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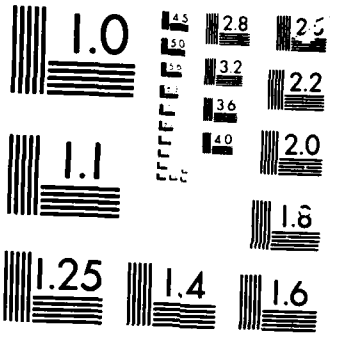

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INTERIM TECHNICAL REPORT

CSMI TR 86-03

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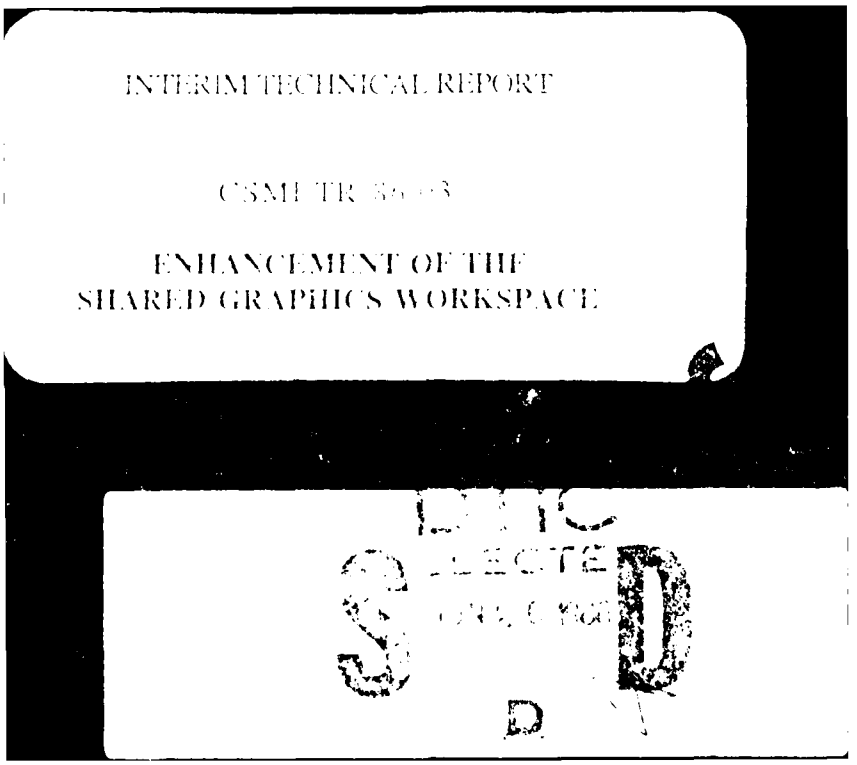

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May 1, 1986

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ENHANCEMENT OF THE SHARED GRAPHICS WORKSPACE

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This report discusses software and hardware enhancements that Computer Systems Management (CSM), Inc., is making to the Shared Graphics Workspace (SGWS) used with the U.S. Air Force/Foreign Technology Division (AF/FTD) video-teleconferencing system. The enhancements include upgrading the UNIX 6.0 operating system to Ultrix, a variation of the Berkeley UNIX, and improving the hardcopy capabilities of the SGWS by adding the Datacopy digital camera and the Apple Laserwriter.

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SUMMARY

Computer Systems Management (CSM), Inc., is designing, developing, and installing software and hardware enhancements to the Shared Graphics Workspace (SGWS). The SGWS was developed by CSM under the auspices of the Engineering Applications Office (EAO) of the Defense Advanced Research Projects Agency (DARPA) as part of a video-teleconferencing system for the U.S. Air Force/Foreign Technology Division (AF/FTD). Software enhancements include replacement of the UNIX 6.0 operating system with Ultrix, a variation of the Berkeley UNIX. To speed transmission and reproduction of hardcopy documents, CSM is developing software to control a digital video camera to be installed in place of the SGWS's relatively slow facsimile machines and is integrating two Apple Laserwriters into the system. Once the enhancements are completed, CSM will add two nodes to the AF/FTD system.

1.0 INTRODUCTION

This Interim Technical Report covers work done by Computer Systems Management (CSM), Inc., under modification P00007 to Contract MDA903-84-C-0008. For this project, sponsored by the Engineering Applications Office (EAO) of the Defense Advanced Research Projects Agency (DARPA), CSM is to design, develop, and install software and hardware enhancements to the Shared Graphic Workspace (SGWS). The SGWS is part of a two-node video-teleconferencing system, developed by CSM under DARPA auspices, that links the United Stated Air Force/Foreign Technology Division (AF/FTD), in Dayton, Ohio, with another U.S. government site, in Maryland. It transmits black-and-white images via the Compression Labs, Inc. (CLI), 19.2 kilobits-per-second (kbps) Sketch Coders; uses TSP-2000 voice codecs (coders/decoders), operating at 4.8 kbps, for the audio connection; and allows teleconference participants to share and annotate information sent via the SGWS. (See Figure 1.) Once the current system is upgraded, this contract calls for CSM to install additional nodes in Grand Prairie, Texas, and Mountain View, California.

