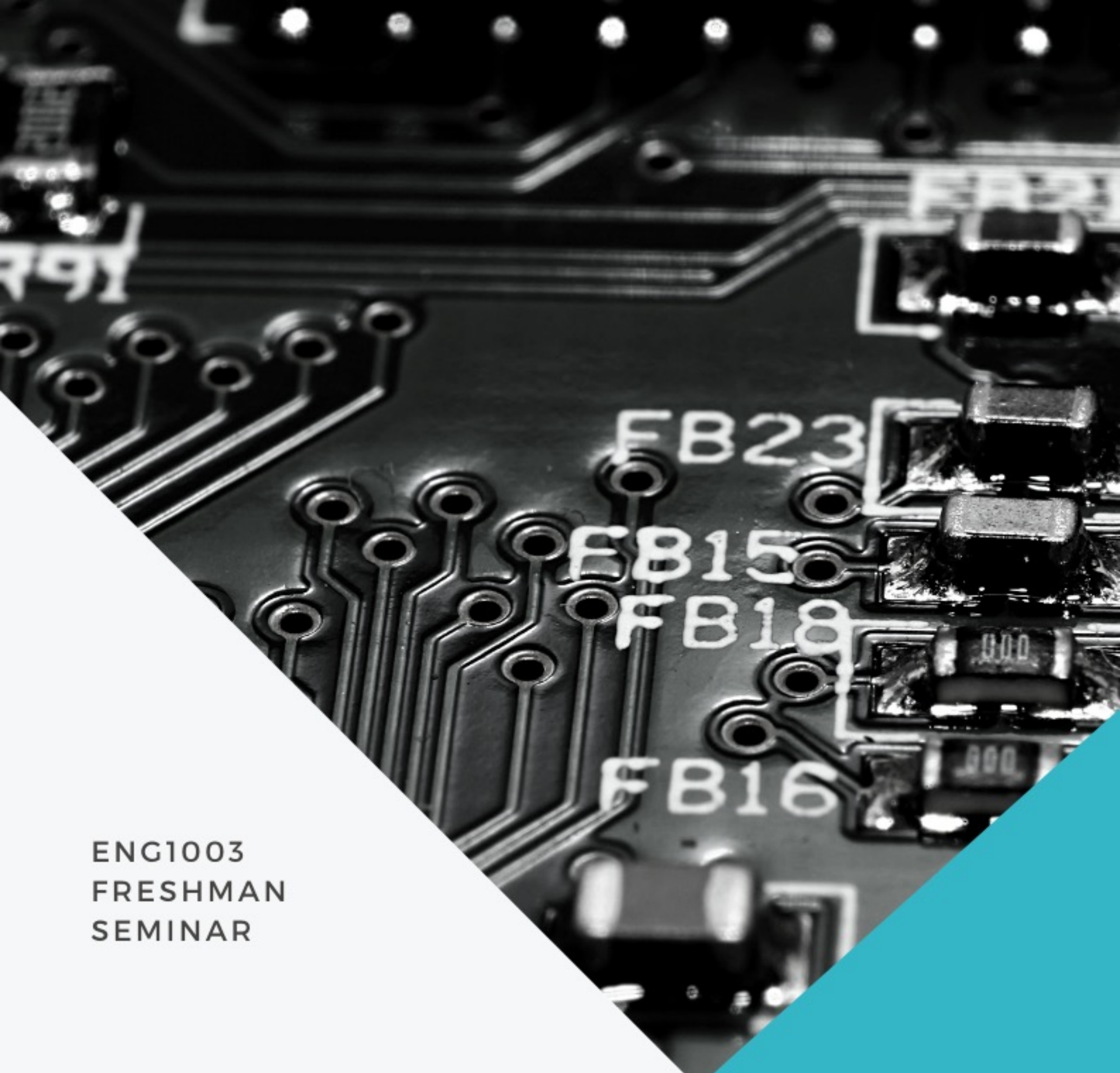


ENG1003
FRESHMAN
SEMINAR

EIE PROJECT

AI ROBOT CAR REPORT

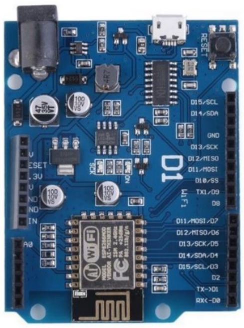
OCTOBER · 15 · 2019

Introduction

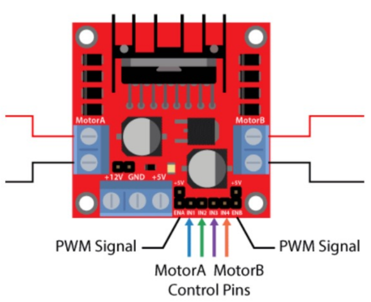
The application of artificial intelligence is ubiquitous and progressively prevalent in our daily lives. As a part of the faculty of engineering or a part of the faculty of computing, the EIE project: Al Robot Car has provided us with increased exposure to this technology and has prepared us for more organized handling of upcoming topics in the future.

This project aims to assemble an AI robot car which is able to run a lap between 2 minutes and win a track competition ultimately. To achieve the purpose, improvements of hardware design and software logic (programming) are promoted as a result of group deliberation and management.

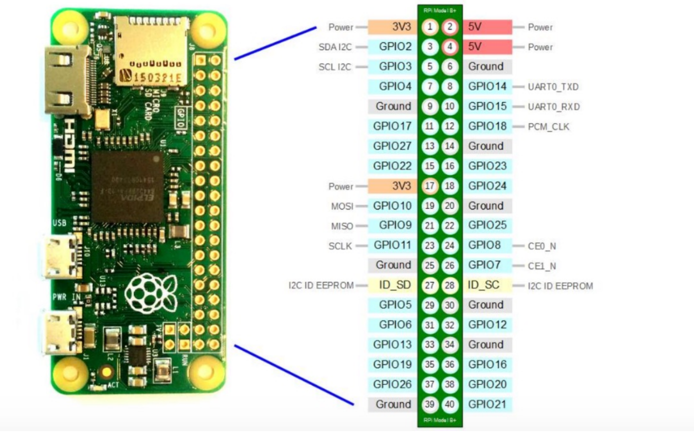
