Research on the road to intelligent cars

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Although safety is improving on European roads, every year over 40,000 people die on Europe's roads and 1.4 million accidents occur. Clearly, there is still plenty of work to be done if the EU is to halve road fatalities to under 25 000 by 2010, a target fixed in September 2001.

Although intelligent ICT-based systems already exist, their market take-up has been very slow. Reasons for this include legal and institutional barriers, competition among car-makers, the relatively high cost of intelligent systems, lack of customer demand, and above all a general lack of information on and awareness of the potential benefits of such systems.

To counter this and boost the take up of new technologies the European Commission launched the i2010 Intelligent Car Initiative on 23 February. It intends to move towards a future where cars no longer crash

and traffic congestion is reduced dramatically.

Concerted effort to improve road safety

Part of this future is the IST-funded PReVENT integrated project which is devoting 55 million euro to the safety of drivers, passengers and pedestrians. It includes over 50 partners and is made up of sub-projects covering specific road traffic and accident situations.

“What we have are car-safety systems that can support the driver in critical situations,” says Maxime Flament, PReVENT manager from ERTICO. In essence, the preventive safety applications help a driver to avoid or mitigate accidents by sensing the nature and significance of the danger, while taking into account the driver’s own state.

Emphasising that this technology must not take control away from drivers, which would restrict user-acceptance, Matthias Schulze, PReVENT coordinator from DaimlerChrysler R&T, says preventive safety systems can create a “virtual safety belt” for drivers. But although it was possible to show the feasibility of such systems a decade ago, only now were the components, software and infrastructure available and sufficiently cheap to roll out on a wide scale.

Enhancing digital maps

Fitted to a BMW dashboard a small screen resembles a standard in-car satellite navigation system. But on closer inspection, the screen provides far more information than a GPS system. It was developed by MAPS&ADAS sub-project partners who are creating safety-enhanced digital maps for a variety of other applications other than just route guidance.

“We use digital maps as a predictive sensor,” says Vincent Blervaque, project coordinator from ERTICO. “They complement other vehicle speed and position sensors such as lasers and video cameras, which have limited range, to extend the driver horizon at least 300 to 500 metres ahead. For example, a driver can be alerted to what is coming after the next road curve or intersection.”

Under the project, a standardised interface between digital maps and the ADAS applications has been developed and tested. A unique standard, its specifications will be delivered to certification bodies this year. The project’s own digital maps are developed by partners such as NAVTEQ and TeleAtlas, which have a kit for prototyping map-enabled ADAS solutions.

Vehicle manufacturers believe the new interface will reduce the implementation costs and marketing of map-based ADAS warning and alert systems. They will also be able to develop their own plug-in applications. Project partner BMW has been using digital maps for their safety applications since 2005 and contributed its enhanced active cruise control to the project.

Besides the interface, the project is working on producing better digital maps – which are now very good for navigation but not good enough or relevant for safety. Such maps are generated by special vans that collect road data, complementing data from relevant authorities.

“We are adding extra attributes to maps, such as information on traffic signs, curves, slopes and speed limits,” says Blervaque. “Maps can be stored in vehicles and gradually updated by wireless communication for new static information, such as a recently built roundabout, or for new dynamic data such as a changed speed limit. Ultimately, we want cars that don’t crash and we want drivers to be in control.”

The coordinator expects applications developed under this project will be common in cars within five years, adding that there is lots of interest worldwide from car manufacturers. Better map information could also be used to reduce fuel consumption.

Tackling lethal spots

INTERSAFE, the biggest PReVENT sub-project, focuses on traffic safety at intersections. The areas where roads meet are especially dangerous for the road users, resulting in 35 per cent to 40 per cent of traffic accidents and 70 per cent of all fatal accidents. In Germany alone, intersections account for 350,000 accidents annually.

“Intersections are the most complex area for drivers and cars’ onboard sensors,” says project coordinator Kay Fürstenberg, Director of Research at IBEO, a laser scanner sensors specialist. Accidents are typically the result of wrong manoeuvres, lack of anticipation of other drivers’ movements and missed road signs or signals.

“Like other PReVent sub-projects, we want to mitigate and prevent accidents,” he says. “We focused on building an intersection driver warning, using advanced sensors, new vehicle localisation algorithms and communication between the vehicle and road infrastructure.” The resulting intersection assistant warns driver of an impending collision or informs them about the situation at the intersection.

The system has been tested on real roads and helps the driver in three main areas: turning left, crossing traffic, and when drivers miss or ignore stop signs or red lights.

Laser scanners record the behaviour of road users (people and vehicles), the situation at the intersection and the environment, while also determining the position of the vehicle at the intersection. Video

cameras also look at lane markings and can detect lane departure as well as stop lines.

“It is a new idea to use sensors in a vehicle or in infrastructure that talks to cars. For instance traffic lights, which are in constant communication with a car’s onboard computer, can transmit extra details about local traffic,” he adds.

“The real challenge was achieving accurate vehicle localisation, matching currently detected objects with the static information of a detailed digital map. This we achieved merging the information from the laser scanners and video cameras, enabling the system to give drivers early warnings of dangers ahead.”

Sensors galore

The APALACI sub-project has put together pre-crash and collision-mitigation applications. These include systems to prepare a car’s brakes and to pre-tension seat belts when a collision is imminent. Demonstrator cars also feature LATERAL SAFE sub-project with wing mirrors that flash small warning lights when sensors detect a dangerous object in the car’s blind spots. Partner Volvo already produces cars with the first generation of this clever system.

Also notable are rear-view mirrors with warning lights for when the car strays out of its lane or risks a lateral collision. They call on a range of cameras and radars, able to assess objects at a range of distances.

“The challenge for intelligent safety systems is to avoid false alarms, so that users quickly come to trust them,” says Schulze.

Time-to-market is becoming a crucial issue for the kind of car-safety systems being developed under PReVENT; a process that many traffic

experts hope will be accelerated by the Intelligent Car Initiative.

Source: IST Results