Enhancing Pedestrian Safety Through AI-Powered Smart Traffic Systems: Developing Smarter Roads for Safer Walks

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In the super-aging society, vulnerable pedestrians, including the elderly, children, and individuals with disabilities, face significant risks due to fixed pedestrian signal timings that fail to adapt to real time conditions. As a solution, an AI-powered system was developed to dynamically adjust pedestrian signal timings based on walking speed and presence. Using YOLOv11 deep learning and OpenCV, the system detects and tracks pedestrians in real time from live video input. It applies perspective transformation to correct camera distortions and estimate walking speed accurately. The system extends the crossing time for pedestrians walking below 1.0 m/s and shortens signals when no pedestrians are detected. It also issues warnings when pedestrians cross outside designated areas for legal protection and alters vehicle signals to yellow if a pedestrian is detected during the red phase. In testing, the system demonstrated an 8.9% error in speed estimation, with congestion reduced by 16.4% and increased by 8.7% from signal reduction and extension, confirming its real-world viability. This solution provides a scalable, AI-powered approach to improving pedestrian safety and reducing traffic congestion. It offers strong potential for integration into future smart city infrastructures, making urban environments safer and more efficient.

Awards Won: