INITIAL USE OF A PLASMA DISPLAY PANEL

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Abstract

A "Digivue" plasma panel is being evaluated for application in computer assisted learning (CAL). This display offers unique opportunities for the instructional designer to mix computer display with photographic media. Several of the advantages including size, selective erasure, rear projection of film, and resolution are balanced against disadvantages of drive electonics, current requirements, media registration, writing and erasing speed, and need for peripheral control at the display site. The initial connection of the display to the PDP-9 computer and the software changes are described.

Resume

On procède à l'évaluation de l'écran à plasma "Digivue", afin de déterminer l'utilité de son application à l'enseignement assisté par ordinateur. Ce terminal met à la disposition de l'auteur de "software" didactique, la facilité unique de présenter des images sur pellicule en les mêlant à celles en provenance de l'ordinateur. On tient compte des avantages tels que la taille réduite du panneau, le raturage sélectif des images, la possibilité de projeter par derrière l'écran des images filmées et la clarté des images -- en les comparant aux faiblesses -- complication des circuits électroniques de contrôle, la consommation élevée du courant électrique, la difficulté de superposer des images de provenances diverses, le lenteur de la présentation et du raturage et l'exigence d'un dispositif de contrôle situé auprès du terminal. On décrit les résultats du premier branchement de l'écran sur l'ordinateur PDP-9 ainsi que les changements qu'on a dû faire à la programmerie.

The "Digivue" plasma display panel is a relatively new device for computer information display. Developed at the University of Illinois for use in the PLATO computer assisted instruction project (Bitzer & Skaperdas, 1970), it is now manufactured by Owens Illinois and is available to terminal manufacturers and researchers as a display device separate from the CAI terminal. OISE obtained one such device for evaluation as a display for its CAI programs. It is packaged with a keyboard and mounting for a slide projector, thus constituting a prototype LEK-130 terminal from Lektromedia, Montreal. This paper describes the plasma tube, reports initial interfacing and use of the tube, suggests further development and use, and attempts to evaluate the usefulness of this technology in comparison to the others likely to be available soon.

The Digivue consists of a display tube of two sheets of glass enclosing a thin gas-filled cavity. On each inner wall of the tube are 512 parallel transparent electrodes. The two sets are perpendicular to each other, giving a matrix of nearly a quarter million intersections. Although the electrodes are separated from the gas in the cavity by a very thin dielectric, application of an appropriate voltage between electrodes on the two walls will cause the gas at their intersection to emit a neon orange glow.

A lower voltage between electrodes is required to sustain a point once it is ignited than is required to turn it on in the first place. By this means, individual points may be maintained on by a general sustaining voltage applied between all electrodes; this illuminates those points already on but does not turn on the ones not already on. Lowering the potential at an illuminated intersection below the sustaining potential will cause the intersection to cease to glow. Thus by providing a general sustaining potential, changes in potential at an individual point can turn on or off the illumination of that point. The actual waveforms that accomplish the sustaining and control of individual points are complex high frequency signals; a description is given in Johnson and Schmersal (1972).

This description suggests the primary advantages of this display technology:

1) Memory is inherent in the display medium, so that information transmitted from the computer remains on the screen without further refreshing by computer or controller. This advantage is more apparent than real, in that substantial electronics are required to provide the sustaining waveform and to address the panel, in comparison with other storage media such as storage oscilloscopes (e..g., Tektronix model 611) or with serial display devices such as video terminals. These electronics are provided as a part of the package from Owens Illinois, and thus are not the responsibility of the terminal designer.

2) The ability to control individual points of the display, and in particular to erase individual points, is a useful feature of this display, which is lacking in the storage CRT. It is available, however, on certain video-based systems such as the Computek 300. In practice this ability is somewhat limited in that one of two conditions must obtain: (a) The computer must be able to reconstruct the display to be erased so that only the individual points that are on are turned off, or (b) the computer erases a specified area of the screen, point by point. In the latter case, the time required with our initial connection of the display makes this area erase feature nearly impractical for areas of medium size. The speed problem could be helped by provision of a controller function for area erase,

allowing this to proceed at about 72 msec.. per square inch erased. Extending this to a larger area, the minimum time to erase a quarter of the screen area is 1.25 seconds.

A related problem is unsolvable by this storage scheme. It results from the sharing of a display point by two separate elements of the display, one of which is to be erased. No simple solution relating to display technology is possible, short of representation of individual elements within the refresh mechanism of a display, as in vector-drawing displays. Although of marginal concern, this feature can result in some unexpected displays.

3) The transparent, flat surface permits mixing of media on the same display. In this way, slides (or motion pictures, TV, etc.,) can be used as a background for the computer display. The LEK 130 terminal is structured for a GAF ESP 1000 slide projector. Preliminary use of this projector indicates that adjustment of lamp wattage is necessary, as the plasma display is easily washed out by a strong rear projection image.