D1-card



L298N



Raspberry Pi Zero

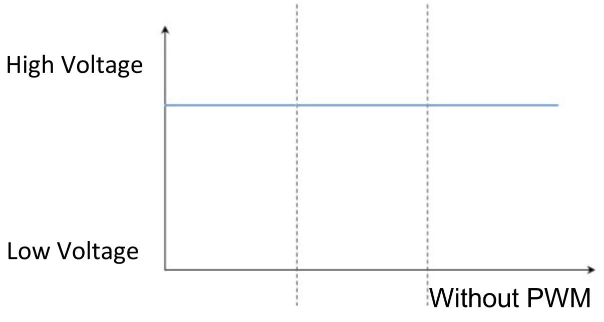


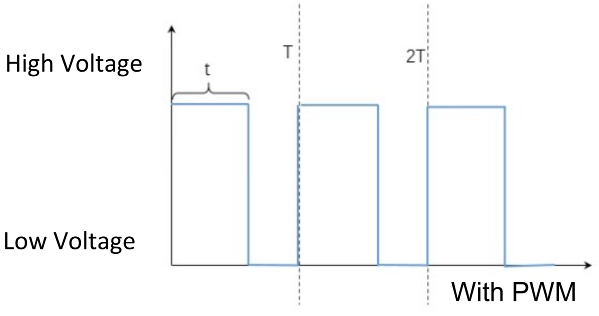
Hardware Design

L298N

The L298N Driver is a high voltage, high current dual ful bridge driver designed to accept standard TTL logic levels and drive inductive loads such relays, solenoids, DC and stepping motors. Two enable inputs are provided to enable or disable the device independently of the input signals. The emitters of the lower transistors of each bridge are connected together the corresponding external terminal can be used for the connection of an external sensing resistor.

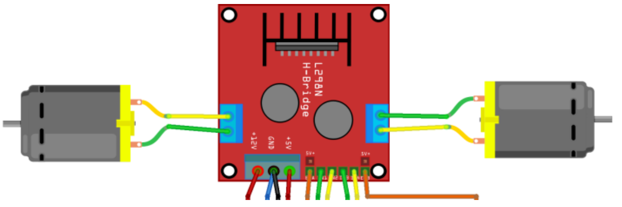
L298N connected to the D1 card, Receiving Pulse width modulation, PWM signal to (IN 1,2,3,4) in order to control the direction of the car. The diagram show how the voltage changes during PWM signal input.





