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ABSTRACT

A new technique called computer augmented lectures (CAL) now in use at the University of Texas at Austin is discussed in this report. The technique is described as involving the integration of on-line interactive time-sharing computer terminals and theater-size video projectors for large screen display, the goal being to promote student learning by supplementing the lecture presentation of fundamental concepts in various fields. The basic idea and history of CAL are reviewed and its pedagogical techniques, technical hardware specifications, programing languages, and economic factors are covered. (Author/PB)

THE USE OF ON LINE VIDEO PROJECTION TECHNIQUES IN COMPUTER AUGMENTED LECTURES

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ABSTRACT

A new technique described as computer augmented lectures (CAL) is being used at The University of Texas at Austin. It involves the integration of on-line interactive time-sharing computer terminals and theatre size video projectors for large screen display. This paper covers the basic concept, pedagogical techniques, technical hardware specifications, programming languages and the economics involved.

THE USE OF ON LINE VIDEO PROJECTION TECHNIQUES IN COMPUTER AUGMENTED LECTURES

INTRODUCTION

The use of video-projection began in the late 1950's in theatres equipped with special television projectors to handle closed circuit live television programs in sports, conventions, and similar events. In the early 1960's, specialized applications for use of displays in the Defense Department war rooms to show a tactical situation on a map overlay were constructed as an integral part of a real-time computer system. The technique consisted of projection of an accurately scaled grid map on a cathode ray tube (called a two port CRT), plus the generation of the tactical symbols (positioned precisely on x and y coordinates) by a computer. The resulting multiple image was fed into a video projection system using a television camera. In the late 1960's and early 1970's, with the expansion and use of computer time-shared systems in education, the primary emphasis was on individualized instruction. Various acronyms were coined such as computer assisted instruction (CAI), and computer managed instruction (CMI). In all cases very little application of group display techniques were investigated in education.

PEDAGOGICAL TECHNIQUES

In 1968, the widespread use of cathode ray tube terminals of the raster scan type in time-sharing systems for computer assisted instruction was well underway. Prior to this time, teleprinters were the most common type of terminals used to communicate with computers. Early in 1969, experimental tests were conducted at the University of Texas at Austin by Lagowski and Muller on the use of videoprojection techniques. Lagowski used a video projector in the Academic Center to augment lectures in introductory chemistry before a class of 200 undergraduate students. Terminal equipment used in this test consisted of a Computer Communications Coporation model CC-30 CRT terminal. The image on the CRT was fed into a Telebeam videoprojector via a 20 foot RG-59/U coaxial cable. The CRT was linked to the University of Texas CDC-6600 time-sharing system through an Anderson-Jacobson Model 260 acoustic coupler on a commercial dial-up line. Data was transmitted at 110 bits per second in a half duplex mode between the computer and the CRT and then to the videoprojector.

The technique of using interactive computer programs for video projection to large numbers of students to teach basic concepts is a new application in education that has found its place as a valuable tool for enhancing lectures.

Matsen, of the University of Texas has called this technique computer augmented lectures (CAL). Lagowski's first programs in introductory chemistry used CAL. The programs in chemistry were written in CLIC, an interactive Fortran-based instructional language containing a repertoire of operating instructions very similar to Coursewriter. A schematic of a typical CAL installation is shown in Figure 1. A listing of the equipment is also shown in Table I.

COURSES USING CAL

Examples of the present use of CAL include a course in theoretical chemistry taught by Matsen. Matsen's interactive programs written in FORTRAN IV include Eigen-Vector theory and molecular orbital theory. Students were permitted to observe interactions and could request program changes. Results of such program changes were shown immediately. Other programs using this technique include Hunt's course in the Business College for teaching statistics using OMNITAB, a National Bureau of Standards interactive language.

It is interesting to report that a very valuable technique was used in Matsen's course, that of providing an auxiliary back-up device to record the programs on digital cassettes. The Techtran Model 4100 digital cassette recorder was placed on line as part of the system as a back-up in the event of a computer failure. "Instant replay" can be accomplished if required, since the terminal can be held on-line while the cassette recorder operates locally!

In addition to the chemistry and business courses other regularly scheduled CAL classes include a course taught by Gavenda in introductory physics. He used an interactive CRT display coupled to a series of large television monitors for 30 students. The students performed laboratory physics experiments and fed data to the computer for problem solving via the CRT.

