Texas A&M Transportation Institute

PROJECT SUMMARY

Texas Department of Transportation

0-6775: NTCIP-Based Traffic Signal Evaluation and Optimization Toolbox

Background

Routine maintenance of traffic signals requires identification and resolution of hardware faults and operational inefficiencies. Like most agencies in charge of operating and maintaining traffic signals scattered over large geographic regions, Texas Department of Transportation (TxDOT) districts do not have the resources needed to proactively maintain traffic signals in their respective jurisdictions. Driver complaints remain the most common mechanism for identifying problems, many of which may require significant effort to troubleshoot and resolve.

TxDOT initiated this project to develop two toolboxes to assist its staff to troubleshoot and resolve operational problems at signalized intersections and diamond interchanges. Each toolbox consists of an off-the-shelf industrial laptop computer loaded with custom software to provide needed functionality. Use of the National Transportation Communications for Intelligent Transportation Systems Protocol (NTCIP) was a key requirement to standardize toolbox applicability to the different brands of traffic controllers TxDOT uses.

What the Researchers Did

Texas A&M Transportation Institute (TTI) researchers developed custom software to provide the desired functionality, installed it on two industrial laptop computers purchased for delivery to TxDOT, and conducted in-lab and field testing to verify that the toolboxes were operating as designed.

The software developed in this project, the NTCIP-Based Portable Traffic Signal Evaluation System (NPTSES), consists of the following three modules:

- A real-time monitoring module (NPTSES-M), which connects to the controller via an Ethernet or serial port. Upon successful connection with a traffic controller, NPTSES-M first uploads static data (e.g., base signal timings, detector data, and pattern data) from the controller's database and then begins polling real-time statuses of various controller events (e.g., phased status, detector status, and statuses of various

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Project Completed:
8-31-2014

alarms). NPTSES-M saves all uploaded data daily into the appropriate files on the hard disk and also conducts real-time processing of data for offline analysis and use.

- An analysis module (NPTSES-A), which provides an offline capability to generate easy-to-use measures of effectiveness, most of which are in the form of plots generated for viewing in Microsoft® Excel®.
- An update module (NPTSES-U), which connects to a controller via an Ethernet or serial port and provides the capability to download new signal timings to the controller using NTCIP-based messages. The user may enter revised timings, or the module may read timings from a Universal Traffic Data Format (UTDF) file generated by a signal timing optimization model.

TTI researchers conducted in-lab tests using TTI's hardware-in-the-loop (HITL) software and HITL simulation using the Corridor Simulation (CORSIM) model to evaluate the toolbox with a wide range of traffic controllers. Researchers also conducted a series of field tests at several selected locations in Milano, Bryan, and Houston, Texas. These locations included signalized intersections and diamond interchanges with various characteristics. Testing also included the center-to-field communications capabilities of NPTSES-M and NPTSES-U modules over the Internet. The objective of these tests was to evaluate toolbox operation and efficiency.

What They Found

Researchers found that NPTSES-M works as desired when communications speed is fast enough for real-time monitoring. Test results showed that direct Ethernet connection from the computer to a controller is the best method for connecting NPTSES-M to a controller. All connection types (i.e., direct Ethernet, remote Ethernet, and serial) are fine for NPTSES-U, which does not require real-time communication. NPTSES-A provides several reports, most of which include measures of effectiveness in graphical format for easy evaluation of traffic signal operations.

What This Means

This project has developed a product that is ready for immediate implementation. Two toolboxes (laptop computers with NPTSES installed) have been delivered to TxDOT. However, software developed by TTI can be installed on any number of laptops to provide additional resources. The next step is to provide toolbox training to TxDOT staff in all districts to allow near-term use of project results. Researchers recommend that an implementation project be initiated as soon as possible to provide for development and delivery of training to TxDOT employees.

For More Information

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Keyword: Research