Researchers develop portable, low-cost traffic data collector

Engineers needing to measure intersection traffic volumes often have few tools at their disposal. This means many must resort to doing things the old-fashioned way—by counting. While both temporary and permanent devices to measure traffic data do exist, issues with their intrusiveness and difficult installation are some factors that often limit or prevent their use. Tubular counters such as the JAMAR Trax series, for example, record vehicle counts by sending air pulses through rubber tubes mounted on the roadway. Although the cost of the system is relatively inexpensive, its drawbacks are its intrusive setup, inability to detect turning movements, and susceptibility to damage by large vehicles. Light Detection and Ranging (LIDAR) and radar sensors are nonintrusive, but they detect only a single roadway location, cannot collect turning movement data, and are very expensive.

As a result, manual traffic data measurements done on-site using a push-button apparatus to record each passing vehicle are the most frequent form of data collection used in traffic engineering studies of intersections and arterial streets, especially those measuring turning volumes. Such data collections are not only prone to error but also often prohibitively expensive and time-consuming. And data collected by manual counting or the other sensors mentioned lack a visual, historical record that would allow researchers to go back and investigate or correct traffic measurement errors.

Although it would be beneficial for transportation officials to perform data-collection studies—essential components for tasks such as retiming traffic signals—on a regular basis, the lack of availability of a low-cost, easily deployable, and nonintrusive data-collecting device means that collection is usually completed only when absolutely necessary—such as for an intersection with unusually high crash rates.

Researchers from the University of Minnesota’s Department of Civil Engineering and the Minnesota Traffic Observatory (MTO) have completed a project they hope will change that. Their work, funded by ITS America’s Community Planning & Implementation Program (CPIP) and supported by project sponsors such as ITS America, the Minnesota Valley Transit Authority (MVTA), the Minnesota Department of Transportation (MDOT), and the Minnesota Pollution Control Agency (MPCA), has led to a device that can help in minimizing delays and congestion levels while improving overall coordination.

Civil engineering professor Panos Michalopoulos, principal investigator on the project, along with MTO manager Ted Morris and graduate student Jory Schwach, began working in August 2007 to develop and test the device, which can gather data on traffic volume, speed, vehicle classification, turning movements, queue size, conflicting movements, and time headways. Most important, the video system also provides a visual record of traffic characteristics.

The prototype data collector, consisting of a camera mounted on a self-raising mast, is capable of elevating 28 to 30 feet above a road’s surface. The mast, attached to a custom-fabricated base, can be secured to signs, luminaires, or traffic signal poles. Approximately 40 hours of traffic video can be stored before battery recharging or swapping needs to take place, which allows the device to be left unattended for substantial periods of time.

Another of the device’s advantages is that a single unit can cover an intersection of up to five lanes per incoming approach, or a total of 20 incoming lanes. This means that the device can be deployed at almost any intersection. Its small footprint also makes it optimal for urban areas where limited space is a primary concern. Morris says.

To test the device’s accuracy, the team deployed the system at five sites and left arterial roadways. Data collected from this device can help in minimizing delays and congestion levels while improving overall coordination.

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driver’s seat provide intuitive warnings of lane departure. Finally, invisible laser rangefinders along the side of the bus detect nearby vehicles, and the information is displayed to the driver on a “virtual mirror” display.

Research with actual bus drivers has shown that the system reduces cognitive demands on vehicle operators, enabling them to operate comfortably in shoulder lanes even in low-visibility conditions while maintaining the safety of the bus, its passengers, and other drivers on the roadway.

The expo demonstrations, which took place during designated time slots on roads and road shoulders near the George R. Brown Convention Center in Houston, featured an MVTA bus equipped with the driver-assistive system. On board, the team used an extra seat and steering wheel to let passengers experience the system firsthand. Passengers riding in the extra seat were able to view the HUD technology, as well as experience the different modes of feedback the IV Lab’s system provides to the driver. For example, passengers could feel steering wheel resistance and seat vibrations, both of which are triggered when the guidance system detects the bus deviating to the right or left. Also as part of the bus exhibit, the IV Lab team had a TV showing video from various cameras on the bus.

The BRT demos were covered by Houston Public Radio (HPR) Station KOHF 88.7 reporter Melissa Galvez as part of a story about the ITS expo. Galvez rode in the MVTA bus and spoke with Mike Abeeg about its technology. Her coverage of the demo is available on the HPR Web site (http://app1.kuhf.org/houston_public_radio-news-display.php?articles_id=127304379).

