AutoMav

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Executive Summary

The purpose of this project is to design and construct an intelligent ground vehicle. With this vehicle we plan to go and compete in the 27th Annual Intelligent Ground Vehicle Competition (IGVC) in June of 2019. By completing this project, the team will experience designing and developing a functional product from scratch while becoming familiar with new technologies along the way. This competition will give the team a chance to showcase their work and demonstrate what the team has learned while studying Computer Science and Computer Engineering at UT Arlington.

Background

Autonomous vehicles have applications in military, industrial, and commercial areas. The goal of IGVC is for the team to construct autonomous unmanned ground vehicle. The vehicle will be tested on an outdoor course defined by painted lanes and both painted and physical obstacles. The vehicle will be given a GPS location to navigate to and must do so without crossing lane markers or striking any obstacles. Related work regarding this project can be found through previous participants of IGVC. The first-place winner in the 2017 IGVC competition was IIT Bombay, their design included 2 motor powered wheels with a single caster wheel in the front, with changes in torque on each wheel affecting how it turns. Their vehicle's sensors included LIDAR, IMC, 2 cameras and a GPS sensor. The second-place winner from that year had two front powered wheels with two caster wheels in the back. Their sensors included a 3D and a 2D LIDAR camera, along with a gyroscope, GPS and omni directional camera. With these sensors, the camera data is used to detect the painted lanes, while LIDAR is used to detect the physical obstacles in order to navigate the course.

Prototype Checklist

ID	Milestone	Status
1	Building housing unit	Complete
2	Develop wiring diagram	Complete
3	Connect underlying systems	Complete
4	Establishing motor connection	Complete
5	Simulation of system	Complete
6	Determine GPS location	Incomplete
7	Establish point cloud video feed	Complete
8	Establish motor control sequences	Incomplete
9	System capable of independent decisions	Incomplete

Table 1. Checklist

Experimental Test Plan

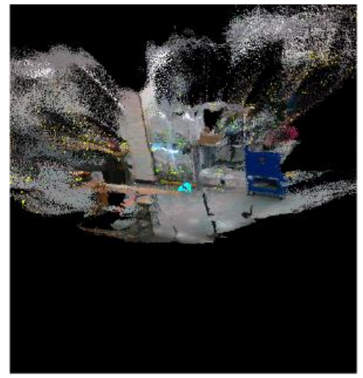
The goal for our project is to create a system that satisfies all the following requirements:

1. The vehicle must maintain contact with the ground
2. The vehicle must have a mechanical emergency stop button
3. The vehicle must have a wireless emergency stop function
4. The vehicle must have a safety light that indicates its current operation
5. The vehicle must carry a payload of 20 lbs and measuring 18" x 8" x 8"
6. The vehicle must demonstrate lane following
7. The vehicle must demonstrate obstacle avoidance
8. The vehicle must utilize way-point navigation
9. The vehicle must complete the course in under 10 minutes
10. Computation, sensing and motion control must occur on board the vehicle

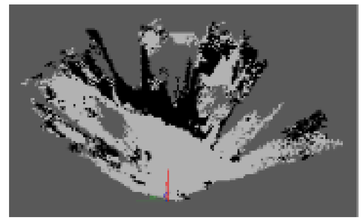
Once the system has been implemented, the nature of this project requires testing to be performed outdoors in an open area. The system will be taken to an open field and each specification will be tested.

Implementation

3D Point Cloud:



Occupancy Grid:



Conclusions

This project has allowed us to implement several machine learning techniques and tie them all together into a single functioning system. We were required to learn how to apply the techniques and tie them together using Robot Operating System(ROS).

References

[1] Indian Institute of Technology Bombay
http://www.igvc.org/design/2017/8.pdf
[2] Hosei University
http://www.igvc.org/design/2017/6.pdf
[3] Bob Jones University
http://www.igvc.org/design/2017/2.pdf