

Multimedia Mania

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Introduction

Over the last year, frequent reports about *multimedia* began to appear in newspapers and on television news. Several large communications companies promised to merge with each other and with computer companies to prepare for the coming of a new age in entertainment, education, and communications arts. Several of the mergers and plans fell through, possibly because each company had a different concept of what the new technology known as multimedia is and will be. Even now, many people do not agree on a definition of the term multimedia. Since the technology is still in evolution, any definition of the term should be left broad: *multimedia technology* is the combination of sound, graphic images, animation, and video presented to a user via computer. Initially, this technology was used to create video games on such computers as the Commodore Atari and later on the Apple Macintosh. When multimedia capabilities were added to the Microsoft Windows environment in 1991, the move toward multimedia gained momentum. Multimedia presentations make extreme demands on computer hardware, so its popularity increased only after the hardware improved in features and cost in the past 2 years. For example, until the price of CD-ROMs fell to the range of several hundred dollars, software that contained video files of several hundred megabytes could not be distributed in any reasonable manner.

Like most of the rest of the computer world, medical computing is beginning to benefit from multimedia. In this article, we will explore some of the concepts behind multimedia and consider some hardware and software issues. In a future ar-

ticle, we will examine some specific multimedia titles now available in the medical field.

Computer Hardware Requirements

Recently, I bought my 5-year-old daughter a multimedia CD-ROM entitled *Just Grandma and Me* (Broderbund, Novato, CA, USA). This "Living Book" is a captivating animated story based on the book by Mercer Mayer. It combines still cartoon images with animated sequences and sound, all under the control of your child (or yourself) working the computer mouse. Here are the minimum system requirements for this child's storybook (PC Version): 386SX or higher computer with at least 4 megabytes of random access memory (RAM), Windows 3.1 or higher, DOS 3.3 or higher, Super VGA monitor (640 X 480 with at least 256 color capability), a sound card, a mouse, a hard drive, and a CD-ROM drive. My office database of 7,500 patients and over 150,000 records of information can run on less robust hardware than that and still provide data access times of <1 second, illustrating the computing power required to run even the simplest multimedia applications. Here are some of the hardware requirements for a *Multimedia PC*, sometimes referred to as *MPC* (a trademark of the Multimedia PC Marketing Council).

Processor, Memory, and Hard Disk

One can never have enough RAM, processor speed, or hard disk space. The original MPC specifications allowed for a 12 MHz 80286 processor, but the current minimum is an 80386 SX running at 16 MHz. For displaying video clips, you should use at least a 33 MHz 386 DX processor. Recently, the 386 computer market has been replaced by 486 SX, 486 DX, 486 DX2, 486 DX4, and Pentium machines. Later this year, the Power PC from Motorola, already available on the newest Apple Macin-

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tosh computers and promising to be faster than the Intel Pentium, will appear in PC compatible machines.

Although early MPC specifications stipulated 2 megabytes of RAM, that is barely enough memory to run Windows 3.1. Most computers sold at this time contain at least 4 megabytes of RAM, and that should be considered a minimum. Many Windows applications, including multimedia ones, will run noticeably faster if you have 8 or 16 megabytes in your machine.

The original MPC specification for 30 megabytes of hard disk space is considered grossly inadequate by today's standards. The Windows software itself occupies over 20 megabytes, and many applications do likewise. When purchasing a new multimedia computer or when upgrading an older one, 200 megabytes should be considered a minimum. The price of drives as large as 540 megabytes has come down recently, so purchase the largest drive you can afford. Although disk compression programs will approximately double the storage capacity of your hard disk, they function by using processor capacity to compress and decompress files in real-time as the files are written to and read from the hard disk. This process places a 10%–15% time overhead on your system, which is unacceptable for many multimedia presentations. Video playback, especially, may deteriorate to unsatisfactory levels when compression software is used, since most computer video playback protocols make use of some compression functions themselves.

