The Docutel/Olivetti M20
A Sleek Import

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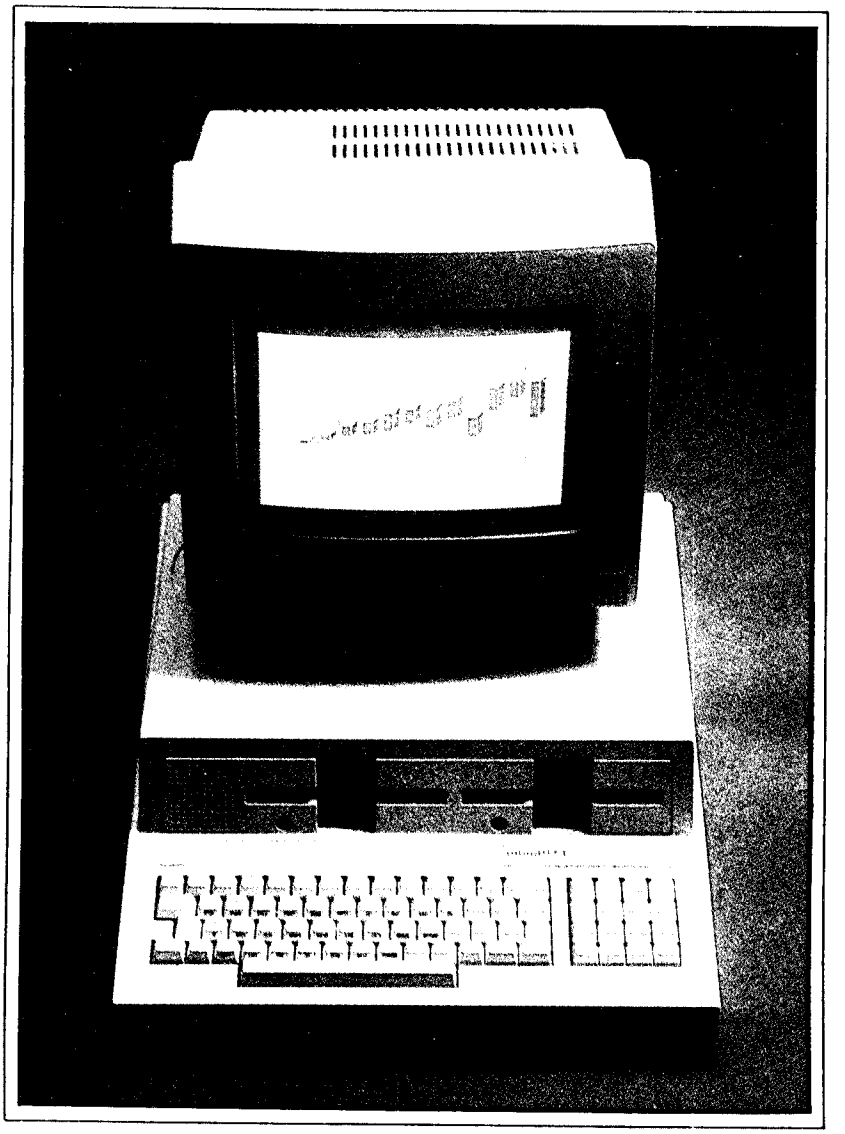

A personal computer that marches to the beat of a different drummer—the Z8000.

The Docutel/Olivetti M20 is the maverick of the second-generation personal computers. It has no function keys, an "unfashionable" microprocessor, and a 16-bit disk operating system that is incompatible with the rest of the micro world. A closer look at this machine, the company's initial foray into the microcomputer market, may shed some light on the reasoning that went into its intriguing design.

Olivetti is an industry giant in the office products arena, a market that has been changing rapidly since digital electronics invaded the business world. Not to be left behind, Olivetti aggressively converted its product line from electromechanical to electronic operation. The company's products ranged from intelligent typewriters and dedicated word processors to minicomputers, peripherals, and networks; a computer/workstation was an obvious addition. So in 1979, Olivetti's California-based Cupertino Advanced Technology Center began the design of the M20. The system was officially announced in the spring of 1982, and more than 50,000 units are estimated to have been shipped in its first year. Manufactured in Italy, the M20 is distributed in the United States by Docutel/Olivetti.

