AUTOmated driving Progressed by Internet Of Things

Results

Project Information

**AUTOPilot**

| Grant agreement ID: 731993 |

Funded under
H2020-EU.3.1.4.
H2020-EU.2.1.1.

Overall budget
€ 26 555 480,33

EU contribution
€ 19 924 984

**Status**

Closed project

**Start date**

1 January 2017

**End date**

29 February 2020

Coordinated by
EUROPEAN ROAD TRANSPORT
TELEMATICS IMPLEMENTATION
COORDINATION
ORGANISATION - INTELLIGENT
TRANSPORT SYSTEMS &
SERVICES EUROPE

Belgium

Deliverables

Documents, reports (31)

Preliminary legal perspectives on use of IoT for AD

Legal issues relating to the use of IoT technologies for enabling or improving autonomous driving in a connected environment. Related tasks: T4.5, T4.6.
Vehicle IoT integration report

"Results of the integration of an "Open" IOT platform component to allow vehicles to access and use IoT devices and capabilities, thus enabling AD functions enhancement. Related tasks: T1.1, T1.2, T1.3, T1.4, T1.5, T2.1, T2.2, T2.3. An Internal Report (IR2.1) will be delivered at M14 to provide a preliminary version of the necessary documentation about the IoT vehicle platform to WP2 and WP3."

Final technical evaluation

This final version completes D4.x with the evaluation results. Related tasks: T1.2, T1.3, T1.4, T2.5, T3.1, T3.4, T4.2, and T4.3.

Standards and conformance of IoT in AD

Report on the applicable reference standards, related processes and procedures identified in the involved standardisation or government organisations, which can be used for conformance testing. Related task: T5.5

Final specification of IoT-enabled Autonomous Driving use cases

Specifies the IoT enabled automated driving scenarios scenarios where the potential of Internet of Things can be assessed for enhancement and enabling of Automated Driving functions. Final revision based on the pilot site experiences.

Report about AD functions adaptation for IoT

Results of the autonomous driving functions adaptation to enable the project use cases. Related tasks: T2.1, T2.2, T2.3, T2.4 An Internal Report (IR2.2) will be delivered at M14 to provide a preliminary version of the necessary documentation about the automated driving functions to WP2 and WP3.

User requirements analysis

Analysis of user requirements, concerns and expectations with view to ensure their acceptance and trust. A survey in several countries on motivation, perceived usefulness, ease-of-use of Level 3, 4 and 5 autonomous technologies and willingness to pay, will serve the user requirement analysis. Related tasks: WP1, WP2, T3.1, T3.4, T4.1, T4.4, T4.5 and T4.6.

Test Data Management platform architecture

Recommendations to test data management. Related tasks: T3.4, WP4.

Final pilot tests specifications

Update of D3.1 based on outcome from pilot site adaptation. Related tasks: T3.1, T3.4, T4.1.

Standardisation plan
The report will form the basis of task 5.5 and provide the main applicable standards in the IoT and ITS domain for the other WPs in the project to take into account in the architectural and design choices in order to make credible, interoperable and future-proof decisions. Related task: T5.5

**Methodology for evaluation**

Common methodology for evaluation, and integrates methodologies for each of the evaluation tasks. The methodology will be enhanced from practical experience and recommendations will be provided to enhance the FESTA methodology. Related tasks: WP1, WP2 and WP3, T4.1, T3.4. An Internal Report (IR4.1) was delivered at M10 to provide a preliminary version of the necessary documentation about the evaluation methodology to WP2, WP3 and WP4.

**Initial pilot tests specifications**

Actions required for setting up the pilot sites, from the beginning of the project, until they become fully operational. Related tasks: T3.1, T3.4, T4.1.

**Report on development and Integration of IoT devices into IoT ecosystem**

Results from the development of mobile IoT objects and IoT infrastructure and their integration into the IoT ecosystem (other IoT devices, vehicle IoT platform and Open IoT platform). Related tasks: T1.1, T1.2, T1.3, T1.4, T2.1, T2.3, T2.4 An Internal Report (IR2.4) will be delivered at M14 to provide a preliminary version of the necessary documentation about the IoT device integration to WP2 and WP3.

**Initial open IoT Vehicle Platform Specification**

Specification of the Open IoT vehicle platform, including the definition of the format to be used for exchanging data between the in-vehicle proprietary network and the IoT platform components embedded into the vehicle itself. Initial release

**Final report about the AUTOPILOT IoT platform**

This final report will update the Deliverable D2.3, as the IoT platform is likely to be updated during the pilot operation.

