Semi-Autonomous With

Directional Navigation Control

By

Ch'ng Eu Gene

A REPORT
SUBMITTED TO
Universiti Tunku Abdul Rahman
in partial fulfilment of the requirements
for the degree of
BACHELOR OF INFORMATION TECHNOLOGY (HONS)
COMPUTER ENGINEERING

Faculty of Information and Communication Technology
(Perak Campus)

JUNE 2015

REPORT STATUS DECLARATION FORM

Title: _____

_____

_____

Academic Session: _____

I _____

(CAPITAL LETTER)

declare that I allow this Final Year Project Report to be kept in
Universiti Tunku Abdul Rahman Library subject to the regulations as follows:

1. The dissertation is a property of the Library.
2. The Library is allowed to make copies of this dissertation for academic purposes.

Verified by,

_____ _____

(Author's signature) (Supervisor's signature)

Address:

_____

_____ _____

_____ Supervisor's name

Date: _____ **Date**: _____

Semi-Autonomous with

Directional Navigation Control

By

Ch'ng Eu Gene

A REPORT
SUBMITTED TO
Universiti Tunku Abdul Rahman
in partial fulfilment of the requirements
for the degree of
BACHELOR OF INFORMATION TECHNOLOGY (HONS)
COMPUTER ENGINEERING

Faculty of Information and Communication Technology
(Perak Campus)

JUNE 2015

DECLARATION OF ORIGINALITY

I declare that this report entitled "**SEMI-AUTONOMOUS WITH DIRECTIONAL NAVIGATION CONTROL**" is my own work except as cited in the references. The report has not been accepted for any degree and is not being submitted concurrently in candidature for any degree or other award.

Signature : _____

Name : _____

Date : _____

Acknowledgement

I would like to express the deepest appreciation to all those who provide the possibility to complete this report. First of all, I would like to thank my supervisor Mr Lee Wai Kong for the valuable guidance and advice. He inspired me to work in this project. He is always willing to teach me knowledge and answer any question about the project. This project may lead me to my first step to establish a career in embedded software design.

Next I would like to thank my lecturer Dr. Liew Soung Yue and my tutor Mr Ooi Joo Onn who teach me the unit of Introduction to Inventive Problem Solving and Proposal Writing. They teach me how to write proposal and some skills on writing a proposal.

Finally, I want to thanks my parent and my family for their love and understanding throughout the course. They talk to me and give me fully support when I feel stress

Abstract

Ideally an intelligent autonomous car would have an automatic pilot, which can park itself and guide the vehicle through dense traffic in towns and at high speeds between towns. This project focuses on developing an Arduino based robot with GPS to get to a coordinate with the help of a compass to get the heading. In order to reduce traffic congestion in cities, we have came up with an idea to integrate lamp post with wifi modules and sensors to detect whether is there any traffic jam or slow moving traffic then send its current road condition to a server. If there is traffic congestion in that area, the server will then communicate with other vehicles to reroute to avoid getting caught in the jam. The autonomous robot will be equipped with an ESP8266 wifi module to communicate with the server, a GPS ublox 6m module, motor driver to control the direction of the robot, a compass HMC 3883L to get the heading in degree and an Arduino to control the robot. The server will collect all the data through an ESP8266 wifi module and stored in a database for analyzing the traffic condition in the particular area.

Table of Contents

List of Tables

List of Figures

List of Abbreviation

MHz	Mega Hertz
mA	milli Ampier
V	voltage
I2C	Inter-Integrated Circuit
UART	Universal Asynchronous Receiver/Transmitter
PWM	Pulse Width Modulation

Chapter 1.0: Project Background

1.1 Problem Statement and Motivation

Traffic congestion is one of the main problems we overcome each day in cities and sometimes in suburban areas. It also happens on public holidays where everybody rushes back to their hometown or when people are rushing to work and back from work. It occurs when the number of vehicles on the road demands for a greater space than the available road capacity. There are many other situations that cause or aggravate congestions for example, traffic incidents, roadwork, and weather events. There are a few things that we can do to prevent traffic jams like car pulling, travel by public transport or widen the road.

The effects of traffic congestion may seem small but what we may not realize is the extend of the effects traffic congestions can have. First of is the delays. During the morning when everybody is already stressed caused by the traffic because that will cause them to late for work. Furthermore, when workers are late for work, manufacturers tend to lose money because with workers late for work, production can't run as expected. And at the end of the day, when everybody is tired from work and wanting to get home as quickly as possible, there is yet another frustrating traffic preventing them. Next is the fuel consumption and pollution caused by traffic congestion. The stopping and moving in traffic jams burns fuel at a higher rate than in a smooth driving condition. Thus will increase the fuel consumption costs for commuters and will also produce more emission that released by vehicles.

Besides, road rage can be an effect of traffic congestions. Road rage is a senseless reaction to traffic when someone is not driving as fast as the person behind him thinks he should, or if someone is selfish and impatient to get to a destination first, they will cut queue or drive recklessly, and most often rage by intentional tailgating, shouting and scolding, retaliatory traffic maneuvers that not only cause danger to oneself but also put danger to other traffic users.

