ReliablE in-Vehicle pErception and decisioN-making in complex environmenTal conditionS (EVENTS)

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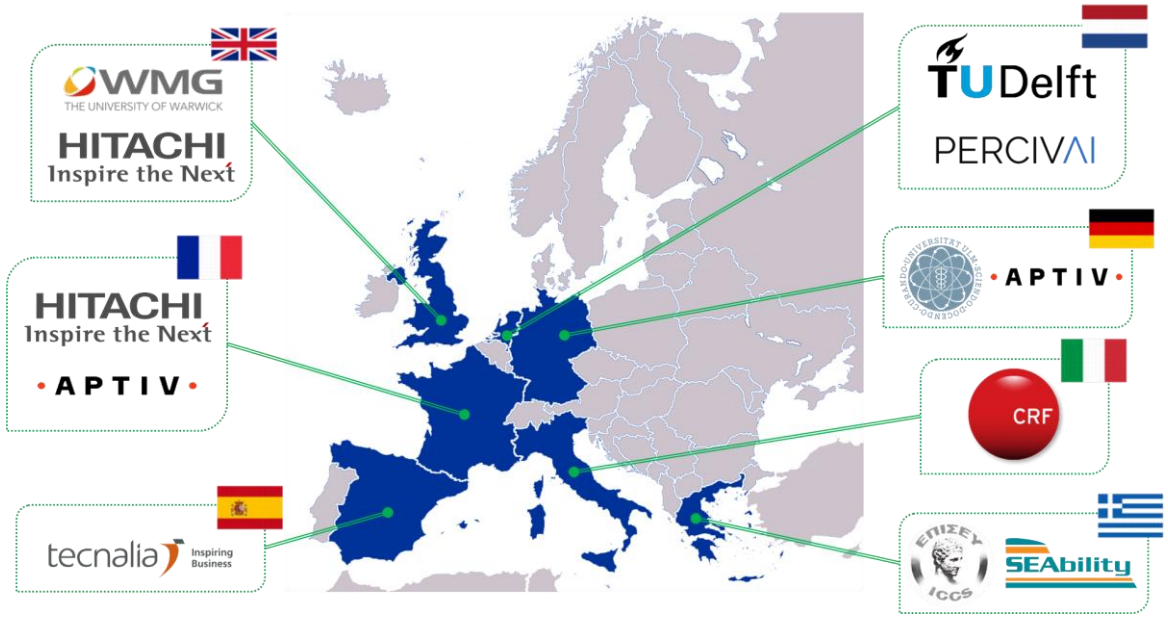
EVENTS

Overall Project Presentation

General facts and figures

- **Title:** ReliablE in-Vehicle pErception and decisioN-making in complex environmenTal conditionS (EVENTS)
- **Call:** HORIZON-CL5-2021-D6-01
- **Topic:** HORIZON-CL5-2021-D6-01-01
- **Type of Action:** Innovation Action
- **Starting date:** 1st September 2022
- **Duration:** 36 months



- **Budget:** 6.920.598 euros | **EU Funding:** 5.534.448 euros
- **Consortium:** 12 partners (2x2 associated) from 7 countries

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Objectives

1	*Design and implement on-board **perception algorithms** needed for safe driving of CAVs in complex environmental conditions by overcoming current ODD limitations.*	7 prototype vehicles collect data and assess perception improvement
2	*Design and implement **decision-making** algorithms able to cope with a **variety of traffic scenarios** including non-standard traffic conditions (edge cases), considering potential contradictions to existing traffic rules.*	Metrics like time-to-collision and ratio (MRM applied) / (MRM necessary)
3	*Develop solutions for continuous **perception system self-assessment** for CAVs safe and resilient operation, triggering an improved **minimum risk manoeuvre (MRM)** in case the ODD limit is reached.*	Ex-ante evaluation like the appropriateness of an MRM
4	***Integrate**, **test** and **demonstrate** the developed perception and decision-making algorithms in both **prototype vehicles** (real conditions) and **simulation** environments.*	End-to-end system tests; Demonstration under real conditions and in simulation
5	***Assess the impact** of EVENTS developments and determine **cost-efficient sensor suites** for CAVs delivering the necessary perception performance for a wide variety of scenarios in complex environments.*	Prove the ODD extension in the selected UCs; Detailed sensor suites analysis
6	***Disseminate** and **communicate** project findings, increase **cooperation** with **international** stakeholders and promote project results, mainly performance requirements for environment perception, to **standardisation** bodies.*	Cooperation with 3 SBs; International AB (Europe, North America, Australia & Asia)

