

Final I hope

by Jordan Sparkes

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Integrating Project

ACHA4008

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Introduction

Maze-solving robotics represents a challenging yet captivating project. The ability to navigate through complex environments autonomously has broad implications, from search and rescue operations to warehouse logistics. In this project, we aimed to construct a Lego Spike creation capable of autonomously solving a maze. The maze-solving task involves two distinct stages: following a guidance line taped to the floor and traversing a physical maze. Through the integration of sensors, motors, and collaborative teamwork, our goal was to design a vehicle capable of navigating through these stages and reaching the exit point.

The significance of maze-solving robotics lies in its practical applications across various industries. For instance, in search and rescue scenarios, autonomous robots can navigate through hazardous environments, such as collapsed buildings, to locate and assist survivors. Similarly, in warehouse logistics, robots can efficiently navigate through maze-like storage facilities to retrieve and transport items. By addressing the challenges of maze-solving robotics, we contribute to the advancement of autonomous systems with real-world applications.



Problem Statement

The maze-solving challenge presented several distinct obstacles that our robot needed to overcome. Firstly, the robot must follow a guidance line taped to the floor, which includes navigating around obstacles such as blocks placed along the line. Secondly, the robot must enter and navigate through a physical maze, avoiding dead ends and obstacles to reach the exit point. The complexity of the maze and the variability of its layout posed significant challenges for our robot's navigation capabilities.

To address these challenges, we needed to design a robot capable of robust sensor integration more specifically light and motion sensors, efficient algorithm implementation, and precise navigation control. Additionally, effective collaboration within our group was crucial to ensure the successful completion of the project.

Group Organization

Our group consisted of three members consisting of myself along with two of my fellow classmates Dylan and Rowan. Our group organization was based on effective communication, collaboration, and shared accountability. Regular meetings were held to discuss project progress, address challenges, and align on next steps. Task delegation was done based on individual strengths and interests, ensuring that each group member contributed effectively to the project's success.

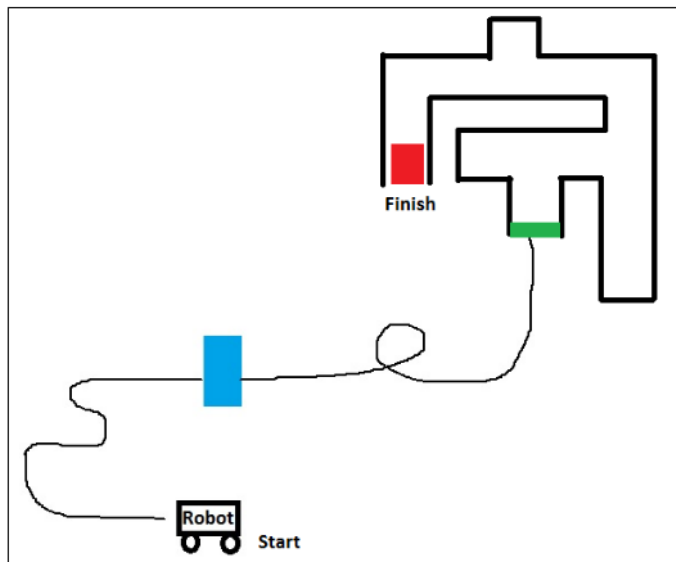
Research and Literature Review

Extensive research was conducted to identify relevant literature and existing methodologies in maze-solving robotics. My research covered a wide range of topics, including sensor technologies, other similar spike projects, and accompanying navigation strategies. We explored various sensor options, such as distance sensors, push button switches, and color sensors, evaluating their suitability for maze navigation based on factors such as accuracy, range, and reliability.

Additionally, we investigated different path finding solutions such as turning at a specific degree of motion, using the pre defined turn commands within spike or by programming to follow a specific colour. To determine their applicability to our maze-solving task, Case studies of other similar spike projects provided valuable insights into design considerations, challenges faced, and lessons learned. By synthesizing information from diverse sources, we developed a comprehensive understanding of the tools and techniques required for our project.

Planning and Methodology

Our project planning process involved the development of a breakdown of what was needed, a rough design of our vehicle and what the course should look like. We identified key project milestones and deadlines, ensuring that each stage of the project was completed in a timely manner. Additionally, we conducted research into similar projects to anticipate potential challenges and developed



The route we need to follow

contingency plans to mitigate risks.