This project was designed to prevent or help in easing the congestion of traffic in the near future.

1.2 Project Scope

As this project is an autonomous robot project, its main functionality is to guide it self from a point to a given waypoints. First thing we need is a GPS module. With the GPS, we can get the longitude and latitude of its current position then by using the coordinates of the waypoint to calculate the distance it must travel in order to reach its destination. Next we will need a compass to correctly get its heading and then calculate the heading that it needs to head to get to the coordinates. Besides, we will need to set up the WiFi module for the lamppost, robot and server in order for them to communicate with each other to make this project run. Next is the ultrasonic sensor on the lamppost, which can detect whether is there any vehicles that stop next to it or is there slow moving vehicles.

1.3 Project Objectives

This project is aimed to develop an Arduino based robot with GPS to get to a coordinate with the help of a compass to get the heading. In order to reduce traffic congestion in cities, we have come out an idea to integrate lamppost with WiFi modules and sensors to detect whether is there any traffic jam or slow moving traffic then send it current road condition to a server. If there is a traffic congestion in the area, the server will then communicate with other vehicles to reroute to avoid getting caught in the jam.

- Build robots that can perform autonomous navigation using appropriate sensors.
- Integrate Wifi connectivity and GPS module to the robots.
- Construct IoT module for traffic infrastructure, which is equipped with WiFi module and sensors to detect various situations on the road.
- Webserver program to collect and analyze data, at the same time communicate with IoT module on traffic infrastructure and robots.

These are the objectives that will be achieved at the end of the project. The basic functions will be implemented first followed by the advanced task.

1.4 Background Information

1.4.1 Autonomous Car

Autonomous car is an autonomous vehicle which is capable of driving a car automatically without a human. It is capable of sensing its environment and navigating through obstacles on its own with the help of radars, lidar, GPS and computer vision. The most famous autonomous car to date is the Google driverless car. The project which was led by Google engineer Sebastian Thrun, won the 2005 DARPA Grand Challenge and got passed a law on June 2011 for allowing autonomous cars in Nevada. The technology used is a light radar system and also a range finder which is a Velodyne 64-beam laser allowing the vehicle to generate a detailed 3D environment of its surroundings (Google Driverless Car 2014).

Google's autonomous car was designed to drive around the globe itself while generating 3D maps of cities. Autonomous cars can almost prevent accidents as there is lack of human error whilst driving providing that the computer in the car don't malfunction or crash. There would be no need to get a pass for driving test as everyone would be able to drive. Besides, parking a car in a shopping mall is much easier with an autonomous car because after getting off the car, it will find a parking lot by itself and even ease disabled or elderly people when going places.

Other than autonomous car, there is also semi-autonomous car which means the car acts independently but still needs a human to control. One of the famous semi-autonomous car is from Toyota. Its semi-autonomous vehicle uses 2 main key systems which are Lane Trace Control and (LTC) and vehicle-to-vehicle communication (V2V) (Michael Austin 2013). LTC helps to maintain the car in the center of the lane by using camera and guiding itself with the white lines of the road and using GPS map data to follow curves and slowing down the speed of the vehicle to ensure safe cornering speed. V2V is a system to not only keep a safe certain distance between 2 cars but also share data about the speed, acceleration, and braking so that when a front vehicle slows down, the vehicle behind can detect the change of acceleration and

can react faster than a human being can. This results not only to fuel saving driving, but also fewer traffic jams.

1.4.2 Microcontroller

Microcontroller is a single integrated circuit consisting of a processor core, memory, and programmable input or output peripherals. Microcontrollers are often used as embedded systems because it only has to perform a specific task with or without an input or output device.

Microcontrollers are easy to use because after programming the chip, even the power supply is turned off, the control logic stores the program and will still functions after the power is turned on. Besides, microcontrollers are cheap and therefore microcontrollers can be seen in almost everywhere.

The microcontroller that we are going to use is Arduino Uno and Arduino Mega2560. Arduino Mega 2560 comes with 54 I/O pins which include 15 PWM output and 16 analog input pins. Whereas Arduino Uno comes with 16 I/O pins which include 6 PWM output and 6 analog input pins. They both are using 5v as operating voltage, the input voltage for both microcontroller are recommended between 7-12v.

In this project, 4 Arduino Uno and 1 Arduino Mega is used. 2 of them are used to control the autonomous robot, another 2 are used to control the lamp post, which are programed to communicate with the server, and the last microcontroller is used process the data and communicate with the lamppost and the robot and also store into a database.

1.4.3 WiFi Module

WiFi is wireless local area network that allows electronic devices to link with the network without any wire. It usually is using 2.4GHZ as the radio frequency.

Starting from 2007, embedded WiFi Modules have become available to real-time OS and also allow to wirelessly enabling any devices that communicates via serial port. WiFi can allow many devices to connect with each other and communicate much easily without any hard cable needed.

1.4.4 H Bridge

H Bridge is used to enable the voltage to be applied across a load in either direction. H Bridge is a circuit which normally used in robotics to allow DC motor to move. In this project, H Bridge will be used to control the mobile robot's movement.

