Control of Mobile Robotics

CDA4621

Spring 2017

Lab 1

Motion Task

Total: 100 points

Due Date: 2-6-17 by 8am

A. Lab Requirements

The lab requires use of the course robotic hardware ("Robobulls-2017") provided to students at no charge for the duration of the course. Required software can be downloaded free of charge from the web. All labs are to be done by teams of two students. Note that no diagrams or descriptions by hand will be accepted. Each student is required to submit his or her joint report through CANVAS. Penalties will apply to any individual student submitting a late assignment even if the partner has already submitted it.

- Hardware Requirements

The "Robobull-2017" (Figure 1) is the main robot hardware used for the course.

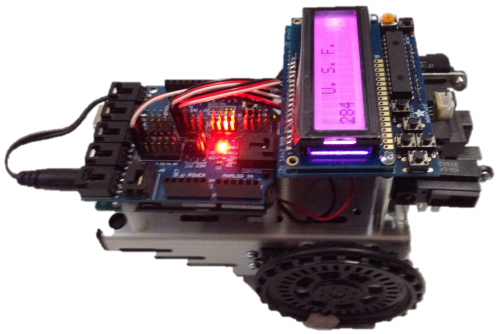

Figure 1: Robobulls-2017

- Software Requirements

Arduino Software (Version 1.8.1 or later)
https://www.arduino.cc/en/Main/Software

B. Task Evaluation

Each individual task is worth a specific number of points where these points are always split 50% between Task Execution and Task Report:

- Task Execution
The robot should execute the task correctly with a video clearly and completely showing the task execution (points will be taken for errors or missing aspects of task execution).

- Task Report
Each task report requires an accompanying document to be uploaded to Canvas together with ALL the files required to run the program in the robot. The task report needs to include ALL the following sections (points will be taken off if anything is missing):

1. Task description.
2. Solution describing the conceptual algorithm used to solve the task described in terms of flow charts to describe the logic of the program and block diagrams to describe the various robot components.
3. Video link to different task executions (you should split each task execution as a different video link most preferably in YouTube making sure the video is public to all). Provide at the beginning of each video your name and description of the task being performed.
4. Description of the code used to program your robot with explanations that clearly relate to the solution previously described.
5. Images taken from the actual robot task execution (at least one image per task).
6. Conclusions where you analyze any issues you encountered when running the task and how these could be improved.

C. Task Description

The objective of this lab consists of the following 5 tasks. Note that these are all introductory tasks involving either sensing or actuating without performing both at the same time:

1. IR Short Distance Sensor (10 points)

The robot incorporates 3 IR short distance sensors (Figure 2) in the range of 2-10 inches each (4 – 30 cm) positioned front, left, and right of the robot. The value measurements of all sensors need to be converted to actual distance measurements in inches and shown in the LCD, clearly stating the sensor name and distance in inches. You should test distances against different objects to the left, right and in front of the robot. Include in the document a graph showing the distance computed in relation to values read by the different sensors.

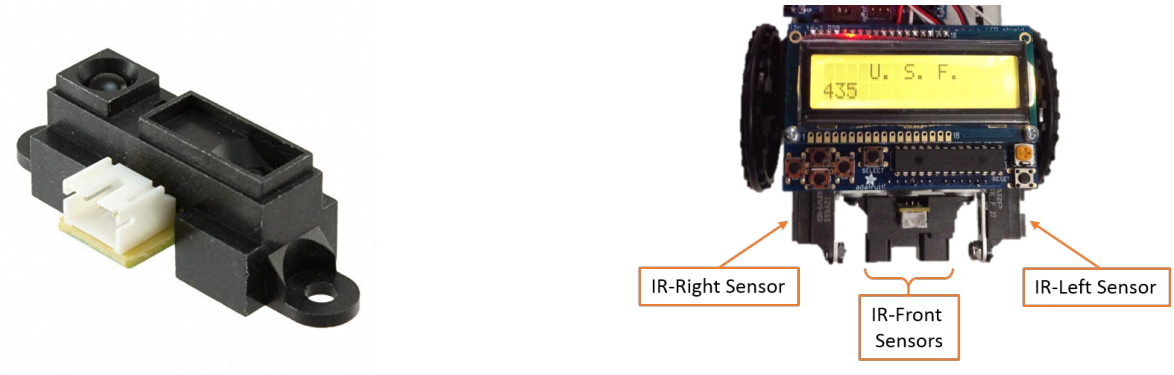

Figure 2: IR Short Distance Sensor (http://www.mouser.com/ProductDetail/Sharp-Microelectronics/GP2Y0A41SK0F)

2. IR Long Distance Sensor (10 points)

The robot incorporates a IR long distance sensors (Figure 3) in the range of 8 to 59 inches (20 – 150 cm) positioned front of the robot. The sensor measurement value needs to be converted to distance in inches displayed in the LCD as a single measure between 2 and 59 inches. Since there are two front distance sensors, you need to provide a single correct distance value obtained from reading both front short and long distance sensors. Include in the document a graph showing the distance computed in relation to values read by the different sensors.

