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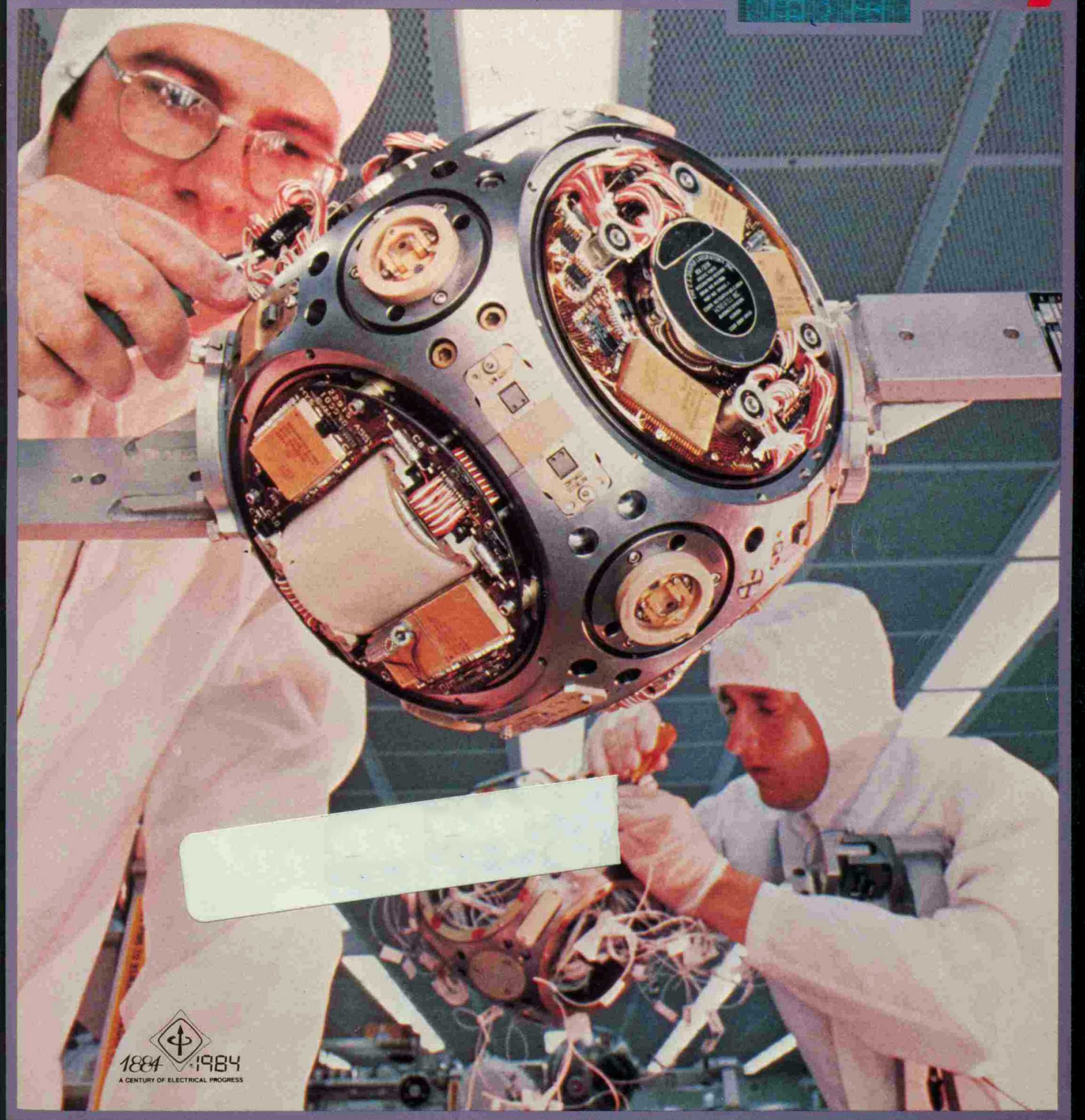

