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BIMODAL DISPLAY.(U)
JUN 77 J BRAMLEY, E G TRELINSKIE
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BIMODAL DISPLAY

JUNE 1977

U. S. ARMY ENGINEER
TOPOGRAPHIC LABORATORIES
FORT BELVOIR, VA 22060

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REPORT DOCUMENTATION PAGE

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1. REPORT NUMBER ETL - 0110	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) BIMODAL DISPLAY		5. TYPE OF REPORT & PERIOD COVERED Research Note
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Jenny Bramley Edward G. Trelinskie, Jr.		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Engineer Topographic Laboratories Fort Belvoir, Virginia 22060		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 4A161101A91D
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer Topographic Laboratories Fort Belvoir, Virginia 22060		12. REPORT DATE June 1977
		13. NUMBER OF PAGES 11
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

403 192

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

This report describes concepts, techniques, and results from experiments conducted using an experimental display device configured for display of map information and symbol presentations on a single viewing surface.

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PREFACE

The work covered by this research note was authorized by the U.S. Army Engineer Topographic Laboratories, Fort Belvoir, Va under In-House Laboratory Independent Research Program, Project 4A161101A91D.

Principal investigator for the project was Dr. Jenny Bramley with Edward G. Trelinskie serving as associate investigator.

CONTENTS

FIGURES

TABLE

BIMODAL DISPLAY

INTRODUCTION

Introduction. The Bimodal Display Device configured and reported on was devised as a medium for display of archival map information and symbol presentation on a single viewing surface with capability for interaction between viewer and display. Concepts, techniques, and recommendations resulting from experimentation with the configured breadboard model Bimodal Display are presented.

Objective. The objective was to develop and demonstrate an electronic technique for presentation of a tactical map section in combination with computer generated military symbology at the same resolution as a standard U. S. Army topographic map.

Background. Primarily, the stimulus for initiation of this In-House Laboratory Independent Research (ILIR) project evolved from a display device need specified in the Department of Army Requirements for the Tactical Operations System (TOS) (U). To address this Army need for TOS display devices, Dr. Bramley authored three Memoranda for Record (MFR) - Display Devices Part I (15 Feb 73), Display Devices Part II (7 Dec 73), and Display Devices Part III (28 Jan 74). In turn, this ILIR project was undertaken to provide a means for validation of some of the unique and innovative display techniques presented by Dr. Bramley in her three MFR concept documents.

DESIGN CONCEPT

General. The purpose of this In-House Laboratory Independent Research (ILIR) program project is to devise techniques for display of topographic map information and tactical, computer-generated symbol presentations on individually viewed display devices with no loss of map detail. Technique development will require that consideration be given to both the spatial resolution of the information to be displayed and the display medium.

First, consider a typical standard 1:50,000 U.S. Army map, 57 by 74 centimeters. This map is required to display lines having a width of 0.076 millimeters. If the 0.076 millimeter is used as a unit of measure for an individual spatial resolution cell, a standard 1:50,000 map sheet could be described in a matrix of 7500 by 9666 resolution cells. This matrix totals approximately 72.5 million data elements and, in effect, represents an efficient static data display medium. However, dynamic data as evident in changing tactical situations or changing environmental conditions cannot be adapted easily to or be brought up to date on a sheet-type static display.

Second, consider the techniques that must be developed for handling dynamic data. Dynamic data can be controlled and displayed efficiently using electronic (analog/digital) means and "refresh" display devices, such as Cathode Ray Tubes (CRT) or projection TV devices. Although efficient in presenting dynamic data, refresh-type display devices pose limitations in display size and resolution. Various techniques and the results of experiments with both static and dynamic display are described next.

Bimodal. The basic concept of bimodal presentation has been used successfully in the television industry for teleprompter devices and generation of special display effects. For this project, concept implementation will be varied using techniques that are unique to tactical army applications.