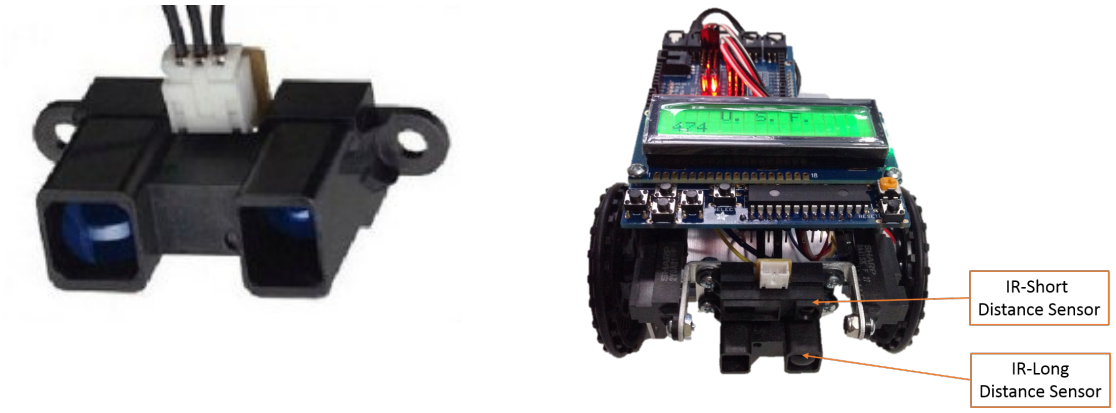

Figure 3: IR Long Distance Sensor (https://www.parallax.com/product/28997)

3. Open Loop Control Motor (20 points)

The robot has to perform four different open loop motions without using any sensor information: (a) straight forward, (b) straight backward, (c) clockwise circle, and (d) anti-clockwise circle. The robot needs to move between the two 70-inch tapes as straight as possible without sensing the tapes (Figure 4). Circular movement will be evaluated putting a mark at 30 inches from every robot side (Figure 5).

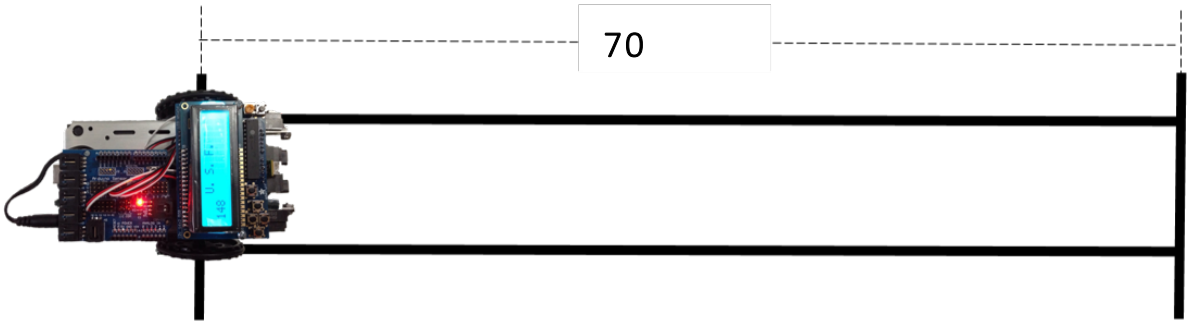

Figure 4. Straight Forward and Backward (in the opposite direction)

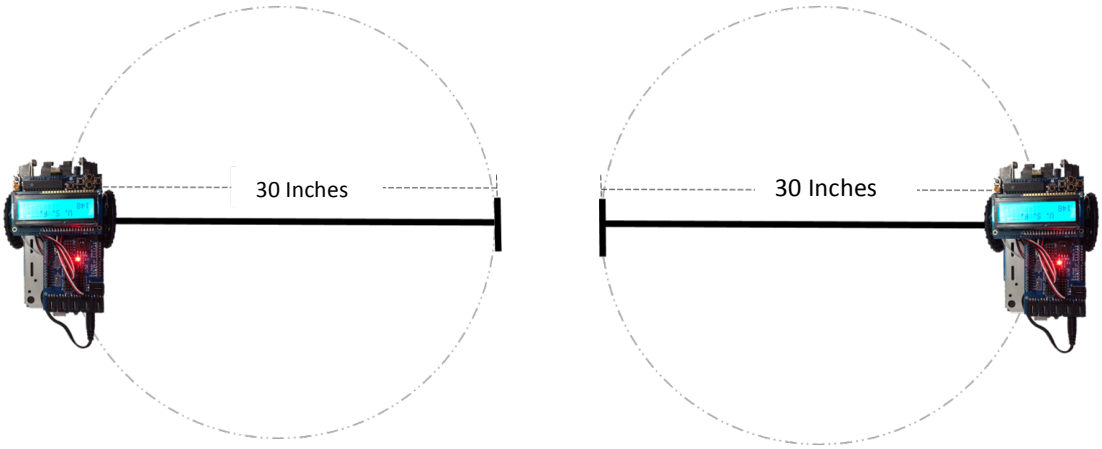

Figure 5. (Left) Clockwise Circle. (Right) Anti-Clockwise Circle.

