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INSIDE

Safe Teen Car technology targets risky driving behavior

The Safe Teen Car provides drivers with audio feedback supported by an icon display.

Motor vehicle crashes are the leading cause of death for U.S. teens. According to the National Highway Traffic Safety Administration (NHTSA), about 3,000 teens, age 15–19, were killed in motor vehicle crashes in the U.S. in 2009. Per mile driven, teen drivers are four times more likely than older drivers to crash. In addition to having less experience, teens are more likely to engage in risky driving behaviors—speeding, cell phone use, excessive maneuvers—than older drivers. And they're less likely to wear their seat belts, which increases the odds of injury or death if they do crash.

In a NHTSA-sponsored project, the University of Minnesota and Maryland-based research organization Westat have developed a vehicle-based technology solution to reduce teen driver crashes. The team, which includes Institute researchers Mike Manser, Chris Edwards, Janet Creaser, Alec Gorjestani, Arvind Menon, and Craig Shankwitz, has recently completed testing of its prototype driver support system—called the Safe Teen Car (STC)—that provides feedback to drivers when risky behaviors are detected.

Before vs. after-market

Because the STC project is focused on what can be integrated into future vehicles during manufacturing, the system is considered an original equipment manufacture (OEM) system. A number of OEM systems have been designed to mitigate the risk factors of teen driving. One example is Ford Motor Company's MyKey system—standard equipment on nearly all Ford and Lincoln models since 2010. MyKey allows owners to program a key to limit the vehicle's top speed and audio volume and give audio seat belt and speed reminders.

Alternately, a growing number of after-market devices—those used in vehicles after manufacturing—address the teen driver problem as well. American Family Insurance's Teen Safe Driver Program, for instance, uses in-vehicle cameras to record hazardous driving events, transmit data to driving coaches, and send parents and their teens weekly reports. Another example, the ITS Institute-developed Teen Driver Support System (TDSS), uses a smartphone to give teens real-time visual and audio feedback about their driving performance and report unsafe behavior to parents. [Manser credits earlier work on the TDSS project with paving the way for the STC research team.]

However, many existing systems are limited by what they can do, adopting a "one-size-fits-all approach," according to Edwards. For example, systems that set a maximum speed limit don't take into account that speed limits vary with the environment, and a safe speed for a straight stretch of highway would be dangerous on a residential street or winding road. Also, systems that record behavior for later review don't give the driver feedback as he or she is driving.

"The breadth of what the STC [considers]

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The researchers developed a prototype driver support system that provides feedback to drivers when risky behaviors are detected.

System detects dangerous conditions on winter roads

To improve safety on potentially hazardous winter roadways, researchers from the University of Minnesota Duluth have developed a system to detect snow and ice on road and bridge surfaces.

At a spring ITS Institute Advanced Transportation Technologies seminar, chemistry and biochemistry professor John Evans outlined the development of the system, which was designed to be inexpensive, versatile, and easily deployable in almost any location. Ultimately, Evans said, the real-time information collected by the system could be used to warn motorists about unsafe conditions or trigger deicing operations by maintenance crews.

Evans's system consists of an array of passive, puck-shaped sensors installed directly in the road or bridge surface. All sensors in a given area, such as on a single bridge deck, are connected to a common local data acquisition system that wirelessly transmits data back to a central processing system. The sensors and acquisition system can be powered by solar panels, making the system ideal for deployment in remote locations.

The detection system uses time domain reflectometry to acquire dielectric relaxation spectroscopy data, a technology that has traditionally been used to determine moisture content in soil, optimize water delivery to agricultural fields, and identify faults in high-speed electronic circuits. Each individual sensor sends out an electric pulse and collects data on how the material surrounding the sensor reflects that pulse. Evans explained that a material's response to the electric field changes depending on its temper-

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Former students thrive in transportation careers

It's not unusual for many University of Minnesota students who have graduated with transportation-related degrees to move into successful careers in industry, urban planning, education, and government. This article explores the lives of a few graduates and highlights their progress as they moved from students to professionals who now work in transportation fields around the country.

Avital Barnea

Lei Zhang

Mat Bevilacqua

Avital Barnea's favorite toys as a child were railroad track pieces that could be assembled into a miniature transportation system. She later became enthralled with transportation systems in major cities and now holds a bachelor's degree in geography and a master's degree in urban and regional planning from the University's Humphrey School of Public Affairs. In August 2011 she joined the U.S. Department of Transportation in Washington, D.C., as a community planner in the Federal Transit Administration's Office of Planning and Environment. In that role, she works with transit authorities and other public agencies across the country.

The combination of her degrees created a strong foundation on which Barnea built her career in the transportation field. Researching case studies of transportation and urban planning systems and studies in technical coursework helped to prepare her for her profession, as did access to the vast resources of a large university while studying in a small learning environment within the Humphrey School. While in graduate school, Barnea interned at Metro Transit's Transit Control Center, which exposed her to the operational aspects of transit and added greatly to her academic planning background.

