

PITT RAS

ROBOTICS & AUTOMATION SOCIETY

OCTOBER 2016

NEWS & NOTES

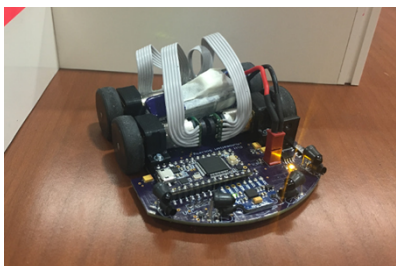
- Check out RAS's new and improved website to stay up to date on what the club is doing:
<http://pittras.org/>

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MOTION CONTROL

Many robotics projects involve controlling a car-like robot to accomplish some task. Examples include last year's Micromouse (below), Line Follower, and Sumo projects.



While each robot has different characteristics and is destined to accomplish a different goal, one thing is the same. They all have wheels. They all need motion control.

Often times in computer science, we find that many projects have the need to solve a similar problem, yet each project has been developing its own solution. This indicates duplicated or “wasted” effort, because the projects could be sharing code where their tasks overlap.

The goal of the Motion Control project is to study control theory surrounding car-like robots, to identify common elements and concepts surrounding these robots, and then to develop a practically useful library or “toolkit” for a potentially large audience. We want to develop a robust and easy to use strategy for getting a car-like robot up and running, so that the developer can quickly and effectively move past the task of motion control and continue on to solving the larger high-level problem (such as following a line or solving a maze).

This project involves a fairly wide scope of skills and knowledge:

- C++ programming, compilation, libraries
- Version control (git)
- PID, feed-forward, and self-tuning control theory
- Adaptability to feedback from unknown sources
- Physics surrounding linear and rotational motion
- Mechanical and electronic design
- Use of diverse computer systems (Arduino, Raspberry Pi, UNIX, Windows...)

As a proof of concept, we would like to design three physically and electronically diverse robots and then load the same program onto each one, demonstrating how our project might adapt to different robots. Above all, we're here to learn.

WORKSHOPS

As Pitt's Robotics and Automation Society (RAS) begins to grow, we are beginning to play a more active role in the Swanson School of Engineering (SSOE). Through this growth a key weakness has been identified in not only RAS, but a majority of project-based clubs throughout SSOE – new, younger, passionate students do not have the technical knowledge to provide significant contributions to advanced projects. Currently attempts are made to teach these students the knowledge necessary to contribute; however, it is extremely difficult to complete a project for a competition when so much background work needs to take place. The lack of strong fundamental knowledge in younger students and lack of time to teach these students often leads these students to slowly drop out of the organization.

In an effort to address this problem, RAS is developing a semester long series of workshops that are aimed to teach the fundamental skills necessary to contribute to advanced technical projects. With the proper fundamentals, students will be able to utilize their passion to build upon their knowledge and become well educated, technically advanced, members of an organization.

These workshops are not targeted just for potential RAS members, but for the entire school. Through collaboration with ASME, Design Hub, IEEE, and BMES the workshops will teach a fully encompassing set of fundamental skills.

This semester marks the Beta 0.1 version of these workshops and has received attendance ranging from 10 – 30 students dependent on the day. Almost all workshops in this beta attempt result in a \$0 cost per workshop and utilize existing materials and resources inside Benedum.

The schedule for the Version 1.0 of the workshop series can be seen on the next page.

Week	Title	Tasks	Skills Taught	Side Lesson
1	Introduction to Basic Circuit Design	Build a Black/White Sensor	Properties of LEDs Breadboarding Phototransistor Circuit	Using Slack Effectively
2	Soldering	Learn How to Solder	Through Hole Soldering Desoldering Techniques	
3	Introduction to Arduino and Motor Control	Control a Motor Through MCU	Basics of Arduino Basics of Motors and Gears Motor Driver Boards	Panther Arm Demo
4	Introduction to Programming	Code Line Follower Logic	Programming Logic Code Organization Good Coding Practices	Using GitHub Properly
5	Introduction to Mobile Power	Assemble Line Follower with Power	Types of Batteries Basics of Power	
6	Introduction to SolidWorks	Create Line Follower Chassis	Basics of CAD Design Exporting CAD Files	3D Printing Basics
7	Test Revision 1	Test Each Line Follower Robot	Test Cases Debugging Issues	
8	Improved Control: PID	Implement PID Control	PID Control Theory PID Control Implementation	
9	Eagle CAD	Design A Printed Circuit Board	Basics of PCB Design Creating Custom Components	
10 - 12	Individual Improvements	Individual Improvements to Line Follower	Prototype Iteration	
13	Final Tests	Test all Line Followers and Determine Fastest	Project Showcasing	

