ENAE380X - Final Project

1 Introduction

It's finally time. The long awaited final project is here! For the final project, you will tackle 3 challenges with your partner and GoPiGo. Write and test your challenge solutions in advance using the provided materials, so you can arrive on challenge day ready to perform!

2 Considerations

Unlike for the labs, **we cannot provide an extension** for the final project since we must return grades for those intending to take the final exam, and we understand many groups may be unable to successfully complete all three challenges given the time constraints. Luckily, you should be able to quickly jump into testing and improving your implementations since you should have already written the majority of the code required to complete the project in your last two labs.

2.1 Prerequisites

We expect by now you are comfortable programming and testing your GoPiGo as well as comfortable processing data from the two indirect sensors we have used over the second half of the semester. If you have completed the entirety of Lab6 and Lab7 that should be enough to get you through the majority of the first two challenges. The third challenge requires an understanding of probabilistic state estimation to reliably complete but can still be done, albeit less reliably, with a cruder approach. We will provide the locations and colors of obstacles in advance to make the challenge more manageable.

2.2 Restrictions

Much like your freshman-year capstone, this project will require you program your GoPiGos to autonomously navigate each of the three challenge courses. You may test your GoPiGo as many times as you'd like throughout the event duration, but precedence will be granted to teams attempting an evaluated run. Teams will be limited to **two evaluated runs for each of the three challenges** and must announce prior to a run their intention for evaluation. Your team's total score will be the sum of the maximum evaluated scores from each of the challenges.

Each challenge will have a time-limit as well as a rubric for evaluation. Evaluated runs will end immediately if the competing team finishes the challenge, reaches the time-limit or makes physical contact with their GoPiGo. At any point, the evaluator on-site may determine the end of an evaluation run for any reason they deem necessary. This may include but is not limited to outside intervention, unsafe operation or student misconduct during the run.

During the span of an evaluated run the GoPiGo must operate solely by the onboard power supply and Raspberry Pi unit. Any sensors used must remain onboard the GoPiGo, and the only remote sensors allowed are the GoPiGo distance sensor and the PyCam provided by the course.

2.3 Resources

Along with this project description you should have received documents containing all the images we will be using to provide your Pi with cues on how to navigate each challenge. Along with these cues, a map for challenge 4.3 has also been provided.

3 Project Breakdown

The project will be broken into three parts – challenges, write-up and peer evaluations. A description of each section been provided in the following sections and a summary of logistics has been provided below.

	Base Points	**Due Date**	**Due Date (Finalists)**
Challenges	40	12/4, 12/5	-
Write-up	40	12/6	12/7
Peer Evaluations	20	12/8	-

4 Challenges

Each challenge will have base requirements for completion as well as stretch goals. Credit will be awarded based on the rubrics to be released closer to the challenge date. The top scoring team from each section will compete during the following lecture for a final competition. Anytime before the final competition, teams will be allowed to modify their implementations. For the following challenge descriptions, **a blink is a 0.5s flash** of the GoPiGo 'eye' LEDs located on top of the board followed by a 0.5s pause. A wink is the same as a blink except with only one of the two eyes.

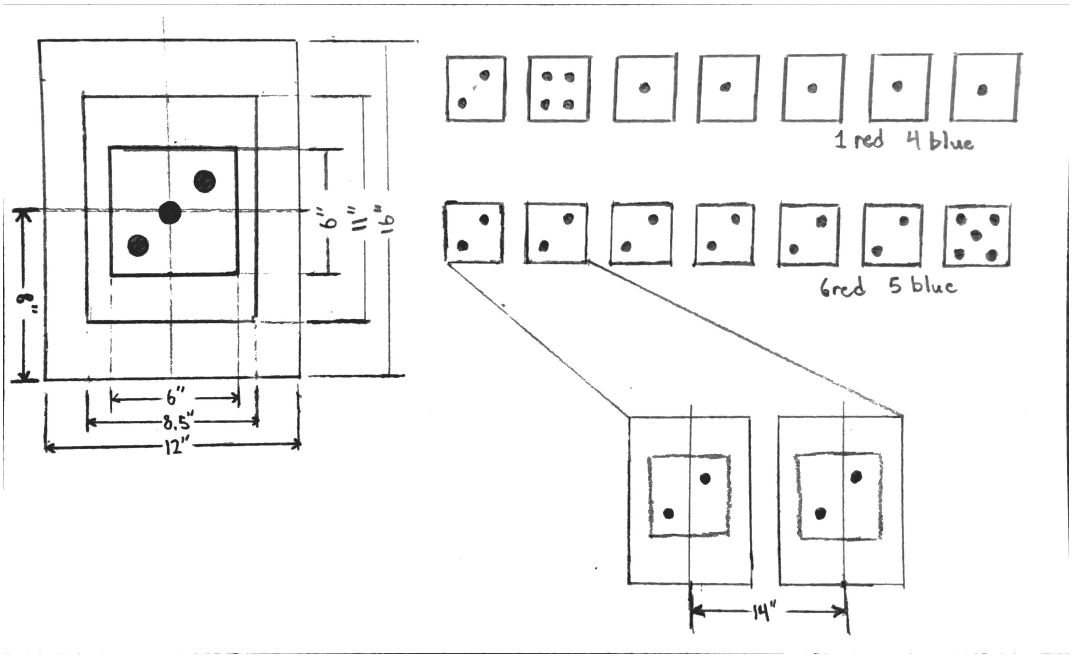
	Base Points	**Bonus Time-Limit**	**Hard Time-Limit**
Interpreter	10	1:00	1:30
A-maze-ing Race	15	2:00	3:00
Search & Destroy	15	2:00	3:00

4.1 Interpreter

Seven boxes will be placed a foot apart from one another in a row in front of the GoPiGo. Each box will feature a die face enclosed in a red square on a white sheet of paper. Of the seven boxes, one will host the answer-die and the others will host clues as to where the answer-die lies. The die face may contain any number of dots from 1-6 indicating the following. All directions are provided from the perspective of a GoPiGo facing the row of boxes.