**Initial technical evaluation**

This initial version includes the evaluation plans. Related tasks: T1.2, T1.3, T1.4, T2.5, T3.1, T3.4, T4.2, and T4.3.

**Final specification of Communication System for IoT-enhanced AD**

Specification of requirements concerning communication means and in particular the capabilities necessary for IoT and AD use cases. Final release on the basis of the pilot site experience.

**Communication plan**
The deliverable defines the overall communication strategy of the project, includes identified target groups and describe the channels, the planned activities and materials to be developed throughout the project. It is a living document that will be updated on a yearly basis based on project phase and related key areas for dissemination. Related tasks: T5.1, T5.2, T5.3, T5.4, T5.5.

Pilot sites adaptation validation (test report)
Results from validation of pilot sites adaptations and readiness to start execution phase. Related tasks: T2.4, T3.1, T3.2, T3.3.

IoT Policy Framework for autonomous vehicles applications
Findings and conclusions of the coordination framework of autonomous vehicle and IoT pilot activities for transfer to other pilot areas. Related tasks: T5.4

Quality of life impact assessment
Expected impacts in the society due to deployment of IoT and automated driving. D4.4 will be delivered as a draft in M24. Related tasks: WP1, WP2, T3.1, T3.4, T4.1, T4.4.

Initial specification of Communication System for IoT-enhanced AD
Specification of requirements concerning communication means and in particular the capabilities necessary for IoT and AD use cases. Initial release.

User acceptance assessment
Assessment of acceptance of IoT solutions by users through polls and workshops will ensure to account for regional specificities. Related tasks: WP1, WP2, T3.1, T3.4, T4.1, T4.4, T4.5 and T4.6.

Data collection and integration methodology
D3.4 will describe data collection and integration methodology together with a summary of the state of the art on tools needed for data acquisition, transmission, database structure, quality assurance, data storage. Related tasks: T2.3, T2.4, T3.1, T3.4, T4.1

Final specification of Security and Privacy for IoT-enhanced AD
Specification of security and privacy requirements which impact on identified use cases, having as a reference the specified architecture and selected communications technologies. Final release on the basis of the pilot site experience.

Performance and KPIs for autonomous vehicles and IoT pilot impact measurement
KPIs for design, testing, validation and impact assessment of autonomous vehicles and IoT pilots. Related tasks: T5.4
Report on the implementation of the IoT platform
D2.3 will document the implementation of the IoT platform. Related tasks: T1.1, T1.2, T1.5, T2.3, T2.4, WP3 and T4.2. An Internal Report (IR2.3) will be delivered at M14 to provide a preliminary version of the necessary documentation about the IoT Cloud platform to WP2 and WP3.

Final open IoT Vehicle Platform Specification
Specification of the Open IoT vehicle platform, including the definition of the format to be used for exchanging data between the in-vehicle proprietary network and the IoT platform components embedded into the vehicle itself. Final release on the basis of the pilot site experience.

Legal perspectives on use of IoT for AD
Legal issues relating to the use of IoT technologies for enabling or improving autonomous driving in a connected environment. Related tasks: T4.5, T4.6.

Initial specification of Security and Privacy for IoT-enhanced AD
Specification of security and privacy requirements which impact on identified use cases, having as a reference the specified architecture and selected communications technologies. Initial release.

Initial specification of IoT-enabled Autonomous Driving use cases
Specifies the IoT enabled automated driving scenarios scenarios where the potential of Internet of Things can be assessed for enhancement and enabling of Automated Driving functions. - Initial release

Open Research Data Pilot (3)

Final data management plan
This final data management plan will provide updates about the data management plan, reflecting the evolution of the data management components and processes at the end of the project. It is essential in the context of ORDP to provide this final version, to allow the access and usage of the AUTOPILOT public data.

Data management plan
D6.7 will determine how research data will be handled during the research project and after the project is completed. It will describe what data will be collected, processed or generated, what methodologies and standards will be followed, whether and how this data will be shared and/or made open, and how it will be curated and preserved. Related tasks: T3.4, T6.4.
Interim revision of the data management plan

This updated data management plan will provide updates concerning the data management plan, as the data management components and processes will be updated during the pilot site integration, until the pilot test are expected to start in M18.

