SURROGATE TRAVEL VIA OPTICAL VIDEODISC

by

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ABSTRACT

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Abstract:

This paper describes a system which "teaches" the landmarks of a path through an area to an unknowledgeable user. The user is taught these landmarks by a sequential display of pictures taken along the user defined path. The system draws on the capabilities and explores the possibilities of an optical videodisc, a graphic frame buffer, and a dedicated mini computer. The intent of the system is two-fold: 1) To demonstrate some of the potentials for computer aided graphical instruction, 2) To add to the field of knowledge about cognitive mapping.

WHAT IS A VIDEODISC?

Optical Videodiscs are something new in the world of video. A good introductory comparision is: videodiscs are to LP records as videocassettes are to cassette tapes. One side of one videodisc can store about one half hour of color video imagery. This figure is nothing special, videotapes can do that, and they have been around for years. However, some of the other numbers associated with videodisc technology are rather impressive. 30 minutes of video signal times 60 seconds a minute times 30 frames a second is 54,000 individual frames. (Translating to computer jargon that comes to 54 billion bits of information on one side of one disk.) On a videodisc each one of these frames is UNIQUELY IDENTIFIED and INSTANTLY ACCESSABLE. Current technology defines instantly as less than 5 seconds but not better than 1/60th of a second, depending on proximity of current location to desired location on the disc.

One can also look at any individual frame for as long as one wants, without harming the image in any way. This is because the images are reconstructed from the disc through the deflection of a low power laser. Thus there is no physical contact with the stored material, nothing to wear, scratch, or harm the data in any way. The data is protected by a thin layer of clear plastic. Except on the most exotic videotape machines, it is not possible to look at an individual frame, and even then great harm is done to that frame if one looks for more than a couple minutes. Magnetic videodiscs also have uniquely identified and instantly accessable frames, but only up to a 1000. They too, do not like to remain in one place for too long.

Cost is a keyword with optical videodiscs. The manufacturers are suggesting a selling price of between one and four thousand dollars for a player, and five to ten dollars for recorded discs, though they are not yet on the public market. The players interface directly to your home TV set and a wall socket, otherwise they are self-contained. These discs are in the fashion of present day LP's, they are exactly the same size, shape, and are manufactured through the same means. The process of producing a disc is to first obtain a master of the source material on videotape, then to carve out a master using a relatively high powered laser. From this master thousands of copies can be made. Overhead involved in makng the master runs to about $1000, but the material cost of each copy is about sixty cents. Eight to ten dollars is the current industry estimate for the retail price of a two sided disc with some movie like "The Sting" on it. This compares very favorably to the fifteen dollar cost of a blank videocassette. The comparisions in table one show that videodiscs are far and away the cheapest storage medium around.

Table 1: Per frame cost, in cents, for still visuals (54,000 per set) 1

MEDIUM	QUANTITY 1	10	100	1000
35mm color slides	0.25	0.20	0.15	0.09
35mm color film strips	0.122	0.02	0.0085	0.0085
Microfiche, color	0.15	0.022	0.0083	0.0083
Microfilm, monochrome	0.10	0.017	0.0076	0.0076
Videodisc	0.0083	0.0008	0.000006	0.000001

Videodiscs are also the most convenient picture storage medium of any form available with current technology. It is possible to store every page of the Encyclopedia Britannica and all of it's supplements, on one side of a disc. Even then there would be extra space. If someone gave you 54,000 slides and a stack of paper telling you where each slide was relative to each other slide, how long would it take you to find any particular slide? The time would be measured in minutes, not seconds as it is with the videodisc. The set of functions available to a user of an optical videodisc include: stepping one frame forward, stepping one frame backward, playing forward at a standard 30 frames per second(fps), searching to any specific frame number, scanning forward at 60 to 1000 fps, scanning backward at 60 to 1000 fps, slow motion forward and backward at any fps from 30 down to 0, selection of on/off for the two channels of sound, plus other capabilites depending on the microprocessor that is controlling the disc.