The enhancements now underway to the video-teleconferencing system respond to several needs that users have identified since CSM installed the system. The system was developed on the PDP11/23, running the UNIX 6.0 operating system. Since then the UNIX System V and the Berkeley UNIX have become the industry standards as well as the accepted test-bed for defense-related research projects. Though these reasons alone would justify the upgrade of the AF/FTD operating-system software to one of these standards, these systems also offer other advantages: Most important, they have the

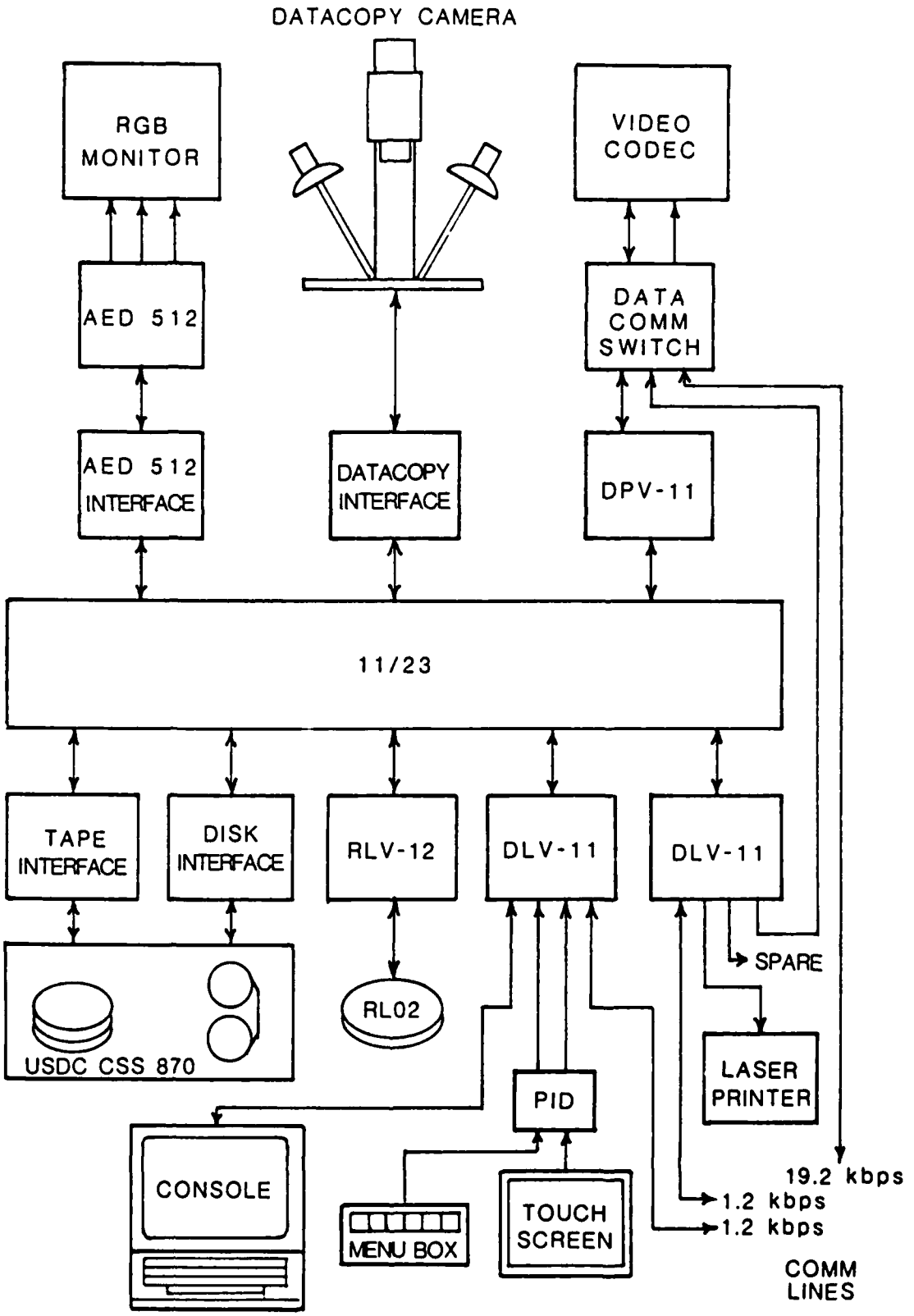

FIGURE 1

SGWS CONFIGURATION

reliability to perform effectively under heavy use. In addition, they are portable, a feature that permits rapid transfer to a large audience of potential users; and they have the flexibility to adapt rapidly to the ever-changing needs of the defense community. Since System V is not available for the PDP11/23, Ultrix, a variation of the Berkeley UNIX, was chosen for the upgrade. It offers the added advantage of access to TCP/IP software, one of the most common Defense Department communication protocols.

