VISUAL INFORMATION DISPLAY SYSTEM

CPT CRAIG F. SMITH AND MR. CECIL BONE
US Army Combat Developments Experimentation Command
and
MR. DENNIS J. RUTLEDGE
DBA Systems, Inc.

I. INTRODUCTION

The Visual Information Display System (VIDS), built by DBA Systems, Inc., for the US Army Combat Developments Experimentation Command (CDEC) represents an innovative and flexible approach to the display of field experimentation data. A fundamental aspect of CDEC's experimentation mission is that of two-sided, free-play field exercises in which casualty assessment is carried out in near real-time, with a high level of data collection instrumentation on down to the individual player elements which can be infantrymen, tanks, aircraft, or other weapon systems. The purpose of this form of experimentation is the collection of pertinent data from a realistic battlefield environment.

The primary function of VIDS is the graphical representation of player position and status data which is collected and processed by the CDEC Real-Time Casualty Assessment Instrumentation for use in real-time monitoring and post-trial analysis of experimentation activities. The display is multichromatic, and utilizes pre-programmed symbols to depict various player types. In addition to computational and display equipment, VIDS includes a map digitization system which provides the capability to record and process terrain or other data for background information overlays.

This paper presents an overview of the VIDS and the CDEC Instrumentation to which it is interfaced. It discusses the capabilities and design features which are built into the display system. Finally, other potential uses of VIDS or a VIDS type system are considered.

II. SYSTEM OVERVIEW

The primary instrumentaion system for collection and handling of CDEC's range experimentation data is the Range Measuring System, or RMS. When interfaced to a central computing complex, the RMS provides a position locating capability as well as a two way telemetry link between this central complex and the individual player element. Other instrumentation systems, such as the Direct Fire System, which is a laser based weapons engagement simulation system, or the posture sensor system which allows for the continuous monitoring of player posture, are interfaced to the RMS in order to provide the capability for Real-Time Casualty Assessment (RTCA) in a mock battle experimentation scenario.

The basic concept of the RMS is that the individual player, instrumented with the proper receiver-transmitter and digital logic equipment, responds with a unique code to signals from multiple interrogation stations which are placed at fixed, surveyed locations. The transmission time of these RF signals between a player element and the fixed interrogator stations allows the computation of position location using a multilateration technique. The raw range data are passed via RF link to the RMS control station or C-Station, which is directly interfaced to an on-line real-time multi-computer complex, where the multilateration computations, simulations, RTCA decisions, and system control take place.

The complete RF link from the individual player element via the interrogator station to the C-Station and Multi-computer System can be used as a two way telemetry link in addition to allowing the measurement of position location. Thus, field event data (such as fire events from the Direct Fire System, or the detection of a "hit" from a laser detector responding to the fire event) are passed back to the Multi-computer System, and data such as the results of the casualty assessment (player kill, near miss, mobility kill, etc.) are passed from the computer to the player element.

Figure 1 shows an overview of the data flow from the RMS through the Multi-computer System to VIDS. Within the RMS are player elements (B units), surveyed interrogator stations (A stations) and a control station (C station) which is driven by a local minicomputer. Field data collected by the RMS includes raw range data between player elements and various interrogator stations, as well as telemetry data such as firing events

