

1 Introduction

This month, our car successfully performed basic maneuvers, and we installed a new Logitech camera on it. This month our team archived the following:

- Building an algorithm for lane tracking.
- Setting up server for localization on map.
- Research on position fusion.
- Detect intersection.
- Detect road signs.
- Setup communication between STM32 and Jetson Xavier.

2 Planned activities:

Activity Description	Members in Charge	Type of Activity
Building an algorithm for lane tracking	Lâm, Trâm, Khôi	Development
Setting up server for localization	Minh	Development
Research on position fusion	Minh	Research
Detect intersection	Trâm	Development
Detect road signs	Khôi	Development
Setup communication between STM32 and Jetson TX2	Khanh	Development

3 Status of planned activities

- **Building an algorithm for lane tracking**
 - **Status:** Completed
 - **Implementation:** The algorithm works by identifying the point sets for the left and right lanes. It then uses polynomial fitting (polyfit) to determine the functions representing each lane. Based on these functions, the middle point set of the road is calculated, and the angle is determined using the middle point set.
 - **Difficulties:** There are many exceptional cases where the algorithm fails to determine the middle point set. To address these, we had to introduce numerous parameters for fine-tuning, making the code lengthy and difficult to understand. Additionally, calculating the left and right lane functions requires significant computing resources and time, leading to unnecessary delays. To overcome these challenges, we plan to implement a neural network for lane-keeping
- **Setting up server for localization on map**
 - **Status:** Completed
 - **Implementation:** Read document and the provided code of *Computer and Brain*. Learn how to use the MDEK1001 kit and find available code to communicate with it.

- **Result:**
 - o Understand the flow of communication between server and brain.
 - o Set up anchors and tags, then get their information (location, id, ...) using computer.
- **Difficulties:** It is hard to become familiar with the Twisted library and multiprocessing at first.
- **Research on position fusion**
 - **Status:** Ongoing: 50%
 - **Implementation:** Learn the theory of the Kalman filter and read the paper on how to model our system based on information from the IMU and UWB systems.
 - **Result:** Slightly understand the concept of the Kalman filter and the mathematics underlying it.
 - **Difficulties:** It is easy to get lost with a ton of math and new concepts.
- **Detect intersection**
 - **Status:** Completed
 - **Implementation:** Detect horizontal line by finding connected lines with certain threshold and RoI
 - **Difficulties:** The y-lines still visible in curve road which makes the algorithm mismatch. Therefore, we should find appropriate threshold for our algorithm.
- **Detect road sign**
 - **Status:** Completed
 - **Implementation:** We use yolov5 nano model for detecting road signs, because it has fast inference time and light to use.
 - **Difficulties:** If the environment around the race track is completely different from the dataset we use to train, it may cause disturbances.
- **Setup communication between STM32 and Jetson Xavier**
 - **Status:** Completed
 - **Implementation:** We use serial communication to communicate between STM32 and Jetson Xavier, 2 boards connected using a USB wire.
 - **Difficulties:** The library to setup serial communication is hard to understand and use. Sometime data sent was corrupted so we have to check if the data received is intact or not.

4 General status of the project

The car now has the capability to detect lanes and maintain its position on straight and curved road. It can detect intersection but can not cross the intersection yet. The car is still occasionally stepping on the lane, still need to improve algorithm.

5 Upcoming activities

In the next month we will do the following things:

- Improve algorithms for lane tracking.
- Intersection navigation
- Position fusion.
- Road signs, lights and pedestrian detection
- Define decision making
- Define path planning and validation