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ABSTRACT

This paper presents a specific bottom-up implementation method for getting started with multimedia for instructional support at the personal level. Some minimal top-down design considerations for an institutional multimedia system include: (1) the instructor should be able to take work from/to the desktop to/from the classroom; (2) the capability in the classroom and on the desktop should be similar; (3) students in the class should be able to easily see what is presented; and (4) students should be able to electronically interact with the instructor. Getting information into and out of the computer is an important part of multimedia gadgets; one way to share gadgets between environments is to use gadgets that interface via common hardware ports. Lower resolution (and lower priced) television screens are suitable monitors for most classroom instruction. The failure of any one part of the instructional technology in use can cause the entire system to fail, with potentially catastrophic consequences; the only viable solution to the technology dependence problem seems to be to make each part of the system as reliable as possible, with provisions for fault tolerance. Multimedia can be used to teach about multimedia and other information systems and computer technology material. Word problems using multimedia in a relative context can help student decision making. When working with large files, some form of backup and transportable storage is essential. There is a number of practical and theoretical concepts that multimedia users should be aware of in terms of multimedia objects (text, graphics, audio, and video) and usage. (AEF)

A Personal Multimedia System for Instructional Support

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Abstract

How can one get started with multimedia in the classroom for instructional support? Someone without a large budget. Someone without a lot of time. This paper will present a specific bottom-up implementation method for getting started at the personal level. The cost-effective techniques will be used for the presentation itself. Ideas for class presentations and assignments are included.

Multimedia

There are many definitions of multimedia. One of the best and most widely accepted is Hofstetter's definition.

- Multimedia is the use of a computer to present and combine text, graphics, audio, and video with links and tools that let the user navigate, interact, create, and communicate. (Hofstetter, 1995)

From the definition, the following can be inferred.

- A sufficiently powered computer is required. In 1990, I started using a black and white LCD panel that sat on an overhead projector. Of course, no one had fitted the fan on the panel, so it was starting to burn out. And it only worked in text mode. But, worst of all, it was connected to an antiquated 8088 PC/XT computer. After purchasing software to context-switch between applications (for demonstration purposes) and word processor (for notetaking and notes display), the context switch time was about 20 to 30 seconds, far to long to wait doing nothing in class. The problem was an insufficiently powered computer. That and the transportation cost and setup/takedown cost led me to suspend the effort after one semester of determined effort. Computers and multitasking operating systems are now readily available such that this is less of a problem than it used to be.

- Text, graphics, audio, and video are required. These facilities generally require both input and output devices (unless one is running canned software that, in many cases, require only output devices). Input devices usually present more problems than output devices. The plethora of storage formats requires one to verify beforehand that a gadget to do input and/or output will in fact produce files in a storage format supported by the rest of the system and, in doing so, interoperate with other system software.

- Finally, software is required to let the user navigate, interact, create, and communicate as desired. There are many packages available. This paper will be limited to off-the- shelf software that is readily available in most University settings, such as Microsoft Windows and Office (Word, Excel, Access, PowerPoint), NetScape (HTML links), and software that is included with input and output hardware gadgets for text, graphics, audio, and video.

Of course, most instructors must use multimedia in the context of an institutional system, not having the resources (e.g., time, money, technology, approval, etc.) to do it alone.

Institutional Multimedia System

Some minimal top-down design considerations for an institutional multimedia system include the following (Snyder, 1922).

- The instructor should be able to take work involving text, graphics, sound, and video from/to the desktop to/from the classroom. This avoids the costly task of preparing physical overheads manually, is environmentally appealing, and can be used to enhance classroom presentation.

- The capability in the classroom and on the desktop should be similar, since additional capability in the classroom that is not on the desktop will not get used, and additional capability on the desktop that is not in the classroom will create frustration.

- Students in the class should be able to easily see what is presented.

- Students should be able to electronically interact with the instructor (for attendance, exams, surveys, etc.). This capability gets into workgroup and idea processing software and is beyond the scope of this paper.

If an organization does not have in place a system that provides general capabilities for multimedia for instructional support in the classroom, how can one get started now?