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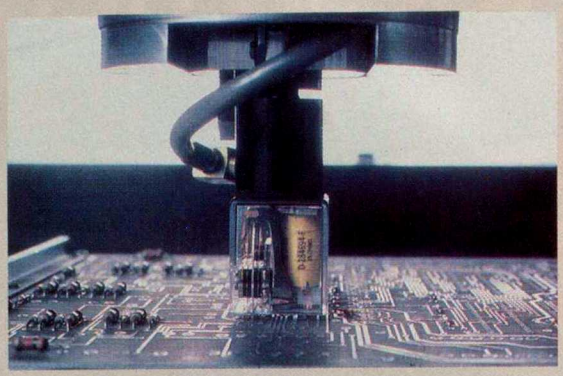
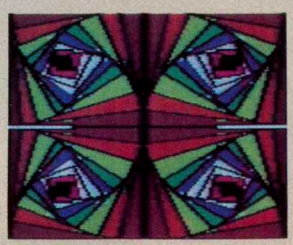


A precision robot (right)—the Mini-Sembler 2000—is about to insert a 20-pin relay into a printed circuit board. Through use of a computer-operated pneumatic valve, the robot picks the relay from a feeder by vacuum suction, then moves it over the circuit board, and places it in the proper position. The positioning is done within 25 micrometers of the desired location.

Produced by Control Automation Inc. of Princeton, N.J., the computer-controlled robot has software that compensates for component misalignment. A force transducer (not visible in the illustration) senses excessive pressure during the component insertion process and stops the robot: the software then makes the robot try again with the component in a slightly different position. This procedure is repeated up to six times maximum, after which the component is rejected. The computer records the search history, alerting the user to a potential problem in a specific component alignment. Other developments in industrial electronics are discussed in the article beginning on page 68.



This picture was drawn using the Koalapad touch tablet attached to a Commodore 64 home computer. The Koalapad, manufactured by Koala Technologies Corp. of Los Altos, Calif., sells for under $125 (with the Micro Illustrator software package). The pad is also available for Atari, IBM, and Apple computers.

The Koalapad, and similar touch tablets introduced in 1983 by other manufacturers, allow a user to sketch using a finger or stylus. The user can also select shapes, shadings, and "paint brushes" from a software menu to create images on the screen. A custom keyboard can be created using overlays. The keyboard, together with accompanying graphics software, can reproduce many of the functions previously only available in sophisticated "paint" systems. But this 'paint' tablet can be used with a computer that costs a few hundred dollars, whereas the sophisticated system costs several hundred thousand dollars. For additional information on other interesting developments in consumer electronics last year, see the article beginning on page 78.

ARTICLES

TECHNOLOGY 84

DEPARTMENTS

1884 1984
A CENTURY OF ELECTRICAL PROGRESS

THE COVER

A key to the increased accuracy of the MX missile that was first flight-tested in June 1983 is the inertial measurement unit being assembled at Northrop Corp.'s Electronics Division in Hawthorne, Calif. The unit senses changes in the strategic weapon's acceleration and attitude and relays the data to the missile's guidance-control computer. For details see page 86.

CONSUMER ELECTRONICS

New audio and video developments await their true test in the marketplace; software support may make the difference

In the ever-expanding consumer-electronics market, 1983 was a year of high promise and dashed hopes. Sales of television sets spurted with the emergence of higher-quality monitors—some included as part of component systems—and the first steps toward high-definition telecasting were taken.

At the same time video-cassette players offered prerecorded films with stereo sound; the compact digital disk, based on laser technology similar to that used in video-disk players, made its debut in the audio field; and videotex and teletext systems, after technical and market testing, finally made it to the marketplace.

But it was a year of chaos in the home-computer and home-video-game industries. Amid a flurry of technical advances, computer prices on many models tumbled and crashed, causing some companies, including such large manufacturers as Texas Instruments Corp., to abandon whole lines of equipment.

In video games, the disarray was worse. Bored with the capability of the older models of video-game machines—like the Atari 2600 VCS and the Mattel Intellivision—some started trading up to systems like the Colecovision or the Atari 5200. Neither of these machines, however, appealed to massive numbers of consumers, as many consumers chose to purchase a home computer rather than a dedicated game machine. A simple mass market for video-game software no longer existed, and the confusion forced video-game software companies to shift their design efforts away from dedicated video-game units to home computers. Some software companies had to drastically reorganize or risk going out of business.

On the positive side, 1983 sales of television sets were 21 percent above 1982 sales, with 15 million sold, according to the Electronic Industries Association based in Washington, D.C. There are several reasons for the increase in sales.

