

Aiden Douglas Report on Lego Mindstorms Robots

by Aiden Douglas

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Report on Lego Mindstorms Robots course

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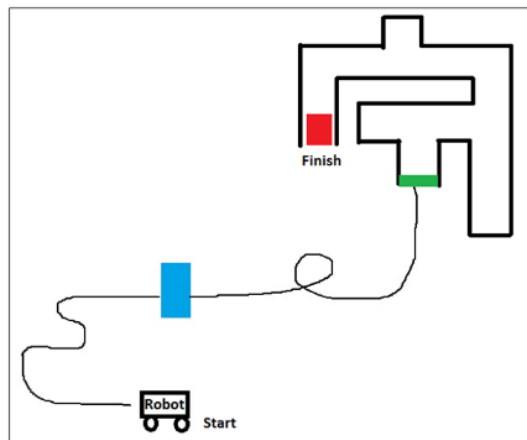
1. Introduction

Within this report, I will be discussing the different ways you can program a Lego Mindstorms robot to complete a maze course two different ways. The course would be set up in a certain way (with the image shown). The Lego Mindstorms robot must be able to follow a line while manoeuvring around the block (the blue rectangle) without touching it. The objective of completing the course, is being able to build a Mindstorms robot that can get from the entrance of the maze (green line) to the finish destination (Red rectangle). By the end of the report, I would have explained how I used the flowchart/pseudocode to navigate the Mindstorms robot to its destination.

2. Follow the line



The first part of the course is to follow a line that is guiding the Mindstorms robot, that



can be done by using a colour sensor. The colour sensor can detect either the colour or intensity of light.

The colour sensor has three different modes: colour, reflected light intensity, and ambient light intensity.

- Colour – In this mode, the colour sensor can differentiate up to seven different colours: black, blue, green, yellow, red, white and brown.
- Reflected light intensity – In this mode, the colour sensor emits a red light and measures the amount reflected into itself from the surface you are testing. The intensity of the light is measured as a percentage from 0 to 100, with 0 being very dark, and 100 being very bright.
- Ambient light intensity – In this mode, the colour sensor measures the amount of light in its environment, *without producing its own light source*.

With information above, I believe that using the colour sensor is the best way follow the line on the ground.

2.1 The block

Before the Mindstorms robot can enter the maze course, it must detect and get pass the block by either moving around it, or by sweeping the block aside. This is possible by attaching a touch sensor and/or an ultrasonic sensor to the Mindstorms robot.

2.1a Detecting the block

- **Ultrasonic sensor** – The Ultrasonic measures distance to an object up to a maximum of 255cm (or

100 inches) away. It does this by sending out high frequency sound waves that bounce off any object in range, and measures how long it takes the sound to return to the sensor. In the software, you can select whether the distance is given in centimetres or inches.

- **Touch sensor**– The touch sensor gives your robot a sense of touch. The touch sensor detects when it is being pressed or released. It can even be programmed to wait until it is both pressed and released (we call this bumped).

Now that the block has been detected, the Mindstorms robot will stop moving. Once that happens, the Mindstorms robot will now get past the block by either moving around it, or by sweeping it aside. This is possible using a few methods.

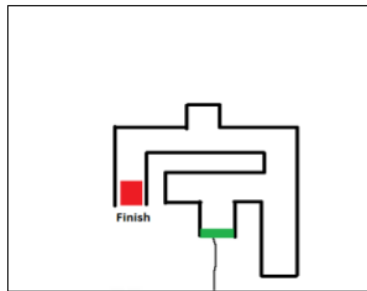
2.1b Getting past the block

Climbing over the block – if the Mindstorms robot is constructed right, it can be programmed to latch itself onto the block and climb over it.

Sweep the block – The Lego Mindstorms robot can be programmed to push or pull the block aside, but the dangers of doing so is the Lego Mindstorms robot might lose track of the line that is guiding it. The other option (my opinion the safer option) if constructed the right way, it can just ram past the block while still following the line.

Drive around the block – Another option for the Lego Mindstorms robot is that it can be programmed to drive out of the line to manoeuvre around to the other side of the block and start following the line again.

Once the Mindstorms robot has been able to move around to the other side of the block, it will then continue to follow the coloured line until it reaches to the entrance of the maze.



3. Navigating through the maze

After guiding the Lego Mindstorms robot to the entrance of the maze by following the coloured line across the floor, I must then navigate the Mindstorms robot through the maze (the image being shown). The way to navigate the Mindstorms robot through the maze is by using the wall as guidance to walk/roll through the maze. This can be possible by attaching one or a couple of devices to the Mindstorms robot, devices like the touch sensor the Ultrasonic. With these two devices the Mindstorms robot can reach the finish line (red block) in several different ways like.



3.1. Ultrasonic Sensor

For the maze being shown the Mindstorms robot you could have the ultrasonic sensor device attached to the front of your Mindstorms robot. So, whenever the Mindstorms robot is about to collide with the wall, its programmed to rotate until there is not an object in

front of the Mindstorms robot. The Mindstorms robot will continue to do this until it has reached the finish line.

By using this method, the Mindstorms robot should have enough space to turn when needed without hitting the wall. But also, by doing it this way it can also take much longer to get through the maze course.



3.2. One touch sensor

For the maze being shown, you could have the one touch sensor attached on the front of your Mindstorms robot. So, whenever it hits the wall with the touch sensor it is programmed to turn to the left (If the Mindstorms robot turns to the right, it will not reach the finish line.)

