**Lab 2: Odometry**

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As part of Group 51

For ECSE 211: Design Principles and Methods

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## Design evaluation

**Hardware**

Overall, the hardware design changed minimally compared to the design in lab 1.

Insert image

There are two large motors, driving two wheels positioned on the outside, that are connected to a EV3 brick resting on top of them. On the middle front part of the robot, there is a light sensor attached along the vertical axis pointing straight down.

**Software**

## Test data

Odometer test (10 independent trials)

1. Note the starting position S of the robot’s center and consider it to be (0,0) for this trial.
2. Run the robot in a 3-by-3 tile square, without using Odometry correction.
3. Measure its resulting signed Xf and Yf position with respect to its starting position S.
4. Note the reported values of X and Y shown for he odometer.

Odometer correction test (10 independent trials)

1. Place the root approximately at the starting position S. You do not need to note the starting position.
2. Run the robot in a 3-by-3 square using Odometry correction.
3. Measure its resulting signed Xf and Yf position with respect to the rigin (0,0) in Figure 3.
4. Note the reported values of X and Y shown for the odometer.

## Test analysis

**Euclidean error distance** ε

**Mean and standard deviation**

***How do the mean and standard deviation change between the design with and without correction? What causes this variation and what does it mean for the designs?***

***Given the design which uses correction, do you expect the error in the X-direction or in the Y-direction to be smaller?***

## Observations and Conclusions

***Is the error you observed in the odometer, when there is no correction, tolerable for larger distances?***

***What happens if the robot travels 5 times the 3-by-3 grid’s distance?***

***Do you expect the odometer’s error to grow linearly with respect to travel distance? Why?***

## Further improvements

***Propose a means of reducing the slip of the robot’s wheels using software.***

***Propose a means of correcting the angle reported by the odometer using software when:***

***the robot has two light sensors***

***the robot has only one light sensor***

In the context where the robot has two light sensors, both can be placed an equal distance on both sides of the robot, facing downwards, such that they’re at the same height and distance, but on opposite sides. This way, if the robot is driving straight, both sensors should detect the black line at the same time. However, if the robot is driving at an angle theta, one sensor would detect the black line before the other and knowing the speed the robot is travelling and the time difference between the two detections, the angle can be computed.

When the robot has only one light sensor,