A general equipment configuration diagram for implementation of the bimodal display concept is shown in figure 1. The map to be displayed is viewed by two TV cameras, each capable of 1,000-line resolution, Camera W_C (wide view) is stationary and views a large area of the map continuously. Camera N_C (narrow view) can be positioned in X and Y and views a rectangle with the longest dimension not in excess of 8 centimeters. The outputs of cameras W_C and N_C are video mixed with character information to be presented at the appropriate locations and then displayed on CRT's W_D and N_D, respectively. Displays W_D and N_D are synchronized with their respective cameras and are capable of operating at 1,000-TV-line rate. The CRT's are placed with their faceplates at right angles to each other and are projected from the rear onto a single viewing surface, screen S. The combined projected image is achieved by means of a plane (half-silvered mirror) with nearly 50 percent reflectivity and 50 percent transmissivity, which bisects the right angle formed by the CRT faceplates.

In concept, camera N_C will view an area A, one-tenth the size of the overall map, whose location with reference to the entire map is arbitrarily selected by the operator. An area is blanked out of the image displayed on CRT-W_D, via camera W_c, which would normally show area A as part of the overall map sheet. The image displayed on CRT-N_D, via camera N_c, is positioned so that when it is viewed at screen S, it is imaged onto the blanked area of W_D. To a viewer, the images projected onto screen S appear as a contiguous image, but with area A having a display resolution 10 times that of the displayed image surrounding it. Position (X-Y displacement from common reference) of camera N_c, the blanked area of image displayed on CRT-W_D, and the high resolution image displayed on CRT-N_D will be established in syncronous fashion by the operator using a joystick positioning device.

Bimodal Display Device Hardware. A brassboard display device, as depicted in figure 1 by the components within the dashed line area, was assembled to implement

