Autonomous Trail Rescue Rover

Introduction

Prior to the onset of COVID-19, hiking has seen an upward trend in popularity in recent years. With hiking comes the possibility of getting injured on the trail--one study shows that 6.1% of hikers and mountaineers at Yosemite National Park find themselves injured [1]. In the absence of cell reception, there are currently no viable solutions for injured hikers to get the immediate medical attention they need. If travelling in a group, a member of an injured hiker's party would need to run to a ranger station and ask for help, or find a place with cell service. If travelling alone, an injured hiker would have to wait for another hiker to pass, and ask for the same preceding actions. For both cases, the solutions take too much time.

An autonomous trail rescue rover would be able to patrol certain parts of a trail and be able to interface with injured hikers and ping gps locations back to a ranger station when medical attention is necessary. This would eliminate much of the time needed for a ranger to be notified of urgent injuries, and also provide an accurate location of where injured hikers are.

Problem Statement

Our project seeks to provide an option for addressing emergencies out in the wilderness, where it can be more difficult getting help. We will accomplish this by building a rover with human detection features to identify people in need of assistance. The rover will be able to interact with hikers through audio and determine whether it is necessary to transmit its current position using GPS to a base station to send for assistance. It will also be able to avoid obstacles while navigating its route.

The completed project should be able to navigate a predefined course while avoiding any small obstacles on the way. When coming in contact with people, it should be able to identify humans and send data back to a base station if prompted.

Responsibilities

Each group member is responsible for implementing a portion of the rover's functionality. James Tsien and Buonkuang Priestley will be responsible for implementing the obstacle and human detection with sensors. Jeffrey Cho will be responsible for building the motors and its interaction with the microcontroller. Tobe To will be responsible for building the rover communications backend and the controls for the rover navigation. Johnny Tran will be responsible for building the audio system, as well as the user interface for interacting with hikers. Once all functionality is complete, the rover chassis will be built by Johnny and James.

Our faculty mentor, Professor Quoc-Viet Dang, will provide us with guidance throughout the duration of this project. We will check in with him weekly for progress checks to stay on schedule. He will also be a source of advice should we encounter any roadblocks in accomplishing any project goals.

Current Work

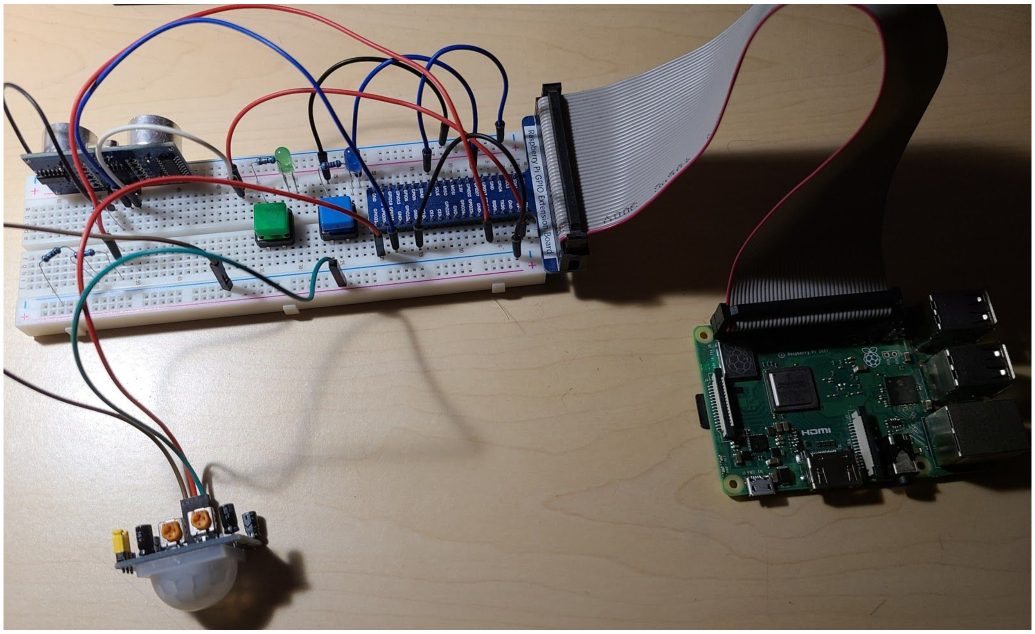

Figure 1: Current Work

The initial setup for the sensors as shown above in Figure 1 has been used to test out the range and accuracy of the distance detection for the rover. Currently the attached modules include a PIS (Passive Infrared Sensor), Ultrasonic Sensor, and LED module. For now the sensors detect a range and if there is an object in front of the sensor within a set distance, the blue LED will trigger. If the sensor detects heat movement in front of it, the green LED will trigger. The system is just an introduction to the object detection and avoidance module on the rover.