Awards honor outstanding graduate students

Three graduate students conducting ITS-related research received awards at the Center for Transportation Studies’ annual meeting and awards luncheon April 7 in Minneapolis. Xinkai Wu, a doctoral candidate in civil engineering, was a recipient of the Matthew J. Huber award, named in honor of the late Professor Emeritus Matthew J. Huber and given to students in engineering, science, and technology fields. Wu’s research contributed to the development of a patent-pending arterial performance measurement system. His advisor is assistant professor Henry Liu.

Shanjiang Zhu, a doctoral candidate in civil engineering and a master’s of science candidate in applied economics, received the John S. Adams Award, given to students in policy and planning fields. Zhu’s research examined the route choice behavior of individual travelers before and after the reopening of the I-35W bridge. His advisor is associate professor David Levinson.

The U.S. Department of Transportation’s Research and Innovative Technology Administration presents an outstanding student of the year award to each of its University Transportation Centers (UTCs). The recipient of the 2009 award at the ITS Institute is Fay Cleaveland, a recent graduate with a master’s degree in urban and regional planning. Max Donath, the director of the Institute, presented the award. Cleaveland’s work included research on e-shopping and its effect on traffic conditions, bicycle facilities, and public policy. Her advisor was Humphrey Institute research fellow Frank Douma.

Kids try traffic engineering at local events

Budding transportation engineers squared off against angry drivers at The Works technology museum in Edina February 27. It was fun with a serious purpose for the pre-teen attendees, who learned about fundamental traffic control issues by playing the online “Gridlock Buster” game developed by the ITS Institute.

The event was Tech Fest 2010, a day featuring a variety of interactive transportation exhibits, and with Gridlock Buster and a working traffic camera on display, the ITS Institute’s booth was a popular attraction. All seven video game stations were consistently packed, and booth volunteers had their hands full answering questions from curious attendees.

Gridlock Buster puts players in control of the traffic signals in a busy city. As rush-hour drivers swarm the street network, the goal is to keep traffic flowing smoothly by regulating the signal changes. The game is designed to introduce basic concepts of traffic management and to give players a taste of what traffic engineers do in their daily work.

Also on display was an ITS Institute-developed traffic camera, the Beholder, which allows researchers at the Institute’s Minnesota Traffic Observatory to gather accurate traffic data for use in many kinds of research applications. Tech Fest visitors could see themselves captured in the camera and displayed on a nearby laptop.

On February 10, sixth and seventh grade students participating in the Trent Tucker Program visited the University of Minnesota to get the inside scoop on the field of civil engineering. Students attended a presentation and question-and-answer session about the role and responsibilities of civil engineers with Jessa Dauer, senior engineer at SRF Consulting, Inc. Afterward, they had the opportunity to get their feet wet in the field by playing Gridlock Buster. Coordinated by U of M alum and former professional basketball star Trent Tucker, the program works to empower youth by developing the skills needed to make positive choices.
Rural intersection system begins field test

A car traveling along a rural road stops at an intersection with a divided highway. The driver waits for a gap in traffic on the highway, then moves forward onto the intersection to merge with highway traffic. But the driver has made a dangerous miscalculation, and the car is struck by an oncoming vehicle that closed the gap too quickly.

This scenario plays out every day on rural roads throughout the United States, often with fatal results. Recent research has shown that gap acceptance problems, rather than issues such as stop sign violations, are the key factor in many of these problems, rather than issues such as stop sign violations, are the key factor contributing to crashes at unsignalized rural through-stop intersections.

But a groundbreaking system now being evaluated at an intersection in Goodhue County, Minn., could reduce the number of such crashes by giving drivers reliable, accurate information about approaching traffic. The system, developed by researchers from the ITS Institute’s IV Lab and HumanFIRST Program in cooperation with the Minnesota Department of Transportation, uses multiple sensors and advanced computer algorithms to track vehicles moving along a rural divided highway. This information is used to warn drivers stopped on a secondary rural road when gaps in highway traffic are too small to merge or cross safely.

The Cooperative Intersection Collision Avoidance System (CICAS)-Stop Sign Assist (SSA) system uses an active LED icon-based sign that switches to an alert or warning as needed depending on the gaps to the left or right.

The field test, scheduled to last three years, will follow two tracks. The first track will focus on how individual drivers respond to the sign by using instrumentation installed in the vehicles of 30 drivers who regularly pass through this intersection. This will allow the research team to do a microscopic analysis of the data. The second track will consist of continuous data collection for all traffic passing through the intersection, which will facilitate a macroscopic analysis. Collected data will be analyzed throughout the test to determine whether measures of system performance, such as gap rejection behavior, are a valid measure of safety benefits.