Direct Current Machine	Spinning Direction	IN1	IN2	IN3	IN4	enable	enableB
M1	Forward	High	Low	/	/	High	/
	Reverse	Low	High	/	/	High	/
	Pause	Low	Low	/	/	High	/
M2	Forward	/	/	High	Low	/	High
	Reverse	/	/	Low	High	/	High
	Pause	/	/	Low	Low	/	High

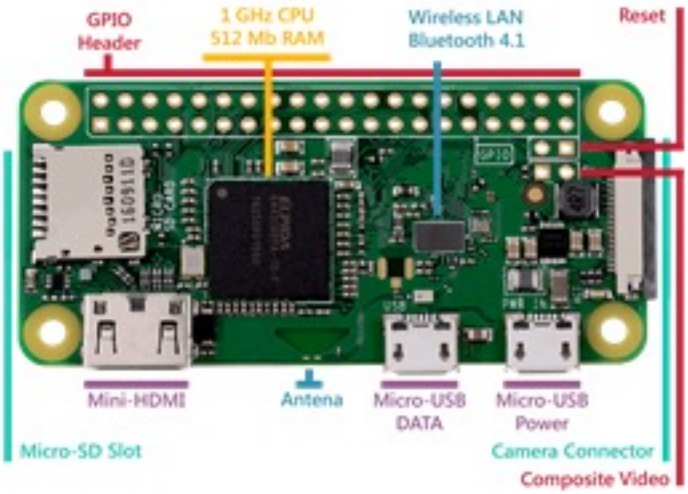
Connection: Using fritzing to show how the motor and the L298N motor driver are connected.



It is connected to the two DC motor thus each wheel separately controlled the speed of each wheel).
connect to the supply voltage e.g. the batteries(get electricity supply to move the motor)
This module allows the 3.3V signals from the Arduino to be amplified to the 12V needed for the motors. It receives pwm signal from the d1 card and change the input voltage to the motor such that the wheel will spin at different speed and thus control the direction of movement of the car.

Raspberry Pi Zero and the raspberry pi camera module

Raspberry pi is a low-cost, small computer that can be plugged into a monitor and use keyboard and mouse.
Power is provided through a microUSB connector. Voltage supplied to themicro-USB power port should be in the range of 5-5.25V. The Raspberry Pi Zero has an onboard camera connector. This can be used to attach to the raspberry pi camera module.



First the Raspberry Pi Zero is plugged into a monitor and keyboard and find the MAC address of it and connect to VNC viewer, a 5.0V power bank with a microUSB connector is also connected to the micro-USB power port to supply power. After the MAC address is marked down and the VNC viewer is connected, the connection to the keyboard and monitor are dismantled. Then the Raspberry Pi Zero is connected to the D1 card using wires to provide power to the D1 card for the upload of the blocky program.

The raspberry pi camera module will be connected to the camera module port/ camera connector of the Raspberry Pi Zero and will keep on capturing images and send the signal to the Raspberry Pi Zero.

In the final product, the raspberry pi is not connected to any monitor nor keyboard and is connected to 3 hardwares, the raspberry pi camera module, the D1 card and the 5V power bank. It receives the image from the raspberry pi camera module and recognize the number, then it sends signal to the D1 card to initiate the corresponding program stored.