Resolution of TV reception improving

Today's TV sets can do more than receive over-the-air signals: they can display pictures received from computers, video games, video-tape players, video-disk players, and teletext and videotex systems. With these additional sources—some furnishing high-resolution pictures—competing for use of the video screen, for many families one color TV is no longer enough. And the capability to reproduce pictures with increased horizontal resolution became available in standard as well as in component television systems [see "Component television," *Spectrum*, June 1983, p. 38]. Higher-quality TV reception will also soon be available by digital signal processing, in which the analog signal that is received is digitized by VLSI chips [see "Digital TV: makers bet on VLSI," *Spectrum*, February 1983, p. 39].

Tekla S. Perry Associate Editor

Such digital TV sets have been introduced in Japan by the Matsushita Electric Industrial Co. and the Mitsubishi Electric Corp., both of Tokyo, and they are expected to reach the U.S. market in the middle of this year. Many other companies, including the International Telephone and Telegraph Corp., the company that currently makes the integrated circuits used in most digital TV sets, are also contemplating manufacturing such systems.

With sources of high-resolution video available and with better monitors that take advantage of that improved quality, the spotlight is on television broadcasters to improve the quality of their transmissions. High-definition television (HDTV) broadcasting, using a larger bandwidth than standard television, can lead to brighter and sharper pictures, but it is still years away [see "The problems and promises of high-definition television," *Spectrum*, December 1983, p. 46]. However, the advent of direct-broadcast satellites (DBS) may lead to HDTV in the home.

United Satellite Communications Inc. in New York has begun direct broadcasting using the Canadian Anik C satellite and will launch its own satellite this year. Several other companies have received permits and slot assignments for direct-broadcast satellites [see table, *Spectrum*, September 1983, p. 54]. These DBS systems will not offer HDTV in the near future; they are designed to offer special programming like that available on cable TV and to reach rural areas. Some of the systems, however, may use multiplexed-analog component signals that can provide a picture with better definition and less noise. And CBS Inc. has proposed an HDTV system that would be compatible with DBS systems.

The audio portion of broadcast may improve more quickly than the video portion in the United States. The Federal Communications Commission has issued a proposal for rule making on the question of stereo TV sound, and a quick decision could lead to the birth of stereo TV broadcasting within a year. The television industry was to vote (through the National Association of Broadcasters and the Electronic Industries Association) in December to select a single system for industry adoption after testing several proposed systems. Their selection was to be submitted to the FCC for its consideration. But the FCC could decide to let the marketplace determine the technology.

But while stereo broadcast television is still on the horizon, prerecorded video with stereo sound exists in several formats. Video-disk players, introduced several years ago, offer stereo sound as a standard feature, and in 1983 video-cassette recorders (VCRs) with stereo sound also became available.

Consumer-electronics companies introduced Beta-format VCRs with high-fidelity stereo sound in the United States in January. The Beta system uses audio frequency modulation: a two-channel audio signal is helically recorded along with the video signal by the video recording heads and later decoded.

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When stereo speakers are attached, stereo sound can be played from prerecorded tapes. The Beta VCR can record TV-FM stereo simulcasts and is expected to be able to record future stereo TV broadcasts. High-fidelity sound for VHS recorders—a second type of video-cassette recorder that is popular—was introduced in Japan in 1983 and is expected to make its debut in the United States in early 1984.

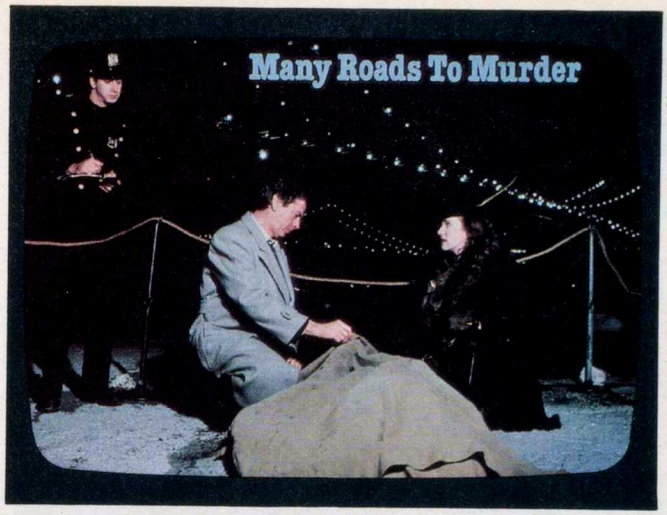
Manufacturers of VCRs have made improvements in areas other than sound quality. VCRs have steadily shrunk in size and expanded in available playing time. Truly portable VCRs, such as Sony's new Betamovie system that combines a camera and VCR into a hand-held package the size of previous cameras, are now being sold, and the maximum playing time available has more than doubled to 16 hours. As a result, a new use for the VCR has developed: in addition to using it for time-shifting (taping a television show for later viewing) and for watching prerecorded movies, the VCR is becoming a substitute for the 8-mm home-movie camera.

