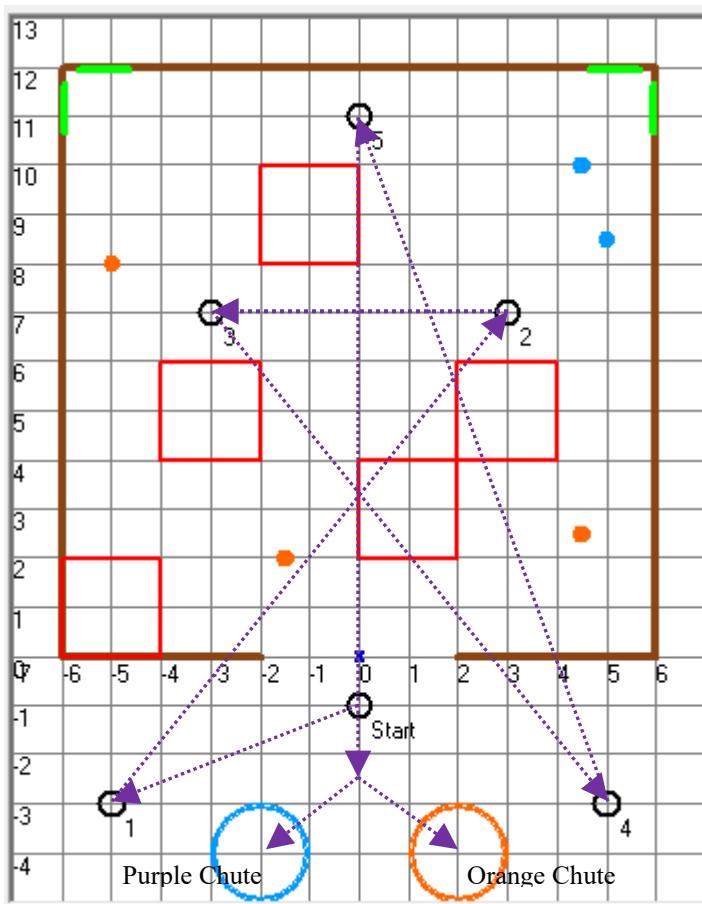


SE423 Project/Contest Spring 2024

Friday May 10th, 11:00am-2:00pm

Contest

The goal of this project is to program your robot to navigate to five different (x, y) points in their numbered order. Along the way to these five points collect at least two of the five golf balls dispersed in the course and avoid the obstacles in your robot's path. Once all five points have been reached, if needed continue collecting the remaining golf balls and then deposit the orange and blue golf balls in their respective deposit circles (chutes). You are only required to deposit two golf balls, but your score will improve if you find more than two.



The golf ball chutes are circular areas near the entrance to the course. Tape will be placed on the floor to indicate their positions. The golf balls must be “dropped off” at their respective chutes, meaning the golf balls are on the floor inside the circle of the chute and no longer underneath the robot or somehow held by the robot. Once dropped off in the chute’s circle you can think of the golf balls disappearing down the chute. This is even the case if the robot rolls the golf balls into the chute’s circle and then they continue rolling outside of the circle. There will be 5 golf balls placed randomly inside the course. Your task is to move at least two of them to their chute. Additional golf balls found and dropped off will subtract seconds from your overall contest time, so find as many as you can. There will be at least 2 orange and 2 light purple balls each run. Before your run, the golf balls will be placed randomly inside the course with the following restrictions: at least one tile away from the course walls, and at least 2.5 tiles away from the center of the 2’ X 2’ obstacles. When you collect

a golf ball your robot needs to communicate to your LABVIEW application the X, Y position and the color of the golf ball collected. Time will be subtracted from your overall time if the color is correct and the X, Y position is within a 0.5 tile radius of the actual position.

Your robot is being asked to move from one X, Y position to another and doing that task with precision. If the robot only relies on its wheel encoders and rate gyro to determine its X,Y position it works for a while but soon a noticeable drift can be seen. This X, Y position is called the robot's dead reckoned position. To correct the drift of the dead reckoned position you will use X, Y and theta positions from the motion tracking camera system (OptiTrack). During lab time, your instructor will be showing you how to start, run and use the motion tracking system. Kalman filter code will be given to you that will mix the dead reckoned data with the data from the motion tracking system.