RESULTS TO DATE

Although the results of the early efforts demonstrated the feasibility of using this technique, there were many operating difficulties due to technical limitations of the 1960 vintage video equipment. Video resolution and brightness were marginal in that the original purpose of the videoprojector was for showing pictorial (video) images and not for displaying a full screen of alpha-numeric characters. The second limitation was the size of the projected letters (within the screen image) for both sharpness and brightness. Results showed that when a full line of 80 characters was projected, students at the rear of the auditorium (some 60 feet from the screen) could not read the text. The reason for this being that the equipment in the facility could not be moved because of serving other requirements, thus the image available was only 6 feet x 8 feet. This led to the problem of trying to (1) lower the lighting levels (using theatre dimmers) to a suitable level to improve resolution of the characters while still allowing enough lighting for student note-taking. From these early experiments, many valuable lessons were learned and the following steps taken:

A set of video-projection specifications for the needs of CAL were prepared and a search made for commercially available video-projectors which would meet these specifications. Expressed technically, video projection requirements included:

a. A high resolution cathode ray tube of 1000 lines or better.
b. A video-projector (1) with the capability of projecting a full 9 foot x 12 foot screen image (using rear view projection) with a screen brightness of 15 foot lamberts in a normally lighted auditorium, (2) that would project a raster scan CRT output of 80 characters per line and 16 lines in a uniformly crisp and sharp image over the entire field (front view projection), (3) that was capable of plotting vector graphics type displays (1024 x 1024 resolution) through the use of a common interface device (scan converters, etc.) and common communication interface, i.e., an E.I.A. RS-232/C, (4) that could handle low, medium, and high data input rates for complex real time graphic displays, and (5) that projected in monochrome.
C. A wide band video amplifier (27 MHz).

In searching for such a unit we were successful in locating one manufacturer who did meet all of the specifications. Accordingly, after the manufacturer test demonstrated the unit on site, one unit was purchased from the Amphicon Systems Corporation of Moonachie, New Jersey, their model 260A videoprojector. One unit is now installed and operating in the University of Texas Academic Center as a normal support facility which is available for booking for any class requiring the use of CAL equipment.

OTHER RELATED TECHNIQUES

There are cheaper methods and equipment for group display, such as the use of the model Mark IIIA "Typrojector" manufactured by Bolt, Beranek and Newman. This device consists of a hood enclosure containing a lighting system and reflective mirror and projection lens. The unit is placed over a model 33 teletypewriter and the page printing projected on a screen.

The device has some limitations in that it is difficult to read the screen in a lighted room because of its low image brightness on the screen. It is similar to the older opaque type projectors which have an inherent characteristic of a poor projected image. Further, the only output that can be projected is teletype output.

Another device marketed is the Model 2510T Teleprinter projector which is manufactured by I. P. Sharp Associates of Ontario, Canada. This device consists of a selectric typewriter (or teletypewriter) which is attached to a 3M portable (Fresnel) overhead projector. The unit contains controls for two rollers positioned to advance a roll of clear mylar. The image is typed on the mylar and is projected after it clears the terminal. The intensity, size, and clarity of the projected image is excellent in a lighted classroom. The only drawback is that the device cannot project an image in a realtime mode, as it has a built-in delay of two or three lines because the typeball is positioned ahead of the image projection area. Some of the newer devices available include an analog plotter designed to fit into an overhead projector. This inexpensive unit is manufactured by the AMF Corporation (Electrical Products Division) of Alexandria, Virginia. It plots on acetate and appears to be a very useful classroom display device. The problem of feeding ASCII teletypewriter signals directly into a video monitor has also been solved. Ann Arbor Terminals of Ann Arbor, Michigan, manufactures an interface device which can be used to display interactive teletype outputs on a video terminal or videoprojector.[1] This is a relatively inexpensive device which converts the ASCII code to a composite video (raster scan) signal which is fed directly into a television monitor. An option for handling of graphics is also available.

The future outlook is indeed bright for improved group display techniques, particularly since the Bell Telephone Research Laboratories' announcement on the Use of a Laser-Holographic Display technique that utilizes a matrix consisting of clear or transparent liquid crystal cells. These cells can be "written upon" by the laser beam in a very rapid manner producing fine "frosted lines" which project as black lines when using overhead projection techniques. This process may be the answer to the need for an ideal classroom device for displaying real time information from computer-based programs. Since no costs have been given for the process, it is a bit too early to make an accurate analysis.

ECONOMICS OF CAL

The economics of using one terminal and one videoprojector and associated data sets for a group of up to 500 students based on a 1:500 ratio equates

1. Zinn, Karl L., "Group Viewing of Interactive Computer Output: A Description of Techniques and Devices," The Center for Research on Learning and Teaching, University of Michigan, October, 1971.

to ess than ten cents per student/per hour. This is calculated on the basis of an amortization period of five years for the video-projector, the terminal, central processor, and communications costs, divided by the total number of student hours per year multiplied by five years.