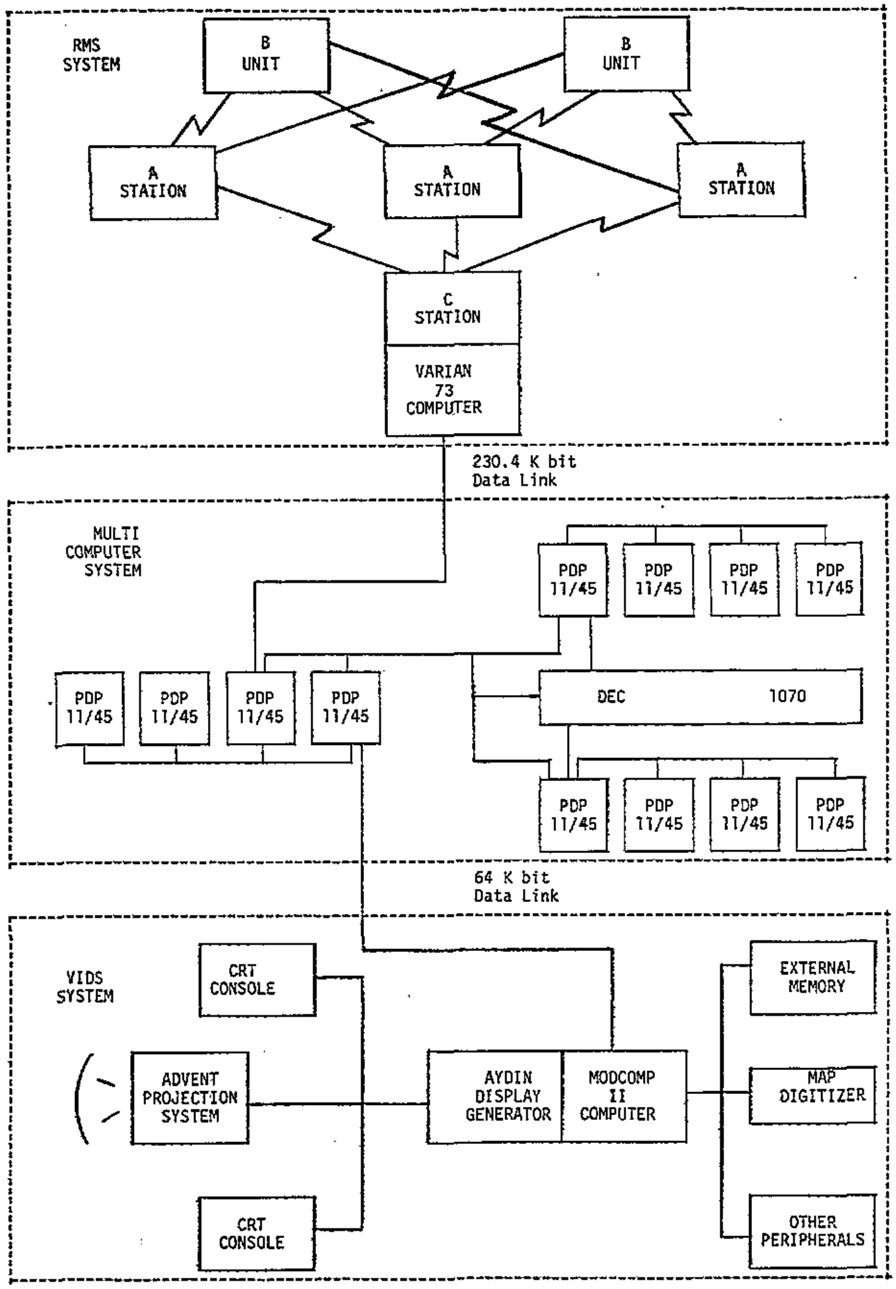

Figure 1

System Overview

from laser weapons simulators, laser hit detection, or other digital data depending on the instrumentation utilized for the particular experiment.

The Multi-computer System communicates with the RMS over a data link. Data is logged and processed at the computer system to allow modeling and simulation of weapons systems, and real-time casualty assessment as a result of events occurring in the field. At the computer center the raw ranging data is processed in near real-time to yield position location in three dimensions as an input to the casualty assessment process.

Finally, VIDS is interfaced via data link to the Multi-computer System. The data handled at the central computer, and therefore available at the interface to VIDS, include player position as a function of time, field event data, and casualty assessment information. The basic design of VIDS permits a high degree of flexibility in the method chosen for the depiction of this basic data. A description of the display design and features will be covered in the following sections of this paper.

III. HARDWARE FEATURES

Figure 2 shows the detailed hardware configuration of the VIDS, which is contained in a 55' by 10' semi-trailer van. The van is EMI protected, thermally insulated, and contains the environmental control and power distribution equipment necessary for system operation.

The data input to VIDS is through a 64 K bit hardwire data link terminated by CODEX 8315 modem adapters.

