Autonomous vehicle with automatic lane following

Northern Illinois University

Antaruo Mama, Liam Soroghan

***Abstract*—The objective of this project is to design and produce a scaled vehicle that can automatically detect lanes, follow the lanes that are detected, and avoid obstacles impeding the vehicles path. The components of this vehicle included on the platforms allow the vehicle to perform as described above. These main components include an RPlidar, along with multiple cameras (Intel Realsense D435 and Intel Realsense T265) and finally the Nvidia Jetson Xavier. The RPlidar will be used to measure range by sending light in form of a laser while the two cameras are for vision. The D435 is used for RGB and depth sensing while the T265 is used for tracking. The Jetson Xavier is used as a mini-Linux computer that connects the programming to the connected sensors.**

I. Introduction

This project will focus on building an autonomous vehicle with automatic lane following, lane changing, and obstacle avoidance. The objective of the project is to make a small scale self-driving vehicle that uses several sensors to drive itself by avoiding any obstacles that can be encountered on the road. The motivation behind this project is to expand on previous research and studies of autonomous vehicles on a smaller scale with lower budget. With most existing autonomous vehicle being valued at high prices, Team 59's project will help future RC autonomous vehicles to be more cost efficient. The work done on a small-scale vehicle will create an opportunity to further the university's research on autonomous vehicles as well as transfer knowledge and technology to the automotive industry.

II. Methodology

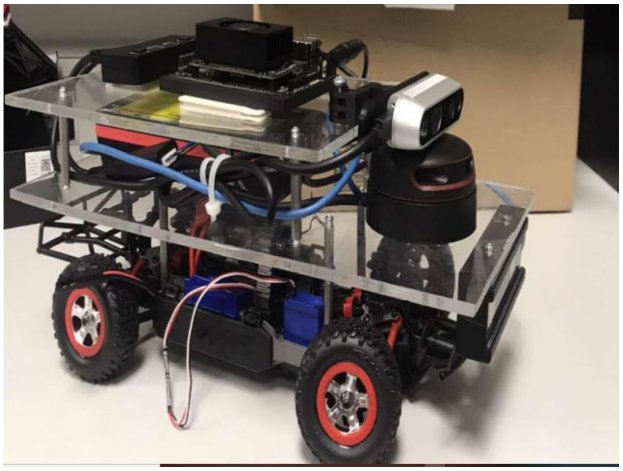
Team 59 decided to split the project into two parts. These parts are the hardware section of the project and the electronic components, including the programming of the vehicle. The first half of the school year was dedicating to studying the problem, developing solutions and researching components of build. The second half of the school year was dedicated to completing the electronic components such as the programming and integrating all the component into the chassis build.

A. Hardware.

The hardware part of project includes machined acrylic platforms, computer automated design (CAD) cases to hold the sensors, which were formed in Solidworks, and the assembly all the components. The autonomous vehicle is one-sixteenth scaled, therefore it cannot support the loads of all the components tight packed on top of the chassis. Due to this, two acrylic platforms were designed to evenly distribute the weight and raise the center of gravity of the vehicle allowing it to function properly.

The vehicle includes three different levels. The first level consists of the base of the chassis, steering components and the motor. The second level consists of a high voltage battery to power the Jetson Xavier and the attached sensors, as well as the RPliadar and the T265. The lidar is located in the front of the vehicle due to the position allowing maximum view of the surrounding area. The high voltage battery is located on the second level due to its size and weight. Finally, the T265 is located between the first and second level. This position allows a clear view of the track and allows the tracking feature of the T435 to be fully

optimized due to the full vision of the sensor. On the third and final level, we have the D435 , the Jetson Xavier and the USB hub. The position of the Jetson Xavier and the USB hub allow easy accesses to the computing components of the project. At the top of the vehicle, adjustments to the program or anywiring issues can be easily located and fixed. The Intel Realsense D435 is located at in the front of the third level and just above the RPlidar. This positions allows for easy angle adjustment if needed and allows the sensor to see a board display of the surrounding area with no impleaded view.



B. *Programming*

For the programming aspect of this project, Dr Hassan Ferdowsi referred us to multiple sources including F1tenth.org and JetsonHacks.com. In these websites, the steps to achieving an autonomous vehicle are laid out in step by step instruction. In this code, the D435 will send snapshot of its vision and will be analyzed to find the lanes that the vehicle will need to stay within, as the images change and the lanes begin to move, the vehicle will adjust and stay within the visible lanes. Along with this, the D435 will work with the RPlidar to detect oncoming obstacles impeding the vehicles path. The use of the depth sense function on the D435 and the RPlidar will display a depth field view of the upcoming surroundings. As objects begin to approach the vehicle, the sensors will detect this and allow the vehicle to switch lanes. Finally, the T265 will allow the path of the vehicle to be tracked, keeping the information of the obstacles that are in the way.

III Results

After the loss of a group member due to him dropping out of the university, Dr. Hassan Ferdowsi allowed us to use only the D435 and the T265 sensors due the increase in workload on the remaining members. With this change in in the project, Team 59 successfully used the Jetson Xavier to program both Intel Realsense cameras and write a feedback loop program that allowed these sensors to receive the intended data and give that data to the Jetson Xavier. With the known data constantly changing, the vehicle was able to move lanes and avoid obstacles.

IV . CONCLUSION

While researching and developing new information on this project, Team 59 was able to expand on the project statement, background ideas, and purpose of the project, which is to create an autonomous vehicle that can change, follow the lane, detect obstacles in front of the car and on the side the car, and automatically change lanes.

The Team was a little behind because of a teammate that dropped out mid semester, but the team is going to complete the project as intended by the client, Dr. Hassan Ferdowsi. The final specification from the client that will allow us to complete the project are completing the hardware parts and implementing a code that will manually move the car.

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