Spotlight: West Virginia University Incorporates Brain-Sensing Headband into Integrated Surface Mining Safety System to Eliminate Equipment-Related Injuries

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A persistent area of concern in mine safety continues to be related to mining equipment with 643 fatal injuries occurring between 1995 and 2011. In order to reduce these injuries, the mining industry has applied numerous technological developments, the most prominent of which is proximity detection used to provide a warning to a vehicle operator when another equipment or mine personnel comes close. Yet, the problem persists and surface mining operations pose special challenges in preventing these injuries due to the equipment size, mine topography, and operational complexity. This project focused on collision avoidance and driver fatigue and delivered a comprehensive suite of technologies that can be expected to significantly improve safety in surface mines.

Proximity Warning

- A zone-based proximity warning system was designed using low power IEEE 802.15.4 radios for detecting mine personnel and vehicles at shorter distances (< 30 ft), and marking them into zones around the vehicle.
- For timely warning about approaching vehicles at long distances (30-600 ft), a GPS system was integrated with Wi-Fi radios in an *ad-hoc* mode. The use of a *peer-to-peer ad-hoc mode* avoids the need for centralized network infrastructure such as cellular systems. Instead, information about approaching vehicles is communicated as soon as they come into communication range of each other.

Fatigue Monitoring

- A novel fatigue monitoring system was designed using lightweight, commercially available brain-sensing headbands that overcomes many of the deficiencies of IR camera-based systems for drowsiness detection.

Cloud Based Data Logging System

- A cloud-based logging framework (named **MapMyTruck**) was designed that can be used for *long-term data collection from GPS and other sensors*, thus recording and analyzing near misses in surface mines as well as facilitating better route planning.

Non-Distractive Graphical User Interface

- A **unified GUI** was developed for the integration and meaningful presentation of the information acquired from the different sensor network components.
- The GUI was built with a **novel dynamic marker capability** that allows drivers to tag observed road conditions at run time on the GUI and then broadcast this to other drivers using an ad-hoc Wi-Fi network.
- An **automated GUI evaluation tool** was developed using a camera-based, driver-activity-monitoring system that analyzes distractions experienced by a driver, especially with respect to usage of consoles and GUI during operation.