DREAM

DRIVING AIDS POWERED BY E-GNSS AI AND MACHINE LEARNING

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Our Mission

Develop innovative artificial intelligence and machine learning methods to improve positioning technologies and environment perception systems supporting the development of driver assistance systems for buses.

Our Objectives

Produce a TRL-7 prototype supporting ADAS systems and providing the following features

Accurate and Robust

A highly precise and robust system for position and attitude determination, utilising a variety of sensors such as GNSS, Galileo differentiators (high precision and OSNMA services), inertial sensors, odometer, lidar and cameras.

Environment Perception

3D bounding boxes for surrounding objects to provide detailed information on object dynamics and improve safety measures.

Situational Awareness

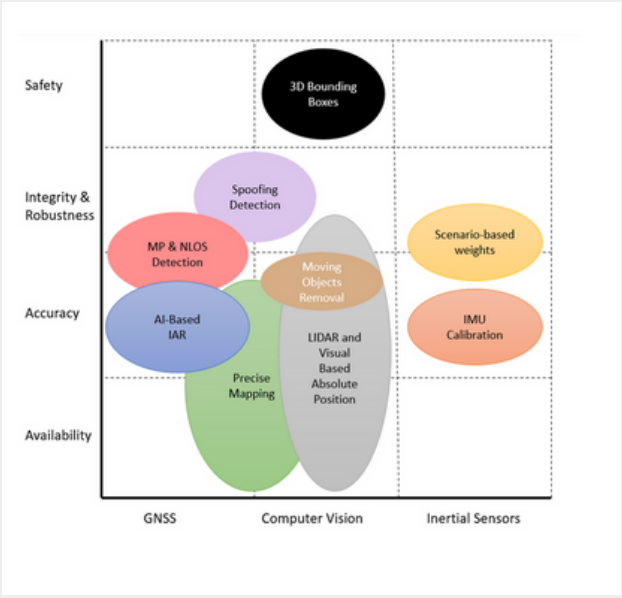
Recognition and classification of traffic lights to improve situational awareness and decision making.

Geo-referenced Maps

Mapping system that uses cameras and lidars to create 3D maps (based on point clouds) and RGB maps. These maps support re-localisation (3D maps) and lane detection (RGB).

Technologies and Solutions

One of the key points of this project is that AI/ML techniques for GNSS, inertial and visual/LIDAR sensors are combined in a very well-balanced way. In this way, the advantages of all these sensors are utilised and their limitations mitigated, resulting in an accurate, highly available and resilient overall solution.



- Precise Mapping
- LiDAR and Visual Absolute Positioning
- Moving Objects Detection and Removal
- 3D Object Detection
- Spoofing Detection
- AI-Based IAR
- AI for Detecting strong MP and NLOS signals
- Calibration and Denoising of an IMU with AI
- Learning of scenario-based measurement weights

Target Application

Driving aids refers to a variety of technologies and systems that are implemented in modern vehicles to improve driving safety, prevent accidents and increase driving comfort. These technologies can monitor various aspects of driving behaviour, such as speed, vehicle position, environment and vehicle dynamics. This project focuses on safety-critical applications that require both high-precision positioning and environment perception features, either from the sensors on board the ego vehicle or from the information obtained from a geo-referenced map.

Red Light Warning	To determine if a Red-Light Warning alert is to be issued, a traffic light detector and classification will be developed. In the event of a red-light situation, the system will assess the need to issue a warning based on the bus position (distance to the traffic light) and velocity, as well as the type of vehicle – information obtained from configuration.
Curve Speed Warning	The curve speed warning will rely on the high-accurate and reliable position and velocity provided by the sensor fusion positioning system and the geo-referenced map.
Wrong Way driving	The Wrong-Way Driving Detection Warning (WWDW) will leverage on the precise attitude information provided by the sensor fusion positioning system and the geo-referenced maps – note that the project generated maps will contain information about the correct way of driving based on the bus attitude information at map data recording time.
Collision Avoidance	Collision Avoidance system, the motion of the surrounding objects will be estimated based on the 3D bounding boxes algorithm. With this information and the bus position, velocity and attitude, a collision detector system will be developed. In the event of a collision risk, a warning alert will be prompted according to the format defined at specification time.

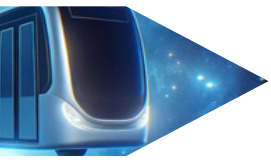
Where we are

Currently we are finalizing the design phase, after successively completing the concept definition and preliminary design. More specifically, on the Solution Requirement Review (SRR) meeting hold on March 2024, together with EUSPA we agreed on the target application, "driving aids for buses", and preliminary define the system and user requirements.

This specification was refined and approved in the Preliminary Design Review hold in June 2024. In this milestone, apart from the requirements definition approval, we conducted an exhaustive review of the SW and HW architecture, with a special detail on the Artificial Intelligence and Machine Learning algorithms that will be developed in the next phase of the project. In terms of HW all the components comprising the system where selected and justified. The platform will include the following sensors: 2 GNSS receivers and antennas, a MEMS IMU, two 128-channel Lidars (both for SLAM and object detection purposes) and two cameras for stereo perception.

The system design will be frozen in the Critical Design Review (CDR) meeting foreseen for September 2024. Together with the system design, the validation approach and its associated test cases and procedures will be defined and reviewed at this stage.

After the successful completion of the CDR objectives, we will start with the AI algorithms development. This activity has been slightly advanced with the implementation of some prototypes supporting the design decisions as well.



Further information about the project evolution and its main outcomes will be provided in upcoming newsletters.

To achieve the very challenging objectives of this project, the following phases will be conducted.

Concept definition. Aimed at describing the target application(s) and user requirements. It also covers the description of the HW and SW features that would be developed within the project.
System Requirements. The user requirements identified in the previous step are flowed down to different SW and HW components comprising the system.

Architecture and Detailed Design. The overall concept is captured in a system architecture. The algorithms that will be employed in each element of the system will be designed and described in this step.

The AI/ML training methodology will also be defined in this phase as well as the approach to obtain or generate the training datasets.

Development. The different subsystem modules and algorithms will be developed as per the system specifications and interfaces defined in the previous phases.

Sub-System and Integration Verification. The hardware and software modules will be tested to prove that each sub-system complies with its own functionality at individual level. Some additional tests will be conducted to verify that all HW and SW components are properly integrated.

System validation. DREAM prototype will be set-up in a bus and tested in a real environment.
Transversal to the activities the **business and dissemination** plan will be defined and implemented.

Project Facts

Project period:
12/2023 – 11/2025

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Coordinated by:
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