A working LABVIEW application is also required for the contest. It should display the location of the robot throughout the entire course. Your LABVIEW application will also be graded in this final project. Points will be given for its appearance, its functionality, and its creativity. The outline of the course and displaying the coordinates of the found golf balls is required, but other nice features for your LABVIEW application would be to show the location of the obstacles as the robot senses them and the colors and locations of the golf balls.

The robot will be scored by the amount of time it takes to navigate the course and bring at least two golf balls to their chutes. Seconds are subtracted from your time if you bring more than two golf balls to the chute (**20 seconds subtracted for each additional golf ball**). Seconds are also subtracted from your time if your robot is able to transmit to LABVIEW the correct color and X, Y location of each golf ball collected. (**20 seconds subtracted for each correctly identified golf ball**. **To identify a golf ball you can place a circle at its location in the LabVIEW Arena, but you also MUST print the x,y coordinates and color in Text Boxes so the coordinates are easy to check on Demo Day. There should be a total of 5 sets of Text Boxes so you can display the coordinates of all 5 golf balls.**) Groups may try multiple runs to get the lowest score possible, and a tally of scores will be displayed recording each group's score. *Yes, a negative score could win the contest.*

To encourage groups to do a better job avoiding obstacles and walls, an additional 80 seconds will be subtracted from your overall time, if your robot does not touch any wood (walls or obstacles) throughout the entire run of the course.

There will be two checkpoint weeks and a final contest day for this project. The checkpoint dates and items are listed below, but briefly...

Checkpoint Week #1: Complete the point to point movement while avoiding obstacles in between those points. LABVIEW application should be displaying the robot's position along with an outline of the course's area.

Checkpoint Week #2: Golf ball retrieval. The robot should be able to find and collect golf balls and drop them off at the chutes. Your LABVIEW program should display the color and x, y coordinate of each found golf ball.

Final Contest Day is Friday May 12th from 11:00am to 2:00pm. Here you will put everything together and compete for the fastest (or smartest) robot. An operational LABVIEW program is required on contest day.

Final Report: This is due two days after the Final Contest Day. The *Final Report* is a web site that includes at least:

1. A paragraph explaining your group's strategy for the final contest. How did you use the robot's various sensors?
2. Pictures and video of your robot in action. Your instructor will be taking video of your robot's runs on the day of the final.
3. All your project source code zipped and downloadable. This includes all your Code Composer project files, your Linux program's source code and all your LABVIEW project files.

4. Picture/pictures and names of all group members.
5. I would prefer that use the Hackster.io website to post your website.

Additional details and description of the Final Project..

- To test your robot on the final project course, open and run the executable balldie.exe (ball dice) in the directory \FinalContest\. Click the “DRAW BALLS” button until you find a golf ball and obstacle configuration that you would like to test your robot with. Move the obstacles and golf balls to the locations specified.
- To start the run, place the robot at the “Start” coordinate (0,-1). You can place the robot at whatever initial angle you wish.
- Golf balls are only going to be inside the wood course so you will probably want to command the robot to go to “Point 1” (-5,-3) first but it is up to you. You could go into the course and collect golf balls. All that is required is that the robot goes to “Point 1” before it goes to “Point 2.”
- After the robot gets within .5 tiles of “Point 1” go to “Point 2.” Along the way avoid obstacles and collect golf balls when you see them. If you collect a golf ball send its color and coordinates to LABVIEW (or store its color and coordinate in memory to be sent to LABVIEW later). Also for added points keep track of the obstacles the Ladar detects.
- After the robot gets within .5 tiles of “Point 2” it should go on to “Point 3.” Avoid and pick up along the way.
- After the robot gets within .5 tiles of “Point 3” it should go on to “Point 4.” Avoid and pick up along the way.
- After the robot gets within .5 tiles of “Point 4” it should go on to “Point 5.” Avoid and pick up along the way.
- After the robot gets within .5 tiles of “Point 5” it has reached the last point. Now the robot’s job is to collect any golf balls it did not pick up along the way to the five points and deposit them in their respective “chutes.” The contest requirement is to collect and deposit at least two golf balls. Seconds are subtracted from the run’s time if more than two golf balls are collected and deposited. To get from “Point 5” to the deposit chutes, the robot could just be told to go to a (x, y) point close to the chutes and deposit the correct color of golf ball and along the way avoid the obstacles that are in the way.

