Test Document

Project: LIBERTY

Task: Square Driver Test

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1. TESTS:

<u>Test 1: Drive in a square without correction</u>

Date: 05/11/2017

Tester: Claire Liu

Author: Claire Liu

1) The purpose of this test is to determine the accuracy of the driving process of the robot
2) The objective of this test is to determine the difference of the starting point and the end point, which is the position where the robot stops after driving in a square.
3) First, measure and record the actual start point of the starting point of the robot. Then, run the testing code in the square driving mode. After the robot finishes a square, record the x-position, y-position and theta respectively of the end position.
4) The positions of the starting point and the end point should not vary much.
5) Results:

Trial	starting point			end point			difference		
	x(+/- 1cm)	y(+/- 1cm)	theta	x(+/- 1cm)	y(+/- 1cm)	theta(+/- 1deg)	x(+/- 1cm)	y(+/- 1cm)	theta(+/- 1deg)
1	-13.5	-8.6	0	-1	-14.3	27	12.5	5.7	27
2	-13.5	-8.6	0	-2.4	-15.2	32	11.1	6.6	32
3	-13.5	-8.6	0	-19	-8.2	21	5.5	0.4	21
4	-13.5	-8.6	0	-7.4	-13.9	23	6.1	5.3	23
5	-13.5	-8.6	0	-1.2	-2.1	340	12.3	6.5	20
6	-13.5	-8.6	0	-21.2	-4.9	19	7.7	3.7	19
7	-13.5	-8.6	0	-11.7	-0.5	31	1.8	8.1	31
						Mean	8.143	5.186	24.714
						Standard Deviation	4.012	2.504	5.314

Figure 1: Square driver starting position and end position

6) From this table, the position change in this test is not perfect and is off a bit much. In addition, during the test, the left motor sometimes accelerates suddenly and will result in a failure in test. This is found due to the fact that the motors are not synchronized properly. Moreover, when the robot drives to the gap between the two boards, it will slip a little bit, which is also a reason causing the inaccuracy of the driving process as well as the odometer reading in the future.
7) A proper way to synchronize the motors should be implemented. In addition, the odometer correction need to be implement because of the slip over the gap.

<u>Test 2: Drive in a square without correction (after synchronized)</u>

Date: 05/11/2017

Tester: Claire Liu

Author: Claire Liu

1) The purpose of this test is to determine the accuracy of the driving process of the robot
2) The objective of this test is to determine the difference of the starting point and the end point, which is the position where the robot stops after driving in a square.
3) First, measure and record the actual start point of the starting point of the robot. Then, run the testing code in the square driving mode. After the robot finishes a square, record the x-position, y-position and theta respectively of the end position. Calculate the difference between the corresponding x, y and theta value from the start point and the end point.
4) The positions of the starting point and the end point should not vary much.
5) Results:

Trial	starting point			end point			difference		
	x(+/- 1cm)	y(+/- 1cm)	theta(+/- 1deg)	x(+/- 1cm)	y(+/- 1cm)	theta(+/- 1deg)	x(+/- 1cm)	y(+/- 1cm)	theta(+/- 1deg)
1	0	0	0	-1	2.3	344	1	2.3	16
2	0	0	0	-3.4	-5.4	339	3.4	5.4	21
3	0	0	0	2.5	-4.3	351	2.5	4.3	9
4	0	0	0	3.1	-0.8	349	3.1	0.8	11
5	0	0	0	-1.2	3.7	337	1.2	3.7	23
6	0	0	0	4.5	-2.2	343	4.5	2.2	17
7	0	0	0	2.8	-4.9	350	2.8	4.9	10
						Mean	2.643	3.371	15.286
						Standard Deviation	1.228	1.661	5.499

Figure 2: Square driver starting position and end position

6) From this table, the position changes are much smaller than that of Test 1. However, it can be observed that the slip issue still happens. The turning is not sharp enough, or, in other words, the robot turns less than 90 degrees and then keeps moving forward. Thus, the parameters of the robot in terms of programming may be changed.
7) The parameter of the robot (i.e. the track of the robot) in terms of programming should be changed into empirical values to improve the accuracy of the turning. The odometer correction need to be implement because of the slip over the gap.

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

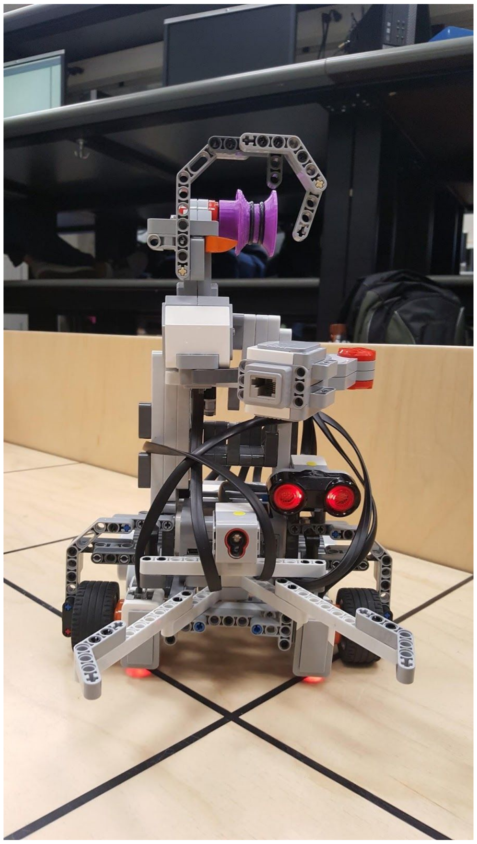
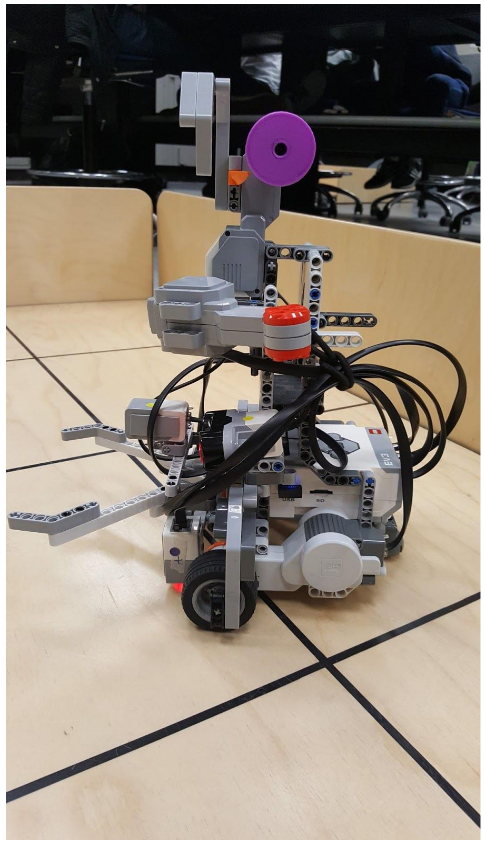
$$Average = \frac{1}{n}\sum_{i=1}^{n} a_i = \frac{1}{n}(a_1 + a_2 + \cdots + a_n)$$

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.***

3. Source Code used

See github group repository at commit: `c9018e75f05fee69e773d5fb70e9d7ff0b3ed406`