Environments and Gadgets

The author teaches classes in at least three environments.

In the first environment, the classroom is in the same building and, sometimes on the same floor, as the author's office. The author's office computer has been placed on a heavy-duty plastic cart designed for an overhead projector. Thus, the cart (and computer) can be moved to and from the classroom. In order for students to see the screen, a TV/VCR is (usually) provided by the media center of the library and connected to the computer via a VGA-to-TV converter.

In the second environment, the classroom is at an off-site location 40 miles from main campus that has some stand-alone workstations on a small network with a VGA-to-TV converter and a TV. In this case, some software and data files must be transported via floppy or Zip disk to and from the site. No CD- ROM drives are currently available.

In the third environment, which covers anything not covered by the other two environments, a laptop computer with a VGA-to-TV converter is used. The laptop computer has an internal fax/modem, a parallel and a serial port, and connections for external video, keyboard, and mouse. A CD-ROM drive is not currently available.

Getting information into and out of the computer is an important part of multimedia gadgets. One way to share gadgets between environments, that is, to have interoperability of gadgets between different environments, is to use gadgets that interface via common hardware ports (e.g., VGA port, keyboard port, mouse port, serial ports, parallel ports) as opposed to gadgets that interface via proprietary ports that require that a special board be installed in a slot of a computer according to the bus architecture of the computer (e.g., ISA, MCA, etc.).

Oh say can you see

The most important part of the system is the way in which students see what is on the screen. Color LCD projection panels that allow full motion video tend to be expensive, in the $4000 range. They also can be broken if dropped, and are easily stolen. In addition, overhead lights must be dimmed with the consequent disadvantages in the classroom.

Although large (e.g., 31 inch) high resolution monitors are quite expensive, in practice, lower resolution (and lower priced) TV screens (that are readily available at most institutions) are suitable for most classroom instruction. One must realize that the student need not see every little detail of the screen. In practice, it is very beneficial for the student to see the intuitive direction of the instruction, and not every little input (i.e., keystroke and mouse movement) and output nuance (i.e., the screen).

True story: I assign assignments that require a word processor and spreadsheet. Some students would spend 20 hours or more working on the spreadsheet part of the assignment. One week, I actually did the assignment on the spreadsheet in real time. The jaw of one of the students dropped with a look of amazement. Here, I had done in 2 or 3 minutes what had taken her many many hours of work.

Since then, I have made it a routine practice to show, as it were, a "proof by example" that the actual work is not that difficult, if only one understands the problem and the software. Complaints about spending too much time have dropped significantly. And, if something is presented on the screen that the student does not understand, or if a shortcut is used that could save the student a lot of time, the student will stop the instructor to find out how it was done. This is a demand-driven goal-oriented approach to learning and problem solving.

True story: A student who had used Windows at work for over two years stopped me when I moved a window by dragging the title bar of the window to a new location. "How did you do that?", the student exclaimed, "I've never been able to get those windows where I want them.". I thought that the student was joking, but he was very serious and, in fact, did not know how to move windows. He was very appreciative of his newfound capability.

Given that a TV with a video-in (or a TV/VCR combination with a video-in) is available, one connection alternative that works well in practice is a low-cost VGA to TV converter. Cost: About $120. Installation: Unplug the computer VGA output cable from the monitor and plug it into the converter. Then, plug the VGA output cable of the converter into the monitor. Then, plug the TV output cable of the converter into the Video-in of the TV (or VCR). Of course, connect the power supply via the transformer brick. Many converter models also support S-Video (which does not cut off any of the horizontal part of the VGA screen).

The computer/cart combination has a VGA-to-TV converter permanently installed on the cart to minimize setup/take-down costs. However, if students want to use their laptop computer for a presentation (e.g., they use a different operating system and/or applications software), the appropriate cable is switched from the computer on the cart to the laptop and they are ready to go.

In Windows, the loss of part of the screen is not crucial, since the Window can be resized so that it appears entirely within the part of the screen visible on the TV. The author has written simple macros in Word, Excel, etc., that automatically reposition the window appropriately so that the repositioning need not be done by hand. And, in many applications programs, the font sizes can be changed to make it easier to see details on the TV screen.

