Hardware Document

Project: LIBERTY

Task: HARDWARE DESIGN

Document Version Number: ***HARDWARE - 1.0***
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Edit History: N/A

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2. GENERATED DESIGN

2.1 DESIGN CHOICES

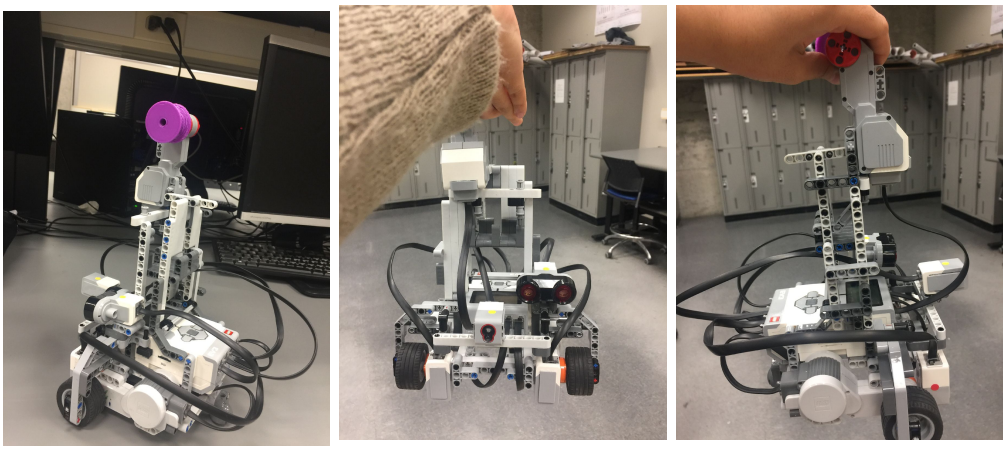

Figure 1: Image of a prototype for the robot (left, front, right)

2.2 SPECIFICATIONS

The robot is built with three color sensors, an ultrasonic sensor, a 3-D printed pulley and 3 motors. The US sensor is set on the robot and facing straight, in order to detect obstacles and provide roughly angle correction for localization. In addition, two of the color sensors are placed in front of the two wheels separately and downward. Design like this will improve the performance of localization and odometry correction. There is another color sensor placed in front of the robot and facing forward. The functionality of it is a complementary of the US sensor to detect the object in the way, as well as detect the targets' color, which will be used in the future project. Moreover, two motors are used to drive the wheel and the other one is connected to the pulley and provide power when the robot is on the zip-line.

In short, the robot possesses the following parts:

- 1 Ultrasonic sensor, place towards the front
- 3 Color sensors (two to the sides of the front wheels and one towards the front)
- 3 Motors (2 NXT motors to control the movement of the system and 1 EV3 Motor to control the movement on the zipline)
- 1 EV3 Brick
- 1 Rechargeable Battery

2.3 ACCURACY

The ultrasonic sensor (or US) has:
- a detection range of [0,250] cm[1]
- an accuracy to within +/- 1cm (in imperial: +/- 0.394 inch)[1]

The color sensor on the other hand has
- a detection range of eight colors. It can tell the difference between color or black and white, or between blue, green, yellow, red, white and brown.[2]

2.4 FACILITIES USED

The playing field was used in the design of the system to determine the appropriate height and to test the if the system could withstand the load under its own weight (see ***REQ - ZIP; 2.2.2***)

3. ALTERNATIVE DESIGNS

Apart from the design proposed above, our team has also established a two alternative solutions in regards to the design of the hardware.

- Assuming that the amount of sensors remains unchanged, two ultrasonic sensors and two color sensors could be used. Two US sensors could be placed in parallel at the front of the robot which would be used to improve the accuracy of the data from the US sensors and would allow to better filter out outliers. Meanwhile, the extra US sensor will make it possible to detect the obstacles from the other side. One of the color sensors would be placed on the back of the robot facing downward. It would be used to finish the accurate localization and the odometer correction. While the other color sensor would still beset in front of the robot and facing forward, with the same role as the current prototype.
- An additional motor could be used for the rotating US sensor. In this way, the robot will detect the obstacles from the all directions which is considered as “forward”.

4. GLOSSARY OF TERMS

US: ultrasonic sensor.

5. REFERENCES

[1] Sensor, E., ACCURATE, I., stuff!, R. and specification, N. (2017). *EV3 Ultrasonic Sensor - 45504 | MINDSTORMS® | LEGO Shop*. [online] Shop.lego.com. Available at: https://shop.lego.com/en-CA/EV3-Ultrasonic-Sensor-45504 [Accessed 23 Oct. 2017].

[2] Sensor, E. and sum-obots....., G. (2017). *EV3 Color Sensor - 45506 | MINDSTORMS® | LEGO Shop*. [online] Shop.lego.com. Available at: https://shop.lego.com/en-CA/EV3-Color-Sensor-45506 [Accessed 23 Oct. 2017].