Driving improvements to night vision

In a bid to reduce the annual death of more than 50,000 people and the countless severe injuries on Europe's roads, future onboard night vision systems have been developed that highlight unexpected obstacles and improve driver visibility.

The system, developed by a team of carmakers, automotive suppliers and university researchers under the IST programme's EDEL project, is expected to increase safety by highlighting unexpected, sudden events; improving visibility of road signs; assisting drivers on unknown roads and the timely detection of obstacles invisible to the human eye under night driving conditions.

The 30 per cent of road accidents that happen at night involve half of the people killed on the roads. Darkness is a major risk factor: while drivers travel just 28 per cent of their miles at night, 55 per cent of all motor fatalities occur after sunset. Ninety per cent of a driver's reaction depends on vision, which is severely limited at night. Depth perception and colour recognition are also compromised after sunset. Other dangers besides reduced visibility include fatigue, drowsiness, blurring of peripheral vision and impairment in judgement of distances and movements.

The numbers behind these statistics do not reveal how many accidents occurred because of lack of visibility at night, but introducing an effective and easy-to-use system to enhance the driver's perception would help prevent accidents and ultimately reduce fatalities and injuries for drivers, cyclists and pedestrians. For example, a pedestrian wearing dark clothes is only visible at a distance of 100 feet to a driver using low beams.

"We designed and developed different technological solutions for future onboard night vision systems," says project coordinator Luisa Andreone, Centro Ricerche Fiat, Italy. "The different solutions can be compared on a cost/benefit basis and will offer the market modular solutions that will enable carmakers to select the most suitable for their vehicles."

By conducting focus groups with potential customers, project partners identified the factors of acceptance by individual users that would likely determine the ultimate decision to purchase or use the system. To determine this, they drew on insights from a panel of 35 drivers attending seven focus group sessions and existing knowledge on major risk factors of night driving.

Following an analysis of customer benefit and technological benchmarking, they designed the system architecture and component design for an advanced vision enhancement system for night driving based on:

- An automotive-specific Complementary Metal Oxide Semiconductor (CMOS) camera.
- A near infrared sensor light source integrated into a newly designed vehicle headlamp.
- An innovative, user-centred human machine interface.

New automotive lighting equipment was developed. Because of the near infrared CMOS sensor, no blinding can occur from glare when two vehicles cross. The sensor is synchronized with the infrared light emitted by a specific headlamp developed within the project.

The scene in front of the car is illuminated by near infrared laser diode arrays. A CMOS specific-camera captures the images in front of the vehicle for further processing and continuously captures images from the road scene ahead, while at the same time taking data from the imager unit. Project partners addressed the issue of enhancing the input video stream, which is encoded in a 10 bit grey-scale frame, according to the camera format specification. For faster performance, the 10-bit 1024 grey-scale format of the camera must be mapped to 8-bit with less grey-scale levels. Three different solutions were developed in this area.

The image data is transmitted to the Image Processing Module and eventually to the windscreen, which features an infrared transparent area. A user-friendly human machine interface displays the relevant information.

Two different modules were designed offering a direct-view display inside the dashboard and a head-up display installed on top of the dashboard in view of the driver's eye. The main components of both are a display, a light source and the interfaces. The head-up display includes a mirror that magnifies and projects the image coming from the display.

EDEL's systems are still technological prototypes and are subject to technological and human factor tests with end users. Says Andreone: “Results are expected to show that drivers benefit from the early detection of potential obstacles while driving at night.”

The project will end in July 2005 and project results will be presented in an International workshop that will be held in Karlsruhe (Gemany) on 13 July.

The EDEL consortium expects the system to be on the market in the next couple of years. Plans for further development aim to make the system interoperable with other onboard driver supports systems, such as those for lane change.

Other issues being addressed by the consortium include detecting lanes and bounding lines until the horizon, as well as recognising cars without lights, static obstacles, pedestrians and cyclists.

Source: IST Results