4) The size of the display itself is a breakthrough, in that it is potentially less than an inch thick, so that the tube could be carried in a briefcase and used anywhere. The actual packaging, however, requires that the electronics be mounted around the perimeter of the tube, constituting a rectangular frame about 3 inches wide and about 7 inches deep. Thus the effective dimensions of the tube are increased by 6 inches on each side and the thickness at least trippled. In addition, the power supply is mounted separately. The power requirements of this display are sufficiently great that the panel is not suitable for a truly portable terminal (Kay, 1972).

5) The resolution of the display is much better than might be imagined, in that each of the 512 x 512 points is quite discriminable. There is no blurring of adjacent points, nor any bleeding of points into adjacent areas as a function of time since display. The square display has 9 small areas within the viewing area (at the intersections of lines dividing the area into 16 subsquares) that apparently help maintain the separation of the two sheets of glass. These areas, about 2 points high by 8 points wide, have inferior display characteristics. In practice this is not a big problem as the content of these areas can be inferred from context; the problem can be annoying, however.

6) The life of the panel is alleged to be affected by sustained display of the same image in one position. The production model has a timer which extinguishes a display that has been on for about ten minutes without any change, presumably as a protection against such deterioration. Our panel has been in use for about 200 hours with no perceptable differential aging of the areas used more frequently, but this is hardly a good test.

Initial Connection to the PDP-9

For initial use and evaluation, the Digivue plasma display was connected to the OISE PDP-9 computer, used in our research and development of computer applications in education. This facility is used by several R & D projects as well as in graduate instruction, so many uses of the panel were anticipated.

The PDP-9 runs a timesharing system, TSS-9, supporting up to 13 terminals at present. Several of these terminals are supplemented by Tektronix 611 storage CRT's driven from user programs through a multiplexed D/A converter. The plasma display was interfaced in such a way that the X and Y axis information for the 611's would be presented to the plasma display in digital form identical to that appearing at the D/A converter. The 611's utilize 10 bits per axis, whereas the Digivue uses 9 bits; this was resolved by using the 9 higher order bits of the D/A converter, thus ignoring the least significant bit. In this way all information presented for display is displayed, but on a slightly coarser grid. In practice, the software used with the 611 typically uses dots at least two points apart for adjacent points, so that nothing is lost in this process.

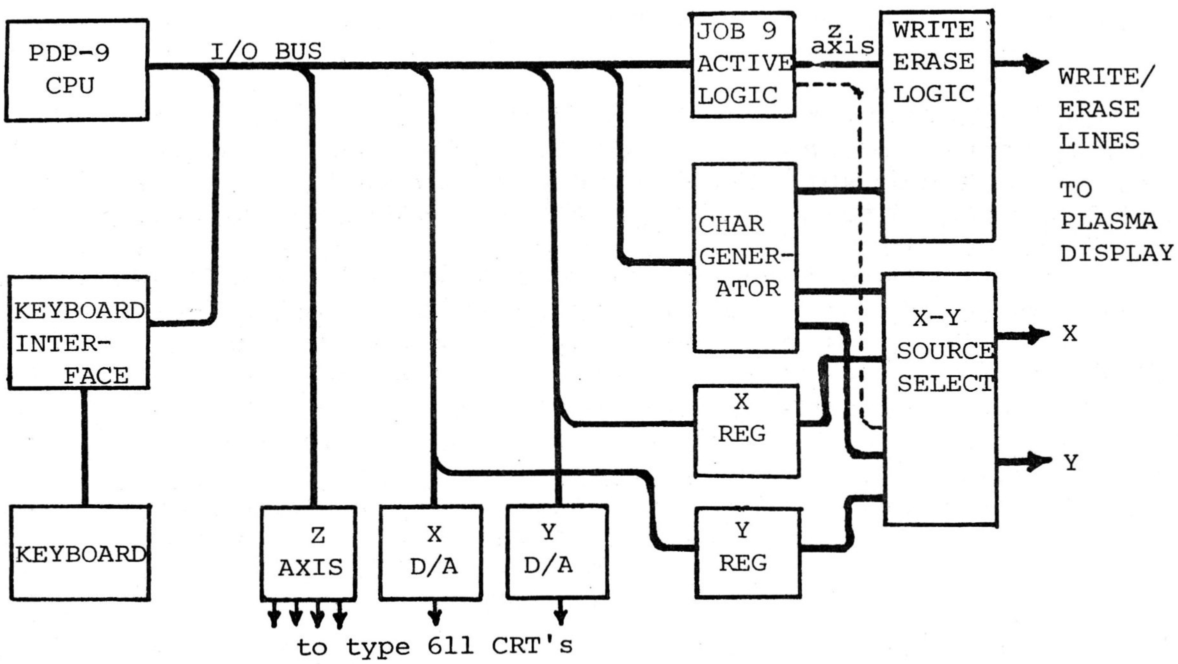

Figure 1: Interface of plasma panel terminal to TSS-9 system.

