Smart vehicles in the urban traffic of the future

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The pedestrian simulator can be connected with to other traffic-simulators. Credit: Uli Benz / TUM

Head-up display on the windshield, connected simulations, tactical behavior of bicyclists and phased traffic lights for trucks: These are

among the technologies being presented by the Technical University of Munich (TUM) at the closing event of the joint research project "UR:BAN" on October 7th at the Messe Düsseldorf trade fair grounds.

More and more people are moving into cities. At the same time, the need to always remain mobile is growing. The cooperative project "UR:BAN" is working on ways to make traffic in the city safer and more efficient. The 31 partners from industry and academia are working on three main topics to this effect: Cognitive Assistance, Connected Traffic Systems and Human Factors in Traffic. "UR:BAN" is funded by the Federal Ministry of Economics and Energy.

Man and machine: Communication is everything

"Driver assistance systems are there to help people primarily without distracting them from their main task of driving," explains Prof. Klaus Bengler from the Institute of Ergonomics and head of the "Human Factors in Traffic" project focus. The goal of the UR:BAN Project is, he says, for the driver to remain an active participant in what is happening on the road. If these systems, however, detect that a collision will soon be unavoidable and the driver is not reacting, they will intervene, for instance by activating emergency braking. "One of the biggest tasks in the research project is to get the timing of this reaction just right."

Optimum communication between man and machine is especially important. "In the road traffic context, we now have at our disposal more information than anyone could have dreamed of," said Bengler. "Different systems like route planning and collision avoidance must be finely attuned and must not interfere with one another."

Integrated concept: Information drivers can see and feel

The sub-project on man-machine-interaction is therefore working on how this information is presented. Scientists at the Institute of Ergonomics are working on an information system within which the three components head-up display, active gas pedal and dashboard are mutually aligned. A head-up display is one where the information is fed into the windshield and appears to hover in front of the vehicle. "There are many advantages to that," explains Bengler. "Drivers can keep their eyes on the road and still perceive the information that's being provided."

The way the information is presented must be clear, which is why the scientists divided the display into three clusters. Dynamic information such as the vehicle's current speed is displayed on the left, everything to do with the driver assistance system appears in the middle, and navigation is on the right. The dashboard is where information like the fuel gauge and engine temperature is displayed. These optical signs are supplemented by information the driver can feel, such as an active gas pedal or steering wheel. "Drivers can feel the gas pedal being less responsive than normal and can look at the display to see why."

Connected simulations

In order to provide meaningful warnings, the programs need to recognize the driver's intentions and those of other road users. This data can be gathered through observation or simulation.

The Institute of Ergonomics is cooperating with the Institute of Automotive Technology to conduct tests using truck and car simulators. They enable the scientists to see when drivers are tired and their reaction times slow, or how the test subjects react to distractions such as those created by children in the backseat. The Institute of Ergonomics is also developing a pedestrian simulator capable of realistically portraying the

behavior of those road users in virtual reality even in dangerous situations - without putting the test subjects at real risk.

In order to study the way road users interact, the researchers linked the simulators. As Prof. Bengler explains: "Pedestrians can be in one lab and drivers in driving simulators in another. They can then encounter each other in a virtual scene and we can watch their reaction times, where they look and where delays occur in critical situations."

Typical bicyclist

The Chair of Traffic Engineering and Control of TUM is studying probably the most unpredictable of all road users: the bicyclist. Bicyclists move fast and they make spontaneous decisions. For example they might suddenly move from the street onto the sidewalk. Bicyclists are also what's known as vulnerable road users, being especially at risk of injury in the event of an accident.

The scientists watch bicyclists using cameras installed over busy intersections. "We're interested in their tactical behavior, the decisions they make in certain situations," explains the Professor, Fritz Busch. Analyzing the behavior patterns of bicyclists is one of four sub-projects the Chair of Traffic Engineering and Control is working on as a part of "UR:BAN".

The scientists are particularly interested in why bicyclists exhibit certain behaviors. When cyclists illegally move from the bicycle path onto the road, is it because they see they'll get through faster that way? "We have now managed to detect a number of typical behaviors," says Busch. All of these go into simulation models. The developers of driver assistance systems use the models to make specific predictions as to how cyclists will behave. They can then check whether their system will react in a suitable way in dangerous situations.

Phased traffic lights for trucks

There's a little more horsepower behind the road users in another of the Chair's subprojects, which falls under the "Connected Traffic Systems" project cluster. "We are attempting to set up a system we're calling platoon management for trucks," explains Busch. The aim is for the phasing of the traffic lights to be altered temporarily to try and prevent trucks from having to stop at a red light. To do this, the system creates platoons. Here's how it works: If the system detects three trucks, for example, approaching the traffic lights, it will ideally modify the lights so that they don't turn red after the first truck but lets all three of them through instead. The overall traffic situation is taken into account as well - the phasing of the lights will only be altered if it doesn't cause a disadvantage to the other road users.

The advantages are not hard to see: Trucks take a lot longer to accelerate than two cars, for instance, that together measure the same length as a truck. The traffic therefore flows faster. Pollutant and noise emissions are also reduced. A pilot study in Düsseldorf has already enabled the scientists to demonstrate the technical feasibility of platoon management. They are also conducting simulations to assess the effects on a larger scale.

In addition to these research projects, Prof. Busch is also in charge of the "Simulation" subproject in the "Human Factors in Traffic" cluster.

These and other "UR:BAN" projects demonstrate the fact that new technologies are going to change road traffic in the future. However, do we have to get used to the idea that cars will soon to be on our roads without drivers at the wheel? "It's not going to be an abrupt change," says Busch. "It's more of an evolution than a revolution. In my opinion, it's going to be years if not decades before automated driving will be happening on our roads on a large scale."

More information: urban-online.org/en/urban.html

Provided by Technical University Munich