Installation of Ultrix will also require changes to the SGWS. System calls differ between UNIX 6.0 and Ultrix, and there are key differences between the 'C' compilers. In addition, system drivers for graphics processors and special devices must be written.

Besides the upgrades required by the installation of Ultrix, the SGWS also needs a way to speed transmission of hardcopy documents. The present system must convert these to a graphics format via a special facsimile interface. This cumbersome procedure is too time consuming to be convenient in a teleconference: It requires two minutes per page to digitize a document, eight minutes per page to distribute it to the other sites, and four minutes per page to decompress the image. When meetings are planned ahead, users can process these documents beforehand. They cannot, however, decide at the last minute to include a just-received document or to hold an ad-hoc meeting to discuss a particular report because teleconference participants would waste too much time waiting for documents to be transmitted.

To solve this problem, CSM is installing digital video cameras in place of the facsimile machines used with the SGWS. These cameras are similar to those

CSM used to develop a video-teleconferencing system for the U.S. Navy. The new system digitizes and displays a photo at the local site in about 30 seconds, a printed or typewritten document in about a minute--a significant improvement over the time required by the original SGWS. Transmission time to the remote site must still be determined.

Because users of the AF/FTD video-teleconferencing system found the facsimile machines time consuming and unwieldy for making hardcopies, DARPA has requested that CSM also integrate two Apple Laserwriters into the Dayton and Maryland nodes.

The following sections discuss how CSM's work on software and hardware enhancements is solving these problems with the AF/FTD system, summarize work remaining to be done under this contract, and present a conclusion.

2.0 SOFTWARE DESIGN AND DEVELOPMENT

Software enhancements of the SGWS include work on the Ultrix operating system, the Datacopy camera, and the Apple Laserwriter.

2.1 Ultrix Operating System

CSM is to install the Ultrix operating system on the PDP11/23s used in the teleconferencing network. So far, the work has been partially completed. A delay occured because the Ultrix supplier failed to meet the promised delivery deadline and CSM had no recourse but to wait. This supplier was chosen after a careful survey of vendors: the company not only offered the lowest price, it was also the only one willing to commit to a delivery date. The Ultrix copy finally received proved to be defective; but CSM staff have rebuilt it, using the tape drive and storage capacity of the PDP11/70, along with a great deal of programmer ingenuity. Work is now proceeding on completing installation of Ultrix.

To increase storage capacity of the PDP11/23, CSM is installing high-density, 70-megabyte (Mbyte), unformatted disk drives with tape backup. Because Ultrix does not work with a U.S. Design Corporation (USDC) CS 800 70-Mbyte disk drive, CSM staff are working to modify USDC and Berkeley drivers and will use whichever one can be made compatible with Ultrix.

2.2 Datacopy Camera

CSM programmers have developed the driver that controls the operation of the Datacopy camera and written application programs that tell the driver whether to scan a printed text or a photo. The driver needs this information because the area it scans on a text is larger than that on a photograph and the image is less sharp. Text images appear on the SGWS red-green-blue (RGB) monitor in black on amber, with a resolution of 1,024 x 512 pixels. Black-and-white photos appear in 16 shades of gray, with a resolution of 512 x 512 pixels.

For the system to display a document, whether text or photo, the camera scans the document, digitizes the data, and sends it via direct memory access (DMA) to the computer, which in turn DMAs it to the Advanced Electronics Design (AED) graphics processor. The AED automatically displays the image on the RGB monitor of the SGWS. The entire process takes about 30 seconds for a photo and about 1 minute for text material. The time difference occurs because before digitization data scanned from printed documents must be changed from eight bits to one bit to make it compatible with the AED.

Originally, CSM programmers developed a system that took only 10 seconds to scan and display a photo. However, the AED allows the use of only eight bit planes; and all eight were used to transmit the image, leaving none to use in annotating it. To solve this problem, CSM staff devised a program to eliminate half of the scanned data and thus leave four bit planes to use for annotations. Which half of the data gets thrown away depends on how light or dark the user chooses to make the image. The process of eliminating the unwanted data adds to the time needed to scan and display a photo. In

addition, integration of the system into the SGWS means less available buffer space for the DMA from the camera, thus slowing the process even further.

