Test Document

Project: LIBERTY
Task: Integration Test (to Capturing)

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1. Test

Test: Integration Capture Test

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1) The purpose of this test is to determine whether the robot can finish several tasks including localization, mounting onto the zip-line, re-localization after dismounting from the zip-line and capture the right flag.
2) The distances and the angle differences of the physical position and the expected positions and directions will be measured at every waypoint. In addition, the results of each task will be recorded.
3) First place the robot with arbitrary direction on the diagonal and run the program. After localization process, the robot will stop and measure the position and direction differences. Press the up button. At the waypoint that is one block away from the zip-line, the robot is going to re-localize itself. Again, record the differences. If the robot mounts onto the zip-line successfully, record the position and direction differences after re-localization. Finally, check if it captures the right flag successfully.
4) The expected result is that the robot should be able to perfectly complete each task. Moreover, the position differences should be within 2 cm and the direction differences should be within 4 degrees.
5) Results:

Integration Test upto Capturing											
	localization(offset)			waypoint (offset)				localization(after dismounting) (offset)			
Trial	x (+/- 1cm)	y (+/- 1cm)	theta(+/- 1 deg)	x (+/- 1cm)	y (+/- 1cm)	theta(+/- 1 deg)	mounting	x (+/- 1cm)	y (+/- 1cm)	theta(+/- 1 deg)	Capturing
1	0.5	0.5	1.1	0.4	0.4	2.3	yes	1	0.4	3.5	Failed
2	0.6	0	1.8	1	-0.7	3	yes	1	0.5	0.7	Failed
3	0.3	0.4	1.4	1.1	-0.4	3.3	yes	0.3	0.2	1.2	Failed
4	1.1	0.5	1.2	1.2	0.5	4.5	yes	1.2	0.5	1.3	Failed
5	1	0.4	1	0.5	2.1	3.4	yes	1	0.2	2.1	Success
6	0.5	0.6	0.2	0.6	0.9	2.3	yes	0.7	0.6	0.6	Success
7	1	0.4	2.2	2.2	0.3	6.1	Failed				
8	1	0.4	0.3	0.3	1.1	0.9	yes	1.2	0.3	0.7	Failed
9	0.4	0	2.3	1.5	2.0	5.4	failed				
10	0.6	0.8	2.4	0.4	1.7	3.2	yes	0.2	0.4	1.1	Success
average	0.7	0.4	1.39	0.92	0.79	3.44		0.825	0.39	1.4	
ST	0.294	0.245	0.785	0.605	0.956	1.54		0.388	0.146	0.975	

Figure 1: Testing Result of Integration Tests.

6) From Figure 1, it can be observed that among the successful trials, the position and direction differences are close enough to the expected values. However, if the angle of the second way point is off more than 5 degrees, the robot is not able to mount on to

the zip-line and, therefore, result in a failure trial. For the first four trials, the process of capturing failed, as the robot searched in a wrong zone.

7) Although overall behavior of the robot is inconsistent, it is within tolerance.

The average (AM) was calculated by using the following formula

$$Average = \frac{1}{n}\sum_{i=1}^{n} a_i = \frac{1}{n}(a_1 + a_2 + \cdots + a_n)$$

We use the sample standard deviation formula (see below) to calculate the sample standard deviation.

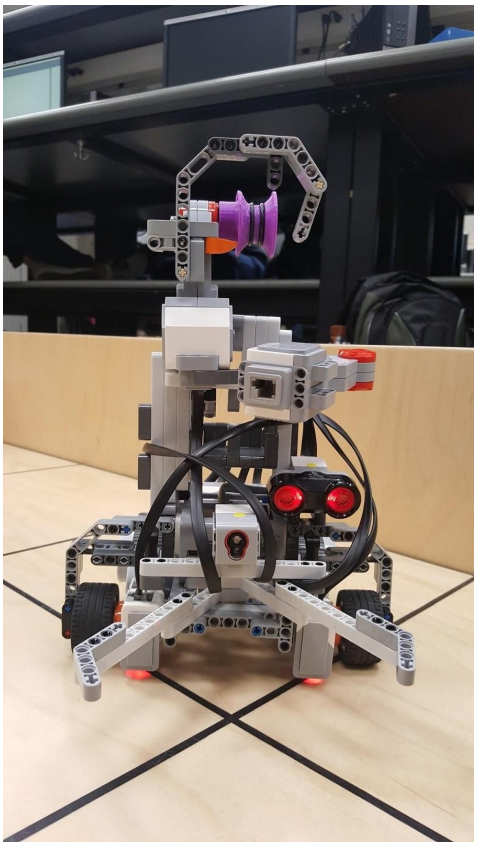
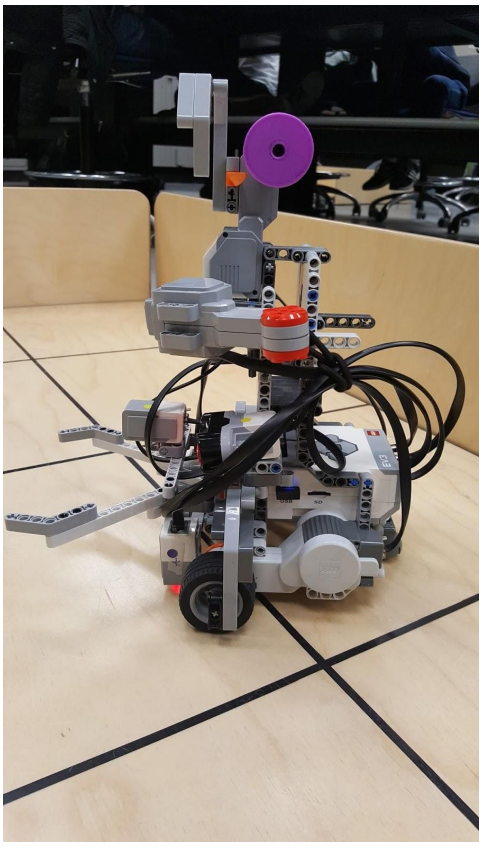
$$s = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N}(x_i - \overline{x})^2}$$

$\overline{x}$ = *Mean*

N = *Sample size*

x_i = *Sample at i*

2. Hardware used

See ***HARDWARE - 2.0*** for reference to the build.