

integrating project

by Iestyn Evans

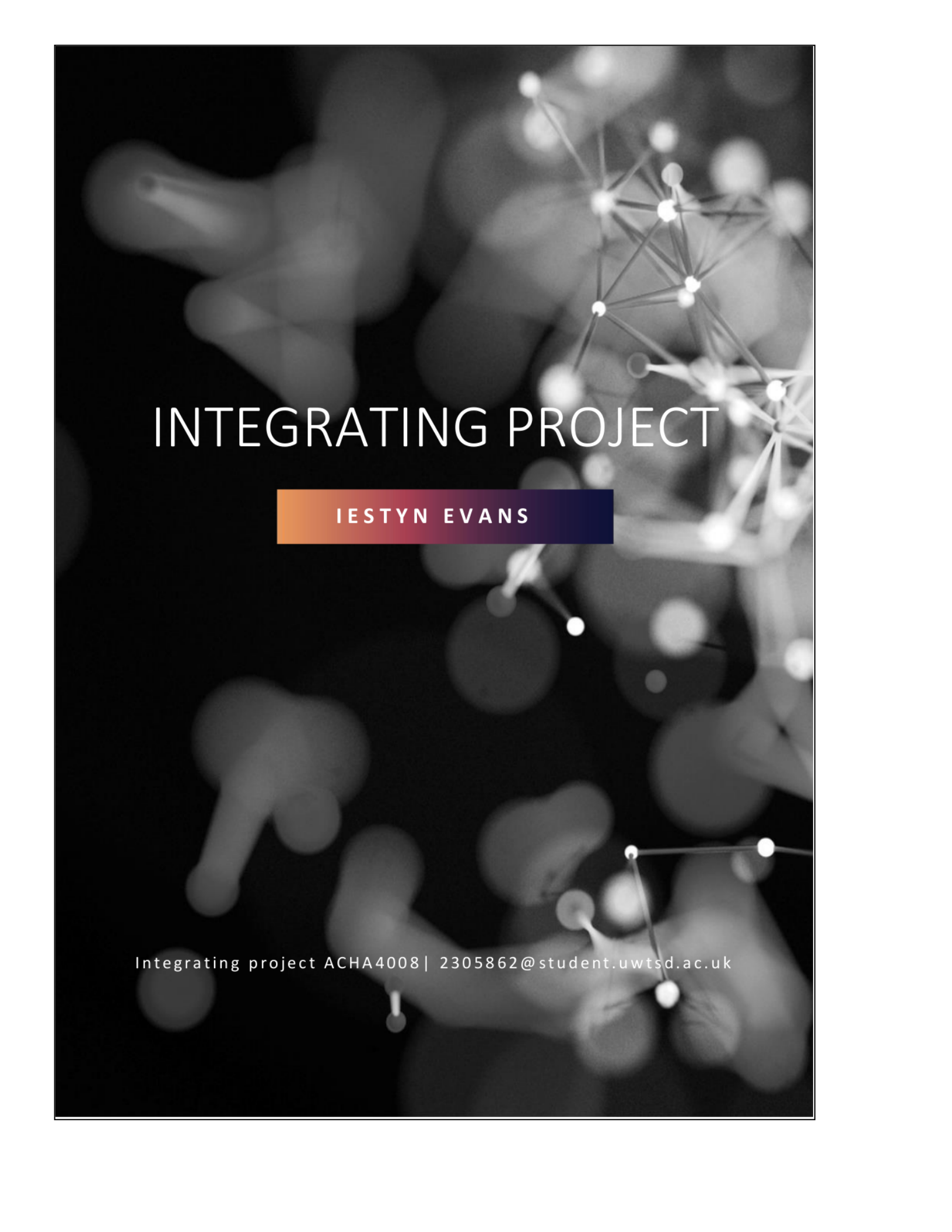
Submission date: 10-May-2024 01:50PM (UTC+0100)

Submission ID: 233127401

File name: 49420_Iestyn_Evans_integrating_project_573445_802195899.docx (6.03M)