The M20 is based on the Z8001, Zilog's 16-bit microprocessor, and it runs a proprietary operating system called PCOS (Professional Computer Operating System). Although there is a rationale for taking such a nonstandard route, the reality is that software vendors have little use for the exotic. In a marketplace in which the IBM Personal Computer has become a de facto standard, the M20 suffers as a result of its uniqueness. In response to its compatibility problem, Olivetti has developed a coprocessor board based on the Intel 8086 chip, which offers the M20 owner access to software running under MS-DOS and CP/M-86.

System Overview

The M20 hardware is divided into two parts: the central unit and the video unit (see photo 3). The central unit houses the processor board, the keyboard, and the disk drives. This represents another interesting departure from the current industry trend toward detachable, low-profile keyboards.

Even more remarkable in an industry that deems function keys essential is the M20's apparent lack of general-purpose, user-definable function keys. Apparently the designers believe that an overcrowded keyboard will confuse the user and slow down user input. Once again, the manufacturer has hedged its bets: although the M20 has no discrete function keys, it is capable of providing alternate functions for some of its standard keys. Furthermore, two auxiliary keys can be redefined using an operating system utility.

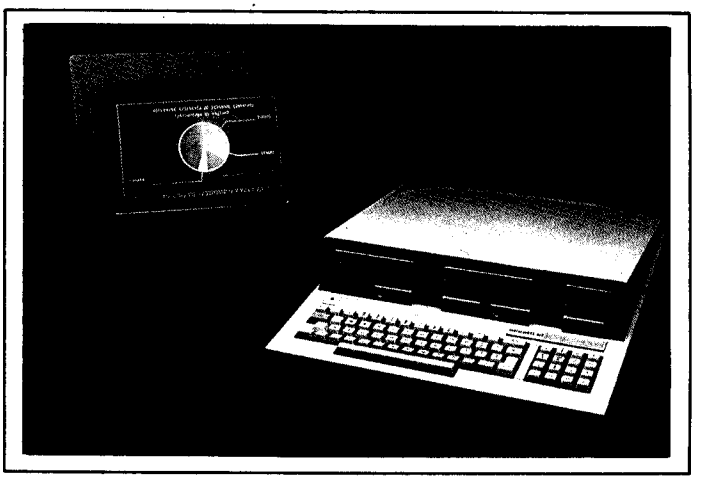

Photo 1: *The M20's color graphics capability.*

Special functions are invoked by two color-coded keys. When either the orange key, Command, or the light-blue key, Control, is pressed along with another key, it creates a new output that can be assigned a logical function. Although the use of compound keys is hardly new, Olivetti has added one interesting twist to identifying key functions. Above the top row of numeric keys is a channel designed to hold a plastic strip that identifies the two additional user-defined functions for those keys. These strips, colored orange and light blue, match the correspondingly colored Command and Control keys, a scheme that effectively offers you 24 user-definable function keys.

The Delete, Tab, and Backspace keys are also conspicuous by their absence. But this deficiency is also surmountable. Two keys, marked S1 and S2, were apparently added in order to maintain keyboard compatibility with Olivetti's previous business systems. The default functions of S1 and S2 are equivalent to Return. If you don't need three Return keys, an operating system utility called Change Key lets you redefine the functions of these auxiliary keys. Typically, you would redefine S1 as Delete (or Backspace) and S2 as Tab. Change Key lets you define any of the 252 unique ASCII (American National Standard Code for Information Interchange) codes that can be generated from the M20's keyboard.

The alpha keys also double up their functions for prospective programmers. On the front of the keys are 26 BASIC statements that can be input by compound keying, as with the numeric keys. On the right of the keyboard is a 16-key numeric keypad that features the numbers 0–9 and 00 as well as the four arithmetic functions (addition, subtraction, multiplication, and division). This keypad also doubles as the cursor controls.

