1. Introduction

As freshmen, we have struggled with balancing between adapting to the university environment while completing this project to our best abilities. Despite hardships in car tuning and calibrations, we have managed to overcome them, as well as learnt new things, from technical to managerial skills

2. Planned activities

In the course of four weeks, we have divided our tasks correspondingly to the timeline as follows:

+ First 2 weeks: All members read the given regulation, documentation, and GitHub repositories, as well as understand the contest's criteria.

+ 3rd week: Team mechatronics improves the hardware part of the car, while team CS installs and runs the given simulation system.

+ 4th week: Team mechatronics does calibrations, while team CS starts researching the perception part of the car

3. Status of planned activities

1. Documentation Analysis: Status: 100%.

This allowed us to understand what to do and therefore we could plan consisting of milestones for each Project Status. By doing this, the whole team could understand what was there for us to complete and follow, and the team leader could assign tasks to teammates according to their abilities. The documentation provided was not easy to fully understand or follow, so each of us folks had to review it a couple of times while taking down notes so that we won't forget and for the other teammates to catch up with.

2. Code base Analysis: Status: 100%.

To grasp how the code works, the team leader assigned different repositories on the BFMC GitHub for different teammates to read and then write what they've learnt down on an opened docs in simple words for other teammates to understand. We've faced quite a lot of difficulties during this task. The base codes of Brain, Embedded_Platform,… were really long and not quite easy to understand, so our team had consulted our mentors, seniors that'd competed in this challenge before and even AI so they could explain to us, along with running the code to see what each submodule do and its role.

3. Tuning the car: Status: 100%.

We spent over 8 hours on this part even though the recommended time length was only 4 hours. We tuned the car in accordance with the recommendations of the BFMC documentation. Difficulties: small challenges kept showing up (stripped screws head, greasy car, unfitted battery head,…). The cover of the ball joint of the right front wheel isn't compatible with the ball joint itself. The worst part is that we are students from two distant universities and each time we planned for a meet up, we came up against with mismatch schedule and difficulties in commuting between two universities because of the distance. To solve this problem, we had to choose 2 specific days that all teammates are free so that we can meet up and work on the project.

4. Developing algorithm for lane detection: Status 100%.

For lane detection, we considered various approaches, including machine learning, but recognized that heavy computation could degrade the car's performance. We therefore chose a non-AI lane detection algorithm described in the paper *"How to Win Bosch Future Mobility Challenge"* by the BFMC 2024 first-place team. As we were new to image processing and transformations, implementing the algorithm directly from the paper was challenging. To build the necessary foundation, we studied additional resources, including a repository by Thomas Fermi. This enabled us to understand, implement, and test the algorithm using downloaded road images. Real-world testing on the car will be conducted in the coming weeks.

5. Calibration: 85%

We have finally done with the calibration of the car. We have managed to get our hands on the dashboard so that we can control the car, having it run straight, turning right and left. Furthermore, we have also managed to send commands to adjust the speed as well as the steering angles of the car to our will. This allowed us to make sure that the RC car will run in accordance with our control and that it will run more smoothly. However, we still encountered a problem with giving commands the USB port's connection is not stable. This means that half of the time, the system wouldn't respond to our commands. We are currently working on this matter with the help of our mentor, trying to figure out a more efficient way.

4. General status of the project

Through dedication and hard work, our team has managed to get our hands on controlling the car. We can now control the car to run straight, making turns through the dashboard. But there are still some issues awaiting us to fix. The problem is the steering part of the front wheels. We gave command for the car to go straight but due to some mechanical problems, the wheel is misaligned by 5 degrees, making the steering inaccurate. Therefore, the car keeps moving diagonally instead of running straight as commanded. We will keep working on this problem.

5. Upcoming activities

1. As for the aforementioned problem, we will try to calibrate the steering and the speed of the car so that it can run smoothly.

2. Our team will focus more on the perception part, including lane and object detection, and the car's brain's control part, enabling it to handle multiple tasks properly and effectively.

3. If possible, we will create a custom dashboard to serve the further development process and allow for easier usage.

Reference:

Papafotiou, T., Tsardoulias, E., Nikolaou, A., Papagiannitsi, A., Christodoulou, D., Gkountras, I., & Symeonidis, A. L. (2025). How to Win Bosch Future Mobility Challenge: Design and Implementation of the VROOM Autonomous Scaled Vehicle. *Machines*, *13*(6), 514. https://doi.org/10.3390/machines13060514

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