SYSC 4805 - Winter 2018

COMPUTER SYSTEMS DESIGN LABORATORY

Progress Report

The Maze Solver

Submitted To:

Ana-Marie Cretu

Submitted By:

Amr Gawish 100897952

Nolan Dickson 100956964

Osama Rachid 100899866

Suheib Haboush 100898373

Date:

Friday, February 9th, 2018

Table Of Contents

1.0 Introduction

The purpose of this project is to assemble and implement a CARL5 robot, such that said robot can navigate three mazes of increasing difficulty. The CARL5 robot is a simplistic combination of electronic and structural components, along with an Arduino Nano logic board to control the operation of the device. A high level hardware schematic is shown below, in Figure 1.

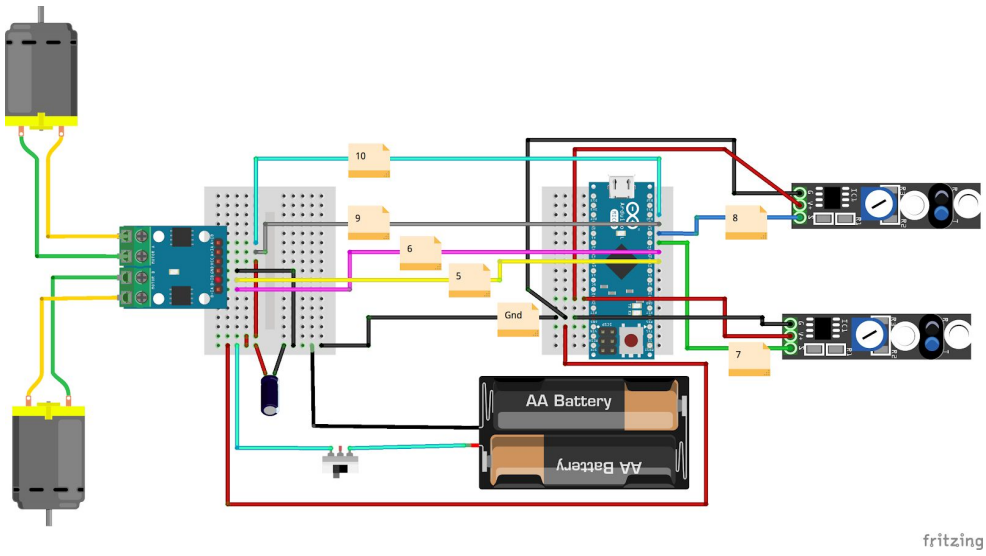

Figure 1: High Level CARL5 Schematic

The two breadboards in the schematic above denote the main components of this machine. The right hand side of the machine consists of the Arduino Nano, where the processing is completed, and two sensors capable of detecting IR, and the absence thereof. The left hand side of the machine consists of the battery, and the two motors, each responsible for powering an individual wheel.

The sensors in the front of the machine detect a black line on a white background (this is how the maze is constructed) and send this information to the Arduino Nano as an input. The logic written to the Arduino Nano defines how this information is interpreted, and can use this information to orient the machine and determine the next steps depending on which sensor is detecting white or black.

Once this information is parsed, The Arduino Nano sends a signal to the motors to perform a corresponding movement. This movement is determined by both the information from the sensors, and the logic programmed onto the Arduino. These two components come together to provide the correct output signal to the motors, and begin navigating the maze.

2.0 Objectives

With this understanding of the purpose and function of the CARL5 robot, a list of objectives can be formed. These objectives are as follows:

1. Assemble and program basic movements for the CARL5 robot.
2. Create a logic system for the robot to follow that can consistently and effectively solve the three iterations of mazes.
3. Document the entire process to maintain organization and cohesiveness while completing the project.

3.0 Team Members

Suhib Habush : ESFP-A

Strengths:

- **Ability to listen:** people person, able to communicate and to relate to other people on an individual level and love paying attention to people. This will help to easily communicate with my members and also with other group members.
- **Efficient and Realistic:** love to experience and see what will be the end result. This will help the group reach the end successfully.

Weaknesses:

- **Fuzzy and unfocused:** being dedicated to a long term project is challenging. This can be as a test so i get rid of this weakness.
- **Lose Interest:** get bored easily, so always need to make the project more exciting to have fun while working.

