Interactive Video Based Training Systems

1987

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INTERACTIVE VIDEO BASED
TRAINING SYSTEMS

BY
ROY H. HIGHTOWER
B.I.E., Georgia Institute of Technology, 1982

RESEARCH REPORT
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ABSTRACT

The training community has focused considerable attention on interactive video technology which in recent years has become a popular method of delivery for training applications utilizing microcomputers. This paper identifies the classifications of interactive video and addresses the hardware, software and processes required to utilize the technology for training applications. The capabilities and limitations of the technology are discussed with respect to the various video devices which are utilized. The major advantages of interactive video identified include the capability to combine computer graphics with video; the ability to deliver realistic video simulation; and the ability to store, sort, and retrieve video still images or full motion sequences on demand. Current limitations of the technology include the permanence of the recorded images on a videodisc and the cost associated with the development of the programs. The trend in the training industry is to gradually incorporate the technology into training materials as the demand for interactive products expands. Advances in the areas of recordable disc technology and compact disc technology should establish a strong position for interactive video products in the training market.
# TABLE OF CONTENTS

**LIST OF TABLES** ........................................................................................................................................... v

**LIST OF FIGURES** ........................................................................................................................................ vi

**INTRODUCTION** ......................................................................................................................................... 1

Chapter

I. DESCRIPTION OF INTERACTIVE VIDEO ......................................................................................... 2

Definition of Interactive Levels ........................................................................................................... 5

II. DESCRIPTIONS OF VIDEO DEVICES ............................................................................................. 8

  Videotape ............................................................................................................................................. 8
  Videodisc .............................................................................................................................................. 11
  Compact Disc ................................................................................................................................... 15

III. DELIVERY SYSTEMS .......................................................................................................................... 20

  Delivery System Hardware Requirements for Each Level of Interactivity .................................. 21
  Touch Screens ..................................................................................................................................... 23
  Video - Computer Interface .............................................................................................................. 26
  Authoring Systems ............................................................................................................................. 28
  Maestro PC ......................................................................................................................................... 30
  InfoWindow Presentation System ...................................................................................................... 32
  Quest .................................................................................................................................................. 33

IV. APPLICATIONS OF INTERACTIVE VIDEO TRAINING SYSTEMS ...................................................... 35

  Military Applications
    Sparrow Aim-7F / Sidewinder Aim-9M .......................................................................................... 35
    Videodisc Interactive Gunnery Simulator (VIGS) ........................................................................... 37
    Universal Maintenance Trainer ......................................................................................................... 38

  Industrial Applications
    Beechcraft Videodisc Project ........................................................................................................... 39
    Service Representative Training ......................................................................................................... 41
    IBM InfoWindow Applications ........................................................................................................ 42

  Educational Applications
    Interactive Biology Program ................................................................................................................. 43
    Space Science Program .................................................................................................................... 44
    Principle of the Alphabet
    Literacy System (PALS) .................................................................................................................... 45


iii
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>V. PRODUCTION CONSIDERATIONS</td>
<td>46</td>
</tr>
<tr>
<td>Media selection criteria</td>
<td>46</td>
</tr>
<tr>
<td>Production process</td>
<td>49</td>
</tr>
<tr>
<td>Cost analysis</td>
<td>50</td>
</tr>
<tr>
<td>VI. AREAS OF FUTURE RESEARCH</td>
<td>55</td>
</tr>
<tr>
<td>VII. SUMMARY</td>
<td>57</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>59</td>
</tr>
</tbody>
</table>
LIST OF TABLES

1. Comparison of Touch Screen Technologies ............... 27
2. Applications Capabilities Checklist .................. 31
3. Interactive Level Selections Considerations .......... 48
4. Program Development Variables ....................... 52
5. Program Development Variables ....................... 53
LIST OF FIGURES

1. A Schematic Representation of Videotape .................. 10
2. Format of CAV and CLV Disc ................................. 14
3. CD-ROM Track Structure ..................................... 17
4. Touch Screens .................................................. 25
5. Student Station ............................................... 40
6. Development Ratio Graph .................................... 54
INTRODUCTION

This report examines and assesses the technology of interactive video systems in training applications for military, industrial and educational organizations. The intention of this report is to familiarize the reader with the capabilities of interactive video and the technology involved. The report begins by providing a description of interactive video and defining the classification levels used. Chapter II examines the types of video systems available and the technical details of each. The two types of video media currently used, videotape and videodisc, are discussed as well as new developments occurring in compact disc technology. The next topic of discussion is delivery systems which are used to develop and present interactive video programs. Also included in the delivery system discussion are the hardware and software requirements for each classification level identified. Following the delivery systems discussion, military, industrial and educational training applications of interactive video are presented. The report concludes with discussions of production considerations involved in interactive video and identification of areas of future research.
CHAPTER I
DESCRIPTION OF INTERACTIVE VIDEO

Interactive video is a logical extension of the computer based training applications that are prevalent today. The enhancement of the visual aspects of computer programs beyond text and graphics to include the incorporation of still and motion video with graphic overlay capability has given instructional designers a limitless electronic canvas on which to convey their thoughts. In addition to the visual enhancements provided by interactive video, the technique also involves the user as an integral part of the program execution. An interactive video program has the ability to deliver a unique experience to the user which would not be possible without the integration of microprocessor technology and a video device.

Interactive video represents the fusion of today's computer and video technologies. It links the data manipulation capabilities of the computer to the presentation capabilities of video and combines two delivery tools that form a third more powerful tool when joined together. A typical interactive video system consists of a videodisc or videotape player, a microcomputer, and a video monitor. A videoplayer controller card and a graphics overlay card are added to the basic microcomputer configuration which allows the computer to control the video sequences and superimpose computer-generated images over the video images.
The possibility of utilizing the computer to store, sort and display visual images was a motivational force behind the development of interactive video (Parsloe 1984). Data can be retrieved from any location within a program and displayed at any other point in the program. One of the most important aspects of interactive video programs is the level of user involvement required. The student can essentially control the program execution within the limits allowed by the program designer. The computer program controls the video sequences and the student controls them both. The student can control the speed and direction of the video sequence to display a video segment in slow motion, for example, or dictate which segment should be seen next. The student is involved with the program from the start and can choose what to view and what level of detail he requires while interacting with the program as it unfolds. Once a segment has been selected, however, the information is delivered with the same impact time after time.

Interactive video instructional delivery systems are designed to provide different outcomes depending on the input given by the student. The branching and remediation capabilities allow students to see the consequences of their selections. Part of what interactive video involves, then, is a technique of varied outcomes which have an immediate visual representation on the video screen (Iuppa 1984).