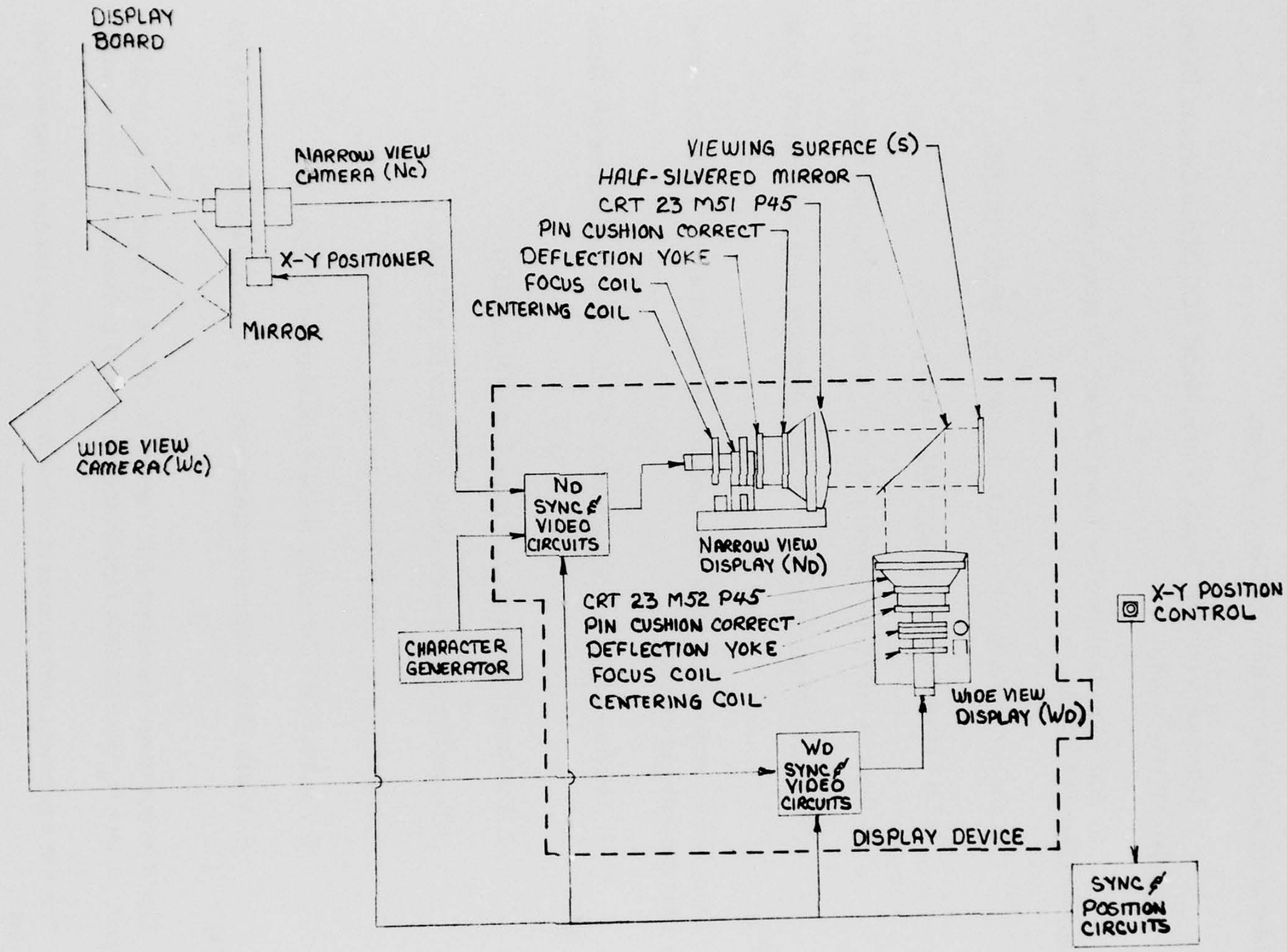

Figure 1. Bimodal Configuration.

evaluation of the bimodal concept. The following equipment was purchased to assemble the laboratory experimental Bimodal Display Device:

1. Television Monitors - 2 each. Conrac Model RQB (Video Circuits, Deflection Sync, High Voltage Supply).

2. Flat Face Cathode Ray Tubes - 2 each. Thomas Electronic, Inc., Type 23 M51 P45 and 23 M52 P45.

3. Deflection Amplifiers - 2 each, Infodex, Inc., Model PDA225.

4. CRT Deflection Component Sets - 2 each. Celco.

5. Beam Splitter (Half-Silvered Mirror) - 1 each. Muffoletto, Model B-101.

6. Special Effects Generator - 1 each. American Data Corporation, Model 1150.

Components shown outside of the dashed line area of figure 1 were borrowed from other projects and include

1. Television Camera (N_c) - 1 each. Sierra Scientific Corporation, Model LSV 1.5.

2. Television Camera (W_c) - 1 each. Cohu, Model 6000.

3. Power Supplies - 2 each. Lambda, Model LE 102 FM.

4. Lighting Units - 2 each. Colortran, Model 100-151.

5. Assorted CRT Deflection Housing and Support Devices.

6. Video Titler (Character Generator) - 1 each. Datavision, Inc., Model D-1032.

The X-Y positioner associated with camera N_c (figure 1) could not be obtained. However, camera N_c was manually repositioned as needed to simulate X-Y positioning.

The test equipment used to assist in evaluation of bimodal concept as implemented included

1. 206-CCTV Color Test Generator, Visual Information Institute Model

2. Oscilloscope, Tektronix Model 545.

3. Scope Camera, Tektronix Model C-12.

4. Display Camera, Polaroid Model CU-5.

5. Video Recorder, 1VC Model 760.

6. Digital Multimeter, Fluke Model 8100A .

7. Multimeter, Triplett Model 630 NA.

8. High Voltage Probe, Pomona Model 4000.

Experimentation. Initial bimodal display device experiments were performed using the test configuration shown in figure 2. Experiments were conducted primarily to evaluate the operational characteristics of the display device. Checks on display characteristics, such as display linearity, pincushion distortion, deflection sensitivity, deflection tracking, and alignment sensitivity, were made to determine compatibility of CRT display surfaces. The bimodal configuration shown in figure 1 was then assembled to conduct experiments and to enable evaluation of the device's ability to display map detail. Response and sensitivity of the device to variations in ambient lighting conditions were also checked. Format testing and evaluation were not undertaken because of the device's brassboard configuration. Experiments were restricted to those needed for validation of concept.