The Processor Board

Inside the central unit, a large motherboard holds the electronic components of the system (see photo 2). There are two reasons for the ample size of this board. First, a true 16-bit microprocessor requires additional data and address lines as well as "wider" memory (16-bit rather than 8-bit), which means more discrete chips. Second, the M20 includes all of the peripheral control functions on the board rather than use the add-on expansion boards. The

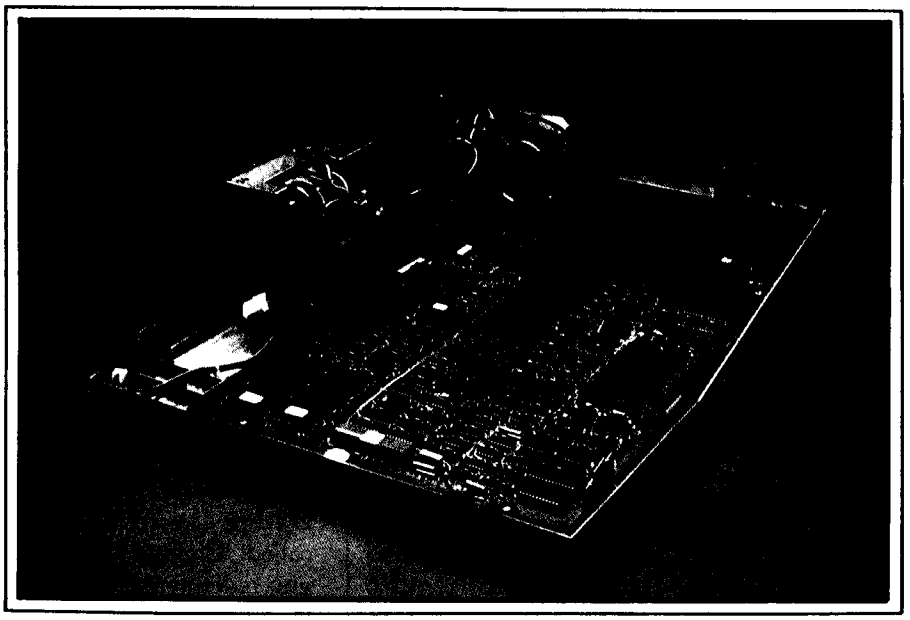

Photo 2: *The large motherboard (approximately 13 by 18 inches).*

standard M20 offers 128K bytes of RAM (random-access read/write memory), a parallel interface, a serial interface, a floppy-disk controller, and high-resolution graphics (black and white or color).

The heart of the motherboard is its microprocessor, a Z8001 that runs at 4 MHz. The Z8000 family offers an extremely advanced instruction set and the unique capability of redefining some of its internal 16-bit registers as 8-, 32-, or even 64-bit registers. This flexibility enables the Z8000 to carry out complex 32-bit arithmetic as well as perform compact byte-size operations.

The Z8001 is capable of addressing as many as 8 megabytes of memory in 64K-byte segments. The designers chose to limit the M20 to 16 of these segments, for a total (theoretical) memory of 1 megabyte. It is worth noting, however, that currently the system can be expanded only from its standard 128K bytes to 512K bytes because the expansion memory boards are limited to 128K bytes each. Presumably, when denser (256K-byte) memory boards become available, the M20 will be able to expand to its full megabyte capability.

Mass Storage

Initially, the standard M20 came with dual 5¼-inch floppy-disk drives with an unformatted storage capacity of 320K bytes (or 286K bytes formatted). Recently, Docutel/Olivetti introduced 160K-byte and 640K-byte drives in order to provide a broader range of system configurations; these can read programs or data from the original 320K-byte disk format, a feature that simplifies software distribution. The 640K-byte drive is particularly appropriate for backing up files from the optional hard-disk unit.

The 5¼-inch Winchester hard-disk drive can replace one floppy-disk drive in the central unit. This three-platter disk offers 9.2 megabytes of formatted storage and requires a separate add-on controller board. This board is inserted into one of the two I/O (input/output) expansion slots on the motherboard.

I/O Expansion

In addition to the hard-disk controller card, other optional cards can be mounted in the I/O expansion slots. Docutel/Olivetti offers both an IEEE-488 parallel interface that can daisy-chain up to 14 peripherals and a twin serial-interface card that can be configured as twin RS-232C ports, as twin 20-milliamp (mA) current-loop ports, or as one RS-232C interface and one 20-mA current-loop interface. Remember that these interfaces are in addition to the standard RS-232C serial port and the Centronics-compatible parallel port provided with the system.

Docutel/Olivetti is reported to be developing a local area network based on the Corvus Omninet CSMA (carrier-sense, multiple access) architecture. By the time that this article is published, a network may be available to connect several M20s together to share such resources as hard disks and high-speed printers.

