# HARDWARE DESIGN DOCUMENT

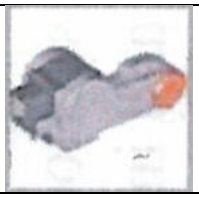
Project: DPM Final Project
Task:

**Document Version Number**: *1.0*
**Date:** 03/11/2018
**Author:** Shaodi Sun

**Edit History:**
[03/11/2018] Shaodi: Created Hardware design document
[03/11/2018] Ayden:
[06/11/2018] Ayden: More design modifications

## 1.0 Motors

(Motor we used)

| Motors Available | Number of Motors we Used |
|---|---|
|  | **1** |
| **Large Ev3 Motors** | **2** |

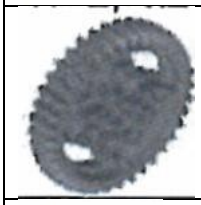
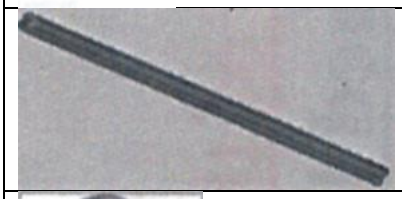
## 2.0 Sensors

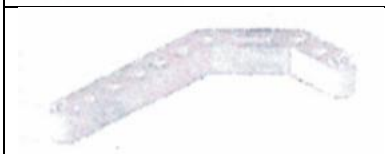
(Sensors we used)
We use two color sensors to detect grid lines and colored rings respectively, and we also used one ultrasonic sensor for localization and navigation.

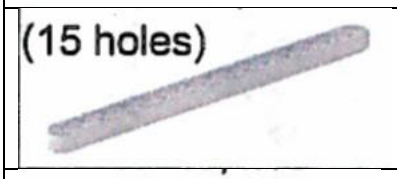
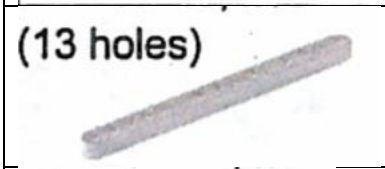
## 3.0 Brick and LEGO Parts

4.0 (Describe features on brick, eg, display, buttons, etc.)

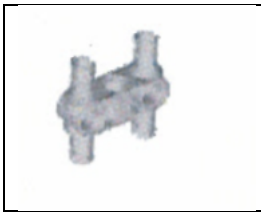
| LEGO parts available | Number of parts we used |
|---|---|
|  | **12** |
|  | **3** |

| | |
|---|---|
|  | **6** |
|  | **15** |
|  | **2** |
|  | **12** |
|  | **27** |
|  | **6** |
|  | **0** |
|  | **2** |
|  | **14** |
|  | **14** |

| | |
|---|---|
|  | **8** |
|  | **9** |
|  | **0** |
|  | **3** |
|  | **7** |
|  | **7** |
|  | **4** |
|  | **1** |
|  | **2** |
|  | **2** |
|  | **2** |

| | |
|---|---|
|  | **0** |
|  | **0** |
|  | **2** |
|  | **1** |
|   | **3** |
|   | **1** |
|   | **1** |
|   | **0** |
|   | **0** |
|  | **0** |

| | |
|---|---|
|  | **3** |
|  | **2** |
|  | **0** |
|  | **1** |
|  | **1** |
|  | **1** |
|  | **2** |
|  | **2** |
|  | **0** |

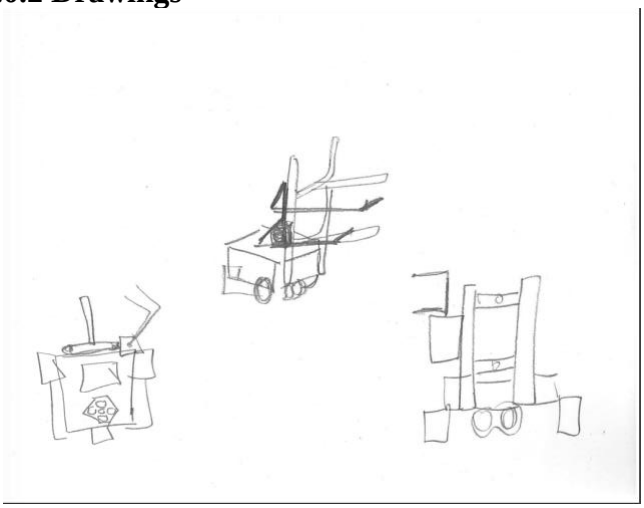
| | |
|---|---|
|  | **0** |

## 4.0 Hugging and arms design

### 4.0.1 Features

Previous we had proposed three designs that we had come up with. After thorough testing and trials. We have concluded that we can combine the 'hugging' mechanism that pulls the rings towards the robot and places them on arms in front of it. Those arms are motorized and can make the rings drops once they have been retrieved. It includes an Ultrasonic sensor mounted at the front, underneath for US localization and 2 light sensors on the sides for light localization.

### 4.0.2 Drawings



### 4.0.3 Justification

Previously we had proposed that we can pull the rings from the tree and they would automatically fall on a basket placed in front but in that case, it would be very hard to unload the rings after retrieving them. So, we placed two arms in front of the robot that are connected to a motor to move them down to unload them.

| Pros | Cons |
|---|---|
| Very easy to retrieve rings | The arms may move away from their positions They are strictly required to be at a fixed distance.(I.e. distance from the branches above and below) |
| Can catch all the rings in one journey | The robot is a narrow fit through the tunnel. |
| Can catch rings from all heights | The arms have to be precisely placed. |

### 4.0.4 Evolution of Design

Our initial prototype involved having on long arm that goes into each ring and lifts up, thereby the ring would fall into the arm. After testing we realized that it would be very difficult to get the arm into the ring. So, we decided that we should place two arms that can automatically catch rings at both heights. To get them onto the arms we use to arms that go behind that rings and pull them.
In terms of sensors, we stick with two light sensors for light localization and Ultrasonic sensor for US localization.