Standard peripherals to the MODCOMP II Computer include a card reader, printer, dual magnetic tape drives, and fixed (1 MB) and moving head (2.5 MB) disks. The Video Map Converter System, which will be discussed later, is a non-standard peripheral designed specifically for VIDS. The display subsystem consists of an Aydin Image Processing Display Generator, two-high resolution color CRT consoles with keyboards and light pens, and an Advent color projection system with keyboard for a large screen interactive display.

The map digitization or video map converter system permits the recording and processing of terrain or other data for background information overlays. Figure 3 is a block diagram of the map converter system. VIDS has the capability of storing up to 30 map background overlays for any real-time trial. The stored map backgrounds can be activated, translated, and scaled in the real-time or playback display of experimentation data. The pre-mission processing of map data includes map digitization, registration of coordinate locations, correction of rotational distortion, and other map editing as required.

Figures 4 through 7 are photographs showing the VIDS trailer, the map digitization equipment, and the CPU and display areas of the van.

IV. OPERATIONAL FEATURES

As previously discussed, the data which can be displayed on VIDS include player position information for up to 100 player elements, and field event and casualty assessment data which can be displayed through alphanumerics or graphic elements.

Figure 8 shows the VIDS display layout. The active playing area is centered on the screen. This area contains the map background and symbols representing player positions registered to the background coordinates. The operator can request display of all players, or a subset by player type. Path points identifying up to 30 previous positions can be requested for the players. An additional player annotate which consists of up to four alphanumeric characters located in the active playing area adjacent to the player symbol can be called up for the players.

The operator has the capability of selecting from up to 30 different map backgrounds. Display maps can be translated, blown-up to two, four, or eight times normal, or a completely different map may be displayed.

The upper right hand area of the display contains the range and elapsed times, and codes identifying the mode of operation and playback rate which is selectable by keyboard command from one tenth to five times real-time speed.

Along the right edge of the display are the control and menu areas. The control area permits the operator, through his light pen or keyboard cursor, to activate player detail data displays and map translation and scaling commands. The menus allow selection of any combination of up to 30 menu overlays which contain static or dynamic graphic element data. As an example, a menu could contain information concerning direct fire events which might be depicted as a flashing straight line connecting the involved players for a predetermined period of time.