With planning, a good video program can be utilized by several different computer programs to address different audiences and purposes. Any one student may never see all the material in one program, and ten different students may see the same program ten
courseware that are subject to change. The main focus of interactive video programs is the video simulation. It is important to deliver a realistic simulation of the task exercise to the user in order to take full advantage of the training capabilities of interactive video.

Although interactive video programs may utilize videodisc or videotape, the following level descriptions for interactive video were developed specifically for videodisc. Interactive videodiscs have been categorized into four separate levels. The descriptions for each level were originally developed by the Nebraska Videodisc Design and Production Group as a way to differentiate the level of intelligence in a system. The levels that evolved are as follows:

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>An interactive disc with no built-in programming for computer control</td>
</tr>
<tr>
<td>II</td>
<td>An interactive disc with the computer program built-in</td>
</tr>
<tr>
<td>III</td>
<td>An interactive disc player which is controlled by an external computer</td>
</tr>
<tr>
<td>IV</td>
<td>An interactive disc that is part of a larger system of information retrieval</td>
</tr>
</tbody>
</table>

The level classification is not an indication of how sophisticated or effective a disc may be. It merely describes the level of intelligence inherent in that system (Floyd 1985).

Interactivity can be defined as the interaction between a student and a computer in which the computer provides a majority of the stimulus, the student responds to the stimulus, and the computer analyzes the response and provides feedback to the student.
A Level I system is the least intelligent and has very little interactivity at all. Program codes allowing the user to interact with the disc are embedded in the video signal. These codes refer to specific frame numbers and chapter stops on the disc. No external computer is required.

A Level II system, like a Level I system, does not use an external computer. The program control is encoded on the second audio channel of the videodisc. True interactivity begins at this level. The on-board microprocessor executes the commands from the program and branches the program based on inputs from the user.

A Level III system utilizes an external computer to control the videodisc material. An interface package is also required to integrate the computer and video into a system configuration. This configuration gives the system increased capabilities such as graphics' overlays and enhanced record-keeping functions. Level III systems are usually more expensive, complex and intelligent than Level I or Level II systems. Level III discs can be played on other manufacturers' players because the program is stored in the computer system and not on the videodiscs.

Level IV systems are sometimes referred to in the trade publications and discussed at conferences, but no system criteria or specifications have been established. In Interactive Video, Parsloe (1984) comments that the Level IV classification represents a speculative level of technology that has not been achieved by existing systems. New developments in mass storage of information with optical disc will likely fall into the Level IV category. Storage systems
that hold from 50 to 150 discs and use a robotics mechanism to change the discs are available today.

Interactive video via compact disc (CD) is currently being developed. Although the exact configurations of the CD video devices is not certain, the proposed uses of the systems as advertised by the manufacturers will most likely fit into the level classifications that correspond to videodisc levels I and II.

Before a system level can be determined the designer must define the specific application requirements. If the requirements are for a simple branching program, then a Level I or a Level II system may accomplish the learning objectives. However, if the requirements call for complex branching capabilities and sophisticated record keeping, then a Level III system would be more appropriate.
Training applications utilizing video have advanced over the last fifteen years from 35 millimeter (mm) film projectors to videotape and videodisc players. Advances in disc technology associated with compact disc (CD) configurations promise to lead to the next generation of interactive video devices. This section will list and describe current and proposed video devices that can be utilized in interactive video systems. Current interactive video applications use videotape and videodisc as the video delivery device, with CD-ROM (Read Only Memory), CD-I (Interactive), CD-V (Video) and CD-DVI (Digital Video Interactive) formats entering the market.

Videotape, while not as sophisticated as videodisc in interactive performance characteristics, has remained a viable method of video delivery for interactive programs. Videotape is normally composed of four bonded layers which consist of a flexible polyester film, a carbon backing, a layer of a magnetically sensitive emulsion and a neutral topcoat. The carbon backing is used to reduce the build up of any static electricity generated when the tape is in use. The recording surface is formed from the magnetic emulsion which is usually comprised of iron oxide or some other metal compound combined with a binding agent and a lubricant. A neutral topcoat is used to protect the emulsion from any dust particles or foreign objects. The
information stored on videotape is recorded in four parallel bands running lengthwise on the tape. The audio signals, the control and cue tracks, and the video signals all run parallel to each other, separated only by narrow guard bands. The audio signals are recorded and replayed from a narrow band on one edge of the tape by a separate audio head. The control track which stores the field synchronization pulse that regulates the tape speed is recorded on the opposite edge of the tape. Also on the edge of the tape containing the control track is the cue track which is used to record signals, codes, and verbal reminders used in the editing process. The video signals are recorded on the wide band in the middle of the tape in shallow diagonal tracks. (Reference Figure 1)

There are five widths of videotape used for various types of applications, not all of which are suited for interactive video. The larger formats are two inch (50mm) and one inch (25mm) and are used in professional broadcast applications. The third type is U-matic three-quarter inch (19mm) tape which is referred to as the institutional standard for semi-professional applications. This tape width was the first to be distributed in a cassette format and was named U-matic because of the U-shaped lacing pattern of the tape within the player (Parsloe 1984).

The fourth type of videotape is the half inch (12.65 mm) which is used in home video systems. Half-inch systems are referred to as the domestic standard and is available in two formats, Sony's Betamax and JVC's Video Home System (VHS). The two formats are not compatible, however, due to physical differences in the cassette size and the
Figure 1. A schematic representation of videotape
lacing pattern of the tape within the player. The last type of video tape available is the quarter-inch (8mm) tape which is referred to as the compact video cassette (CVC) format. The CVC format is also referred to as 8 mm video and is currently utilized in the camcorder video camera market. The types of videotape primarily utilized in interactive video applications are the U-matic or the institutional standard and the Betamax and VHS format domestic standard tapes.

Many interactive video applications use videodisc for the delivery of the video segments of the program. Videodisc represents an enhancement over videotape applications in that quick and accurate random access of individual frames or video segments can be accomplished. Certain types of videodisc systems are capable of searching for an exact frame address of a still video or the first frame of a motion sequence and are not subject to pulse synchronization problems inherent in videotape systems. The access time for a videodisc system to locate and present a requested video segment is reduced from that of videotape. The laser system incorporated in the videodisc player can easily and efficiently move directly to the frame address specified in the program versus searching linearly through unrequired segments of videotape. Besides the improved capabilities of frame location and access speed, videodisc also allows for better freeze frame and step frame capabilities. The videodisc can hold any frame for an extended period of time with no threat of damage to the frame since there is no actual contact with the disc surface. A videotape, however, has a limited time span in which a single frame may be sustained on the screen.
without risking damage to the film emulsion as the video head repeatedly reads the same video tracks. The length of time a video still frame is presented should be limited to avoid any potential damage to the video monitor.

