A Wearable System for Real-Time Detection and Attenuation of Hazardous Visual Stimuli

West, Syd (Morgan) (School: Horton High School)

Flashing lights are a common everyday occurrence that may seem insignificant but for people who suffer from migraines, neurodivergence with light sensitivity or photosensitive seizures, certain frequencies can induce a medical emergency. My previous research involved the development of an algorithm to differentiate continuous lighting from strobe lighting based on the period and amplitude of received light signals. The current research continued this work by developing a wearable optical system that detects hazardous light patterns and dynamically attenuates the light in real time. Original hardware and software systems were evaluated and optimized. LCD and PDLC lens technologies were tested for their ability to attenuate and diffuse light, with a composite LCD-PDLC lens showing optimal characteristics. The light detection circuit was optimized to improve its ability to detect light from a variety of distances and angles. Combining optimal components, a wearable system was constructed. This device was mechanically tested under real-world conditions to identify false positive and false negative scenarios. Certain LED and fluorescent light readings showed harmonic frequencies, falsely triggering a strobe detection. This was resolved by implementing noise reduction via a rolling average. A low-light mode was implemented with increased amplitude sensitivity to address failed detections in low-light without increasing false positives in regular lighting. The final design attenuated over 99% of light with a reaction time less than 400ms. This work showcases the significant potential of this system as a real-time method of identifying and attenuating hazardous visual stimuli, with low cost and minimal lifecycle replacement.

Awards Won:
Third Award of $1,200