Qatar University

College of Engineering

Department of Computer Science and Engineering

CMPE 483

Introduction to Robotics

Activity 1

Straight Line Inspector Robot Challenge (SensaBot)

Due Date: 23rd September 2021

Project Group Number: 3

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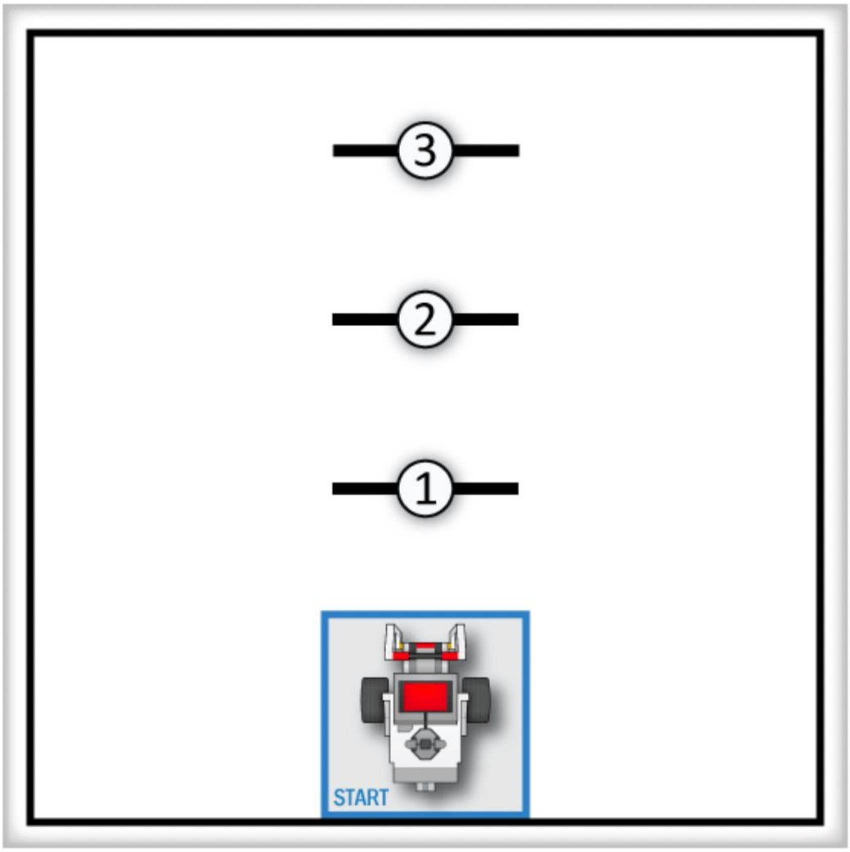
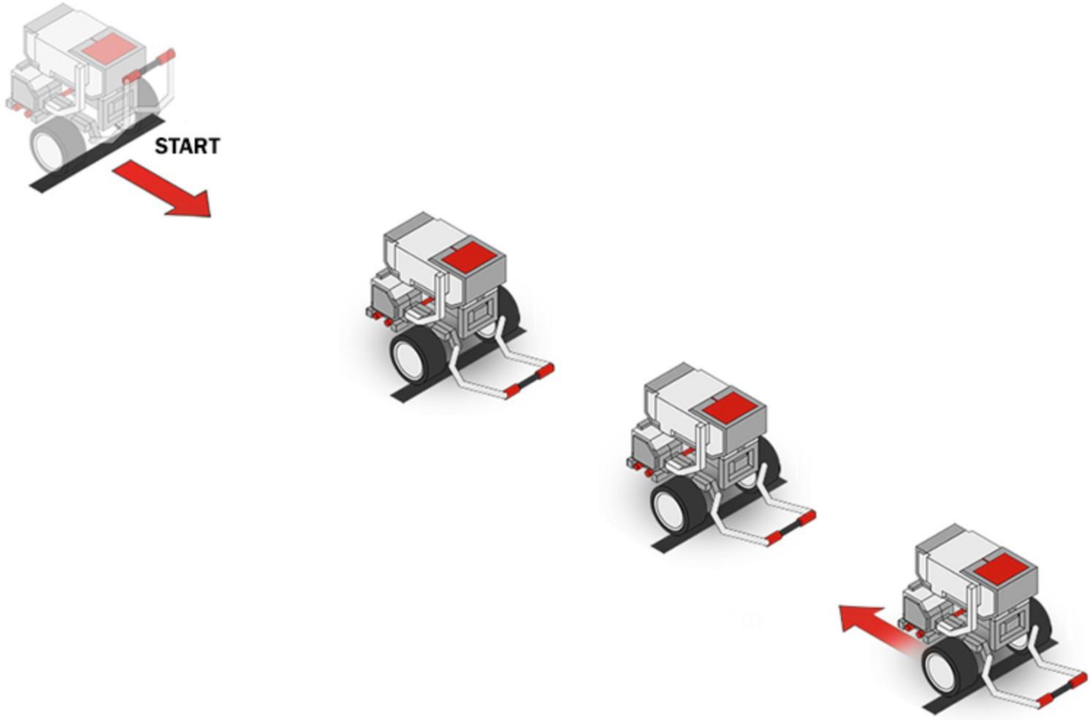
Problem Statement