To date it is still too early to state any accurate findings, since CAL has only been in use a short time. Also, there have not been enough tests conducted on students who were exposed to CAL versus students given conventional lectures. It is planned to make this evaluation and publish results under Project C-BE in the coming year in several disciplines: chemistry, statistics, and physics.

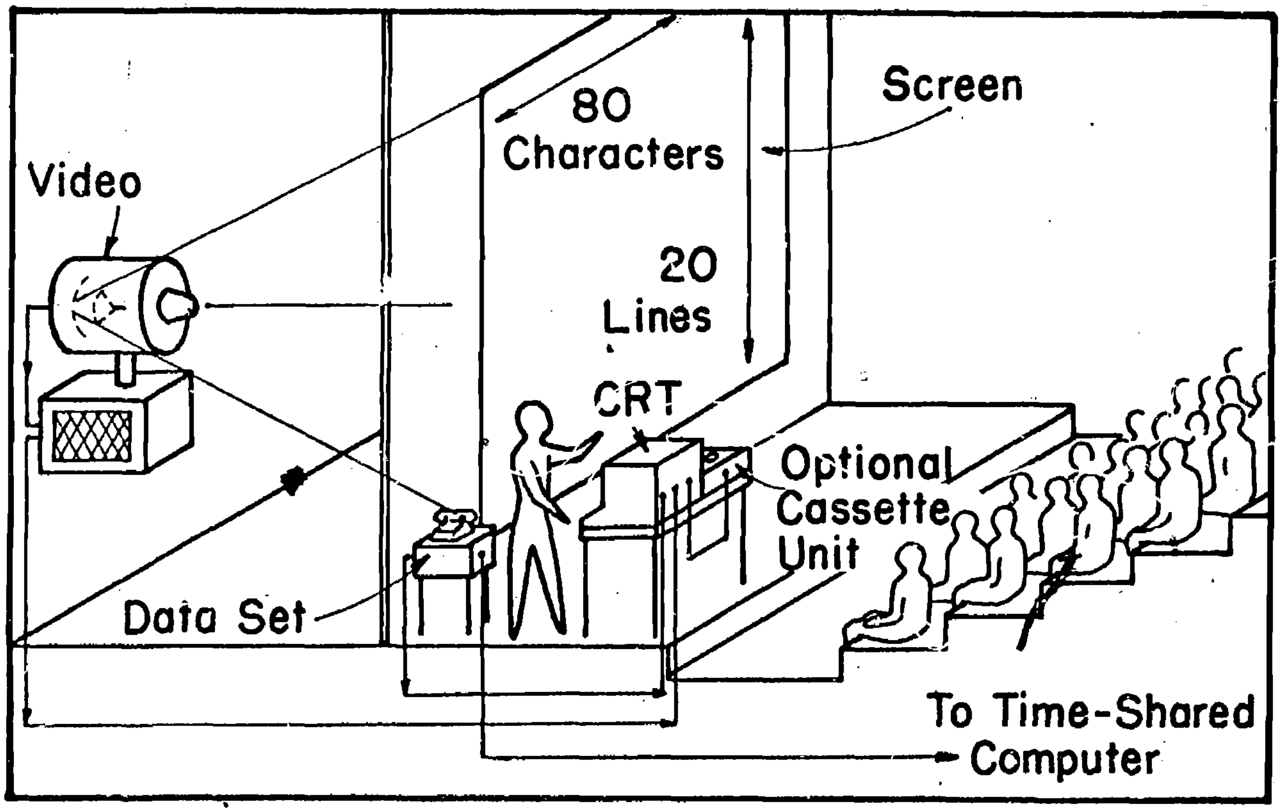

FIGURE I

SCHEMATIC REPRESENTATION
OF A TYPICAL CAL INSTALLATION

TABLE I

LIST OF EQUIPMENT

Videoprojector

One (1) Amphicon Model 260A with type 22X face plate (16' from projector to screen) specified for 9' x 12' projected image.

Terminal Devices

One (1) Beehive Model 1 alpha-numeric CRT fitted with standard 525 line video output BNC connector and selectable data transmission rates of 110 BPS to 2400 BPS. CRT settings use full duplex mode.

One (1) Coaxial Cable RG-59/U with BNC connectors.

One (1) Techtran Model 4100 Digital data cassette recorder with selectable data rates of 110 BPS, 300 BPS, and 1200 BPS.

Data Set

Omnitec Model 701A Acoustic Coupler.

Communications

Either (1) private (leased) line from computer to line receptacle of Acoustic Coupler using half duplex mode for transmission or (2) one dial up line to computer using half duplex mode for transmission.