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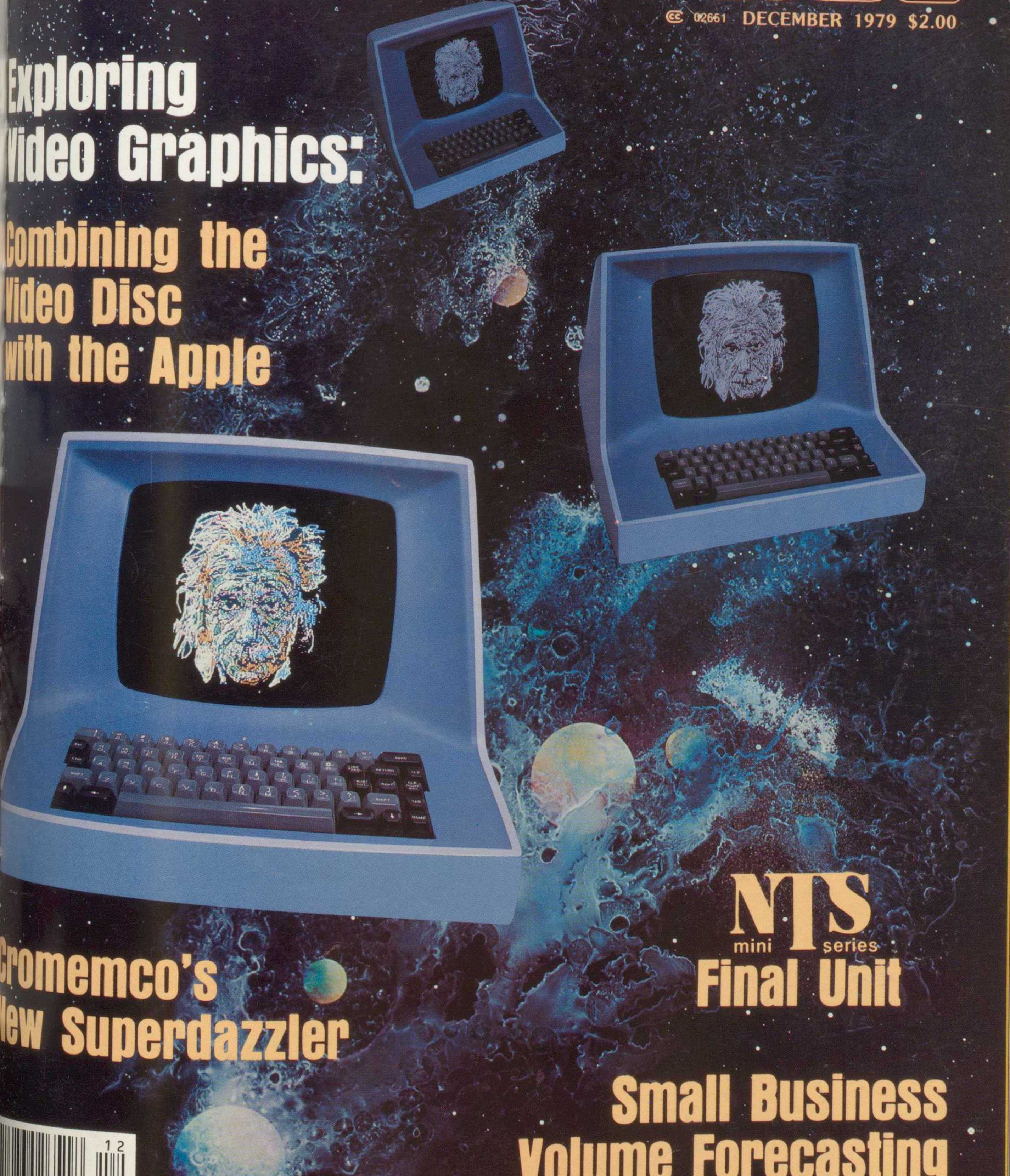

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THE COMPUTERIZED ARTIST

A GRAPHICS UNIT FOR ARTISTS WHO AREN'T PROGRAMMERS

By
Betsy Gilbert,
Staff Reporter

There has always been an aura of mystery and romance surrounding the artist in society. We like to imagine him in a cramped garrett, painting by the waning light of the sun, creating a Mona Lisa or a Blue Boy.

