

Test Document

Project: LIBERTY

Task: Localization Test

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1.0 TESTS

Test 1: Localization facing away from wall

Date: 3/11/2017

Tester: Edward Son

Author: Edward Son

- 1) The purpose of this test is to validate that the addition of the funnel will not affect the robot's ability to localize using the ultrasonic sensor when starting facing away from the corner.
- 2) The objective of this test is to measure the maximum and minimum distance from the point (1,1) that the robot can still localize using ultrasonic sensor.
- 3) First, measure with a ruler 1cm from the (1,1) along the 45 degree line, and place the robot at this distance, facing away from the corner. Then, run falling edge ultrasonic localization. This consists of the ultrasonic detecting a falling edge while turning -360 degrees, which is when the current detected distance is under a threshold of 50, and the previous distance is over 100. Also, the alpha angle should not yet be set. Once detected, set alpha from odometer using "alpha = Math.toDegrees(odometer.getTheta());", then turn 360 degrees. Using the same condition and when alpha does not equal 0, detect the next falling edge. Set beta using "beta = Math.toDegrees(odometer.getTheta());". Then, calculate the real angle error using the following conditions:

```
if (alpha < beta) {  
    deltaTheta = 55 - (alpha - beta) / 2;  
} else {  
    deltaTheta = 265 - (alpha - beta) / 2;  
}  
}
```

Finally, set the odometer theta to deltaTheta. Repeat the first step, but increment the distance, until the robot does not successfully complete ultrasonic localization.

- 4) The expected plot is a scatter plot of values close to 0, which represents a success in the ultrasonic localization. The angle does not need to be perfect at this point, since light localization will take care of the angle error. Also, where this plot will end is going to be considered the maximum distance from (1,1) that the robot can successfully localize.
- 5)

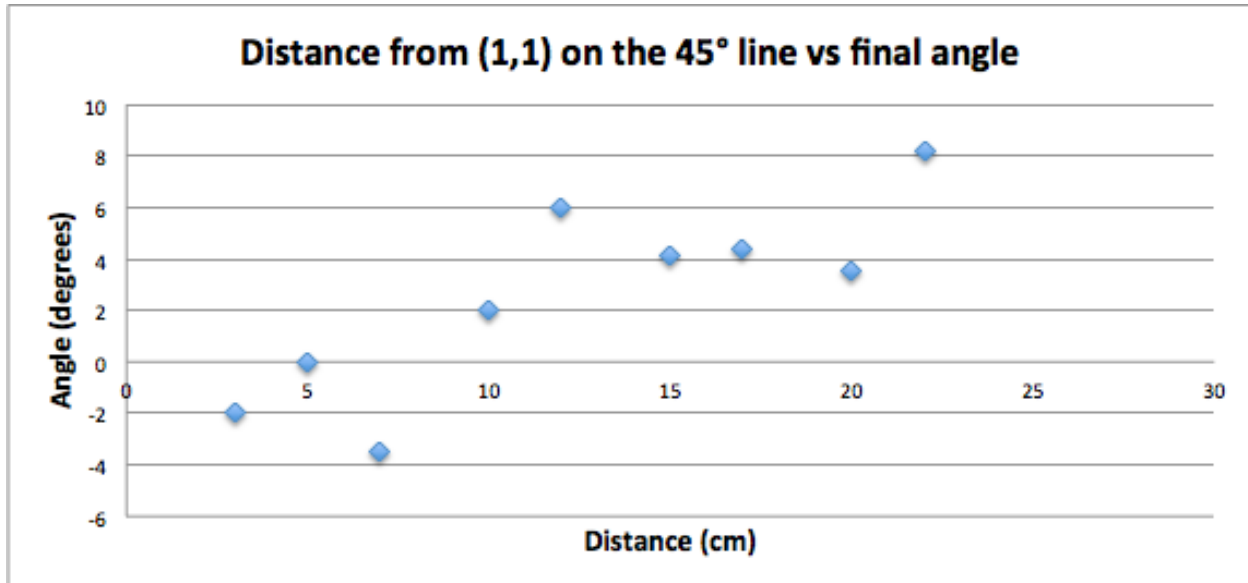


Figure 1: Distance v.s. final angle after localization

- 6) As seen from the graph above, the robot successfully localizes from a distance of 3 cm up to 22 cm down the 45 degree line from (1,1) to (0,0). The reason 22 cm is the maximum, is because the funnel attached to the front of the robot prevents the robot from turning enough to detect a falling edge.
- 7) Using this information, we can safely assume that the funnel does not prevent the robot from localizing when starting facing away from the wall. However, we will need to make sure that it is not placed further than 22 cm from the nearest corner, as it will not be able to complete ultrasonic localization.

Test 2: Localization facing corner

Date: 3/11/2017

Tester: Edward Son

Author: Edward Son

- 1) The purpose of this test is to validate that the addition of the funnel will not affect the robot's ability to localize using the ultrasonic sensor when starting facing the corner.
- 2) The objective of this test is to measure the maximum and minimum distance from the point (1,1) that the robot can still localize using ultrasonic sensor.
- 3) First, measure with a ruler 1cm from the (1,1) along the 45 degree line, and place the robot at this distance, facing the corner. Then, run falling edge ultrasonic localization. Refer to **Test 1** from this section for falling edge implementation. Repeat the first step, but increment the distance, until the robot does not successfully complete ultrasonic localization.

