Immersive display provides a new solution for tactical information viewing

David Tremper

A handheld monocular display eliminates night-time illumination and daylight readability issues.

As in the commercial mobile display world, the readability of military displays commonly suffers when they are viewed in direct sunlight. Often this daylight-readability issue is overcome by manually or automatically increasing the device’s luminance. But, in addition to this daytime concern, night-time use of traditional military displays can also prove problematic, both by negatively affecting a user’s night vision and by jeopardizing his tactical position. The standard method for completely eliminating light leakage in such displays has required the user to view the display under cover (e.g., canvas coat), which is certainly not ideal. For displays being used for both day and night-time operations, addressing readability issues also requires continuous adjustment of the luminance, a solution that is far from optimal.

Previous research revealed that daylight/night-time readability issues were common to most, if not all, commercial off-the-shelf display packages. As a result of these operational concerns, a new solution is needed that can be used in both daytime and night-time conditions, and requires no adjustments to operate in either.

The Naval Research Laboratory began exploring display technologies for a potential solution to the problems discussed above. Based on observations from wearable computer testing and subsequent technology research, NRL scientists formulated the basic goals of a design effort for a military display, shown in Table 1.

Our approach solves the daylight readability issue by preventing external effectors from entering the display space. At the same time, night-time illumination issues are addressed by preventing emitted light from escaping. This configuration isolates the display space from the surrounding environment.

However, in order to realize this approach and make it operational, it becomes necessary not only to isolate this space, but to also to provide a simple entry point for a user to gain access to its contents.

The immersive input display device (I2D2) monocular concept combines a shuttered eye guard (Figure 1) with an eMagin 0.5in \( \times \) 0.5in micro organic light emissive display (OLED, see Figure 2) and an optical lens, creating an immersive space for viewing tactical information. While the microdisplay provides the capability to show tactical data in a compact and portable form factor, the shuttered eye guard allows consistent readability of the display, independent of ambient light conditions. The eye guard also preserves the integrity of the user’s tactical positioning during night operations, and the monocular form factor allows for maintained environmental awareness and night vision in one eye at all times. Additionally, a three-button input device on the monocular provides user feedback to the computer system.

The shuttered eye guard is impervious to both external light and internal emitted light, effectively creating a sealed viewing space. However, for practicality, a display should fit inside the eye guard’s 1.75in inner diameter. OLEDs have been cited as a

Figure 1. The CMI Rubber Company shuttered eye guard seals an enclosed microdisplay off from the external environment.
Table 1. Primary Objectives of a Military Display

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<td>1</td>
<td>Provide a readable display regardless of ambient light.</td>
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<td>2</td>
<td>Eliminate illumination of the user in the dark.</td>
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<td>3</td>
<td>Provide a display device which does not completely remove the user’s awareness of the surrounding environment.</td>
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<td>Mitigate the loss of night vision caused by viewing the display in the dark.</td>
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Figure 2. The eMagin Corporation OLED SVGA+ 800 × 600-pixel resolution microdisplay, at 0.5in square, fits within the eye guard’s diameter. (Photo provided by eMagin Corporation)

possible future display technology for military applications, so NRL experimented with the eMagin Corporation OLED SVGA+ 800 × 600-pixel resolution microdisplay. The 0.5in square eMagin display can be connected to any system with SVGA+ or NTSC output, the television standard in North America and Japan. Its resolution is more than sufficient for displaying tactical data to the entrenched warfighter. Magnification of the screen with a custom optics package provides the readability of a 19in monitor at two feet.

In cooperation with Cardinal Scientific Inc., NRL began the development of a practical hand-held monocular display. This final design (Figure 3) fulfills the objectives listed in Table 1 while achieving a compact, lightweight form factor (see the specifications in Table 2).

Figure 3. I2D2 Monocular combines a shuttered eye guard, a microdisplay, and an optical lens to create a compact handheld tactical display. (Graphic provided by Cardinal Scientific, Inc.)

The I2D2 monocular demonstrates the feasibility of eliminating both day and night-time operational concerns with tactical displays using a single form factor. By sealing the viewing space between the user’s eye and the display, a separation between internal and external light sources is created. This boundary effectively prevents direct sunlight and ambient light from factoring into readability, and simultaneously prevents the display’s light emissions from entering the surrounding environment at night. As a result, the display can be continuously used without the need for hardware adjustments to account for time of day. Additionally, the monocular form factor preserves night-vision and environmental awareness for the user in one eye at all times, both critical for operational use.

Development of both advanced handheld and heads up displays will continue at NRL during the 2006 fiscal year. Efforts will focus on improvements to the existing handheld monocular with wireless connectivity and optimized ergonomics, as well as further research and design of techniques for non-obstructive heads-up displays (HUDs). The resulting display systems will attempt to provide dismounted soldiers with enhanced situational awareness without negatively effecting environmental awareness, mobility, dexterity, or tactical integrity.

David Tremper would like to acknowledge the efforts of Cardinal Scientific Inc. of Clinton, MD for the design of the I2D2 enclosure and mounting of components; Duane Burchick of Envisioneering Inc. at NRL for research in optics packages suitable for the I2D2; Allen Electric Connector Sales Inc. for I2D2 connectors and cabling; and eMagin Corporation of Hopewell Junction, NY for technical support associated with their micro-OLED.
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