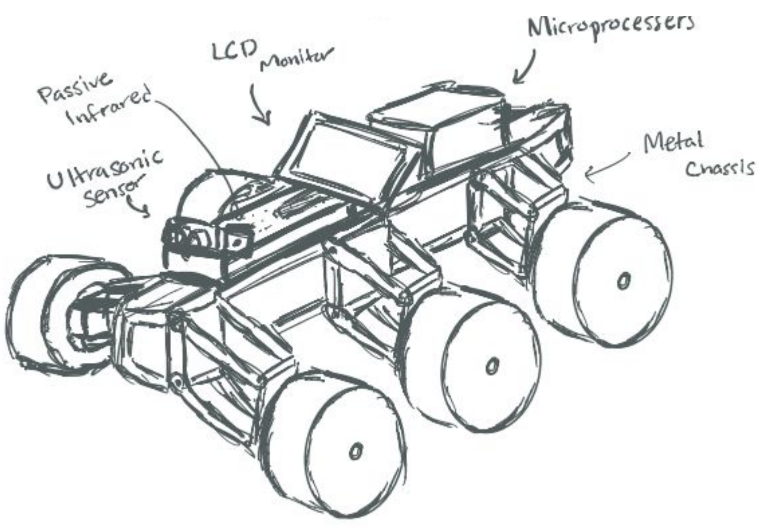

Figure 2: Proposed Work

Proposed Work

In this project, the aim is to construct and add innovative modules that will interact with people while traversing on semi-challenging terrain. In order to accomplish those feats, building an effective rover will be an important step. The first thing that needs to be accomplished is how well it can traverse terrain. For that purpose, six wheels are needed for better navigation over uneven ground and also decrease the weight load on each motor. Engineering the rocker-bogie suspension for the wheels will be an important part of the building process.

As for how the rover will transverse autonomously, the idea is to program/build multiple sensors that can work in tandem to detect obstacles and human beings. For testing purposes of the movement of the rover, there will be a variety of environment settings that will be tested on. For example the track field at the anteatery recreation center will be a simple test for the rover, while crossing the central park in UCI can be a more challenging test.

A communication via gps was the intended purpose of how the project was seen to work. However for now the plan is to use wifi as a substitute to connect the rover with the base camp. This is so that any debugging process will be swift and reliable during the software development.

The final system will combine various sensor modules into a metal chassis along with a user interface on the rover. At this point the last step would be to fine-tune the software for various scenarios that the rover may encounter.

Project Schedule

Autonomous Hiking Rover

Project Start: Tue, 10/20/2020

Display Week: 1

TASK	ASSIGNED TO	PROGRESS	START	END
Fall Quarter				
Choosing Materials	Everyone	70%	10/20/20	10/23/20
Applying for Fundir	Everyone	0%	10/20/20	11/9/20
Testing Sensors	James + BK	0%	10/20/20	11/2/20
Testing Motors	Jeffrey	0%	10/20/20	10/30/20
Audio User Interfac	Johnny	0%	10/20/20	10/30/20
Building Communic	Tobe	0%	10/20/20	10/30/20
Combining Motors ·	Tobe + Jeffrey	0%	10/31/20	11/13/20
Implementing Obst	James + BK	0%	11/3/20	11/17/20
Building Chassis	James + Johnny	0%	11/18/20	11/30/20
Have a Running Rov	Everyone	0%	12/1/20	12/10/20

Figure 3: Project Schedule

So far, we are on track with our project schedule. We have chosen materials to test certain functions we want to include in the rover such as obstacle avoidance and human detection. As of right now, we are each currently assigned to work on a function of the rover and are testing it through the use of Raspberry Pi. Aside from applying for funding to further obtain equipment, we have arranged to test functions of the rover concurrently to make sure that task distribution is as efficient as possible. If one team member is to finish early, help may be needed on another task, thus that team member would be able to offer assistance on another task. We are currently on schedule to test the featured functions of the rover which will then lead to building the chassis in order to fit the components into the chassis. We will then begin assembling the chassis of the rover itself in order to test the functions of the rover in tandem with each other. By the end of this quarter, our scheduled goal is to get the rover up and running.

Budget

Item	Manufacture #	Quantity	Cost
Raspberry Pi 3 Model B+ Board	BCM2837B0	6	$252.00
Passive Infrared Sensor (PIS)	MCM 287-18001	12	$36.00
Adafruit GPS Receiver	B01H1R8BK0	2	$84.00
USB-to-TTL Serial Cable	B00DJUHGHI	2	$28.00
Micro USB Cable Power Supply 5.25 Volts 3 Amps	Argon ONE B07MC7B9X3	2	$24.00
Breadboard Jumper Wires (MtF, MtM, FtF)	ED-DP_L20_Mix_120pcs	2	$16.00
Universal PCB Breadboard	EL-CP-003	6	$18.00
5 Inch Raspberry Pi Screen	RPA05010R	2	$80.00
6pcs Button, 4x4 16 Key Matrix Keypad	B07B4DR5SH	4	$34.00
Rover Chassis (Aluminum)	---	2	$80.00
5V Brushed DC Motor	ROB-11015	6	$10.00
7” Wheels	---	12	$72.00
		TOTAL	$734.00

References

1) Krolikowski M, Black A, Richmond SA, Babul S, Pike I. Evidence Summary: Hiking/Mountaineering. Active & Safe Central. BC Injury Research and Prevention Unit: Vancouver, BC; 2018.