

Tanisha's Lego Mindstorms Report

by Tanisha Bath

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Report on Lego Mindstorms Robot's Course

Name: Tanisha Bath

Student Number: 1905383

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Abstract

In this report, I will be showing the different ways of programming a Lego Mindstorms robot to follow a set course and overcome the obstacles and issues surrounding each part of the course and I will show a flowchart on how I would program the Lego Mindstorms robot to maneuver through the course.

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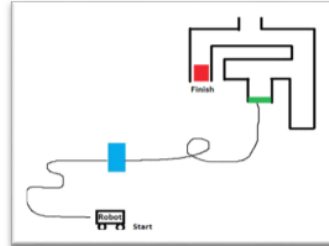
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1. 0 Introduction

Within this report, I will be discussing the different ways you could program a Lego Mindstorms robot to complete a course with two very distinct and identifiable stages.

This course will be set up in a set way As shown on the right (1) which consists of following a line with a block on it that the Lego Mindstorms robot must manoeuvre around Blue Block (said block is a light wooden object and should avoid



being touched as to not move it), completing a maze and indicating that it has reached the finishing point Red Block in a way such as playing a little tune or signal at the end. Each part of this course comes with its own problems that need to be solved with the use of some devices compatible with the Lego Mindstorms robot to be able to continue and at the end of the report, I will show a flowchart / pseudocode to show the logic of how the Lego Mindstorms robot will negotiate the course in the way I think would be best.

There should be a set amount of time between the line following and before the start of the maze to edit the build and / or program of the Lego Mindstorms robot.

2. 0 Following a Line

The first task of the course is to follow a line, this could be achieved by including a Colour Sensor ⁽²⁾ pointing towards the ground. This colour sensor should not be touching the floor but hovering just above it for the sensor to work. The colour sensor is capable of distinguishing between 8 different colours, is able to do this by emitting a red light which measures the intensity of the light that is reflected back into the colour sensor that then sends signals to the intelligent brick that the Lego Mindstorms robot then uses to detect and differentiate between colours allowing it to follow the line on the floor.

2. 1 Avoiding the Block

To begin the course the Lego Mindstorms robot must follow the coloured line that is on the floor while following the line the Lego Mindstorms robot must be able to detect a block that is in its path, it could detect the block by using the Ultrasonic Sensor or a Touch Sensor.

2. 1. a Detecting the Block

2. 1. a1 Ultrasonic Sensor

The Ultrasonic Sensor ⁽³⁾ works by generating sound waves that bounce off objects and reads their echo to calculate how far the object is like a sonar it can also start a program by listening for sound waves, by using this device as a sonar it is possible to get the Lego Mindstorms robot to stop a certain distance away from the block.

The pros to this device being used are that once it is the desired distance from the block it will stop which gives the Lego Mindstorms robot space to move after and (if it works properly) shouldn't touch the block (in turn does not move the block).

There are also cons to this device where it could possibly stop too soon because it heard other sounds around it e.g. people talking in the class or it could be a little faulty and not read any sounds and be unable to detect the block in its path (although it is a small possibility that it is broken).

2. 1. a2 Touch Sensor

The Touch Sensor's ⁽⁴⁾ programming is rather simple but precise, it is able to detect when its button is pressed or released and it is able to count multiple presses, this device could be programmed to stop the Lego Mindstorms robot when the button is pressed once it runs into the block.

The pros to this device being used are that it is very precise and would not get stopped accidentally unless someone walked over the course.

There are also cons to this device such as it needs to touch the block in order to stop which in turn could (most likely) move the block, and even if it doesn't move the block it won't give the Lego Mindstorms robot much space to move after, which means Lego Mindstorms robot needs to be programmed to reverse a little or increase the possibility of moving the block.

Once the block has been detected if the Lego Mindstorms robot has stopped it must then manoeuvre around the block, there are a few ways that the Lego Mindstorms robot could accomplish this;

2. 1. b Moving around the block

2. 1. b1 Sweep the block out of the way

It is possible that the Lego Mindstorms robot could just ram the block or sweep it out of the way and then continue forward till it finds the coloured line again.