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Results Presentation

Use Cases & Experiments

Use Cases

- UC1: Interaction with Vehicles and VRUs in Complex Urban Environment
- UC2: Non-Standard and Unstructured Road Conditions
- UC3: Low Visibility & Adverse Weather

Experiments

- **EXP1**: Interaction with VRUs in complex urban environment.
- **EXP2**: Re-establish platoon formation after splitting due to roundabout.
- **EXP3**: Self-assessment and reliability of perception data with complementary V2X data in complex urban environments.
- **EXP4**: Decision making for motion planning when faced with roadworks, unmarked lanes, and narrow roads with assistance from perception self-assessment.
- **EXP5**: Decision making for motion planning when entering a jammed highway.
- **EXP6**: Small object detection at a far range in adverse weather conditions.
- **EXP7**: Localization/perception self-assessment for advanced ACC and other vehicles' behaviour prediction under adverse weather or adverse road conditions.
- **EXP8**: Driving on secondary roads under adverse weather.

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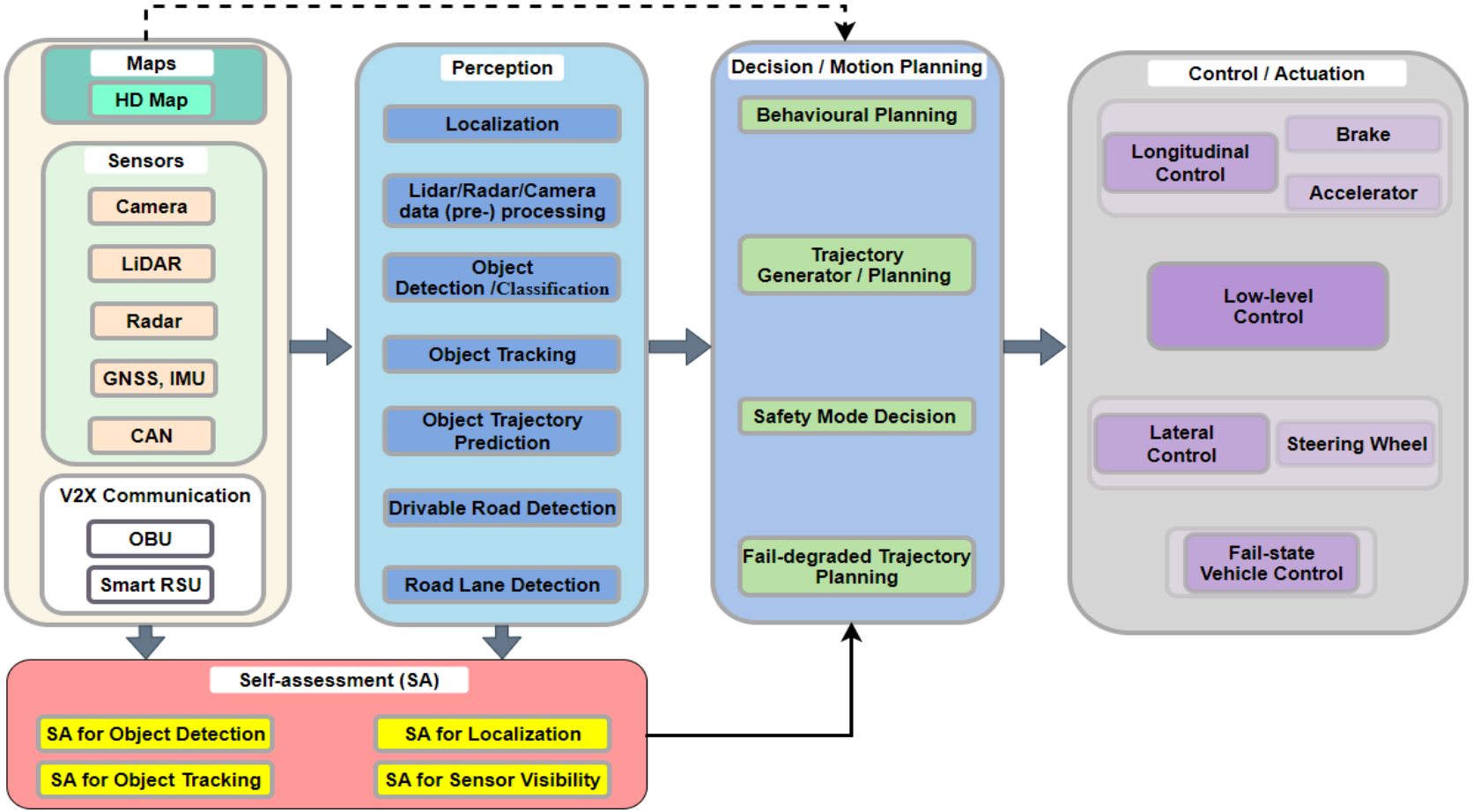
System Architecture



