MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 21-447 (project 547) | December 2021

Infrastructure Safety Support System for Smart Cities with Autonomous Vehicles

Smart Sensing & Smart City Analysis

the ISSUE

Smart cities are home to a growing number of autonomous vehicles (AVs) that can sense their environment and navigate without human input. Studies suggest AVs will significantly improve transport efficiencies, reduce crashes, provide smoother rides, decrease congestion, and increase traffic flow through speed harmonization and reduced demand for roadway capacity. However, many expect that the full adoption of AVs will take 50 years or longer. Therefore, driverless vehicles will share the roads with human-operated vehicles for a long time. Subsequently, AVs of various levels of automation will continue to rely on human inputs. Thus, one of the biggest challenges facing smart cities is achieving fully harmonized vehicle operation in mixed-driver scenarios.

the RESEARCH

This research seeks to develop an infrastructure safety support system by embedding vehicle-to-infrastructure (V2I) enabled sensor networks into the transportation infrastructure to provide AVs and human drivers with inputs to improve their decision making when obvious decisions may not possible. A new car-following algorithm is also developed to enable AVs to integrate the real-time traffic and road condition data from such an infrastructure safety support system to improve traffic safety and mobility with autonomous vehicles in mixed driver environments. The performed sensitivity study also optimizes such an infrastructure safety support system for combined considerations on effectiveness and affordability of the system.

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Project Title

Infrastructure Safety Support System for Smart Cities with Autonomous Vehicles

the FINDINGS

This project developed an infrastructure support system based on infrastructure sensors and a new V2I algorithm for AVs to effectively use the infrastructure support system for enhanced safety and mobility. The infrastructure support system can monitor various vehicle and road condition data, including vehicle speed, wheelbase distances, the number of axles, vehicle classification, weigh in motion, road roughness, and in-pavement cracks. With the real-time information from the infrastructure support system, the new cumulative-adaptive, car-following model (CACF) can significantly improve the mobility and safety of the transportation system with different penetration rates of AVs.

the IMPACT

This research will contribute toward the existing knowledge of vehicle and highway automation using intelligent transportation system (ITS) applications. Effective communication between vehicles using the sensors embedded in the road infrastructure will ensure the safety of drivers by reducing the number of conflicts and crashes, improving travel times for different routes, and providing a tool for managing traffic congestion and traffic flows.

For more information on this project, download the Main report at https://www.ugpti.org/resources/reports/details.php?id=1056