HIGHLIGHTER

ENHANCING DRIVER SAFETY DURING SEVERE WEATHER CONDITIONS

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PROJECT TITLE
ENHANCING DRIVER SAFETY DURING SEVERE WEATHER CONDITIONS

FINAL REPORT
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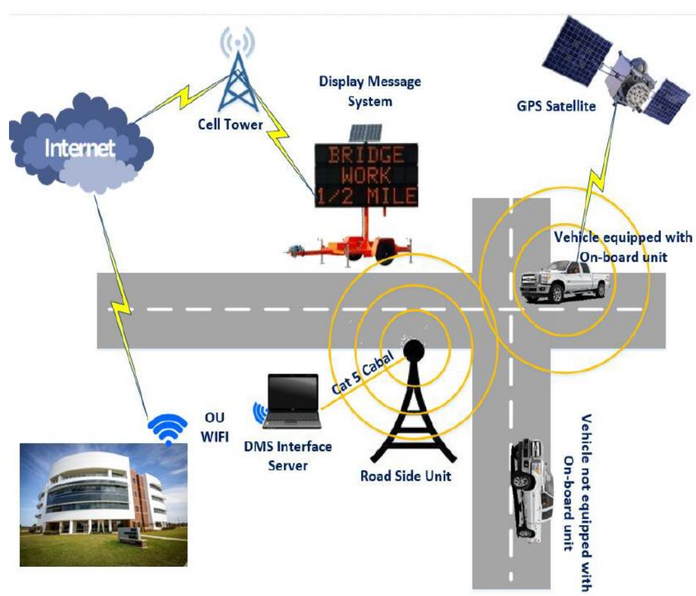
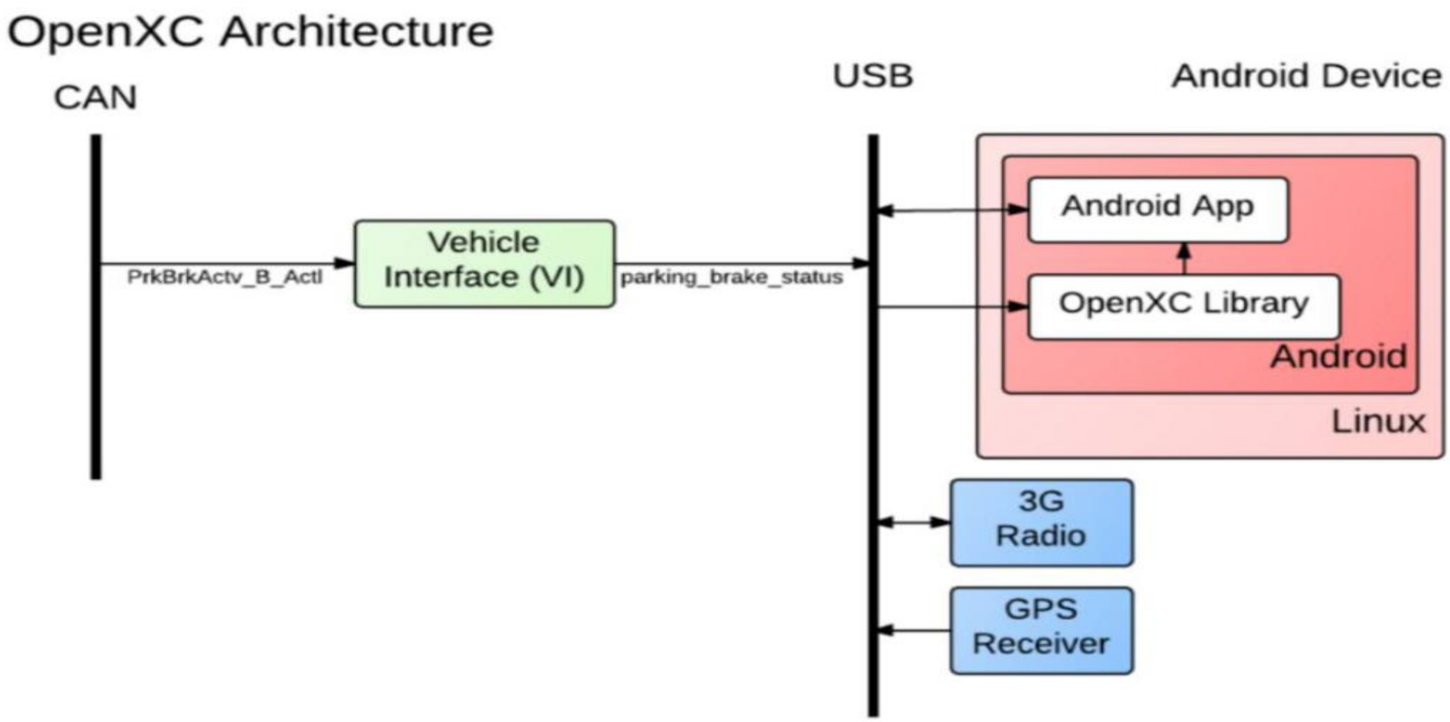
OVERVIEW Vehicle crashes on roads and highways cost loss of life and damage to property. According to the National Highway Traffic Safety Administration (NHTSA), almost a quarter of the crashes happen during severe weather conditions. The weather-related crashes arise from wet pavements, rainfall, snow 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 re-search 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 includes 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.