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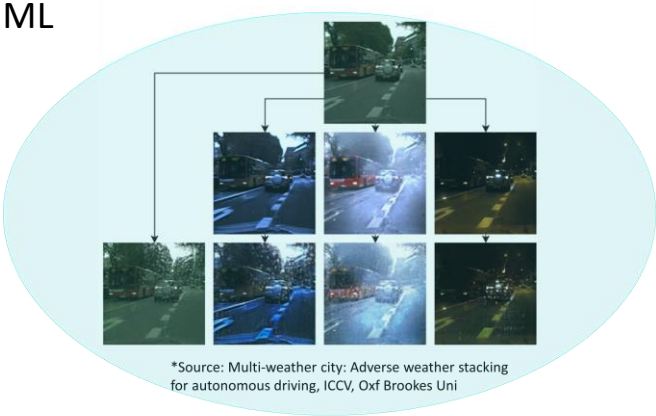
Data Generation & New Datasets

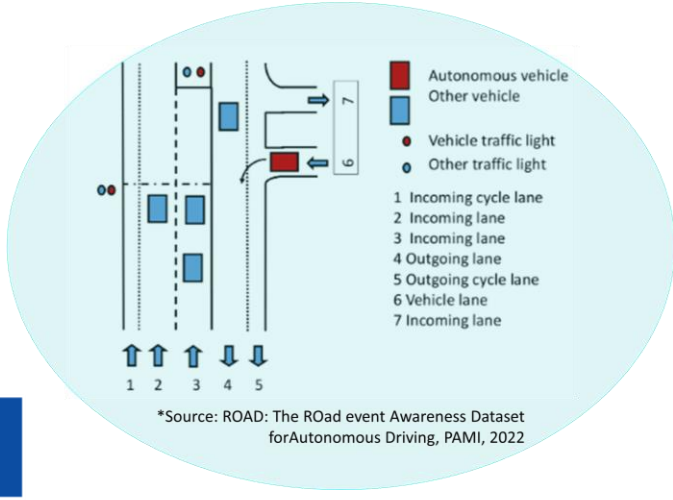
Data Generation from Simulation

- Creating artificial bad weather images from original images using ML



*Source: Multi-weather city: Adverse weather stacking for autonomous driving, ICCV, Oxf Brookes Uni

- Annotating events in videos using ML



*Source: ROAD: The ROad event Awareness Dataset forAutonomous Driving, PAMI, 2022

New Road Debris Dataset

- A prototype vehicle equipped with a front-facing radar and a GNSS/IMU system is used to collect data on a test track
- The debris is positioned on a straight line marked on the test track

- Collection of 47 different objects from 1cm to 3m
- 12cm was deemed the cut off height for overdriveable objects

