

Integrating project Assignment

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Introduction

The modern world depends on technology to resolve daily challenges. Robotics stands as one of the most captivating technological fields because it unites engineering with coding and problem-solving to develop machines that automate tasks. The project seeks to develop a functional robot which performs its designated task with maximum efficiency.



The main objective of this project involves following the complete robot development process which includes research along with planning and designing and programming and testing stages. The project demands expertise in hardware and software development through mechanical design and electronics and coding techniques. The process enables us to develop robotics expertise while enhancing our problem-solving abilities and learning effective teamwork methods to reach our shared objective.

The report presents information about robotics tools and techniques alongside design steps and results. The document will present both a project schedule for work completion and an assessment of the project's total success. The objective is to build a robot which executes its designated purpose successfully while acquiring essential skills in engineering and programming.

Background Research

Our robot project started with the process of understanding the LEGO SPIKE Prime V3 kit and its operational aspects. The LEGO SPIKE Prime V3 kit functions as a tool for students to discover robotics through robot construction and programming [1]. The kit contains various components which include motors sensors wheels beams and an Intelligent Hub that functions as the robot's central control unit. Users can create programs through a block-based coding system that features drag-and-drop functionality instead of writing complex code. The system provides an ideal learning environment for novices who begin their studies in programming and robotics [2].



Our research examined the combined functionality of sensors and motors operating within the SPIKE Prime system. The colour sensor detects various colours in its field of view while serving as a primary component for line-following operations. The ultrasonic sensor provides distance measurement capabilities to detect objects which helps the robot avoid collisions. The force sensor functions by detecting touch and pressure inputs. The Intelligent Hub receives sensor data which enables it to execute programmed code to determine robot responses. Our understanding of robot functionality improved through studying loops together with conditional statements and sensor inputs which enabled us to program turning and stopping and direction changes [3].

Our background research established fundamental knowledge before beginning construction and coding activities. The research enabled us to select better design elements by determining sensor positions and designing robot movements for maze navigation and black line tracking. Our research into real-world robotics applications in manufacturing and healthcare and delivery services demonstrated the future potential of these skills [4]. The research provided better understanding of technical project aspects which enabled us to begin robot construction and programming with increased confidence [5].

Project plan

Our robot project success depended on developing a detailed plan which contained every necessary step for completion. Our initial step involved studying the LEGO SPIKE Prime V3 kit to understand its sensors and motors and programming software. The team divided responsibilities according to individual skill sets so members handled building and coding and testing tasks which maintained organization and ensured complete team contribution. The project timeline spanned six weeks during which we developed our plan.

Week	Task	Role
Week 1	Research LEGO SPIKE Prime and robotics basics.	learn and gather information from different sources.
Week 2	Design and build the robot.	Build and focus on structure to be fit in maze.
Week 3	Start programming [basic movement and line following].	Coding, programming and teste to figure out the problems And find a good solution.
Week 4	Test robot, debug code, improve design.	build adjust design and developing the structure.
Week 5	Final testing and adjustments.	Test and give the final Robot demo.
Week 6	Prepare the report to submit on time.	Review work and submit it before date line time.

Educational Significance:

The implementation of LEGO SPIKE Prime in this project offers multiple educational benefits which improve problem-solving abilities and creativity and teamwork and technical competencies. The project work involved essential STEM education through robotics by allowing students to design and build and program a working robot.

1.Developing Problem-Solving Skills:

The process of robot construction together with programming demanded both logical reasoning and problem-solving abilities. The project presented several obstacles which included:

- We needed to modify the robot's movement system to achieve better precision.
- The sensors needed proper configuration to function correctly for obstacle detection and line following tasks.
- The team needed to identify and fix programming errors that appeared in block-based programming.

The process of identifying problems and implementing various solutions helped us build critical thinking abilities which prove valuable for academic work as well as real-world applications.

