SmartBlink: Real-Time AI-Driven Adaptive Pedestrian Traffic System for Enhancing Perceived Pedestrian Safety and Traffic Efficiency

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Pedestrian-vehicle conflict at intersections is a major safety challenge, as conventional fixed-time traffic signals do not adapt to real-time pedestrian crossing behavior and drivers often fail to yield. Traffic infrastructure has historically been designed to prioritize traffic flow, treating pedestrian movement as a secondary constraint and overlooking pedestrian-driver interactions that shape safety outcomes. This study presents SmartBlink, the first low-cost, adaptive traffic system to simultaneously integrate individual pedestrian mobility and vehicle behavior into a single closed-loop system for enhancing perceived pedestrian safety at intersections. SmartBlink consists of hardware, YOLOv11-based real-time pedestrian speed detection system with perspective-corrected model, driver behavior algorithm, and bi-directional mobile application delivering alerts via tactile, audio, and visual cues. The system accurately detected real-time pedestrian speed to calculate the additional time needed for individuals to cross in real-life testing conditions. Assistive device detection achieved 95% accuracy for wheelchair users and 90% for crutch users. Distance estimation accuracy increased by 50-57% over baseline through perspective-correction algorithm. CLAHE preprocessing improved nighttime detection by 2-3%, enabling reliable operation across varying lighting conditions. SUMO simulations utilized to evaluate traffic efficiency showed minimal impact to the overall traffic flow. SmartBlink demonstrates how behavior-based urban infrastructure can transform intersections from static vehicle-centered systems into adaptive systems that respond to real human mobility patterns, fostering intersections where all individuals can move with greater autonomy, safety, and confidence.

Awards Won:
First Award of $6,000