

Mindstorms Project

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Lego Mindstorms Project

Introduction and explanation:

The problem that is to be solved is building and programming a robot using the Lego EV3 software to navigate around obstacles and through maze; the robot should be able to identify and follow a coloured line on the floor and make its way around obstacles and into the maze once in the maze the robot should then be able to navigate its way through the maze and reach the finish. The robot will do this with the help of sensors and coding which requires the robot to perform multiple tasks in the right order to allow itself to navigate the course.

the robot needs to be programmed using the EV3 software and specific coding needs to be introduced to allow the sensors and robot to work in tandem with eachother to allow the robot to make the decisions and manoeuvres it requires with precision to allow the robot to navigate the maze successfully.

Tools and Techniques:

To solve this problem, we will use several tools and attachments for the EV3 robot.

The main tools we will use for the robot will be the Colour sensor which will be used for identifying and following the coloured line that we are required to follow just outside of the maze this tool will allow the robot to track the colours and follow them accurately.

We will also use 2 ultrasonic sensors the ultrasonic sensors allow the robot to track obstacles and walls accurately up to 255 CMS away this will be a critical tool in allowing our robot to follow the walls, identify walls inside the maze, and manage its way out of said maze we will programme the sensors using the right hand rule which is a rule that involves keeping your right hand or in this case sensor tracking the wall and following it until eventually you exit the maze this method was the one we chose to use in our project as it was quite simple to implement the required code to our sensor to allow it to follow the right wall until eventually the robot exits the maze.

Wall following explained in detail.

The wall follower algorithm contains two rules which are the right-hand rule and the left-hand rule. Regarding the rules, both rules can be applied to solve the maze in a fast and without any extra memory to solve maze. The rules are based on the simple logic of movements whereby either following along the left side or the right side of the enclosure wall. Following one side of the enclosure wall will form a pathway that leads to the exit. [1]

The only exception is if you are touching an 'island' wall, that is a closed area, but you can check this by marking the ground and if you walk past it again, then you know you are touching an 'island' area. All you do then is reach out the opposite hand, touch the opposite wall and set off again. [2]

This exception is not applicable to the maze we will be conducting our test on

Colour sensor explained

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. Each colour is also represented by a value (Note: For best results, the colour sensor needs to be 1-2 cm away from the colour you are trying to detect and have consistent lighting).

Reflected light intensity – In this mode, the colour sensor emits a red light and measures the amount reflected back 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. [3]

Ambient light intensity – In this mode, the colour sensor measures the amount of light in its environment, *without producing its own light source*. Ambient light intensity is measured as a percentage from 0 to 100, with 0 being very dark, and 100 being very bright.

For the purposes of our course we will be using the Colour mode of our sensor [3]

Ultrasonic sensor explained

The ultrasonic sensor 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 measuring 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.

The ultrasonic sensor also has a "listen only" mode that can detect whether another robot is using an ultrasonic sensor nearby. In this mode, the sensor listens for signals but does not send them. [3]

Large and medium motors explained

Both the large and medium servo motors are equipped with internal rotation sensors. The rotation sensor is used to measure how far a motor has turned (or has been turned). Rotation sensors can detect an amount of rotation in degrees or full rotations. You can also use the rotation sensor to find out what power level a motor is currently running at. [3]

The motors are particularly useful at telling the robot how many rotations its done in relation to the wall or obstacle its identified as this then allows it to know where its facing in relation to the wall and of course it also allows the robot to move.

Planning:

To solve our problem we will need to manage our time effectively, firstly we will research the required attachments and methods that we may need to be able to get our robot through the maze the project will be divided into stages the first stage will be assembling the robot and making sure all our attachments are in place and are in working order.

Secondly we will begin to programme our robot we will do this by using the EV3 Software provided we will use this software to programme and set the parameters for our colour sensor and ultrasonic sensors then we will also programme the movement block of our robot so that it is able to move in accordance with our sensors our code will allow our robot to move independently and use its sensors to detect incoming obstacles or walls and to continue tracking existing walls with our second sensor the robot can then take this information and stop and adjust its course to avoid these obstacles eventually working its way out of the maze. My role in this section was programming the ultrasonic sensors to do this I programmed them separately as they both had different roles the frontal sensor was programmed by me to identify walls and obstacles the robot was driving towards and the second sensor was used to allow the robot to track the walls of the maze on the right side eventually achieving its goal of escaping the maze.

Design:

The design of the robot will be fairly simple using only 2 ultrasonic sensors a colour sensor and the block itself followed by 2 motors and a steering ball at the back of the robot to allow turns the chassis will house 2 wheels at the front to allow forwards and backwards movement these are powered by 2 motors towards the back of the robot that are plugged into the Lego block to allow power into the motors the colour sensor will be at the front of the robot looking down at the floor to allow accurate tracking of the coloured line featured in the course.

The ultrasonic sensors will be placed on top of our robot one facing forward to look out for and adjust for incoming obstacles and one facing the right side of the robot to allow for accurate and stable tracking of the mazes walls and to allow the robot to identify where it is at all times in relation to the maze itself.

Bibliography

- [1] A. Y. Z. Dao, "Medium," Medium, 5 February 2021. [Online]. Available: <https://andrewyong7338.medium.com/maze-escape-with-wall-following-algorithm-170c35b88e00>. [Accessed 6 May 2023].
- [2] "The Natural Navigator," Natural Navigator, 16 11 2015. [Online]. Available: <https://www.naturalnavigator.com/news/2015/11/how-to-find-your-way-out-of-a-maze-or-labyrinth/#:~:text=There%20is%20a%20simple%20method,will%20eventually%20get%20you%20out..> [Accessed 7 May 2023].
- [3] J. Burfoot, "EV3 Sensors," Lego Engineering, 22 03 2018. [Online]. Available: <http://www.legoengineering.com/ev3-sensors/>. [Accessed 06 05 2022].

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GRADEMARK REPORT

FINAL GRADE

47 / 100

GENERAL COMMENTS

Instructor

ASSESSMENT COMPONENT 1 (60%)

Project Introduction 4/5

Background research 9.5/15

Project plan 5/10

Design Process 15/40

Evaluation and results 0/30

Total: 33.5%

Comments:

Introduction is generally good, would be helpful to have a diagram of the task included as it is a very visual assignment.

Some good areas are mentioned here, would have been good to have more detail on right hand and left hand rule, although you have considered and referenced this.

Plan need to include a list of tasks in order, potentially with timescales. It's a bit confused when written as a narrative.

Design is a bit limited - you could include some pictures/diagrams here to illustrate.

No evaluation?

ASSESSMENT COMPONENT 2 (40%)

Technical knowledge/skill 14/20

Analytical and problem-solving skills 14/20

Quality of result (performance of the finished application or suitability of the design) 38/60

Total: 66%

Comments: A good attempt, although there were limitations in the maze section

OVERALL TOTAL FOR MODULE: 46.5%

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