Making Crosswalks Smarter: Using Sensors and Learning Algorithms to Safeguard Heterogenous Road Users

Abstract

The research described in this research began in response to frequent questions from users of several crosswalks near a university campus. At each crosswalk was a sign indicating that motorists should yield to pedestrians in the crosswalk. That this message was not being interpreted uniformly was a concern at locations where heterogeneous road users (pedestrians, cyclists, and motorists) were interacting. Instead of trying to impose a single interpretation on users of each crosswalk, it was decided to observe and analyze the interactions between users of the crosswalk.

Several hours of video were recorded of pedestrians and motorists "negotiating" the right of way at the crosswalk. Because these crossing locations were marked but not signalized, they were called "semi-controlled crosswalks". The negotiations took place during what were called pedestrian-motorist interactions (PMIs). The PMIs observed on video can be characterized as a "zebra-crossing" game.

Recently, computer vision (CV) algorithms have been extensively used in road users' detection and tracking in an unparalleled spatial-temporal scale. In this study, CV algorithms have been applied to convert the video recordings into a large-scale spatial-temporal trajectory dataset including 800 pedestrians and cyclists interacting with more than 500 vehicles. Utilizing the trajectory dataset, a spatial-temporal graph convolutional network-based sequence to sequence (ST-GCN-Seq2Seq) algorithm has been developed to reasonably forecast heterogenous road users' trajectories and behavior in real time. Combining CV and ST-GCN-Seq2Seq algorithms can help the design of an intelligent tracking system and achieve a form of "smart" interaction at semi-controlled crosswalks for heterogenous road users.

Keywords: Crosswalks; Pedestrian-motorist interaction; Heterogeneous road users; Learning algorithms