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DIGIVUE PLASMA PANEL SOFTWARE

Richard S. Camden

November 1976

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U. S. ARMY HUMAN ENGINEERING LABORATORY
Aberdeen Proving Ground, Maryland

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report describes the system and graphic software written to add a gas-plasma-panel display device as an integral part of the U. S. Army Human Engineering Laboratory (HEL) interactive-graphics system.

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DIGIVUE PLASMA PANEL SOFTWARE

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November 1976

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DIGIVUE PLASMA-PANEL SOFTWARE

INTRODUCTION

This report describes the software developed to add a plasma-panel display device[a] as an integral part of the U. S. Army Human Engineering Laboratory (HEL) interactive-graphic display system. The central processor for this system is a Varian 620/f-100 minicomputer which uses a disk-based operating system. HEL's display system also includes three monochrome cathode-ray tubes (CRT) and one four-color penetration CRT.

The plasma-panel hardware interface, including a character generator, was designed and built at HEL (2). The software described here provides the capability for displaying graphics on the plasma panel by using primitive graphic subroutines and a software special-character generator. Also described here is the software for using the panel as a standard output device under the operating system.

PLASMA-PANEL DISPLAY DEVICE

The DIGIVUE(R) gas-display unit is an 8.5" x 8.5" flat panel with 512 x 512 addressable lines, providing 256,144 independently addressable points. In addressing a point, the panel is considered as a cartesian plane where coordinates (o,o) designate the lower left corner. The resolution is 60 points per inch. Since it is inherently a memory device, the DIGIVUE(R) does not require refreshing or a display file. Each point, when written, glows with neon's characteristic color.

The basic operations permitted by the controller are: (a) write a point, (b) erase a point, (c) bulk erase, and (d) write or erase a set of two characters. The controller requires 20 microseconds to write or erase a point. The entire screen can also be bulk-erased in 20 microseconds.

OPERATING SYSTEM

The interactive-graphics system at HEL operates under the HIGHER operating system, which is a disk-based operating system developed by Information Displays, Inc., for Varian computers. HIGHER employs a dynamic memory management and an automatic-overlay technique which provides virtual-storage capacity. The core capacity is 32,768 words, 16 bits per word. Included in the system are a full FORTRAN-IV compiler and a Data 620 Assembly System (DAS) assembler. The FORTRAN-IV compiler allows imbedded DAS coding, which provides the capability of writing efficient assembler-language coding for special purposes.

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[a]Owens-Illinois DIGIVUE(R) Display/Memory Unit, Model 512-60.

Also included in HIGHER is a package of FORTRAN-graphic subroutines designed for interactive use with the CRT displays and the interactive devices as the lightpen, keyboard, joystick, and trackball. By developing FORTRAN-graphic subroutines for use with the plasma panel, this display has been incorporated as an integral part of the interactive-graphics system under HIGHER.

DIGIVUE(R)-DEVICE DRIVER

HIGHER includes a device-driver subroutine that controls a specific input/output (I/O) device. Normally, all I/O for a particular device is handled through a single device driver written to reflect that device's characteristics and capabilities. Users access device drivers through standard FORTRAN I/O statements to the logical-unit number assigned to a device. The plasma panel's device driver provides only for output of ASCII data.

The plasma panel's character-generator hardware is capable of outputting 64 characters in two font sizes (5 x 7 and 7 x 9 dots), in rotated or normal orientation, and in write or erase mode. The controller accepts six-bit packed ASCII data and generates pairs of characters for display on the panel.

When a standard FORTRAN "WRITE" statement is executed for the logical unit assigned to the plasma panel, the I/O routines output ASCII data through the device driver. The starting location, character size, mode, and orientation are default values (Table 1) unless they are specified individually.

TABLE 1

Defaults for Character Output

Parameter	Default Value
Starting location	(10,500)
Mode	Write
Size	5 x 7
Orientation	Normal

To change these parameters, the program calls subroutine CHM. The calling sequence is:

CALL CHM (IX, IY, IMODE)

Where:

IX = X location $0 \leq X \leq 511$

IY = Y location $0 \leq Y \leq 511$

IMODE = character size, orientation, and mode, as given in Table 2.

TABLE 2

Argument Values for CHM

Mode	Size	Orientation	Mode
0	5 x 7	Normal	Write
1	7 x 9	Normal	Write
2	5 x 7	Rotated	Write
3	7 x 9	Rotated	Write
4	5 x 7	Normal	Erase
5	7 x 9	Normal	Erase
6	5 x 7	Rotated	Erase
7	7 x 9	Rotated	Erase

The number of characters per line depends on character size and starting location. The maximum possible number of characters per line is 85 (5 x 7 characters beginning at x = 0). When the screen has been filled with output, the computer will pause until a teletype key is pressed; then it will erase the screen and continue writing at the top of the panel. When writing in the rotated mode, writing proceeds from bottom to top, and from left to right on the panel.