Interactivity lifts hopes for video disks

While 1983 sales for video-cassette recorders are up an astonishing 108 percent over 1982, video-disk players have not sold nearly as well as manufacturers expected. In 1980, the RCA Corp. predicted it would sell half a million units of its video-disk player that year. However, sales of video-disk players by all manufacturers totaled a paltry 40 000 that first year, and they only reached 350 000 in 1983.

The problem with video-disk players was that they could not record from broadcast television, as could video-tape players, so consumers could not create their own selection of software and therefore were dependent on a limited library of prerecorded selections. Prerecorded software in disk form is substantially cheaper than that available in tape form ($15 against $50). But even though this was an advantage, the CED (for capacitance electronic disk) video-disk player, priced at approximately $300 compared with $500 or more for a video-tape recorder, offered the consumer no new capabilities.

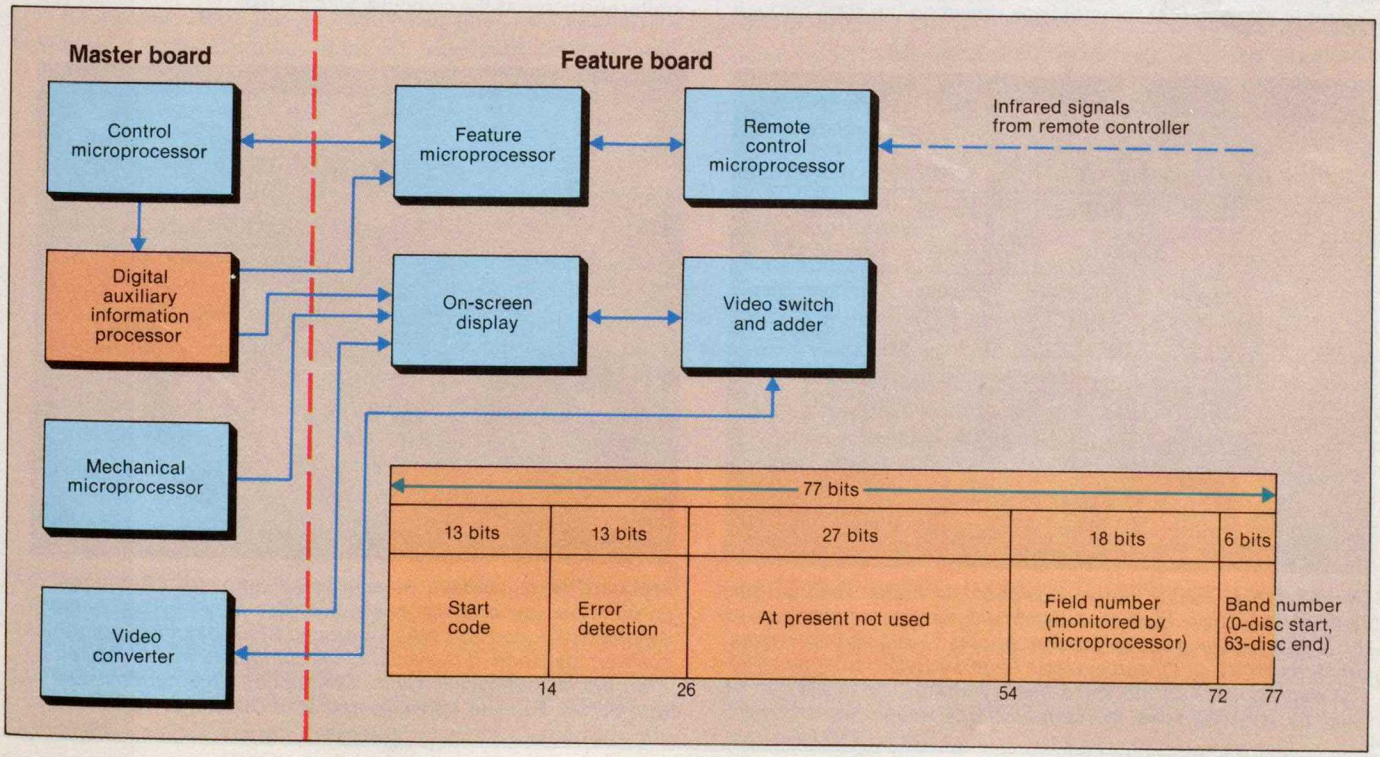
Faced with the need to compete, video-disk manufacturers decided to highlight interactivity in 1983. This feature already existed in laser video-disk players—the more expensive format priced at approximately $700—and only needed novel software



VidMax Inc.