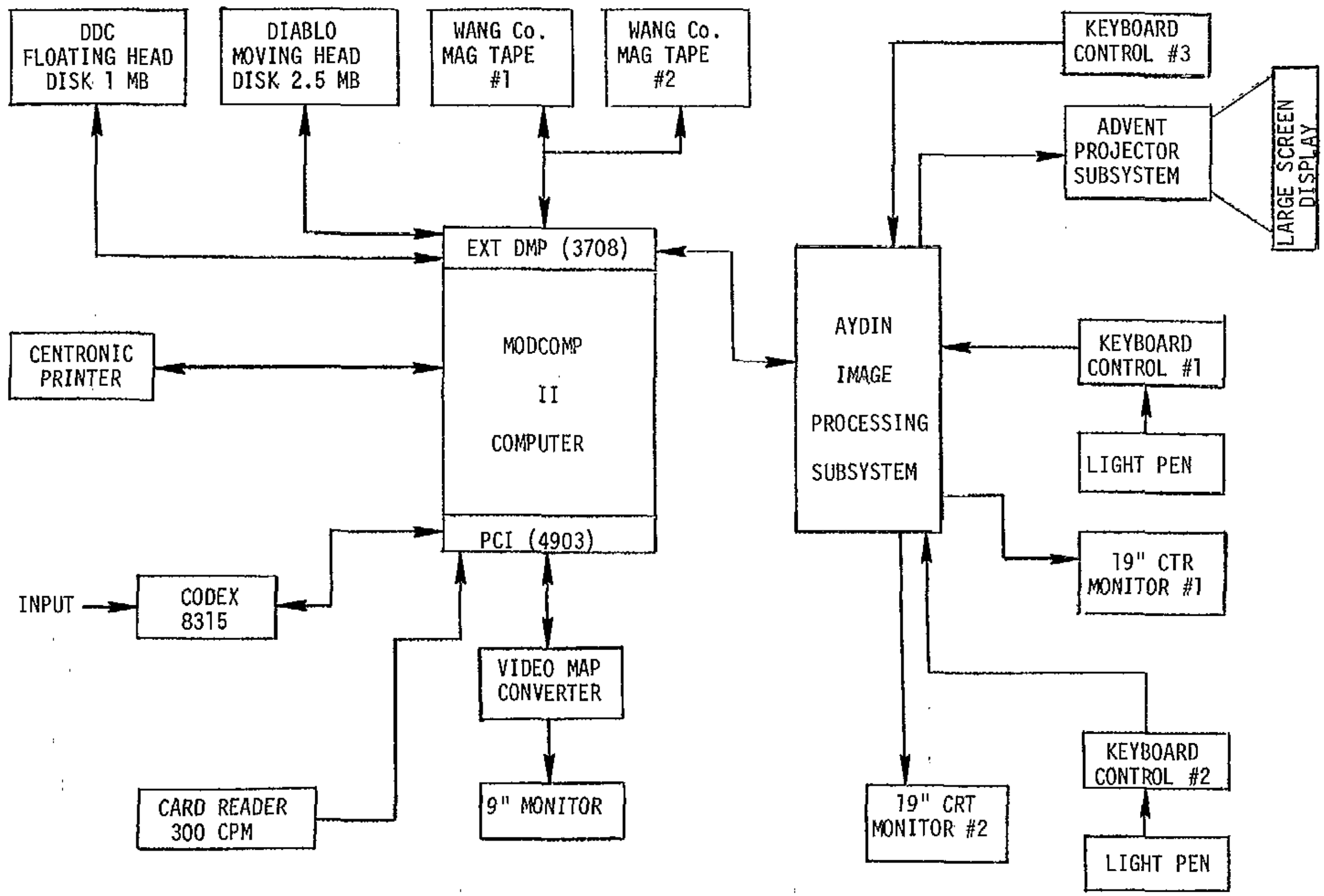

Figure 2

Visual Information Display System Block Diagram

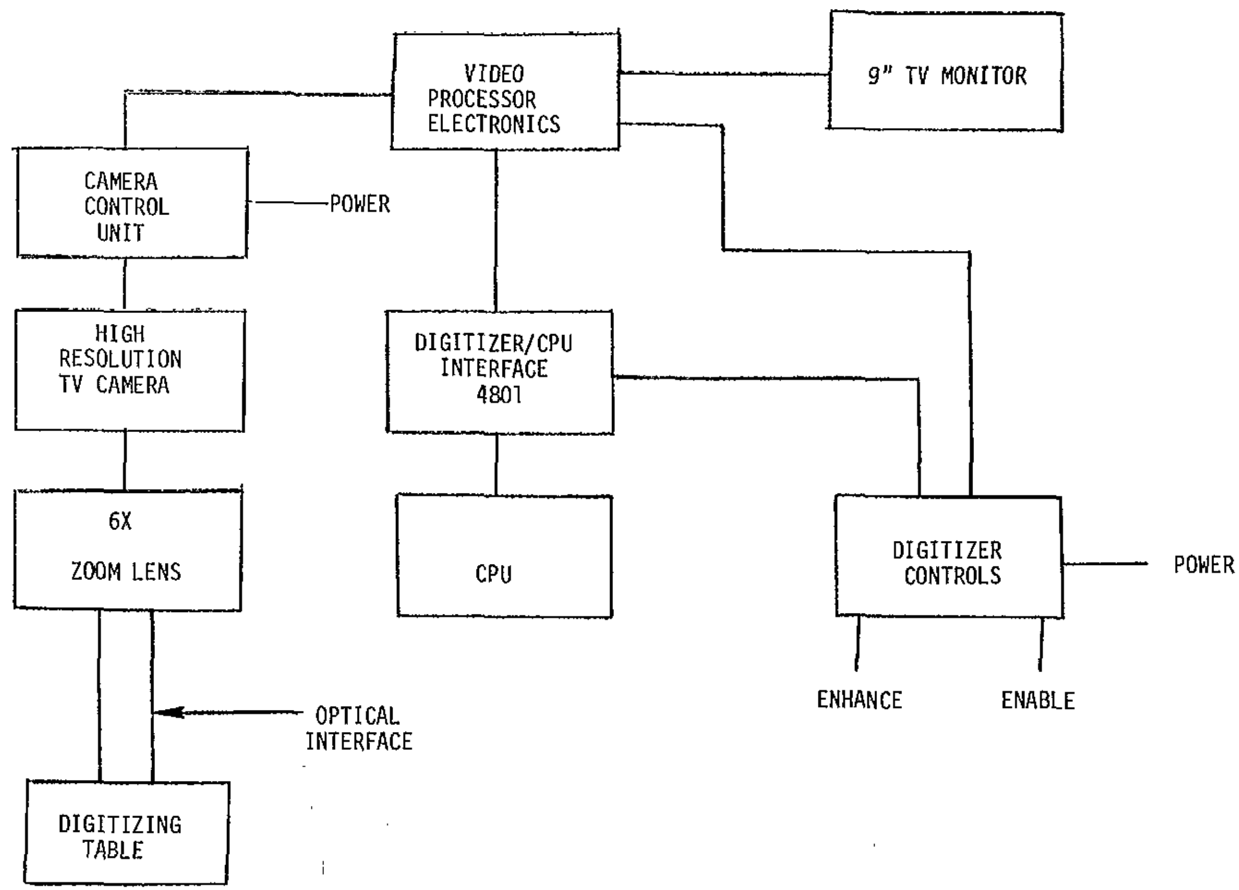

FIGURE 3

Map Converter Block Diagram

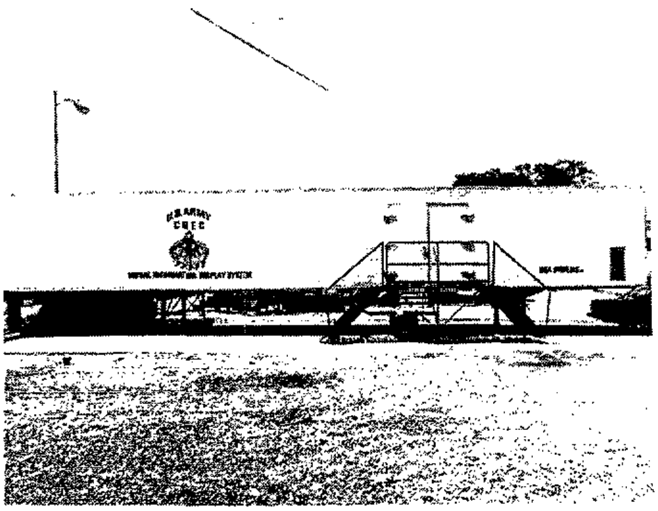

Figure 4
VIDS Trailer

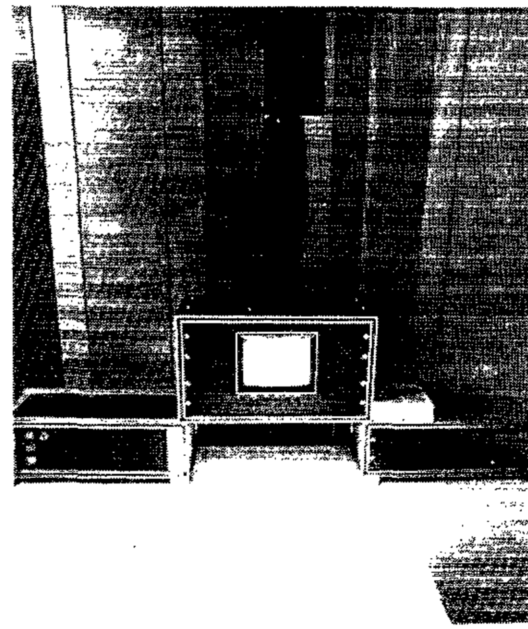

Figure 5
Map Digitizer

Figure 6
CPU Area

Figure 7
Display Area

Figure 8
VIDS Display Layout

The left margin of the display contains detail data concerning individual players which can be selected from the keyboard or the cursor/light pen system. Information such as X, Y, Z coordinates, number of rounds of ammunition remaining, and time of last direct fire event could be included in this area.

