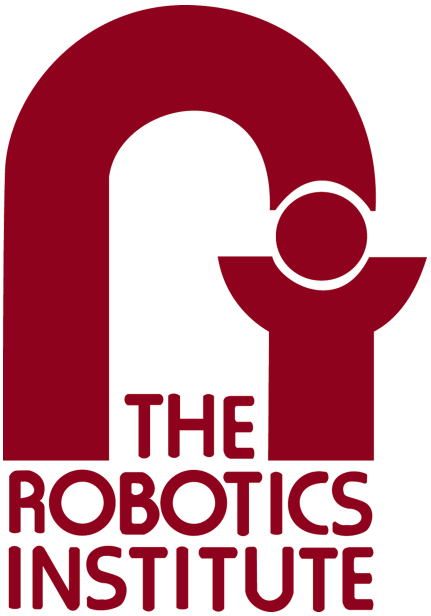


MRSD Project Course

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**Team I – AIce**

# Autonomous Zamboni Convoy

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## Individual Lab Report 5

**Team**

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Nick Carcione

Yilin Cai

Jiayi Qiu

Kelvin Shen

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Contents

# 1. Individual Progress

Since the last Progress Review, I majorly worked in three domains:

a. Integration of Jetson Xavier and Arduino with Encoder on RC Car
b. Validation of localization on RC Car
c. Final PCB development with soldering

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## 1.1. Integration of Jetson Xavier and Arduino :

I worked on integrating the jetson with Arduino on an RC car so that we can control the Arduino with ROS. The major task was migrating the whole stack on Arduino to ROS so that we can use ROS Serial to communicate between them (Figure 1). I also validated the integration by doing unit testing of each sub-section of the code after migrating it on Jetson, namely unit tested

a. Encoder Reading Code
b. Steering Control Code
c. Velocity Control Code
d. ROS – Arduino communication code

Another important task under this activity was setting up the environment so that Arduino, ROS, and all the sensors can work flawlessly and with just a single click. So I created a package to launch the Arduino - RC control code, perception code as well as communication code and unit tested that as well. The complete integrated system is shown in figure 2.

This was an important activity before moving ahead to validate our localization stack on the vehicle.


