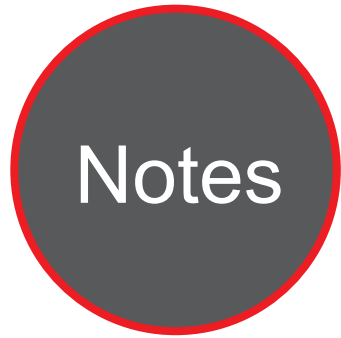




Caltrans Division of Research,
Innovation and System Information

Research



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Project Title:
UTC - Traffic Monitoring for
Pedestrian and Cyclist Safety
Using Deep Learning and Artificial
Intelligence

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Traffic Monitoring for Pedestrian and Cyclist Safety Using Deep Learning and Artificial Intelligence

Development of the Deep Convolutional Neural Networks (Deep CNN) for pedestrian/bicyclist detection and recognition.

WHAT IS THE NEED?

Improving the safety of pedestrians/bicyclists has always been one of the priorities of transportation officials in California. Two of the main goals of Pedestrian and Bicycle Safety Branch under California Department of Transportation (Caltrans) Traffic Operations are developing programs to improve the safety of transportation infrastructures for pedestrians/bicyclists; and encouraging research and technology transfer in the field of pedestrians/bicyclists fatality.

Understanding the movement of people, bicycles, and their interaction with vehicles is critical to avoid traffic accidents and improve safety. Currently, there is not an efficient automated system for monitoring the movement of pedestrians/bicyclists across the state of California and in major urban areas. Such system can also provide valuable information about the traffic stream parameters once implemented and calibrated.

This research project will facilitate the goals by providing a platform that allows for enhancing and improving safety measures for pedestrians/bicyclists in California using automated systems to monitor, detect, track, and count the flow of pedestrians/bicyclists.

WHAT ARE WE DOING?

The purpose of this project is to design and develop an automated system based on advanced Artificial Intelligence (AI) and Computer Vision to monitor, detect, track, and count



DRISI provides solutions and knowledge that improves California's transportation system

the traffic, particularly pedestrians/bicyclists using traffic cameras. The proposed system will just use the regular video streams captured by existing traffic cameras operated by Caltrans, and there is no need to install any special cameras or new sensors.

The ultimate goal is to improve the safety of pedestrians/bicyclists by developing self-sensed and AI-powered systems to monitor the flow of pedestrians/bicyclists. The information and statistics generated by the proposed system can allow Caltrans to optimize the flow of traffic and travel time as well as improving safety measures for pedestrians/bicyclists.

The system can include the following methods and algorithms:

- Algorithms for traffic video pre-processing, motion detection, background removal, and foreground extraction.
- AI and machine learning/deep learning for pedestrian/bicyclist detection and localization.
- Algorithms for traffic tracking and counting including algorithms based on optimal state estimation to estimate or predict the trajectory of every moving object and build a dynamic trajectory map for tracking and counting pedestrians/bicyclists.

WHAT IS OUR GOAL?

To design and develop a set of algorithms and methods for processing traffic videos, which were captured from traffic cameras, based on AI, machine/deep learning, and Computer Vision to monitor and detect pedestrians/bicyclists.

WHAT IS THE BENEFIT?

The proposed research project will facilitate the goal of improving pedestrians'/bicyclists' safety by providing a platform that allows for monitoring of pedestrians/bicyclists and consequently, enhancing the safety in California.

Vision Zero, a national and state initiative to reduce and eliminate traffic fatalities, has been adopted by several cities and counties in California. This project will help the transportation authorities enhance the advancement of Vision Zero implementation across the state, which directly benefits Californians.

WHAT IS THE PROGRESS TO DATE?

As proposed in the original research plan, the research team finished the development of Deep Convolutional Neural Networks for pedestrian/bicyclist detection and recognition. They used deep learning algorithms to achieve higher accuracy for pedestrian/bicyclist detection.

The researchers also tried more advanced deep learning models including You Only Look Once and Region Convolutional Neural Network. They evaluated the performance of deep learning models on actual traffic videos, and the results demonstrated high accuracy of the developed methods in detecting pedestrian/bicyclist on real traffic videos.

Then, the research team focused on pedestrian/bicyclist tracking and counting algorithms. They developed algorithms for tracking each object by connecting and comparing the detection results in sequential frames. The tracking and counting algorithms predict the pedestrian/bicyclist path and location in next frame (based on the information from previous frames), and then compare it with actual detection and location in the next frame.

This way the algorithm will generate a trajectory map for each subject and will be able to track each pedestrian/bicyclist individually to avoid double counting them in traffic video. The researchers also tested the tracking and counting algorithm on actual traffic videos from city of Los Angeles, and the results demonstrated high performance and accuracy of the developed algorithms.