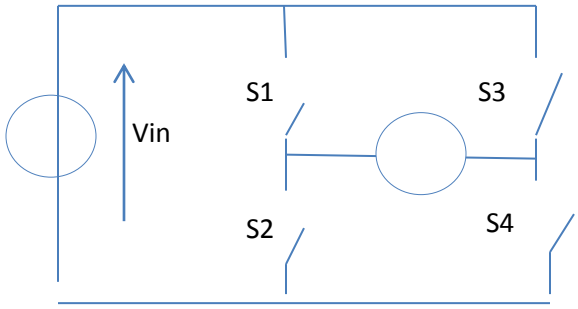


Figure 1.4.4-F1 Structure of H Bridge

H Bridge is built with 4 switch, when the first, S1 and the forth, S4 switch are close and the second, S2 and third, S3 switch are open, a voltage will apply across the motor. When S2 and S3 are close and another 2 switches are open, the voltage is reverse; it will allow the motor move opposite position.

To avoid short circuit on input voltage source, S1 and S2 is not allow to close at the same time, the principal goes vice versa to S3 and S4.

1.4.5 Compass

Compass is a component that is used for navigation and also orientation that can show the direction by using geographic cardinal directions. Compass can differentiate the direction of north, east, south and west. North is corresponds to 0 degree, east is 90, south is 190 and west is 270. In this project, 3-axis magnetometer HMC5883L compass is used to find out the heading of both of the autonomous robot and decide which direction they should go. The digital compass functions by using X and Y axis to calculate the heading then convert it from raw data into

degree format. In order to determine the rising angle or declining angle of the module, the Z, X and Y axis will be needed to calculate.

1.4.6 Global Positioning System

GPS is a navigation system that uses the space-based satellite navigation system that can provide a coordinates and time information in all weather conditions. In order for a GPS to get information from the satellites, the antenna of the GPS module must be placed in an open door area. Besides getting the location information, GPS receivers can also compute the velocity, altitude and wind speed. Most of the GPS out there needs at least 4 satellites to get a more precise coordinates. The coordinates received by GPS is in latitude and longitude (degrees, degrees-mins and degrees-mins-secs).

1.4.7 Ultrasonic Ranging Module

Ultrasonic sensors are sensors which generate a high frequency sound wave and evaluate the echo received back by the sensor when the high frequency sound wave hits an object. Then distance is then calculated by

Distance to object = (T x Speed of Sound) / 2

Where T = time between when an ultrasonic wave is emitted and when it is received

The ultrasonic sensor that we are going to use is a HC-SR04 ultrasonic sensor. Its range of detection is 2cm to 400cm which is suitable to detect objects at the front of the car.

Chapter 2: Literature Review

2.1 Google Driverless Car

Google driverless car is a project by Google X which also known as Google Self-Driving Car, SDC. It is a new development technology of autonomous cars, and it mainly for electric cars. The software that power the Google's car is known as Google Chauffeur. This project is currently under responsible of Google engineer who name Sebastian Thrun, director of Stanford Artificial Intelligence Laboratory and also as co-inventor of Google Street View.

The Google car consist a 64-beam laser that mounted on the top of the car which used as a range finder. The laser is function to help the vehicle to generate a 3D map of the surrounding. After generate the 3D maps, the vehicle will then combine all the maps together with the world maps, then it will process with the maps and allow the vehicle to drive on its own.

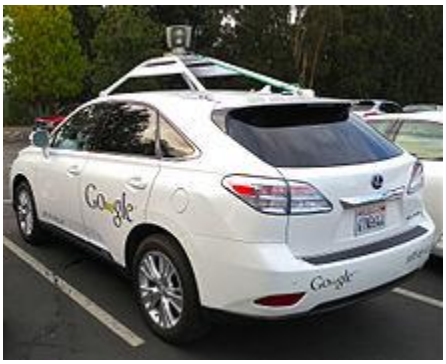


Figure 2.1-F1 Google Driverless Car

Google Driverless Car is a kind of autonomous car.

Advantage of autonomous car

- Reduces human error while driving, result in decreasing possibility of accident occurring.
- Autonomous car are allow to park nearer due to the accuracy of the sensors, sensors are always more accurate than human self-estimation.
- Disabilities will not be a reason in driving.
- Get to the destination with shortest time, the car is able to identify the shortest route.
- Save time, during the journey, the drivers can spend their time on other things.

2.2 Adaptive Technology

Adaptive signal control is one of the technologies that not many will notice compared to driverless car but will help in reducing traffic congestion and accommodate in changing traffic patterns. In order to accomplish adaptive traffic or signal control, the system must consist both hardware and software. Rather than having the conventional traffic control which is preset with a certain time for green light and red light even though in a junction where there is no cars. By using adaptive technology like setting up an electromagnetic loop on pavement, cars that drive through the loop activates the sensor prompting the traffic light to stay much longer for a certain period.