Websites, patent fillings, videos etc. (1)

Project identifiers and website
Project identifiers, including a logo and associated visual identity for project materials and templates will be produced. A public website will be launched that will be used as the main information platform for the project outreach activities. Related task: T5.1

Publications

Peer reviewed articles (7)

AUTOPILOT Project: Development of Intersection Safety Information System and Service Technology for Autonomous Driving
Author(s): Jeong-Woo Lee, Shin-Kyung Lee, Hyun-Seo Oh
Published in: The Journal of Korean Institute of Communications and Information Sciences, Issue 43/1, 2018, Page(s) 83-90, ISSN 1226-4717
DOI: 10.7840/kics.2018.43.1.83

Embracing the Future Internet of Things
Author(s): Flavio Cirillo, Fang-Jing Wu, Gürkan Solmaz, Ernő Kovacs
Published in: Sensors, Issue 19/2, 2019, Page(s) 351, ISSN 1424-8220
DOI: 10.3390/s19020351

Toward Understanding Crowd Mobility in Smart Cities through the Internet of Things
Author(s): Gurkan Solmaz, Fang-Jing Wu, Flavio Cirillo, Erno Kovacs, Juan Ramon Santana, Luis Sanchez, Pablo Sotres, Luis Munoz
Published in: IEEE Communications Magazine, Issue 57/4, 2019, Page(s) 40-46, ISSN 0163-6804
DOI: 10.1109/mcom.2019.1800611

Real-time city-scale ridesharing via linear assignment problems
Author(s): Andrea Simonetto, Julien Monteil, Claudio Gambella
Published in: Transportation Research Part C: Emerging Technologies, Issue 101, 2019, Page(s) 208-232, ISSN 0968-090X
DOI: 10.1016/j.trc.2019.01.019

A Standard-Based Open Source IoT Platform: FIWARE

Author(s): Flavio Cirillo, Gurkan Solmaz, Everton Luis Berz, Martin Bauer, Bin Cheng, Erno Kovacs
Published in: IEEE Internet of Things Magazine, Issue 2/3, 2019, Page(s) 12-18, ISSN 2576-3180
DOI: 10.1109/iotm.0001.1800022

Learning to Automatically Catch Potholes in Worldwide Road Scene Images

Author(s): J. Javier Yebes, David Montero, Ignacio Arriola
Published in: IEEE Intelligent Transportation Systems Magazine, 2020, Page(s) 1-1, ISSN 1939-1390
DOI: 10.1109/mits.2019.2926370

On the needs for MaaS platforms to handle competition in ridesharing mobility

Author(s): Venktesh Pandey, Julien Monteil, Claudio Gambella, Andrea Simonetto
Published in: Transportation Research Part C: Emerging Technologies, Issue 108, 2019, Page(s) 269-288, ISSN 0968-090X
DOI: 10.1016/j.trc.2019.09.021

Other (2)

Driving automation and the Internet of Things: Data on the road
Author(s): François Fischer, AUTOPILOT Coordinator and Senior Manager at ERTICO-ITS Europe, and Francesca Corazza, FIA Region I
Published in: Baltic Transport Journal, 2017

To Hit or Not to Hit the Road: A DNN approach to caught Potholes from an onboard camera
Author(s): Javier Yebes, David Montero, Ignacio Arriola (Vicomtech)
Published in: Poster presentation of related paper, 2018

Book chapters (2)

IoT Technologies for Connected and Automated Driving Applications
Author(s): Ovidiu Vermesan, Joël Bacquet
Published in: Cognitive Hyperconnected Digital Transformation, Issue 1, 2017, Page(s) 1-310
DOI: 10.13052/rp-9788793609105

Electronic Components and Systems for Automotive Applications - Proceedings of the 5th CESA Automotive Electronics Congress, Paris, 2018
Author(s): Willenbrock, Ralf (et al.), T-SYSTEM
Published in: How IOT based Automated Driving can help cities to reduce Air Pollution, 2019
DOI: 10.1007/978-3-030-14156-1

Learn from IoT - Pedestrian Detection and Intention Prediction for Autonomous Driving
Author(s): Gürkan Solmaz, Everton Luís Berz, Marzieh Farahani Dolatabadi, Samet Aytaç, Jonathan Fürst, Bin Cheng, Jos den Ouden
Published in: Proceedings of the 1st ACM Workshop on Emerging Smart Technologies and Infrastructures for Smart Mobility and Sustainability - SMAS '19, 2019, Page(s) 27-32
DOI: 10.1145/3349622.3355446

Estimation of Absolute Scale in Monocular SLAM Using Synthetic Data
Author(s): Danila Rukhovich, Daniel Mouritzen, Ralf Kaestner, Martin Ruffli, Alexander Velizhev (IBM Research - Zurich, Switzerland)
Published in: ICCV 2019 workshop papers, 2019

IoT-based interaction of automated vehicles with Vulnerable Road Users in controlled environments
How may connected automated driving improve quality of life?