The reflective optical disc (or laserdisc) and two different capacitance systems are examples of three incompatible systems of videodisc which have been developed in recent years. The reflective optical disc incorporates a system using a two-piece plastic disc. The outer or top surface is smooth and the inner surface is stamped to produce the pits and grooves that represent the proper profile of the master disc. An aluminum membrane is laid over the stamped surface to produce the reflective layer required for the laser to read the encoded data. The second surface, which can also be stamped if required, is then bonded to the first surface forming the completed disc. Reflective discs are scanned by a helium neon laser within the player which does not require contact with the recorded surface.

Videodiscs are capable of reproducing dual channel audio. The two audio channels may be played together or separately. Stereo audio is available when both channels are played simultaneously. If stereo is not desired, each channel can be used to deliver a different audio message. The two-channel capability allows for recording the audio tracks of a program in more than one language or providing more than one level of detail in narrating a video segment.

Constant angular velocity (CAV) disc and constant linear velocity (CLV) disc are two formats of reflective discs. Constant angular velocity discs are well suited and widely used as a medium for
interactive video because of its random access and frame addressable capabilities. For use in interactive applications, these discs require an industrial standard player with an internal microprocessor that can run small computer programs contained on the disc, loaded from the player's keypad, or sent from an external computer. Constant linear velocity discs or long-play videodiscs are usually reserved for movies and are played on domestic standard players that have less memory and features than industrial players. A CAV disc contains 54,000 video frames which translates into 30 minutes of playing time for each side of the disc. A CLV disc has about one hour of playing time per disc side. The difference in the playing time is due to the increased number of frames for the CLV disc. A CAV disc plays exactly one frame per revolution whereas a CLV disc plays one frame at the innermost track and gradually increases to three frames at the outermost track. The number of revolutions per minute (RPM) is constant for a CAV disc and variable for a CLV disc. The inner track of the CLV disc turns at 1800 RPM and the outer track of the disc turns at 600 RPM. Due to the single frame per track layout of the CAV disc, features such as freeze frame, step frame and slow motion are possible. The features just mentioned are not available with CLV disc. (Reference Figure 2)

Capacitance discs are different than laser discs in that the reading head must touch the disc surface. Capacitance discs are stored in a plastic jacket and are only removed from the jacket while in the player. Both types of capacitance discs are produced via a stamping process utilizing an electroconductive plastic for the disc
Figure 2. Format of CAV and CLV disc
material. The RCA system, called the Capacitance Electronic Disc (CED), has a shallow groove to direct the electrode bearing stylus that senses changes in the electrical capacitance of the metal elements in the disc. CED originally appealed to the home entertainment market; however, RCA does market a player useful for interactive applications. The Video High Density (VHD) capacitive disc system by JVC is a grooveless disc that uses a spiral track of pits that contain video and audio signals. The system can hold computer data, digitized audio or a combination of digitized still frames with compressed audio. Capacitance systems did not perform well in the market place and were discontinued. JVC is reportedly working on an updated version of its system.

Compact discs (CDs) are the basis of a growing technology that has many applications. Several new products utilizing compact discs are being developed for interactive video applications. The new products which are spinoffs of the CD audio revolution are compact disc read only memory (CD-ROM), compact disc interactive (CD-I), compact disc video (CD-V) and compact disc digital video interactive (CD-DVI).

A CD-ROM unit is a computer peripheral made to interface with several different computer operating systems. The CD-ROM disc can store digitized images in color or black and white as well as audio and computer data. The storage capacity of CD-ROM is approximately 550 megabytes of data, which is roughly equivalent to fifty 10 megabyte hard disc drives or 1000 single sided floppy disks. However, a CD-ROM can only store thirty seconds of full motion analog video.
Data is stored on the disc as a series of microscopic indentations called pits and flat areas called lands that are arranged in a spiraling pattern starting from the inside edge of the disc to the outer edge of the disc. The recorded information is read by a gallium arsenide laser beam focused on the disc surface. A photodetector detects the reflected optical signals, decoding them into binary ones and zeros (Dixon 1986). A CD-ROM disc is produced from a polycarbonate plastic which is 120 millimeters (mm) wide and 1.2 mm thick. The pits of the disc have a depth of 0.12 micrometers and a width of 0.6 micrometers. The lands, which are the raised areas between the pits, range from 0.9 to 3.3 micrometers long. The spacing of the spiral tracks is 1.6 micrometers apart, giving the disc an effective track density of 16,000 tracks per inch. Information recorded on a CD-ROM disc is non-magnetic so there is no risk of magnetic eraser or disc wear as non-contact laser technology is incorporated (3M 1986). (Reference Figure 3)

The production process for CD-ROM is similar to that of videodisc. The polycarbonate plastic material used as the data substrate is formed by an injection molding process. A transparent layer of plastic covers the information surface. Next, a reflective coating is applied behind the information surface. And, a label and final protective coating is added.

In 1986 Philips and Sony announced a third compact disc standard called Compact Disc Interactive (CD-I). The CD-I system is not meant to operate as a computer peripheral but as a self contained computer player. The CD-I system will require its own operating system called
Figure 3. CD ROM track structure
CD-RTOS which stands for Compact Disc Real Time Operating System. CD-RTOS is an expanded version of the OS-9 operating system by Microware which has been modified to the requirements of CD-I. CD-I is an attempt to include pictures (video still frames), sound, and data all combined in a user interactive configuration (Clegg 1987). Programs for CD-I currently being developed are interactive travel guides, music almanacs, games, and learning and educational projects.

Another compact disc standard is called Compact Disc Video (CD-V). CD-V is also planned as a stand alone system which will incorporate full motion video on a disc rather than just video still frames as in CD-I. The system will operate on the same principle as CD-ROM and, like CD-I, it will use a proprietary operating system (Ofiesh 1987). The problem with CD-V is that having both digital audio and full motion video limits the video program length to only five minutes when constrained by the 12 cm standard size CD. The video signal of CD-V is analog which is the same as a videodisc, while the soundtrack is digital. The CD-I medium is intended for music videos, clips, and short feature films.

A new product introduced in 1987 by the David Sarnoff Research Laboratory called Digital Video Interactive (DVI), challenges the CD-I, CD-V, and videodisc markets. The technology which is owned by General Electric has demonstrated that CD-ROM technology with DVI is capable of 72 minutes of full motion, full screen video, and digital audio from a compact disc. DVI is made possible by a new two chip set of microchips used in an IBM PC-AT to decompress video stored as digital data on a CD-ROM. The technology can be installed as an add
on board for IBM PC compatible computers or as a stand alone product. The system can store digitized animated and motion video images, graphics, and stereo audio signals. DVI was reported as having poor video resolution in the first public showing of the technology and is currently being refined to correct the resolution problem along with other problems encountered. One drawback noted with DVI is that a mainframe computer is required to compress the video images which is performed one frame at a time. The cost of the process to digitize the images is estimated at $200 to $300 for each minute of full motion video (Emerson 1987).

