Swarmathon Competition

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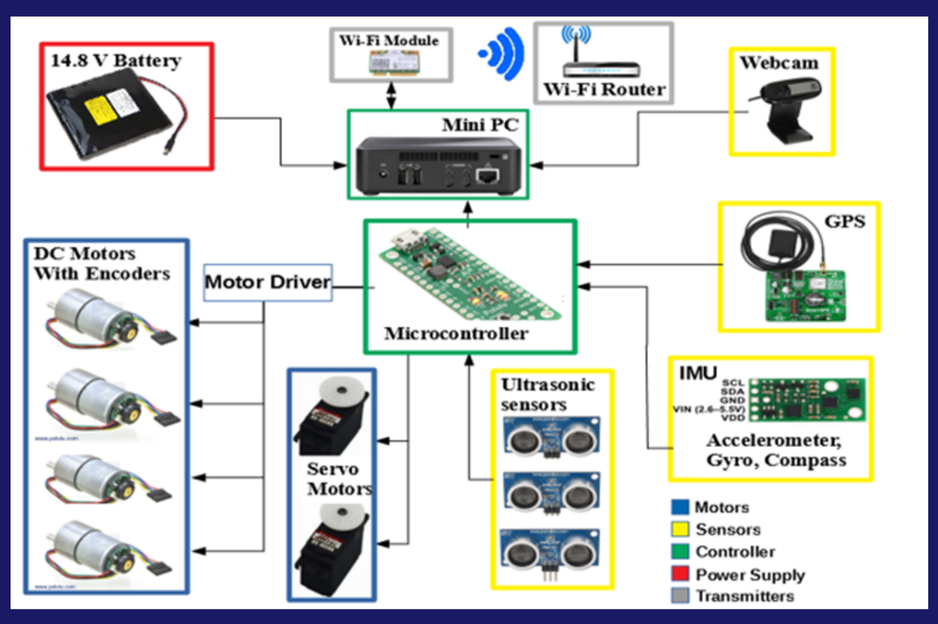
Background

Swarm robotics is a method where multiple robots are used to efficiently and autonomously communicate, locate, and retrieve resources through traditional computation techniques, data and learning aggregation.

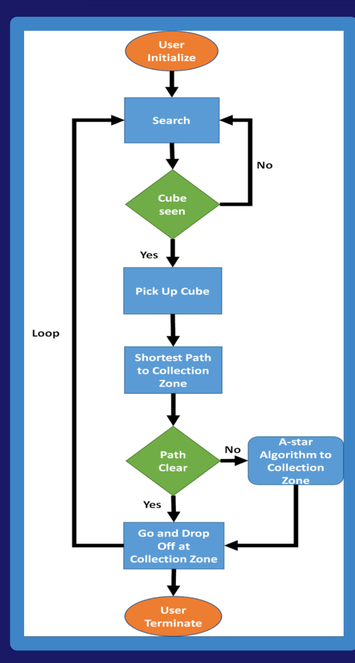
Objective

The objective of the Swarmathon competition is to develop integrated robotic algorithms to search and retrieve resources while avoiding obstacles in the arena. Rovers must operate autonomously and communicate as a collective swarm.

