ITEA 3

Project Results

DANGUN

Paving the way for the autonomous vehicle revolution

EXECUTIVE SUMMARY

When it comes to automated driving, the ITEA project DANGUN has shown that expensive sensors need not be part of the equation. Through tele-operation and new perception components, a comparable performance has been achieved at a significantly lower cost.

PROJECT ORIGINS

By 2021, the advanced driver-assistance systems market will reach USD 37 billion. Growth is largely due to automated driving (AD), which promises better accessibility and safety – 90% of traffic-related deaths are due to inattentive driving. Vehicle manufacturers, however, struggle to enter this market. Customers must be willing to pay for AD features as part of the total vehicle costs, yet current sensors are simply too expensive. Additionally, AD must be improved in low-speed situations. The ITEA project DANGUN (Intelligent Perception System for Autonomous Vehicles) addresses both of these issues.

Research objectives and key achievements of the DANGUN project

DANGUN has focused on the development of a Traffic Jam Assist (TJA) System and a Tele-Operation (TO) System. For the former, low-cost perception sensors have created a safe and robust autonomous scheme for speeds of 0 to 50 km/h, which has been validated using the project's own test procedures. The latter, meanwhile, allows for remote control of driverless vehicles at speeds below 20 km/h, as well as cellular network communication between the vehicle and tele-operation console. This presents realistic solutions for communication delays, path planning and the decoupling of planning and navigation.

TECHNOLOGY APPLIED

DANGUN's technological deliverables have already been integrated into two Renault ZOEs, which were transformed into computer-controllable AD vehicles by installing a Vehicle Interface Box (VIB) and a power box for AD hardware. A controller allows communication between the existing vehicle system and the AD system, while the VIB lets the AD system control the vehicle actuators and receive information such as measurement data. These cars serve as Electric Vehicle-based Research Platforms that can be used as an internal tool for innovation.

There are three perception components. The front camera is a mono system that includes processors with advanced computational powers. This allows for a 125 by 40.1° field of view and 2880 by 1080-pixel resolution. The Around View Monitor (AVM) uses the camera view from four channels and lane detection algorithms to create high-quality images – the first implementation of this technology globally. Two types of radar have been incorporated: 77/79 GHz dual-band radar with a dual-band radio frequency (RF) chip and single-board radar featuring low-cost complementary metal–oxide–semiconductor (CMOS) technology.

These technologies are combined through TJA core algorithms. Object information convergence (radar and front camera) overcomes the limitations of each sensor, lane information convergence (front camera and AVM) allows for robust lane estimation and vehicle control optimisation ensures safe and comfortable driving. Planning algorithms are also used to create a tele-operation library that quickly computes or recomputes a path to the destination. A Human-Machine Interface provides information to the tele-operator and allows for cross-platform implementation.

MAKING THE DIFFERENCE

DANGUN's results are beneficial technologically, commercially and societally. In terms of technology, the TJA camera has a lane detection rate of 91% and a range of 110 metres, while the radar perception system has a range accuracy of under 15 centimetres. The AVM system already has a lane detection rate of 85%, with ongoing tests working to push this to over 95% in the near future. Such results almost match the state-of-the-art in these areas yet have been achieved using sensors which cost 20 to 30% less. The TJA test procedure has now been published as a KSAE standard. Additionally, the work item leader of ISO 22737 LSAD (Low Speed Automated Driving) standard has agreed to adopt the TJA test procedure, which is now the sole document with five detailed test cases and passing criteria.

These breakthroughs have allowed the consortium partners to expand both their products and markets. LGE will begin producing 600 thousand sets of the AVM system in 2019 and six million sets of the single camera in 2021, resulting in an expected market share increase of 20 to 30%. Valeo is now testing in Korea, anticipating a market of 50 million units per year for both their front camera and corner radar by 2022. Meanwhile, OEMs have used the research platform to test the LGE single camera and AVM system, reducing development time by over 30% and allowing them to enter new markets. Software libraries have been published for exclusive use by the consortium, helping them to maintain their competitive edge while expanding AD.

As for societal affects, these developments will reduce insurance fees as the responsibility for AD vehicle accidents will lie with manufacturers, data providers and road operators. DANGUN has set up its own insurance business in Korea and the US and expects insurance savings of USD 600 billion by 2035. That same year, the first robo-taxi businesses are predicted. Many companies are working on this but DANGUN has laid the foundation by using the TO System to control a driverless vehicle from the other side of the world – the first ever remote driving of this nature. Finally, DANGUN demonstrates the strength of the ITEA framework: participants reported that the international collaboration was technologically and culturally enriching, leading to better results. The fact that exploitation has been achieved in such a short timeframe is a testament to this.

MAJOR PROJECT OUTCOMES

Dissemination

- 14 journal publications (IEEE ITS, IEEE Access, Machine Vision and Applications, Sensors, Robotics and Autonomous Systems, IJAT)
- More than 10 presentations at international conferences/fairs (IEEE ITSC2017, KSAE2017, IEEE ICVES2018, EUREKA Innovation Days 2018, KSAE 2018, IEEE IV2019, EVS32 2019, SAE 2019)
- Promotions of the DANGUN project in the Korea-France Forums on Innovative Industries (2017, 2019)
- Demonstration of 5G based autonomous driving on express and urban roads in Korea (2019)

Exploitation (so far)

New products:

- Research platform (ZOE): a computer-controllable vehicle for autonomous driving
- Mono camera for lane and vehicle detection with wide Field Of View (FOV) and high resolution
- Around View Monitoring (AVM) cameras for lane detection with high-quality images
- 77/79 GHz dual-band RADAR sensors for surrounding vehicle detection

New systems:

- Traffic Jam Assist (TJA) system for an electric vehicle based on affordable sensors
- Teleoperation system allowing for remote control of a driverless vehicle

Standardisation

- Standardisation of TJA test procedures at the Korean Society of Automotive Engineering (KSAE)
- Proposal of international standardisation of TJA test procedures at ISO

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Partners

France

Renault SAS

Valeo Comfort and Driving Assistance

ENSTA Paris

Republic of Korea

Hanyang University

Renault Samsung Motors

LG Electronics

KATECH

ControlWorks

Project start

September 2016

Project end

August 2019

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Project website

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