Nolan Dickson: INTP-T

Strengths:

- **Analysis and Abstraction -** These skills give me the ability to both break down the CARL5 robot into its individual components and understand the purpose of each component, and to look at the entire project from a high level view in order to understand the intended consequences of the interaction between each component.
- **Receptiveness -** This interpersonal skill allows me to effectively communicate with the other members of the group, and discern when someone else's ideas might be more valuable than mine in the context of completing a task.
- **Objectivity -** This skill allows me to step back from my role as an individual in the group and examine the project from a non-biased perspective. This will be valuable later in the term in determining the completeness of our project.

Weaknesses:

- **Disorganization -** This weakness is self explanatory, and will be corrected with thorough documentation and communication with the rest of the group.
- **Independence -** This weakness means that I am not very receptive to impose structure, and like to follow my own schedule. This will also be corrected by following course deadlines and making sure everything is submitted on time.

Role: I will take the lead in the second iteration of maze, ensuring that the CARL5 robot will be able to complete the intermediate maze. Aside from this I will be assisting in Quality Control and revision of group members work, staying involved and offering feedback or suggestions as necessary.

Osama Rachid: ISFJ-T

Strengths:

- **Above and beyond:** one of the unique skill I'm gifted with is that i'm hard worker and that everything has to be perfect. I always try to exceed the expectation to impress my team and to get recognized by others.

- **Emotional and Sensitive:** this skill is useful in a group project where all the members have to work together regardless of their conflicts to accomplish the goal of the project. I will use this skills to make sure that all the group members are happily working together, so everyone give their full potential for the project.

Weaknesses:

- **Fear of public speaking:** a weakness I need to work on is getting comfortable to be in the spotlight between audience and to practice public speaking to express the accomplishment of the project to the audiences
- **Overstressing:** one of my greatest weakness is that i overstress when i'm overwhelmed with work, and this usually affect my performance. I will be controlling my stress by organizing my calendar and setting a due date to stay on track all the time.

Amr Gawish : ESFP-A

Strengths:

- **Bold:** I like to stand out; that is true. I am not that type of person to be holded back, which make me step out of my comfort zone. This skill will make me able to exceed in working through the project, exploring new solutions and ways in order to satisfy the requirements.
- **Practical:** I like to say "what-if", I like to explore all the chances that I have before deciding which one should I go with. That helps in making better decisions and choices.

Weaknesses:

- **Easily Bored:** I am usually easily bored from the things I am not interested in. As I would rather to do something more exciting to do.
- **Sensitive:** Although I don't agree with this weakness. My kind are known to be sensitive, where they are easily affected with words and vulnerable.

Role: I am the third phase leader in the team, where my team and I will work towards getting the CART 5 go through the maze without hitting any of the walls or any other obstacles. On the other hand I will be doing the Software aspect of this project along with my team members aiming to improve our robot.