Both color and black-and-white versions of the video unit are available. The video unit sits atop the central unit on a pedestal that adjusts to the user in three ways. The unit can tilt vertically, rotate horizontally, or move to either side of the central unit. It also has an antiglare screen to reduce eyestrain.

Both monochrome and color units have the same text and graphics characteristics and are completely software compatible. In text as well as graphics modes, the screen displays a high-resolution bit map of 512 pixels (horizontal) by 256 pixels (vertical). Unlike other systems that use a traditional character generator for text, the M20 creates text characters as it would graphics characters—pixel (picture element) by pixel. This approach allows users to modify the existing character fonts and has led to the development of several international character sets, including kanji and Arabic. In normal text mode, two display formats are available: 16 lines of 64 characters or 25 lines of 80 characters.

The system's extraordinary graphic capability emerges when you use the color display (see photo 1). An M20 with two additional memory boards (either the 32K-byte or the 128K-byte) can display eight colors simultaneously. With only one additional memory board, the M20 displays four colors simultaneously from a palette of eight. If you have a monochrome display, the colors are displayed as different shades of gray.

PCOS Operating System

By adopting the Z8001 instead of the more common 8088/8086, designers of the Docutel/Olivetti could not use off-the-shelf operating sys-

tems such as MS-DOS or CP/M-86, so they developed PCOS, a proprietary operating system. Essentially, PCOS is a single-user, single-tasking operating system. Like CP/M, PCOS is built on a nucleus and a set of resident commands that is enriched with a set of transient commands. When the computer boots up, the nucleus and the resident-commands module are loaded into RAM; together, they take up more than 20K bytes of memory. Also, 16K bytes of RAM are reserved for the screen memory; thus, of the original 128K bytes of RAM, about 90K bytes remain.

PCOS has some advanced features worthy of mention. First, it can be custom-made, so you can change transient commands into resident commands and easily modify the PCOS to "remember" such changes. To explain these features properly, we must define the terms "permanent memory" and "user memory."

Permanent memory is that portion of RAM in which you can store information that will not be overwritten or erased until the system is reset. User memory is that portion of RAM that's left over for program and data storage; this area can and will be overwritten in the course of using the system. The division between permanent and user memory is only logical; no physical boundary exists between the two.

For frequently used transient commands, you could spend much of your time waiting for disk accesses. Moreover, the system disk containing those commands must always be mounted on the drive. To avoid these problems, the PLOAD command transfers a transient command into permanent memory. Such a command will be executed immediately upon being called. Naturally, the more commands you transfer, the less user memory remains.

When you turn off the system or reset it, the previously transferred commands will be lost. To avoid a series of PLOADs every time the system is booted, the command PSAVE lets you create a personalized version of PCOS. Once you have performed a PLOAD on the commands you want resident (and have reassigned function-key values, etc.), you save a customized version of the operating system by using the utility PSAVE.

