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Final Report

Project Title:

Development of a Conceptual Framework toward an Integrated Transportation System (Continued)

Project Number:	Project End Date:	Submission Date:
UMAR20-10	06/01/2011	07/31/2011

As a continuing effort documented in the first phase project UMAR19-13, this research focuses on the design of a prototype application under the framework toward an Integrated Transportation System. More specifically, this research aims at improving safety at intersections using wireless technology. In order to warn drivers of on-coming traffic, a vehicular ad-hoc network acts as a safeguard using various types of equipment to inform drivers of a possible accident. Two devices, one known as On-Board Equipment (OBE), and the other as Road-Side Equipment (RSE), act as the chief components in a system that activate warning lights based on conditions of on-coming traffic on minor approaches.

In the ad-hoc network, an OBE unit inside a user's car obtains information about the car's location and speed via Global Positioning System (GPS). The OBE constantly requests information from its GPS to receive coordinate information about the car it is monitoring. The RSE consists of a laptop and transceiver, which are connected to traffic lights. The RSE monitors the condition of the traffic light at a given intersection, as well as other on-coming car's speeds and positions relative to the intersection's stop line. At all times the OBE and RSE are able to monitor real-time physical conditions and wirelessly communicate.

In cases when a light at an intersection is yellow or red, the RSE uses speed, location, and signal information to calculate whether an approaching vehicle can make a complete stop before crossing the stop line in front of a red light. If the RSE determines that an oncoming driver cannot make a complete stop before the light, the device generates a warning. The warning is sent from the RSE wirelessly to a car's OBE, which then to notifies the driver not to proceed through the intersection until it is clear.

This warning is intended to particularly alert drivers of on-coming cars that may be passing through intersections without a green light, or of on-coming cars not visible due to trees, poles or other obstructions. When the RSE detects that the intersection is again clear, the warning light disappears.
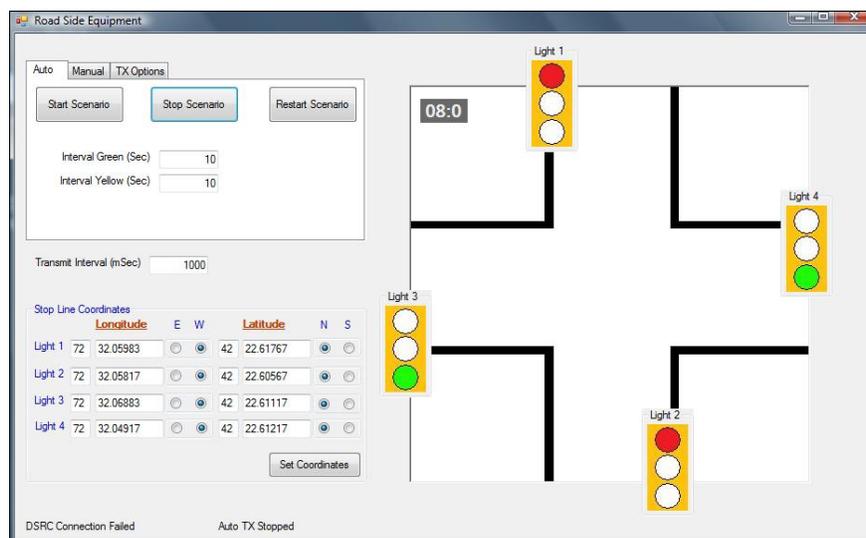
Interface of the RSE program

A fully functioning prototype system was developed to test the technology at a cost of about $1,100. Specific hardware used to create the OBE included an AC-12 board, ethernet controller, header board, and a Dedicated Short Range Communication (DSRC) antenna. Specific hardware used to create the RSE included an Atmega-128 microcontroller, header board, ethernet controller and transceivers. The prototype performed successfully when tested in properly equipped cars on a quiet road in western Massachusetts.

Results of Prototype Testing

Test		Driving Vehicle Warned?	Stopped Vehicle Warned?	Test Passed?
1	Vehicle traversing red at 20 MPH (8.9 m/s)	YES	YES	YES
2	Vehicle traversing red at 35 MPH (15.6 m/s)	YES	YES	YES
3	Vehicle stopping at red	NO	NO	YES
4	Vehicle traversing yellow with 0.1s to red	YES	YES	YES
5	Vehicle traversing yellow with 10s to red	NO	NO	YES
6	Vehicle stopping at yellow	NO	NO	YES
7	Vehicle traversing green	NO	NO	YES

In the future, this research suggests possible uses and implementations of the OBE and RSE devices at stoplights anywhere desired, in conjunction with state departments of transportation.

In addition to the above, an intelligent traffic sign is explored in this project aiming to improve safety at intersections without a traffic light. The purpose of this device is to assist drivers in making correct decisions at intersections. The device is designed to increase driver alertness when approaching an intersection without a traffic light. The device issues a warning – a flashing light - to the driver when there is risk a traffic accident can occur.

In essence this is a smart traffic sign for intersections without traffic lights. It consists of two cameras installed on a pole at the intersection – one facing the main street and the other the secondary street. Below the cameras is a computer that constantly processes data it receives from the cameras. When it identifies a risk of collision, it activates a flashing light on two yield signs positioned at the intersection. The flashing light is intended to increase driver alertness when approaching the intersection.

Accidents at intersections without traffic lights can occur in two instances: (1) when the driver coming from the secondary street does not notice the traffic sign and is not aware that he may not have the right of way, or (2) when he notices the traffic sign but does not internalize correctly the information. In both cases, the driver may make an incorrect decision. The flashing light draws the driver's attention to the sign and increases his/her alertness. It is expected that this device will reduce accidents and near accidents at the intersection, without impeding traffic flow on the main street.