In recent years, more sophisticated equipment is used to manage the traffic signals. Rather than changing the timing at intersections every few years, engineers have developed an adaptive system that uses algorithm that work in real time that figures out how much traffic is moving and then adapt automatically to change the timing of the signals. While the cost of implementing adaptive systems has gone down over the years, it still can be quite expensive –ranging from $30,000 to $50,000 per intersection but the results of it is cost-effective because they can reduce delays anywhere from 5 percent to 40 percent (Jenni Bergal 2015 March 13).

2.3 Car 2 car Communication

Car to car is a technology that relies on GPS systems and dedicated wireless network which allows car to automatically linked to another car and able to exchange information about parameters such as their respective direction, position and speed. Furthermore, by installing transmitters in road infrastructures such as traffic signals and road signs would further extend of this network. One of the car companies that use this technology is Volvo. The potential benefits of using this technology is green light optimum speed advisory, emergency vehicle warning, road works warning, slow vehicle warning, weather information, in-vehicle signage, motorcycle approaching indication and red light violation warning.

Information from the traffic light can be informed to a vehicle to another vehicle advising its driver to optimize the speed in order to pass through green lights, thus allowing the driver to

avoid unnecessary braking for red. Besides, when a car is caught in a jam, it can inform other vehicles to avoid that route. In addition, vehicles can get warnings about any bad weather such as heavy rain, snowfall or icy roads. There are many things that can be done by implementing this car-2-car communication technology.

2.4 Smart Parking and Environmental Monitoring

Smart city has a concept of the next stage in urbanization. It has gained ground with leading to investment in human and social capital, policymakers, resource management and new developments in environmental sustainability. Smart cities can also be considered as ecosystems, this type of urban metabolism is an open and dynamic system that consumes, releases and transforms materials and energy, develops and adapts to changes, and have a good interaction between humans and other ecosystems.

One of the main pollution we face today is air pollution that brings great harm to humans and to the environment. Despite the fact that automobile industries and factories have develop new technologies to reduce emissions, but air pollutant concentrations still remain high and air quality problems still persist. The cities we lived in may already have where air quality standards have exceeded emission limits for several air pollutants: ozone, carbon monoxide, nitrogen dioxide and particulate matter pollution which poses serious health risk. Air pollution threat does not only affect in the cities, it may also affect other local cities, or regional or international as air pollution emitted in a country can be carried long distances by atmosphere to other locations, causing poor air quality. Another pollution that we face in the cities today is environmental noise. It can affect people in both physiological and psychological ways thus interfering with basic activities like sleep, rest, study and communication.

A smart city's concept is to offer a better quality life to people, reduce cost and minimize environmental impact. In the city, whoever owns a car will come across a parking problem. Parking scenario involves all the three factors which are atmospheric pollution and congested roads depreciating the quality of life, resulting in lost time for drivers and wasted fuels, and economy loss. The need to search for available parking spaces is a significant contributor to widespread congestion and a major cause of stress for motorists.

SmartSantander is one of the projects with a smart parking solution. SmartSantander is a city-scale experimental research facility in support of various applications and services in building future Smart Cities. It is sufficiently large, open and flexible to enable vertical and horizontal federation with other experimental facilities and to develop new applications by various types of users including experimental advanced research on Internet of Things technologies, based on the realistic assessment of users' acceptability. The Santander project is mainly formed by 3 things, nodes, networks and cloud. The sensors were calibrated to check that all the outputs are accurate. In order for the sensors to withstand the harsh environment in the city, they were placed within a SmartSantander box. It will then be placed on building fronts or light lamps or on parking slots depending on the sensors. Then a gateway (Meshlium) is placed on top of buildings in order to maximize the area covered in order to gather all the data from all the sensors within a zone, stores the data in MySQL database then sends the information to the internet through Ethernet or 3G more efficiently.

