Volvo Construction Equipment Goes Back to School to Save Construction Workers’ Lives

Graduate students at the Integrated Innovation Institute proposed a new solution to boost safety, curb road construction fatalities

PITTSBURGH, August 17, 2015 – Keeping the nation’s highways in top condition is integral to the country’s infrastructure, but construction sites can be perilous for heavy-equipment operators, surrounding workers – and other passing vehicles. In the last decade, fatal workplace injuries at road construction sites have remained relatively constant, with nearly 1,000 workers dying from workplace-related injuries in 2013 alone, according to the Bureau of Labor Statistics. Volvo Construction Equipment (Volvo CE), recognized industry-wide as a leader in safety, partnered with the Integrated Innovation Institute at Carnegie Mellon University to identify ways to use existing technology to bring those numbers down.

The result is a proposal dubbed SiteAware, a system that leverages state-of-the-art LIDAR, RFID technology and cameras to help operators manage their complex, dynamic surroundings by providing full situational awareness via 360-degree vision. Employing the Institute’s hallmark integrated innovation methodology, Team Street Smart, Institute graduate students with backgrounds in engineering, design and business, designed an intuitive, easy-to-use interface that monitors and tackles obstacles, including traffic and pedestrians, even in environments crowded with workers and other machinery.

“More machines are moving toward computational interfaces, providing operators with significantly more information about their environment and the performance of their machine,” said Jonathan Cagan, the Ladd Professor of Mechanical Engineering and director of Innovation and Entrepreneurship in the College of Engineering. “SiteAware utilizes the available technology to bring together all these factors under one system, creating a safer, viable work environment for all.”

Volvo CE expects to integrate ideas and concepts from the proposal into Volvo’s advanced engineering projects.

Despite technological advancements in the automotive industry, specifically partial or fully autonomous driving, there has been minimal adoption of active safety technology in the construction industry; being struck by a vehicle or mobile equipment is the largest single event for fatal occupational injuries.¹

During the research phase of the project, Team Street Smart spoke with personnel on the ground – from contractors to site managers to machine operators – to get a holistic picture of roadside construction and identify key factors that could reduce injuries and fatalities on the job, including:

• eliminating blind spots

¹ Bureau of Labor Statistics
• providing real-time data positioning
• alerting operators and ground workers
• working without assistance and requires a short learning curve
• utilizing real-time visualization to reduce false alarms

A Relay of Systems Working Together to Provide Optimal Safety Coverage
The proposed solution uses a combination of existing technology to provide greater awareness of the surrounding environment to increase safety without reducing efficiency. Sensor stacks gather data from connective technology to give machine operators an accurate, real-time representation of their current work environment:

- LIDAR, which provides a 360-degree field of view horizontally, 40-degree vertically;
- The RGB camera system, which has a 130-degree field of view; and
- RFID tags for on-the-ground personnel, which communicate with antenna on the machine.

The system uses data fusion – the process of integrating and aggregating data from multiple sensors– to create the most accurate picture of all personnel and equipment in the immediate vicinity, allowing operators to avoid collisions and other incidents.

Two sensor stacks are employed per system, each with three cameras and one LIDAR unit; on-the-ground personnel are equipped with personalized RFID tags. The data collected is then transferred to a screen on the operator’s dashboard, showing the locations of other workers and machines. If a worker is too close, the system issues a combination of visual and auditory warnings to the operator. The screen in the cab displays a visual cue while an audio warning identifies by name any worker who is too close. The team included name recognition as it has been proven to “cut through the noise” and is more likely to attract the operator’s attention. Finally, perimeter lights around the machine act as a “visual fence,” reminding other workers and pedestrians to keep a safe distance.

“The outcome of this project is proof of the power and value of collaborating with an academic institution that puts a premium on integrated innovation,” said Dr. Fares Beainy, Research Engineer in Emerging Technology for Volvo Construction Equipment. “We gave the students a simple mandate, without any restrictions or limitations: to design the future road construction operator’s workplace, with an emphasis on safety. The students developed new ideas and, in the process, brought forth improvements that will make an impact in the field. Ultimately, that means saving lives.”

Volvo Construction Equipment will publish the results of the students’ research instead of pursuing proprietary rights. “We view this as a way to challenge our entire industry to reconsider how it thinks about safety,” said Dr. Beainy.
Building on a History of Collaborative Innovation
Building on decades of cross-discipline collaboration, which earned the university a reputation for innovation, Carnegie Mellon formally launched the Integrated Innovation Institute in 2014 as a market-focused center designed to speed the pace of innovation by producing master’s degree graduates cross-trained in engineering, design and business – the three disciplines considered to be the core of innovation.

The curriculum is designed to train and unleash a new breed of innovators able to “fix” deep-seated barriers to innovation. Companies sponsor graduate student teams to create solutions or products that will help them maintain industry leadership, provide a competitive edge, position them as industry leaders – and to give good ideas the time to percolate outside of a business-structured environment.

“The absence of truly integrated, collaborative teams that bring diverse perspectives can hinder the process of new product development, which is why our partner companies reap real market-impact benefits from working with our students,” said Cagan.

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About The Integrated Innovation Institute at Carnegie Mellon University
The Integrated Innovation Institute is a joint initiative of the College of Engineering, the College of Fine Arts and the Tepper School of Business. The Institute is built on primary disciplines in product and service innovation covering functional performance (engineering), human interface (design), and economic value (business). The Institute focuses on education and research in innovation methods and practice and is unique among top educational institutions in that it unites the three disciplines to cross train students to become elite innovators, enhancing the effectiveness of thinking and generating results. The Institute confers professional master degree programs, conducts proprietary applied research, and extends its training through executive education, customized company programs and open-enrollment consortia.