Discussion. The Cathode Ray Tubes (CRT) used in the bimodal display device (figure 1) are round, flat face, 58-centimeter diameter, high resolution tubes. Evaluation of the operating characteristics of the tubes revealed that the active useful operating area of the tube is restricted to a 36-by 36-centimeter area in the center of the tube. Distortion and display aberration becomes excessive outside the 36-by 36-centimeter area (figure 3). The active 1,264-square centimeter CRT display area represents an area coverage of approximately 30 percent of a 57-by 74-centimeter map sheet.

Areas N_D and W_D of figure 3 have a capability for displaying point matrix greater than 1024 by 1024. Experiments with the display device were conducted using a display

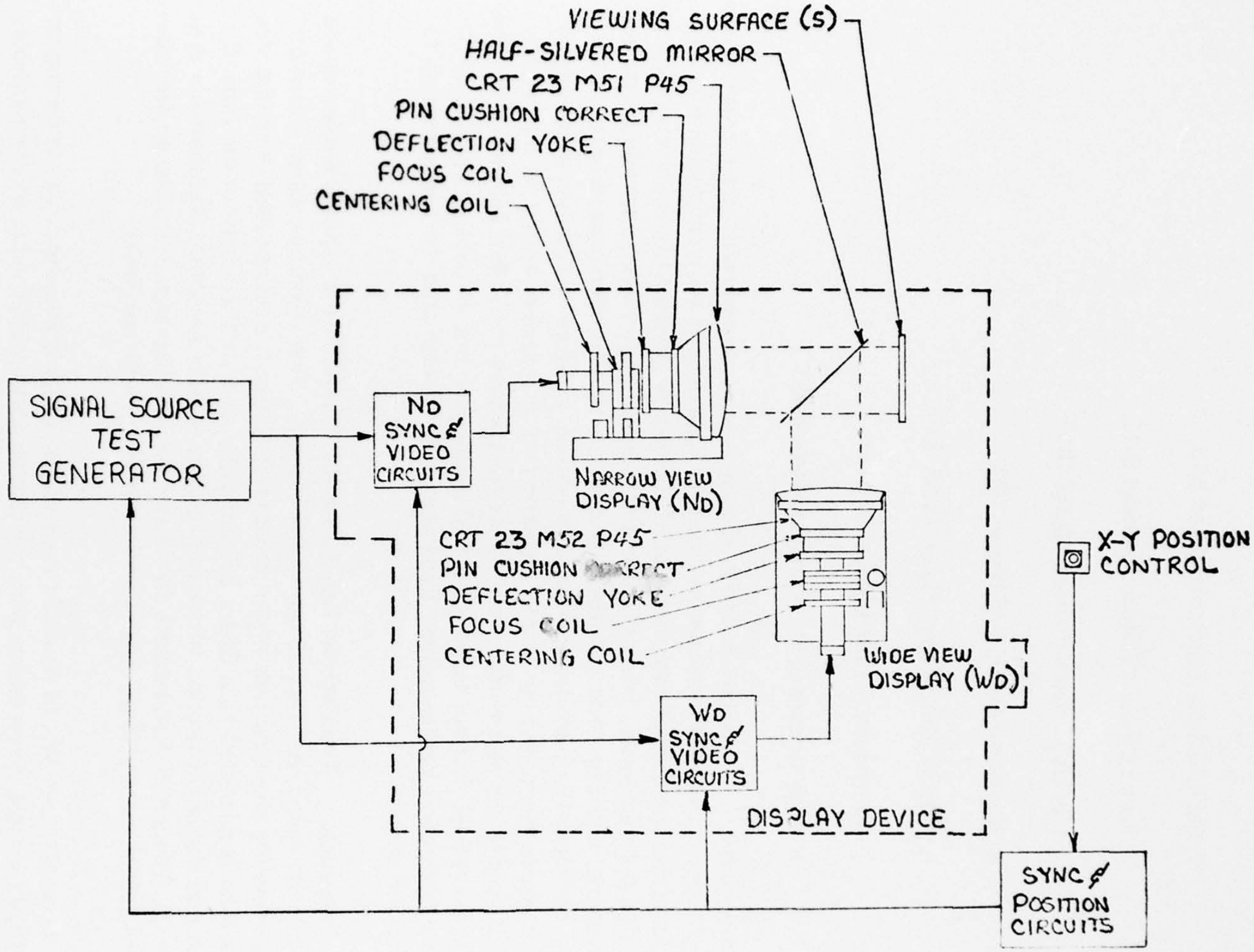

Figure 2. Display Device Test Configuration.