Electrical Architecture



Software Flow

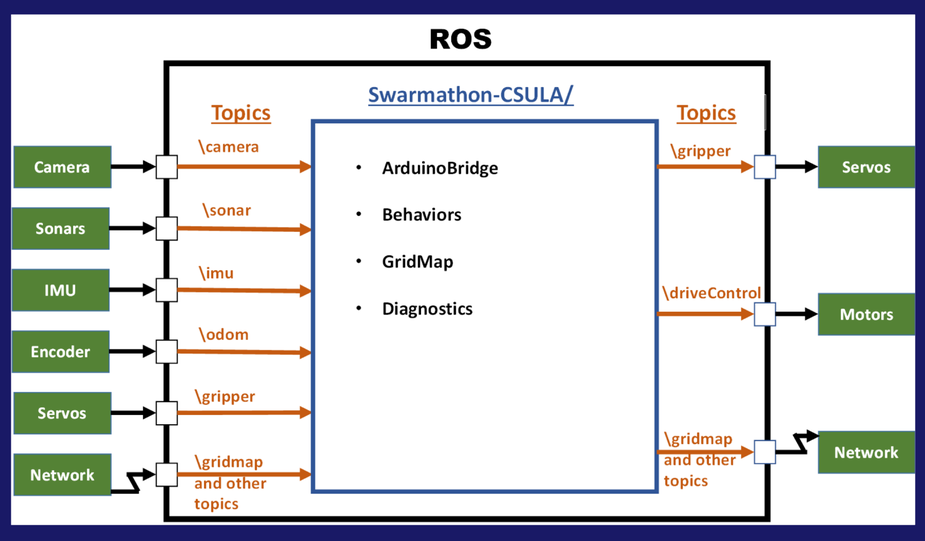


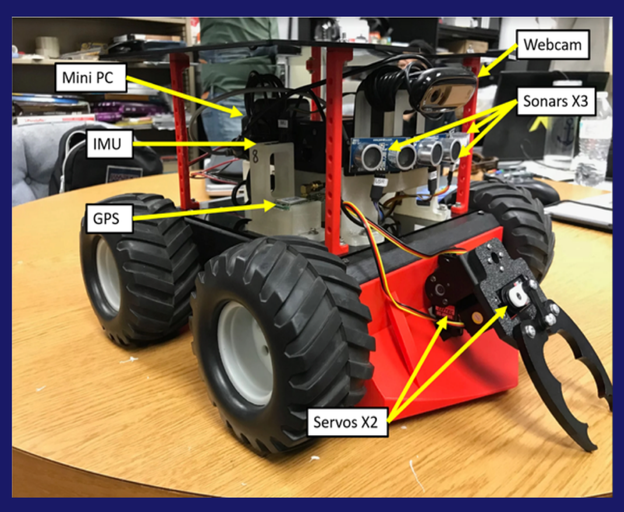
Note: Obstacle Controller and GridMaps are continuously running in separate threads and can disrupt any of above processes

Requirements

Requirement	Performance Objective	Capability	Method of Verification
Operation Time	Preliminary round – 2 20 minute Periods Quarter Final round – 40 minute Period Semi Final round – 40 minute Period Final round – 40 minute Period	Compliant	Design
Search Dimensions	Preliminary round – 15 x 15 meters Quarter Final round – 22 x 22 meters Semi Final round – 22 x 22 meters Final round – 22 x 22 meters	Compliant	Design
Language	C++	Compliant	Design
Robot Communication	ROS	ROS Kinetic	Design
Obstacle Avoidance	Avoid obstacles in the course	Avoids any obstacle 0.8 m away from rover	Test
Searching and Retrieval	Detect and retrieve resources within the arena	20 cube per 40 minutes	Test
Rover Max Velocity	1 m/s	0 m/s – 1m/s	Test

Robotic Operating System



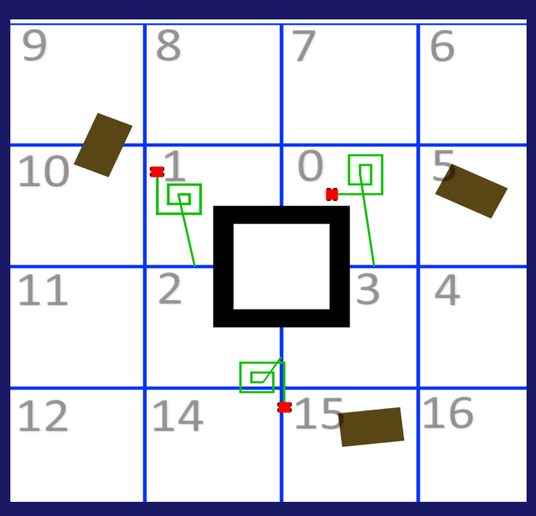


IMU Filter

We use a magnetometer sensor to control the rover's movements. The magnetometer is a very noisy sensor, so we filtered out the noise by using a moving average filter.