As an output device, the plasma panel provides high resolution, high speed, and easily read output.

GRAPHIC SUBROUTINES

The basic graphic figures for the plasma display were patterned after the system described in (1). The subroutines, written in DAS assembler language, are accessed through FORTRAN CALL statements. A series of subroutines provide the graphics capabilities listed in Table 3.

The vector generator implements the Digital Differential Analyzer described in (3). Circle and triangle algorithms are described in (2). Two-dimensional clipping is performed on all figures, thus removing the limitations on positioning circles, disks, etc., when calling these subroutines. Portions of the figures which lie off-screen are simply not displayed.

After the controller has been commanded to write, it requires approximately 20 microseconds to begin writing a point. After it returns to the ready state, it requires an additional 12-20 microseconds to reload the position registers for the next point. Thus the speed of the display is 32-40 microseconds per dot (25,000 to 31,250 dots per second) depending upon the subroutine and its argument values.

TABLE 3

Graphic Subroutines

Subroutine	Description
ERAS	Bulk erase
PT (IX, IY, MODE)	Write/erase a dot at (IX, IY)
VECT (IX, IY, LX, LY, MODE)	Write/erase a line from (IX, IY) to (LX, LY)
CIRC (IX, IY, IR, MODE)	Write/erase a circle with radius IR and center (IX, IY)
BOX (IX, IY, LX, LY, MODE)	Write/erase a rectangle whose lower left corner is (IX, IY) and upper right corner is (LX, LY)
DISK (IX, IY, IR, MODE)	Write/erase a solid disk with radius IR and center (IX, IY)
TRI (IX, IY, LX, LY, MX, MY, MODE)	Write/erase a solid triangle whose vertices are (IX, IY), (LX, LY), (MX, MY) where $IY \leq LY \leq MY$

MODE is an optional argument in each of the above subroutines.

SOFTWARE CHARACTER GENERATOR

A software character generator has been written which can display any user-defined special characters up to 15 dots x 15 dots. The characters may be rotated through any angle. The calling sequence for writing a string of software characters is:

CALL STRING (IX, IY, NCHAR, IC, THETA)

where: IX, IY = starting display location
NCHAR = number of characters
IC = address of character string
THETA = angle of rotation (radians)

The user defines a software character by describing its dot design in a 15 x 15 dot matrix. Each character is assigned an ASCII code, which is the reference used for displaying it.

EXAMPLE:

Figure 1 is a photograph of the DIGIVUE(R) plasma-panel device. The design was generated with the routines described in this report.

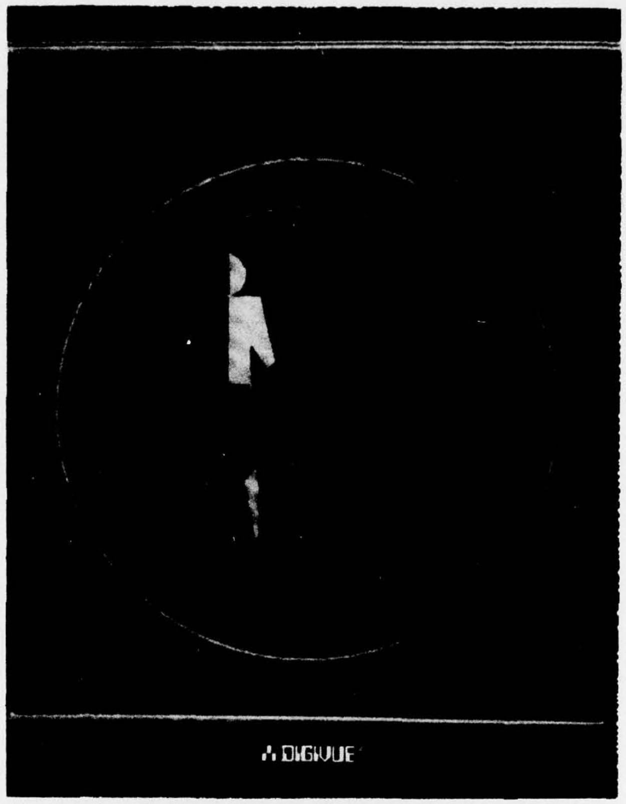

Figure 1. Plasma display example.

CONCLUSION

The DIGIVUE(R) plasma panel is now a fully operational output device in the HEL interactive-graphic display system. The panel can be used as a standard output device or as an interactive-graphic output device. The software described in this report provides the capability to build complex graphic displays from primitive graphic elements.

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