The criticism against optical disc technology, versus videotape, is that the user cannot record and re-record information directly. Advances are being made in this area however; a laser disc system called the Optical Memory Disc Recorder (OMDR) can record 15,000 frames on one 8 inch single sided laser disc. The system is primarily used for archival still frame storage and does not allow for re-recording, although bad frames can be detected while recording and ignored during playback. Also, a new programmable compact disc, or WORM (Write Once Read Many) disc is expected in early 1988. Many companies are working towards recordable optical discs that can store information of all kinds cheaply and compactly, in analog or digital form, on one medium with processing performed quickly and easily.
CHAPTER III
DELIVERY SYSTEMS

A delivery system for an interactive video program is simply the equipment on which the program is presented. However, the selection of the equipment used for the presentation of an interactive video program cannot be determined in such a simple manner. A delivery system must have the capability to meet or exceed the requirements of the application that will run on the system. A basic rule to follow when selecting equipment for a delivery system is to first establish the requirements of the application (Floyd 1985). Once the application's requirements have been defined the hardware and software specifications can be selected to meet the needs of the application. In the event that hardware and software are on hand prior to the application's development, the user will have to work within the limitations of the existing system when designing the application. Additional selection criteria will be discussed later in this chapter when authoring systems, the software used to develop and execute programs, is discussed.

The exact hardware configuration selected will be primarily influenced by the level of interactivity of the application. As mentioned in Chapter I, each level has general hardware requirements associated with the classification. A typical Level I delivery system...
would consist of a videodisc or videotape player, a remote control unit, and a video monitor. Level I systems do not have programming capabilities but simple interactive capabilities are possible (Pioneer 1986). The user can initiate commands to the player to perform a chapter search in which the player forwards to a special control code at the beginning of a new chapter. In addition to the search function, a "picture stop" function is also available. The user can skip over material to display video segments to support a presentation rather than viewing material that is not relevant to the immediate discussion. Level I systems can be used for individual instruction but are usually utilized to supplement an instructor's or speaker's live presentation. The equipments used in Level I systems are generally domestic standard players.

Level II systems, on the other hand, utilize industrial standard players which have programming capabilities via their own internal microprocessor. System equipment in this category includes an enhanced videodisc player, a remote control, and a video monitor. The internal microprocessor allows for playback sequences to be delivered based on the selection of the user. Programming of the player's microprocessor can be accomplished automatically by a "program dump" which is loaded from the videodisc and read by the internal microprocessor. Programming can also be accomplished manually by using the remote control unit or the player's keypad. Level I and Level II systems have the advantage of the internal microprocessor and do not require an external computer. A major drawback of these systems is that all the delivery material must be contained on the
recorded medium including any text required and cannot be easily updated should a change be required.

The hardware requirements for a Level III delivery system differ from Level I and II systems in that an external computer is required for delivery of the program. The system configuration usually consists of a microcomputer, keyboard, floppy disk drive, computer monitor, video monitor, and videodisc or tape player. An interface card which allows the computer-generated text and graphics to be combined with the video presentation on the same screen is also required. In a Level III delivery system, the computer has control over the video presentation and the user issues responses to computer prompts generated by the delivery program. The delivery program is not contained on the videodisc as in Level II systems but is loaded into the computer from the floppy disk drive or a hard disk drive if the computer is so configured.

A Level IV delivery system has not been defined to have specific hardware requirements as yet. Systems that do not fit into any of the first three levels are placed in the Level IV category by default. Several different hardware configurations are emerging as designers extend the capabilities of interactive technology to include new applications. Level IV delivery systems range from configurations with two videodisc players to systems with banks of videodiscs and multiple screens. Other systems are now in place that utilize CD-ROM to store audio and digital data for interactive programs. Level IV systems are also being designed that are incorporating the latest mass storage devices such as Direct Read After Write (DRAW), Write Once
Read Many (WORM) technology, multichanger videodisc banks and hybrid videodiscs. Hybrid videodiscs combine the analog storage features of videodisc with the digital storage features of CD-ROM. The hybrid disc can store 16 Kb of digital data on each frame or up to 1.8 gigabytes on a single disc.

A common enhancement of Level III systems is to add touch screen capability to the delivery system. A touch screen allows the user to make a selection to an exercise by simply pointing directly to the screen and touching the desired selection’s location on the screen. Touch screens are certainly not the only add on type peripheral to a delivery system. Other indirect pointing devices such as a mouse, graphics tablet, trackball, and joystick enable the user to position the cursor and make a selection. A touch screen is simply an easier way for the user to interact with the delivery system to input responses. When using the touch screen the user simultaneously inputs the position and selection of the desired response (Hall and Cunningham 1987).

With indirect pointing devices, the user must first position the cursor at the desired location and then perform the selection of the desired response. Another aspect of indirect pointing devices is that the student must move his/her hand on a different surface than the surface the visual information is on, which increases the coordination and skill required to perform the activity.

There are three general categories of touch sensitive screens which use different approaches to recording a response from the user. This discussion will only briefly state the general features of each
category as there are several variations on each method. The different types of screens are categorized as follows; capacitive, resistive membrane, and light emitting diode (LED) screens. (Reference Figure 4) The capacitive system uses a thin resistive coating which is fused to the glass faceplate of the screen. A limited number of discrete touch pads are etched into the glass surface, each with a conductive path leading from the pad to the edge of the screen. An oscillating circuit is set up for each touch pad. When the pad is touched, there is a capacitance change which alters the oscillating circuit's frequency, and the screen's controller unit interprets the change as a signal.

The second type of touch screen is the resistive membrane screen which consists of two layers of material sandwiched together. This system registers a touch by the compression of the top Mylar plastic layer against an underlying layer of treated plastic or glass. Both layers are coated with a resistive material on the inside surfaces of the sandwich, and clear plastic spacers are placed between the Mylar and the underlying surface. The top layer deforms when touched and makes contact with the bottom layer signaling an input.

The LED touch system operates by a grid system of scanning beams that is projected above the monitors cathode ray tube (CRT) surface. The LED system is the only system that does not place a layer of material over the monitors CRT. A touch is recorded by interrupting the scanning grid as the user touches the screen's surface. Due to the nature of the scanning grid, the LED system is more difficult to accurately touch the desired location on the screen. The light beam
Figure 4. Touch screens
grid can be as much as one and a half inches above the curved portions of the CRT surface. This difference requires the user to look directly at the screen to accurately make a selection. Table 1 lists some key performance characteristics of the different touch screen types which highlights the advantages and disadvantages of each system (Logan 1985).