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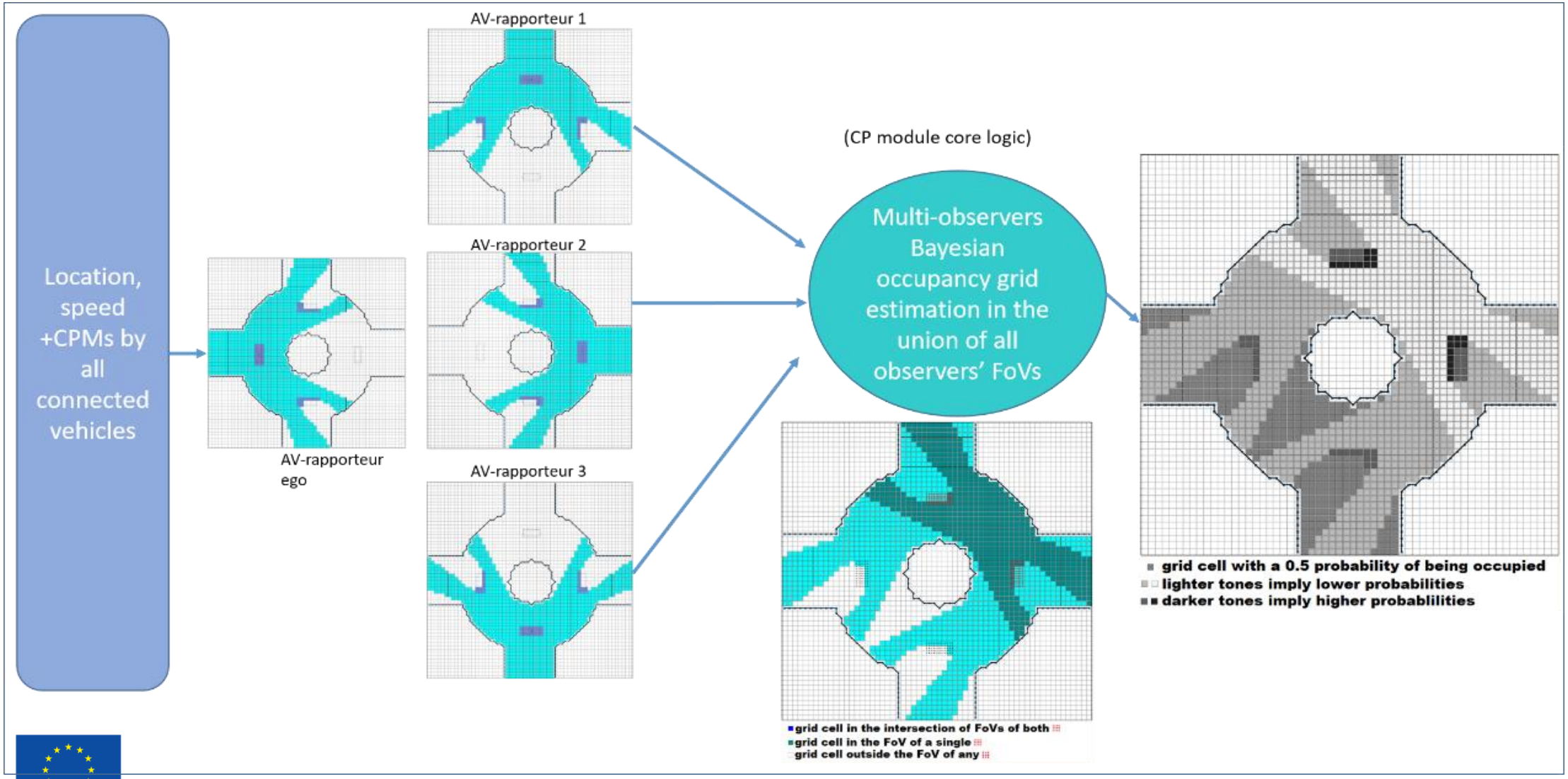
Collective Perception Messages



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Mid- to Long-Term Expected Impacts of the Project

Mid-Term Expected Impact

Expected Outcome	Dimension	Metric
Cost-efficient sensor suites	Technological/Economic	Cost benefit analysis for sensor suites
Advanced environment and traffic recognition and prediction	Technological/Societal	Decrease false detections and non-detections of VRUs by at least 10%
Determine the appropriate course of action of a CAV in a real-world environment	Technological/Societal	Compare appropriate course of action with action suggested by EVENTS algos
Safe and reliable operation of automated vehicles in expanding ODD	Technological	≥3 OEMs & 1 Tier 1s interested in building on EVENTS results on ODDs expansion
Standardization mandate for performance requirements for environment perception systems with respect to different automation levels and ODDs	Technological	≥2 relevant WGs in standardisation orgs consider input from EVENTS

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Long-Term Expected Impact

Expected Outcome	Dimension	Metric
Validated safety and security, improved robustness and resilience of CCAM technologies and systems	Technological/Societal	Decrease by 10% the critical cases where CAVs are involved.
Secure and trustworthy interaction between road users, CCAM and “conventional” vehicles	Technological/Societal	High detection rate of VRUs and other objects limiting false detections and non-detections at least by 10%
User oriented CCAM based mobility and goods deliveries for all	Societal	High public acceptance rate (>80%) of EVENTS results
Better coordination of R&I and large-scale testing activities in Europe	Societal	Exchange of information and liaise with ≥2 other CCAM projects on a regular basis (Hi-Drive & ROADVIEW)
European leadership in the development and deployment of CCAM systems	Societal	Creation of highly-skilled jobs in automotive industry

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Thank you for your attention!

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