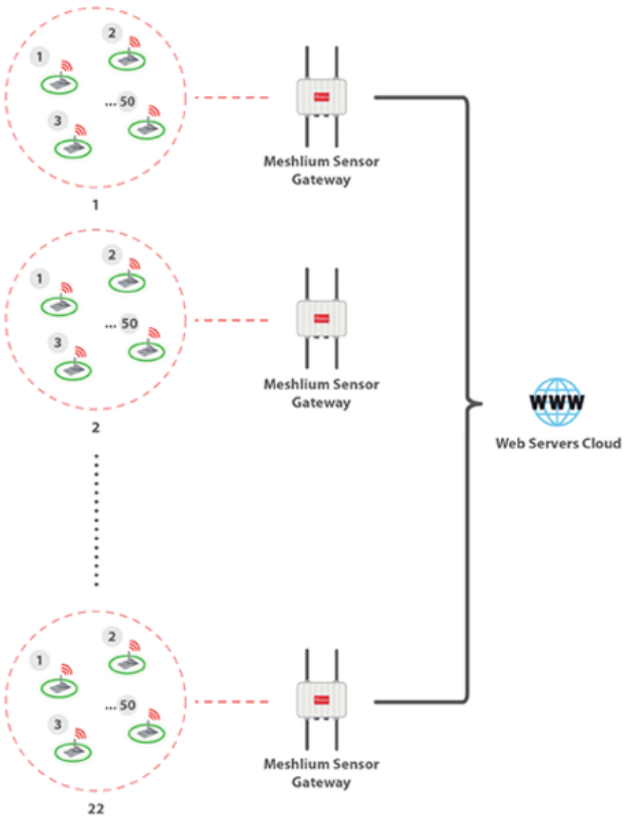


Figure 2.4:F-1 Smart Santanders Overview

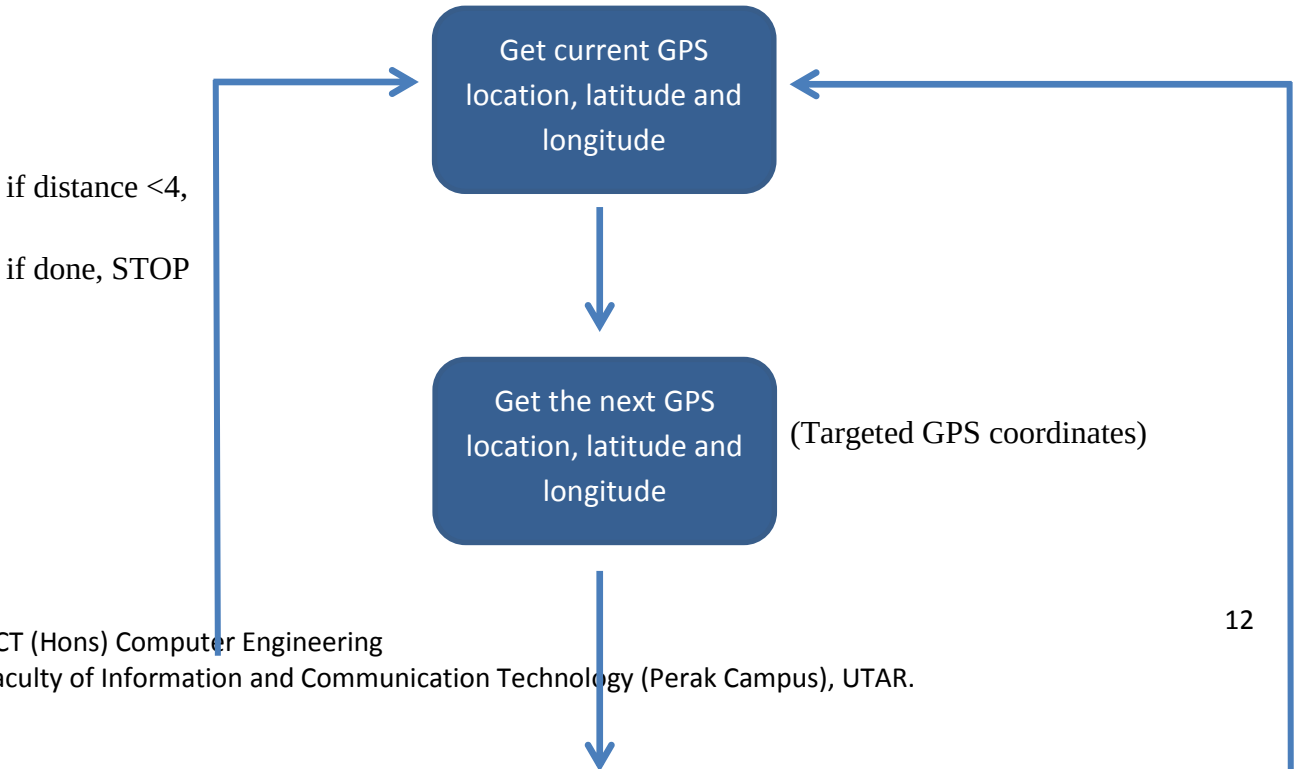
Waspmote is a device which collects temperature and luminosity data can also connect gases sensor board (CO sensor), Smart Cities Sensor Board (noise sensor) and Parking Sensor Board (parking) then sends the information wirelessly to a gateway.

Each of the sensors is embedded with 2 radios for communicating at 2.4 GHz. DigiMesh protocol is used to send the environment information. While IEEE 802.15.4 protocol is used to carry out experiments within a network. This will allow developers to test new algorithms without any downtime allowing citizens to still receive information about the environment.

