A vision for smarter, safer autonomous vehicles

Self-driving vehicles are the future. Spartan researchers are working to secure the road ahead.

Autonomous, or self-driving, vehicles have captured the imagination of the public, but many drivers are apprehensive about the prospect of letting go of the wheel.

In fact, according to a recent poll from Advocates for Highway and Auto Safety, nearly two-thirds of the public are concerned about sharing the road with driverless cars, citing safety as a major worry.

However, advocates for self-driving vehicles note the cars actually have the potential to reduce accidents and injuries. At Michigan State University, researchers are making autonomous driving smarter and safer by perfecting computer vision and "superhuman" sensing.

Navigating a new environment

MSU's CANVAS—Connected and Autonomous Networked Vehicles for Active Safety—is at the forefront of technology that promises solutions and benefits to real-life driving problems, including preventing accidents and improving traffic flow.

"CANVAS is the centerpiece of an overarching multi-disciplinary mobility effort at MSU that also includes smart infrastructure and mobility management," said John Verboncoeur, associate dean for research in the College of Engineering. "The goal is to improve mobility safety and efficiency."
For autonomous vehicles to become a reality on the roads requires technology that best detects and communicates impending challenges such as ice, snow or a pedestrian crossing into a vehicle's path.

CANVAS director Hayder Radha is helping MSU lead in this space, with an eye toward a more connected future in which vehicles communicate in real time with other vehicles, their physical environment and their passengers.

"Much of our work focuses on technology that integrates the vehicle with its environment," said Radha, professor of electrical and computer engineering. "In particular, MSU is a recognized leader in computer vision, radars and antenna design, high-assurance computing and related technologies, all areas that are at the core of self-driving vehicles."

The Spartan autonomous research vehicle, currently on public display at the North American International Auto Show in Detroit, is an important part of MSU's work. The hybrid car is equipped with cameras, radar and lidar—the laser version of radar—to create "high-tech eyes," integrated sensors that see more than human eyes.

Sensing obstacles

CANVAS researchers are focusing on a complex set of research problems by looking beyond the anticipated capabilities of early or 'entry level' autonomous vehicles that were not equipped to deal with challenges such as freezing temperatures.

"Having snow on the ground is certainly a challenge; however, when you have near-blizzard conditions with extremely low temperatures, then virtually all of the state-of-the-art sensors and perception algorithms cease to operate adequately," explained Radha. "We are trying to address these rather unique challenges while keeping close communication and collaboration with our automotive industry partners."

MSU's strong track record of industry partnerships and funding for auto research helps position it for success, and its proximity to Detroit, the nation's car capital, as well as Michigan's diverse climate conditions, make it an ideal automotive research environment.

Daniel Kent, a graduate student in the College of Engineering, was drawn to MSU because of CANVAS. His work focuses on sensor fusion, correlating sensors for a more effective collective impact.
"You can't get all of the information from a camera in all conditions," said Kent. "Radar works in more inclement conditions, like rain, fog or snow. Lidar, with the right maps, can be accurate to the centimeter. New developments from sensors are coming all the time."

For example, lidar technology has the ability to develop a 3-D map of the area in which a car is driving for improved maneuverability, as well as to develop advanced algorithms that will assist in navigating a particular environment, such as Michigan's winter road conditions. Radar, on the other hand, quickly can detect a variety of objects that are moving or are stationary in the vicinity of the car or at longer distances under various weather conditions, including fog and snow, by using high-frequency signals.

**Staying connected**

The specificity of what lidar technology is able to identify is especially significant as MSU continues to move forward in its current stage of research—connectivity and communication.

The ability to communicate with other vehicles and the surrounding infrastructure can enable a car to detect other vehicles approaching an intersection and to recognize whether the other vehicle is going to stop in time.

In addition to improving safety, connected vehicles may have an impact on the environment. Verboncoeur explained that such a vehicle can be used to synchronize traffic lights, so traffic can move more efficiently and reduce backups.

"If the sensors in the car and in traffic lights are communicating, much information can be gathered- information that can save lives and fuel and reduce greenhouse gas emissions," he said.

Biometrics and recognition technology research at MSU also will be an invaluable part of a safe autonomous vehicle. Specifically, Verboncoeur noted, the technology will monitor not only the identity but also the health and well-being of a vehicle's occupants.

"In the event of a problem, a human has to be ready to take over," Verboncoeur said. If a vehicle occupant is unable to drive, the technology can detect that and pull the car to the side of the road safely.

**Building trust in new technology**

While the work of Spartan researchers is helping to ensure a future in which safety takes top priority, even the most sophisticated technology may not win public trust. That's why a team of researchers in Michigan State's [College of Communication Arts and Sciences](http://www.ccas.msu.edu) has joined forces to study human interaction with autonomous vehicles, with a special focus on trust and comfort.
Robby Ratan and Taiwoo Park, both researchers in the college's Department of Media and Information, and communication Ph.D. candidate Sanguk Lee, have developed a virtual reality simulation of the self-driving car experience using Oculus Rift technology, which also is on display at the North American International Auto Show in Detroit.

Complete with a city landscape, pedestrians and traffic lights, and featuring the kinds of unexpected experiences that occur in everyday traffic, the experience gives participants the sense of being passengers in self-driving cars.

The team will study the simulation experience of participants to better understand what would make people most comfortable during the autonomous driving experience.

Read more about MSU's display at the auto show in John Verboncoeur's Faculty Voice column.

Related Website: Story courtesy of MSUToday.
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