Display

Since displaying graphic images and photographs is such an important part of multimedia presentations, the computer monitor is an important component of your system. A computer system should include a "super VGA" monitor with a vertical scan rate of 72 Hz or greater and the capability of displaying at least 256 colors at resolutions of 640 × 480 pixels (picture elements), 800 × 600 pixels, or higher. Standard 14- and 15-inch displays are adequate, but for higher resolutions, such as 1,024 × 768 pixels, a 17- or 21-inch monitor is better. At the higher resolutions, text size is small on a small screen. The larger monitors are

expensive, with 17-inch models retailing for over \$1,000.00, and 21-inch models over \$1,500.00

The VGA display card that runs the monitor should have at least 1 megabyte of memory. More memory allows the card to display more colors at each given resolution. This memory is independent of the system's main RAM. In the future, display cards will become faster. Presently, many VGA cards will fail to send some frames to the monitor when displaying full motion video clips, especially when the video picture is meant to fill a large part of the screen (more data to process with each frame). Faster cards will solve this problem and permit at least 30 frames per second (current television standard) to appear on the full monitor screen.

Sound

Although the Apple Macintosh was designed to play high quality sound and has hardware to accomplish this built into the system, PC-compatible computers require an additional sound card in order to play high fidelity sound and recorded speech. These cards fit into one of the slots inside your computer, and have input/output jacks on the back of the computer for connecting microphones and stereo speakers. They also provide a digital and often analog audio connection to an internal or external CD-ROM drive. This provides for communication between the card and the drive, as well as the capability for playing standard audio compact disks through your computer's external speakers. Although a sound card could produce simple sounds through the PC's internal speaker, external speakers are recommended to achieve better quality voice and music.

Sound cards play back either digital sound files, or analog audio. There are two types of sound files, waveform and non-waveform, and Windows 3.1 supports both. Waveform files store sampled sound data created by analog to digital conversion. These files are usually large, since they contain information that was sampled with a resolution of 16 bits and as fast as 44.1 kHz for high quality stereo sound. Sounds sampled at this resolution and frequency produce files as large as 10.5 megabytes for each recorded minute. By convention, the common type of waveform file used in Windows applications have a file extension of ".WAV"

(sometimes called "wave" files). These files can be used to store any sounds, including voice and music. The non-waveform files, also called ".MIDI" files, store information as instructions, such as musical notes and their duration, and because of this the file size tends to be much smaller than waveform files. They can store music or some sound effects, but not voice. Many of today's sound cards can play back MIDI files, or the files can be played through an external synthesizer. One problem with MIDI files is that their playback instructions are device specific. If codes for certain instruments are different between two playback devices, the notes will sound different.

Besides playback, sound cards allow you to record sounds and save them in files on your hard disk. Using a microphone or line outputs from another audio source, and software contained in Windows 3.1 or sold with the card, you can sample sounds and construct ".WAV" files, which can be played back later. This is how many voice mail systems work. The software also allows you to edit the file, often with the aid of a graphical display of the waveform data.

Fortunately, sound cards are now increasing in quality and decreasing in price. Popular cards include the Sound Blaster series (Creative Labs, Inc., Milpitas, CA, USA), and the Pro Audio series (Media Vision, Inc., Fremont, CA, USA), ranging in price from about \$85 to \$300 for a state-of-the-art 16-bit model.

CD-ROM

Since image, sound, and video files consume so much disk space, most serious multimedia software is distributed on CD-ROM disks (Compact Disk, Read-Only Memory). Think of a CD-ROM disk as a large read-only hard drive that can hold approximately 600 megabytes of data. Digital information is stored on a CD-ROM similar to the way it is stored on an audio CD. Most CD-ROM drives can read audio CDs. CD-ROM drives are not required for multimedia presentations, but are a convenient tool for distribution of such programs, since the disks can hold so much information. CD-ROM drives can be used by non-multimedia applications, and more software applications are beginning to replace floppy disks with CDs as their primary distribution medium.