2. Enhancing Creativity and Innovation:

The SPIKE Prime kit allows for customization and experimentation. The structure of the robot and programming its behaviour was designed to encourage creativity as we had to think of efficient ways to complete tasks. This project demonstrated how robotics can be used to solve real world problems such as automation and smart navigation.

3. Strengthening Teamwork and Collaboration:

The project required teamwork because various members handled structure design and movement programming and sensor response programming and design testing.

- Designing the robot's structure.
- Programming movement and sensor responses.
- Testing and refining the design.

The project experience taught us effective communication methods and task distribution techniques and collaborative support for problem-solving which will prove valuable for our future careers in engineering technology and other fields.

4. Learning Engineering and Robotics Concepts:

Through SPIKE Prime's motors, sensors, and intelligent hub, we got hands on experience with engineering principles such as:

- Mechanical design using LEGO Technic parts.
- Motion control and navigation.
- Sensor based automation.

These concepts are basic in fields like robotics, computer science, and mechanical engineering.

5. Preparing for Future Technology and Careers

The increasing role of robotics and automation in healthcare, transportation and manufacturing industries makes learning robot construction and programming essential for future careers. The project taught us the fundamental concepts of robotics which enabled us to grasp how automation works across various industries.

Design progress

Maze challenge:

The main problem we encountered during our robotics design stage was the excessive size of our robot. The oversized robot created movement difficulties through the maze which prevented us from finishing the challenge. We addressed this problem by creating a new structure through frame modifications and component repositioning and part replacements which resulted in a more compact design. The modifications enhanced robot mobility so it could move more efficiently through the maze. The sensor-related adjustments we made led to a new obstacle detection problem which affected the robot's performance.

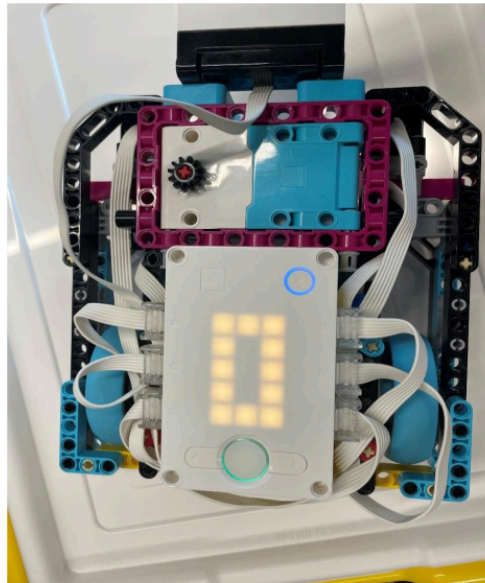
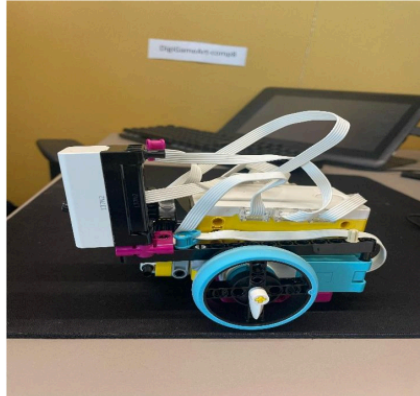
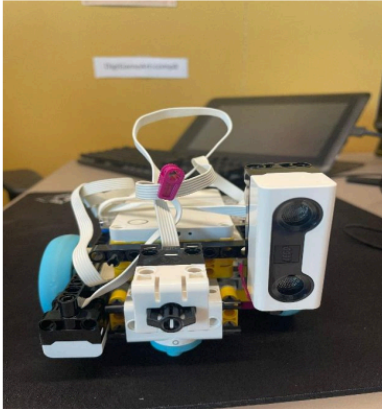


Figure {1} First Robot version for the project

The second challenge was the distance sensors on the robot which were not picking up objects at certain angles. This caused problems when the robot tried to avoid obstacles because it would

sometimes not see walls or openings. We tried to improve detection by adding a second distance sensor in the hopes that it would give better coverage. This did not completely solve the issue. We thought that the problem might be due to sensor placement, interference from surfaces, or incorrect software calibration. Even after changing the positions and angles of the sensors, blind spots still remained which made it hard for the robot to navigate accurately. We thought about other solutions to this problem, like using different types of sensors or improving the software to process sensor data better.



