HARDWARE DOCUMENT

GROUP 4

30th November 2016
Version 1

Contents

1 BACKGROUND

1.1 Edit History

Jake Zhu: Initial set up 28 Oct

Kareem Halabi and Jake Zhu: Updated information for the brick 29 Oct

Quentin Norris: Updated problem statements, requirements, possible solutions, sketches, and feasibility for collectors, crane, and grabbers October 31st.

2 PROBLEM STATEMENT

2.1 Collectors

Collectors are the structural object we are considering to utilize to simplify the stacking of our blocks. The goal of our robot is to find the blue styrofoam blocks and stack them. By creating a cage like skeleton tower attached to the robot, we can immediately "stack" the bricks after grabbing them and lifting them with the crane.

The goal of this assessment is to see if it is feasible to construct and utilize a collector effectively to stack blocks, without taking up too many resources.

2.2 Crane

In order for the styrofoam blocks to be picked up to be stacked, a lifter or crane will be necessary to actually pick up the block. The goal of this assessment is to develop a crane strong enough to lift the block and move itself

2.3 Grabbers

In order to physically "grab" the block to pick it up and stack it, we must implement a "grabber" to do so.

The goal of this assessment is to find the best possible way to grab a brick to pick it up.

2.4 Collector-Grabber-Crane Hybrid

2.5 Brick

The brick is one of the most important parts, if not the most important part, of the robot. The software team will upload code to the brick that will make it run based of the sensors and motors plugged into it. Our issue with the brick is that there may not be enough ports in order to supply all the sensors and motors that are necessary.

The goal is this assessment is to test whether it is feasible to use two bricks and have them communicate with each other.

3 REQUIREMENTS

3.1 Collectors

Multiple legos from the four EV3 kits, in addition to one motor for the release mechanism.

3.2 Crane

The legos inside the four EV3 kits we are given to use, a piece of string, one of the EV3 motors, and a tube with the diameter slightly larger than the length/width of the block (large enough to fully encompass it). The tube can be hand constructed from thick cardboard paper.

3.3 Grabbers

Legos from the four EV3 kits are going to be used to construct the grabber. String will be used to connect the grabber to the crane. Cardboard paper will be used to construct a tube in which the block will sit after it is grabbed.

3.4 Collector-Grabber-Crane Hybrid

3.5 Brick

Look at the Section 2 of the MULTIPLE BRICKS TEST Document.

4 IDENTIFICATION OF POSSIBLE SOLUTIONS

4.1 Collectors

One possible solution is a skeletal tower constructed on the back of the EV3 brick(s). This tower will be tall enough to contain four or five of the blue styrofoam blocks and will include a mechanism to transport it from the grabber to the tower. The tower will have a release system to drop off all the blocks in their stacked form once the tower is filled. The release system will be done through a motorized door hinge which will empty the tower.

4.2 Crane

Our main solution for a crane, or "lifter," is a design stemming from an EV3 motor attached to one of the brick's ports. The motor will have a piece of string attached to a wheel that will be threaded through a stabilized group of blocks as it increases in height (preferably to that of our designated collector height). The string will hang down attached to the grabber. As the motor activates it will pull the string up, including the grabber to a designated height. It can move the block down by activating the motor once again to lower the string and thus the grabber.

Another add on to the crane to make it more mobile would be to add another EV3 motor on which it is constructed, to allow it to rotate itself. This would simplify the process of putting the bricks in the collector.

4.3 Grabbers

One possible solution for the grabber is two prongs long enough to wrap themselves around the styrofoam block. They will settle themselves around the block after the EV3 has posi-

tioned itself in front of it. The cardboard paper tube will serve as closing mechanism around the block. It will hover over the block and once the EV3 motor pulls the string up, the cardboard tube will force the prongs to close and clamp themselves over the block. The block will then be pulled up through the tube and will stay there until the EV3 motor from the crane releases the string in which the block will fall.

4.4 Collector-Grabber-Crane Hybrid

4.5 Brick

We may have to use multiple bricks connected through USB.

5 SKETCHES

5.1 Collectors

5.2 Crane

5.3 Grabbers

5.4 Collector-Grabber-Crane Hybrid

6 FEASIBILITY

6.1 Collectors

The feasibility of this is going to be quite challenging, but would save the software team a lot of time. The time saved would be from the alternate process of picking up a block, bringing it to a known location and stacking it on top of another one. For that process, the software team would have to code the robot to not only pick up, but release the block from the grabber onto another one at a specific location. The precision of this would be extremely challenging.

The challenge in building the collector would not be its actual lego construction, although it would utilize many legos to construct and would be very large and may cause small mobility issues. The main issue with the collector is the release mechanism. This mechanism must be designed so that when the tower is released it is done so in a smooth manner in which the blocks that have been stacked will not fall over. In addition, the release mechanism must reset in order for the EV3 robot to continue picking up and stacking blocks.

6.2 Crane

The solution is very feasible. We can adjust the height the motor pulls the string in to bring the block up by changing its length of rotation.

6.3 Grabbers

The feasibility of this grabber is very practical, easy to construct and does not take up much of our budget.

6.4 Collector-Grabber-Crane Hybrid

6.5 Brick

This solution is feasible. We are able to connect multiple bricks to each other and run them from a master brick.

7 PROS/CONS

7.1 Collectors

Pros: Save software team a lot of time, but in addition would save a lot of time in the demo as the robot wouldn't have to relocate to an exact location to stack the blocks it picks up. If developed correctly would perfectly stack the blocks with no issues, therefore the software side would mainly have to focus on picking up and finding blocks.

Cons: Release mechanism will be difficult to design to release blocks without them falling over. The tower's size may also cause mobility issues due to balance and or hitting other blocks as the robot moves around. An easy fix would be to program the robots final width and length into its navigation.

7.2 Crane

Pros: Ability to pickup and rotate blocks specific distances. Cons: None

7.3 Grabbers

Pros: Picks up block fairly easily and once the block is in the cardboard tube it is secured to stay there.

Cons: If the EV3 robot lines up so the grabber is awkwardly over the block it may not successfully pick it up. This may be a problem for the software team as they will have to determine a way to check and see if the grabber has successfully picked up a block.

7.4 Collector-Grabber-Crane Hybrid

7.5 Brick

The pros of this system is the fact that multiple bricks can be used to run from one brick. The disadvantage is to make sure there is no interference. As stated in Section 4.1 of the MULTIPLE BRICKS TEST document, there was some interference when separate motors were running and they did not close. We will have to make sure that they are closed after each use.

8 OPTIMUM SOLUTION(S)

8.1 Collectors

8.2 Crane

8.3 Grabbers

8.4 Collector-Grabber-Crane Hybrid