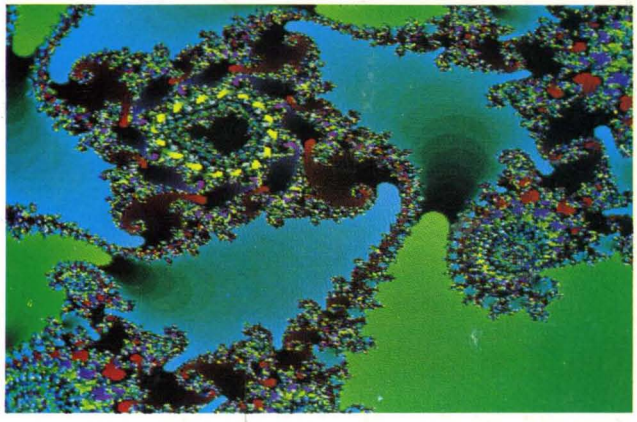

High resolution fractal produced on the PC Tech COLOR 34010

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