The requirement to update text and graphics presents obvious problems when all the material is stored on the visual medium. By using the computer to store the text and graphics portions of the courses, the content can be modified as required.

The incorporation of computer-generated text and graphics with video segments is possible with the use of a video overlay board. Several companies offer video boards that enable computer text and graphics to be superimposed or overlayed onto a video image. In order to combine video and computer generated signals, the two output signals must be synchronized. The television engineering term used to define the synchronization or locking together of two signals is genlock. The synchronization takes place when the synchronization pulse generator of the video board, which controls the timing of the computer signals, is given the command to genlock the incoming video. The next step is to key or overlay the computer's signal with the video source. The meaning of the term "key" can be thought of as cutting a hole in the video picture so that the computer signal is visible through the opening (Mistrot 1987).

There are two methods commonly used by monitor manufacturers to key video signals. The first method adds a second video input
<table>
<thead>
<tr>
<th>TYPE</th>
<th>CAPACITIVE</th>
<th>RESISTIVE - MEMBRANE</th>
<th>LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution</td>
<td>32 points</td>
<td>8 x 10</td>
<td>25 x 40</td>
</tr>
<tr>
<td>Resolution Degradation</td>
<td>-</td>
<td>with coating wear</td>
<td>-</td>
</tr>
<tr>
<td>Stylus Limitations</td>
<td>must be conductive</td>
<td>-</td>
<td>must be perpendicular to the screen</td>
</tr>
<tr>
<td>Scratch Resistance</td>
<td>high</td>
<td>low</td>
<td>high</td>
</tr>
<tr>
<td>Durability Problems</td>
<td>-</td>
<td>coating wear and separation scratching</td>
<td>rough handling causes misalignment</td>
</tr>
<tr>
<td>Optical Clarity</td>
<td>high, but etched lines are visible</td>
<td>low</td>
<td>high</td>
</tr>
<tr>
<td>Installation Problems</td>
<td>complex interconnections</td>
<td>complex interconnections</td>
<td>high tooling cost poor fit and finish</td>
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<tr>
<td>Response</td>
<td>light touch</td>
<td>pressure limits speed &amp; lateral movement</td>
<td>proximity</td>
</tr>
<tr>
<td>Environmental Sensitivity</td>
<td>changes in temperature &amp; humidity</td>
<td>glare &amp; humidity</td>
<td>dust strong ambient light</td>
</tr>
<tr>
<td>Cost</td>
<td>less than $1000</td>
<td>less than $1500</td>
<td>$1500</td>
</tr>
<tr>
<td>Comments</td>
<td>simple sensors</td>
<td>simple controllers</td>
<td>difficult to repair</td>
</tr>
</tbody>
</table>
connector and an internal high speed switch or keyer to the monitor. The key material is inserted in its RGB (Red, Green, Blue) component signal just as it enters the picture tube. The key is accomplished by interrupting the video signals for the target locations on the screen and substituting the signals from the second connector. This method is called downstream keying as the key signals are inserted just prior to display on the monitor. The second method of keying is called the decoder-keyer. This method breaks down the composite video signal into its RGB components and replaces the video signal whenever there is a signal from the computer. As with the keying monitor, the transfer between the decoded input signals and the signals from the computer is via high speed switch or keyer.

**Authoring Systems**

The programs used on delivery systems are developed and presented using authoring software. Authoring software can be packaged as an authoring system which consists of a group of software programs that allows the user to develop, modify, and present a program. Authoring software also includes authoring languages which are high level computer languages that can be used for program development. Authoring languages require an instructor who has some programming experience and knowledge of the particular language whereas authoring systems are very user friendly and do not require any previous computer skills (Parsloe 1984). The key disadvantage to authoring systems is the lack of flexibility due to the structure of the
system. Authoring languages allow for the flexibility required for custom applications.

Many authoring systems are developed using their own authoring languages to give the user a choice of developing programs with the authoring system's procedures or using the authoring language for customized program development.

As users become more proficient with the authoring system, they may expand beyond the confines of the system's program shell and work with the language for a more direct programming approach. Authoring systems use menus, prompts, templates, and symbols to provide the user with an easy, structured method to develop a program. There are typically two types of authoring systems; frame oriented and line oriented. In frame-oriented systems the designer works on the screen that will appear in the completed program. The branching patterns of the screens and video segments are defined in a separate phase of the authoring process. Line-oriented systems use long lists of commands to design the appearance of the screens and the structure of the program's branching requirements.

In the beginning of this chapter it was mentioned that the application requirements must be defined prior to the selection of the hardware. The previous statement holds true for authoring software as well. The application's designer must determine the capabilities required to meet the objectives of the application and select authoring software that can provide the needed capabilities. Authoring software packages have different hardware system requirements and peripheral interface capabilities. Some packages may
interface with videodisc players, touch screens, and external software packages while others may not. The features required for a specific application must be analyzed and priorities placed on the most critical features when selecting an authoring software package. The critical features can be weighted in the evaluation of potential software choices to favor an authoring package that will satisfy the application's requirements (Floyd 1986). The application's capabilities checklist (Table 2) identifies many of the items that should be considered when selecting an authoring software package.

The following section provides descriptions of some representative authoring systems available for development of interactive video programs.

**Maestro PC by Aimtech Corporation**

Maestro PC is a frame-oriented system that utilizes extensive windowing features with pull down menus and an icon library to represent the system's building blocks. The authoring process consist of building the structure of a course from the library of building blocks and adding content to each element in the structure. Icons are used to represent the building blocks and dialog boxes are used to fill in the content.

An object is selected and actions are performed on the object through the pull down menus. The program structure is designed in the main authoring window and the icon library is located in a smaller window within the authoring window. Maestro provides unrestricted branching which is limited only by the memory size of the computer. The system supports interactive video applications via icons that
<table>
<thead>
<tr>
<th>System features</th>
<th>Critical</th>
<th>Advantageous</th>
<th>Unnecessary</th>
</tr>
</thead>
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<tr>
<td>Full video control</td>
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<td></td>
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<td>Audio channel switching</td>
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<td>RGB overlay</td>
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<tr>
<td>Still - frame audio</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Integration with other packages</td>
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<td></td>
<td></td>
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<tr>
<td>Student function keys</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Student bookmark</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Types of answer input</td>
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<tr>
<td>Multiple choice</td>
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<td></td>
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<tr>
<td>Fill in the blank</td>
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<td></td>
</tr>
<tr>
<td>True/False</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Matching</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>String manipulation, spelling</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Decision trees</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input devices</td>
<td></td>
<td></td>
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<tr>
<td>Touch screen</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Keypad</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Light pen</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mouse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Course management</td>
<td></td>
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<tr>
<td>Register/enroll</td>
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<td></td>
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<td>Tracking</td>
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<td></td>
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<tr>
<td>Record keeping</td>
<td></td>
<td></td>
<td></td>
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<td>User feedback</td>
<td></td>
<td></td>
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<tr>
<td>Report generation</td>
<td></td>
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</table>
CHAPTER IV  
APPLICATIONS OF INTERACTIVE VIDEO TRAINING SYSTEMS

Interactive video training applications have increased in a wide variety of areas. The most common area for the delivery medium has been military training. The advancement in microcomputer capabilities and subsequent price reductions have made interactive applications a viable alternative training medium for many military, industrial, and educational training requirements. The following section describes some of the applications in which interactive video is being used for training.

