

Report No. 1

Team XLR8

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1. Introduction:

- The following report contains information about team XLR8's first split during the Bosch Future Mobility Challenge 2025

2. Planned Activities:

Activity	Members	Type
Start of Project meeting	Everyone	Organizational
Hardware maintenance	Armin	Environment Setup
Multiprocessing architecture	David, Razvan	Research
RPI environment setup	Razvan	Environment Setup
CV Workspace Setup	David, Mira	Environment Setup
Lane detection	Mira, David	Research & Development
Simulation Env Setup	Andrei	Environment Setup
Racetrack Setup	Armin, David	Research & Development

3. Status of planned activities:

- Start of Project meeting
 - Status: **complete**
 - Description: General meeting for assigning tasks, responsibilities, and matching timetables
- Hardware Maintenance
 - Status: **complete**
 - Description:
 - Disassembled and reassembled the kit.
 - Re-oiled front and rear differentials.
 - Adjusted ride height and camber on all four wheels.
 - Diagnosed and tested the DC motor and servo motor.
 - Verified sensor connections and functionality.
- Multiprocessing Architecture
 - Status: **complete**
 - Description:
 - Researching and designing a multiprocessing-based planning and control architecture.
 - Focused on ensuring real-time performance and modularity.
 - Initial prototype implemented for testing task distribution and parallel execution.

- RPI environment setup
 - Status: **complete**
 - Description: Installed and configured Raspbian Lite and Rust for low-level programming.
 - Switched to Raspbian Lite for a lightweight, optimized OS.
 - Utilized Rust for memory safety, high-level constructs, and low-level performance comparable to C++.
 - Setup libraries for high-level Python tasks (e.g., OpenCV, PyTorch, Pillow, NumPy).

- CV workspace setup:
 - Status: **complete**
 - Description:
 - Set up an Anaconda environment with essential libraries for computer vision tasks.
 - Configured dependencies that were Linux-only and ensured compatibility for all team members.
 - Set up CUDA-accelerated PyTorch for faster model training and inference.

- Lane Detection
 - Status: **ongoing**
 - Description: Developing, evaluating and benchmarking the performance of two lane detection algorithms based on classical image processing techniques
 - Fully Implemented and fine-tuned a first lane detection approach based on Canny Edge Detection and Hough Line Transformation from OpenCV
 - Started implementing the second lane detection approach based on the Sliding Windows Technique, which involves scanning the image in small windows along the lane area to identify pixels corresponding to the lane markings and fit polynomial curves to them
 - Goal: The goal of this task is to evaluate, benchmark, and compare the performance of the two lane detection algorithms in order to select the most accurate and efficient approach for our system

- Simulation Env Setup:
 - Status: **complete**
 - Description:
 - Using the provided skeleton of a simulator (Gazebo + Ros) we configure our project for smoke-tests and feature testing and evaluation.
 - The plugins for camera and movement are working. The Realsense 435i plugin is working on its own, other sensors might be added in the future.
 - Difficulties: Extensive dependency resolution, lack of documentation on certain packages, and need of using wrappers to convert non Ros code to Ros nodes.

- Racetrack Setup:
 - Status: [ongoing](#)
 - Description:
 - Designed and built a simple testing racetrack
 - Included crossings, intersections, and turns.
 - Difficulties: Bulk material purchases resulted in logistics/storage issues

4. General Status of the project

- Initial working versions of the simulator and lane detection are working. Future work will focus on integrating the two so that development can happen on the simulator.
- The vehicle has been calibrated, a simple racetrack was built and testing will follow.

5. Upcoming activities:

Activity	Members	Type
Start of Sprint meeting	Everyone	Organizational
Lane detection	Mira, David	Development
Steering Assist	Razvan, David	Development
Camera calibration	Andrei	Environmental Setup
Traffic Signs Detection	Mira	Research & Development
Simulation Env Integration	Andrei, Armin	Development
Racetrack Setup	Armin, David	Development