4.0 Project Plan / Scheduling

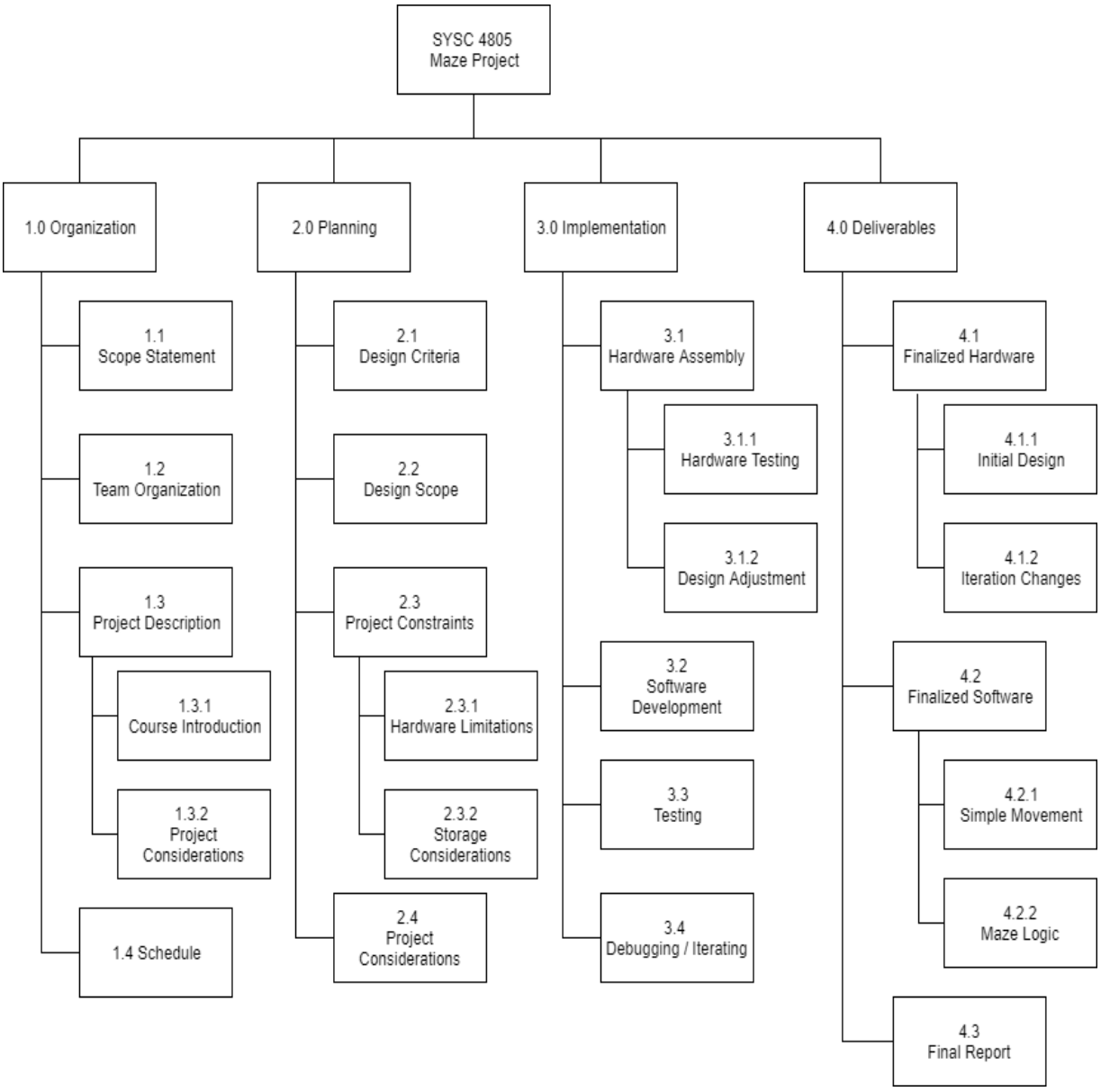

Figure 1: Project Work Breakdown

Table 1: Deliverable/Task List

Task No.	Task	Time Required	Start Date	End Date	Resource	Pre Required Tasks
1	**Organization**	25 days	Jan 25	Feb 9		
1.1	Requirements	10 days	Jan 25	Feb 4		N/A
1.2	Team organization & project planning document	15 days	Jan 25	Feb 9		1.1
2	**Planning**	30 days	Feb 16	Mar 5		
2.1- 2.4	Design document	15 days	Feb 16	Mar 1		1.2
2.2	Project progress report	15 days	Feb 20	Mar 5		2.1
3	**Implementation**	83 days	Jan 12	Apr 10		
3.1	Hardware Assembly	5 days	Jan 12	Jan 17		2.1
3.1.1	Hardware Testing	3 days	Mar 10	Mar 15		3.2
3.2	Software Development	60 days	Jan 15	Mar 15		2.1
3.3 - 3.4	Software Testing	15 days	Mar 25	Apr 10		3.3
4	**Final Deliverables**	35 days	Mar 25	Apr 25		
4.1	Final project demonstration	15 days	Apr 9	Apr 25		3.4
4.2	Final project presentation	10 days	Apr 9	Apr 19		3.4
4.3	Final report	10 days	Mar 25	Apr 5		4.2

From the previous Table 1 we can visualise the tasks and requirements to show in a gantt chart to look as shown in Figure 2 below. Where it can be seen which tasks are being done between certain times, which makes the road map for the project.