Well, you can take your musty old romantic notions and put them away in the closet along with your 78 records, because they just don't hold water any longer. Today's artist is as modern as the age he lives in — the computer age — and he is as much affected by electronics as any of us.

Saul Bernstein, a commercial artist and teacher in the Los Angeles area, has made an ideal marriage between art and electronics. The union is not only making a tidy living for Bernstein; it is also opening doors to new roads in the future of art.

"It's been my dream for years to be able to put art into a computer," says Bernstein, an artist by profession for more than 20 years. "Don't ask me why," he adds, "because I've never had any working knowledge of electronics. It's just an idea that kept nagging at me."

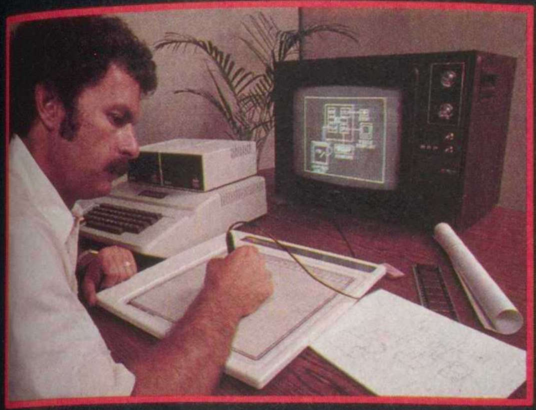
Bernstein contacted a variety of technological types, from engineers to computer experts, and the answers they offered him weren't encouraging. Many said that it simply couldn't be done. Others said that it might be possible, but not without Bernstein first taking a number of background courses in computer science.

"I'm an artist, not a computer expert and I figured it was best to leave the science of computers up to those who were experts," he said. Still, he didn't give his idea up. It stayed in the back of his mind while he pursued his painting and teaching.

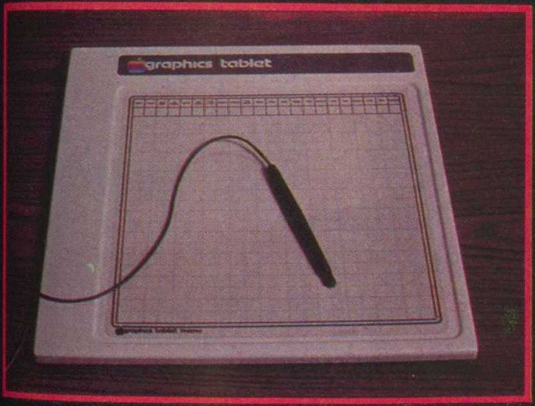
Then chance stepped in.

"I bought an Apple II in December 1978 just to play around with," Bernstein said. "It's a very simple system to operate — perfect for people like me who tend to be intimidated by things they don't understand."

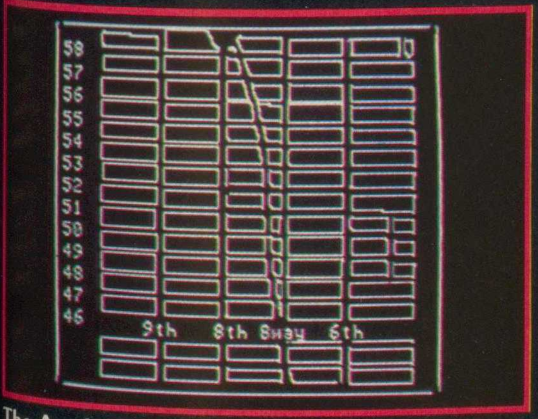
A friend of Bernstein's daughter happened to be over one day when Bernstein was operating the Apple II and mentioned that her father sold computers for a living. That led to a meeting with the girl's father, Ron Mansfield, and the first step toward the realization of a dream.



The user can copy from an original or rough sketch, then add the corrections or final touches without having to redo the entire drawing.



The Apple Graphics Tablet.



The Apple Graphics Tablet can be used to assist in such diverse fields as fine arts like the Einstein sketch on the cover and this street map for New York City.

Mansfield told Bernstein that what he wanted to do was indeed possible. He set the artist up with a digitizer and Bernstein, using his television set as a monitor, got to work. Three days later, he gave his resulting disk to Mansfield, who made sure the people at Apple saw it. The rest, as they say, is history.

Using Apple's new graphics tablet and his own unique process of breaking a picture down in a technical, abstract way, Bernstein designed the cover, label, poster and commercial for the newly released Wayne Newton album. The striking design is turning heads in record stores around the world.