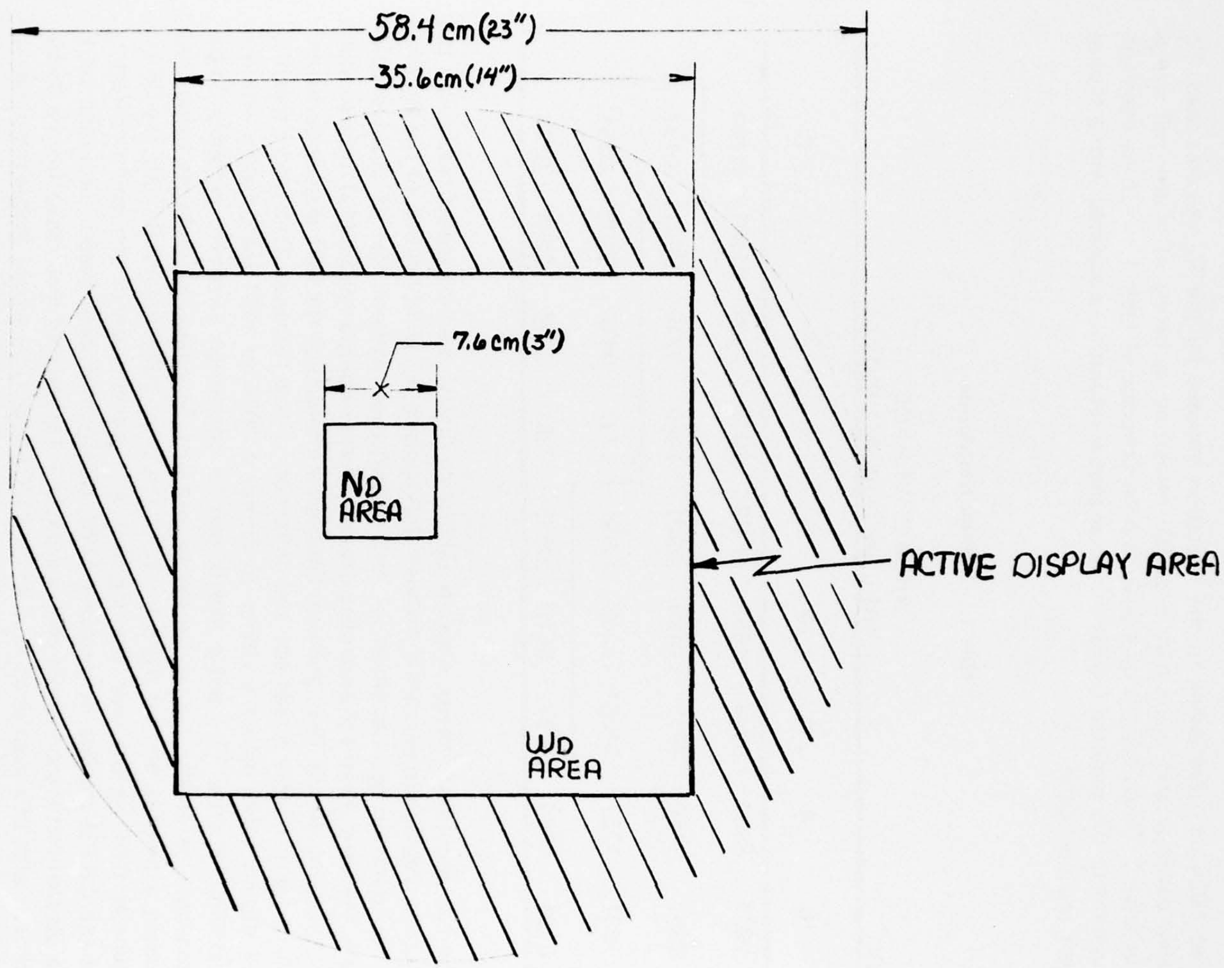

Figure 3. Useful CRT Area.

matrix of 1024 by 1024 owing to the limitation imposed by the TV cameras used. To relate area coverage and point matrix spatial resolution, a listing of matrix cell size is shown in table 1. Combinations of Matrix vs Area Coverage of table 1, which are adequate to accommodate the required 0.076-millimeter spatial resolution associated with a typical map sheet, are blocked in.

Table 1. Spatial Resolution

POINT MATRIX	AREA COVERAGE MILLIMETERS PER SIDE								
	16	14	12	10	8	6	5	4	3
512	.7925	.6934	.5944	.4953	.3962	.2972	.2489	.1981	.1499
1024	.3962	.3480	.2972	.2490	.1981	.1450	.1245	.0991	.0737
2048	.1981	.1727	.1450	.1245	.0991	.0737	.0610	.0508	.0381
4096	.0991	.0864	.0737	.0610	.0508	.0381	.0305	.0254	.0178

Evaluation of the display device response (ability to display scanned spatial resolution) to various static graphic display media revealed that concern for identification of the limiting factors for dynamic representation of map information without loss of detail should actually be directed toward the scanning device (camera resolution capability) more so than toward the display device. The significant limitations imposed by the CRT display device are primarily those of display screen size and deflection system response. To be more specific, the CRT display tubes have the ability to display a 1024-by 1024-point matrix within a 8-by 8-centimeter area. This point matrix can be positioned anywhere within a 36-by 36-centimeter area on the display. In reality, the 8-by 8-centimeter blocks are being used to represent a point matrix of 4778 by 4778 (14/3 by 1024 = 4778.6) over the 36-by 36-centimeter CRT surface area. Development of a scanning device (matching characteristics of the CRT's) capable of resolving 4778, (0.076-millimeter) spatial resolution cells, across a 36-centimeter span would enable a direct 1:1 display of map detail from a 36-by 36-centimeter area of a map sheet on a single CRT device. This would enable the dynamic (changing) data to be displayed on a single CRT surface, thus eliminating the need for optical superimposition of images as required by the bimodal configuration.

Further evaluation of the bimodal configuration established that the quality of the displayed image as viewed at surface (S) (figure1) was generally good. That is, the high resolution image (N_D) projected well (good detail), but the wide image display (W_D) was degraded when projected. The cause of the degradation was due primarily to image reflections created by the mirrored surfaces of the half-silvered mirror and by the W_D CRT display surface.

When considering the approach taken for implementation of the bimodal concept, that is displaying at high resolution small blocks of map detail, alternative display techniques become apparent.

CONCLUSIONS

It is concluded that

1. The Bimodal Display Device served as an excellent test for validation of concept.

2. The Bimodal Display Device as configured does demonstrate an electronic technique for presentation of map detail combined with computer-generated symbology without loss of detail.

3. There is no appreciable advantage in displaying static data using dynamic display devices.

4. Further development effort will be required to configure the Bimodal Display Device into a viable cost-effective solution for tactical army display applications.

5. Alternative display techniques using new and emerging technologies should be investigated.