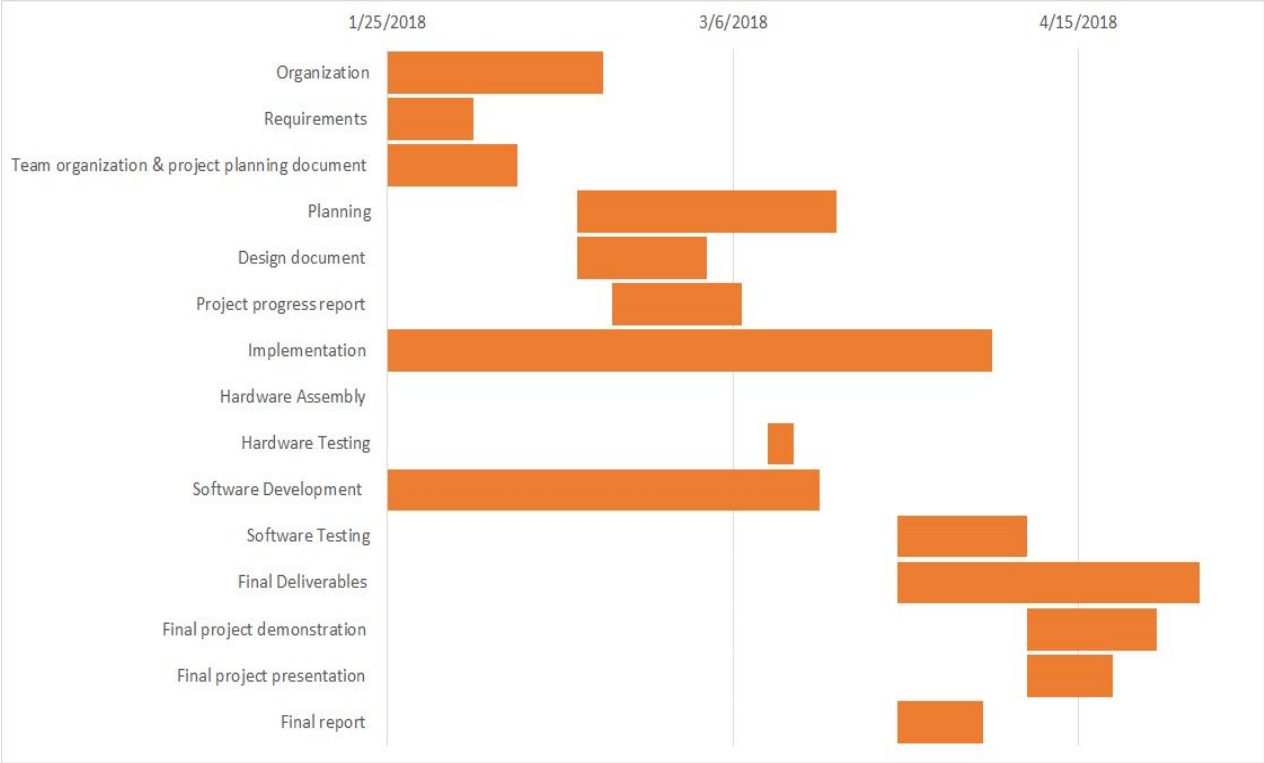

Figure 2: Road map / project schedule

5.0 Risk Management / Register

Table 1: Risk Register

Number	Category /Type	Risk Events	Probability	Impact	Priority	Response	Owner
Risk 1	Hardware	- Broken parts - Hardware not responding (unfunctional)	Med	High	High	Contact the lab technician in order to get a replacement arranged	Nolan Dickson Amr Gawish
Risk 2	Software	- port errors/ in use - not compiling - sensors not giving right data	Med	High	High	- close ongoing process - calibrate sensors	ALL
Risk 3	Project Management	- Behind schedule, running out of time. - Team disagreements and conflicts - insufficient budget	Med	Med	High	- push the team members to work - solve the disagreement if possible. - talk to the professor	Amr Gawish

6.0 StakeHolders

Table 3: professor stakeholder

Stakeholder Name	**Title**
Ana Maria Cretu	Course supervisor (predefined)
Stakeholder Role	**Contact Information**
Project Manager	Office: Mackenzie Bldg. Room 4476 Email: acretu@sce.carleton.ca
Stakeholder Requirements	
Provide team members with requirements. Provide feedback to the team at the end of the project in the report and presentation.	