Military Applications

SPARROW AIM-7F / SIDEWINDER AIM-9M Training Course

The SPARROW AIM-7F / SIDEWINDER AIM-9M training course was developed for the Canadian Forces to provide instruction in the theory of operation and maintenance of the missile systems and associated test equipment. The self-paced course contains computer-based and paper-based components, including five double-sided videodiscs providing simulations and linear video sequences, thirty computer-based theory of operation block diagrams, five volumes of student materials and two volumes of instructor materials, with lesson guides
and performance test. The self-paced aspect of the course was
designed to require a minimum of instructor intervention. Four types
of interactive video instructional designs were developed for the
training course:

1. Simulation of a hands-on task.
2. Physical and functional descriptions to acquaint the students
   with the missiles' assemblies or test sets.
3. Motion sequences to provide information.
4. A special motion video segment that allows a trainee to view
different areas in a missile repair shop by touching the
computer-controlled screen.

Procedures and actions such as fault isolation, disassembling,
assembling, inspecting and troubleshooting are stored in visual files
on the videodisc to provide hands-on simulation. Procedures were
selected for simulation based on the task complexity, frequency of
occurrence, and relative danger to personnel or equipment. A student
can view the procedures as many times as desired, followed by
unlimited practice. The final performance of each simulation is
automatically recorded and scored by the computer.

Four stand alone Missile Systems Training Stations (MSTS) were
assembled with all the systems hardware which included a
microcomputer, dual floppy disk drives, a graphic overlay system,
numeric keypad, light pen, printer, videodisc player, monitor, and
headphones (Raytheon 1985).
Videodisc Interactive Gunnery Simulator (VIGS)

VIGS is a portable, desk top, part task trainer that simulates the gunner's control station for the M60A1, M1/M1A1, and the M60A3 battle tanks. The trainers' objectives are to enable new soldiers to develop target acquisition and reticle aiming skills and maintaining the proficiency level of experienced tank crews. The trainer allows the student to search, acquire, and identify a target that is generated by a videodisc. The student selects the weapon and ammunition desired by depressing palm switches on the control handles and fires at the target. The fired projectile has a simulated tracer that allows the student to follow the shot. If the target is missed, the student must make the necessary adjustments and fire again. When the target is hit the action freezes and the number of hits and misses is superimposed over the target displaying where each projectile landed. A detailed record of the firing position of the weapon and the students' adjustments and response time for each round fired are displayed on a small monitor on the front of the trainer. The trainer also utilizes audio simulations to differentiate between hits and misses and supply tank commander fire commands. Several different training scenarios can be generated by the videodisc including multiple targets.

The VIGS hardware configuration is an exact size replica of the gunnery station housed in a self contained portable unit. The front console of the trainer has the gunner's eye piece and brow pad, the gunner control handles, ammunition indicator and selection handle, and the switch box panel stabilization control. The front panel also
contains a 5" CRT that displays the training exercise menu as well as the firing information mentioned previously. The system uses a computer controlled videodisc player that is external to the housing unit for display of the training scenarios (ECC 1987).

Universal Maintenance Trainer

The Universal Maintenance Trainer combines interactive video with three dimensional mock-up display panels. The trainer may be configured to teach maintenance procedures on several different pieces of equipment. A different display panel mock-up is used for each device. The system covers maintenance procedures for the following areas:

1. Diesel engine charging, cranking and fuel systems,
2. Mobile hydraulic crane systems,
3. Air brake and air operated accessory systems.
4. Hydraulic steering systems,
5. Hydraulic brake systems,
6. Two stroke / four stroke diesel engines,
7. Osmosis water purification unit.

The display panels are generally representations of the system under study depicting certain control panels or subcomponents of the device. Malfunctions are simulated on the panel and the student must troubleshoot test points to determine the problem area. The interactive video is used when the problem area is narrowed down to a particular subsystem. The student selects the suspect area and can view different levels of detail on the subsystem as required to
pinpoint and verify the malfunction. The video displays the malfunction and shows how to repair the unit.

The student station for the universal maintenance trainer consists of the mock-up display panels, a micro-computer with dual floppy disk drives, videodisc player, computer monitor, video monitor, and printer. The student stations are linked to the instructor station but can be operated as stand alone units (NTSC 1986). (Reference Figure 5)

Industrial Applications

Beechcraft Videodisc Project

The Beech Aircraft Corporation developed an Integrated Training Program for the Super King Air (SKA) 200 Series Pilot Course. The training program takes a student through classroom instruction, interactive instruction via the Interactive Videodisc Station, and cockpit procedures instruction in the Cockpit Systems Simulator. The Beechcraft program presents a unique training problem in that each SKA 200 aircraft is custom built to the specifications of the individual owner. The training program must therefore deal with students that have a wide range of general aviation skills and previous experience with the SKA 200 aircraft.

The training program is individualized and self paced with emphasis placed on the tasks in which a SKA 200 pilot performs. The Interactive Video Station section of the program uses computer generated text, symbols, and animation as well as photographs, diagrams, and motion video from the videodisc for student
Figure 5. Student station
presentation. A separate computer program controls the presentation to assure that the student sees only the information pertaining to the serial number aircraft they have purchased. The student becomes familiar with the cockpit procedures by using a touch screen to manipulate the flight instruments. Gauges, levers, and switches move and stop on command as the student interacts with the simulated cockpit shown on the touch screen. Upon completion of the interactive video portion of the course, the student moves on to the actual flight simulator. The interactive video portion of the course allows the student to become very familiar with the aircraft control systems prior to entering the simulator. The student is now more proficient in the cockpits operation and can concentrate exclusively on the training scenarios delivered by the more expensive flight simulator.

The hardware used for the Interactive Videodisc Station includes an IBM PC XT, a color monitor with a touch panel and, a videodisc player (Raytheon 1985).