The possible set of applications for this piece of technology is only just being discovered. This project is the beginning of one possibility. Other possibilities, as suggested by the Movie Corporation of America, MCA, (one producer of optical videodiscs) are listed in the Appendix.

A summary of the capabilites of a videodisc is in order. A videodisc is:

1. A storage medium capable of storing one half hour of NTSC video signal.
2. Capable of complete random access to any of 54,000 frames.
3. Cheap to reproduce in large quantity
4. Convient because of broad range of functions built into player.
5. Compatible with your home TV set.
6. A read only medium.

THE SYSTEM IMPLEMENTED

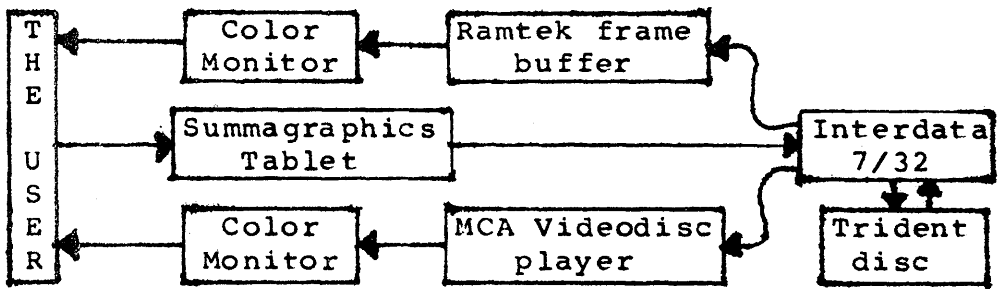
The system implemented is one to help teach the landmarks of an area to someone unfamiliar with the physical environment. The user defines to the machine a path he/she wishes to learn about, and the system "teaches" the user the physical landmarks along that path. This is done through the use of the large image storage capabilities of an optical videodisc and the image manipulation capabilities of a raster scan frame buffer.

When a user sits down to use the system, he/she is presented two video images. One is a digitized map of the central part of the MIT campus. Various controls are placed along-side this map. The other image is a picture of some place on that map. This picture changes over the course of the users stay with the machine. Through the use of a location sensing tablet the user defines a path on the base map she/he wishes to learn about. This path is stored as a series of points in the memory of the machine. Small transparent dots are overlaid onto the base map. These dots show the exact location of each point in the machine representation of the path. The user is free to add and delete points from this representation through simple control mechanisms.

After the user has fully defined the path, he/she touches the "START" button which is overlaid onto the map. The machine then looks into its data bases and pulls out a set of pictures which are taken from points along that path. The system then overlays onto the map representations of where, and in which direction, each picture is taken from. On the other monitor the actual pictures are shown, one at a time. The pictures taken nearest to the path beginning are shown first and then moving point by point along the path, finally reaching the end. The user controls how quickly or slowly he/she wishes to see these pictures. The user can also stop and review any group of the pictures from anywhere along the path. As a picture is being displayed, its corresponding symbol on the map changes color. This is to inform the user exactly where that picture has been taken from. When the next picture comes on the monitor, the symbol for the previous picture returns to its original color and the symbol for the new picture changes color.

From a more specific viewpoint the system consists of two color monitors, a Ramtek RM9300 frame buffer graphic display system(640 by 480 rasters), an MCA videodisc player, a Summagraphics tablet, an Interdata 7/32 minicomputer with 256k core memory and a Trident magnetic disc. These are configured as shown in diagram 1.

Diagram 1: Block diagram of system configuration



All input from the user is via the tablet. A cursor is superimposed on the map monitor coresponding to the pen position on the tablet. Moving the pen on the tablet to the right will cause the cursor on the screen to move to the right. This allows an easy method of "pointing" at any place on the map. All of the picture images are stored on the MCA videodisc. The MCA and monitor together form an independant subsystem. The central processor sends only a frame number; the MCA calls up the picture associated with that frame number and shows it on the monitor.

