UC7 Autonomous robot functions

UC Leader: Virtual Vehicle Research

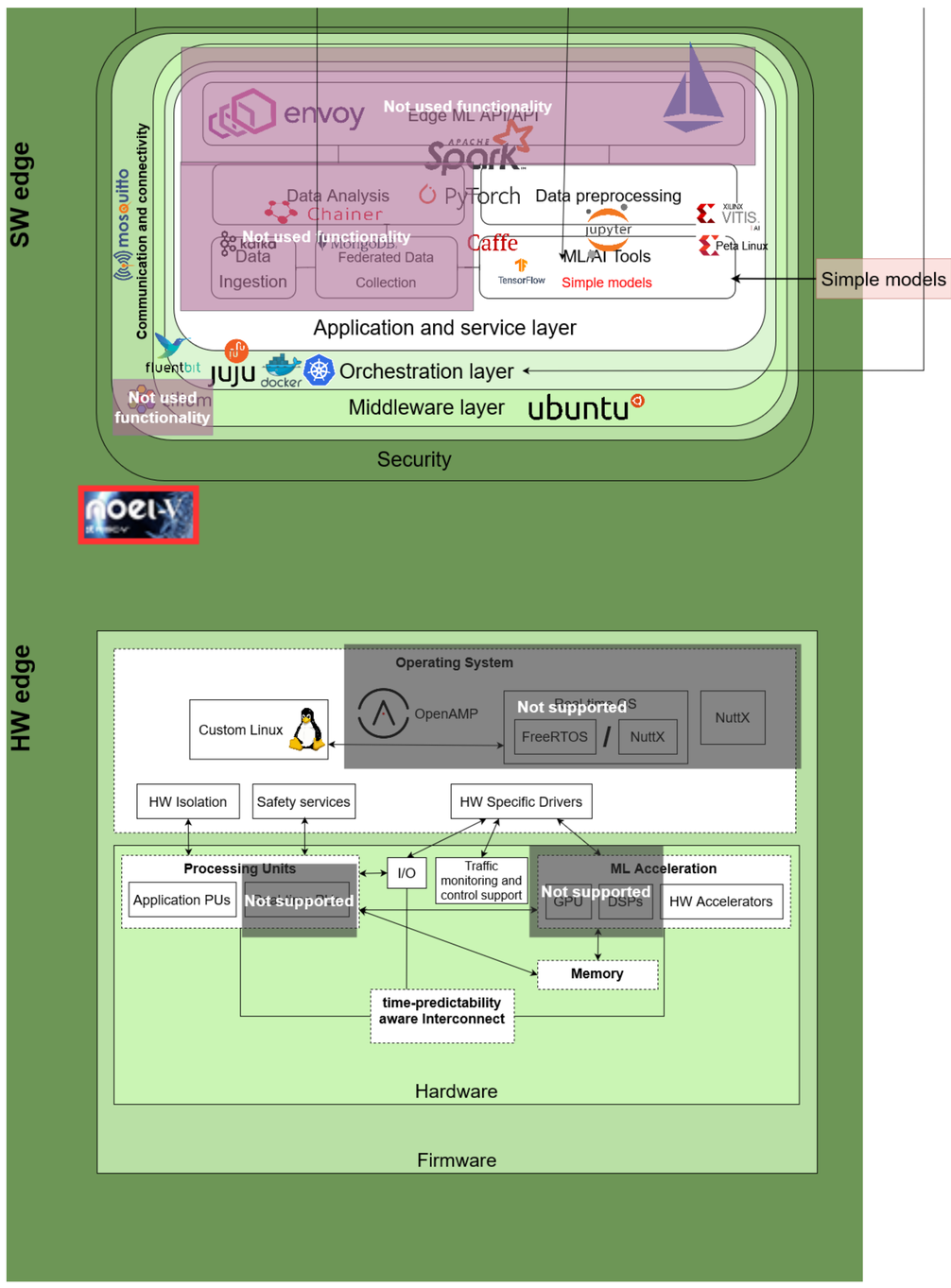
UC Description

The objective of UC7 is to demonstrate the capability of the FRACTAL platform to execute demanding autonomous robot functions at edge computing platforms with limited resources. The demonstrator includes a typical safety relevant function, the collision avoidance function, with requirements on reliability and frequency; as well as an experimental function including artificial intelligence, the path tracking function.

The proposed system will have the ability to:
- Follow a predefined path,
- evade static objects , and
- stop for obstacles on the way.