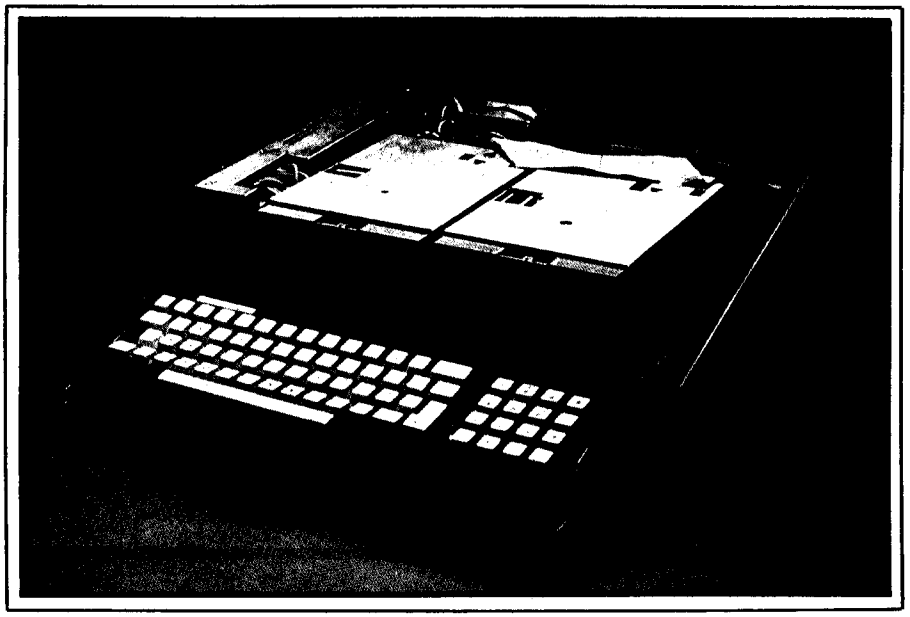

Photo 3: *The M20 with its cover removed. Note the modular construction.*

Memory Usage

In addition to flexibility, PCOS is unique in that its memory-segmentation design features dynamic allocation of memory—a concept that has been passed down from mainframes and minicomputers. PCOS (version 2.0) allows the software developer to use all of the available system memory without any difficulties created by the boundaries between the 64K-byte segments.

What this means to the programmer is that Pascal and Z8000 assembly-language code do not necessarily reside in contiguous memory. That's because the compiler and the assembler generate an intermediate z-code that is processed by the linker, which remaps the code in an effort to optimize memory usage.

The drawback to this scheme is that you don't know where your code resides within memory. Some programmers, accustomed to direct access to memory to perform software tricks, won't appreciate the PCOS dynamic-allocation feature. As always, when the M20 creates an obstacle, it offers you some software wizardry to bypass it. The PCOS utility DCONFIG gives you a memory map showing where the various pieces of code are located, so you can find all the memory pointers you need.

BASIC

Obviously, the PCOS memory management cannot override the addressing limits of Microsoft BASIC. All computers using this popular BASIC are limited to 64K bytes. Because the M20 has no BASIC ROM (read-only memory), the whole interpreter (37K bytes) is loaded into RAM. Without memory management, you would have had only 20 to 25K bytes of user memory available. Even with memory management, the stock 128K-byte system has only about 40K bytes of usable BASIC memory. The serious BASIC user needs 32K bytes more RAM.

The M20's Extended BASIC features excellent graphics, control of the IEEE-488 interface, program segmentation by using the CHAIN and COMMON commands, and the ability to call and execute object code routines and PCOS commands.

The graphics statements take full advantage of the bit-mapped screen and let you manage multiple windows. You can also draw points, lines, boxes, circles, and ellipses.

Windows

The integrated bit-mapped approach lets you use multiple (up to 16) windows, each with its own attributes. Each window can display both alphanumerics and graphics and can scroll independently of other windows. These windows can be created either through PCOS calls or BASIC instructions. Although windows may not overlap and do not support multitasking, they have some interesting properties. Among these are automatic word wrap and graphics scaling, in which drawings automatically shrink to fit within previously defined windows.

Data Security

PCOS offers three varieties of data security. The first makes it possible to protect a BASIC program against listing, editing, or copying. The second lets you define a volume password that is thereafter required to enable that volume. The third password protects your individual files.

Finally, PCOS provides support for the serial (RS-232C) and parallel (Centronics-compatible and IEEE-488) interfaces. It also includes a real-time clock feature in two formats, hours:minutes:seconds and day/month/year.

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Coda

The uniqueness of PCOS places the M20 out of the software mainstream as compared to machines that run MS-DOS and CP/M-86. Furthermore, the choice of the Z8001 limits the portability of software packages from other 16-bit personal computers.

Although Docutel/Olivetti has adopted Microsoft BASIC (which should encourage the transfer of BASIC programs) and has acquired and developed some good application packages such as Multiplan and Data Factory Plus, its nonstandard hardware/software environment represents the most serious limitation to the M20's prospective sales. For this reason, Docutel/Olivetti just introduced its Alternate Processor Board (APB 1086), which is based on an 8-MHz 8086. This board, designed by Tecmar, gives the M20 access to MS-DOS and CP/M-86 software and makes the system "data compatible" with the IBM Personal Computer.

In the near future, you can expect a new release of PCOS, the UCSD p-System, and CP/M-8000 to be running on this elegant, but slightly puzzling, import. ■

About the Author

Sergio Mello-Grand is a Silicon Valley-based editor for the Italian technical magazines Bit *and* Informatica Oggi.