External and internal drives are available. Usually the drive is connected to your computer's data bus by an SCSI interface card. These cards can control other devices in your computer, such as hard drives. Some sound cards contain a built-in SCSI adapter for use with a CD-ROM drive. Although when upgrading a computer, selecting each component individually allows you to choose the highest rated hardware in each class, purchasing upgrade kits from one manufacturer assures that all the components will work together. Installation of a CD-ROM could be a difficult and frustrating undertaking, and hardware incompatibility just compounds the difficulties.

Newer drives are referred to as double-speed or triple-speed CD-ROMs and they transfer data at 300 Kbytes or 450 Kbytes per second rather than the older MPC standard of 150 Kbytes per second. Data access times have also been reduced to under 300 msec, versus the older standard of approximately 600 msec. An important feature that has emerged over the past 2 years is support for multiple session CDs and Kodak Photo CDs. This allows your drive to read CDs that were created in more than one session. Photo CD is becoming an important graphics tool in the multimedia industry. By sending slides or film to Kodak, you can obtain high quality Photo CD files of your images. These files can be displayed on the computer if your drive is Photo CD compatible, or they can be transferred to your hard disk or floppies and incorporated into presentations.

The cost of CD-ROM drives has been decreasing steadily. Double speed drives now cost approximately \$200 to \$400 including cables for installation. Recordable drives are now available, but current cost is in the range of \$3,000 to \$5,000, and blank media (useable for recording only once) cost about \$20 per disk.

The Media Components of Multimedia Software

The major components of a multimedia presentation include text files, images, sound files, and video files, all controlled by a software program written in a standard high level computer language or in one of several authoring programs that are available.

MULTIMEDIA

Text

A major use for CD-ROMs is for storage of large amounts of reference information. Commercially available CD titles include the Bible, several different encyclopedias, the complete Physicians' Desk Reference, the Merck Manual, complete text of five American Heart Association journals (including *Circulation* from 1987 to 1993), text and figures of 2 years of the *New England Journal of Medicine*—all on one CD each. While these works do not qualify as multimedia, they are usually included in descriptions of multimedia programs since they use powerful searching software that was written for use with multimedia applications. A single CD-ROM holding even 1 year of a journal can help you save valuable storage space on your medical bookshelf, and searching for articles or topics electronically is much easier than using a paper index.

Images

Graphic images for multimedia presentations come from several sources. Libraries of cartoon images known as clip art are now widely available in all fields, including medicine. These line drawings or colorized sketches can be used to illustrate parts of the anatomy, for example. A photograph, drawing, or x-ray can be scanned into a file using a flatbed or hand scanner. Because multimedia computer monitors can display in high resolution with 256 or more colors, the images usually contain enough detail to demonstrate even the most intricate points.

Animation

Computer animation is like a children's cartoon. Graphic images are played in rapid succession giving the impression of smooth motion. The images (which are displayed as fast as 30 frames/sec) are all stored in a special type of graphics file, usually with the extension ".FLI", and are

"played" using the multimedia presentation software.

Sound

These files were discussed in the section on sound cards. They consist of waveform (".WAV") and non-waveform (".MIDI") files.

Video

This is the component that places the greatest demand on your hardware. Video images from a camera or video tape recorder are digitized by the author of the multimedia presentation using a video capture board. The images are placed in audio video interleaved files (with the file extension ".AVI"), which contain sound and video data. The size of an AVI file depends upon the resolution of your video images, the size the image occupies on the computer screen, and the duration of the recording. A single minute of video can occupy more than 20 megabytes of data, so most recording and playback systems utilize some form of data compression. A video digitizer board is needed to record AVI files, but not to play them back. A fast computer, a fast CD-ROM drive, and a fast display adapter are required to play back video files without losing frames. The bottleneck is usually in the transfer of data from the CD-ROM drive to the computer's data bus, so double or triple speed drives are better suited for video playback.

Potential in Medicine

The potential uses of CD-ROM and multimedia technology in medical education and as a platform for storing reference material should be obvious at this point. In a future column in this series we will examine some specific programs and references in detail. Until then, please send me your comments or questions via the Internet at adm4@columbia.edu, or through Prodigy mail at JHC51A.