Threat Response: a Compelling Application for Wearable Computing

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Abstract

This paper explores the application of wearable computer systems to threat response, exemplified by the Multi-functional Micro-controllable Interface Module (MMIM)/Digital Military Policeman (DMP) system. The system consists of a wearable computer, eyewear interface developed by MicroOptical comprising display, camera, and audio, and software incorporating the FaceIt face recognition algorithms developed by Identix (formerly, Visionics). This system will enhance gate security at military installations by enabling guards to use automated face recognition to verify the identity of visitors and check the database of known threatening individuals automatically.

1. Introduction: The Digital MP concept

We propose that threat response situations offer a compelling application for wearable computers. In threat response and prevention applications, immediate access to information enhances the responders effectiveness and reduces the risk to their safety. Typically, however, the primary task requires the full attention, unobstructed vision and free use of both hands of each team member, and so would be hindered by using even small handheld computers. Thus ergonomic wearable displays are an enabling technology for these critical wearable computer applications.

In this paper we describe the Multi-functional Micro-controllable Interface Module (MMIM)/Digital Military Policeman (DMP) system developed for the U.S. Army Military Police for entry gate security at military installations. The system includes a wearable computer, a software application developed by ViA and Identix, and the eyewear interface developed by MicroOptical. The eyewear interface comprises a display, camera and audio system. The system is modular and designed with standard software and hardware interfaces to maximize its flexibility for other configurations and applications.

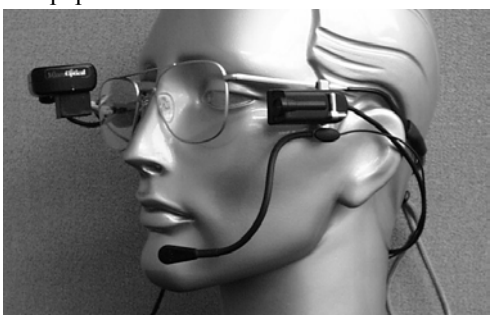

Figure 1 MMIM headset incorporating SVGA display, VGA camera, and audio.

2. User interface: The MMIM headset

A number of display approaches were evaluated for use in this system including display systems integrated into eyewear and clip-on systems[1]. We chose a clip-on type system for flexibility in use and in system configuration. The headset is shown in Figure 1.

The display subsystem is based on a reflective AMLCD from Microdisplay Corporation (San Pablo, CA) which has 800x600 pixels (SVGA) and runs in a color sequential format at 180 Hz. The optical system provides a horizontal field of view (HFOV) of 20°. The view of the display occludes the external view to maximize contrast and brightness under all viewing conditions. Outside the image the side and downward vision are unobstructed, allowing the wearer to maintain situational awareness. For some applications the system may be configured with MicroOptical's VGA clip-on display which has 16° HFOV, improved peripheral vision, and substantially lower weight and cost.

The camera uses a 1/3 inch format CMOS sensor which is available in either full color or high sensitivity grayscale, and communicates over the USB. A CMOS imager was chosen for low power consumption and the need for minimal electronic components at the head. While USB 1.1 bandwidth is limited to 12Mbps, it is a commonly available, mature interface which permits us to leverage existing software and hardware. Image compression allows frame rates up to 15 fps for full VGA, 30 fps for CIF format. The number of pixels in the image can be reduced either by pixel decimation or by windowing within the active area depending on the needs

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of the application (field of view vs. resolution). At the camera HFOV of 19° a face just fills the screen at a distance of approximately 3 ft and the image still contains approximately 30 pixels between the eyes for a subject 30 ft away to allow for face recognition at a distance. The focus range is 60 cm to infinity. The current focusing mechanism is manual but the design includes provisions for automatic focusing. The camera weighs 37 grams.

3. Digital MP Software

The Digital MP software provides the user with several functions, including face recognition, access to maps, interface to a GPS unit, voice and data communication over a wireless LAN, and voice translation into a foreign language. The user interface of the Digital MP software was specifically designed for use with a speech controlled, wearable system. Only essential information is displayed in any given screen, and text is presented in large, easy to read fonts. Buttons may be selected either using a mouse or voice activation. The syntax of the voice commands was chosen to maximize the reliability of the voice command and control for a wide range of users. The user interface is designed to be easily viewed in the VGA viewer although the higher resolution display is more convenient for some functions including map viewing.

A screen shot of the face recognition application is shown in Figure 2. Two different face recognition algorithms were implemented to improve the system performance. Using the FaceIt® Surveillance software developers kit (SDK) from Identix, the application automatically recognizes faces in the video stream. The FaceIt Identification SDK utilizes manual camera pointing and image capture. The system would normally operate in automatic mode, monitoring the video input stream and attempting to match faces against a database of known individuals. When a face is captured, the system automatically displays the three best matches in the windows at the bottom of the screen. The user can either share the matches with his or her supervisor over the network, or switch to manual mode. In manual mode, the user can recapture the image for better image quality or enroll the subject into the surveillance database.

Figure 2 Screen shot of face recognition interface for Digital MP software.

The incorporation of speech recognition and high quality audio in the system allows also the integration of the two-way communication among team members. In its final version, the software will also incorporate a phrase translation utility based on speech recognition.

4. Conclusion

Military and civilian threat response provides a compelling application for portable computers. On the one hand, the individuals we rely on in emergency situations must have completely unhindered mobility. On the other hand, they should be armed with as much information and data as they can effectively utilize. We have described the Digital MP Program, which provides military police with face recognition, navigation and mapping, information gathering, translation, and communication functions either on the base or on missions anywhere in the world. Similar conditions exist in civilian applications such as airport security. The system is flexible and reconfigurable, and both hardware and software components of the system will find use in other military and civilian threat response applications.

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