1 Introduction

After the initial phase when we needed to wait for our car to come, upon receiving the car model that we needed to program, our first step was to install an operating system for the Raspberry Pi. We successfully transferred it onto the car's board and initiated the system. Despite having mututal issues during the activation of the operating system, we managed to resolve the issues and get the car operational. Ultimately, we achieved our primary goal of running and driving the car by the second report deadline. But, driving the car suddenly our powerboard stopped working so we got another problem to solve. So, our next step was to write to the organization on GitHub in order to get a new powerboard or try to fix it ourselves.

2 Planned activities

In the period after the last monthly report, we received the car, so we were able to physically start it. At the beginning of this cycle, we set the main goals that we wanted to achieve by the next monthly report, namely:

- *Enable remote control of the car* – the main thing to do was to install the right Operating System for the Raspberry Pi which controls the whole car
- *Drive the car on the track* - an important thing to say is that we also have a track that we have set up on which we can drive a car
- *Record a video of the car driving of the track*
- *Implement the line detection algorithm on the car* – using YOLOv8 algorithm
- *Implement recognizing the traffic signs*

The first three tasks needed to be done by Lazar, Kristina and Ognjen, and the last two tasks were needed to be done by Maja and Andrej.

3 Status of planned activities

Tasks 1, 2 and 3: As for the first task we installed the operating system as indicated in the documentation. At first there were problems installing certain packages through the terminal, so we had to install several times until we finally started the car. After successfully setting the operating system to the Raspberry Pi board, we drove the car on the set track and recorded a driving video that clearly shows the lines and traffic signs where the car is moving. This video was necessary for later line detection and traffic sign recognition. To download the video we had to create a server. This part of job is done by *Lazar*, *Kristina* and *Ognjen*, as it was decided earlier.

Tasks 4 and 5: To address the effectiveness of algorithms for line and traffic sign detection, we tested multiple methods to identify the optimal solution. *Maja's* task focused on evaluating a deep learning-based algorithm, specifically YOLOv8, an one-stage object detection algorithm known for its speed and real-time applicability.
The project used a dataset of 984 images, divided into training (80%), validation (15%), and testing (15%) sets. The YOLOv8 model was trained on 774 images across 100 epochs, using gradient descent optimization to refine weight parameters. Performance was assessed through precision, recall, and F1-score, evaluating the detection of lines, traffic signs, traffic lights, and pedestrian markings.
Beyond static images, the model was tested on an unseen video with challenging lighting and environmental conditions. Despite no prior exposure to similar scenarios, the model demonstrated satisfactory results, particularly in line detection and managing false

positives/negatives. The test highlighted the potential of incorporating video data into training to enhance robustness.
YOLOv8's efficiency and accuracy make it well-suited for real-time applications. While initial results were promising, future work could improve model performance by fine-tuning hyperparameters and expanding the dataset to cover more complex scenarios. An accelerated video showcases the model's capabilities in real-world conditions.
Andrej's task involved using a car-mounted camera video to detect white lines essential for autonomous driving.
The function **process_frame** processes each video frame to detect and highlight straight lines within a defined region of interest. The key steps are:

1. **Grayscale Conversion**: Simplifies analysis by enhancing contrast and visibility of key details.
2. **High-Intensity Filtering**: Removes reflections and overly bright regions for better clarity.
3. **Smoothing and Edge Detection**: Reduces noise and identifies potential lines.
4. **Region of Interest Definition**: Focuses detection on a specific frame area to improve accuracy.
5. **Line Detection and Drawing**: Identifies straight lines using reliable methods and overlays them on a blank canvas.
6. **Combining Results**: Merges detected lines with the original frame and visually marks the region of interest for clarity.

This process highlights relevant lines while ignoring unnecessary elements, simplifying video analysis for autonomous driving applications.

4 General status of the project

The current state of the project is such that remote control of the car is enabled, as well as line detection and recognition of traffic signs. However, during the development of our plan and work on the car, we encountered many problems of a hardware nature.
Namely, while testing our algorithm for character recognition and line detection, our power board stopped working. Through a detailed analysis, we determined what kind of problem it is. With a multimeter, we checked the correctness of our board and the spread of the signal.
Our conclusion is:
The P mosfet in the switching circuit is short-circuited, and therefore the LED received a constant voltage, and regardless of the state of the switches, it lit up. The switch works correctly. The voltage from the battery comes to the input of the voltage regulator whose output should be 5V, but its output is 0V. The regulator itself is not in proper condition.
How did we solve the problem?
At the output of the regulator there is a coil, which we unsoldered from the board. In translation, we separated the regulator from the rest of the circuit. Instead, we put "external". We connected its input to the power supply from the battery, and connected the output to the end of the coil, which further leads 5V to the connectors that are important to us.
There are photographs in the prologue

5 Upcoming activities

The next plan of this project is the training of automatic car control