IGV: Intelligent Ground Vehicle

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Team Introduction

Intelligent Ground Vehicle is a design project at UCI exploring systems integration to unify different engineering practices to tackle autonomous driving.

The concept of IGV relates to the upcoming future of the automotive industry that the top companies like **Zoox**, **Tesla**, and **Cruise:** Self-Driving vehicles.

Students at all undergraduate levels can contribute to the team efforts, and those at lower levels (Freshmen, Sophomore) benefit greatly from the experience and mentorship of the seniors.

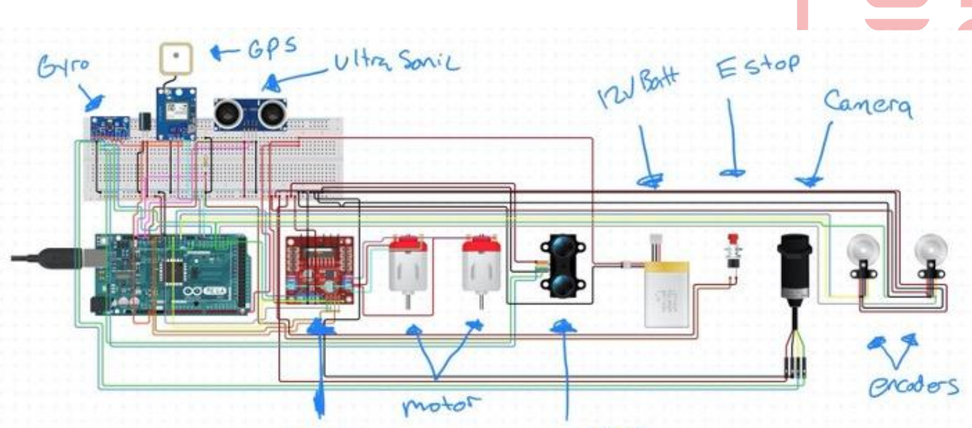
Project Objectives

The goal for students in IGV is to design a **Level 5 autonomous** vehicle and developing a method to allow it to navigate through an obstacle course. This project includes usage of **Finite State Machines**, **Sensors**, **microcontrollers, machine learning,** and **visual algorithms**.

The goal for Winter 2021 was to have a fully prepared design ready for manufacturing and modeled with the appropriate sensors and software. The goal for the year 2020-2021 is to have a fully working autonomous vehicle to run through Aldrich Park.

Electrical

The circuitry was designed with efficiency and reliability in mind. Having all sensors powered by the Jetson Nano allows for easy debugging in case of failure. Two scooter motors are controlled by the Sabertooth Dual 2x32A 6V-24V Motor Driver, with rotary encoders to control speed and direction. There is a LIDAR scanner and 2 cameras for lane and obstacle detection as well.



Future Goals

Future Design Tasks:
- Motors/shaft
- Weather-proofing material and hood
- Manufacturing

Future Electrical Tasks:
- Run simulations with mechanical components in mind
- secure lab space for testing and debugging of circuits
- explore types of communication between sensors and jetson nano

Future Controls Tasks:
- Implement CAD model of the vehicle in Gazebo for simulations
- train a YOLO model specific to competition obstacles
- test sensors and software algorithms in smaller scale model

Mechanical

Newly redesigned chassis nearly halved the weight of the previous iteration of the design. By creating the design in a more modal type fashion the manufacturing will prove to be more simple and have simple fixes on the fly during competition. The new design should be able to be completed by the midway point of spring quarter which allows ample time for testing. The team is currently working to organize mechanical parts and designing electrical component mounts.