[2] In the interactive video-disk game, Many Roads to Murder, produced by VidMax Inc. of New York, the player controls the sequence of action by making a series of choices. As a result, the story that unfolds via the filmed action can have 16 different outcomes. Here, a body is discovered under the Brooklyn Bridge, but depending on player actions, different crimes can occur.

[1] In RCA Corp.'s new CED (for capacitance electronic disk) player, the digital auxiliary information decoder is the key to the player's interactive features. The decoder reads signals (inset) that contain 77 bits of information. The player-control microprocessor controls all primary functions of the player, and the mechanical-control microprocessor handles disk loading and unloading, the turntable drive, and power. The remote control microprocessor translates user commands from the remote controls. The feature microprocessor executes commands. The on-screen display unit generates messages to prompt the user.



to be exploited. In 1983 RCA manufactured the first CED player with interactive features, including: a page capability that allows the display of still frames; a band, or chapter, feature that allows users to enter the number of a predetermined section that the disk player automatically searches for and plays; and seek and repeat functions that allow consumers to program up to five segments for replaying at will.

In RCA's CED system, video and audio signals are encoded on a conductive vinyl disk in the form of frequency-modulated undulations in the grooves. As the disk player's stylus travels over these undulations, a thin metal electrode at the rear of the stylus acts as one plate of a capacitor, and the disk acts as the other plate. As the disk rotates, changes in capacitance generate an output signal that can be demodulated to reproduce the signals encoded on the disk. To make CED systems interactive, a digital auxiliary information encoded signal was added [Fig. 1]. This signal is located in the vertical blanking interval in each frame of video on a disk. Each signal consists of 77 bits of information, including a code that indicates where the frame starts, an error-detection code, a field identification number, and 27 bits for future applications. The field identification number allows the player to locate a specific point on the disk.

The interactive CED player has slower random-access times than the laser systems—the worst case being a 30-second search as opposed to a 5-second search—and still-frame material must be designed into the software for the CED system and cannot be displayed in real time, unlike the freeze-frame capabilities of the laser system. But the CED systems have an additional feature—a memory button that allows users to mark their place and automatically seek that place the next time they use the system.

The interactive capabilities of video disks were brought to the public's attention in 1983 by arcade-game manufacturers, who adopted such disks for use in video games [see "Video games: the next wave," *Spectrum*, December 1983, p. 52].

Some interactive software is already available for the home. Examples include the MysteryDisk games produced by VidMax Inc. of New York [Fig. 2], which will be available in both laser and CED formats and are designed to allow players to act as detectives trying to find a murderer, and Maze Mania, a disk sold by a consortium, Optical Programming Associates, that contains four maze games that require the player to answer questions correctly to journey through a maze of filmed action to the winning finish. More fully interactive game systems, with accompanying software, are expected to be introduced this year.

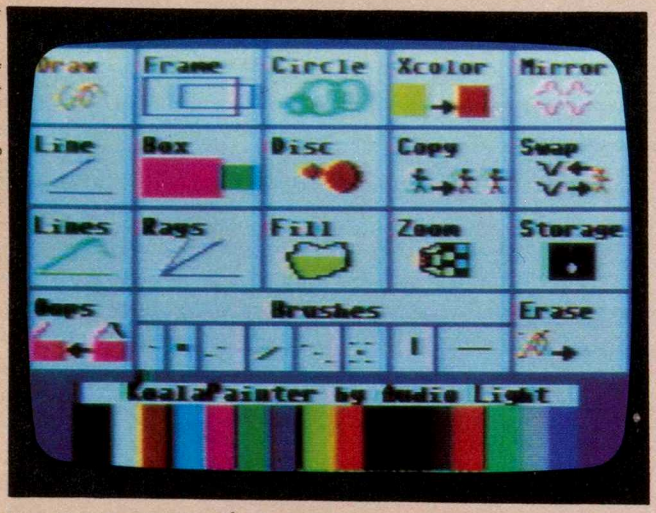
A choice of ways to 'talk' to a computer

Before 1983, only people with high-priced business-computer systems could afford the luxury of communicating in a sophisticated way with their computers without a keyboard. Those with home-computer systems were limited to use of a joystick or paddle controller if they wanted to avoid typing. During 1983, however, light pens, touch tablets, track balls, mice, and voice controllers were introduced to the consumer market.