Figures {2,3} of the modified version

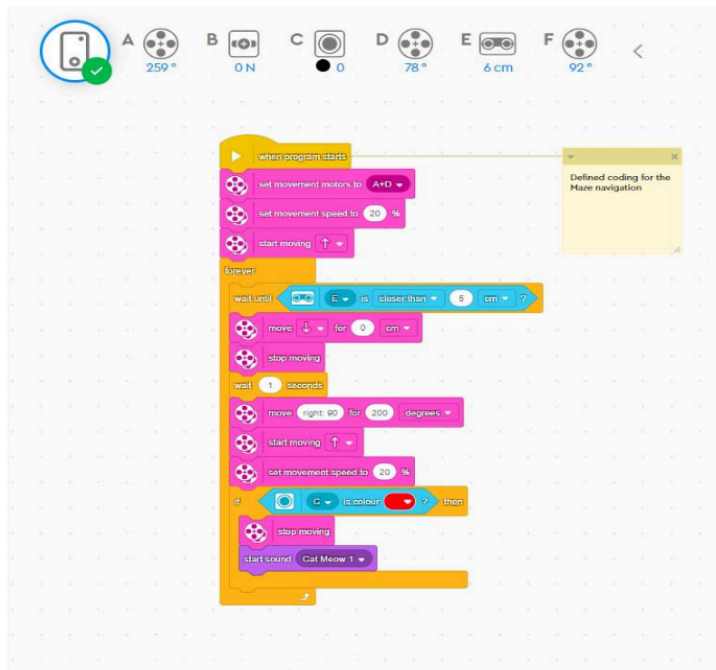


Figure {4} Maze navigation code for wall detection

Flowing line challenge:

The third challenge was to equip the robot with a colour sensor to follow a line, and I oversaw the coding. This part of the challenge was enjoyable because we had enough experience with line following robots and at the beginning everything worked smoothly. However, we had a problem when the robot was in front of a wall and had to find another way. After the obstacle was avoided, the robot sometimes was unable to detect the line again, which made it lose its path. This problem may have been due to the sensor not being correctly aligned when the robot rejoined the line or the robot moving too far away before trying to detect it again. To solve this, we need to enhance the robot's approach to searching and realigning with the line, perhaps by modifying the sensor's detection zone, tweaking the code, or incorporating a recalibration step to guarantee accuracy.