Service Representative Training

Xerox is using a Level III interactive video program to train its service representatives in technical and personal skills. Students can watch experts perform troubleshooting procedures and make the necessary repairs. A student can branch back through the program to review any lesson as many times as needed. The program allows the student to observe the interaction between the service representative and the customer in acquiring information pertinent to the machines malfunction. The student can hear both sides of the conversation and watch how the representative responds to the situation.
The program was developed using the Authority authoring software and utilizes an IBM PC with a video controller card, a videodisc player, and a high resolution color monitor. The Xerox training program is now consistent throughout their many locations and has been well received (Livingston 1985).

The following Level III industrial technology applications are designed for delivery on the IBM InfoWindow system. Each application was developed by a different training house and is intended to show the diversity of off-the-shelf material being developed for the industrial interactive video market.

The DELTAK Training Corporation has developed several interactive video programs ranging from basic electronics to robotics. One of the programs in the series is on the use of the oscilloscope. The program is intended for maintenance personnel, technicians and engineers. The objective of the program is to train the student in the basic fundamentals of the device's operation starting with identifying the parts and controls of the scope. The student will learn to use the vertical and horizontal deflection and triggering controls and to check the vertical and horizontal calibration of the unit. The program also takes the student through the steps necessary to align and measure square and sine wave voltages.

TAPPI produces an interactive video program that covers the processes involved in paper making. The program is intended for mill operating personnel, new engineering personnel, and technician personnel that need a better understanding of the overall paper making
process. The program explains the major areas of pulping which includes the recovery process, batch and continuous digesters, and the washing, screening, bleaching and drying process.

The Industrial Training Corporation markets an interactive video program that covers the subject of statistical process control (SPC). The program instructs the student in statistical process control methods and shows how SPC can be used to reduce quality cost. Upon completion of the program, the student will be able to explain the difference between a prevention system and a detection system, define SPC, describe the concept of variation, and generate frequency charts and histograms (IBM 1987).

**Educational Applications**

**Interactive Biology Program**

Gene Elson, a biology teacher at Atascadero High School in California, has developed an interactive video program to supplement the course textbook. The videodisc used in the program is an off the shelf disc called BioSci which covers basic Biology and was developed by Videodiscovery. The instructor surveyed the video material on the disc and developed a program that can retrieve the video segments appropriate to his lesson plan. Using the LaserWorks authoring system, he created menu listings for the relevant material categories which can be selected to reveal additional menus on specific subject areas. The Level III program also includes the text needed to supply a description of the related video segment. The video allows students to observe an organism or a biological process in a controlled environment.
The delivery system used for the interactive biology program is an Apple IIe with an overlay interface, a videodisc player, and the LaserWorks authoring system (Knapp 1987). The BioSci disc seems to be popular in education circles. Another article describes how a high school biology student used the disc material in an interactive program developed on basic cell division and mitosis (Luskin 1987).

**Space Science Interactive Program**

Another example of interactive video in education was developed by Rita Henry, a high school science teacher. Henry used the Astronomy and Earth Science videodisc from Optical Data Corporation in a Level I application for initial presentations and topic reviews. She also developed Level III applications programs that allow the students to work as a class or in small groups. The Level III segments are designed around a simulated journey from Alpha Centauri to Earth. The class is divided into small crews for the journey and the crews must perform specific tasks along the trip such as using the ships telescopes, navigating by celestial objects, and collecting and analyzing data. The Level III programs are also used for tutorials, drill and practice, and data base access.

The delivery system used for the program consists of an Apple IIe computer with an overlay interface, a videodisc player, 13" video monitor, and the LaserWrite authoring software (Emerson 1987).
Principle of the Alphabet Literacy System (PALS)

IBM has developed a Level III interactive video program called PALS which is designed to teach illiterate adolescents and adults how to read and write the English language. A pilot lab has been established in one of Atlanta's adult basic education centers to serve high school students, adult citizens, and city employees that cannot read. The program teaches concepts based on alphabetic principles and the phonemic spelling system. The PALS hardware and courseware is a package system that includes four IBM InfoWindow touch sensitive monitors, videodisc players, IBM PC XT, PCjr, typewriters, 15 diskette packages of computer software, and twenty-four double sided videodiscs (Emerson 1987).
CHAPTER V
PRODUCTION CONSIDERATIONS IN INTERACTIVE VIDEO

This chapter will discuss issues involved in the production of interactive video programs. There are several factors to consider when designing and producing this type of training program. The first factor involves the selection of the media that will be used. This factor considers selection of the interactive level and the video medium the program will use. Following the media selection, the formation of a project team and the process used to develop the program will be explored. Finally, a cost analysis of development variables will be discussed.

The first issue in the media selection process is the decision to use interactive video or some other method of delivery for a training program. Many references choose to ignore the issue and leave the decision to use interactive video for others to address. An examination of the training objectives using a media selection model should be performed to verify interactive video as the most appropriate method for the delivery of a program. Factors that support the selection of interactive video include; full motion picture capabilities which provide examples of realistic settings, user feedback and information management capabilities, and the ability to motivate, stimulate and interact with the user.

Interactive video and computer-based training in general have been selected based on the fact that the training methods reduce the time
required to train an individual as well as increase the retention level of the student. Studies have confirmed reductions of at least 30% in the time required to complete material using interactive training. The studies also note an increase in the level of retention of the material by the student. Trainers generally agree that people retain approximately 25% of what they hear, 45% of what they see and hear, and 75% of what they see, hear and do. Interactive programs are designed to keep students seeing, hearing and doing (Roush 1984).

The next step in the media selection process, given an interactive program has been selected, is to choose the level of interactivity for the program. The capabilities and limitations of the various levels have previously been discussed in chapters I and III. The selection of a level should be based on whether the level will support the learning objectives of the training task. Other considerations should include the capabilities of the project team to develop programs at the level and the cost factors associated with the level. Table 3 identifies some of the features of each level that should be considered when deciding on a level for a program. The last consideration in the media selection process involves the decision to use videotape or videodisc. The differences between tape and disc have been addressed in chapter II.

