To Predict ▶ To Design ▶ To Perform

College of Engineering
Department of Mechanical & Industrial Engineering

ME, ECE, BE Capstone Design Programs

Intelligent Ground Vehicle Competition Team

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LSU | Student Government

Competition Overview

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Oakland University
Rochester, Michigan

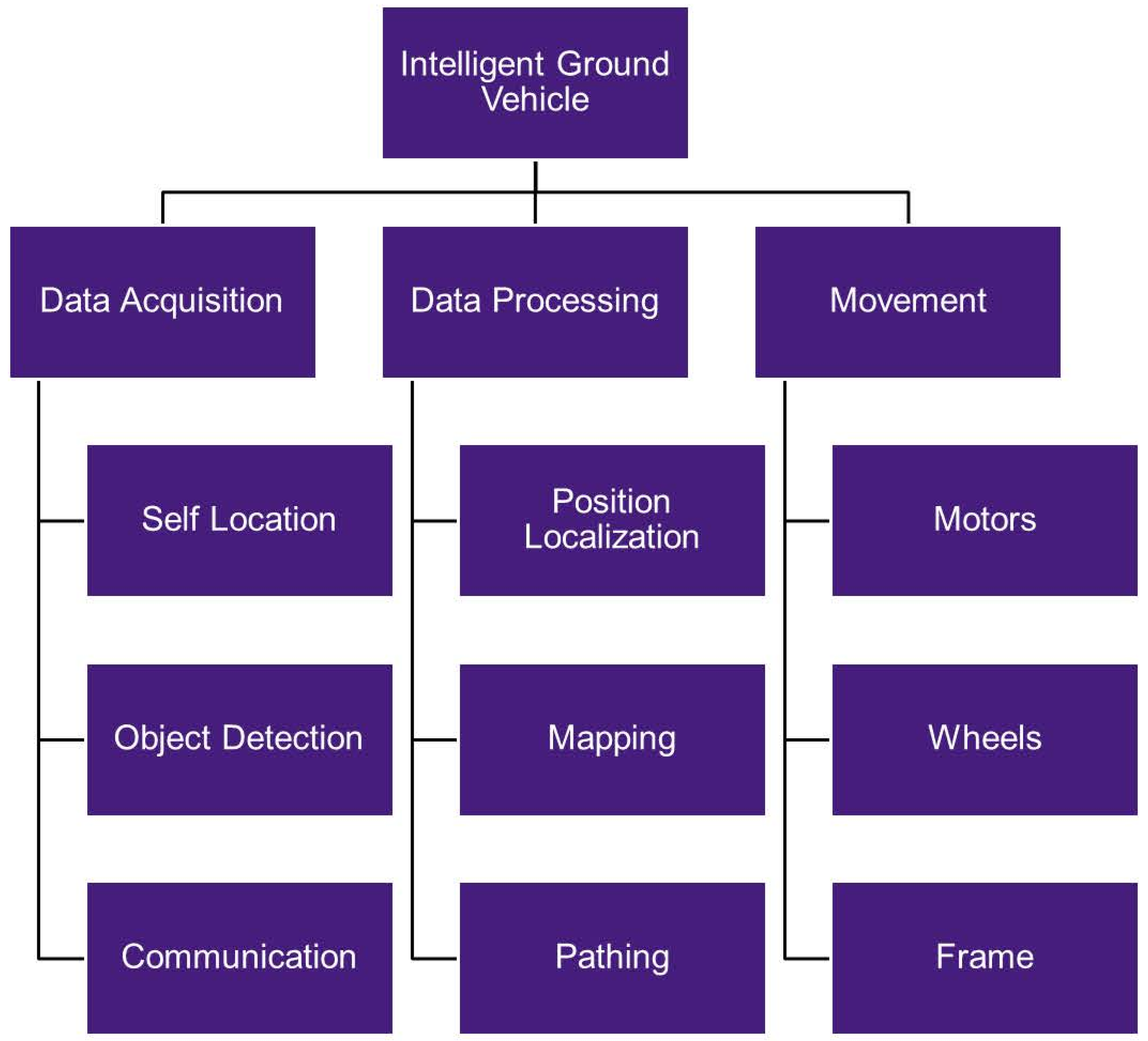
Robotics competition for students to design and build an autonomous robot that can navigate through a course with many various obstacles.

Constraints

Robot be autonomous.
It must navigate through a unknown course.
Course consists of a lane outlined by white lines and various obstacles, such as barrels, cones, saw horses, and posts.