The Ramtek and monitor are also a seperate display system. The area base map is loaded into the Ramtek from storage on the magnetic disc through the main processor. Overlays onto this map are controlled by the system program residing in the core of the Interdata.

The magnetic disc stores the base map, the program source, and a permanent static data base. This data base is used by the program to determine which pictures on the videodisc are around which point. For each picture the data base stores: where the picture is taken from, and what angle of view it covers.

The heart of the system is the software running in the Interdata. It is controlling when to show what picture from the videodisc, what to overlay on the map in the frame buffer, when to generate a new set of pictures based on the current path, when to clear the frame buffer of all overlays. Some of these functions are directly controlled by the user, such as clearing the overlays; others are implied by the user, as in regenerating the set of pictures to show when a new point is inserted into the path.

THE THEORETICAL FRAMEWORK

> In the process of way-finding, the strategic link is the environmental image, the generalized mental picture of the exterior physical world that is held by an individual. This image is the product both of immediate sensation, and of the memory of past experience, and it is used to interpret information and to quide action. The need to recognize and pattern our surroundings is so crucial, and has such long roots in the past, that this image has wide practical and emotional importance to the individual. 2

But how is it that one obtains this "mental picture" of the environment? The world around us is very complex and often overwhelming. Yet to survive, we must get arond. Occasionally one finds oneself in an unfamiliar place. One grasps for directional aids, be they road maps, tourist office handouts, friend's descriptions, walks in which one "checks out the scene," remembrences of movie scenes; almost anything can and will be used. The value of these tools is in teaching the individual a set of landmarks in the area, from which one can navigate easily.

Landmarks in an environment can be anything from the Empire State Building to a tuft of grass squeezing out of a crack in the sidewalk. Each individual looks for, and is comfortable with different landmarks. By becoming familiar with these elements in the environment, an individual "learns" about a place.

But how does one learn these landmarks; how does one come to form a "mental image", technically referred to as a cognitive map, of a new place? Despite almost twenty years of research into the subject, the answer is not yet well known.3 Kevin Lynch's studies in "The Image of the City", published in 1960, still stand as the best attempt at an answer. Yet it was those same studies that basically posed the questions in the first place. In that he stated.

> If an image is to have value for orientation in the living space, it must have several qualities. It must be sufficient, true in a pragmatic sense, allowing the individual to operate within his environment to the extent desired. The map, whether exact or not, must be good enough to get one home. It must be sufficently clear and well integrated to be economical of mental effort: the map must be readable. It should be safe, with a surplus of clues so that alternative actions are possible and the risk of failure is not too high. If a blinking light is the only sign for a critical turn, a power failure may cause disaster. The image should preferably be open-ended, adaptable to change, allowing the individual to continue to investigate and organize reality: there should be blank spaces where he can extend the drawing for himself. Finally, it should in some measure be communicable to other individuals. The relative importance of these criteria for a "good" image will vary with different persons in different situations; one will prize an economical and sufficient system, another an open-ended and communicable one. 4

This system is a high-bandwidth map of the MIT campus. It seeks to form a "good" image in the mind of a user how to get from one place to another. It is rich in clues. The user is presented with a set of photographs of the reality, not a group of symbols. These photographs are choosen specifically to fit the user in his task. It has been said a picture is worth a thousand words; this system gives you a thousand pictures. There is a gross redundancy of information presented. It is left entirely to the user which elements to pick out and store away in his/her cognitive map of the area.

If one has travelled from one point to another once, it is usuallly possible to "retrace one´s steps." One remembers many seemingly insignificant clues from the journey. Once placed among these clues, "it all comes back" and the way to go next follows easily. Someone using this system, "reading" the map, developes that same feeling without ever having travelled the path.