SCORPION

The Scorpion is currently in the design phase. We will be finishing up preliminary designs and picking out parts in the next couple of weeks. The end goal of this project is to design and build a scorpion bot that can mimic the natural motions of a real scorpion. In addition we are hoping to be able to interface it with a myo band, so we can control the bot through our hand gestures. In order to make it more of a challenge we have decided to use one of the TI microcontrollers in place of the usual arduino or teensy. In addition to using the TI chip we would like to design a pcb for the chip, so we will be able to remove any unnecessary ports and pins. The code will be written in C and will be mostly firmware and servo control heavy.

ARTBOT

This past month, Artbot has accomplished as much as it did in an entire semester last year.

We realized that a major area to improve in was leadership and giving members interesting projects. Team members were entrusted with an integral aspect of the panther that they are 100% in charge of. All projects involve a combination of ME, COE, and EE principles. For example, one person was tasked with making the eyes of the panther. This includes CS for the camera's software, EE for communications with the camera and motor control of eyelids, and the ME design work/fabrication for the eye assembly.

The projects are administered through Trello, a good 'To Do' list software. We have multiple boards, split up by the team's needs. Additionally, we realized we cannot effectively delegate tasks to our members and contribute substantially to the project. Due to these facts, we assigned multiple people as chairs to lead sub-teams within the overall team. We delegate overarching goals to the chairs, who in turn work with the rest of the members for specific tasks to accomplish.



On the computer side of things, Artbot has made much progress in the logic of fluid motion control of our motors. We have developed a variety of functions for controlling linear actuators, and servos. We are able to control the exact position and variable speed of the motors; allowing us to create a fluid movement of the motor instead of just a constant speed applied to the device. This is more representative of movement obtained from an animal, and will lead to a more realistic version of our robotic panther. We are in the process of developing libraries for these motors that will ease our efforts in coding once we have the limbs constructed.

The arm, ear, and eye CAD models have been completed. The jaw is nearly complete. The head is projected to be fully prototyped within a month. The arm BOM is complete and is ready for fabrication. There is a team of three working on making neck prototypes

The user interface design for the touchscreen of the kiosk has also seen improvement. We have a sleek, engineering-centric design for the main menu with rotating cogs as buttons leading to separate areas of the kiosk, as can be seen below. The separate sections of the kiosk are currently being designed and implemented and will be detailed further in a subsequent newsletter.



IARC 7

RAS is participating in Mission 7 of the International Aerial Robotics Competition (IARC). IARC has been running since 1991 and centers around the concept of missions which can span multiple years. There have been seven missions in total, with each successive mission pushing the boundaries of aerial robotics. See www.aerialroboticscompetition.org for more information.

Mission 7 began in 2014 and has not yet been solved. Teams are required to develop an autonomous aerial robot capable of directing ground robots through physical interaction. More specifically, 10 iRobot Create 2 differential drive robots move around along a randomly generated path inside an arena. The arena consists of 10m by 10m flat area marked with a grid line pattern. The aerial robot can interact with the ground robots by either blocking its path, forcing it to turn around, or by touching a switch on the top of a ground robot, causing it to rotate by 45 degrees. The goal is to direct four of the ten ground robots across one side of the arena.

So far, the most accomplished team has demonstrated tracking and getting in front of the ground robots while avoiding obstacles. However, they did not direct a ground robot across a particular side of the arena.

MAIN CHALLENGES

- Localization without the use of GPS, external beacons, or nearby landmarks necessary for SLAM
- Making physical contact with ground robots during flight
- Finding an optimal path to guide ground robots
- Locating ground robots using computer vision

- Planning motion profiles to avoid targets and interact with ground robots

CURRENT STATUS

- Using ROS to manage software complexity
- Implementing MORSE robotics simulator to test AI and computer vision
- Designing a custom quadcopter suited for the application
- Implementing safety infrastructure to prevent crashing and harm to bystanders
- Using Agile reminiscent project management
- Using Slack, Github, and Trello to encourage collaboration

We are interested in a dedicated faculty advisor. If interested, please send the project leads an email. We would enjoy meeting with you.

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