Table 4: Students

Stakeholder Name	**Title**
Amr Gawish Nolan Dickson Osama Rachid Suhain haboush	Students / team members
Stakeholder Role	**Contact Information**
Team members	Email: amrgawish@cmail.carleton.ca Email: nolandickson@cmail.carleton.ca Email: osamarachid@cmail.carleton.ca Email: suhibhabush@cmail.carleton.ca
Stakeholder Requirements	
Work as a team in order to get the requirements done. Provide feedback to the other team members in order to improve performance of the team.	

7.0 Progress Status

In this section we will be discussing what is our progress that was achieved, What does the robot do, what does not the robot to. As well as we will be discussing what is the work on progress, what is the future work to be completed.

7.1 Work Completed

The robot was assembled using different hardware pieces, nano arduino, two IR sensors, a specifically designed plastic board that holds everything together, two wheels, two motors and a power supply. They are all put together and connected as shown in figure 3.

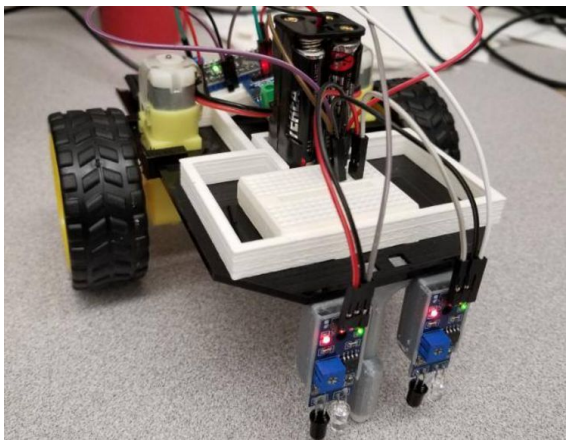

figure 3: the CARL5

As mentioned previously there are electrical components such as the arduino, sensors and motors. These electrical components of the robot are connecting together, figure 4 below shows how they are connected.

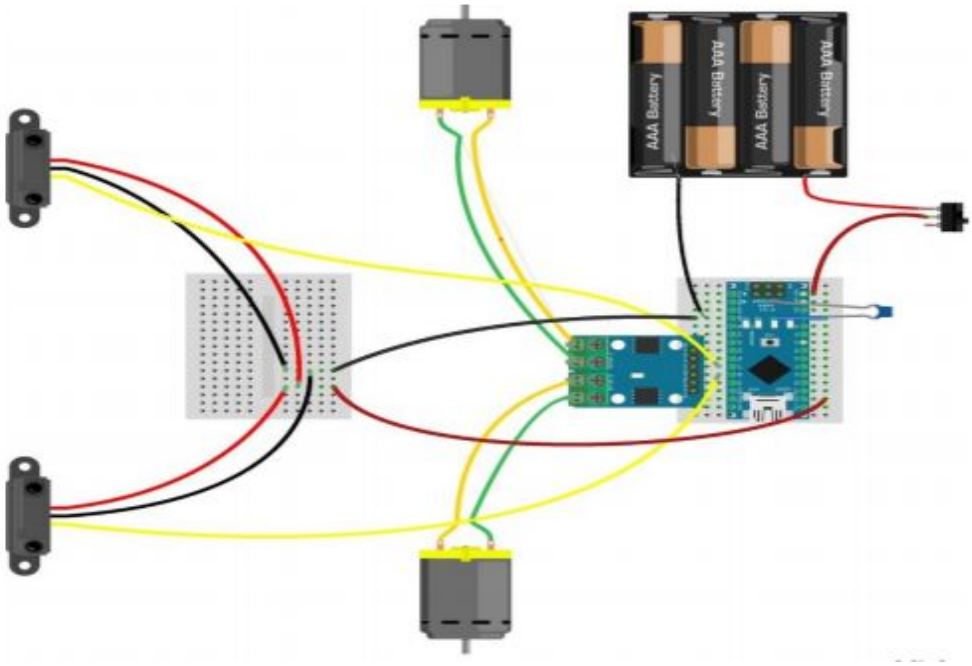

Figure 4: the wire connections for CARL 5

Lastly from the hardware perspective, an extra IR sensor was added between the two original sensors where it will help in detecting the line which will be explain shortly.