Barnea encourages current students to get involved outside the classroom by joining professional organizations and attending seminars and conferences to expand networks, all while gaining professional experience. "I believe transportation affects and is affected by almost every facet of our daily lives," she said. "I am dedicated to this issue because all people have the need, the desire, and the right to travel in a manner that promotes health, social well-being, ease of use, and environmental sustainability."

Lei Zhang has been fascinated by the connection between transportation and the social sciences ever since he was young. In 2006 he graduated with a Ph.D. in transportation engineering and a minor in industrial engineering and operations research from the University of Minnesota.

"The congestion in the transportation systems in both China and the U.S. fascinated me, and I wanted to do something about it," he says. Zhang explained that transportation is more than engineering; it's also about how humans can move efficiently within the transportation system, which in turn influences congestion.

Zhang completed his undergraduate degree at Tsinghua University in China in 2000 before acquiring master's degrees from the U of M in civil engineering and applied economics.

During graduate school Zhang interned with the Minnesota Department of Transportation as an engineer at a traffic management center. After graduating, he worked for two years as an assistant professor in civil and construction engineering at Oregon State University; he is currently in his fourth year as an assistant professor in the Department of Civil and Environmental Engineering at the University of Maryland in College Park.

Zhang says that the projects he completed as a graduate research assistant were incredibly valuable to him. "Research is the bridge between human public policy, human behavior, policy relevance, and the social side of transportation," he says. "Being able to link the coursework to my research projects made the research experience real to me...The experience I got from the University of Minnesota directly correlates to what I do now."

Zhang tells graduate students that they should aim to find a balance between academics and accomplishments and to take advantage of the resources the university offers.

"Be exposed to all types of courses [and] subjects, and find out what you're interested in doing so that you can use the resources you have to find a job that you love," he says.

Mathew Bevilacqua graduated from the University of Minnesota with a master's degree in mechanical engineering in 2006.

"I always have liked cars," Bevilacqua says, which is how he knew he wanted to do something related to transportation.

Bevilacqua completed his undergraduate degree in computer engineering at the University of Waterloo in 2003. During his senior year of college, he decided he wanted to go to graduate school.

"I wasn't fond of computers anymore and I wanted to do something more mechanical in nature—computer engineering applied to mechanical engineering and to cars," he explains.

Bevilacqua worked as a research assistant with the Institute's HumanFIRST Program throughout his time in graduate school, from September 2003 to March 2006.

After graduating, he first worked for financial software company Bloomberg in New York City. He later moved to

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ature and state—so ice, water, and air all react differently. The processing system can determine whether the roadway surface contains ice, water, deicing chemicals, or nothing at all by comparing the collected data to baseline measurements for a variety of materials.

"We ultimately use this very complex information to determine a simple response: Is the roadway safe or unsafe?" Evans said. When the system detects ice or other dangerous conditions, it could trigger electronic signs that alert drivers. It could also send information to maintenance crews or plow operators pinpointing where deicing is needed.

Evans's research was sponsored by the ITS Institute.

Annual career expo attracts variety of students, exhibitors

More than 100 students seeking transportation-related career opportunities converged on the east bank campus of the University of Minnesota in Minneapolis on February 28 for the 2012 Transportation Career Expo. The event featured a panel discussion with transportation industry experts providing career-planning advice. The ITS Institute was among the annual expo's sponsors.

Exhibitors met with students at the annual career expo.

Safe Teen Car *continued from page 1*

is something that sets it apart from other systems," adds Manser.

Like having a parent ride along

The STC system implements a combination of several existing safety concepts and utilizes the advanced computer intelligence of today's vehicles to provide beginning drivers with information tailored to their needs and behaviors.

"The STC project was an attempt to determine how the manufacturer could build [a system] given the chance," Manser says. The project, which wrapped up in late 2011, resulted in recommendations and final specifications for a safe teen vehicle.

The STC system, which is active only when the vehicle determines the driver is a teen, monitors speed, excessive maneuvers (such as hard acceleration or sharp turns), cell phone use, seat belt use, and passenger presence, then provides real-time feedback to the driver when it detects a crash risk factor.

When the driver exceeds the speed limit or a vehicle maneuver exceeds a certain threshold, the STC system issues warnings in the form of auditory tones, visual icons, and spoken notifications. The focus of these systems is on feedback and adaptation, not reporting.

Among the many options for these systems, Manser says the researchers considered how the information could best be presented to teens and how it functions. Because of the extensive human factors testing the team conducted, "We know this is a good structure," he says.

Test drives

In spring of 2011, the research team carried out a four-week preliminary functional road test with teen drivers and parents to evaluate the individual driver feedback subsystems that make up the STC system. Those subsystems address the most common risk factors associated with teen crashes and are grouped by the type of behavior the STC is trying to affect—primarily cell phone use, excessive maneuvering, and speeding.

At the end of the study, the majority of teens said the system improved their safety, and most parents said they would recommend the system to other parents and teens. One significant finding involved the speed management subsystem, which showed a reduction in the levels of speeding.

The researchers used their observations to refine systems and methods prior to the start of a 10-week full system evaluation that began in July 2011. This study combined subsystems for a longer time period and explored if and how the STC influenced drivers to choose safe behaviors even after the system was switched off. The researchers also hoped to learn how acceptable the system was to teen drivers and their parents.