As Bernstein points out, the capability of drawing into a computer has been around for about 15 years, but it has not been done well until now. "This very simple, inexpensive system now offers artists like myself a whole new art form to explore and develop," he said.

Apple introduced its graphics tablet at this year's National Computer Conference in June. According to John Jones of Apple's marketing group, the response was everything the company had hoped for, and more.

"I don't remember any time during the show when we didn't have a crowd gathered around our demonstration area," Jones says. "Saul Bernstein was there to help us out and I don't think there was a single person who walked away from our booth unimpressed."

Jones feels the new product's appeal will be wide ranging. "Other companies sell graphics tablets, but no one else offers the software support and the complete operating system that we do," he says. "Also, I don't think there's any other manufacturer on the market who can match our price."

Apple took an OEM tablet and worked it into an easy-to-operate, affordable system. The total system, consisting of an Apple II (or an Apple II Plus) computer with 48K of memory, BASIC software, the graphics tablet and one disk sells for around $3,000. A standard color or black and white television set can serve as a monitor.

The system is ideal for drawing, lettering and low-level technical drawings. It offers a variety of choices for drawing modes and the BASIC language makes it easy for Apple to change the program to fit the needs of the user.

According to Jones, a finished product done with the tablet can be turned out in hours instead of the weeks sometimes required using drawing or painting modes. The user draws on the tablet and the image appears on the monitor. If he wants to make a change, he can take out any portion of the drawing simply by pushing a button, then resume his drawing in that area.

"When you think of what is involved in making a change in a sketch, or especially a painting, the simplicity of this system becomes even more impressive," says Jones.

In designing the Wayne Newton album cover, Bernstein tried several versions on the tablet and took Polaroid snapshots of each of them. The record company was able to choose the one they liked best and make suggestions for changes. Bernstein noted their changes, went back to the tablet and made them and was able to provide them with the new version promptly. Had he shown paintings instead, the modification process would have taken weeks.

"Time is money to a commercial artist," says Bernstein, "and the more time you save yourself, the more money you've made. My Apple system has already paid for itself several times over."

According to Jones, the current system, which is limited primarily to the drawing mode, will be enhanced in the future to provide a capability for diagramming on a higher technical level. In the meantime, the marketing effort will be aimed at artists like Bernstein.

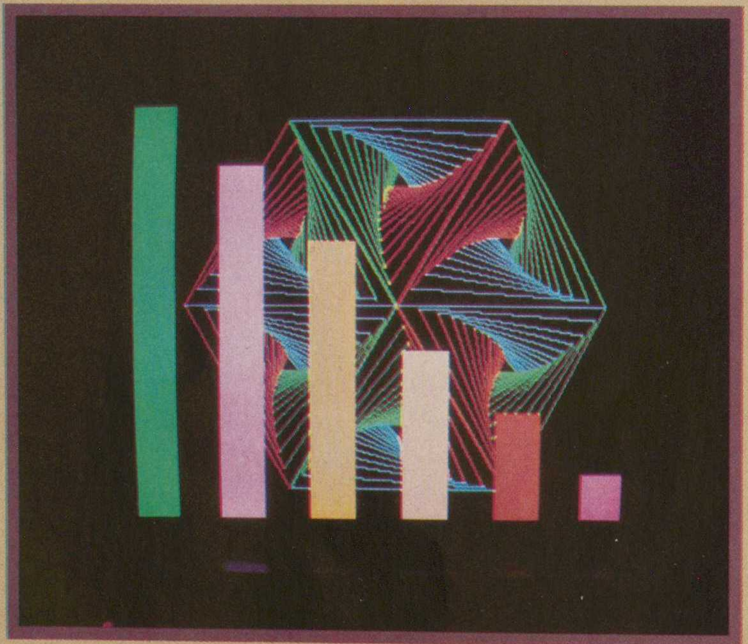
"I think it'll be the easiest product in the world to sell," says the artist. "Artists are generally scared to death of things like computers, but once people are made aware of just how simple this system is, I think you're going to see a lot more computer art."□

Cromemco's Superdazzler!

By Tom Fox, Systems Editor

The project was two years in the laboratory. Born in an engineering bull session or during a sleepless night or while viewing the climax of *2001: A Space Odyssey* — the origins are lost, now. People talk in two years. Engineers meet friends in other cities; programmers take advanced studies at nearby colleges. The word gets out.