- **Length:** 3 ft. - 7 ft
- **Width:** 2 ft. - 4 ft
- **Height:** < 6 ft
- **Average Speed:** 1 - 5 mph
- **Mechanical and Wireless E-Stop**
- **Safety Lights**
- **Payload of 20 lbs**

System Overview



Data Acquisition

The Data Acquisition system encompasses our computer vision line detectors, Ping))) ultrasonic range finders, Swiftnav GPS systems, and wheel encoders. This components are split into two different categories: self- location and obstacle detection.

Self-Location
Using the wheel encoders we can get a relative location from our start point and we can verify this with the GPS location. In order to find the painted lines on the field we will be using a computer vision algorithm centered around the Canny Edge Detector.
Object Detection
For the 3D objects we are using Parallax's Ping))) ultrasonic range finders in a static array at the front of the robot.

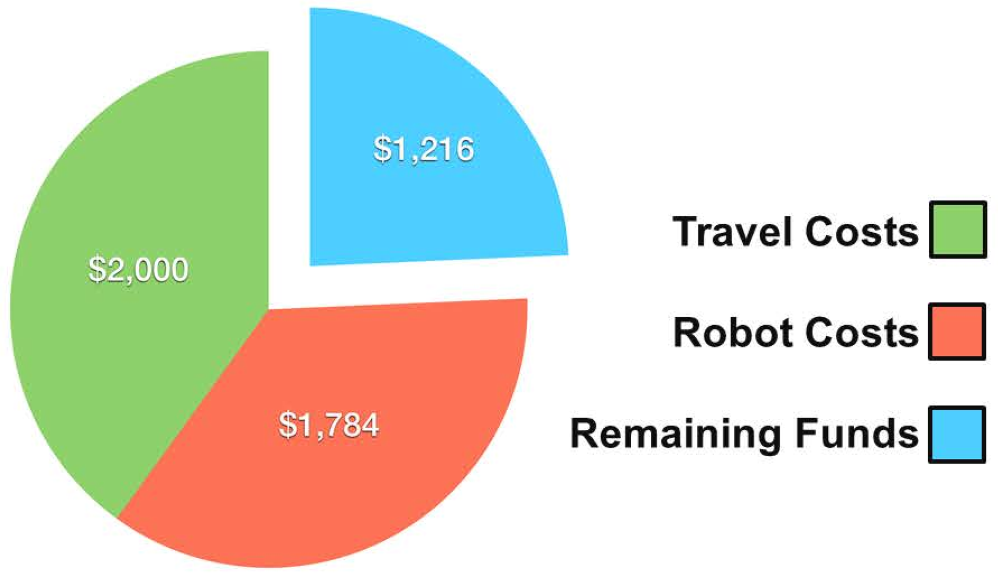
All of this data will be used to construct the map in Data Processing.

Data Processing

Position Localization
Three layers of redundancy for finding position: Wheel Encoders, PID controller, and GPS location
Mapping
Map a small window of the course that is visible to us using a Gaussian weighted grid.
Pathing
Determine a path using the A* algorithm, which combines both Greedy BFS and Dijkstra's algorithms.

While traversing our path, we will be reacquiring data to update our map, and the adjust our path accordingly.

Budget



Power

Battery type
LiFePO4
Battery Capacity
24v LiFePO4 20Ah 60A Max Draw.
8x 3.2V LiFePO4 Cells

Movement

The frame, wheels, and motor assemblies were the concerns of the Mechanical Engineering team. The frame is made of 304 Stainless Steel, having a total frame weight of approximately 61 pounds. The frame provides a flat platform for the electrical components, as well as 2 lifted beams for elevated supported components. The frame is connected to 2 individually-powered 1.6 HP motors. The 2 front wheels attached are 13-inch diameter rubber off-terrain tires. The rear wheel consists of a caster assembly with two 4-inch diameter rubber tires.

Complications
Caster Length Adjustment
As the frame was built, the caster spring was found to not have the spring constant expected. The clearance was too low in the rear to safely pass over obstacles. Thus spacers were introduced to the caster to lower the caster assembly to the ground
Caster Rotation Adjustment
Full rotation required in the caster was unanticipated, thus the frame was adjusted post-manufacturing to allow 360-degree rotation in the caster
Stripped Motor Holes Repaired
Previous groups using our motors used inappropriate bolts for the holes of the motor. The grooves were relined for the use of our bolts.

Sponsors: Jack Rettig & LSU Student Government

Advisors: Sean King