Putting pedestrian safety in the driving seat

Every year in the European Union there are over 9,000 deaths and 200,000 injured victims in road accidents in which pedestrians and cyclists collide with a car. Hoping to improve on these grim statistics, is a cutting-edge sensing system that could ultimately help to save the lives of vulnerable road users (VRUs).

"The concept is relatively straightforward," explains Dr Marc-Michael Meinecke of Volkswagen, which is one of the chief partners in the IST-sponsored SAVE-U project along with other key industry players such as CEA, DaimlerChrysler, Faurecia, Mira, Siemens and VDO Automotive. "SAVE-U combines sensors such as radar, vision and infrared camera, as well as sensor fusion and actuators to increase safety for pedestrians. The main idea is that the sensors will recognise pedestrians and if a pedestrian has a high probability to collide with the vehicle then automatic braking will be initiated by the system," he says.

The project, which officially ended in August, set out to develop an innovative pre-impact sensing platform that operates three different technologies of sensors simultaneously, and then fuses their data to protect cyclists and pedestrians under different weather and light conditions. The system comprises a radar network composed of several 24 GHz sensors working in parallel and an imaging system composed of passive infrared and colour video cameras.

Prototype successfully tested

A prototype vehicle incorporating the new system has already been successfully tested in the United Kingdom. Installed on the car are two cameras – one video and one infrared – as well as the radar device. The system calculates in a matter of seconds the movement of pedestrians within the 'capture zone', which can be anything up to 30 metres away from the vehicle. From that point on, the car's onboard cameras tracks the pedestrians' movements and this information is correlated with data received from the radar network (such as distance to objects and their speed). SAVE-U can thus identify any pedestrian or cyclist coming within the trajectory of the vehicle and after analysing the situation, warn the driver or apply automatic braking if there is a risk of collision.

At the outset, the project partners opted to tackle the problem of protecting cyclists and pedestrians in three distinct stages: firstly, detection of VRUs at sufficient distance covering a relevant set of scenarios; second, definition and implementation of driver warning and vehicle control strategies to avoid, or at least minimise, the impact of a crash; and finally, defining vehicle-mounted VRU protection strategies in case the crash cannot be avoided.

"During the first phase of the project, accident statistics from Volkswagen Accident Research in cooperation with the Medical University of Hanover were analysed," says Dr Meinecke. "One of the main outcomes of the analysis was the conclusion that active hood concepts, external airbags, automatic braking systems, night vision, and other actuators seem to be very sufficient measure to lower the injury level of pedestrians. Within the SAVE-U demonstrator vehicles mainly automatic braking measures are implemented."

Bearing in mind that pedestrian accidents represent the second largest source of traffic-related injuries and fatalities in the European Union, the researchers were optimistic that their collaborative efforts would yield tangible rewards for improved road safety for VRUs.

The benefits of collaboration

In terms of the various obstacles that the project needed to overcome to reach its objectives, Dr Meinecke says that there were a number of key areas that benefited from a collaborative approach.

"Teamwork helped a lot in areas such as sensor development – including sensor hardware and signal processing/image processing – for cameras and radars to be able to detect and classify pedestrians. It was also important for the development of sensor fusion algorithms to combine the measured information coming from the individual sensors in order to get a consistent and precise description of the objects in front of the vehicle," he says.

Major advances were also made in areas such as object tracking to obtain a robust trajectory, and the development of a deployment algorithm to be able to activate the automatic brakes without false alarms. Aspects of cost reduction and the reduction of sensor size also benefited from the close teamwork, says Dr Meinecke.

In August, the project culminated with a special workshop in the United Kingdom showcasing the technology developed over the course of the previous three years. The workshop featured samples of radar sensors and passive infrared video camera integral to the system, as well as demonstrations of the technology in action using two test vehicles (Mercedes E Class and Volkswagen Passat) equipped with the sensing platform, driver warning and vehicle control systems.

While there is clearly a strong demand for such technology to be implemented in vehicles as soon as possible, there is still a long road ahead before the SAVE-U innovations become standard features in the average automobile.

“For a start, the sensors have to be shrunk further in size and price to enable them to be integrated in serial cars. The sensor costs will also have to be decreased dramatically to have a chance to make the systems cost effective. And, last but not least, the software components are still not fulfilling the requirements for serial production. I think in the area of pedestrian protection these pedestrian recognition systems will be the main focus of research activities in coming years,” he says.

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