As part of the test, the research team will determine how driver gap decision making and subsequent behaviors may change over time as a result of learning, familiarity, or satisfaction with the CICAS-SSA system. The test will facilitate the analysis of driver responses in relation to the system’s sign modes and also enable researchers to determine whether the CICAS-SSA system improves the gap acceptance of drivers. If drivers learn better behavior, crash rates should drop for all intersections, not merely those at which the CICAS-SSA system is deployed.

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Researchers speak at ITS Minnesota event

Rajesh Rajamani
Assistant Professor Xin Yu, Department of Electrical and Computer Engineering, Duluth, outlined the development of an in-vehicle sensor system designed to detect driver drowsiness. Yu’s approach is based on polymer-film sensors mounted on the steering wheel, which detect a driver’s heart rate through his or her palms and tracks changes in heart rate that can indicate a transition from waking to sleeping.

Frank Douma, assistant director of the State and Local Policy Program at the Humphrey Institute, presented recent findings from his investigation of the legal and policy implications of new ITS technology deployments. Linda Preisen, incoming ITS Minnesota chapter president and CTS director of research administration, gave closing remarks.

Overall, the research team concludes that this system could successfully function as a temporary data-collection tool, offering transportation practitioners, planners, and researchers a functional and affordable alternative to in situ manual measurements and other data-collection devices. The visual record collected by the device—something not available from other traffic data-collection methods—proved to be a valuable tool. The video can be used for additional analysis and research, leading to improved safety and control practices at all types of intersections. For example, Morris notes the device’s usefulness for capturing irregular and infrequent traffic events outside the regular scope of traffic data collection, including pedestrian/vehicle conflicts, crashes and near misses, and gap selection by turning vehicles.

Another possible use for this system, Morris says, is for monitoring traffic conditions in real-time. In 2009, the research team adapted and tested the prototype for detecting rapidly stopped vehicles resulting from vehicles traveling upstream entering work zones, and preliminary results showed it is feasible, Morris says. “The system could also be used in the general transportation security and surveillance field, providing mobile surveillance at trouble spots or special events to first responders and law enforcement, Morris says.
University of Minnesota researchers have begun work on a “Safe Teen Car” project targeting the primary risk factors for crashes and fatalities among teen drivers. The research is part of a project sponsored by the National Highway Traffic Safety Administration and led by Washington, D.C.-based Westat, Inc. As part of the project, ITS Institute researchers from the HumanFIRST program and the Intelligent Vehicles Lab will examine factors such as not wearing seat belts, distractions caused by cellular phones and teenage passengers, and speeding in order to develop systems designed to alter teen driving behavior and improve safety.

According to HumanFIRST program director Mike Manser, the project’s goal is to design devices that auto manufacturers can install in vehicles during the manufacturing process. This means devices must be both successful in increasing teen safety and realistic for manufacturers, parents, and teens to use. Interlocks preventing a vehicle from starting, for example, may be more effective in reducing risky behavior than visual alerts, but the technology required to make them function is more complex and they are often viewed less favorably by both teens and parents.

Since beginning work in September 2009, the team has focused its efforts on three critical aspects of teen crash risk: compliance, performance, and distraction. Within these categories, the researchers have identified seven specific factors, including seat belts, speeding, and cell phone use, that will be addressed by devices installed in Safe Teen prototype vehicles.

Several options to address risky behavior were identified for each component, including in-vehicle interfaces and interlocks. When choosing which to use in Safe Teen vehicles, the researchers had to balance the devices’ effectiveness in altering teen driving habits with the need to make them practical.

Once the designated devices are installed in Safe Teen prototype vehicles, the next step will be two separate studies. The first, Manser says, will examine how teens react, adapt, and use the Safe Teen vehicle’s components in the short term. This study is expected to be under way by August. A second, longer-term study is scheduled for next winter. This study, Manser says, is going to be especially important to the project because of interest at the federal level in seeing how the technology works in the long term: “Does teen behavior improve at first or does it continue to improve over time?”

Manser credits ITS Institute director Max Donath and his team’s work with the earlier Teen Driver Support System (TDSS) project for paving the way for the Safe Teen research team. "A lot of the work in developing TDSS contributed to our being able to get the Safe Teen project,” Manser says. TDSS, which also addresses teen driver crash factors, was designed as an aftermarket system, to be installed in vehicles after they were manufactured. “Their efforts really laid the groundwork to allow us to compete for this (Safe Teen project) on a federal scale,” says Manser.

(More information on this project can be found at www.its.umn.edu/Research/ProjectDetail.html?id=2010077.)

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