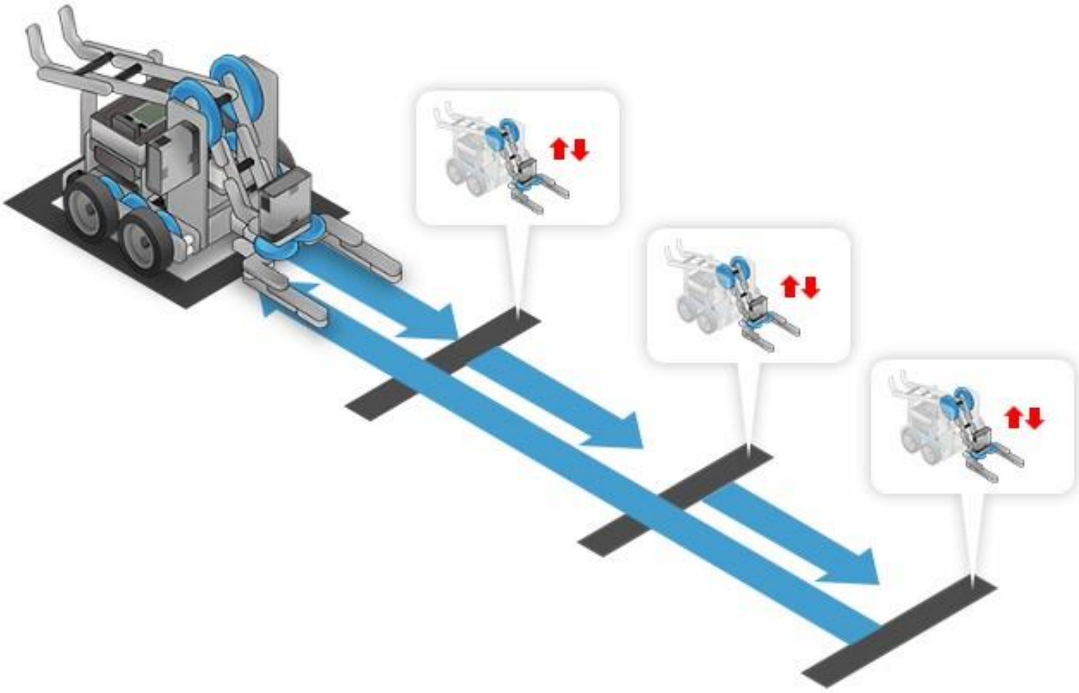
In this challenge, you will program your robot to move from its starting box to three different lines on a game board, stopping at each one to perform an inspection, represented by lowering and raising the robot's arm. When the robot is done inspecting all three locations, it should back up and return home to its starting box to recharge.



- Create the robot's starting area with electrical tape that is slightly larger than the robot.
- Use the electrical tape to mark three (3) inspection points along the robot's path. The exact location is not important, but they should not be moved once the board is finalized.
- Robot must start inside the starting box (no parts over the line) and with its arm lowered.
- The robot must move and stop at each line, lowering and raising its arm, representing the inspection process. The arm must be directly over each line when the inspection is performed.
- The robot must return to its starting box after completing the inspection process at the third line. The entire robot must be inside the box (no parts over the line).
- An illustration of this process is shown in the next figure.



The same challenge applies to all students whether they are using the Lego Mindstorms EV3 robotic kit (see figure above) or the VEX robotic kits (see the image below).



Instructions:

You must program the physical robot using the appropriate programming software.

For the Lego Mindstorms EV3 robotic kit, you should use the Scratch programming interface or the MicroPython 2.0 interface. This software is downloadable form https://education.lego.com/en-us/downloads/mindstorms-ev3/software#downloads

