DRISI

Caltrans Division of Research,
Innovation and System Information

Research Results

Transportation Safety and Mobility

MARCH 2020

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

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Task Manager:
Jerry Kwong,
Transportation Engineer,
Electrical
jkwong@dot.ca.gov

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

Designed and developed a system based on advanced Artificial Intelligence (AI) and Computer Vision to monitor, detect, track, and count pedestrians and bicyclists using traffic cameras.

WHAT WAS THE NEED?

Improving the safety of pedestrians and 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 Caltrans' Traffic Operations are developing programs to improve the safety of transportation infrastructures for pedestrians and bicycles; and encouraging research and technology transfer in the field of pedestrian and bicycle 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 and 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 can facilitate the aforementioned goals by providing a platform that allows for enhancing and improving safety measures for pedestrians and bicyclists in California using automated systems to monitor, detect, track, and count the flow of pedestrians and bicyclists.

WHAT WAS OUR GOAL?

The goal was to design and develop a set of algorithms and methods for processing traffic videos (videos captured from traffic cameras) based on Artificial Intelligence (AI), Machine/ Deep Learning, and Computer Vision to monitor and detect pedestrians and bicyclists.

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WHAT DID WE DO?

The purpose of this project was to design and develop an automated system based on Artificial Intelligence (AI) and Computer Vision to monitor, detect, track, and count the traffic, particularly pedestrians and bicyclists using traffic cameras. The developed system can be applied on the regular video captured by existing traffic cameras operated by Caltrans.

The following algorithms and methods have been developed as parts of the system:

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

WHAT WAS THE OUTCOME?

The outcome was a group of methods and techniques that have been developed and tested for pedestrian/cyclist detection, tracking, and counting. We learned that it is possible to use AI and computer vision algorithms along with cameras to automatically monitor the traffic and understand the movement of people, bicycles, and their interactions.

WHAT IS THE BENEFIT?

Improving the safety of pedestrians and bicyclists has always been one of the priorities of transportation officials in California. The proposed research project will facilitate this goal by providing a platform that allows for monitoring of pedestrians and bicyclists and consequently, enhancing the safety measures for pedestrians and bicyclists 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.
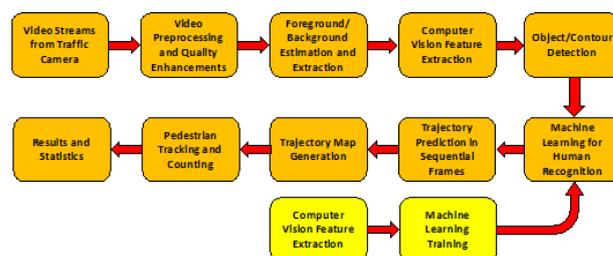
IMAGES

Image 1: End-to-end system architecture

(a)   (b)

Image 2: System results on real-time traffic video streams: (a) Bicyclist tracking and counting, (b) Pedestrian tracking and counting