



RESEARCH SERVICES

OFFICE OF POLICY ANALYSIS,
RESEARCH & INNOVATION

TECHNICAL SUMMARY

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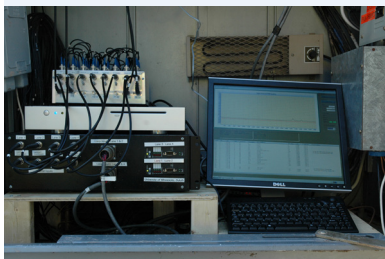
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Principal Investigator:

Taek Kwon, University of
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PROJECT COST:

\$89,611



The developed system takes up very little space and was specially designed for use in the field.

Development of a PC-Based Eight-Channel Weigh-in-Motion System

What Was the Need?

Weigh-in-motion devices are designed to capture and record the weights of vehicles driving over a sensor, including the weight per axle for trucks. Unlike older static weigh stations, current WIM systems do not require the vehicles to stop, making these stations much more efficient. This type of weight monitoring is useful for an array of applications, including pavement design and research, bridge design and monitoring, and size/weight enforcement.

The WIM systems currently used by Mn/DOT are proprietary; the algorithms and designs used to weigh vehicles in motion are closely guarded and cannot be easily improved. The current problem with these systems is that external factors such as wind and the suspension system of the vehicle make it very difficult to maintain accurate weight readings. Many WIM readings can be off target mere days after system calibration, rendering the collected data unusable.

What Was Our Goal?

The purpose of this research project was to improve the WIM technology in use in Minnesota through better system design and signal processing algorithms. Researchers wanted to develop an eight-channel WIM system that could record vehicle weights across four lanes of traffic and be easily built using a standard PC and off-the-shelf components.

Success in this endeavor could enable Mn/DOT to produce future systems in-house instead of purchasing and upgrading proprietary systems. This would save significant time and money, and could set a new standard for WIM system vendors.

What Did We Do?

During the system prototype development, the research team learned that creating a WIM system using an actual truck with known weight is not only labor-intensive and tedious, but also relies on an inaccurate weight reference due to external factors. To save time and money, the first step was to develop a software program that would allow calibration of the sensors without ever having to actually drive a vehicle over them.

With the consequent vehicle simulator in place, the team then began assembling the off-the-shelf hardware they would need to complete their system, including a PC and a WIM signal box. At the same time, researchers were writing the software program that would be used to collect and analyze the WIM data.

In June 2007, researchers field-tested the newly designed system at the Trunk Highway 61 WIM site and successfully demonstrated the working hardware and software. This field demo was accomplished using live traffic to demonstrate real-time operation. The system successfully detected vehicles and vehicle classification, accurately computed data and generated appropriate error messages.

Researchers developed technology for a WIM system that can be easily built, can record vehicle weight across four lanes of traffic and does not need to use actual vehicles to calibrate. The system is much less expensive and easier to modify than a proprietary system.

“We’ve proven that you can create a user-friendly and accurate WIM system for a much lower cost than buying a proprietary system. Mn/DOT stands to save a lot of time and money by implementing this system.”

—Alan Rindels,
Senior Engineer,
Minnesota Department
of Transportation

“The project showed Mn/DOT and other agencies that building a more cost-effective and nonproprietary system is possible.”

—Matthew Oman,
former Technical Liaison,
Mn/DOT Maplewood Lab

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The software includes a graphic display of axle signals from trucks passing over the sensors (top) and populates a database (bottom) that records information about each vehicle, including the speed, vehicle class, number of axles, axle weight and time it was weighed.

What Did We Learn?

This project provided a demonstration and documentation of a nonproprietary, high-quality WIM system built inexpensively with off-the-shelf components. The final system consists of a thin, fanless PC with a standard LCD monitor, keyboard with trackball and modem, with an analog signal interface box and a splice panel for loop wires. The software runs as an application program loaded from a hard disk. The system occupies a small space and was specially designed for implementation in a field cabinet or other small space. The research team also delivered documentation for the system that included its methods, findings and recommendations.

The main innovation introduced in this research was the new WIM simulation software. Whereas development of a new WIM system or calibration of an existing WIM system typically requires repeated driving of trucks with known weights to verify the algorithm and measurement accuracies, this project eliminated this need, saving time and expense.

What’s Next?

The system developed through this study on TH-61 is still successfully recording and measuring vehicle information, though some of the sensors used (not produced through this study) are no longer functional and have not been replaced due to staffing and cost considerations. The data produced by the system are combined for analysis with WIM data produced by proprietary systems at other Minnesota sites, and [a recent research effort resulted in the development of a warehouse for this data](#); an implementation effort is planned to enhance the reporting capabilities of this warehouse.

Another Mn/DOT research project is currently in progress that will look into the development of a fully portable system. This project is making use of the same type of equipment and methodology developed in the course of this project.

Mn/DOT has yet to realize the full benefits of development of a nonproprietary WIM system through widespread implementation; additional funding would be required for this to occur.

This Technical Summary pertains to Report 2007-45, “Development of a PC-Based Eight-Channel WIM System,” published October 2007. The full report can be accessed at <http://www.lrrb.org/PDF/200745.pdf>. For information about the current studies mentioned, please contact Benjamin.Timerson@state.mn.us.