The University of Oregon learns about it and wants one for neurological studies of a monkey's eyesight. They get it. Stanford University needs one for a PhD thesis. A deal is struck: Write us some software, you can have our developmental model. The prototype shop gets busy again. An urgent call from a Las Vegas casino: help us identify our high-roller check cashers. They're still working on that deal.



What kind of a machine elicits enthusiasm from such a wide range of people? It's obvious that these early users, whose excitement wouldn't allow them to wait for the production units, were fired up by more than the thrill of seeing yet another arrangement of parts on a circuit card. If analyzed, it could probably be shown that these people were excited not by a part they could hold in their hand; but by the potentiality of their own minds. "I need that machine because there's this idea I have, see — this *thing* in my head only I can see. Give me a way of showing it to you; make me a tool so I can pry it out and lay it on the table, that you can see what's painted on the inside of my eyelids."

What we are talking about is yet another card or two or three for the S-100 bus. But far more than just that, the SDI (a sophistication of the project name: Super Dazzler Interface) has been a vehicle to cut loose the imagination of nearly everyone who has come into contact with it.

The SDI corner of the Cromemco factory is more popular than the water cooler ever was. Visitors who know where the SDIs are plan their routes to include a look at the colorful screens. They are rewarded by a glimpse into the future of computers, for that is certainly the place for tools such as the Superdazzler.

COMPONENTS OF THE SDI SUBSYSTEM

In its simplest form, this high-resolution color graphics subsystem consists of a pair of SDI cards and a color monitor (a kind of a stripped-down color TV set). As we shall see later, performance of the system is enhanced dramatically by the addition of other hardware, but these two pieces are all that are really necessary to add a spectacular graphics capability to most any computer built around an S-100 bus.

The SDI subsystem will plug right into any Cromemco product (System Two, System Three, Z2-H, etc.). It should also be adaptable to nearly everyone else's machine, if careful attention is given to such things as port addresses and memory locations of the resident programs.

The two-card SDI set consists of a DMA Board and a Video Board, $595 the pair. The former is responsible for scanning the picture area of the computer's memory on a continuous basis and sending this information to the Video Board. The Video Board then interprets this digital information and converts it into analog signals, which are sent to the color monitor for display.

The color monitor must be of the "RGB" (named after the red, green and blue colors of its three electron guns), whose synch signals conform to the TV industry's EIA Standard RS-170. An RGB monitor is usually more expensive than the common "composite" color sets, but the quality of the display is far superior. Cromemco's 19-inch RGB monitor (supplied to them by Mitsubishi) provides a grade of resolution and stable, saturated colors the likes of which you've never seen on your home television set. At $6,995, it should!

For reasons we shall soon see, the SDI subsystem benefits greatly if the computer it is attached to is equipped with a brace of special two-port memory boards. These boards plug right into the S-100 bus also, and become the area wherein the picture is stored while it is being displayed.

"Two port" means that in addition to the normal connection that exists between the memory and CPU, there exists an additional direct link between the memory and SDI and DMA Board. This allows the SDI to refresh the image on the screen without having to compete with the CPU for time on the "normal" S-100 bus.

The two-port memory is currently available as a $795 16-kilobyte static product, large enough for one low-resolution picture or one-third of a medium- or high-resolution one. There is no reason, however, that two-port memories cannot follow the same trend towards higher density (more kilobytes per board) and lower cost, as we have seen in other memory products.

