UTC Spotlight

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Real-time and Secure Analysis of Pedestrian Data for Connected Vehicles

According to the National Highway Traffic Safety Administration (NHTSA), pedestrian fatalities increased 75% from 2012 to 2021 in urban areas. A team consisting of researchers from Clemson University and Benedict College, consortium members of the Center for Connected Multimodal Mobility (C^2M^2) headquartered at Clemson University, developed a vision-based real-time pedestrian safety alert system that can help reduce the crash risks involving pedestrians and vehicles. By enabling vehicles to communicate wirelessly with each other and with roadside infrastructure, this technology potentially enhances road safety, reduces accidents, and optimizes traffic flow. Integration of off-the-shelf cameras and pedestrian-held smartphones with roadside infrastructure showcases the practicality and accessibility of the technology. This system represents a significant step toward realizing the potential of future smart cities. Figure 1 shows the system components for generating real-time vision-based pedestrian safety warning messages.

Abyad Enan

Figure 1. System components for generating vision-based pedestrian safety warning messages.

The system combines the vision-based pedestrian detection system with a dynamic video compressor for reducing data communication bandwidth while maintaining a high pedestrian detection accuracy. Video compression reduces the bandwidth requirement to transmit the video but degrades the video quality. The system includes a real-time error-bounded lossy compression (EBLC) strategy to dynamically change the video compression level depending on different environmental conditions to maintain a high pedestrian detection accuracy while reducing the bandwidth requirement.

Future intelligent transportation system deployments will rely on wireless transmission of massive amounts of data among connected vehicles, smartphones, roadside sensors, cameras, and roadside computing devices in a connected environment. As the number of connected devices increases, the need for reducing bandwidth requirements grows. Thus, the dynamic video compressor developed in this project will be useful for a wide array of future transportation applications.

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Figure 2. Pedestrian safety alert system using dynamic lossy video compression.

C^2M^2's pedestrian safety alert system is poised to change how people interact with transportation systems, fostering a future where traffic crashes become increasingly rare,

traffic congestion is minimized, and pedestrians can navigate streets more safely—all within the context of an interconnected smart city ecosystem.

Clemson Photo Services

Figure 3. Pedestrian and connected vehicle receiving warning alerts.

The algorithms developed for this project use video data to generate industry-standard pedestrian safety messages, which are also being utilized in another project involving truck safety in highway work zones sponsored by the Federal Motor Carrier Safety Administration (FMCSA). The FMCSA-sponsored project involves extending the algorithms developed for the C^2M^2-sponsored vision-based real-time pedestrian safety alert system to identify risks of crashes involving trucks in work zones.

Clemson University recently announced a ground-breaking project in collaboration with Innova EV, a pioneering force in electric vehicle technology, and the South Carolina Research Authority (SCRA) that will also utilize the algorithms developed in this C^2M^2 project. This collaborative effort will generate real-time pedestrian warnings to alert Innova EV vehicles as well as pedestrians at intersections of any impending crashes. This will reduce pedestrian-vehicle conflicts and improve roadway safety. This project will serve as a model for electric vehicle deployment at other college campuses. Figure 4 shows an Innova EV vehicle that will utilize the C^2M^2-developed technology on the Clemson University campus.

M Sabbir Salek

Figure 4 Innova EV launch event at the Clemson University campus.

About This Project

TThe project was led by the Principal Investigator, Dr. Amy Apon, professor in the School of Computing at Clemson University, and Co-Principal Investigators, Dr. Mashrur "Ronnie" Chowdhury, professor of the Civil Engineering Department at Clemson University and C^2M^2 director, Dr. Gurcan Comert, professor in Computer Science, Physics, and Engineering Department at the Benedict College. More details about the project are available here: https://cecas.clemson.edu/ideas/creating-smart-cities-of-the-future/