Light pens are being sold for $30 to $100 by Atari Inc. of Sunnyvale, Calif., General Consumer Electronics Corp. of Santa Monica, Calif., and several smaller companies. They allow consumers to "talk" to their computers by drawing directly on the television screen. Touch tablets, which are being sold for approximately $80 to $120 by Atari Inc., Commodore International's Computer Systems Division in West Chester, Pa., Koala Technologies Corp. in Los Altos, Calif., Spectravideo in New York, and others, are electronic "slates" that transfer lines drawn on the slate through the computer and to the television screen. These graphics tablets begin to approach the capabilities of sophisticated "paintbox" computers used by graphic artists. Mouse controllers rest on wheels or ball bearings. When they are moved around on a flat surface, the computer translates their movements to the screen. A mouse priced at less than $100 is being sold by Human Engineered Software of Brisbane, Calif.

Milton Bradley Inc. has developed a voice controller designed to interface with computers and video games made by Texas Instruments Inc. in Dallas, and Atari. The user enunciates commands before the game begins to allow the controller to recognize the user's speech patterns and then uses these commands to control the computer or game system. One of the more unusual controllers introduced in 1983 was the Joyboard designed by the Amiga Corp. of Santa Clara, Calif. The user stands on this $50 controller and controls the computer with his feet. —*T.S.P.*

Koala Technologies Corp. (photos)



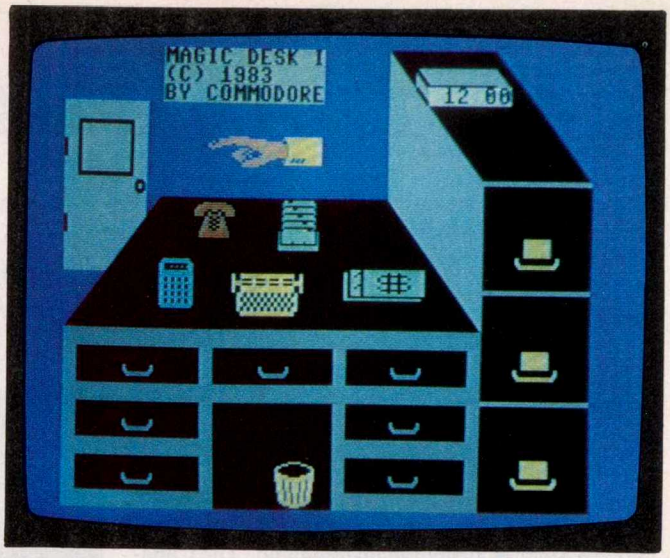
The Koalapad Touch Tablet, designed by Koala Technologies Corp. of Los Altos, Calif., is a hand-held peripheral connected to the computer with a cable. The user selects functions from a menu (left) then draws on the tablet with a finger or stylus, creating an image that appears on the video display (right). The tablet can be used as a sketch pad to reproduce any image, as a custom keyboard with overlays of any combination of characters or graphics, or as a game controller. The 6-by-8-by-1-inch tablet weighs one pound and sells for around $100, including a graphics software package. It is available for computers manufactured by Atari Inc. of Sunnyvale, Calif., Commodore International Ltd. of Norristown, Pa., and Apple Computer of Cupertino, Calif.

Now that video products offer high-quality stereo sound, can audio products compete? Since 1980 sales of standard audio products have been slipping. And there have been few innovations, other than the size and cost reductions in personal audio systems of the Sony Walkman type. In 1983, however, a truly new product was introduced—the compact disk (CD).

Based on the laser technology used in video-disk systems, the CD system was the result of a cooperative venture between North American Philips in Briarcliff Manor, N.Y., and Sony Corp. of America in Paramus, N.J. The disk is less than 5 inches in diameter and achieves more accurate sound reproduction than the best of conventional stereo long-playing records. In effect, a digital recording is transparent—that is, the reproduction quality is only limited by the software and the speaker. The digitally encoded information is scanned by a solid-state laser beam. Because there is no physical contact with the disk, there is no wear, and performance is not affected by dirt, scratches, or fingerprints on the disk.

