IEEE Ottawa Robotics Competition
Compétition de robotique d'Ottawa d'IEEE

Green Arm Challenge
Last Revised: March 17, 2018

Table of Contents

Disclaimer

It is your responsibility to read and understand this document on a regular basis because we may update it from time to time.

If you have questions, please contact our Arduino Team at orcarduino@gmail.com.

Green Arm Challenge

We only have one Earth and much of the waste in our world is the result of our never-ending production of goods. There will likely be a day where we have no place to store our garbage.

Recycling helps give the materials a second life. Thus, instead of drawing up on limited resources from our environment, we should focus on reducing, reusing, and recycling. However, sometimes it is hard to do so because we don't know how to properly recycle.

Your task in the Green Arm Challenge is to program an arm that will quickly and accurately sort recyclable materials from a pile of garbage.
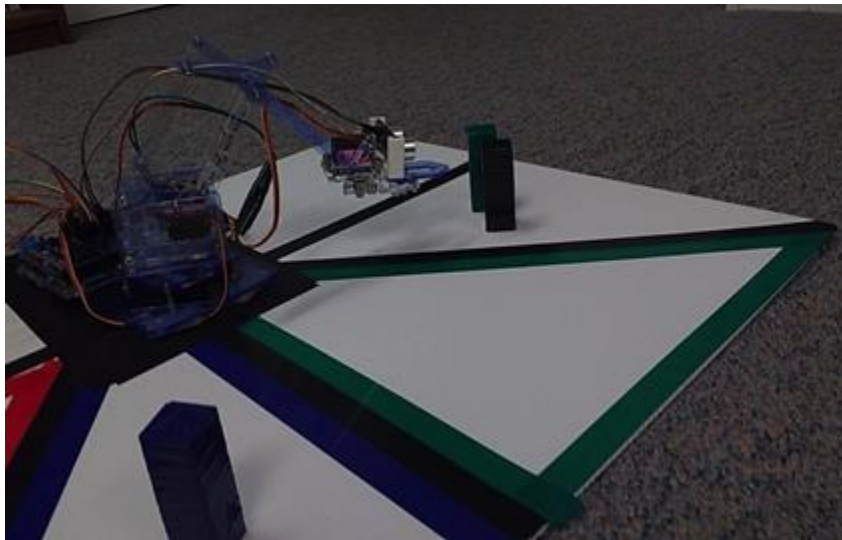
Challenge Rules

Trucks deliver 4 types of material to the loading dock in bins: garbage (black), plastic (blue), paper (green) and metal (red). Once delivered, you need to sort the recyclables on to the matching conveyor belt. The bins will be one inch by one inch and four inches tall.

The conveyors are arranged in a semicircle around the robot and each conveyor (including the loading dock) is 45 degrees. The robot will be positioned so it can reach each conveyor.

1. Your robot will be placed in an area where it can reach all the conveyors.

2. Time will start when the team captain starts the robot.

3. Time will stop when all the recyclables have been placed.

4. After the robot starts, it cannot be touched. Touching the robot will stop the test and the maximum time plus applicable penalties will be recorded.

5. The bins must be moved to the matching colour area.

6. The garbage must stay in the loading dock.

7. Time penalties apply if any bins get knocked over, are misplaced, or are placed on multiple conveyors. If any part of a bin is touching a conveyor, it is counted as in that conveyor.

8. If a bin is knocked over in the wrong conveyor, the knocking over a bin penalty will apply to all conveyors the bin is touching, and the wrong conveyor penalty will apply to all the conveyors the bin is touching that are the wrong colour.

9. You may have to move garbage bins in the loading dock to be able to reach all the recyclables.

10. Seventy percent (70%) of your final score for the challenge will be based on the average time it takes for your robot to sort the recyclables. Teams must also present in front of judges (30% of the final score).
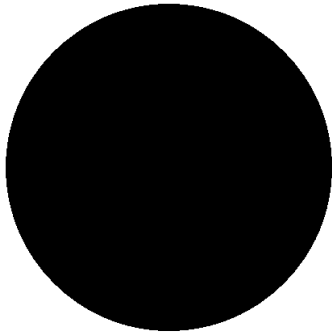
Robot Arm

The selection and construction of the robot arm are the responsibility of the contestants. For the arm, we are recommending the low cost MeArm kit.
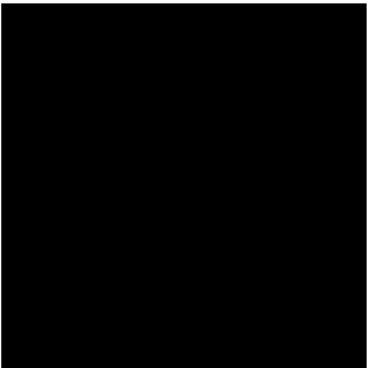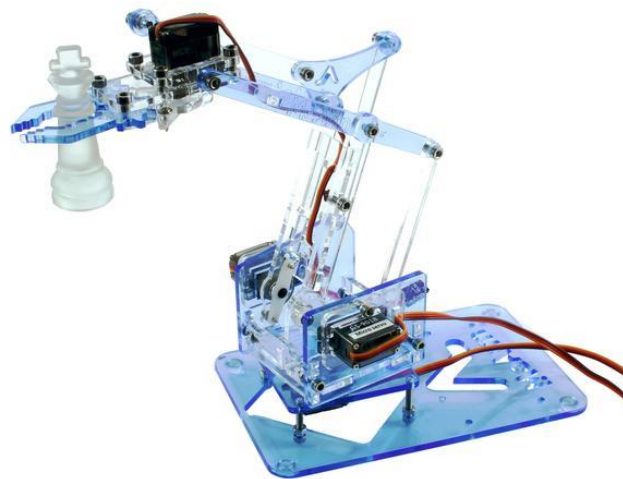
From there, several sensors need to be added. A range sensor to find the blocks, and a colour sensor. Any colour sensor is acceptable, but for the range finding sensor we strongly recommend a time of flight sensor such as the VL53L0X. Other sensors such as Ultrasonic or IR Rangefinders can work but have a large detection cone that will make them harder to program.