- 4) The expected plot is a scatter plot of values close to 0, which represents a success in the ultrasonic localization. The angle does not need to be perfect at this point, since light localization will take care of the angle error. Also, where this plot will end is going to be considered the maximum distance from (1,1) that the robot can successfully localize.

5)

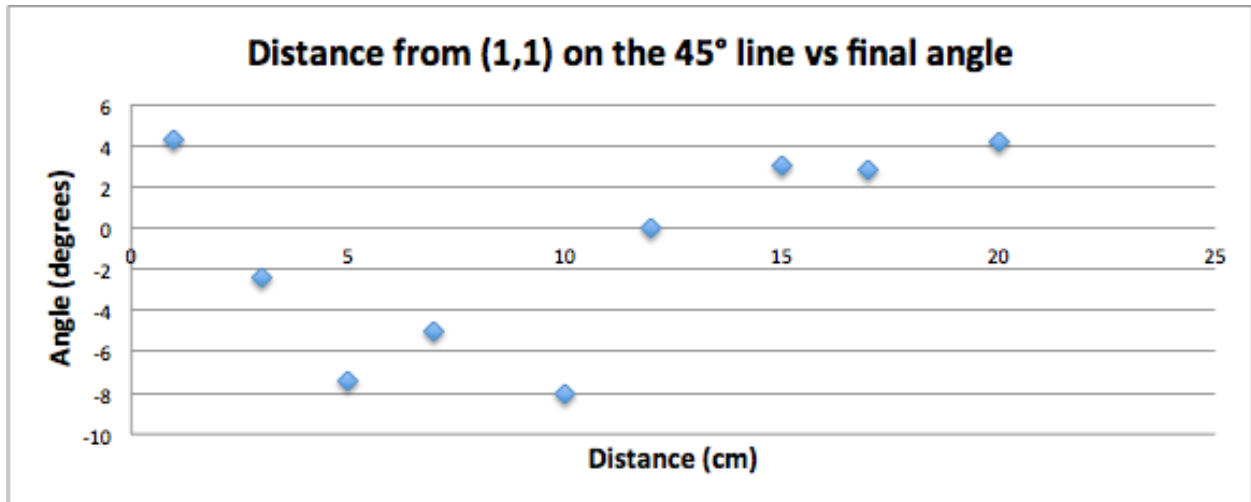
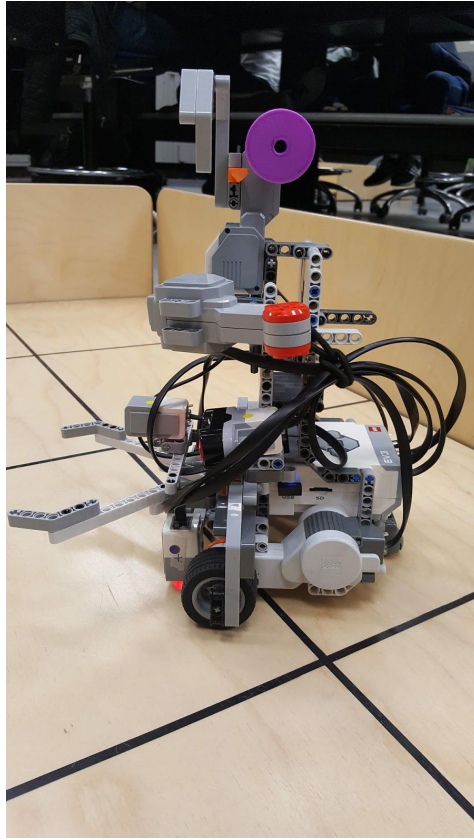
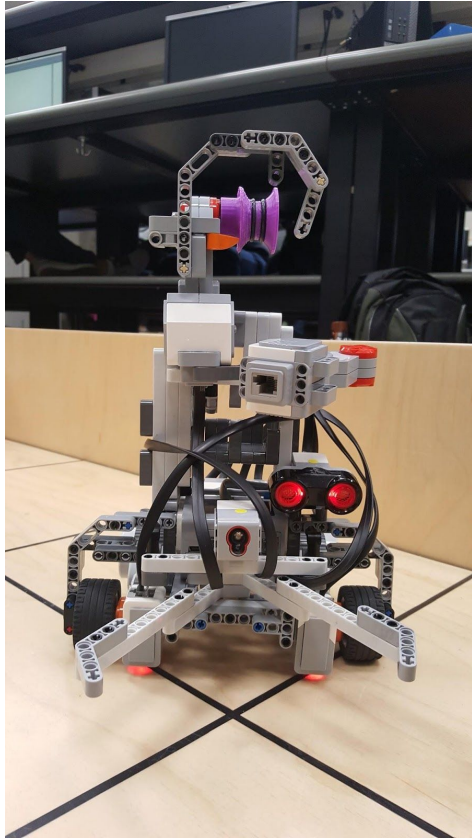


Figure 2: Distance vs final angle after localization

- 6) As seen from the graph, the robot successfully localizes from a distance of 1 cm to 20 cm down the 45 degree line from (1,1). The reason 20 cm is the maximum, is because the funnel attached to the front of the robot prevents the robot from turning enough to detect a falling edge.
- 7) Using this information, we can safely assume that the funnel does not prevent the robot from localizing when starting facing toward the wall. However, we will need to make sure that it is not placed further than 20 cm from the nearest corner, as it will not be able to complete ultrasonic localization.

2.0 HARDWARE



See *HARDWARE - 2.0*.