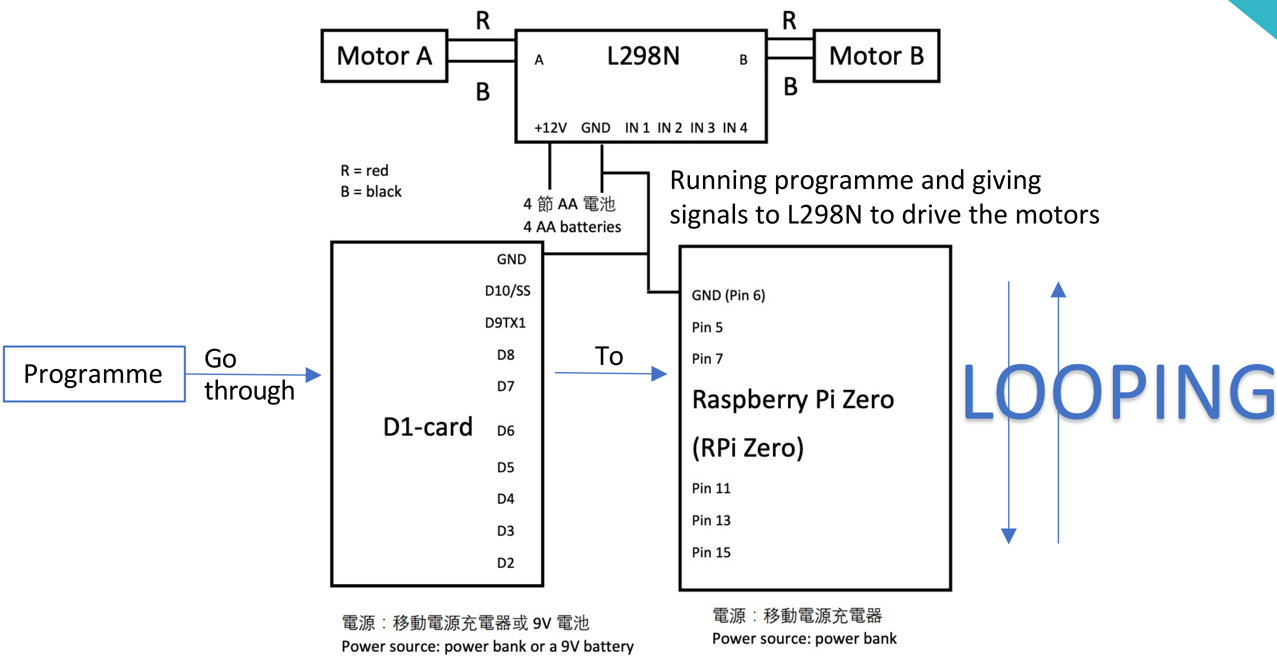
Battery

In this project, we use 4 AA batteries as power supply for the motor driver and use portable battery charger to supply power for the D1 card and Raspberry Pi and the camera.

D1 Card

D1 Card is an Arduino board which is used to receive data and program from the computer using wifi connection as well as emitting signal from other devices and giving signal to different devices such as motor driver L298n to push the motors in this project. Therefore, it stands for a transfer station.

In the following diagram, the connection of the D1, motor driver and Raspberry pi with Raspberry pi web camera is shown below.



連接 Connections:

一端 One End	另一端 The Other End	一端 One End	另一端 The Other End
IN 1, L298N	D6, D1-card	Pin 5, RPi Zero	D4, D1-card
IN2, L298N	D10/SS, D1-card	Pin 7, RPi Zero	D2, D1-card
IN3, L298N	D9/TX1, D1-card	Pin 11, RPi Zero	D3, D1-card
IN4, L298N	D8, D1-card	Pin 13, RPi Zero	D5, D1-card
		Pin 15, RPi Zero	D7, D1-card

The D1 Card is used to store the program of and giving out signal. The program and the logic will be shown on the software part.