The pros to this method are that there is not much programming involved to ram the block out of the way, as long as the Lego Mindstorms robot is

programmed to drive forward and then follow the coloured line again this could work

But there is also the con of actually moving the block, which we are trying to avoid, and the chances that the block gets dragged with the Lego Mindstorms robot are heightening the chances of stopping it completely or rendering the Lego Mindstorms robot incapable of finding the coloured line by dragging it just of course.

2. 1. b2 Climbs over the block

If there are enough materials to build a mechanical system that would allow the Lego Mindstorms robot to climb, then it could be programmed to climb over the block.

The only pro that I am able to think of for this method is that if it was performed successfully it would look cool.

There are a few cons to this method though such as the possibility of moving the block is high as the Lego Mindstorms robot would need to touch the block, to build a Lego Mindstorms robot that can climb over the block needs a lot of building pieces that may not be available and there would be quite a bit of programming involved.

2. 1. b3 Drives around the block

There is also the option to program the Lego Mindstorms robot to drive around to the other side of the block and back onto the coloured line.

The pros to this method are that the chances of moving the block are slim to none and compared to climbing the block it is rather simple to build.

The con to this method is that it is rather bland and common, it could take some time to drive around the block and if not programmed correctly could possibly hit or move the block.

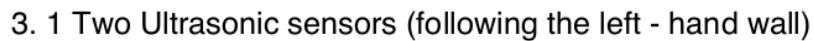
Once the Lego Mindstorms robot has moved around to the other side of the block and found the coloured line again it should continue to follow it through the loop and up until it reaches the maze and should stop.

(when it comes to the loop, I would try a slower speed to ensure that the Lego Mindstorms robot is capable of continuing on the coloured line and doesn't venture of course)

(there should be a set amount of time here between the different stages in the course to change the build and / or program of the Lego Mindstorms robot)

After completing the first half of the course that is following the coloured line the Lego Mindstorms robot must then navigate the maze to the right.

Mindstorms robot, of course, does not have hands to place on the wall so it will have to use one or more of the devices that can be attached, devices such as an ultrasonic sensor and a touch sensor. Here are several different methods that could be used to navigate to the end of the maze;



By using this method, it should give the Lego Mindstorms robot enough room to turn when needed which should avoid hitting the wall of the maze,

3. 2 One of each sensor (following the left - hand wall)

This method would show the capabilities of the Lego Mindstorms programming system buy showing two different devices working together,

But with the touch sensor on the front, there is not much room to turn with a high probability of hitting one of the maze walls and there is a chance that the ultrasonic sensor could trigger at the same time as the touch sensor at the fork on the right - hand side and the top left corner.

3. 3 One Ultrasonic Sensor

For the maze above the Lego Mindstorms robot could have an ultrasonic sensor attached to the front and have it turn left every time it detects an object (if it turned right the Lego Mindstorms robot would get trapped in a loop on the right - hand side of the maze).

By using this method, it should give the Lego Mindstorms robot enough room to turn when needed which should avoid hitting the wall of the maze and unlike with two sensors (same sensors or different) shouldn't have the possibility of two sensors clashing,

But it could take the Lego Mindstorms robot a while to get through the maze.

3. 4 One Touch Sensor

For the maze above the Lego Mindstorms robot could have a touch sensor attached to the front and have it turn left every time it detects an object by pushing the button into the wall (if the Lego Mindstorms robot turned right it would get trapped in a loop on the right - hand side of the maze).

By using this method, unlike with two sensors shouldn't have the possibility of two sensors clashing,

But it does not give the Lego Mindstorms robot much space to turn and it could take the Lego Mindstorms robot a while to get through the maze.

4. 0 Finishing the Maze

Once the Lego Mindstorms robot gets to the end of the maze it needs a way to differentiate between the maze wall and the finishing (which is a red block) for this I suggest using a colour sensor pointing forwards, this should be programmed to, once it sees the red block, stop and play a little tune once to indicate that it has finished the course.

5. 0 Flowchart

The flowchart below is how I would personally program my Lego Mindstorms robot by deciding between the decisions explained above and what ones I believe would work best.

The flowchart / pseudocode below starts I have calibrated the colour sensor to notice the difference between colours so it knows what colour to follow when the maze starts and when to stop moving so it can play its little tune / signal to finish and state that it is at the course.

