DEPARTMENT OF
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TCU COLLEGE OF SCIENCE & ENGINEERING

Autonomous Vehicle With Room Mapping And Obstacle Avoidance

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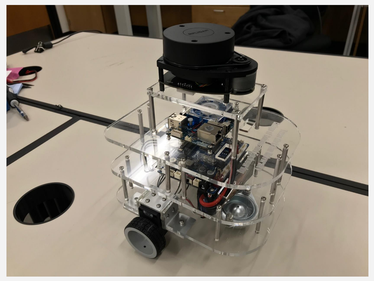
The goal of this project is to design and construct a small modular autonomous car with room mapping and obstacle avoidance capabilities. The vehicle would be useful in cases where it is dangerous for a human to complete a task, or where it is more efficient to have an autonomous vehicle to scout ahead. A key design goal for this project was also to create an inexpensive platform for research into the realm of autonomous vehicles. The car uses lidar technology to create real time 2D room map and detect obstacles. It is programmed to explore rooms and move without human input. We designed the car with a powerful on board computer, enabling it to run complicated programs and operate without the need of an outside computer.

Background

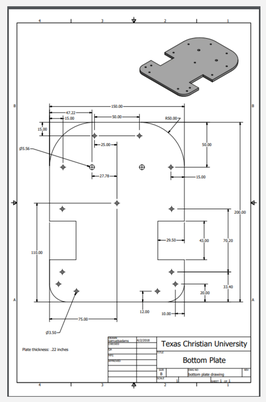
❖ Motivation: Need an effective, user-friendly and affordable way to physically communicate and send medical supplies between severe patients and doctors in hospitals.

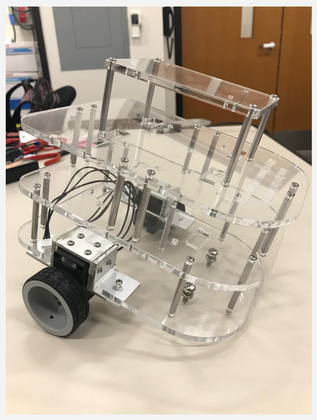
❖ Goals:
- Create a small unmanned vehicle as a communicator between patients and doctors
- The unmanned vehicle can generate 2D maps at locations it travels through, which enables the autonomous driving and effective interaction in the hospital.



Construction of the Vehicle

❖ **Chasse**: Designed and manufactured by our team





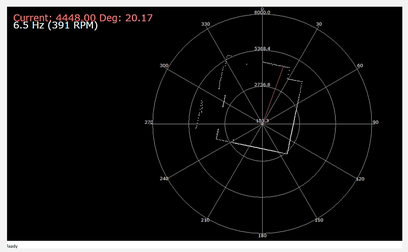
❖ **Components:** Ordroid, RPLidar, OpenCR, Stablizer, DYNAMIXEL motor, LiPo Battery

Core Technology

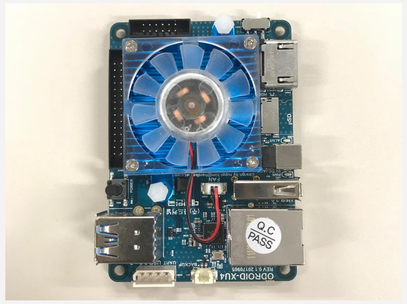
❖Motor:
- Our codes are developed from the DYNAMIXEL-Workbench (DW) library, which is a variant of the Robot Operating System (ROS) library. DW library allows us to control the motor on two modes: Joint Mode and Wheel Mode. Joint mode controls the motor with respect to position, and wheel mode operates with respect to speed.
- Function itemWrite() allows us to set a goal position/speed for the motor, and itemRead() allows us to read the current position/speed of the motor. syncWrite() function is used when we want to run both motor simultaneously to minimize the discrepancy between the two. We use a combination of those functions to accurately control the position and direction of the car.

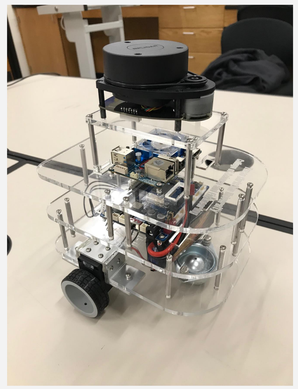
```
dxl_wb.itemWrite(DXL_ID, "Goal_Position", goal_position[index]);

dxl_wb.syncWrite("Goal_Position", goal_position);

present_position = dxl_wb.itemRead(DXL_ID, "Present_Position");
```

❖RPLidar:
- The RPLidar sensor is a time of flight rangefinder that takes measurements while rotating to create a 2D map of its surroundings. This was used in the car to measure relative distances between the car and obstacles as well as to provide a visual understanding of its location.
- The RPLidar spins at 330 rotations per minute, and takes 2000 samples per second. This allows it to create an accurate real-time map of its surroundings.



❖**Ordroid**: An onboard, small computer used to process the sensor data without the need of an external PC





The Application

❑ The car demonstrates the ability to generate a 2D map of its environment using the RPLidar sensor. This allows the car to detect obstacles, and allows the operator to learn the geometry of the car's surroundings. The design of the car is modular, enabling it to be customized to fit its desired task.

❑ The use of two motor driven wheels and one stabilizing ball makes the car highly maneuverable in small areas. The car is able to operate autonomously, enabling it to move items and gather data without being controlled by a human.

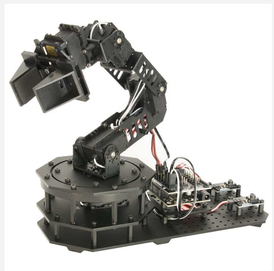
Future Goals

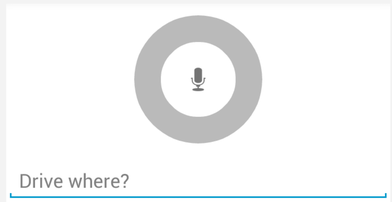
❖ The team has decided to search for ways to improve the car and make it more effective in its application. These goals include:

1. Add a robot arm to enable safe movement of dangerous items.

2. Develop an algorithm using machine learning to make the car more effective in navigating its environment.

3. Add voice control capabilities to allow the car to be controlled by anyone.





Conclusions/Results

This model of the robot car demonstrates that the unmanned vehicle can navigate its surroundings while avoiding obstacles and generating a 2D map. These capabilities are made possible by the RPLidar sensor data, accurate positioning of DYNAMIXEL motors, and real-time data processing of the ODroid. In the future, we would like to collaborate with the hospitals in order to develop something that can benefit them the best.

Acknowledgements

The team is thankful to Dr. Kiani for her support and mentorship in developing this project, and for her dedication to ensuring its success. We are also thankful to Ms. Tammy Pfrang for her assistance with logistics and resolving technical issues. Additionally, we are grateful to the TCU College of Science and Engineering and SciCom for their dedication to undergraduate research opportunities.