Word count: 1288

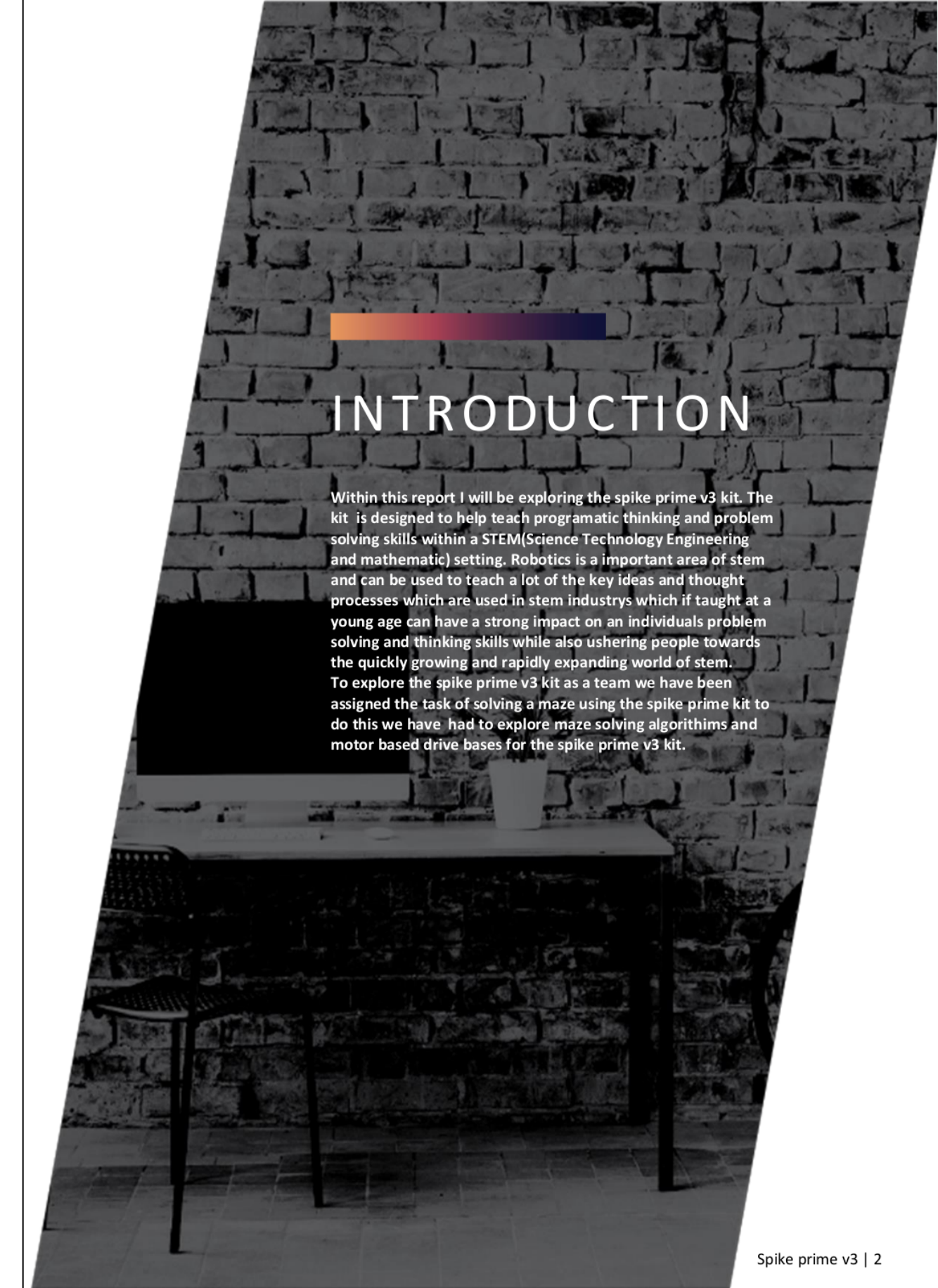
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INTEGRATING PROJECT

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The background of the page is a grayscale photograph of an outdoor setting. It features a rough stone wall in the background. In the foreground, there is a dark-colored table with a metal mesh chair tucked under it. A small white pot sits on the table. A diagonal white line cuts across the image from the top left to the bottom right. Above the title, there is a horizontal bar with a color gradient from orange to purple.

INTRODUCTION

Within this report I will be exploring the spike prime v3 kit. The kit is designed to help teach programatic thinking and problem solving skills within a STEM(Science Technology Engineering and mathematic) setting. Robotics is a important area of stem and can be used to teach a lot of the key ideas and thought processes which are used in stem industrys which if taught at a young age can have a strong impact on an individuals problem solving and thinking skills while also ushering people towards the quickly growing and rapidly expanding world of stem. To explore the spike prime v3 kit as a team we have been assigned the task of solving a maze using the spike prime kit to do this we have had to explore maze solving algorithmis and motor based drive bases for the spike prime v3 kit.