Research fellow Arvind Menon installs components of the Safe Teen Car prototype.

Thirty teens from Minnesota and Maryland participated in the field evaluation. Vehicle and driver data obtained directly from the STC included vehicle position, distance driven, posted speed limit, vehicle speed, occupancy, seat belt activation, time of day, and number of system warnings. Usability data were collected from discussions with parents and teens at the end of the study.

The final report, which will be published in late 2012, also documents the methods, findings, and recommendations of the entire project for NHTSA and other stakeholders.

For more information on teen driver research at the ITS Institute, see www.its.umn.edu/Research/FeaturedStudies/teendriver.html.

Former students *continued from page 2*

California to work for Qualcomm, researching next-generation positioning technology and integrating sensors into modern GPS.

Since February 2012, Bevilacqua has been employed by California-based Intel as a software engineer, working on integrating GPS into solution smartphones.

"Graduate school at the University [of Minnesota] taught me to be an independent worker…You aren't guided like in your undergraduate studies," he says.

Bevilacqua advises mechanical engineering graduates to avoid limiting themselves to typical mechanical engineering careers, since they have a broad education that is also well suited to positions in electrical engineering, computer science, and even finance. "Most companies these days, especially in Silicon Valley, are looking for bright, ambitious problem solvers, rather than someone with specific subject matter experience," he says. "Explore different career opportunities while you're young, so you can better understand where your interests lie."

ITS Institute and Intelligent Vehicles Lab technology a 'Modern Marvel'

Driver-assist technology developed at the University of Minnesota is helping snowplow drivers keep Thompson Pass open during Alaska's long, severe winters—and The History Channel recently profiled this technology as part of a show, "Modern Marvels," about Alaska.

The Alaska Department of Transportation and Public Facilities has outfitted some of its snow removal vehicles with the driver-assist system developed at the ITS Institute's Intelligent Vehicles Laboratory. The system is composed of differential GPS, collision avoidance technology, and a driver interface that enables drivers to plow snow in zero-visibility conditions.

The "Modern Marvels" episode can be viewed at www.history.com. The technology was also featured in the March 15 issue of *Government Technology*, available at www.govtech.com.

Snowplow on Alaska's Thompson Pass

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Students, staff attend TRB

Faculty, students, and researchers from the University of Minnesota presented current and recently completed ITS-related research at the Transportation Research Board 91st Annual Meeting, held in Washington, D.C., in January.

Brian Davis

Each year, the ITS Institute awards travel grants to graduate and undergraduate students. The Institute also selects one graduate student for the Outstanding Student of the Year Award, which is sponsored by the U.S. Department of Transportation's Research and Innovative Technology Administration (RITA). At a ceremony held in conjunction with the TRB meeting, USDOT officials presented a certificate to this year's recipient: Brian Davis. Davis is a master's degree candidate in mechanical engineering (ME), advised by Institute director Max Donath. His thesis research—Aggregating VMT Within Predefined Geographic Zones Using a Cellular Network—is part of an ITS Institute-sponsored project investigating a system to charge drivers by miles rather than fuel use. Davis also served as a teaching assistant for an ME robotics class for three years.

Other students attending the TRB meeting were Carlos Carrion, Indrajit Chatterjee, Qian Chen, Xuan Di, Kyle Hoegh, Heng Hu, Umair Ibrahim, Saif Jabbari, Panagiotis Stanitsas, Jie Sun, Hui Xiong, and Jianfeng Zheng.

Faculty and researchers presenting ITS-related research this year included:

- Department of Civil Engineering: Gary Davis, John Hourdos, Chen-Fu Liao, Henry Liu
- Department of Civil Engineering, U of M Duluth (UMD): Eil Kwon
- Department of Electrical and Computer Engineering, UMD: M. Imran Hayee
- Department of Mechanical Engineering (HumanFIRST Program): Janet Creaser, Christopher Edwards
- Hubert H. Humphrey School of Public Affairs: Xinyu (Jason) Cao, Frank Douma, Yingling Fan, Greg Lindsey, Lee Munnich

A complete list of University of Minnesota presenters is available at www.cts.umn.edu/News.

Distraction Dodger premieres at Teen Safe Driving Summit

Distraction Dodger, an online game developed by the ITS Institute, premiered at the 4th Annual Teen Safe Driving Summit on February 2 at the Rosemount (Minn.) Community Center. Institute director Max Donath and program coordinator Shawn Haag demonstrated the game to the 160 teenagers, school advisers, law enforcement officers, and others who attended the daylong event. The game, designed to help teens and young adults understand the importance of concentrating on driving, has already received attention with an award at the 2011 International Serious Play Conference and media coverage by local television news, Minnesota Public Radio, and the Minneapolis *Star Tribune*, among other outlets.

Institute director Max Donath spoke at the Teen Safe Driving Summit.

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Benefit and Cost Analysis of the I-394 MnPASS Program
February 2012, Report no. CTS 12-03

Vehicle Speed Impacts of Occasional Hazard (Playground) Warning Signs
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