A second more complicated method to get from “Point 5” to the chutes would be to perform some kind of path planning. As the robot goes from “Point 1” to “Point 2” to “Point 3” etc. the robot could keep track of the obstacles it locates with its Ladar sensor. By the time the robot gets to “Point 5” it has probably seen most of the obstacles and a path planning algorithm could be run to figure out how to get the robot from “Point 5” to the chutes without running into an obstacle. This is NOT required, but would add many points to your final contest grade.

- How to deposit the golf balls? If you gather the five golf balls under the front of the robot you will need to come up with a method to roll the golf balls out from under the robot. Any ball that stays under the robot even if the robot is sitting in the circle has not been deposited.

Final Project/Contest Grading

Your Final Project grade is going to be broken down into three parts:

Check Point #1	worth	35%
Check Point #2	worth	35%
Final Contest Day	worth	30%

Check Point #1: Complete the point to point movement while avoiding obstacles in between those points (Demonstration by 5:00PM Monday May 1st).

When: You can check off this part of the contest any of these times (or schedule another time before May 2nd):

- 9:00am to 5:00pm Tuesday April 25th.
- 2:30PM to 6:00pm Wednesday April 26th.
- 9:00am to 1:00pm and 2:00pm to 5:00pm Thursday April 27th.
- 9:00am to 5:00pm Monday May 1st.

How will you be graded:

50%	Individual	How much effort did you put into the project? Can you work well with the robot on your own? Did you try some “new” ideas on the robot? Creativity.
10%	Group	The robot can complete the full X, Y position movements: Start to 1 to 2 to 3 to 4 to 5.
25%	Group	The robot avoids the obstacles in its way during the x, y movements.
15%	Group	LABVIEW application must include: <ol style="list-style-type: none">1. Robot displayed in the course with option to leave a trail of where it has been.2. Course outline3. Ability to download/upload parameters to/from robot, either from LABVIEW or from your Linux program. Additional points for bells and whistles, some ideas (but I love your own ideas): additions that help you debug your DSP code, fun graphics, make the application speak to you (LABVIEW or Linux), play music, etc.

Check Point #2: Golf ball retrieval (Demonstration by Tuesday 5:00PM May 9th).

When: You can check off this part of the contest any of these times (or schedule another time before May 9th):

- 9:00am to 5:00pm Tuesday May 2nd.
- 2:30pm to 6:00pm Wednesday May 3rd.
- 9:00am to 5:00pm Thursday May 4th.
- 9:00am to 5:00pm Monday May 8th.
- 9:00am to 5:00pm Tuesday May 9th.

How will you be graded:

- | | | |
|-----|------------|--|
| 50% | Individual | How much effort did you put into the project?
Can you work well with the robot on your own?
Did you try some “new” ideas on the robot?
Creativity? |
| 25% | Group | How well does the robot collect golf balls? Can it collect five golf balls? Can your robot bring golf balls to the chute circles consistently? |
| 15% | Group | How well does the robot avoid obstacles while it is collecting golf balls. How are you using all the different sensors of the robot? |
| 10% | Group | LABVIEW application must include, in addition to Checkpoint 1 items:

Display in text boxes, the x,y location and color of each golf ball retrieved
Additional points for bells and whistles, ideas: displaying a ball in the arena where the robot found the golf ball, displaying where the obstacles were found. |

Final Contest Day

When: Friday May 12th from 11:00am to 2:00pm

How will you be graded:

- | | | |
|-----|------------|---|
| 50% | Individual | How much effort did you put into the project? |
| 25% | Group | How well did your robot work? |
| 15% | Group | Completed Web Page? |
| 10% | Group | Is your LABVIEW application working and including all specification from above checkpoints? |