Finally, the upper edge of the display contains space for header messages, and the lower edge contains space for footnote information to include operator communications messages within the VIDS system or between VIDS and the host computer system.

The three interactive consoles are independent of one another with the exception that playback rate, selectable at any console, applies to all displays.

V. SYSTEM UTILIZATION

The primary intended uses for VIDS include monitoring of field experiment data in real-time and enhancement of the post-trial analysis of experimentation results.

The real-time activities permit quality control during the trials with the potential to allow trials to be stopped, continued, or re-run as necessary depending on the quality of the data being collected. In the past, invalid experimentation trials have been due to instrumentation failures on key players which were not detected until the data was reduced. The quick look quality control capability can be used to avoid this costly form of experiment invalidation.

Used as a tool in conjunction with instrumentation checkout and initialization, VIDS is expected to reduce the time requirements for countdown and fault analysis, thereby reducing costs and increasing the potential number of trials per day.

The system can provide the experiment proponent and CDEC planners and controllers with an immediate and comprehensive understanding of the complex relationship between players, instrumentation, and equipment.

In its use as a tool in the post-trial analysis of experiment data, VIDS places the pertinent information at the finger tips of the analyst through visual graphics as well as alphanumeric displays. This represents a significant enhancement of the data reduction capabilities which previously were restricted to CRT and hard copy alphanumeric printouts. Additional analysis enhancements include slow motion - fast motion playback capability, map translation and scaling to change perspective, and menu selection to correlate trial activities with other data of importance.

The flexibility in depiction of display information which was designated into VIDS permits a wide range of additional potential uses for the system, primarily in the area of a command and control display. Some of these alternative uses include command and control for experimentation activities and training operations.

The logical first expansion of the capabilities of VIDS would be in going from a pure test data monitor and analysis system to an active command and control center for experimentation operations. The primary system upgrades which would be required to provide for this enhancement are increased radio communications, additional display monitor stations, and possibly an improved large screen display capability.

In the area of training operations, a VIDS type system can be envisioned as being used in the monitoring of large scale training operations, and in the post-operational de-briefing stage of the training exercise. The training operation would require data collection instrumentation in addition to the display system and host computer.

The training exercise being monitored could be of the form of a National Training Center type operation, or the training mission of tactical field units at their normal field training sites. In addition, such a system could be visualized as being used in conjunction with large scale joint service field exercises to provide important information concerning key personnel in the operation.

The slow motion - fast motion capability of the system, as well as the capability to portray information against selected background data make a system such as VIDS an effective debriefing tool in the post-operational phase of the training exercise. In addition, the on-board computer may provide the capability for data reduction and post-operation tabulation of results. This could be used as an effective tool in the utilization of the training exercise results to guide the unit or key personnel in improving its level of performance in the future.

In summary, the flexibility of the design of VIDS and its unique map digitization system provide CDEC with an improved experimentation monitor and analysis capability, and these same features will allow for future expanded uses within CDEC or alternative uses for a similar system elsewhere in the military community.

ABOUT THE AUTHORS

CAPTAIN CRAIG F. SMITH has served four years as a commissioned officer in the U.S. Army in communications and electronic engineering positions. His most recent military assignment was as project officer, Engineering Division, U.S. Army Combat Developments Experimentation Command. He received his Ph.D. in nuclear science and engineering from the University of California at Los Angeles.

MR. CECIL L. BONE has served as a computer programmer and systems analyst at the Fort Hood Management Information Systems Office and two major U.S. Army testing commands. He holds an M.S. degree in computer science from American Technological University.

MR. DENNIS J. RUTLEDGE is currently a Project Manager for the Range Instrumentation Division of DBA Systems Incorporated. He has over eleven years of experience in real-time computer hardware/software systems in aerospace, data acquisition/reduction, computer graphics, radar acquisition and control, and communications systems. He joined DBA in 1971 as a senior-level systems analyst.