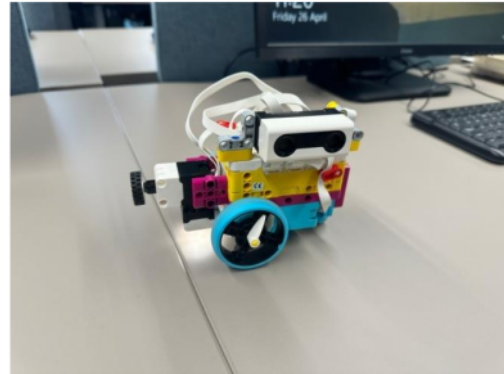
The methodology used for designing and implementing the robot involved a combination of prototyping, testing, and iteration. We adopted an iterative approach to software development, continuously refining algorithms based on testing results and feedback.

Hardware design iterations

were conducted to optimize the robot's performance and reliability. Throughout the project, we prioritized communication and collaboration to ensure alignment on project goals and objectives.

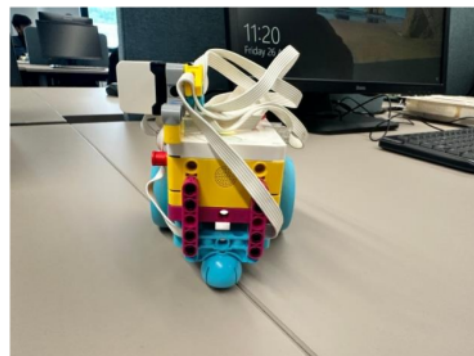
Robot Design

The design of our robot encompassed both hardware and software components, each carefully chosen and integrated to achieve optimal performance. On the hardware side, we selected a combination of sensors, motors, and structural components to construct a robust and versatile vehicle. The software architecture comprised of movement blocks, colour following blocks, and motion sensing algorithms implemented in a modular and scalable manner by way of conditional statements.



Sensor integration was a critical aspect of our robot design, enabling it to perceive and interact with its environment effectively. We chose distance sensors for obstacle detection and colour sensors for line following. These sensors were integrated into the robot's chassis using the Lego bricks provided as mounting brackets and connectors, ensuring optimal positioning and alignment.

The software implementation involved developing algorithms for sensor data processing, path finding, and motion control. We utilized the Lego Spike software development environment, to implement



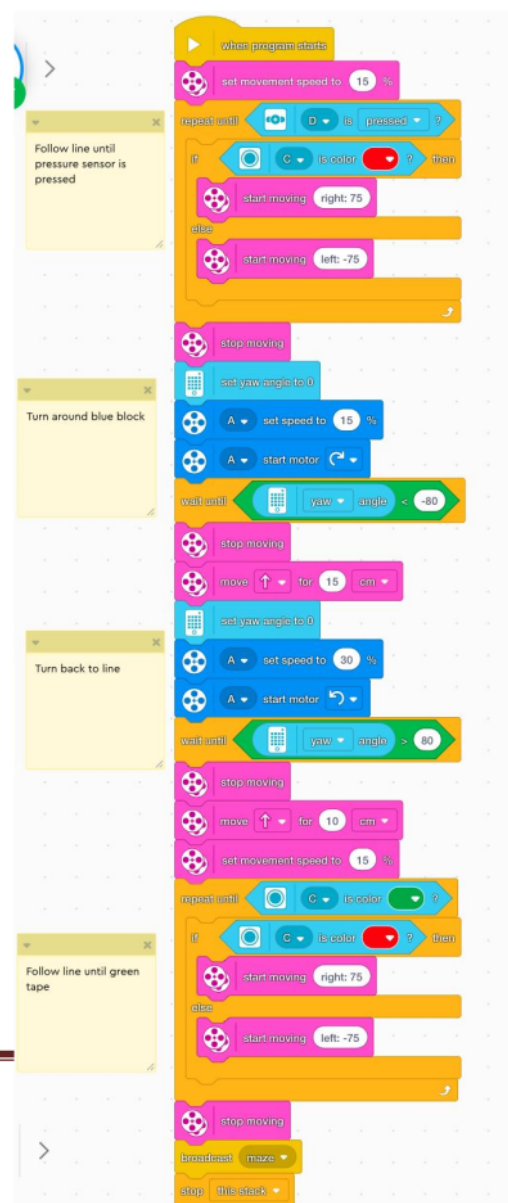
these algorithms. Our software architecture followed a modular design, allowing for easy integration of new sensors and algorithms as needed.

Code design

When trying out different approaches to the task at hand we established the following two code examples one for following a line using a colour sensor and the other for navigating a maze using distance sensors and a push button pressure sensor.