Improvement

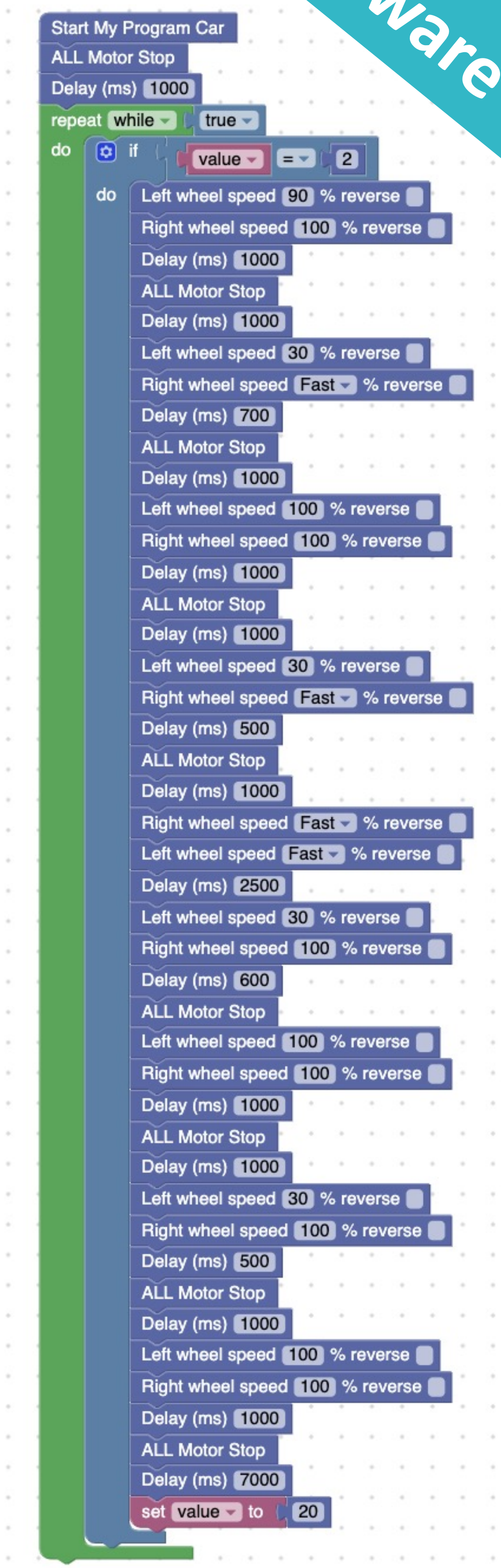
In terms of the improvement of the hardware part, we found out that the voltage from the batteries could change from time to time because of the unstable voltage supply of those batteries. Under this circumstance, the speed of the wheels may be differed from different voltage supply because the program is fixed. So we need to adjust the program from time to time because of the instability of the voltage supply from the batteries. Then, we want to improve the power supply system like attaching voltage stabilizer to stabilize the system and then we can apply different program to this AI robot car.

Software Logic

Use vnc viewer to determine '2' as a trigger for the whole program.

Since the car is difficult to run in a perfect oval, we dicide to run the car in rectangle. Therefore, we need to provide delay time at the four corners.

After the car runs through all the program, we set the value to '20' so that the program will not repeat.



Procedure and explanation

1. First, the car should run in a straight line. The right wheel speed is slightly higher than left wheel for 10% so that the robot car will not need to turn at such a high angle, 90 degrees.
2. “All motor stop” is required in order to start the next step.
3. Set the right speed to “fast” so that the robot car can turn left. However, the speed of left wheel should not be too low since the turning angle may be too large. The total spinning time last for 0.7second. Then, the car runs straight for 1 second.
4. The turning of the car is same as the previous one.
5. Both wheels should run at fast speed in order to pass through the length of the rectangle. It lasts for approximately 2.5 seconds.
6. The next two right turns and the method that the robot car runs through the width of the rectangle are basically the same as the original one. However, due to the fact that every situation is not exactly the same as expected, the time that the car spends on turning is slightly different. Consequently, small changes are required for every run.
7. Finally, the robot car goes straight for 1 second with both wheels reach to maximum speed and then passes through the finish line.
8. The function for the last “7 seconds” delay is to identify that the whole cycle is done.

Conclusion

The reason why we chose to let the robot car runs in rectangle rather than a perfect oval is that it takes more time to run in curve instead of in straight line. Even though sometimes one wheel or even two wheels are outside the track, it is acceptable.

Furthermore, when the robot car runs in curve, the total distance is longer, and if the speed is too fast, there is a chance that the car will go imbalance. However, if the robot car run straight forward, the speed can be quite fast, and the car can be stable. The program that the car runs in rectangle is much easier than the oval one. The program is kind of simple, and we think the main focus we should put is in the four corners. If the turning goes well in the four corners, the car can definitely run in a correct direction.

Consequently, we put a lot effort on the 4 corners, and try to figure out what is the best speed between two wheels and the perfect delay time when the car turns right. In conclusion, the stability and the simple program is the main reason why we choose to let the robot car runs in a shape that is nearly a rectangle.

