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DEPARTMENT OF TRANSPORTATION

OFFICE OF RESEARCH & INNOVATION

IMPLEMENTATION SUMMARY

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Principal Investigator:
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PROJECT COST:
$97,484

Putting Research Into Practice: Improving Traffic Volume Estimates

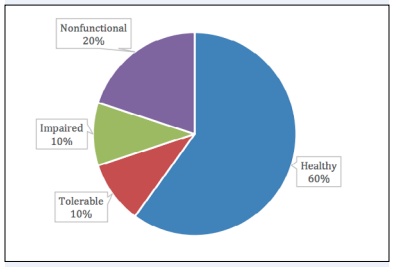
Investigators developed a system that collects loop detector data and evaluates it for signs of failing functionality. The system sends data to a software tool for remote users that translates and reports current loop detector health in an easy-to-read graphic format. Failing loop detectors are quickly and easily identified for repair.

What Was the Need?

MnDOT's Regional Transportation Management Center (RTMC) collects traffic data from more than 7,800 vehicle detectors to manage the freeway network in the Twin Cities area. The data, which are collected every 30 seconds from in-pavement loop detectors and mounted radar, provide information about freeway volume, occupancy and vehicle speed.

The data have essential uses beyond daily traffic operations. MnDOT's Office of Transportation System Management, especially Traffic Forecasting and Analysis (TFA), uses this information to determine annual average daily traffic (AADT), which is used along with other statistics for Federal Highway Administration (FHWA) reporting, traffic forecasting, and maintenance and safety planning.

Because AADT and related information form the basis of so many decisions and plans, it is crucial that the data be accurate. One of TFA's challenges has been a lack of information about the quality of the loop detector data. Knowing which detectors produce high-quality data and which may be unreliable is key to TFA's planning.



The new system displays the range of loop detector functionality for each day.

What Was Our Goal?

The project's primary goal was to develop a system that would screen loop detector data to allow TFA to generate more accurate estimates of AADT. More accurate AADT data would prevent TFA from using faulty information that could adversely affect planning and safety-related decisions.

What Did We Implement?

Building on previous research that identified faulty detectors, investigators enhanced previously established diagnostic algorithms for this project. Then they created and implemented a software tool that classifies loop detectors' level of functionality by continuously evaluating detector data from the RTMC.

Diagnostic results are conveyed from the central client-server system running the diagnostic program and database to the computers of individual users. A software tool for users, detHealth_app, translates the data into four, easily understood health levels for loop detectors: healthy, tolerable, impaired or nonfunctional.

The system allows users to quickly identify defective loop detectors and those functioning at less than optimum levels. It also provides many additional categories of information about the detectors. The system is operating now for the Twin Cities freeway system.

How Did We Do It?

Investigators reviewed literature about traffic detector diagnostic algorithms and techniques to detect erroneous data. Then they adopted 13 diagnostic parameters derived from the raw 30-second interval detector volume and control data from RTMC. These

continued

"This project saves us time in checking traffic sensor health to determine if detectors are working or are in need of repair. Repairs are now done quickly. The project improves the accuracy of data we use for official traffic volumes."

—Gene Hicks,
Director, Traffic Forecasting and Analysis, MnDOT Office of Transportation System Management

"The project's results will enable MnDOT to quickly determine which detectors are providing inaccurate data. Better detector data will allow more accurate annual average daily traffic totals, which are widely used for planning and safety-related decisions."

—Taek Kwon,
Professor, University of Minnesota Duluth Department of Electrical Engineering

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Loop detectors are installed in the pavement and incorporated into the system through complex electrical connections. Traffic flow data is collected every 30 seconds and sent to the RTMC.

detector-health parameters form the basis of the quality control for this project, which is designed within a client-server model. The parameter values are computed daily for each loop detector and stored in a relational database, a free version of Oracle's MySQL. The data are then fed into a software classifier that produces the health level of each detector for the day.

Every day, the detHealth_app displays the detector health classifications in a pie chart. Users can retrieve further information about loop detector health parameters, parameter visualization, station AADT computations and other factors from this screen.

Close examinations of highway incident RTMC data from January 2015 through December 2016 allowed investigators to identify the electronic signatures of roadway situations other than detector faults, such as stalls, roadwork, hazards and crashes. Identifying and separating these anomalous signatures from the 13 parameters determining detector functionality further improved the software's accuracy. Thus, the system does not mistake common traffic flow disruptions for detector failure.

What Was the Impact?

The new detector health system allows users to instantly learn how well loop detectors are functioning and select those most appropriate for important traffic counts. Detectors that are categorized as healthy can be specified for vehicle counting program use, providing accurate counts. Detectors classified as tolerable can be used only if no healthy detectors are available in the same location. Impaired or nonfunctional detectors are not used for counting, but are instead targeted for maintenance operations.

The new system assures TFA and other groups that the traffic count data they use for forecasting and decision-making are as accurate as possible.

What's Next?

The success of this project led to the expansion of the effort with an additional research project, which is now in progress. The new project will work toward using loop detector data to categorize the types of vehicles passing over the detectors. It will make another area of information easily available to TFA professionals, enhancing their ability to make accurate traffic forecasts and better decisions.

This Implementation Summary pertains to Report 2020-02, "Improve Traffic Volume Estimates From MnDOT's Regional Traffic Management Center," published February 2020. The full report can be accessed at mndot.gov/research/reports/2020/202002.pdf.