The interface scheme is shown in Figure 1. Also shown is a character generator that is partially completed and will allow the terminal to operate as a combination graphics display and teletype substitute. The digital registers for X and Y always receive X and Y information which is output to the D/A converters that are multiplexed among the several type 611 scopes by the timesharing software. When the job associated with the plasma tube (line 9) is active, commands to plot on the scopes control the appropriate portion of the write/erase logic, and set the XY SOURCE switches to connect the X and Y holding registers to the plasma tube during each point's writing or erasure. The rest of the time the XY SOURCE switch points to the character generator to allow display of alphanumeric information.

The keyboard input is completed and results in input on a polled basis at the command of the TSS-9 monitor, currently at 60 samples per second.

By electing to connect the Digivue as a 611, we were able to use software already available for that device. This includes display commands in the OISE CAI language, CAN (Churchill, Naess, and Olivier, 1971). Variations of the commands for displaying text and plotting vectors have been added which allow the user to specify that the text or vector is to be erased rather than displayed. This facility allows area erase to be programmed by the user.

Interactive Instructional Uses

Although the plasma display has certain desirable features for computer-assisted learning (CAL) applications, the cost is not likely to drop to the level of the teletype or even teletype compatible video displays in the near future. One must, therefore, justify the device for the moment as a research tool and as an assist to the CAL instructional designer. Whether or not the plasma display is widely used in CAL systems, it seems likely that devices with comparable characteristics will be available in the next generation CAL systems.

The instructional designer, through use of the plasma device, is now freed from many constraints of currently available displays, and may explore new interactions made possible by it. The single unique feature of the device is the ability to combine film projection with data overlay. The instructional designer should focus on this feature, as well as the nearly unique one of selective erasure of information.

Film projection on a separate rear projection screen has been used in the IBM 1500 instructonal system along with that system's ability to display prestored dot/bar graphics on a disk-refreshed video display. Although available for very advanced terminals, combined CRT and film terminals utilizing projection ports in the CRT tube have not been used in education.

The other major feature, selective erase, has not been implemented in many CRT systems, but such a feature is likely to emerge more strongly as the plasma panel becomes a viable alternative to CRT terminals. To date the economy of the alphanumeric representation in the refresh memory has ruled this feature out of most terminals, but the instructional designer can anticipate its availability in the future.

Therefore, it is advisable to explore the projection and selective erase capabilities of this terminal without being tied to the plasma tube for a production CAL system.

We can imagine an example of instructional interaction using these features. A ninth year public school student sits in front of such a display with projection facilities. After the usual "sign on" procedure, the computer resumes the dialogue with the student using alphanumeric symbols displayed on the panel. The slide selector mechanism is then activated by the computer and a coordinate plane with a polygon is projected in colour on the screen. Simultaneously, the computer issues a bulk erase and then generates a similar shaped polygon in another quadrant. The computer then asks the student to indicate x and y displacements to move the computer generated figure to coincide with the coloured polygon. The student may make several attempts; each time the computer erases alternate dots from the last figure and produces a new figure where the students displacements indicate. By using a coordinate plane stored on film one saves computer time and storage to generate the axes, labels and figure and gets colour added to the display. Additionally, when the computer partially or completely erases a figure there is no danger of erasing the axes and labels. Since one would not know in advance where the student's displacement values would cause a figure to be displayed, one could not easily protect a set of coordinate axes drawn by the computer.

While the foregoing example may not be the specific interaction one would use for teaching, it illustrates how the features of the plasma display may be used. Less obvious are many of the practical problems associated with the production of materials for the display.

For instance, the current slide selection mechanism is limited to 100 35mm slides, although the tray may be changed with human intervention for another block of 100 slides. In addition, the current slide display is slow, but acceptable (longest access time under 5 seconds). It is not known yet whether the present system will repeatedly register slides precisely enough to allow the computer to evaluate the position of overlays that it generates. Added to this is the problem of mounting the slides so that the material is properly positioned in the first place. The microfiche projector mechanism (Bitzer & Skaperdas, 1970) reportedly solves these problems, but for R & D work, the complete production and replacement of all copies of one microfiche card just to change one frame is too costly.

Some Final Questions

There are a few more questions that can be raised as a result of our initial experience with this display. Several of them are not answerable by our direct experimentation with one device, but they form a set of concerns that may be of help in evaluating this new display technology.

Does the plasma emit radiation outside the visible spectrum? If so, is there any long-term hazard?

Will the cost of this technology come down to a reasonable level (say to the cost of a colour TV, rather than the $5,000 to $7,000 currently)?

What is the life span of the panel? Will it develop a few areas of the screen that refuse to work or simply gradually decay?

Will the other competing technologies produce a panel that is smaller (including electronics), less power consuming, faster, more flexible, more naturally coloured, etc., before the plasma display becomes a household feature?

In summary, it appears that the plasma display presents some of the likely attributes of future CAL terminals and is useful as a research tool; it is too early to declare it the device of choice for our CAL use.

References

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