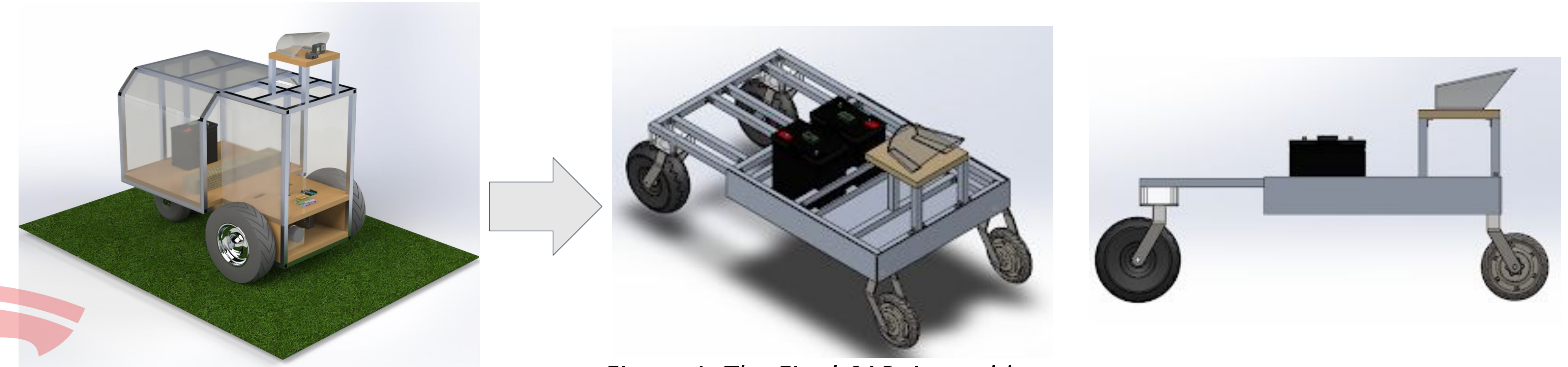


Figure 1: The Final CAD Assembly

Controls

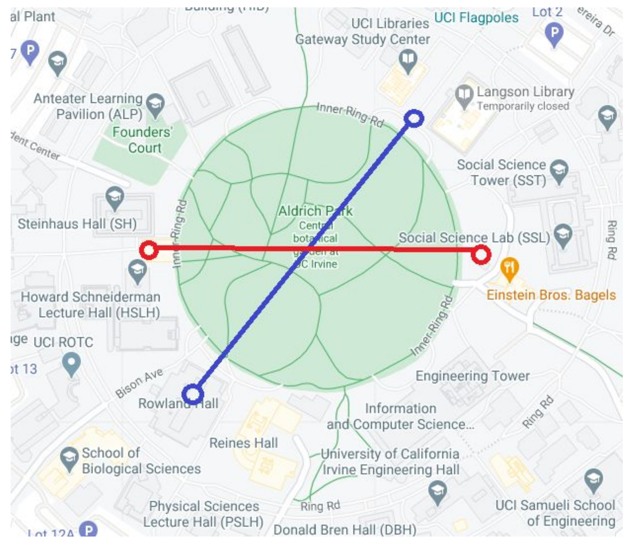
A Nvidia Jetson Nano is the brains of the vehicle. Using the OpenCV image and video processing modules we have written code in C++ to take camera input and find lanes using hough line transforms.

Figure 2 & 3: The black and white image is the processed output from the Jetson. The lines are drawn to match what the program output.

Figure 4 & 5: Using a photo of traffic on a highway as an example, the YOLO algorithm is able to detect multiple cars within the frame.

Using OpenCV and a YOLO algorithm trained model, we were able to detect objects and classify them and bound them to a box. This will be used to detect where the object is and how far based on the changing size and location of these bounded objects.

Utilize TinyGPS++ library to calculate distance and bearing to different waypoints on the course. Will implement magnetometer into robot to detect current bearing.



```
Files\Year 4\Winter\MAE 189\GPS Nav\"GPS
Distance between Red: 321.188m
Bearing between Red: 179.667degrees
Distance between Blue: 357.082m
Bearing between Blue: 120.871degrees
```

Figure 6 & 7: Code represents the distance and bearing between the two points of the same colors.

The team is furthering code development and preparing for software and hardware incorporation.

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