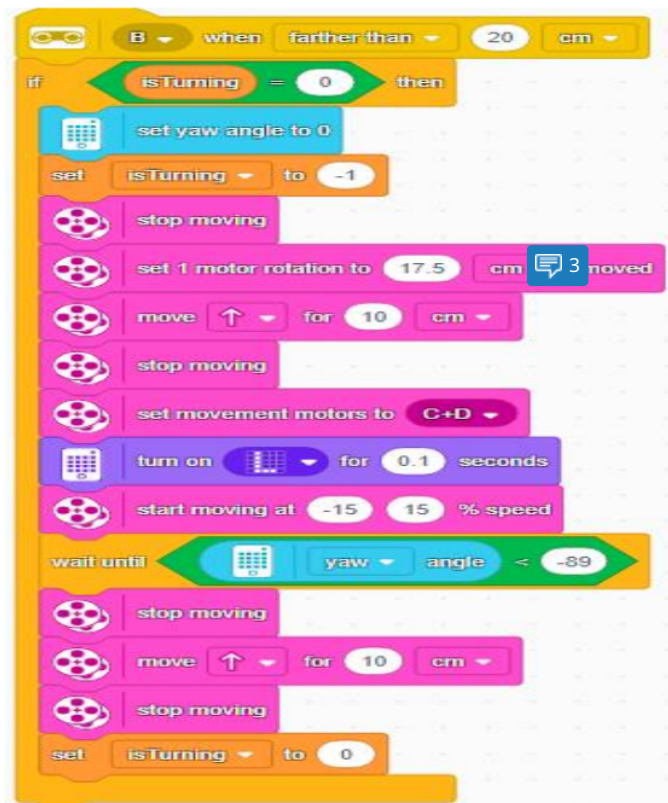
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KEY PROJECT AREAS

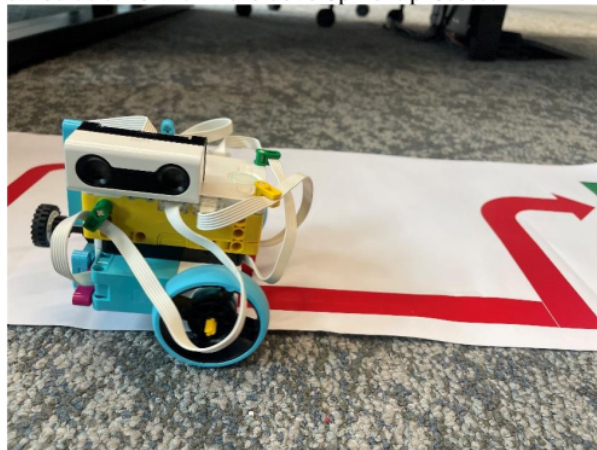
CODE DEVELOPMENT

As during this project we are using the spike prime v3 development kit we had 2 choices for developing our code base we could either use the scratch block based coding or python. ¹ We decided to use scratch as this would allow us to have a more rapid development and iteration cycle greatly increasing improving development times and also allowing us to have a more concise code base as the code blocks within scratch enabled us to have a clearer code base. We also needed to process the sensor data within the code to do this we monitored the yaw for the spike prime v3 kit at all times as this allowed us to respond to any updates in the kits position and adjust while on the fly the below code snippet demonstrates this within python. ² In our code the below snippet uses the distance sensors to track if the spike prime v3 kit is parallel to a wall at any time and if it is not it will rotate to stay on path as we used the pledge algorithm monitoring our relative distance from the current path was a key piece of data that we needed.



MECHANICAL DESIGN

While building the vehicle we used various resources in optimising our vehicle to solve mazes we also had to have multiple sensors to input data from the world around the robot to the robots into code to allow the algorithm to programatically solve the maze. We also used inspiration from other vehicles and engineering design choices from a myriad of similar projects. We also followed some of the design ideas from the lego spike prime v3 website however as the spike prime wheelbase was not specifically design for maze solving projects we had to make some adjustments with adding additional sensors allowing us to retrieve data from the world to allow the robot to accurately traverse the maze. We also needed to make changes to the vehicles wheel base as the broad wheelbase of the original kit did not allow for an accurate enough turning radius to navigate the maze. The below image of our maze solving robot demonstrates both the range sensors and the narrower wheelbase we had installed in our spike prime v3 kit however we believed that in future designs we would have had a singular drive shaft-based system allowing for more precise control of the vehicle and allowing for a greater level of torque allowing our spike prime v3 kit to traverse a wider span of terrains. The below image also includes the force sensor this was used to detect when the spike prime had hit an obstacle however shortly after taking this photo, we added a broader actuation area for the pressure sensor as it allowed for more accurate detection of obstacles while also allowing for minimal changes within the code which saved us time within the development process.





RESEARCH

During development our key areas of research focused around the code, algorithms and vehicle design for research into code we used github and the official spike prime documentation. During our research we also discovered alternative ways of implementing code within the spike prime as the spike prime allows flashing with custom firmware such as pybricks which allows for a fully featured version of micro python which allows for a wider code base as micro python has far more features than legos base version of python included with the spike primes.  Pybricks also enables a much faster development cycle as they allow the  of traditional IDE's. However we unfortunately could not use pybricks as installing custom firmware on the university's devices is strictly prohibited. During our research into the spike prime v3 kit and its use in maze solving algorithms we discovered the pledge maze solving algorithm which allowed us to solve the maze using programmatic instruction. The pledge maze solving algorithm uses ideas from the hand on wall algorithm which typically struggles with dealing with any obstacles within the maze the pledge algorithm named after John Pledge of Exeter if the robot repeats a loop around one wall 4 times it will drive itself forwards to escape any obstacles and then will return to the hand on wall style of maze solving.