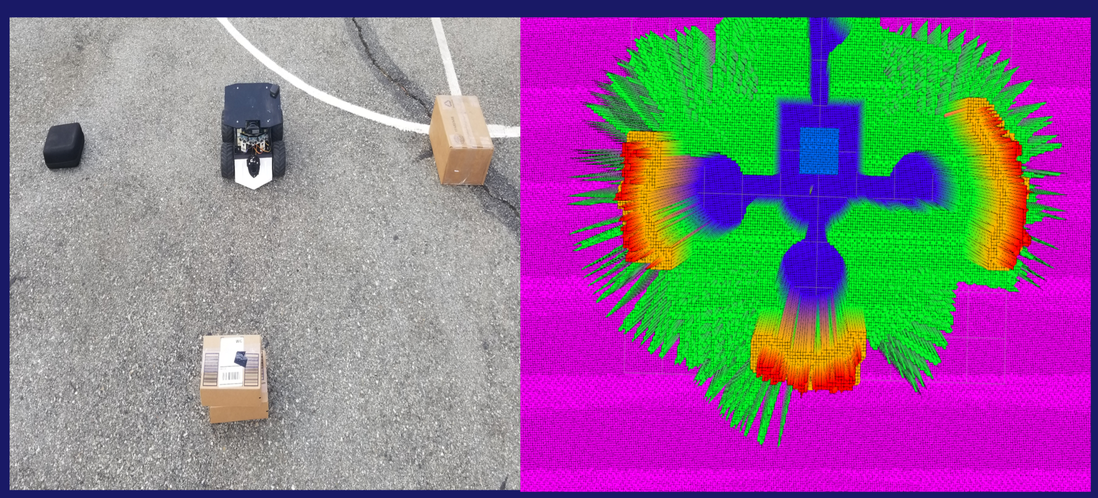
Search Algorithm

A divide and conquer approach was chosen with small spiraling patterns in each gridded section. Each rover must search 80% of their section before moving on to another



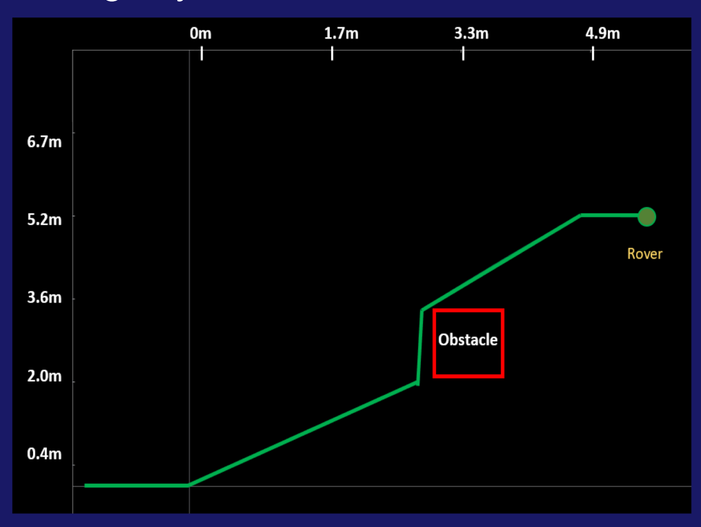
Mapping

Implemented the ROS package Grid-map which utilizes the rover's sonars, IMU, and encoders, to record obstacles and rover's locations, while providing a map for navigation and motion planning.



Obstacle Avoidance

When returning to collection zone to drop off a resource, we use the map created using Grid-map and an a star algorithm to create the shortest path to the collection zone while avoiding any known obstacles.



Results

- Competed in the 2018 Swarmathon competition at the Kennedy Space Center in Florida
- Placed 10th place out of 21
- Rovers now have a have a mapping module to record obstacles and rovers locations.

Conclusion

- Rovers are able to successfully search and retrieve resources autonomously
- Rovers are able to communicate and interact as a collective swarm
- Improvements in localization and being able to decrease drift on the encoders will improve resource retrieval rate