1 Introduction

Currently, the team has made significant progress in the line-following algorithm and its integration with the developments made throughout the competition so far. An important milestone was also achieved with the preparation of a complete track for more realistic testing, allowing us to focus on fine-tuning the autonomous vehicle's performance.

2 Planned activities

- **Camera Handling & Preprocessing** – Manage camera input, including image capture, preprocessing, noise reduction, and ROI definition.
  Responsibilities: Cristian, Emanuel, Agustin | **Type:** Development

- **Define Use-Case & IMU Integration** – Process IMU data, apply noise filtering, and calibrate for accurate vehicle navigation.
  Responsibilities: Cristian, Matias | **Type:** Development and documentation

- **Define Use-Case & Server Testing** – Design and validate communication with the competition server.
  Responsibilities: Cristian, Agustin, Emanuel | **Type:** Development and documentation

- **Intersection Detection** – Implement algorithms for detecting intersections and managing vehicle behaviour at junctions.
  Responsibilities: Cristian | **Type:** Development

- **Position Fusion** – Manage the vehicle's position to follow a predefined map or trajectory.
  Responsibilities: Cristian, Matias | **Type:** Development

- **Traffic Sign Detection** – Implementation of YOLO for sign detection and optimize it for efficient performance on the brain system to ensure real-time processing and accurate detection in the vehicle's environment.
  Responsibilities: Dylan, Emanuel | **Type:** Development

- **Define Path Planning & Validation** – Establish strategies to accurately determine the vehicle's position within a predefined map, considering the environmental context.
  Responsibilities: Agustin, Cristian, Dylan, Emanuel, Matias | **Type:** Planning

- **Define Decision Making** – Design the decision-making process for the state machine that will shape the actions of the autonomous vehicle.
  Responsibilities: Agustin, Cristian, Dylan, Emanuel, Matias | **Type:** Planning

- **Intersection Navigation** – Add the ability to adapt to intersections.
  Responsibilities: Cristian, Dylan, Matias | **Type:** Development

3 Status of planned activities

- **Camera Handling, Preprocessing, Noise Cancelling, ROIs Definition** – With the installation of the new test track, additional tests were conducted to ensure proper functionality in a more controlled environment representative of the competition conditions.
  Status: Completed | **Difficulties:** It was necessary to adjust parameters to adapt the tests we had conducted in the simulator to a more realistic context with the newly installed track.

- **Define Use-Case, IMU Integration, Preprocessing, Noise Cancelling** – Work has begun on IMU data, primarily focusing on its processing for transmission to positioning functions.
  Status: Ongoing | **Difficulties:** No major difficulties.

Bosch Future
Mobility Challenge

- **Define Use-Case and Test Given Servers Information** – We focused primarily on the development of the deliverable and postponed this task.
  Status: Pending | **Difficulties:** Not applicable.
- **Intersection Detection** – We were able to finalize intersection detection by leveraging our new physical work environment.
  Status: Completed | **Difficulties:** We didn't have any issues with this task.
- **Position Fusion** – We are still working on the analysis of this function.
  Status: Ongoing | **Difficulties:** No difficulties at the moment.
- **Traffic Sign Detection** – We have successfully optimized the object detection model by converting it to NCNN format, making it significantly more efficient on the Raspberry Pi 5.
  Status: Ongoing | **Difficulties:** No major difficulties..
- **Define Path Planning and Validation** – Map planning and validation are in an analysis stage.
  Status: Ongoing | **Difficulties:** No blocking issues found.
- **Define Decision Making** – The first prototype of the state machine that will control our autonomous vehicle has been defined.
  Status: Ongoing | **Difficulties:** No major difficulties.
- **Intersection Navigation** – Intersection handling was integrated along with the line-following function that was pending. We refined the performance using the new test lab.
  Status: Completed | **Difficulties:** Since we were working in the simulator and were delayed in obtaining the track, the transition between environments made the task more challenging. However, after a few days of testing, we successfully adapted to the change.

4 General status of the project

The team is moving forward together in the integration of the defined modules. Intersection detection was successfully validated using the new physical track, improving navigation reliability. Lane detection and line-following are fully integrated, and intersection navigation has been refined. Position fusion and path planning are still being analyzed to optimize localization and trajectory control. Traffic sign detection is stable, with ongoing efficiency improvements. The decision-making system is in early development, with an initial state machine prototype defined. The transition from simulation to the physical track presented challenges, but the team adapted quickly. Current efforts focus on finalizing integrations and enhancing overall system robustness.

5 Upcoming activities

- Define use-case, integration (IMU, distance), preprocessing, noise cancelling.
- Define use-case and test given servers information
- Traffic light detection
- Position fusion
- Define objects properties file
- Environmental server interaction
- Define robustness and safety measures
- Define decision making
- Simple action taking maneuvers (parking, stop for traffic sign, stop for traffic light, stop for pedestrian)
- Fine-tune a pre-trained object detection model with a custom dataset.