> Fallacy: With screen display, there is no need for a white board or overhead projector and screen.

Why should one technology replace the others? I find that, although this may seem obvious, it is quite necessary in practice to justify such concerns. I actually would prefer two or three overhead projectors. One for concepts that last throughout the entire class period, one for new information, and one for the previous slide, to allow both instructor and students to refer back to. In practice, it is difficult to get even one overhead projector that focuses and has a working bulb that does not burn out during in class (who keeps the spare in its place, anyway), and, hey, who needs a screen anyway, just use a white board. One must then politely inform those advocating that policy that using a white board as a projector screen causes a large white spot of glare that is quite irritating to most observers. But, a white board is useful at times. I often have to deal with projector screens in one direction, a TV screen in another direction, to white board in another direction, and the podium in yet another location. Perhaps the students should get credit for a 1.0 credit physical education course in exercise of the neck.

Ergonomically, the TV should be positioned such that glare from overhead lights (in classrooms not designed for such presentation) is minimized. This often requires removing lights close to the screen and, in some cases, tilting the TV screen slightly. Unfortunately, the TV is often installed without such considerations in mind and it may be difficult to change (the orientation of the TV) after the fact.

Output Gadgets

Some other output gadgets and/or software used by the author include the following.

- Logitech AudioMan microphone/speaker (connects to parallel port) is used for sound input/output. The sound is not as good as a dedicated sound board, but the device is small and portable. Cost: About $100.

- Labtec speakers are used for (louder) sound output in a classroom setting. Cost: About $20.
- An AverKey VGA to TV converter is used for TV output (discussed above).
- Microsoft Word, Excel, Access, and PowerPoint software is used for overhead presentations.

Note the absence of a CD-ROM player in the portable system. CD- ROM players connected via a parallel port are still costly and perform poorly (due to slow throughput via the parallel port). This means that canned programs on CD-ROM cannot, at this time, be used with the portable system. A CD-ROM player is available, however, on the computer/cart combination.

Input Gadgets

Some input gadgets and/or software used by the author include the following.

- A wireless mouse (one less wire to worry about) provides some freedom from being bound to the computer. Cost: About $90.
- An external keyboard provides some freedom from being bound to the laptop. A wireless keyboard/mouse combination would be nice.
- A Logitech ScanMan EasyTouch scanner (connects to parallel port) is used for scanned input. Cost: About $200. Logitech OmniPage Direct OCR software (bundled with the scanner) is used for OCR (optical character recognition) purposes.
- A Logitech FotoMan camera (connects to serial port) for real time picture taking. Cost: About $600. Logitech FotoTouch Color software (bundled with the camera/scanner) is used for photo image processing.
- A Logitech AudioMan microphone/speaker (connects to parallel port) is used for sound input/output. Cost: About $100. Logitech AudioMan software (bundled with the microphone) is used for audio sound processing.
- A Connetrix VideoCam (connects to the parallel port) is used for real time movies and pictures. Cost: About $100. Connetrix VideoCam software (bundled with the camera) is used for movie and/or picture processing.

Reliance on Technology

Preparing course instruction that uses multimedia technology can be a time-consuming endeavor, even with the best of hardware and/or software. In (expensive) self-contained personal multimedia systems, this effect can be minimized. But when the instructor requires that a larger institutional system not fail, chances are that some part of the system will fail. For example, if an adequate display mechanism is not available (e.g., the library media center forgot to deliver the TV/VCR combination, etc.), what is to be done?

As we rely more and more on information systems and computer technology, the failure of any one part of that technology can cause the entire system to fail, with potentially catastrophic consequences. In terms of this paper, catastrophic in that the class cannot be taught as planned and some alternative presentation needs to be done on short notice. This need happen only once for the instructor to be discouraged from continuing that course of action.

