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I400/H590 Human-Robot Interaction Design **Spring 2014**

Final Project

Search and Rescue Robotics

Robot Marco Polo, Remote Control, Line Following

Objectives:

- To implement a search and rescue robot by using the Arduino robot behavior. The robot should be able to follow lines by using the IR sensor array, use a range sensor to identify survivors on the track and move them off the line path to continue searching. The robot should also be able to communicate with other robot rescuers by using IR transmitters and receivers.

Deliverables:

- Mid-Project Presentation/Demonstration due on Monday, 04/21/14
- Final Project Presentation/Demonstration due on Monday, 4/28/14
- Final Project Competition due on Monday, 5/05/14
- Final Project Report and Code due on Monday, 5/12/14

Equipment: Arduino Robot Base

Remote Control

Line following LED sensors

Infrared receiver

Infrared transmitter

Remote Control

Range Sensors (Infrared or Ultrasonic)

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Procedure:

Part I – Line Following

1. Review Arduino Robot Video Tutorial 4 on YouTube on following lines
2. You can create a line path by using a black marker or black electrical tape on sheets of printer paper
3. Modify the example programs, `Examples\Robot_Control\explore\R02_Line_Follow`, or `Examples\Robot_Control\learn\LineFollowWithPause`, or `Examples\Robot_Control\learn\IRArray`, to create a line following robot
4. To test that the robot is working correctly, it should make two full loops around an oval track

Part II – Search and Rescue Robot

1. Review Arduino Robot Video Tutorial 4 on YouTube on the search and rescue robot
2. You will use the same line path that you created in Part I but you will now put objects along the path
3. Mount enough range sensors on the front of the robot to be able to see the objects along the path.
4. Make sure the objects are tall or wide enough to be seen by the range sensors
5. When the robot senses an object, it should push it off the path and then return to follow the line
6. Modify the example programs, `Examples\Robot_Control\explore\R10_Rescue`, to create the search and rescue robot

Part III – Robot Communication (Marco Polo)

1. Mount the infrared receiver that you used in the remote control lab to the front of your robot.
2. You will use this receiver to decode signals from three different robots. The codes are given on the following table:

Robot	IR CODE	Signal

1	1234	`Robot.beep(BEEP_SIMPLE);`
		`delay(1000);`
		`Robot.beep(BEEP_DOUBLE);`
		`delay(1000);`

2	2014	`Robot.beep(BEEP_DOUBLE);`
		`delay(1000);`
		`Robot.beep(BEEP_LONG);`
		`delay(1000);`

3	1040	`Robot.beep(BEEP_LONG);`
		`delay(1000);`
		`Robot.beep(BEEP_SIMPLE);`
		`delay(1000);`

3. Based upon the signal received you will identify which robot sent the signal and make the same audible signal in order to indicate which robot was found. You will also show the sender robot on the LCD.
4. You will not use the *IRremote* library in order to complete this part of the lab. You will use the *IR_Receiver2.ino* sketch program posted in the Resources folder on Oncourse. This program will read signals from the robot and a Sony remote. ***IT WILL ONLY WORK WITH THE SONY REMOTES OR A UNIVERSAL REMOTE PROGRAMMED TO A SONY TV.***

Part IV – Robot Surprise!

This semester you have learned about many concepts related to human-robot interaction. The final part of the final project requires you to reflect on what you have learned and create a program on your robot related to HRI. You can select topics related to or build on what we discussed in class, what you read in the literature, or what you did in a prior lab. Surprise me!

Resources:

Arduino Tutorial	Arduino Robot Tutorial 4:	Following lines, going to the rescue http://www.youtube.com/watch?v=bnqDzNAU7JQ
References:	Arduino Language Reference:	http://arduino.cc/en/Reference/HomePage
	Arduino Robot Library:	http://arduino.cc/en/Reference/RobotLibrary

Demonstration:

The demonstration of the final project will be completed in parts. Parts I and II will be demonstrated by the mid-project presentation due date. The remaining parts will be demonstrated the week before the final project competition on the last day of class.

If you have any questions, please do not hesitate to ask your instructor.

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Report Guidelines:

Please use the following checklist to insure that your report meets the basic guidelines.

1. The document should use default Microsoft Word settings with respect to font and margins
2. All pages should be numbered
3. All headings must be numbered, left-justified, bolded, and capitalized at the beginning of the section.
4. All figures must have a number and caption underneath (i.e. GUI screenshots)
5. All tables must have a number and title above it (i.e. results error analysis)
6. The cover page should have title, partner names, course number and title, date
7. The report should order should be:

   Cover page

   Abstract

   Table of Contents

   I. Objective
   II. Theory
   III. Methods
   IV. Results
   V. Conclusions and Recommendations

   Appendix/Supplementary Materials

   References (if any)
8. The ***abstract*** should be a brief statement of the experiment purpose, verification and relevant results
9. The ***objective*** should state the purpose of the project and associated tasks in your own words
10. The ***theory*** should state relevant theory that will be used to achieve the purpose
11. The ***methods*** section should summarize the algorithms implemented to achieve the purpose and the procedures used to test the robot algorithms
12. The ***results*** section should summarize the results of the tests and verify that the robot was able to achieve the purpose and meet the project objectives
13. The ***conclusions and recommendations*** should address whether the purpose was achieved, possible sources of error, recommendations to improve the robot algorithm and answer any relevant questions related to the project.
14. Remember this is only a guide for the minimum requirements of your report. You are required to answer any questions or provide any details that you feel aid the reader in understanding the objective, theory, procedure, implementation and results of your project.

Grading Rubric:

The project is worth a total of 100 points and is graded by the following rubric.

Percentage	Demonstration (48 points)	Report (30 points)	Code (22 points)
90%	Excellent work, the robot performs exactly as required, all parts present	Follows all guidelines and answers all questions posed	Properly commented with a header and function comments, easy to follow with modular components
80%	Performs most of the	Does not answer some	Partial comments and/or

	functionality with minor failures, a few parts missing	questions and/or has spelling, grammatical, content errors	not modular with objects
60%	Performs some of the functionality but with major failures or several parts arts missing	Multiple grammatical, format, content, spelling errors, questions not answered	No comments, not modular, not easy to follow
0%	Meets none of the design specifications or not submitted	Not submitted	Not submitted

Submission Requirements:

You must submit your assignment as a zipped folder of the Sketch code and the project report in to **OnCourse**. Your properly commented code should be modular and organized with functions and classes as needed in order to make it more readable. Your report should follow the guidelines detailed in this document.