From a software perspective, the main objective of this phase is to make the robot capable of following the line drawn on the ground. At this stage the robot is able to follow a straight line, as well as it follows curves. The robot also deals nicely with dead ends where it just turn a full cycle until it find the line back. The problem comes to the sharp turns, the robot gets stuck between weather to go right, left or continue straight.

From a technical perspective the three sensors are meant to read real time data from the environment detecting the line. The sensors should read 0,1,0 for right, middle and left sensor respectively, this is when the wheels will both start moving forward. When the sensors read 0,0,1 for example that represent a curve were in that case the curve is going to the left, this will cause the right wheel to spin backwards and the left wheel to

spin forward until the middle sensor find the line. That movement will get the robot back on track. When all the sensors are 0,0,0 that means the line is not there anymore, which will cause the car to start spinning in a 360 motion until it finds the line again.

7.2 Work to be Completed

There are several parts that need to be added to the Robot to run properly. First, Sharp turns make the robot confused when turning right or left and it will try to do the sharp turn but still fail and go outside the black lines. So the main step is to make it do sharp turns. Furthermore, the robot has to be aware of its surrounding and operate regarding that matter. So the next step is the robot avoid hitting anything around it. The robot works using these sensors and for us to make sure this step is working, more sensors must be added and configured in the right way to help this robot avoid physical barriers. For example, in this figure below these woods are an example of a physical barrier that he robot must avoid hitting and be able to move and reach the other end.

In the next step, one of the most important parts of this project which is being able to deal with dead ends. Instead of making so many turns, the robot has to do a turn around but without leaving the maze line it was on. Also, whenever the robot does a 180 turn, it should not worry about anything other than doing this 180 turn without hitting any barriers. Also what is going to help a lot with this step is the configuration of the old sensors and the new added sensors to this robot. Moreover, in this figure below, the robot must be able to operate in the fast way possible but also covering all the paths and avoiding any barriers. So this robot must find the shortest path to the end point or cover all the paths in the fastest time possible with efficiency to solve this maze.

Finally, this robot must be able to demo the maze in the lab more than once and count the shortest time, and focus on getting a the robot to finish the maze in a short time but also making sure its doing the right steps while moving in this maze between these lines

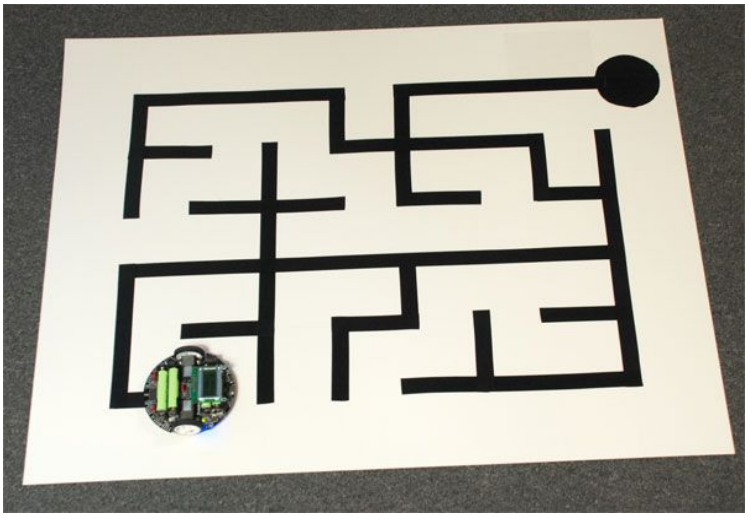

figure 5: an example of a robot solving a maze

7.3 Problems

Through the development process couple of problems were faced such as miss wiring in the hardware connection which caused the elements not to respond to the software commands. Another problem is that the sensors are not calibrated perfectly, that affects the code as the code won't be detecting real time changes of the line, which will cause either a delay or a wrong information to be analysed, moreover wrong actions will be made. Lastly, although the wheels are given the same power, the two wheels don't go at the same speed and that causes a extra tilt in the forward direction of the robot.

8.0 Conclusion

The first phase of this project is almost done where the robot can follow the black line of the ground including most of the turns and edges. There is a lot that have been accomplished through the development phase of this project, but there is more yet to be completed and even more problems to overtake.