Bonus Objectives

The optional bonus objective will be to use a camera to recognize symbols on the top of the bin. Then, instead of sorting by colour, you will sort by symbol. All symbols will be black on a white background. The table below lists the symbols and the corresponding area they should go in.

Symbol		Area to Drop Bin In
		Green

		Blue
		Red

If you wish, you can also use the camera (or another) to locate the bins in the field. It is recommended to use either a raspberry pi or beagle bone using the OpenCV library.
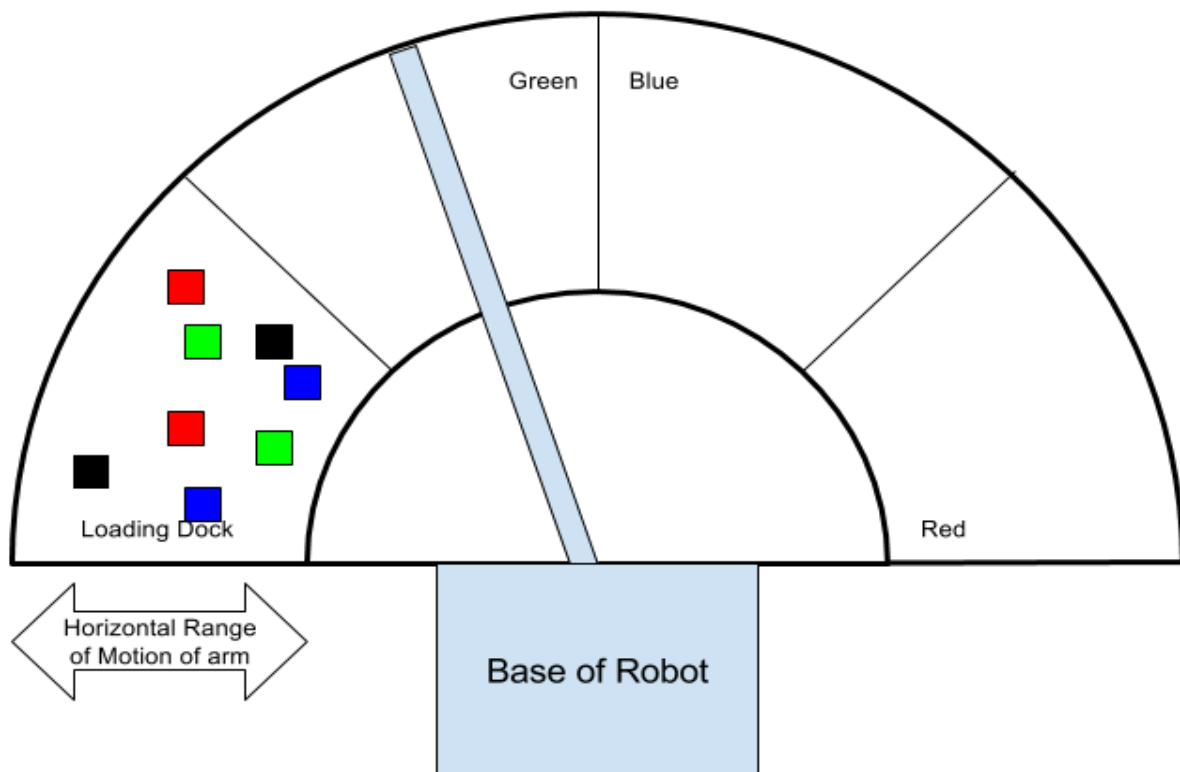
Contestants are expected to also have a solution without a camera. The bonus and regular challenges will be judged separately.

Judging & Scoring

1. The starting placement of the bins will be modified on the day of the competition.

2. All teams will gather at the competition area and remain there for the remainder of the round.

3. Judges will time and score your run.

4. If after 2 minutes there are still bins that need to be sorted, the robot will be stopped, and any recyclables left in the loading dock or in the robot gripper will be counted as in the wrong conveyor with penalties applied as appropriate.

5. The time penalties applied are as follows:
   a. Knocking a bin over: 10 seconds
   b. Placing a bin on the wrong conveyor: 5 seconds

6. The winner of the Challenge will be determined by your robot's average completion time and the mark you receive on the presentation. The team with the highest combined score will be the winner of the Challenge.

7. Decisions of the judges are final.

Green Arm Challenge Arena Diagram

Green Arm Challenge Arena Photo