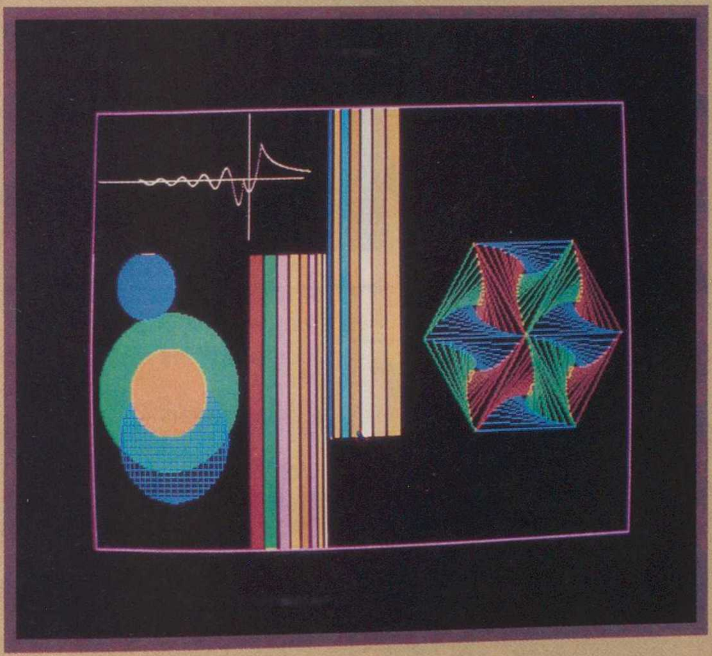
REMEMBER THAT PICTURE

With few exceptions, a television tube will retain an image on its screen for only a fraction of a second. After that, everything goes black. Such a feature is, of course, necessary in order to show "moving" pictures, but it means that every detail of a picture must be remembered somewhere else in the system if the screen is to show a steady, unmoving image. The "somewhere else" in this case is either a portion of the computer's normal Random-Access Memory (RAM) or the special two-port RAM described above.

To display a stationary image, the SDI electronics continuously interrogate the contents of the RAM and re-write the picture to the screen. This is done 30 times each second, the same rate as an ordinary TV set. Since the human eye cannot detect such a rapid flicker, the image appears to be standing still.

Your eyes have a marvelous capacity for viewing a complex image and delivering meaningful information to the brain. Systems such as the SDI take advantage of this fact by forming pictures that are rich in detail. The price that must be paid is that this detail must be retained in the RAM. That means that a large chunk of memory must be dedicated to remembering the contents of the image.

The designers of the SDI have taken a direct approach to this problem, allocating a portion of the memory to each tiny area of the screen. The smallest viewable area is called a pixel (for "picture element"). Each of the 22,869, 91,476 or 365,904 pixels in a single image (depending upon the chosen resolution) is represented either by a bit or a nybble in memory, depending upon whether the image is black-and-white or color. (A nybble is four bits of memory — one half of a byte.)



There is a direct trade-off between picture resolution and memory requirements. Twelve kilobytes of memory can hold either a low-resolution color picture or a medium-resolution black and white one. Forty-eight kilobytes will retain a medium-resolution color picture or a high-resolution monochrome one. Table 1 shows the options. The user of the system is not restricted by the nomenclature. "Color" can be any 16 colors, including 16 shades of grey or tan, and "black-and-white" can be replaced with blue-and-yellow or red-and-pink, or whatever combination you desire.

The most common arrangement is to dedicate a 48-kilobyte chunk of memory to the function of holding either a single medium- or high-resolution picture or four low- or medium-resolution ones. Unless the two-port RAM is utilized, the operating system and any user programs have to be limited to the first 16 kilobytes of memory. This restriction can be alleviated by using Cromemco's proven memory-mapping scheme, which allows several banks of 64-kilobyte memory to be contained in the computer.

If the two-port RAMs are specified, they can be allocated to the higher memory banks. The system we saw had three 48-kilobyte banks of memory for picture retention in addition to 64 kilobytes of normal computer RAM.

THE CONTENDERS

The DMA board of the SDI interrogates the picture memory by the use of a Direct Memory Accessing method. This technique, sometimes called "cycle stealing," allows the DMA Board to take priority over the CPU for the purpose of looking at a memory location.

Because of the vast number of such accesses that are needed in this application, the CPU is robbed of its time to a noticeable extent. In fact, the simple task of displaying a low-resolution picture can take up to 45% of a memory's available time, reducing the CPU's efficiency to 65% of its full-strength value. A high-resolution picture takes a crippling 95% of the CPU's capacity away.

That might sound like a serious problem, but consider that SDI subsystems are most likely to be used in computers that are dedicated to graphics applications, and this restriction may be an acceptable one. Even 5% of a Z-80 is still a pretty powerful tool.

Cromemco is concerned enough, however, to offer several ways around the problem. Two of them are simple: tell the SDI that you want to trim 12.5% off the top and bottom of the picture and/or reduce the vertical resolution by half, and the CPU is given back up to 70% of its oats. Add the two-port RAMs, and the problem goes away almost entirely. This is due to the fact that the DMA accesses to the picture memory take place over separate cables, freeing the S-100 bus to the nearly exclusive use of the CPU.