Author(s): Elina Aittoniemi, VTT Technical Research Centre of Finland Ltd., Viktoria Kolarova, German Aerospace Center (DLR), Yvonne Barnard, University of Leeds, UK, Katerina Touliou, CERTH, Greece, Bart Netten, TNO, Netherlands
Published in: 2018

Integration of an Automated Valet Parking Service into an Internet of Things Platform

Author(s): Louis Calvin Touko Tcheumadjeu, Franz Andert, Qinrui Tang, Alexander Sohr, Robert Kaul, Jörg Belz, Philipp Lutz, Moritz Maier, Marcus Gerhard Müller, Wolgang Stürzl (DLR)
Published in: 2018

In-Vehicle IoT Platform Enabling the Virtual Sensor Concept: A Pothole Detection Use-case for Cooperative Safety

Author(s): Ilaria Bosi, Enrico Ferrera, Daniele Brevi, Claudio Pastrone
Published in: Proceedings of the 4th International Conference on Internet of Things, Big Data and Security, 2019, Page(s) 232-240
DOI: 10.5220/0007690602320240

Autonomous Driving Progressed by oneM2M: The Experience of the AUTOPILOT Project

Author(s): Giovanna Larini, Giovanni Romano, Mariano Falcitelli, Sandro Noto, Paolo Pagano, Miodrag Djurica, Georgios Karagiannis, Gurkan Solmaz
Published in: 2019 European Conference on Networks and Communications (EuCNC), 2019, Page(s) 204-208
DOI: 10.1109/eucnc.2019.8801948

Quality of life impacts of connected automated driving - Case: AVP

Author(s): Elina Aittoniemi, Fanny Malin (VTT), Viktoria Kolarova (DLR), Katerina Touliou (CERTH)
Published in: 2019

“Smart Roads” for AD cars: the AUTOPILOT Project in Livorno

Author(s): Daniele Brevi/LINKS, Mariano Falcitelli/CNIT, Stella Nikolaou/CERTH, {Lorenzo Maraia, Lorenzo Pieri}/AVR, {Francesco Bisconti, Luca Di Mauro, Sandro Noto, Paolo Pagano, Niccolò Pieretti, Alexandr Tardo,
Paper Automated Valet Parking enabled by Internet of Things: A pilot site realization and validation at Brainport

Author(s): Louis Touko Tcheumadjeu, Qinrui Tang, Marcus Gerhard Müller, Thomas Lobig, Philipp Lutz, Robert Kaul (DLR), Emi Mathews, Arjan Teerhuis (TNO), Garcia Castano Jorge (Vicomtech)
Published in: 2019

EU AUTOPILOT project: Platooning use case in Brainport

Author(s): TNO, Antoine Schmeitz, Ramon S. Schwartz, Daan Ravesteijn, Geert Verhaeg, Daniel Altgassen and Harry Wedemeijer (TNO)
Published in: 2019

OneM2M-Based, Open, and Interoperability IoT Platform for Connected & Automated Driving

Author(s): M. Djurica (TNO), G. Romano (TIM), G. Karagiannis (Huawei), Y. Lassoued (IBM Research – Ireland), G. Solmaz (NEC)
Published in: 2019

Multi-sensor fusion localization framework: map-based

Author(s): Siavash Shakeri (TomTom)
Published in: 2019

Benefits and uptake sensitivities of connected and automated vehicles

Author(s): Dr Gillian Harrison, Professor Simon Shepherd, Dr Haibo Chen, Dr Yvonne Barnard (University of Leeds)
Published in: 2019

Assessing Requirements and Concerns of Potential Users of Automated Driving Services Progressed by Internet of Things Using a Co-Designer Approach

Author(s): Viktoriya Kolarova, German Aerospace Center, Institute of Transport Research; David Ertl, FIA; Elina Aittoniemi, VTT; Gillian Harrison, University of Leeds; Yvonne Barnard, University of Leeds; Katerina Touliou, CERTH
Published in: 2019