Sonopticon: Auditory Display in Automobile Interface Design

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ABSTRACT

The multiplicity of interface elements in an automobile can present a hindrance to usability and safety. We prototyped and conducted preliminary testing of an automobile display interface. Our key design principle was to maintain driver situational awareness while minimizing distractions. We aimed to accomplish this task by exploiting the benefits of an auditory display coupled with a minimized visual head up display (HUD). Results from our testing indicated that this approach could be an effective method of improving driver safety in hazardous situations.

Keywords

Automobile, auditory display, usability, head up display (HUD)

INTRODUCTION

Current automobile dashboards are becoming increasingly cluttered. Drivers must pay attention to the tachometer, speedometer, stereo, temperature controls, cellular phone, gas meter, and road signs. Additionally, onboard computers, radar detectors, and GPS tracking maps contribute to driver information overload. In tactical aircraft, this problem has been addressed through the use of head up displays (HUD's). Auto manufacturers are currently integrating HUD's into future car designs [3].

A NEW APPROACH: AUDITORY DISPLAY

The Sonopticon project is a prototype for an interface that would use spatialized sound and a "smart" mixing system to alert the driver to potential road hazards, cars in blind spots, impending collisions, and other extra-vehicular situations. Our system aims to exploit the advantages of auditory displays as compared to visual displays. As described in [2], auditory displays are well suited for providing warning signals. Audio warnings can be detected without requiring drivers to look away from the road, keeping the eyes free [1, 2]. Also, auditory displays facilitate rapid detection [1, 2]. Sonopticon's interface scales volume, panning, and duration according to the immediacy, location, and severity of extra-vehicular occurrences. Rudimentary versions of audio displays do exist in automobiles. The click-clack of a turn signal or hazard light, the beep of the button as the radio memorizes a station, the ding-dong signaling keys left in the ignition, and even the whine of the engine as it climbs a steep grade. However, sound in general has been neglected in car interfaces. This is perhaps in part due to the failure of speech systems in car models of the 1980's.

PROTOTYPE DESIGN AND EVALUATION

We chose three different techniques to evaluate Sonopticon to determine if it could actually enhance driver situational awareness.

Our first assessment technique was a heuristic evaluation. Four subjects viewed video story boards of Sonopticon. These scenarios included an impending collision, an approaching emergency vehicle, and of a vehicle in a blind spot when attempting a lane change. Subjects were asked to evaluate the system based on the following heuristics:

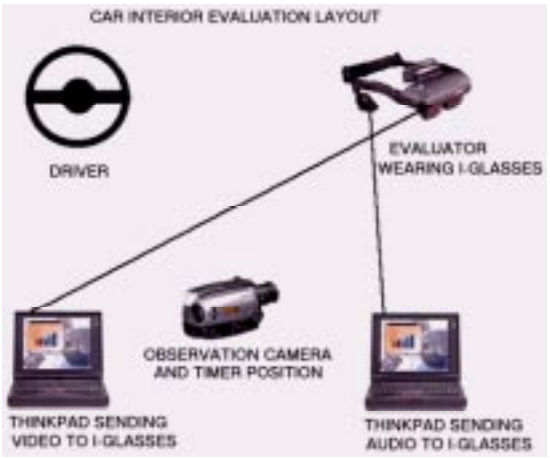
1) Simple and natural dialogue: Are the signals provided to the user easy to understand and distinguish from each other? When a sound is played, is it clear what the system is trying to communicate to the user?

2) Recognition rather than recall: When the system provides a signal to the user, does

signal contain any other meaningful information than the user needs to know?

3.) Robustness: Is necessary information conveyed to the user in more than one manner? Is the user presented with an option as to which way they would like to receive the information?

Next, the subjects were led through a drive session in order to determine how users would respond to the system while driving. To simulate the experience of using Sonopticon while driving, each subject was placed in the passenger seat of a moving automobile wearing virtual I/O glasses and earbud earphones. Virtual I/O glasses are devices which allow a user to view computer graphics overlaid onto a real world scene. As seen in the figure below, audio and visual information was sent to the virtual I/O glasses using laptop computers.



As Sonopticon displayed information about the driving environment, the subjects described what they thought the system was telling them. After the think aloud session, we completed our user testing by issuing a questionnaire.

EVALUATION RESULTS

The subjects found Sonopticon to be an overall positive user experience. They agreed that, although the prototype was somewhat "rough around the edges", the overall concept of Sonopticon was an engaging and useful tool for improving driver awareness. A chief concern of the subjects was the appropriateness, customizability, and form of the audio and visual signals. They expressed an interest in being able to customize the audio warnings to fit their own personal preferences. Some subjects felt that the graphic information presented was sometimes confusing and presented unnecessary information. There was concern that repeated audio warnings could become annoying to the user. They commented that they did not use the system long enough to determine if this issue presented significant problem.

CONCLUSION

An informal evaluation of the Sonopticon prototype interface indicates that the integration of advanced auditory displays into automobile interfaces can potenitally enhance driver situation awareness. In particular driving scenarios, auditory cues can be more effective than visual cues in providing warning information without distracting from the driving task. A more extensive evaluation with a larger group of subjects is necessary to verify these findings.

REFERENCES

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