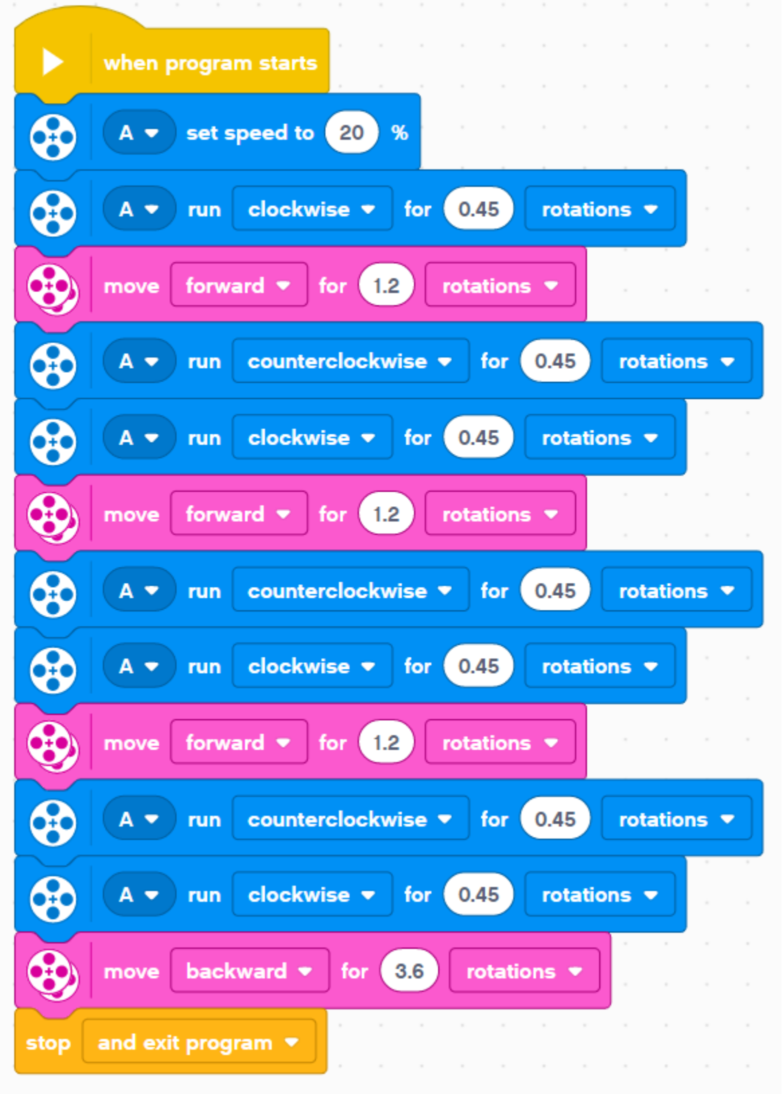
For the VEX robotic kit, you should use VEXcode Software (https://www.vexrobotics.com/vexcode-download).

Hints:

1. Use a meter stick or ruler to measure the distances to each line on the board so you know how far you need to move each time!
2. Try finding the number of centimeters your robot travels in each rotation, and using that to find the number of rotations you need
3. You can also make a test run, then calculate "how many times as far" you need to move to get to each line, compared to the test run

Report (2.5 marks)

1. Design Code



```
when program starts
A set speed to 20 %
A run clockwise for 0.45 rotations
move forward for 1.2 rotations
A run counterclockwise for 0.45 rotations
A run clockwise for 0.45 rotations
move forward for 1.2 rotations
A run counterclockwise for 0.45 rotations
A run clockwise for 0.45 rotations
move forward for 1.2 rotations
A run counterclockwise for 0.45 rotations
A run clockwise for 0.45 rotations
move backward for 3.6 rotations
stop and exit program
```

Fig 1: Screenshot of EV3 code

2. Code Explanation

The following is an explanation of the steps executed by the EV3 program.

1. The first block is a hat block designed to start the program in the robot.
2. The next stack block is set to operate the SensaBot at 20% speed.
3. The next stack is programmed to run clockwise for 0.45 rotation (162°) in order to move the arm of the robot upwards.
4. The movement block is set to move forward direction with 1.2 rotation which is equivalent to 21.12cm (approx.)

5. The next two blocks are set to move the arm counterclockwise (downwards) at 0.45 rotation and clockwise (upwards) at 0.45 rotation.
6. Steps 4 & 5 are repeated two more times to make the SensaBot stop at three lines and inspect.
7. Then, the movement block is set to move backward for 3.6 rotations to go back to its initial position which is 63.36 cm (approx.)
8. Finally, the hat block is used to stop the programming

This team challenge was solved in three steps, first step was the assembling of robot, next the programming of robot and finally the placement on carboard and adjustment of arm and wheel movement.
The components given in the EV3 kit had to be placed in appropriate compartments to enable us to assemble the robot in a fast and efficient manner referring to the manual. This step took the longest time among all. For programming of the robot, the resources available on ev3 website were used, it mainly helped us to understand that the robot will not proceed to the next program statement unless the previous one is completely executed. Before knowing this, we spent quite some time trying to know what caused our robot to not proceed with the next step after the arm movement command of 1 rotation. We realized 1 rotation is a movement of 360 degrees which cannot be accomplished, hence the program gets stuck. We then changed the command to 0.5 rotation and then to 0.45 rotation, since arm movement of 180 degrees is not always achieved. We then taped the cardboard as mentioned and changed our distance values in the program for correct halt point.

Team Member	Contribution
Myesha Hoque	Assembling the lower body of the SensaBot, Finding programming error, Report, Programming explanation in video.
Marim Elhanafy	Assembling the lower body of the SensaBot, programming, step three in video.
Salam Albatarni	Assembling the arm of the SensaBot, Programming, Robot Assembly (Step 1) explanation in video and video compilation.
Sofia Basha	Assembling the arm of the SensaBot, Finding Programming error, Report, Introduction and Step 3 in video.

Video Template (2.5 marks)

MP4 file uploaded on blackboard.

Please note that you also must create a video for this activity in which you show your team working on this project and show that your robot has completed this challenge successfully.

The video must be 5-10 minutes long and should also contain a narration of the steps you took to solve the problem and should briefly describe the code developed for solving this problem and the steps taken for assembling the body of the robot.