CD systems may take a while to catch on in the consumer market. Interactive CD players sell for about $600, with the disks priced at about $15. The software is currently limited—CDs are mass produced only in West Germany and Japan, though CBS is scheduled to begin production in mid-1984 at a plant in Indiana.

But the future of CD audio is promising. It is potentially a highly portable system that is expected to turn up in automobiles. The future also includes digital-disk systems that can be used to record as well as play and the integration of CDs and computers. Philips and Sony have proposed a format for using the CD as a read-only-memory device in computer systems.



Commodore International Ltd.

[3] The answer to the question "but what does it do?" is obvious from a glance at the screen of the Magic Desk software package, introduced by Commodore International's Computer Systems Division, West Chester, Pa. This series uses pictures of objects instead of words as a menu: if you want to type, move the pointer to the typewriter; if you want to store or look up information, go to the filing cabinet; or if you want to erase information, point to the trash basket. In its functions it is similar to, though simpler than, Apple's $10 000 Lisa computer, yet it is designed to operate on the $200 Commodore 64 computer.

Chaos in home-computer and video-game markets

There was considerably less optimism last year as sales slowed in the home-computer and video-game industries. Startup video-game companies proliferated in 1982, and while industry sales for video games grew by approximately 25 percent in 1983, the number of video-game cartridges produced increased by many times that amount, flooding the market. Also, consumers began moving away from the purchase of traditional video games and toward home computers.

As a result, Atari Inc. of Sunnyvale, Calif., a subsidiary of Warner Communications, dumped truckloads of game cartridges in a landfill in New Mexico after absorbing heavy losses. (Atari said the cartridges were defective.) Several recently started companies—like U.S. Games, a subsidiary of Quaker Oats; Data Age; Fox Video Games; and Games by Apollo—closed their doors. Imagic Corp. of Los Gatos, Calif., sold its inventory and cut staff: games that previously cost $30 now reached the consumer priced near $5. Even Activision Inc. of Mountain View, Calif., which held on to profit margins longer than most other companies, posted a large loss late in the year.

While the video-game business was weakening, sales of home computers were on the upswing and consumer interest was high. The Christmas of 1983 was expected to be the season of the home computer. Coleco Industries Inc. of Hartford, Conn., introduced the Adam computer system at the Consumer Electronics Show held in Chicago in June and astounded visitors to the show. The Adam was proposed as a complete home-computer system—a CPU with over 80 kilobits of random-access memory, a high-speed tape-storage device, word-processing software, and a daisywheel printer—all for $600 retail, at a time when CPUs with only a 64-K RAM were selling for that price. The Coleco system was expected to appeal to consumers who had not been interested in computers before, because it could clearly do something useful—replace the family typewriter as soon as it was plugged in, plus play games, educate, and, yes, balance the checkbook. Commodore International Ltd. of Norristown, Pa., cut the price of its top-of-the-line home computer, the Commodore 64, from $600 to $200. Atari Inc. announced a new line of computers compatible with the Atari 800, some with built-in disk drives and modems. Also at the June show, Texas Instruments Inc. in Dallas, Mattel Electronics in Hawthorne, Calif., and others introduced new models of computers.

But several months later Texas Instruments and Mattel Electronics dropped out of the home-computer business, canceling their new models—and their whole line of home computers. Coleco demonstrated its Adam system to various groups of computer enthusiasts and journalists and could not get the system to work properly. Finally, in October, Coleco announced that it had shipped systems to selected retailers but would not say to whom. Atari and Commodore reportedly had production-line problems and were not filling all orders. The very merry Christmas that home-computer companies had expected faded away.

Contributing to this chaos in the fall of 1983 were the rumors in the industry about the IBM Corp.'s plans to introduce a home computer, nicknamed the Peanut. Other computer manufacturers feared that consumers would hold off their purchase of a computer in expectation of a super system from IBM. When IBM finally announced the PCjr, as it is officially called, in October 1983, the home-computer manufacturers were relieved. Because it is priced at $700 for the cheapest model—which has a 64-kilobyte CPU and a cordless infrared keyboard with "chiclet" (flat rubber instead of standard typewriter) keys and uses cartridge programs—the other manufacturers hope it is too expensive for the home market. With this price as a standard, the price wars could end. One such indication is that Coleco and Atari announced they would increase the base price for their systems this month. ◆