

Computer-assisted cyclist road safety warning system

Cyclist safety remains a major global concern. According to the World Health Organization, an average of 1.3 million traffic-related deaths occur annually, with cyclists contributing significantly to these fatalities. This issue is particularly severe in metropolitan areas where cyclists face frequent encounters with motor vehicles and often rely on poorly visible road markings. Research shows that most accidents are caused by limited awareness of approaching vehicles and their intended movements.

This study proposes a computer-assisted cyclist safety warning system that leverages state-of-the-art computer vision and machine learning methods to improve hazard detection and anticipation. The system incorporates YOLO (You Only Look Once) for real-time object detection, bounding boxes for distance estimation, and Inverse Perspective Mapping (IPM) to transform camera images into a bird's-eye view, making it easier to calculate the angles and trajectories of approaching vehicles and cyclists. Unlike many existing solutions that focus only on proximity, this approach emphasizes predicting vehicle intentions and routes.

To enhance performance, the system integrates Convolutional Neural Networks (CNNs), Generative Adversarial Networks (GANs) for expanding IPM research, and multi-object tracking frameworks such as MOT and DeepSORT for efficient, real-time vehicle tracking. Preliminary expectations include improved object identification, distance estimation, and angle calculation accuracy, ultimately leading to timely safety alerts for cyclists.

The system was able to detect approaching vehicles, estimate their distance and angle relative to the cyclist, and anticipate possible maneuvers such as overtaking or turning. However, due to limited data, the efficiency of the model could not be fully evaluated. To address this limitation, future testing will involve collecting larger datasets and applying XGBoost to assess and improve the predictive performance of the system.

Future work will address data limitations, particularly the challenge of obtaining diverse training datasets. The system could also be extended by incorporating additional sensor inputs to improve robustness under adverse weather conditions and by refining the predictive models to handle more complex traffic patterns. Ultimately, the system aims to provide cyclists with real-time warnings through a practical interface, supporting safer navigation in traffic environments.