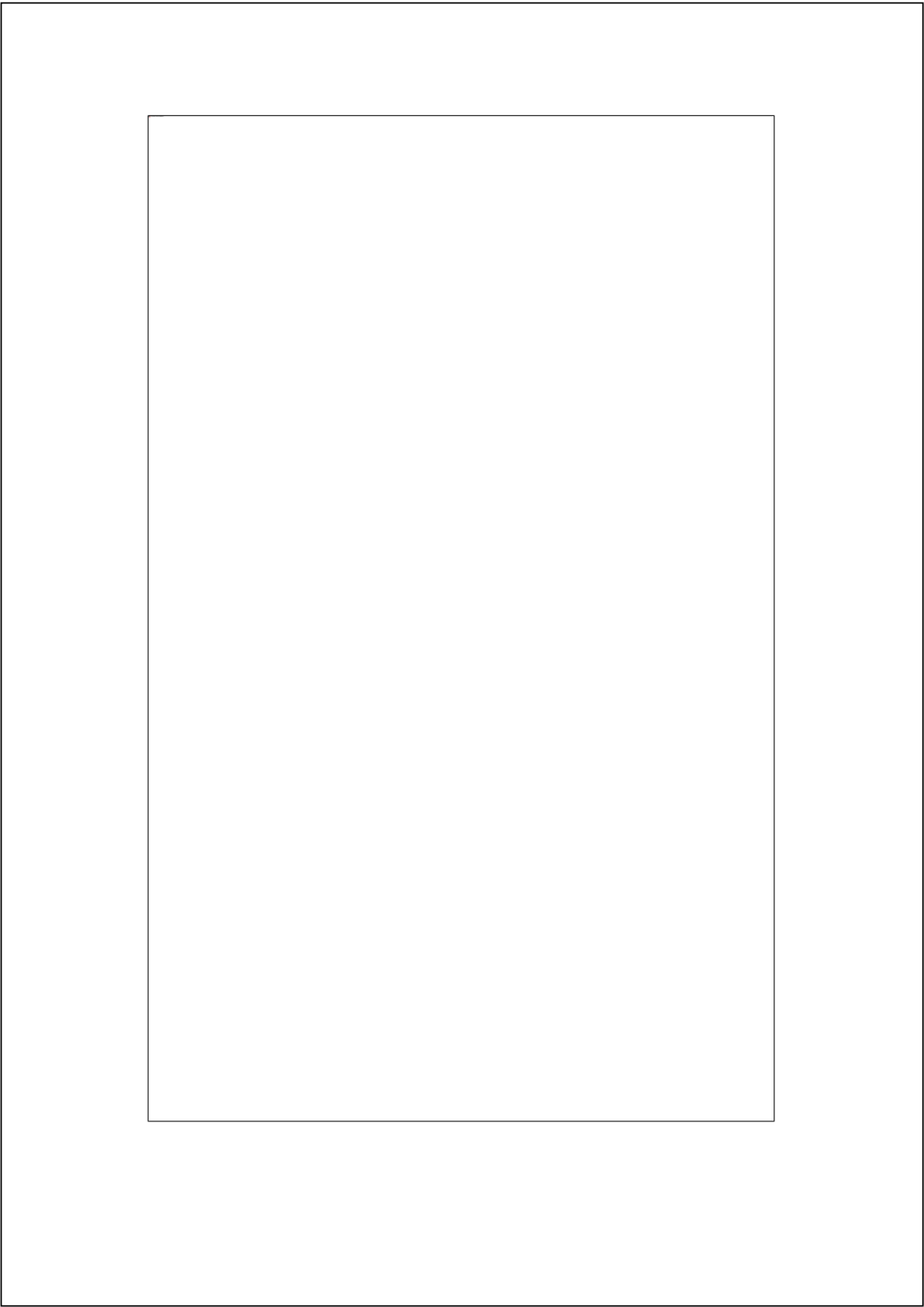


Figure {5} following line code

Solving the problem:

The block-based code had a problem with the robot not detecting the colour in the second part of the program, probably because the colour detection condition was not checked continuously. This was because of the logical structure of the program, where the program was designed to move and detect distance and may have skipped the second colour check. To fix this, we reprogrammed the code by adding forever loops to make sure that the colour detection was continuous. Also, we changed the condition order to check for colour before checking the distance sensor. These changes helped the robot to detect the colour and respond correctly, so that it would not miss the detection while in motion.

Self-Evaluation

My skills in technology along with problem-solving abilities and teamwork have advanced substantially through this robotics project based on LEGO SPIKE Prime. The process of designing and programming and testing a working robot has presented both difficult moments and satisfying experiences.

Personal Contribution:

I was mainly in charge of the colour sensor part of the robot and making it work for line following. This task included writing and debugging the block-based code and I oversaw how the robot detects and follows the line and even after encountering obstacles. I also helped with the redesign of the robot's structure when it was too big for the maze challenge and also helped with testing the sensor placements.



Problem-Solving and Challenges:

We encountered several problems throughout the project. The first robot structure proved too large to effectively move through the maze. I assisted in creating a new framework and moving components to achieve a smaller design. The ultrasonic sensor produced unreliable sensor detection results especially in certain situations. The addition of a second sensor provided some improvement, yet we jointly adjusted sensor positions and software code to enhance obstacle detection capabilities. The robot lost track of the line following path after performing obstacle avoidance manoeuvres. I modified the code structure through continuous colour detection with loops and condition reordering to enhance system reliability. The challenges I faced during this project improved my ability to identify problems and demonstrated how testing along with iterative development remains crucial for engineering success.

Technical and Academic Growth:

The project allowed me to put theoretical knowledge into practice. I learned how to work with the block-based programming environment of SPIKE Prime and how different components (motors, sensors, and structural elements) work together. I also learned about mechanical design and how sensor feedback is used for real-time robot behaviour.

Teamwork and Communication:

The project was collaborative and required clear communication and task division. I was actively involved in team discussions, I regularly shared progress, and I helped my teammates when they had difficulties. This helped me to learn how to work in a group and handle responsibilities.

Reflection

The LEGO SPIKE Prime robotics project provided me with a significant educational experience that enhanced my technical abilities and teamwork performance. I spent most of my time writing code for the colour sensor to track lines which helped me develop my skills in block-based programming and problem-solving. During my work on this assignment, I encountered problems when the robot lost track of the line following an obstacle avoidance sequence. I fixed this issue by modifying the code structure while implementing continuous detection through loop functions. I helped the team redesign the robot to create a more compact design which improved its ability to navigate through mazes. The obstacles I encountered during this project taught me about the critical nature of testing along with the need for iterative development and creative thinking in robotics. My experience working as part of a team enabled me to develop better communication skills and improve my collaboration abilities. Every team member took on distinct responsibilities which required our collective effort to address sensor placement challenges and navigation precision issues. I developed skills to distribute work evenly and listen to team members' suggestions while helping colleagues during difficult moments. The project deepened my robotics and programming knowledge

while demonstrating my preference for practical learning alongside technical issue resolution. I feel more confident moving forward in computing and excited to apply these skills in future projects.

Conclusion

The project delivered an extensive robotics education through mechanical design and programming and team collaboration. The LEGO SPIKE Prime kit enabled us to explore sensors and motors and coding through direct experimentation which improved our understanding of robot-environment interactions. Our team overcame sensor blind spots and structural limitations and code adjustments to enhance robot performance by solving problems persistently. Our practical approach to technical issues emerged from these experiences which helped us develop resilience.

The project achieved complete success by delivering both educational value and effective teamwork. The project improved our technical abilities while promoting teamwork and creativity together with analytical thinking. The acquired skills from this experience including coding and sensor calibration and system design will directly benefit real-world problems and future careers in computing and engineering. The project established a solid base for robotics exploration while motivating me to advance my technological development skills.

Reference's



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Integrating project Assignment

GRADEMARK REPORT

FINAL GRADE

GENERAL COMMENTS

74/100

PAGE 1

PAGE 2

PAGE 3



Comment 1 | Transferable Skills(15)

clearly outlines the goal of the project and connects it to real-world relevance in robotics and computing careers



Comment 2 | Engagement with Literature(15)

mix of LEGO kit information and external references used however could benefit from comparing different strategies

PAGE 4



Comment 3 | Transferable Skills(15)

A visual plan like timeline or Gantt chart would make the workflow clearer.

PAGE 5

PAGE 6



Comment 4 | Knowledge and Understanding(40)

strong account of the line-following logic shown.

PAGE 7

PAGE 8

PAGE 9

PAGE 10



Comment 5 | Cognitive and Intellectual(30)

evaluation is thoughtful and honest. Could improve with metrics, screenshots of trials,



Comment 6 | Engagement with Literature(15)

credible references included and makes links to real-world applications.

GRADING FORM: DC-ACHA4008

ADAM IBRAHIM

74

ENGAGEMENT WITH LITERATURE(15)



11

KNOWLEDGE AND UNDERSTANDING(40)



30

COGNITIVE AND INTELLECTUAL(30)



22

TRANSFERABLE SKILLS(15)