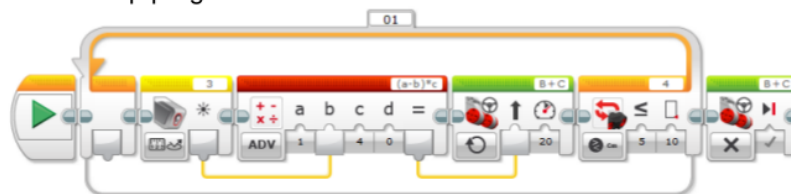
On my Lego Mindstorms robot is a colour sensor facing the floor (not touching the floor but just hovering above it) and an ultrasonic sensor at the front of the Lego Mindstorms robot facing forward.

Follow coloured line (using colour sensor) >>>> Break 10cm away from block (using ultrasonic sensor) >>>> Turn Lego Mindstorms robot 90 degrees right >>>> Drive forward 30cm >>>> Turn Lego Mindstorms robot 90 degrees left >>>> Drive forward 40cm >>>> Turn Lego Mindstorms robot 90 degrees left >>>> Drive forward 30cm >>>> Reconnect with coloured line (using colour sensor) >>>> Follow coloured line (using colour sensor) >>>> Break at green line at start of maze (using colour sensor) >>>> Stop program

This is where I will be given a set amount of time to make and changes to the build and or program of the Lego Mindstorms robot, in this time I would move the colour sensor from the bottom of the Lego Mindstorms robot and place it on the front of the Lego Mindstorms robot (a little further forward than the ultrasonic sensor).

(This flowchart is assuming that there is enough room in the maze to stop 10cm away)

Drive forward >>>> Break 10cm away from block (using ultrasonic sensor) >>>> Turn Lego Mindstorms robot 90 degrees left >>>> Drive forward >>>> Break 10cm away from block (using ultrasonic sensor) >>>> Turn Lego Mindstorms robot 90 degrees left >>>> Drive forward >>>> Break 10cm away from block (using ultrasonic sensor) >>>> Turn Lego Mindstorms robot 90 degrees left >>>> Drive forward >>>> Break 10cm away from block (using ultrasonic sensor) >>>> Turn Lego Mindstorms robot 90 degrees left >>>> Drive forward >>>> Break 10cm away from block (using ultrasonic sensor) >>>> Turn Lego Mindstorms robot 90 degrees left >>>> Break once colour sensor detects change in colour (from black maze wall too red finish block) >>>> Bark like dog (to indicate that robot has finished the course) >>>> Stop program



(Above is an image ⁽⁵⁾ of the programming flowchart for the colour sensor and ultrasonic sensor to drive, following the line and stop 10cm before the blue block (as to avoid touching) it and how it should look in MindstormsEV3 educational programmer)

6. 0 Acknowledgement

I would like to give my gratitude and thanks to my teachers, especially Sue Maw, and the faculty team for all the help they offered. I would like to thank my uncle for helping me spell check my work and thanks to those who have contributed to the completion of this report directly or indirectly.

7. 0 Bibliography

(1) Lego Mindstorms Robot's Course Image

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(4) Touch Sensor Information

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(5) Coloured line programming

T. Bath. 2020. Coloured line programming.

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GRADEMARK REPORT

FINAL GRADE

63/100

GENERAL COMMENTS

Instructor

You have risen to the challenge of the new assignment and solved the problems with good explanation. The one area I'd emphasize is references – make sure that you include all the books and websites you used for research and consider reading more widely.

Project Introduction 10% 5

An outline of the problem area with some good explanation. It's tough when writing your own ideas but consider using the passive voice or "the author" instead of I.

Line Follower 25% 17

Good evidence of your thought process in solving the problems. This could have been backed up with supporting diagrams and further evidence of research/

Block avoidance 25% 16

Again good explanation.

Maze 25% 18

Explanation of the maze solving problem could have been backed up to further reference to work done in class before lockdown.

Overall summary 15% 8

The heading is not there but reflective content is included throughout.

Assessment Component 2 – Coursework - 40% 62

Pseudocode is presented with evidence of effective design work.

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