True story: I was teaching class on the first floor using the computer/cart combination. My office is on the second floor. A lightning strike causes power to be disrupted. The power goes out for several seconds. Although the UPS (uninterruptible power supply) on the computer kept the computer running throughout the blackout, the elevator was knocked out. In this case, there was no place to store the computer and it took about an hour to disassemble the computer/cart combination, carry it up one floor, and reassemble the computer/cart combination.

The only viable solution to the technology dependence problem seems to be to make each part of the system as reliable as possible, with provisions for fault tolerance. In overhead projectors, this means having a spare bulb. In classrooms, this means having redundant TV/VCR combinations, or at least, reserves that can be committed on short notice to immediately rectify the solution. In the case of lightning strikes knocking out elevators, it means having a computer with TV connection in the classroom that is connected to the campus network (which does not go down in the middle of class). And so on.

Instructional Uses

Multimedia can be used for many purposes. In teaching MIS and other computer related courses, multimedia is used to teach multimedia (and other information systems and computer technology material). Such an introduction typically goes as follows. Note that the conference presentation will lump these ideas together. In an actual course setting, the material would be distributed over many weeks with a fuller discussion of each of the concepts and word problems provided to be solved as exercises.

- Use Microsoft SoundBits (Flintstones, Jetsons, Yogi, etc.) to grab the attention of the students.
- Set up the video camera "eye" before class and see the reactions of students as they realize that the computer is watching them.
- Take each student's picture with the camera. Note that it can take substantial time to download the pictures via the serial cable to the hard drive of the laptop. Analyze the transfer rate problem while it is happening.
- Crop an appropriate part of each picture and save each as a TIF and BMP file on the hard drive.

- Display the pictures on the screen. Change shades of gray, rotate the picture, draw a mustaches on a selected photo,etc.

- Print out a class listing with pictures.

- Record each student saying their name into the microphone. Display the sample, and save each as a WAV file on the hard drive. Assign one of them to a Windows action, such as maximizing a window.

- Play each student's voice file using the speakers.

- Scan text (via OCR software and OLE support) directly into a document. Note the problems in doing the conversion (i.e., it is not 100.0% accurate).

- Scan a picture from a magazine. Display and print it to illustrate the differences between gray scale and line art.

- Fax a line art picture, just scanned, to a nearby office. Discuss how a fax machine handle graphics, data compression, etc.

- Show the scalability differences between scanned bit maps and vectorized (scalable) fonts, etc. A discussion of PostScript graphics and EPS files is appropriate here.

- Print individual pictures with sound waveforms for each student.

- Supply each student with files for their picture (BMP, TIF, EPS), sound (WAV, EPS), icon (ICO), etc.

- Have the student import EPS files directly into their work for output on a (PostScript) laser printer.

Students find these exercises very interesting and relevant. A practical use of the system for the teacher is that names, faces, and correct pronunciations of names can be more quickly learned.

Problem Solving

It is not enough for a student to see what is being done and say, "Yes, that's impressive.". A primary objective, from a quantitative and MIS point of view, is to drive home the cost of processing multimedia information in terms of storage space and transfer times. One way to do this is with word problems. Word problems that now have some relevant meaning, such as the following:

- A sampling rate suitable for voice recording (not high fidelity music) is 11KHz (1 KHz is 1024 samples per second). If each sample can have one of 256 possible sound frequency values (Hint: How many bytes per sample are required?), how much sound can be put on a floppy disk that has a maximum capacity of 720KB? Give your answer in terms of hours, minutes, and seconds. Briefly discuss how this method compares with using a cassette tape recorder?

- A photo has a width of 100 dots and a height of 200 dots. Each dot can have 1 of 256 possible gray scale values. How many pictures can be put on a floppy disk that has a maximum capacity of 720KB? What happens if we decide to store photos that have a width of 200 dots and a height of 400 dots (that is, twice the resolution)?

- Why might we want to compress sound and picture files? What are some possible disadvantages of data compression?

Notes: In the second problem, doubling the resolution requires four times the space requirements. The last question is asking for a specific answer that uses the results of solving the previous two questions.