4. Square Open Loop Movement (30 points)

The robot has to move following two square trajectories having 30 inches of every side (Figure 6). The movements will be evaluated using the deviation of robot from tape. Note: The robot cannot sense the tape.

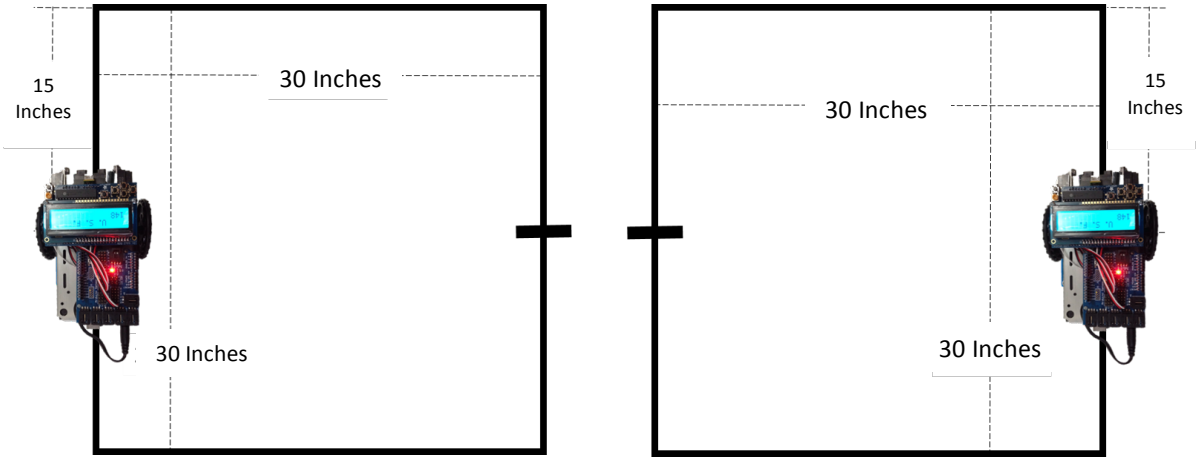

Figure 6. (Left) Clockwise Square. (Right) Anti-Clockwise Square.

5. "8" Open Loop Movement (30 points)

The robot has to move through an "8" path having 30 inches in diameter (Figure 7). The movements will be evaluated using the deviation of robot from tape. Note: The robot cannot sense the tape.

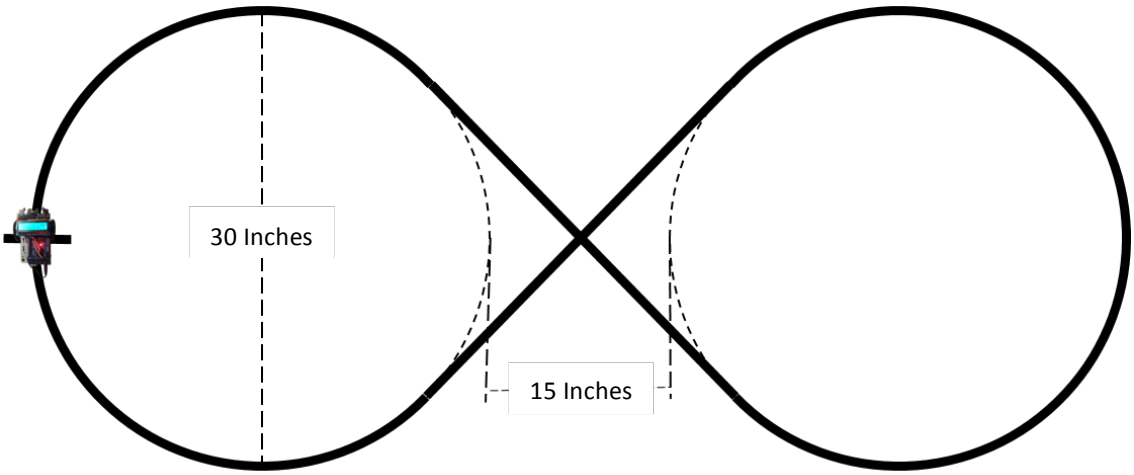

Figure 7. “8” open loop path.