Chapter 3: System Overview

3.1 Design Specifications

3.1.1 Autonomous Car Methodology



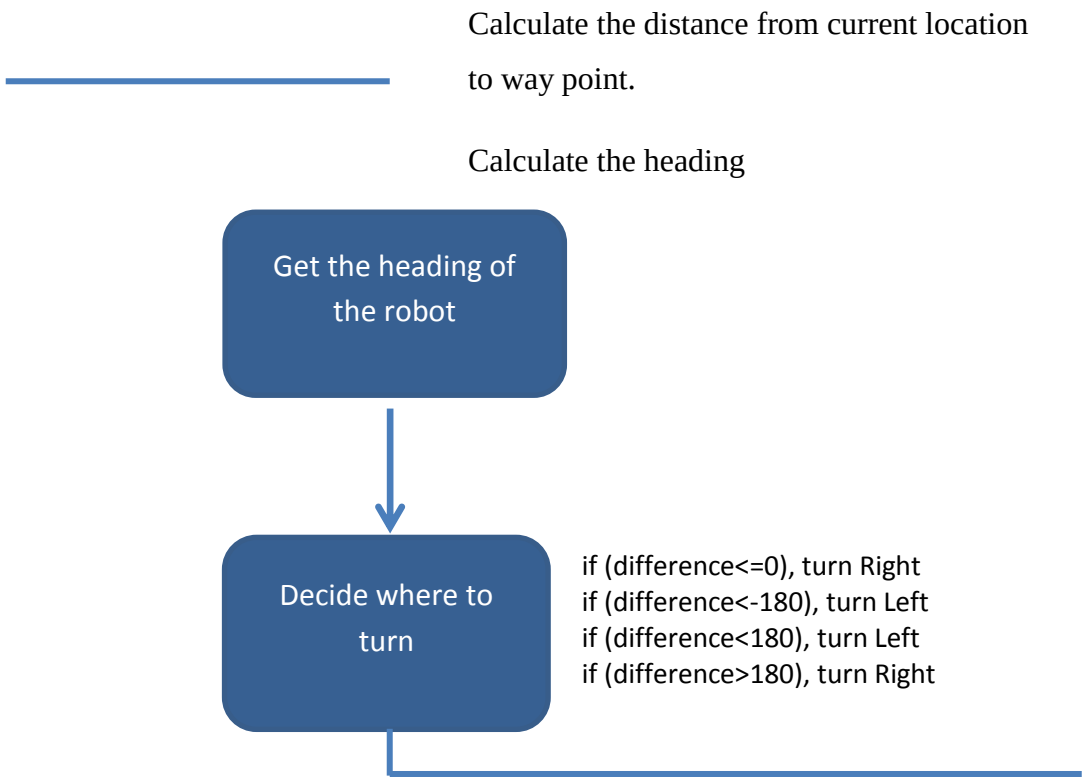


Figure 3.1.1-F1: Overview of the Autonomous System

3.1.2 Server Methodology

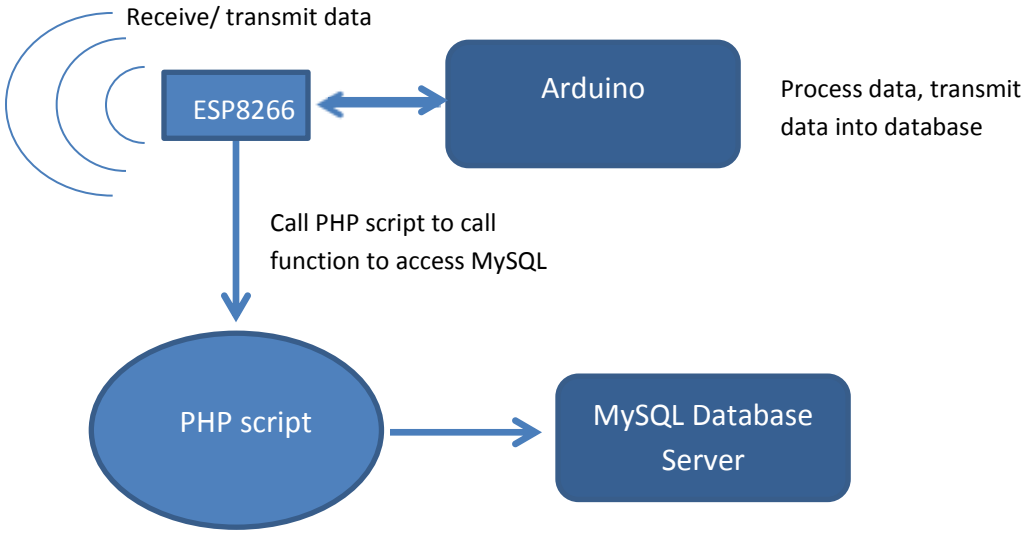


Figure 3.1.2-F1: Server Methodology

3.1.3 Lamppost Methodology

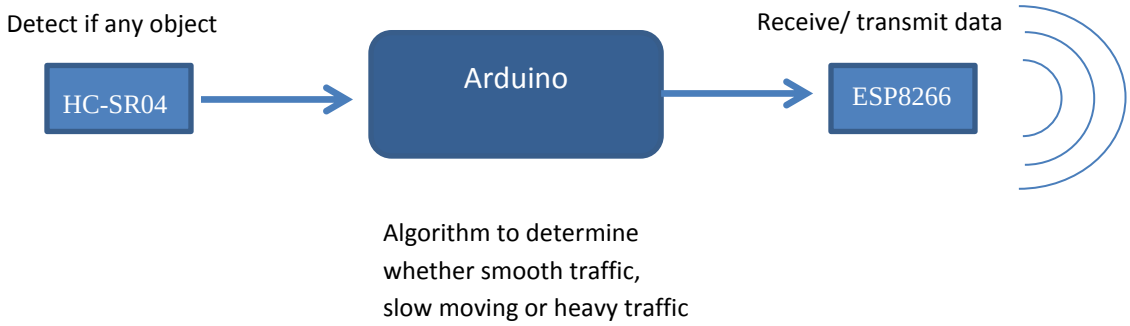
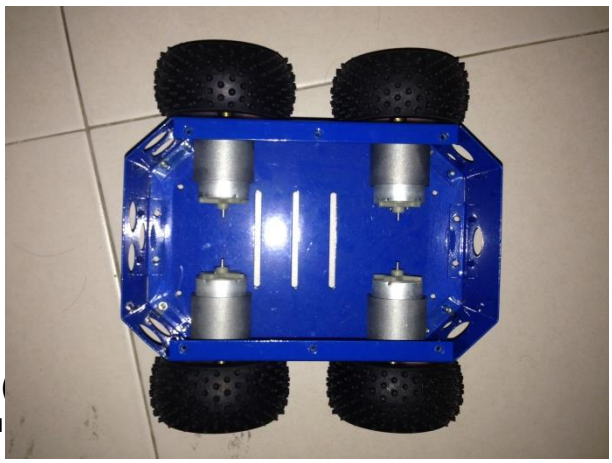


Figure 3.1.3-F1: Lamppost Methodology

3.1.4 Tools: Hardware

3.1.4.1 Chassis

The chassis is the body of the car where all the components are placed on or inside the chassis. It is fitted with 4 DC motors along with 4 wheels. The chassis is mainly made out of metal and the wheels are plastic. It also has predrilled holes for easy placement of sensors and other components.



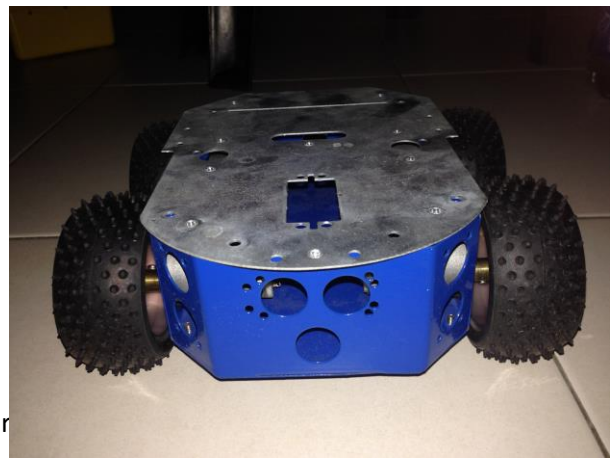


Figure 3.1.4.1-F1: Interior view of the chassis

Figure 3.1.4.1-F2: Front view of the chassis

3.1.4.2 Microcontroller (Arduino UNO and Arduino MEGA 2560)

Arduino MEGA 2560

Figure 3.1.4.2-F1: Arduino Mega 2560

A microcontroller that base on ATmega 2560. Arduino Mega 2560 has 54 digital input and output pins, which have 15 pins that can be used as PWM outputs. There are also 16 analog input, 16Mhz crystal oscillator, USB connection, 4 hardware serial ports, a power jack and reset button.

Operating voltage(v)	5
Input voltage (limit)(v)	6-20