Line following

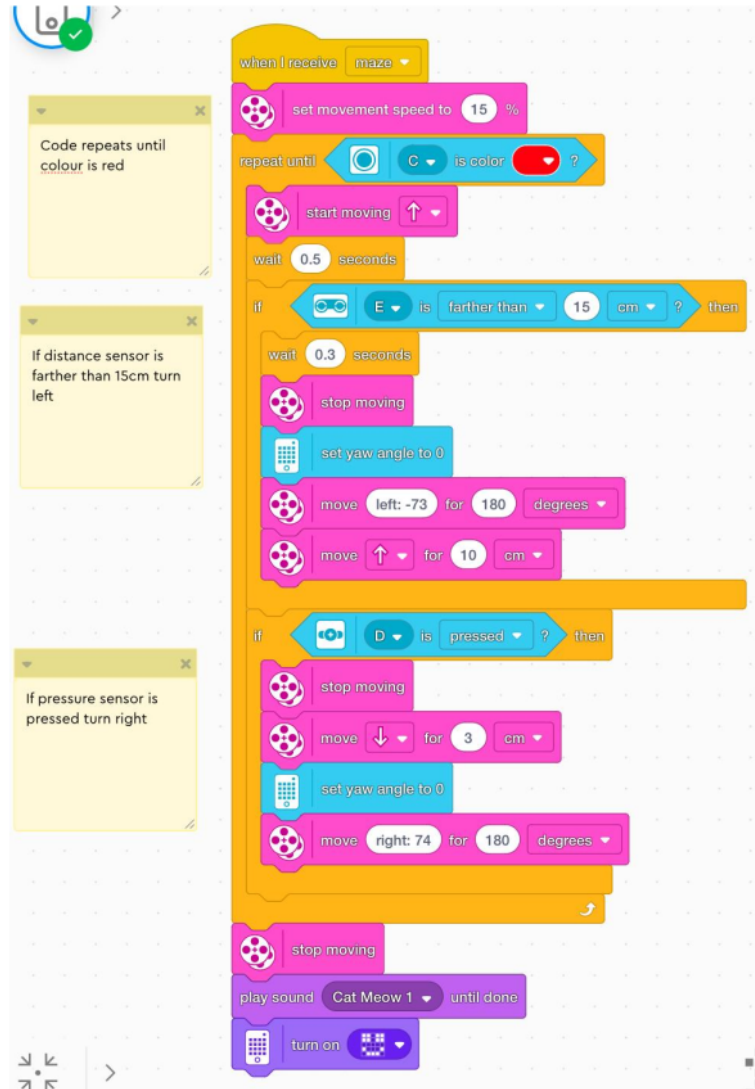
The first example of this code handles the robot's ability to follow a line until it encounters a specific trigger, pressure sensor activation. The robot starts at a movement speed of 15% for precision. It continues following the line, using a colour sensor to detect the path. The robot moves right; otherwise, it moves left. This decision-making process repeats until the pressure sensor on port D is activated, indicating an obstacle or a specific condition met. Once the robot encounters an obstacle, as detected by the pressure sensor, it executes a sequence to navigate around it. This involves turning by specific angles and moving straight to reposition itself on the line. Specifically, the robot turns left until it reaches an angle less than -80 degrees and then moves straight for 15 cm before resetting its orientation. After navigating the obstacle, the robot realigns to the initial line and continues its navigation. It does this by turning right



until it surpasses 80 degrees and resumes the line-following logic based on colour detection until it encounters green tape.

