PHYS CS 15C Research Proposal
Remotely Operated Vehicle with Visualized Terrain

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1 Introduction

Often times there exist terrain on which people cannot tread on. Imagine the complex structure of the debris after an earthquake or hurricane, where an external force of a human stepping on it might cause additional collapse of the structure, putting victims under it in further danger. However, we would like to conduct massive search for survivors under the debris. General search could be done by some high-end device far away, and close up confirmation for each potential signal of life could be carried out by smaller sized vehicles such as drones and ground robots. While drones have high mobility around, the ground robot can go under small holes closer to the survivors. By carrying necessary communication tools and sensors, we could get specific conditions of the survivors, which would be immensely helpful in forming the rescue plan accordingly.

However, even when a signal of life has been detected, there are still obstacles. Removing the top layers of debris might do damage to the lower layer. Depending on the actual situation of the victim and the structure above the victim, a mature rescue plan might take hours in finalizing. Time is an important factor in this process. To earn more time and make sure the victim can stay with us, a ground robot that have access to the victim could then provide necessary care such as food, water, conversation, and hope to stabilize the conditions of the victim.

In this project, we propose to control the robot with a visualized terrain that serves like a sandbox in military planning. This visualized terrain inspired by project Electrick [1] will provide visual aid to help anyone just arriving grasp the overall picture and the current progress of the rescue plan.

Viewer should be able to identify all the potential, confirmed, and successfully saved signals of life as well as the location of the robots and their past and queued trajectories and missions.

2 Significance

3 Objective

1. Construct the conductive control pad that serves as the visualized terrain model;
2. Read in path planned by touch control on the terrain model;
3. Build the self-balancing robot with wireless receiver module;
4. Move the robot according the path planned on the terrain model.

4 Methodology

5 Proposed Project Timeline

Research Timeline	
Week	Description
1	Order necessary parts
2	Assemble the conductive layer control pad, supply constant AC current through one pair of electrodes, and measure the voltage difference at different vertices
3-4	Supply current through all adjacent pairs of electrodes, and readout the voltage differences at all other vertices
5-6	Visualize the 2-D voltage current density when touching the control pad with tomography imaging
7	Output coordinate of touch on the control pad; assemble the self-balancing robot
8-9	Assemble the self-balancing robot and the bluetooth module
10	Move the robot with control robot

6 Budget

Budget Planning		
Item	Amount	Price($)
6” x 6” copper sheet	1	7.00
Jumper with aligator clips	20	15.98
Jumper pack	1	6.98
ABS by Zen Tool Works	1	46.00
Carbon conductive paint by MG Chemicals	2	32.00
Arduino Mega	1	33.49
Arduino Pro Mini	1	9.95
FTDI friend	1	14.75
GY-521 module with MPU-6050	1	5.99
DRV8833 Pololu motor driver	1	4.95
5V boost converter	2	1.78
NCR18650 battery and holder	1	3.06
Micro metal gear motors and brackets	2	11.42
42 x 19 mm wheels	2	2.90
Double-sided prototype PCB pack	1	6.57
25cm Nylon spacers pack	2	4.38
Nylon nuts pack	1	1.15
Estimated shipping and tax	/	50
Grand Total		258.35

7 Conclusion

The rescue process is often complicated for survivors in debris left by a natural disaster such as earthquake and hurricane. In order to save time and stabilize the survivors, we propose this remotely operated ground robot with visualized terrain that can serve as visual aid in planning the process and communicating the rescue end directly with the survivor end.

References

[1] Y. Zhang, G. Laput, and C. Harrison, Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (CHI '17) , 1 (2017).