Input voltage (recommend)(v)	7-12
DC current for I/O pin(mA)	20
DC current for 3.3v pin(mA)	50
SRAM (KB)	8
EEPROM (KB)	4
Flash Memory	256KB, 8KB for bootloader
Clock speed (MHz)	16

Table 3.1.4.2-T1: Arduino Board Mega Specifications

Arduino UNO

Figure 3.1.4.2-F2: Arduino Uno

Arduino's microcontroller is based on ATmega328P. It is the smaller version of Arduino Mega 2560. Arduino Uno only have 14 digital I/O pin, 6 of it can be used as PWM output. There are also 6 analog input pins, USB connection, ICSP header, 16MHZ quartz crystal, reset button and a power jack port.

Operating voltage(v)	5
Input voltage (limit)(v)	6-20
Input voltage (recommend)(v)	7-12
DC current for I/O pin(mA)	20
DC current for 3.3v pin(mA)	50
SRAM (KB)	2
EEPROM (KB)	1
Flash Memory	32KB, 0.5KB for bootloader

Table 3.1.4.3-T1: Arduino Board Uno Specifications

3.1.4.3 WiFi Module ESP8266

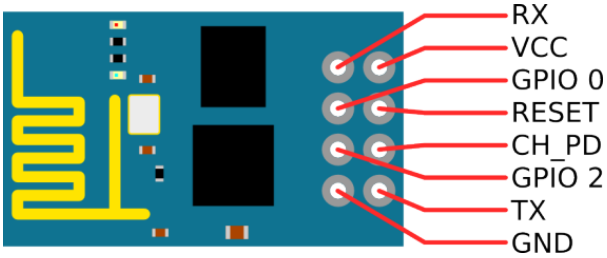


Figure 3.1.4.3-F1: ESP8266 WiFi Module

The WiFi Module in this project is ESP8266. It is a self-contained SOC with TCP/IP protocol stack which allow any microcontroller to access the WiFi network. This ESP8266 WiFi Module is able to host application or communicate with another application processor. ESP8255 WiFi Module has GPIO, ADC, PWM and SPI. It runs on 80MHZ. It has 64KB boot ROM, 96KB data RAM and 64KB instruction RAM. Besides that it has Winbond W25Q40BVNIG SPI flash.