1	Answer-die lies to the left
2	Answer-die lies to the right
3-6	This is the answer die

The location of the answer-die will be randomized at the start of each run with an equal chance of being at any location aside from the middle. Each time the GoPiGo reads a 1 or 2 it must indicate the direction in which the answer box lies with a white wink. It is not required to read all boxes or to even to read the boxes in any particular order, and your team will earn points dependent on the number of boxes read. Once the GoPiGo discovers the answer die, it must indicate index at which the answer box lies with red blinks, where indices run from 0 to 6 starting at the leftmost box. It must then indicate the number on the die with blue blinks.



4.2 A-maze-ing Race

The GoPiGo will begin at one of two locations and in one of six orientations to start navigating the maze. The goal is to escape the maze as quickly as possible without causing 'damage' to the GoPiGo or its surroundings. To officially complete the challenge, the GoPiGo must confirm its completion with 3 green blinks.

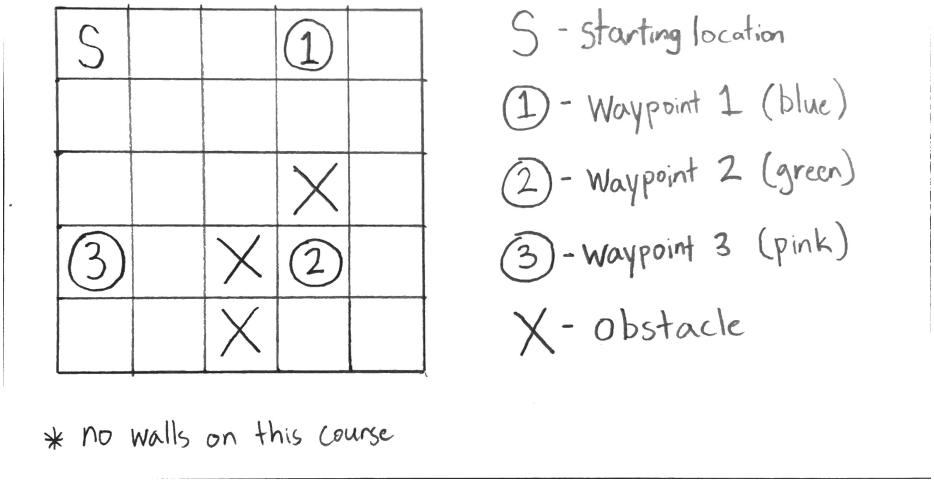
The maze will be a created on a 5'x5' grid revealed on the weekend before the event. Like the maze provided in the final project overview, the grid will be broken up into 25 discrete 1'x1' space around which walls will be formed. The initial location and orientation of the GoPiGo will be randomized immediately prior to a run to discourage any attempts at hardcoding a solution, but given the precision of the hardware provided, a memorized solution would likely fail miserably even without this randomization (big hint).

To further encourage a robust solution, we will provide visual cues that indicate the direction of exit. Throughout the maze, black triangles will be strategically posted indicating the direction of escape. The indicated escape will either be in the grid-space containing the triangle or the one immediately prior to it. It is up to the user to determine how the GoPiGo will use these cue, if at all. An example has been provided with this project release.

4.3 Search & Destroy

An arena with a known map will be provided for this challenge. The GoPiGo must navigate the map to reach all waypoints in order of ascending ID number. The course will have obstacles obstructing the path from waypoint to waypoint, which the GoPiGo must avoid.

Waypoints will be uniquely colored folders indicated in the map below. To receive credit for reaching a waypoint the GoPiGo must stop in the grid-space directly south of the waypoint and blink three times the color of the given waypoint, while facing the waypoint. Obstacles may be of any color, shape and size but will be contained within the boundaries of their grid-space.



5 Write-up

For your project, your team will submit a written report for the design of your implementations. For each challenge, you should include an explanation as to how and why you implemented the solution the way you did and what you could have done differently (with software) to make your system more robust. Each explanation should be at most 1 page long in standard submission format (single-spaced, 12pt Times New Roman, 1" margins). Your explanations on methodology should be based on the topics we covered in class as well as an explanation of your own intuitions and strategies. We recommend a full submission around 2 pages in length, but you will be evaluated based on the content rather than the length of your write-up. Teams competing in the final competition will be granted an extra day for their write-ups but should still submit their report based on their code from the preliminary event.

6 Peer Evaluations

Peer evaluations for this project are optional. If you feel the distribution of work between you and the member(s) of your group was fair you do not need to submit an evaluation. All members will get full credit for this section. If you feel the distribution of work was unfair, however, you should fill out the peer-evaluation survey provided and gather any evidence corroborating your claim. This will help us determine an appropriate grade for each member with a more thorough investigation.

7 Submissions

Sumission instructions TBD.