Many organizations prefer to produce their video material in-house and may already own videotape equipment and production facilities which often drives the media selection. Videotape performs well for
## TABLE 3

INTERACTIVE LEVEL SELECTION CONSIDERATIONS

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>TAPE</th>
<th>DISC</th>
<th>FEATURES</th>
</tr>
</thead>
</table>
| I     | Y    | Y    | o Controlled via keypad or remote control  
|       |      |      | o No interface for computer control  
|       |      |      | o Simple random access (search)  
|       |      |      | o Freeze frame, still frame  
|       |      |      | o Domestic level players  |
| II    | N    | Y    | o Small onboard memory  
|       |      |      | o Program coding on disc  
|       |      |      | o Branching capability  
|       |      |      | o Score keeping  
|       |      |      | o Simple program input via keypad  
|       |      |      | o Industrial standard players  |
| III   | Y    | Y    | o Video player linked to an external computer  
|       |      |      | o Computer program store on floppy disk  
|       |      |      | o Multiple programs for videodisc  
|       |      |      | o Volatile data stored on computer disk  
|       |      |      | o Video overlay capabilities  
|       |      |      | o Information management capabilities  |
| IV    | Y    | Y    | o Multiple video players  
|       |      |      | o Utilization of mass storage devices  
|       |      |      | o Hybrid videodisc  |
full motion sequences but falls short when still frame or freeze frame features are required. Also the delay in the search time caused by the linear constraints of the tape make the system less desirable than disc systems.

The choice between the two videodisc formats CAV and CLV can also be determined by the program requirements. CAV discs allow for perfect still frame images to be selected whereas CLV discs do not. Also CAV disc can address up to 54,000 searchable locations and a CLV can only address 79 chapter start points. CAV discs are by far the best selection for interactive video applications to date.

Once the media selection considerations have been decided, the next phase of the production process can begin. This phase of the production process deals with the formation of the project team and the development process. An interactive program requires the expertise of a varied group of professionals to successfully conceive, develop, and produce the program. The project team members should consist of subject matter experts, instructional designers, editors and producers. In addition, directors and technical experts such as programmers and camera technicians are also required (Donahue 1983). The management of the production process calls for effective utilization of the various team resources. The individual responsible for the project will need to rely on project management techniques to track the progress and cost of the project.

There are many program development processes documented in the available literature. The one that follows is a generic process that outlines the basic steps involved in the development and production of
an interactive video program. The generic process should include the following tasks:

1) Defining the target audience
2) Performing a needs assessment
3) Establishing the learning objectives
4) Developing the instructional strategies
5) Developing the program flowchart
6) Developing the scripts and storyboards
7) Generating the preliminary program code and filming the video segments
8) Assembling the program per the flowchart
9) Testing the pilot version, performing any required corrections and validating the program
10) Producing the master disc or tape

Interactive video programs have a reputation as an expensive method of delivery. As with any creative process the design and development process is difficult to estimate the cost that will be incurred. One reason for the high cost of interactive video programs is that many of the producers of the programs have very little experience in program development of this type.

As mentioned previously, a well organized and documented plan is required for the effective development of interactive video programs. There are several variables that must be considered when estimating development time and cost associated with interactive programs. The variables can be classified into four groups: courseware variables,
technical variables, human variables, and other variables. Tables 4 and 5 list the variables types, elements and weighting associated with each variable element. Some of the courseware variables involved are the nature and complexity of the material, the level of the learning objectives, the instructional design strategy, and the nature and frequency of the interactivity. The technical variables include the capabilities and limitations of the authoring tools, media interfaces, automated design tools and delivery hardware. Some of the human variables associated with development time and cost include the number of team members, member knowledge, skill and experience, and the number of projects completed by the team. Finally the other variables associated with the time and cost of program development include the availability, nature and quality of existing training material, courseware standards, the project development methodology and the availability of a graphics library (Gery 1987). To estimate the cost and time of a program the variable elements contained in each of the four variable type groups should be evaluated and selected if applicable. The weighting values of each variable selected as applicable to the program should be added to determine the total value of all the elements chosen. The value obtained can be plotted on Figure 6 to determine the time/cost range estimate the program development process. Given the varied methods of development and the variety of applications which are utilized through interactive programs, the approximations given by this model represent the lowest level of estimation practical at this time.
<table>
<thead>
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<th>VARIABLE TYPE</th>
<th>VARIABLE ELEMENT</th>
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<tbody>
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<td>HUMAN</td>
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</tr>
<tr>
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</tr>
<tr>
<td></td>
<td>EXPERIENCE WITH AUTHORING TOOLS</td>
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<td>SOME DEVELOPMENT EXPERIENCE</td>
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<td>DP SIMULATIONS</td>
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Figure 6 Development ratio graph
There are several areas of interactive video design and production that need to be explored in more detail. Possible fields of research exist in both the applications area and the hardware area. In the applications area, the development process and the phases involved in the process need to be better defined. Another area of study might include classification of the various types of applications, such as training and management information system, into groups and examining associated traits. The technique needs a comprehensive cost model developed for the estimation of program cost in a more detailed manner. The refinement of the development process into measurable tasks and the identification of applications characteristics should aid in the development of a more accurate cost model. Among the most promising areas of research in the applications area is the incorporation of artificial intelligence and expert systems with interactive video. Authoring systems that utilize natural language features will enable instructors with very little computer knowledge to develop interactive programs. The areas mentioned here will also be applicable to the next generation of interactive video devices scheduled to appear in the near future. The hardware areas of further study include the development of an optical disc comparable to a
magnetic disc with respect to recording characteristics and standardization of video controller and graphics interface packages which will aide in the transportability problems that now exist.
CHAPTER VII
SUMMARY

This paper has addressed the use of interactive video technology as a delivery method for training. The areas of consideration discussed in the first three chapters included the definition, classification and characteristics of the levels of interactivity, the types of video devices used presently and the proposed video devices, and the delivery systems used for the presentation of interactive programs. Chapter IV presented example applications of the technology as applied by military, industrial and educational organizations. Chapter V discussed production considerations involving media selection, program development, and cost analysis. Chapter VI identified areas of future research in the field.

To briefly summarize the findings of the report, interactive video can be classified into four separate categories each with its own characteristics, applications and hardware configurations. A major advantage of the technique is its flexibility to conform to very simple applications as well as very complex applications. The discussions on the levels of interactivity and the video devices available should give the reader the necessary insight required to make appropriate media selection decisions. Other advantages of interactive video include the ability to combine video with graphics,
the consistent delivery of the information, and the self pacing features of the systems. An interactive delivery system can be established or shipped to a distant location or office. Employees at that location can receive the same quality of training as employees at a central facility. Interactive systems can effectively perform basic and routine instruction, which frees instructors to focus on individual student problem areas. The drawbacks of interactive video include the permanence of the recording for videodisc systems and the expense associated with the development of the programs.

The training market is slowly recognizing the advantages of interactive video in training. New selections of training material utilizing interactive video are steadily increasing. The trend in the industry is to incorporate interactive video into current training programs in order to remain at the forefront of training technology. The current trend is expected to continue for many years as trainers become more familiar with the capabilities of interactive systems. As refinements in the development process are documented and improvements in authoring software achieved, interactive video will become a very common tool in training.
REFERENCES