By taking this approach to complete the maze course, the robot will take a long time to complete the maze course.

3.3. Two touch sensors

For the maze being shown, you could attach two touch sensors on each side of the Mindstorms robot or have a touch sensor at the front and one at the back. By using this method you can have two of the same devices operating different codes, for example when the touch sensor at the front is pressed the Mindstorms robot turns left, then when the touch sensor at the back is pressed, the Mindstorms robot turns right.

Although two of the devices are the same, the programming can still be difficult. But if correctly done the Mindstorms robot should be able to get to the finish line (red block) faster than have just one touch sensor attached.

3.4 Ultrasonic sensor and One touch sensor

The Lego Mindstorms robot can have the ultrasonic and the one touch sensor attached, this is possible by having the ultrasonic on the front of the Mindstorms robot and having the touch sensor on the side. The ultrasonic device can be programmed to turn left when it detects the wall, then when the touch sensor on the side of the robot is pressed, it turns to the right and goes forward when there is nothing there.

The method being told above shows two different devices being programmed and working together. Although that is difficult to do, if correctly programmed, the Mindstorms robot should complete the maze course quicker than with just one sensor.

4.0. The Finish Line

Once the Lego Mindstorms robot has reached the end of the maze it needs to be able to differentiate between the wall and the finishing line (the red block.) By programming the Mindstorms robot to respond to the red line across the floor, with the colour sensor attached to the robot, it should respond to the red line by stopping and playing a tune to acknowledge that it has completed its maze task/course.

5.0. Flowchart

The flowchart below is how I would design my Mindstorms robot to be programmed in order to complete the maze course above. Giving the examples I have explained above, I believe that the method I am about to take is the best way to approach this maze course.

On my Lego Mindstorms robot has a colour sensor facing the floor (so it can follow the coloured line guiding my Lego Mindstorms robot to the maze entrance) and two touch sensors on each side of the robot (programmed the same, I chose to have two for extra security).

5.1 My approach to the maze entrance

Following the coloured line across the floor (by using the coloured sensor) -> -> -> when the touch sensors has made contact with the block -> -> -> turn Mindstorms robot 90 degrees left -> -> -> drive forward 30cm -> -> -> turn Mindstorms robot 90 degrees right -> -> -> drive forward 40cm -> -> -> turn 90 degrees right -> -> -> drive forward 30cm -> -> -> reconnect with the coloured line (by using the colour sensor) my Mindstorms robot will then continue to follow the coloured line until it comes across the green line at the start of the maze. The Lego Mindstorms robot will then stop.

When my Lego Mindstorms robot has stopped, I would then reprogram it so it can complete the maze course without any complications. Once I have reprogrammed the Lego Mindstorms robot, I can then proceed to complete the maze course.

5.2. Completing the maze

Drive forward -> -> -> the touch sensors detect the wall -> -> -> turn Mindstorms robot 90 degrees left -> -> -> drive forward -> -> -> the touch sensors detect the wall -> -> -> turn Mindstorms robot 90 degrees left -> -> -> drive forward -> -> -> the touch sensors detect wall -> -> -> turn Mindstorms robot 90 degrees left -> -> -> drive forward -> -> -> the touch sensors detects wall -> -> -> turn Mindstorms robot 90 degrees left -> -> -> drive forward -> -> -> touch sensors detect wall -> -> -> Mindstorms robot turns 90 degrees left -> -> -> drive forward -> -> -> Once the colour sensor detects the coloured line across the floor (red block) -> -> -> makes clapping noise (acknowledging the red line and understanding its finished the maze course) -> -> -> end program.

6.0 Acknowledgement

I would like to express my gratitude by thanking all my lectures this year for helping me understand flowcharts and a special thank you to Sue Maw for helping understand about Lego Mindstorms ev3. She is an amazing lecturer and I hope to have her lecturing me again in my first year (If I pass the Foundation year.)

7.0 References

(1) Lego Mindstorms robots course image

S. Maw 2020, GA36a-M4X01506, Moodle.uwtsd.ac.uk

(2) Lego Mindstorms image

<http://www.legoengineering.com/ev3-sensors/>

(3) Ultrasonic reference

<http://www.legoengineering.com/ev3-sensors/>

(4) touch sensor reference

<http://www.legoengineering.com/ev3-sensors/>

(5) Colour sensor reference

<http://www.legoengineering.com/ev3-sensors/>

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GRADEMARK REPORT

FINAL GRADE

44/100

GENERAL COMMENTS

Instructor

You've done really well in catching up on this assignment and it's great that you followed my advice of including work in each section so it's good to see that you have passed the assignment. Please check out the referencing guidelines for future assignments, there's more to it than pasting in a web address! And what about the book we used in class as a reference?

Project Introduction 10% 5

Brief outline of the work is given here. Try to rewrite the sentence instead of using I.

Line Follower 25% 12

The short discussion here gives a good explanation of design choices and use of the sensor.

Block avoidance 25% 13

Another good short report on the problem solving. Your consideration of the physical and logical problems shows good problem solving.

Maze 25% 13

Again, brief but with evidence of good problem solving ability that will be useful in your studies.

Overall summary 15% 7

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

Assessment Component 2 – Coursework - 40% 40

Pseudocode is presented with some evidence of thinking through the problem. Further explanation of design choices would be an improvement.

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