A MAP IN COLOR

Representing each spot on the screen by a piece of RAM is a straightforward plan, but Cromemco has enhanced the idea with a simple but powerful technique: color mapping. The SDI contains a small extra area of memory designated the Color Mapping RAM. It is equivalent to only 24 bytes of regular memory, but it contains the secret of many of the more spectacular attributes of the SDI images.

The Color Mapping RAM is organized as shown in Figure 3. Each of the 48 cells can contain a numeric value from 0 to 15, representing the power with which the red, green or blue electron gun of the color tube bombards the cathode screen. Each of the 16 triplets of such intensities is a "color value." It is this value which is actually retained by the larger (12K or 48K) picture RAM.

In the partially completed color map shown in Figure 1, a nybble containing the value 0 would cause its corresponding pixel to be displayed in black (all guns off). White (all guns turned to full intensity) is represented by a value of 15. A few other simple examples are shown. An incredible 4,096 different shades of color are possible, although only 16 can be utilized for any given image.

For monochrome images, each pixel is represented by one bit in the picture memory area. If the bit is a '0,' the color value of 0 in Figure 3 is sent to the tube. A '1' bit causes a color value of 15 to be sent.

By retaining a given image on the screen and varying the values of electron gun intensity in the color map, the hue and warmth of the picture can be instantly altered, subtly or radically. False-color images, such as those received from crop-mapping satellites, can be made in this manner. Cromemco programmers have come up with demonstration programs that play with the Color Mapping RAM to produce some mind-boggling dynamic displays.

Taking advantage of the speed with which the color map can be altered — thousands of times each second — the image can appear as if it were illuminated by a spinning color wheel or rapidly moving light source. Given enough imagination and an SDI, the television industry could create TV commercials that would defy you to take your eyes away from the product being shown.

MAKING PICTURES

Images are created when the CPU writes information into the picture area of the computer RAM. In addition, there are five control ports to the SDI that must be managed by the CPU. The rules to utilize when doing this are relatively simple, and a programmer with average skills could be drawing pictures the first day. The SDI User's Guide gives several program examples in Z-80 Assembler and FORTRAN, and the principles can be applied to BASIC and other languages as well.

Soon, the manufacturer will release extensive FORTRAN subroutines that can be called from user's programs. One of the more useful ones will plot any two-variable functions, automatically providing the X and Y axes and scaling the image to fit into a defined space. Other routines ensure that circles and disks come out round when drawn. In time, you can expect to see a simple statistical analysis package, programs for factor analysis and routines for drawing high-resolution characters in various type styles.

Once an image is created, it can be permanently stored in two ways. The program that was written to create the picture can be saved on a disk, floppy diskette or cassette and executed again to re-generate the picture. In addition, the 12 or 48 kilobytes of RAM that represent the raw image can be saved as is onto any of these magnetic media.

The computer we tested was a Cromemco System Three equipped with standard-size floppy disk drives; five 48-kilobyte images could be stored on each single-density surface of the diskettes. It takes about 15 seconds to read or write an image using this method of archiving. Work is in progress on a compaction program which will increase the storage capacity by a factor of four.

OTHER TRICKS

The SDI has the capability for displaying high- and low-resolution pictures, in a mix of color and monochrome, all on the same screen. Images can be lifted from previously-generated pictures and reduced or expanded in size and added to an existing image. Windows in any shape can be opened on an image to reveal a portion of another image that is stored in a separate bank of memory. Pictures can be "hidden" in other images and faded into existence by controlling the Color Mapping RAM.

There is already talk in Cromemco's back rooms about additions to their graphics "family": cards for character generation, cards for rotating and zooming images, software for three-dimensional representation, and on and on. It's apparent that Cromemco is committed to the development of graphics products to an extent far exceeding that of their earlier TV Dazzler boards.

In all, the SDI color graphics subsystem presents a breakthrough in capabilities that have previously been available only in far more expensive computers. It is an exciting, well-designed solution in search of someone's tough problem — maybe yours.

If it is, don't be disappointed if you can't see right away how your situation can be helped with graphics displays of this type. We are all somewhat limited in our minds to solving problems with the tools we have grown up with. When a new one comes along, it's seldom obvious just where it fits in. That's how business computers started out, and look where they are now. You can bet that, given time, you will wonder what you did before high-resolution color graphics became commonplace.☐