From experience, assigning these word problems without a relevant context will tend to cause resentment and lack of motivation on the part of students. Comments such as, "But we will never use this", are commonplace without a relevant context. But once a student has experienced the process first hand, and have in their possession a disk with their own picture and voice, and can see how many bytes are required (50KB to 150KB for the picture file, 20KB to 60KB for the sound file), the student can better make decisions concerning implications of multimedia use.

This demand driven goal-oriented approach to problem solving and learning by workers in business and industry is called Just-In-Time learning by Hofstetter (Hofstetter, 1995), although the same techniques can be applied to students in an academic environment.

Storage

When working with large files, which is the case in multimedia (and databases), some form of backup and transportable storage is essential. It has been said (by Arthur Clarke) that magic and sufficiently advanced technology are indistinguishable. That is the way I felt when I first obtained an Iomega Zip drive that boasts a 100MB floppy disk. I now have three Zip drives (one for home, one for work, and one as backup and for the road) and a backup disk for each day of the week, allowing both a multilevel source file backup and a way to automate transfer of large files and large numbers of files between computer systems. The Zip drive works via a SCSI or parallel port interface, making it easy to set up and transfer information between computers (in this case, any Intel-based computer running DOS and/or Windows). Although the transfer rate is slow for large amounts of data, it is much faster than 1.44 MB floppy disks, especially when only files that have been changed are being updated. On a foreign computer, one can plug in the Zip drive, run the guest.exe program that autodetects and add the drive to the DOS drive list, and then use the Zip drive as any other DOS drive. Cost: About $200 for a Zip drive with one disk. Disks cost about $20 each.

Power Supplies

With a number of gadgets, it is inevitable that most of them have their own transformer brick (some small and some not so small). It should go without saying that one should not plug the output of a transformer brick into the wrong device. To avoid this problem, put a label on each indicating what device it is for. One can also add matching number and color coding on both the gadget and the transformer brick. On a cart, it is advisable to either hide the cables and wires, or, at least, wrap them around the legs of the cart to keep them from getting loose and grabbing onto something and getting torn apart.

Parallel Ports

The standard parallel port on most computers, called LPT1:, is very convenient for connecting devices, but is somewhat slow. And, with many multimedia gadgets, each of which wants to own the parallel port, each of which allows a printer bypass but does not support other gadgets, and each of which recommends that you power down the computer before plugging and/or unplugging cables, it is desirable to have more than one parallel port. One attractive solution, and the one used by the author on the desktop computers, is to add two high-speed bidirectional parallel ports (requiring one slot each) that can be configured to use high IRQ's (interrupt levels, of which each computer only as a few free ones), and act as LPT2: and LPT3:. Cost: About $45 for the first additional port and $30 for the second additional port. Technical installation required (i.e., inserting chips, installing the board, setting switches on the board).

Theoretical Concepts

There are a number of practical and theoretical concepts whose underlying models are essential to avoiding a time-consuming trial-and-error approach to multimedia objects (in the form of text, graphics, audio, and video) and usage. A sampling of these concepts include the following.

- An understanding of bits and bytes is essential to forming a model of multimedia objects.
- Multimedia objects can be compressed using lossless or lossy compression schemes.
- Multimedia objects can be encrypted/decrypted.
- Multimedia objects can be stored in a variety of file formats.
- Multimedia objects can be shared via OLE (object linking and embedding).
- Audio sound can be sampled, smoothed, filtered, converted to/from analog/digital, and represented discreetly as MIDI.
- Graphics requires an understanding of coordinate schemes, Bezier curves, lines, polygons, scalability (dpi), gray scaling, thresholding, dithering, light and color models, texturing, printing methods, and animation techniques.
- Information can be stored as hyper-text, hyper-media, searched, and shared via clipboard and/or DDE techniques.

Summary

This paper has presented a specific bottom-up implementation method for getting started with multimedia for instructional support at the personal level. There is a learning curve to the entire process, so you might want to gather ideas and get started as soon as you can in whatever way you can. It is hoped that this paper has given you some of those ideas from which the reader can pick and choose as desired. For more general information, see, for example, (Hofstetter, 1995).

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