1 Introduction

This report provides an update on the ongoing development of the autonomous vehicle system, building upon the progress outlined in the previous report. Since the last update, the project has seen continued progress across key areas, including successful completion of lane detection and initial testing of vehicle control algorithms. Current efforts are focused on refining system integration, including the tuning of sensor data preprocessing, finalizing intersection navigation, and testing in both virtual and physical environments.

2 Planned activities

- **Sensing and Input Working Package**
  - **Camera handling, preprocessing, noise cancelling, ROIs definition**
    Manage camera input, including image capture, preprocessing, noise reduction, and define regions of interest (ROIs) for relevant areas.
    - Responsibilities: Cristian, Emanuel, Agustin
    - Type: Development
  - **Define use-case and test given servers information**
    Specify use-case scenarios and validate the provided server data to ensure system reliability
    - Responsibilities: Cristian, Emanuel, Agustin
    - Type: Development
- **Perception and Scene Understanding Working Package**
  - **Lane detection**
    Detect Lane boundaries using sensors and cameras to enable autonomous vehicle positioning within the lane.
    - Responsibilities: Cristian
    - Type: Development
  - **Intersection detection**
    Implement algorithms for detecting intersections and managing vehicle behavior at junctions.
    - Responsibilities: Cristian
    - Type: Development
  - **Traffic sign detection**
    Implementation of YOLO for sign detection.
    - Responsabilities: Dylan, Emanuel
    - Type: Development
- **Behaviour and Motion Planning Working Package**
  - **Define architecture and communication between packages**
    Design software and hardware architecture for the autonomous vehicle.
    - Responsibilities: Agustin, Cristan, Dylan, Emanuel, Matias
    - Type: Planning
- **Vehicle Control Working Package**
  - **Lane following and speed control**
    Implement lane-following algorithms and speed control mechanisms to ensure stability and safe lane detection.

        - Responsibilities: Agustin, Matias
        - Type: Development
- **Miscellaneous**
    - **Prepare physical environment**
      Set up the physical environment with necessary markers, boundaries, and sensor placement for testing lane-following and speed control.
        - Responsibilities: Agustin, Cristian, Dylan, Matias, Emanuel
        - Type: Environment Preparation
    - **Hardware acquisition**
      Analyse, purchase, and install necessary hardware to support the proposed architecture.
        - Responsibilities: Agustin, Dylan, Emanuel, Matias
        - Type: Updates
    - **3D modelling**
      Design mechanical structures for sensor mounting and bases to reorganize electronic boards.
        - Responsibilities: Agustin, Dylan
        - Type: Development

3 Status of planned activities

- **Sensing and input working package**
    - **Camera handling, preprocessing, noise cancelling, ROIs definition**: ROIs defined, and preprocessing steps planned.
        - Status: on going.
        - Difficulties: we resolved the previous problem, and now we are setting up the physical track to properly define the ROI and others parameters.
    - **Define use-case and test given server information**
        - Status: on going.
        - Difficulties: we didn’t have any issues with this task.
- **Perception and scene understanding working package**
    - **Lane Detection**: Path detection functional, but preprocessing inconsistencies affect line stability.
        - Status: completed.
        - Difficulties: we have developed lane detection enough to complement it with the line-following algorithm.
    - **Intersection detection:** Intersection detection functional, but we need to test it in the physical environment, so we might only need to adjust some parameters when switching environments
        - Status: on going.
        - Difficulties: we didn’t have any issues with this task.
    - Traffic sign detection: We have made progress on the task of sign detection, as we gained more time by advancing other tasks such as intersection detection and line tracking, for now, we are controlling the stop sign.
        - Status: on going.
        - Difficulties: we didn’t have any issues with this task.
- **Behaviour and motion plan working package**

    - **Define project architecture and communication between packages**: Initial design adapted to team needs; minor adjustments expected as the project progresses.
        - Status: completed.
        - Difficulties: We didn’t have any issues with this task.
- **Vehicle Control working packages**
    - **Lane Following and Speed Control**: Using Pure Pursuit control algorithm, early simulator tests started. Integration with lane detection pending; mock data used for testing.
        - Status: on going.
        - Difficulties: We didn't accomplish the integration with the lane detection module, so we are generating mock data to test the algorithm.
- **Miscellaneous**
    - **Prepare physical Environment**: we planned to plot a 6x6 test track to install in a classroom of our university, and a 2x3 early test track to test at Home.
        - Status: on going.
        - Difficulties: we are waiting for the 6x6 track to be sent.
    - **Hardware Acquisition**: HC-SR04 sensors integrated, debugging completed; additional hardware acquisitions delayed due to supplier negotiations.
        - Status: on going.
        - Difficulties: we are waiting for the delivery of the required hardware.
    - **3D Modeling**: Initial sensor-mount designs printed; ongoing adjustments to dimensions and new parts development for added stability.
        - Status: on going.
        - Difficulties: the biggest difficulty was making minor corrections to the dimensions of the pieces.

4 General status of the project

The project is advancing steadily with significant milestones achieved. Lane detection, lane following, and intersection detection functionalities are either completed or in the final stages. Both virtual and physical testing environments are operational, with remaining tasks focusing on refinement and integration. Delays in hardware acquisitions are being managed effectively, and the team is addressing minor challenges in testing setups.

5 Upcoming activities

- Camera handling, preprocessing, noise cancelling, ROIs tuning
- Define use-case, integration (IMU, distance), preprocessing, noise cancelling
- Define user-case and test given servers information
- Position fusion
- Define path planning and validation
- Define decision making
- Intersection navigation