CONNECTED VEHICLES: ENHANCING DRIVER SAFETY DURING SEVERE WEATHER CONDITIONS

OVERVIEW: Vehicle crashes on roads and highways cost loss of life and damage to property. According to the National Highway Traffic Safety Administration (NHTSA), almost a quarter of the crashes happen during severe weather conditions. The weather-related crashes arise from wet pavements, rainfall, snow or sleet, icy pavement, and snowy or slushy pavement.

Connected vehicle technologies can equip drivers with the tools needed to anticipate potential crashes and significantly reduce the number of lives lost each year. Road safety research related to wireless-based communication between vehicles is being coordinated by the US Department of Transportation (USDOT) through the Connected Vehicles program. The USDOT and NHTSA are involved in a joint research initiative, called Safety Pilot, to investigate the connected vehicle technology for real-world application. The connected vehicles concept that is promoted by the program is primarily focused on enhancing driver safety by enabling collision prevention applications during “normal driving conditions” and include contributions related to forward collision warning, blind spot warning, lane change warning and emergency braking.

However, there has been limited effort related to enhancing driver safety by enabling collision prevention applications during “inclement weather driving conditions” using connected vehicle technologies. Therefore, this project aims to develop technology to alert drivers in real time of potentially hazardous weather-related road conditions in the region based on information from neighboring vehicles, as illustrated in Figure 1.

In this project, connection among vehicles is being established to exchange data (i.e. vehicle-to-vehicle communication (V2V)), which is based on Dedicated Short Range Communications (DSRC) protocol. In collaboration with the University of Oklahoma Center for Intelligent Transportation Systems, a proof-of-concept testbed is being developed where cars are being outfitted with DSRC-capable equipment to facilitate the wireless communication between the vehicles.

DSRC is similar to Wi-Fi but has faster network acquisition, low latency, and high reliability to enable development of vehicle safety applications. Specifically, it supports communications between vehicles as well as communications between vehicles and roadside infrastructure. The technology developed in this project will enable a vehicle to connect to all vehicles within its range to form a Vehicular Ad Hoc Network (VANET), with the cars as nodes of the network.

Figure 1 Experimental Dedicated Short Range Communications (DSRC) Based Vehicular Ad Hoc Network

In the testbed, the vehicles will also connect to DSRC-based roadside infrastructure, which will be used to send information from vehicles to a Road Weather In-
formation System (RWIS) server and dynamic message signs to warn drivers who are out of communication range.

Modern vehicles are equipped with sensors that collect the data needed to relay vehicle operating conditions and the surrounding weather conditions through this network. This project will use the data to obtain parameters related to the following:

- traction control status;
- anti-lock braking system status;
- airbag status;
- ambient temperature;
- brake pressure;
- brake pedal acceleration;
- automatic braking status; and
- windshield wiper park to park time.

A safety application and its algorithms are being developed that will receive and analyze these data from neighboring vehicles relative to a vehicle’s location to determine the risk of collision. This will allow the creation of a threat map for driver alert and safety. It will also be able to provide recommendations for drivers in terms of area avoidance or driving condition. The threat map transmitted from the vehicle experiencing adverse weather conditions can be broadcast to all vehicles within a region using geographical-based routing over the multihop Ad Hoc network, transmitted from the vehicles to the Road Side Equipment (RSE), roadside Dynamic Message Signs, and then transmitted to the server via cellular links for integration with RWIS.

**APPLICATION:** The application of the working prototype of a vehicular network created by this research that uses state-of-the-art wireless communications between vehicles and roadside infrastructure will enhance driver awareness and safety. It offers a feasible connected vehicles technology option that can be implemented by vehicle manufacturers. The transmitted information related to adverse weather and driving conditions can also be used by traffic management agencies to, for example, dynamically change the duration of the traffic signals in response to changing road conditions due to adverse weather.

**BENEFITS:** Benefits of application include reducing vehicle crashes, fatalities and injuries due to adverse weather conditions by alerting drivers of potentially hazardous weather-related road conditions in real time.

**About the Researchers**

Dr. Mohammed Atiquzzaman is the Principal Investigator (PI) of this project. He is a *Presidential Professor of Computer Science* at the University of Oklahoma (OU). Co-PIs of this project are Dr. Ronald Barnes, *Presidential Associate Professor of OU Electrical and Computer Engineering* and *Co-Director of Center for Intelligent Transportation Systems (CITS)* and Joseph Havlicek, *Presidential Professor of OU Electrical and Computer Engineering* and *Director of CITS*. Please send inquiries to Dr. Atiquzzaman (*atiq@ou.edu*).