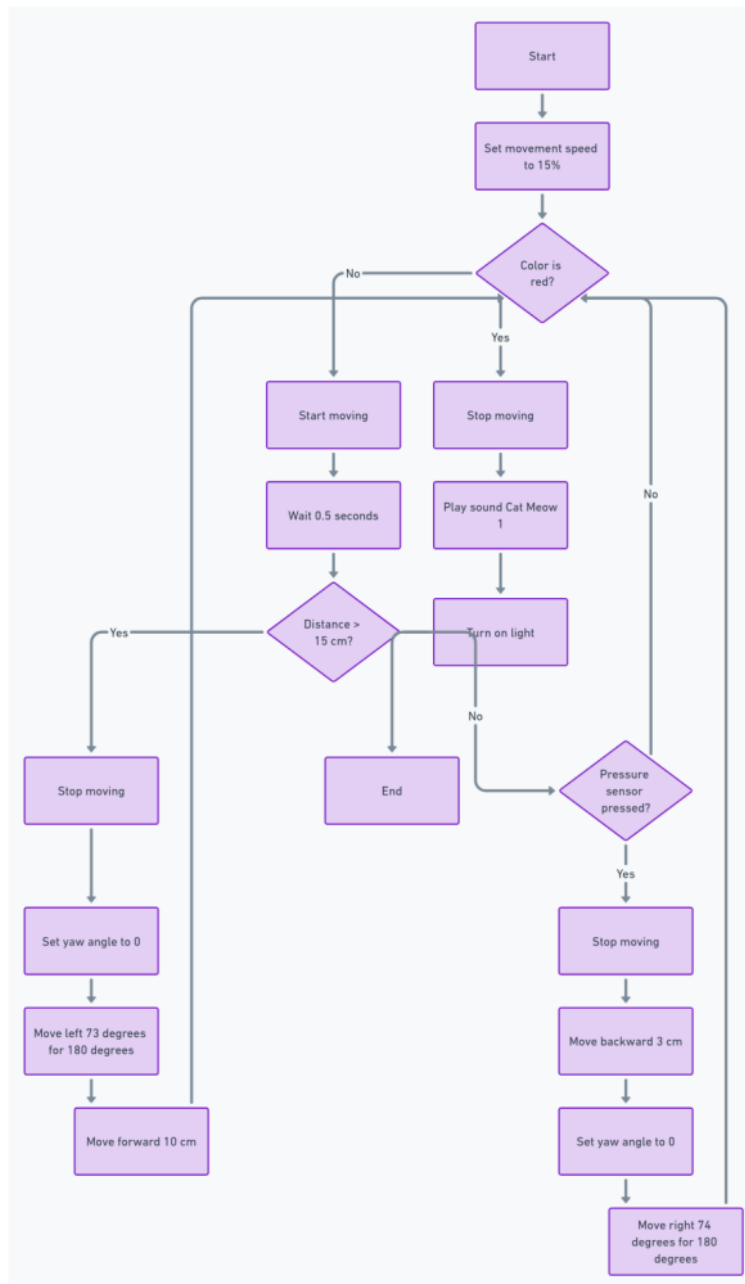
Maze navigation

This code example uses both pressure and distance sensors to make real-time navigation decisions. The robot continues moving forward until it detects the colour red, indicating an endpoint or a critical navigation cue. During this process, if the distance sensor detects a path longer than 15 cm, the robot turns left, suggesting an adaptive path finding approach based on sensor inputs. Additionally, if the pressure sensor is activated again, it performs a right turn, indicating dynamic response to physical obstacles.

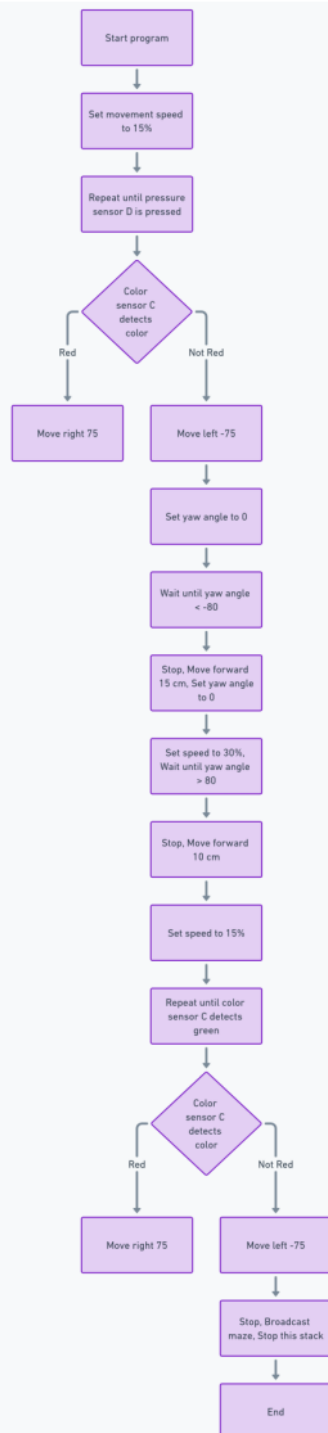


Flowcharts

Maze



Line Following



Conclusion

In conclusion, the construction of the Lego Spike robot for maze solving presented a challenging yet rewarding opportunity to apply theoretical knowledge to practical problem-solving. Through effective collaboration, thorough research, and meticulous planning, we successfully designed and implemented a robot capable of autonomously navigating through a maze. Our project contributes to the advancement of maze-solving robotics and underscores the importance of interdisciplinary collaboration in addressing complex challenges.

Final I hope

GRADEMARK REPORT

FINAL GRADE

80/100

GENERAL COMMENTS

Great job on your report! Here are some things I noticed:

- The step-by-step plan for the project shows a well-organized approach to problem-solving.
- A clear mention about the project objective.
- It would be helpful to hear more about the specific challenges faced when placing sensors and how it was rectified could have added credits.
- Your conclusion is good; however, you could also mention how these robotics skills can be helpful in interdisciplinary fields.

Overall, this report demonstrates a solid foundation in robotics and LEGO Spike programming.

Introduction- 13

Research skills- 11

Plan-34

stage wise success-16

Reflection-6



Comment 1

clear ToC



Comment 2

clear introduction