Project Management

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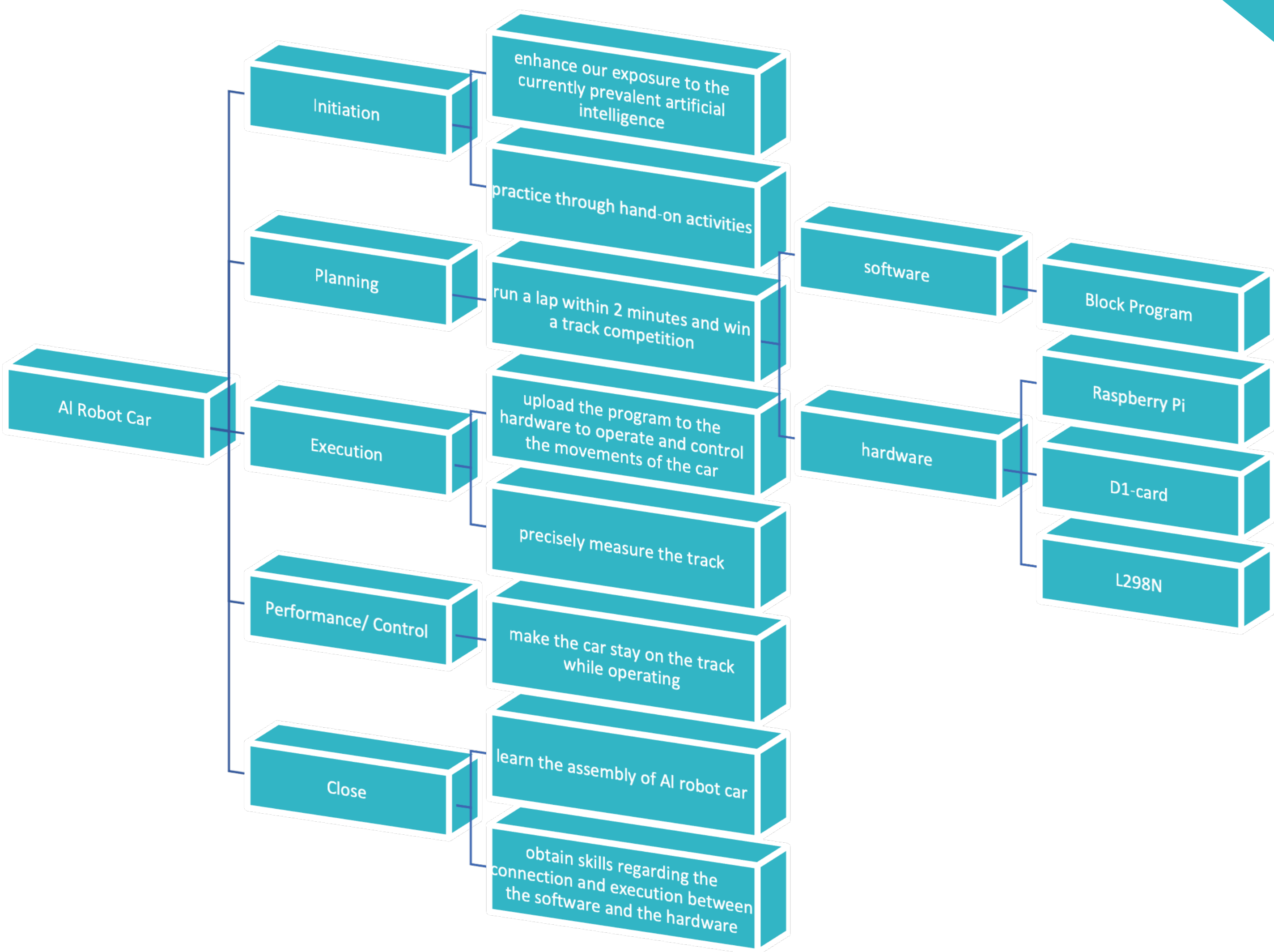

Conclusion

Under myriad collaboration and examination, we have established the AI robot car in our most ideal form. We have paid efforts in a few areas for instance, hardware design and software logic to improve the performance of the AI robot car. In the progress of the project, we have fostered the problem-solving ability and global outlook.

During the hardware improvement, our problem solving skills are gradually developed. We realized that the unstable voltage supply of batteries may breed varied wheel speed at first. Our first approach is to improve the program which is fixed fixed at default. Then we noticed that program improvement cannot solely alleviate the problem thus we turned to the power supply system. We attempted to stabilize the system through the attachment of a voltage stabilizer and eventually tackled the problem.

Ranging from Taiwanese to Hongkonger, we have formed a group with varied cultures and languages. Fortunately, our group members can communicate fluently in English or Mandarin, so every member can play their role as a group and discuss without the language barrier. Whenever we do not understand what others are deliberating, we will proactively join the conversation by simply listening and asking what are the contents concerned.