Figure 1. Integration of Jetson Xavier and Arduino

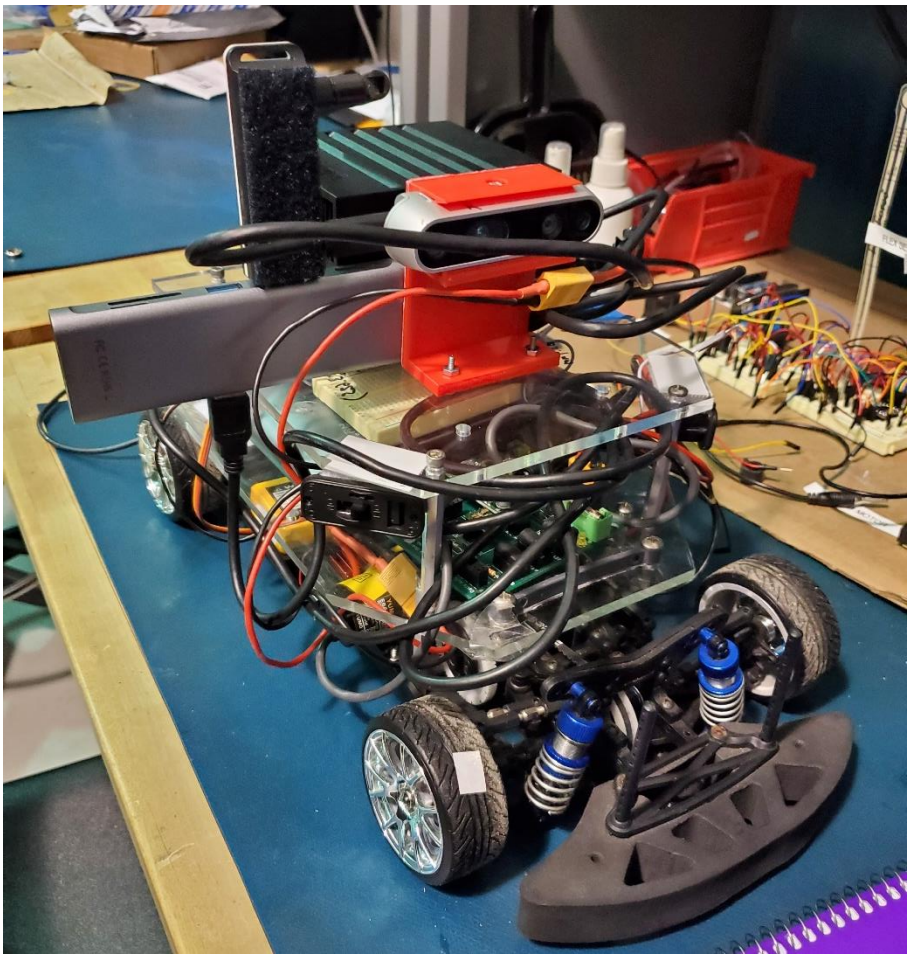

Figure 2. Final Integration on RC Car

## 1.2. Validation of Localization subsystem on Hardware

The other main task that I worked on was validating the localization stack on the RC Car. I first worked on getting the wheel odometry data (wheel rpm and distance traveled) from the encoder installed on the RC Car. This was then used to fuse with the IMU data from the RealSense camera to get the vehicle localization. This was integrated with the Jetson and we validated the localization as per the performance requirements. By integrating with the IMU, we could also get the yaw angle of the vehicle along with fusing x and y positions as shown in figure 3.

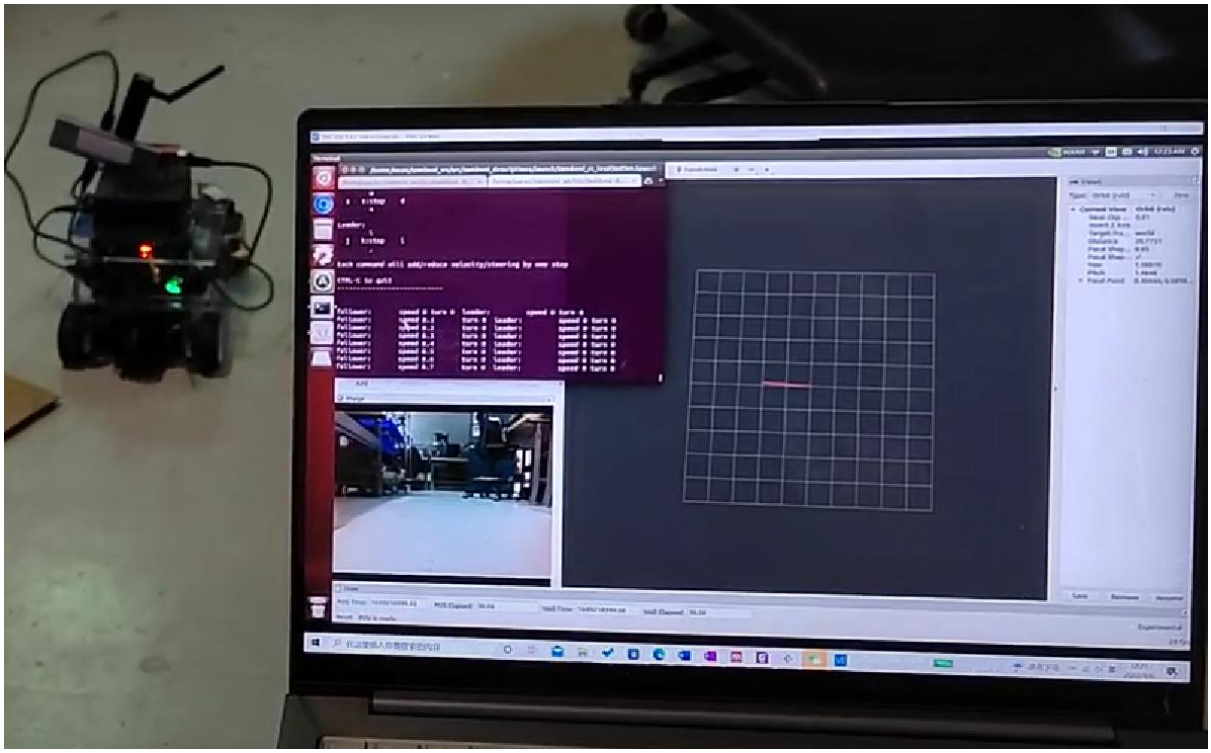

Figure 3. Localization Validation on the RC Car

I then carried on the testing in the NSH Basement by measuring the actual distance moved by the vehicle, its actual position on the ground concerning the origin, and also the odometry values given by the localization node as shown in figure 4. The x position error was lesser than 0.1m and the y position error was lesser than 0.3m.