The system is accurate, being photographic images of the reality. Compared to traditional maps, it is highly readable; there is none of the translation from a two-dimensional symbolic representation to a three dimensional real world. This system gives you both, leaving little possibility of translation errors.

This system attempts to work with the user in their quest for understanding the environment. It invites exploration. When using the system, one is visiting, almost travelling through the area mapped. This visit serves to acquaint one with the area. Thus, actually going to the area becomes like returning to someplace already known.

APPENDIX

APPLICATIONS OF THE MCA DISCO-VISION INDUSTRIAL PLAYER

(as stated in MCA marketing literature)

In government and public agency activities, DISCO-VISION will fill two well-defined needs. The first, audio-visual applications will be for training purposes, in lieu of film and videotape. A variety of departments, such as Agriculture, HEW and Justice, can enjoy dramatic cost savings in the storage and distribution of their training materials on disc.

A second use will be archival in nature for governmental and public departments or agencies which have an urgent need for high-density storage capacity. DISCO-VISION's enormous packing density exceed that provided by conventional photographic film, magnetic tape and microfilm systems.

Libraries will be able to offer their patrons a mass information retrieval service via the videodisc. This "electronic filing cabinet" concept will enable patrons to have quick and easy access to the centralized information and retrieval facility of any library. Not only will printed material be stored on the videodisc, but motion pictures, slide presentations, and even television programs now stored on film or tape can easily be transferred to the videodisc and made available to the library patron.

Audio-visual material for instruction and training can be presented interactively on a standard TV receiver using the videodisc, which has the ability to store multiple answer material that can be selected at will. When used in conjunction with minimal data processing equipment, question-and-answer routines employing a "branching" and "sub-routine" capability could continuously feed back a program of appropriate audio-visual material predicated upon the students' response to initial presentations

Videodisc systems can be used as point-of-purchase sales tools in retail outlets, checkout counters and automobile salesrooms, replacing the more costly film and tape machines now in use at such locations.

Videodisc systems can also be utilized as training devices for salespeople, mechanics, technicians and others, for the storage and retrieval of maintenance manuals and information for automobile, airplane and other maintenance mechanics.

An important DISCO-VISION application in the field of medicine is the potential for archival storage and retrieval of X-rays. Storing X-rays on videodiscs could reduce significantly the amount of space needed at present for this purpose. Once on the disc, stored X-rays can be accessed immediately for viewing on a CRT monitor.

The disc could be used as an inexpensive, mailable, information storage medium for credit card verification. Each week videodiscs containing the numbers of all cancelled or stolen credit cards could be mailed to retail subscribers. The unacceptable or conterfeit card inserted into a reader terminal would flash a red light.

Television programs currently distributed in the form of film prints or magnetic tapes could be distributed more easily and economically on videodiscs. The player's capability to lock onto any given point or frame within a videodisc program permits precise and easy cueing and insertion of commercials and other program material. In the same way, videodiscs can replace film or videotape for showings of in-flight movies, on ships, or on oil platform complexs at sea.

Audio-only optical videodiscs which can play recorded music for 15 hours on one disc side can be used in commercial outlets as replacement for Muzak type services.

The videodisc can fill instruction, training and information need in emerging or lesser developed countries where no over-the-air TV exists or is available on a limited basis.

The applications of the MCA DISCO-VISION system are far more numerous than the few examples provided above. The unique high-density storage and retrieval technology of the optical videodisc makes it the core, the vital element in a rapidly developong video envoronment. Opportunities for its applications lie in all known print, graphic, audio-visual, universal still and motion, aural, visual and information storage and retrieval systems ever devised.

N O T E S

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2. Kevin Lynch, (1960) "The Image of the City", Cambridge, Mass. page 4

3. Roger Downs & Donald Stea, (1977) "Maps in Minds: Reflections on Cognitive Mapping", New York, NY, pages 4-5

4. Kevin Lynch, ibid, page 9

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