RESULTS In this project, connection among vehicles was established to exchange data regarding inclement weather driving conditions (i.e. vehicle-to-vehicle communication (V2V)), which is based on Dedicated Short Range Communications (DSRC) protocol. Cars have been 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 and communications between vehicles and roadside infrastructure. Using the technology for this project enables 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.



The research team worked with the University of Oklahoma Intelligent Transportation Systems Laboratory. Specifically, information was gathered from vehicle sensors regarding vehicle operating conditions and surrounding weather conditions via CAN bus, which is connected to an On-Board Diagnostic II (OBD-II) interface. An OBD-reader was used to read data which supports Bluetooth. Extracted data from CAN were transmitted to an On-Board Unit (OBU). If DSRC device supports Bluetooth, it can assist in making connection between the OBU and OBD reader. The OpenXC platform is available as open-source code as well as pre-built specialized binaries from Ford Motor Company. The OpenXC firmware core for the C5 device is built within a Linux-based build environment. This project programmed the C5 with the latest available source-code (v7.0) built on a Linux laptop and pre-built binary. The C5 translates known messages on the CAN bus in a vehicle. The data was transmitted through the Bluetooth or USB to a receiver such as the OpenXC mobile application, OpenXC Enabler. The enabler has a basic Graphic User Interface which displays vehicle data obtained from the car in a clearly interpretable form. The figure shows the architecture of OpenXC. Initially, the C5 is programmed and plugged into the car to capture the near real time vehicle data available on CAN bus. The data is transmitted to the mobile phone read by the mobile app using Bluetooth. All the devices have been programmed to ensure that all the equipment is interoperable.



A safety application and its algorithms were developed that receive and analyze these data from neighboring vehicles relative to a vehicle's location to determine the risk of collision. This allows the creation of a threat map for driver alert and safety. It also provides 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.

POTENTIAL BENEFITS Potential benefits of project implementation include reduction of vehicle crashes, fatalities and injuries due to adverse weather conditions, by alerting drivers in real-time of potentially hazardous road conditions in the region, based on information from neighboring vehicles. The data measured by vehicle sensors can be transmitted to roadside units for transmission to servers for road condition prediction and control of road side infrastructure, such as traffic lights, work zones, dynamic message signs, pedestrian signals, and curve speed warning. The concept was demonstrated through a working prototype of a vehicular network using the connected vehicles technology to increase driver safety.