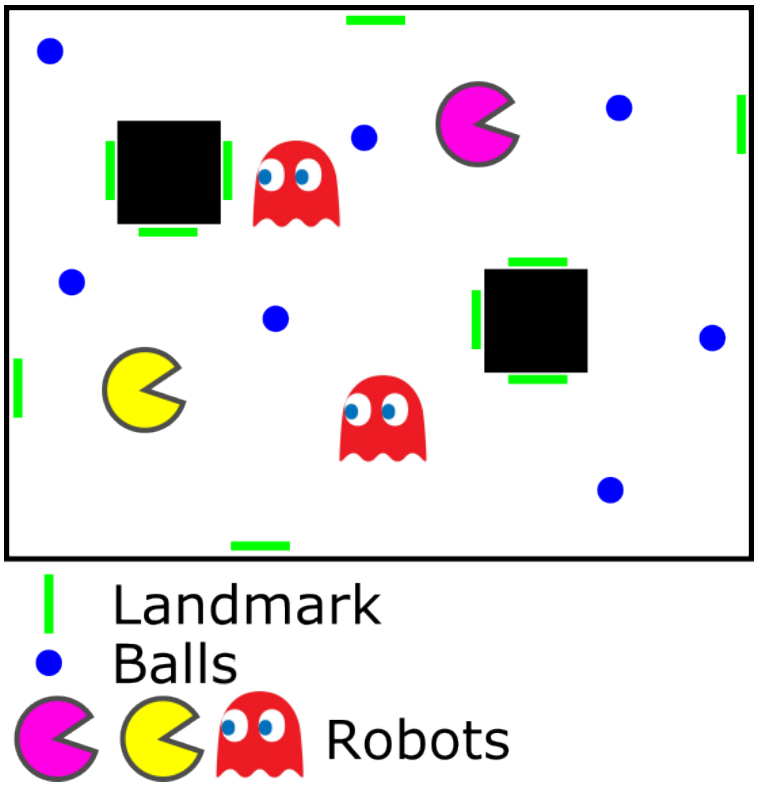
CSCE 439/839: Robotics
Final Project Overview

Instructor: Carrick Detweiler
carrick _at_ cse.unl.edu
University of Nebraska-Lincoln
Spring 2022

Started: Fri, April 8, 2022
Proposal Due: Tues, April 12, 2022
Checkpoint: Fri, April 22, 2022 (through Sec. 3)
Competition: April 29th and May 2nd, 2022
Presentation: May 4 and 6th, 2022
Project Report Due: Fri, May 6, 2022

1 Overview

For the final project you will be programming your robots to compete in a "Pac-Man" type game. As shown in the figure there will be a number of balls to collect, landmarks that could allow your robot to figure out where it is, and potentially other robots. We will hold a few different types of competitions, including single robot, multiple robots trying to collect as many as possible at the same time, and with an adversary (e.g. a robot trying to block collection).



2 Proposal (25 pts.)

The proposal should be no more than 3 pages and should describe your proposed approach. It should give an overview of:

- Planned algorithmic approach
- Additional needed hardware (if any), including costs
- Timeline and plan describing distribution of work and milestones

Additional hardware will be approved based on availability and cost. Note that this is due soon so I can give you quick feedback and approve any hardware additions.

3 Checkpoint (25 pts.)

For the checkpoint, you must demonstrate your robot finding a specified landmark number and then "collecting" a ball that is in front of the landmark. There will be multiple landmarks and multiple balls, but only one ball at the specified landmark will be the correct one to collect.

3.1 Visual Landmarks

On the course website there is link to download ROS modules needed to identify barcode-like visual landmarks (called `landmarkSelfSim`). Download this code, place it in your catkin_ws directory, and compile it.

I have also provided a number of these landmarks for use in class. These are "self-similar landmarks"[1], which means they are easily and quickly identified by only looking along one scan line in an image, no matter how far away they are. In addition, they have a binary bar code on the side that uniquely identifies each landmark.

There are two different launch files for the vision code `landmarkSelfSim.launch` and `displayDebugImages.launch`. The first launches the landmark detection system (along with the camera drivers) and the second is used to display the output images, which is useful for debugging.

The landmarks will be distributed around the course and can be used to aid in navigation and localization.

In your report you should characterize the visual landmark system.

3.2 Ball Collection

We will not be adding devices to actually collect the balls. Instead, a ball is considered collected when the robot hits it. Once it is hit, it will be removed from the course.

4 Competition/Demonstration (25 pts.)

We will hold two different types of competitions on the compeition days (one each day, in this order). These are:

- **Time Trials**: The goal of this trial will be to collect as balls as you can in 3 minutes with only a single robot in the course.
- **Head-to-Head with Adversaries**: This will be similar to Head-to-Head, except it will last for 5 minutes and there will also be two "ghosts" with one each trying to impede the progress of the robots.

A few notes:

[1] D. Scharstein and A. Briggs. Real-time recognition of self-similar landmarks. Image and Vision Computing, 19(11):763-772, September 2001.

- The balls that must be collected will all be yellow.
- Each robot must have a ball on top that can be identified by other robots (green).
- The ghosts will also have a ball on top (purple).
- For all of these the robots must be fully autonomous. If you have to intervene to assist it, you may lose points.

For this part, your overall standing in the competitions will be worth 10 points, while your individual performance will be worth 15 points (e.g. you could get all of these points if your robot is reliable and performs well, but never wins).

Make sure to analyze the performance of your robot in your report.

5 Video and Presentation (25 pts.)

For this project you will create a short video and do a presentation. The video should be an approximately 60 second brief overview that focuses on the results (I will post these online and everyone will need to review and evaluate them). The presentation should be 15 minutes and discuss your robot configurations, the algorithms you implemented, characterization of the system, and results. The presentations will take place the last week of class.

6 Project Report (25 pts.)

The project report should follow a format similar to the lab reports you have done. It should describe your hardware configuration, algorithm, experimental results characterizing individual components, and a detailed characterization of the overall system. In addition, it should be well written and have an introduction, conclusion, and logical flow between sections. If you have any questions regarding the expectations for the final project, please contact the instructor.