PROJECT PLANNING STAGES

REQUIREMENTS

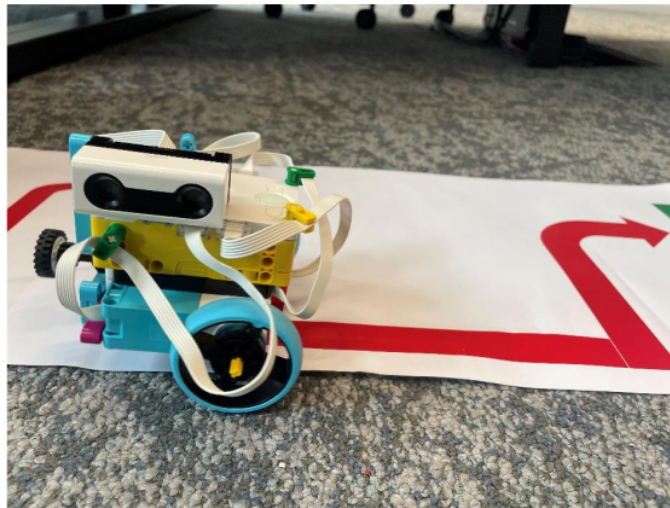
The main requirements for the project were to path-find along a pre defined route and to then solve a maze once we had received these guidelines we needed to start developing and designing a way to complete these tasks as they both used the same sensors. We needed to have individual code bases for each task allowing us to use each of the sensors for different aspects of each of the task.

DESIGN

During our design process we went through multiple iterations of our design most of which had similar designs however the key change that netted us the most improvement with our design was narrowing the wheelbase which allowed us to have a better control of the steering systems.

IMPLEMENTATION

Our final implementation took many stages of iteration before we were finally certain it was the right fit for the task. The below image is our final implementation of our spike prime v3 kit traversing the path for the challenge it is using the color sensor that is on the bottom of the spike prime to guide it along the path to have it consistently follow the route we had it iterate through the path 1 inch at a time as this made it less likely to lose the path.





CONCLUSION

To conclude this essay I think it is important to highlight the importance of kits like the spike prime and there importance in introducing the younger generations to the world of stem having access to kits like this from a young age can massively improve the likelihood of a child pursuing stem while also learning a vast myriad of skills that if they do not end up in the stem industry can still massively benefit their problem solving and programatic thinking skills. During this project myself and my team have learnt a lot about how to design and iterate within a team setting and the importance of having multiple view points on one task this is another strong aspect of the spike prime v3 as it can be assigned to a group to improve interpersonal and team building skills while also learning how to program. The spike prime also has a lot of functionality beyond what myself and my group have explored which I believe can help in developing s and helping people into the STEM industry

integrating project

GRADEMARK REPORT

FINAL GRADE

53/100

GENERAL COMMENTS

Iestyn,

I wanted to let you know that your grade will be capped to 40% because of late submission. The grade provided here is your actual score without the cap.

There are some suggestions on your work here:

- report demonstrates a comprehensive understanding of the both the design and code block.
- Insights into the decision-making process behind the choice of sensors and motors were chosen however outlining the objective of the project would have been an even better start.
- While the assignment outlines the components and basic functionalities well, it could benefit from more detail on the specific programming techniques or algorithms used to achieve the desired behaviors, such as line following or obstacle avoidance.
- Proof reading the document to avoid grammatical mistakes is encouraged.
- Incorporating references or citing sources related to robotics concepts or LEGO Spike programming techniques would add credibility and demonstrate research skills.

Overall a good attempt.

There's a lot to discover in robotics, and you're on the right track.

Introduction- 7

Research skills- 6

Plan-20

stage wise success- 15

Reflection - 5

PAGE 1

PAGE 2

PAGE 3

PAGE 4



Comment 1

A good start with a right justification for choosing word block however defining about the problem which needs to be evaluated would have added credits.



Comment 2

???



Comment 3

adding comments in the coding is a professional style coding

PAGE 5



Comment 4

what are they?



Comment 5

more specific reasoning of the analysis could have been mentioned



Comment 6

more specifics about the color sensor and distance sensor could have been mentioned

PAGE 6



Comment 7

proof reading the document is a must before uploading



Comment 8

???

PAGE 7



Comment 9

not clear



Comment 10

more details about the components used in the design is expected

PAGE 8



Comment 11

what were they?

PAGE 9
