

3rd-Eye: A Novel Embedded System for Driver Attentiveness Monitoring Using Data Fusion and Machine Learning (Year 2)

Ponnusamy, Pranav (School: West Shore Junior/Senior High School)

Numerous studies estimate that over 150,000 police-reported accidents in the United States annually are caused by drowsy and distracted driving, leading to 400,000 injuries and over 4,000 deaths. The research focused on the development of a reliable Driver Attentiveness Monitoring System (DAMS) that can detect and respond to drowsy and distracted driving in real-time to enhance road safety. The DAMS uses a combination of physiological and vision-based data to detect drowsiness and distraction using Data Fusion and Machine Learning. The implemented system consists of a Vision Processing Module (VPM) and a Remote Sensor Module (RSM). The VPM uses a camera, illuminated with IR LEDs, coupled with a vision processing pipeline to extract key behavioral features from the driver's face for drowsiness and distraction detection. The RSM implements a signal-processing pipeline to extract Pulse Rate Variability (PRV) from raw Photoplethysmography (PPG) sensor signals to detect drowsiness using key statistical parameters in both frequency and time domains. The performance of the DAMS was evaluated in three phases: file-based, lab-based, and simulator-based. The file-based and lab-based testing focused on evaluating the basic functionality and accuracy of the system in various lighting conditions, while the simulator testing evaluated the system's performance in a dynamic environment. The overall accuracy of the system was 93% for drowsiness detection and 95% for distraction detection. The physiological PPG signal-based drowsiness detection was independently evaluated to be 91% based on lab and simulator testing. The results of the study indicate that the DAMS performed consistently well in all testing phases, indicating its potential for real-world implementation.

Awards Won:

Florida Institute of Technology: Full Tuition Presidential Scholarship