UC7 consist of:
- FRACTAL Edge node for collision avoidance function,
- FRACTAL Edge node for path tracking function,
- Lidar sensors for object detection,
- Localization system with differential GPS, IMU and odometry,
- Ethernet connection to SPIDER robot platform.

UC7 architecture is filling the gap in the automotive sector between software development for prototypes with powerful hardware and graphics cards and the protective system with low power ECUs.



FRACTAL Components

The FRACTAL platform supports UC7 implementation with components that allow to execute safety relevant functions on the same platform with accelerated AI models.

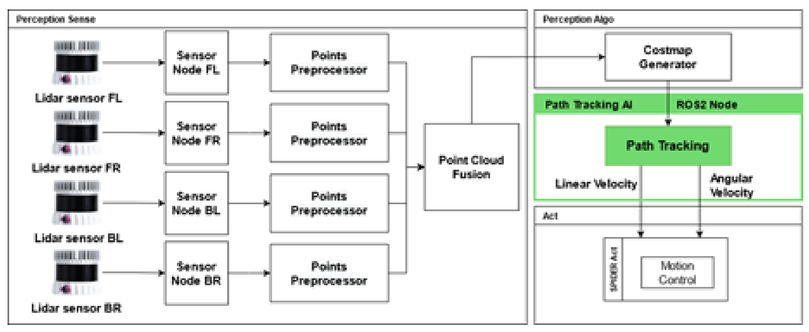
The FRACTAL edge node used for the UC7 consists of:
- RISC-V based NOEL-V processor,
- Hardware accelerator,
- Low Energy EDDL (LEDEL),
- Performance Monitoring,
- Diverse redundancy scheme,
- Deployment with Docker,
- Evaluation with Jupiter.

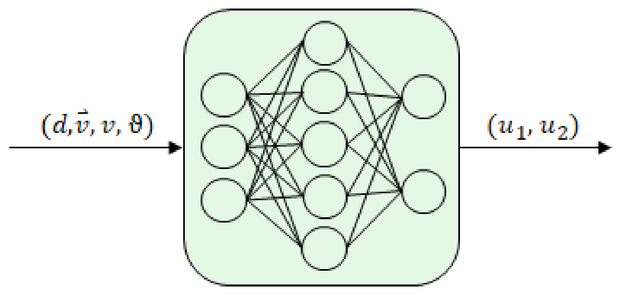
UC Components

The core components of UC7 are the collision avoidance function and the path tracking function.

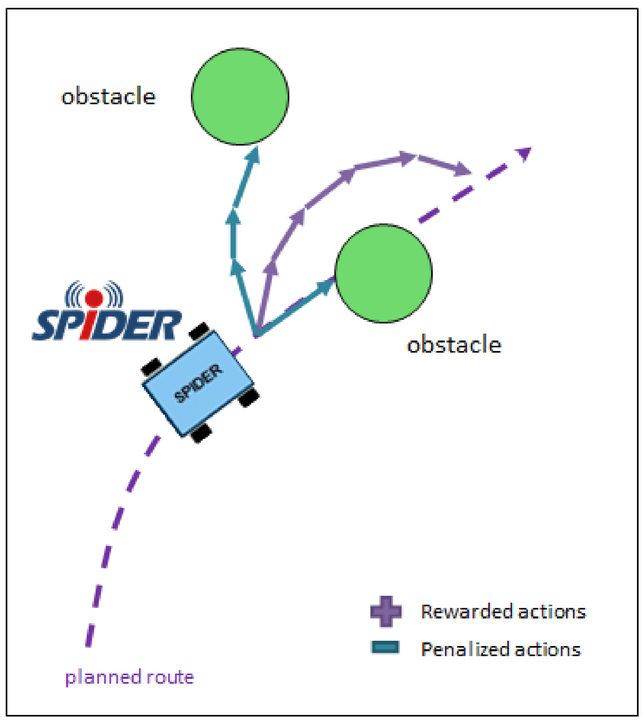
Collision Avoidance Function
- Safe stop in case of an obstacle on the way.
- Using lidar sensors for detection of obstacles.
- Redundant execution.
- Monitoring of process timing.

Path Tracking Function
- Follows a predefined path.
- AI model to evade static obstacles on the way.
- Reinforcement learning approach penalizing path deviation and collisions.
- Adjusted hardware accelerator and LEDEL library for execution





Reinforcement Learning Approach using a NN



KPIs

- Requirements from safety concept based on ISO 26262 satisfied.
- Frame rates of 10 Hz.
- AI model performs with a collision free rate of 95 % at a path deviation < 1m.

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