2.3 Apple Laserwriter

CSM has acquired the two Apple Laserwriters that are to be incorporated into the AF/FTD video-teleconferencing system to improve its hardcopy capabilities. Each printer has its own internal 68000 processor and 768K of memory; and each is controlled by the PostScript language, from Adobe Systems. This printer can accept RS-232 data at speeds up to 9.6 kilobits per second (kbps) with XON-XOFF handshaking. In addition, it has an RS-422 port that can accept data at up to 288 kbps. It can print graphical, half-toned, and gray-scale data as well as standard text.

PostScript programs tell the Laserwriter whether incoming data consists of text or graphics and direct its manipulation of that data. Software has been written that sends to the printer the PostScript program required for the data to be printed. Because of the delayed delivery of the Ultrix operating system for the PDP11/23, CSM programmers wrote this software to run under UNIX System V, Release 2.0, on the PDP11/70 so they could begin testing the PostScript programs. This software can be easily modified to run under Ultrix on the PDP11/23.

The Laserwriter, running on the PDP11/70, can now print computerized text and graphics files. Persuading it to print scanned text or photos presents a problem, however, because the digital data is stored on a disk--and no PostScript program can print data quickly from a disk. To solve this problem,

CSM programmers have devised a way to encode the data. A PostScript program then directs the Laserwriter to print a picture of the document from this coded data. Running under UNIX on the PDP11/70, the process takes from 12 to 15 minutes. This time is not a critical factor in the operation of a video-teleconference since the PDP11/23 runs the printing program in a background mode. All other SGWS functions occur almost immediately: Users can transmit, display, discuss, and annotate documents while the system prints hardcopies in the background.

3.0 HARDWARE ENHANCEMENTS

Work on hardware for the FTD video-teleconferencing system has focused primarily on enhancements of the pod interface devices (PIDs), design and development of the data communications switches, and modification of the PDP11/23.

3.1 Pod Interface Devices

CSM engineering staff have modified the PIDs, which interface the PDP 11/23 to the touch screen and menu box. This work includes the following:

1. Modification to insure that menu-box lights are off immediately after power up and that the menu-box boards no longer send extra characters when an operator presses a button for longer than usual. The system confused the operator by showing all options as selected when power was turned on; in reality, nothing should have been selected at this point.

2. Additions of power switches and pilot lights. The power switches represent a safety feature: previously, the operator had to remove the fuse to turn off the system and reset the PID. The pilot lights are a convenience that tells the operator whether the system is on or off.

3. Elimination of switch bounce from the menu boxes so that unwanted characters are not transmitted.

3.2 Data Communications Switch

The data communications switch, under command of the PDP11/23, switches data channels between the CLI Sketch Coder and the SGWS. CSM engineers have designed, built, and tested three of these devices. In addition, modifications to three CLI Sketch Coders now allow software to direct the data communications switch to reset the Sketch Coders on a command from the PDP11/23. This feature has simplified a complex process that required the user to perform several manual operations.

3.3 PDP11/23

Modifications were also made to four boards that interface the PDP11/23s to the Datacopy camera. Improperly designed hardware caused the overhead lights to default to "on" whenever the system was turned off. The lights now work as they should.

4.0 SUMMARY OF WORK REMAINING

Because of the delayed delivery of the Ultrix operating system, much work remains to be done.

Installing Ultrix on the PDP11/23 will require significant changes to SGWS software, and SGWS programs must be modified to conform to the new compiler. In addition, drivers for the Datacopy camera and the AED, as well as the HK driver for the USDC disk drive, must be modified to work on Ultrix rather than on UNIX 6.0. The DPV11 driver, which at present reads data from and writes it to the facsimile machine, will be used to transfer files from one node to the other via the 19.2-kbps line. Therefore, it too will need modification. Fortunately the DL driver, which handles serial communication ports, appears to work with Ultrix; thus, it will not need to be modified, as it had to be to work with UNIX.

Once Ultrix works as it should on the PDP11/23, efforts will continue to speed up the printing of documents scanned by the Datacopy camera.

Finally, when the system has been perfected in CSM's facilities, CSM staff will upgrade the two existing AF/FTD nodes and install additional nodes in Texas and California.

5.0 CONCLUSION

Work on both the software and hardware enhancements to the SGWS has progressed apace. The system's ability to make hardcopies has been improved by addition of the Apple Laserwriter, and the Datacopy camera significantly decreases the time required to scan and display text and photos.

A major obstruction to progress was the three-month delay in delivery of the Ultrix operating system. As a result, work on all aspects of the project has fallen behind. CSM programming staff salvaged some lost time by writing programs to test new equipment under UNIX, System V, Release 2.0, on the PDP11/70. These will have to be rewritten, however, to run under Ultrix on the PDP11/23. For this reason, systems that should have been installed at the end of April 1986 may not be in place until July 1986.

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