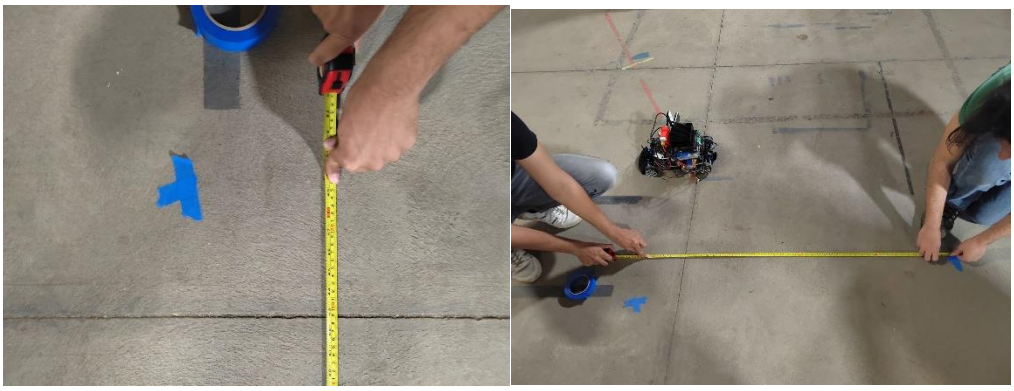

Figure 4. Validation of Localization

### 1.3. Development of power distribution board PCB

I developed the power distribution board PCB for the RC car and tested it out. This included soldering the required components on the PCB (with help of Kelvin) and validating the working of the individual parts. Once the whole system was soldered, I made the necessary connectors to connect the motor and Arduino. I fitted the PCB on the RC car and tested its final working.

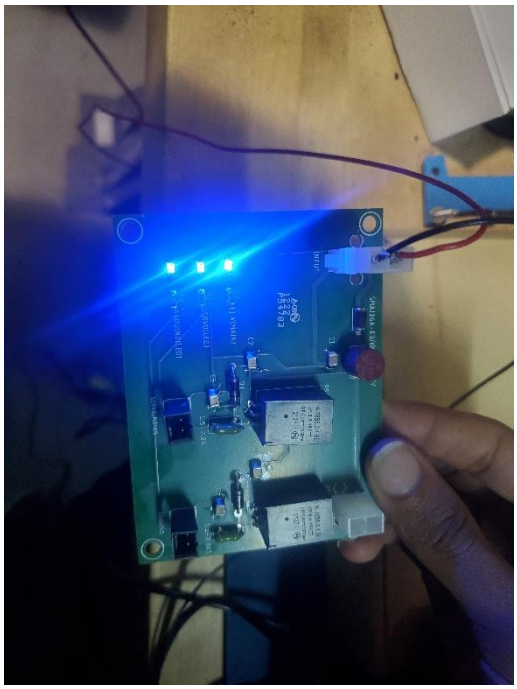

Figure 5. Power Distribution PCB

## 2. Challenges

The main challenge was faced when validating the localization of the RC Car. The major challenges are highlighted as follows:

- Ground clearance of RC car after integration
- Adjusted suspension system, replaced wheels
- OpenCV on Jetson
- Communication between ROS and Arduino

Another challenge was soldering SMD components on the PCB, these being very small, had to be very careful while soldering.

# 3. Teamwork

### a. Kelvin Shen

Kelvin worked on the following:

1. Completed two-camera setup with three marker boards on left, rear, and right sides of the follower to avoid losing track of the markers
2. Got Husky running
3. Integrated pose estimation with waypoint generation with Jiayi
4. Soldered PCB with Me

### b. Nick Carcione

Nick worked on the following:

1. Added PID speed control to the RC car using encoder measurements
2. RC car integration and tire change/suspension fixing
3. Helped run localization tests and debug ROS-Arduino communication

### c. Yilin Cai

Yilin worked on the following:

1. Integrate odometry of RC car using encoder and IMU for localization, and tested localization accuracy with Me and Nick
2. Integrate remote teleoperation and odometry visualization on RC car
3. Integrate perception, motion planning, and control code on RC car
4. Solve real sense communication problem with Kelvin

### d. Jiayi Qui

Jiayi worked on the following:

1. Integrated two-camera perception subsystem with waypoint generation with Kelvin
2. Optimized waypoint generation to maintain the longitudinal offset
3. Improved the initialization process for leader-follower convoy

## 4. Future Work/Plans

Following is the plan for the coming weeks:

- Smooth follower local path to deal with perception noises
- Validate yaw localization
- Test leader detection using RC car and Husky
- Integrate vehicle controller on RC car
- Finish and validate simulation
- Conduct real-world leader-following test

# 5. Appendix

PDS schematic

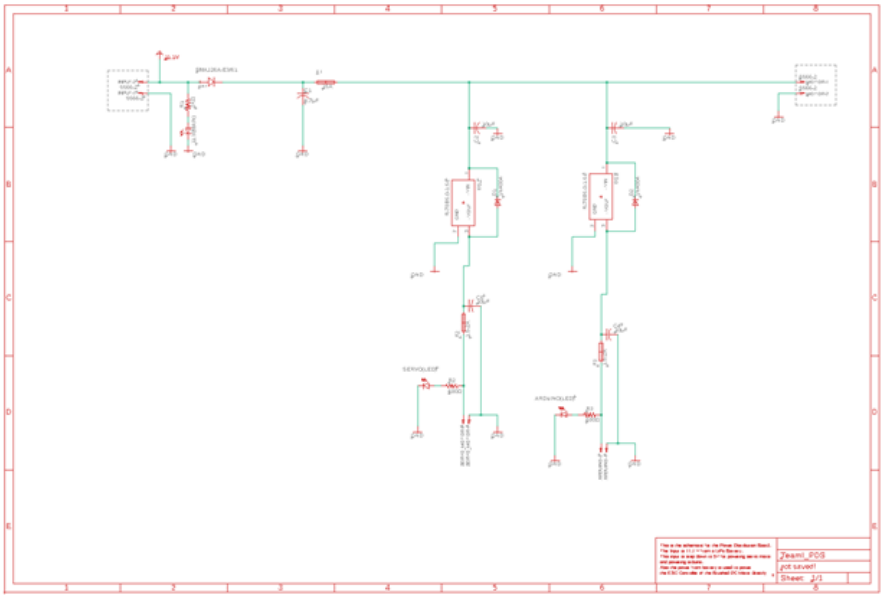

Figure 6. PCB Schematic

PDS layout

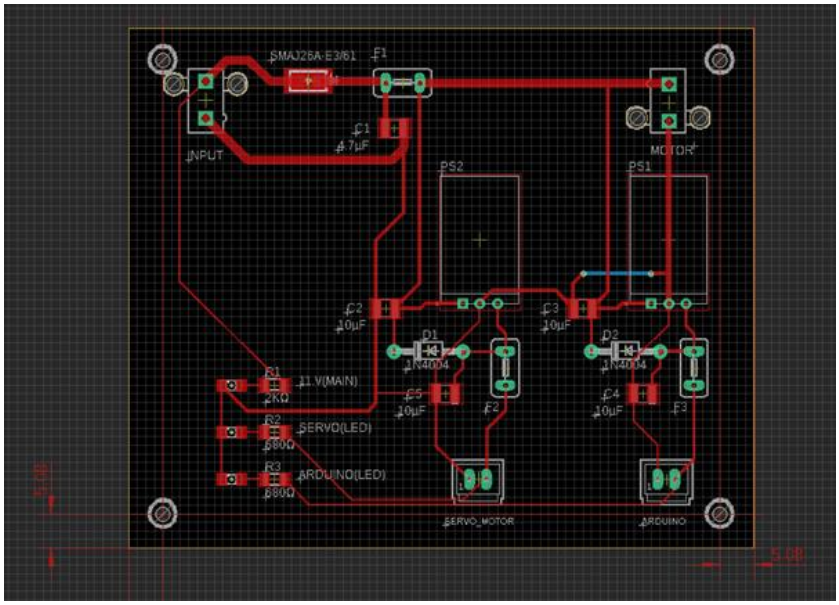


Figure7. PCB Layout