Features of ESP8266 WiFi Module

- using 802.11 b/g/n protocol
- Using 2.4GHz WiFi, which supports WPA and WPA2
- Self-contained SOC with TCP/IP protocol stack
- Integrated LNA, TR switch, power management unit, power amplifier, balun and regulators, matching network integrated and integrated 10-bit ADC.
- SPI, I2C, SDIO 2.0, UART
- 1x1 MIMO, STBC, 2x1 MIMO
- Transmit and wake packets in less than 2 ms
- Less than 1.0mW of standby power consumption
- 40C to 125C of operating temperature
- Antenna diversity is supported
- Less than 5uA of power down leakage current

(sparkfun WiFi Module-ESP8266, 2015) https://www.sparkfun.com/products/13678

3.1.4.4 2Amp Motor Driver Shield

Figure 3.1.4.4-F1: 2Amp Motor Driver Shield

2Amp Motor Driver Shield uses L298P chip. L298P chip allow the motor driver shield using maximum of 2A current for each channel to control 2 5 to 26 volt DC brush motors.

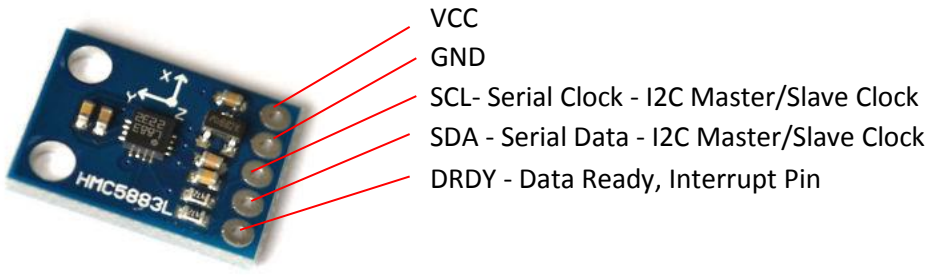
Features and Specification of 2Amp Motor Driver Shield

- Logic control, 5V from Arduino main board
- Polarity protection for External motor power input
- fast test buttons for each motor channel
- indicator LEDs for each channel
- bi-directional control of two DC brush motor
- Motor Driven Voltage：6.5 to 12VDC(VIN Power Supply), 5.0 to 26VDC (External Power Source)
- Up to 2A current each channel
- Pin 4, 5,6,7 are used to drive two DC motor
- Support PWM speed control
- Support advance speed control
- Socket for LSS05 - Auto-Calibrating Line Sensor, doing line following robot will be easy

(Cytron Technologies 2Amp Motor Driver Shield, 2015)
http://www.cytron.com.my/p-shield-2amotor

3.1.4.5 3-Axis Digital Compass Breakout Board (HMC5883L)

The compass is a simple 3-axis digital compass which interfaces through I2C. The specifications of the compass are listed below.



(Figure 3.1.4.5-F1: 3-Axis Digital Compass Breakout Board)

Specifications:

- Simple I2C interface
- 3.3V - 5.0V DC supply
- 3.3VDC logic level
- Low current draw
- 5 milli-gauss resolution
- Dimension: 19mm x 14mm

(Cytron 3-Axis Digital Compass Breakout Board 2014)

3.1.4.6 NEO-6M u-blox GPS module

Figure 3.1.4.6-F1: NEO-6M u-blox GPS module

This GPS module uses UART to interface with Arduino. It has been designed to be low powered consumption and low cost but not lowering the performance. The receivers combine a high level of integration capability with connectivity options in a small package.

Specifications:

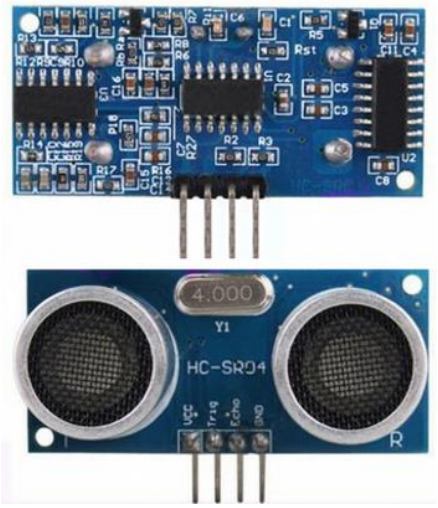
- Standalone GPS

- 2.7-3.6V DC supply
- Interfaces with UART, USB, SPI and DDC (Pc compliant)
- Crystal Oscillator
- RTC crystal
- 3 configuration pins
- 1 Timepulse

(NEO-6 series (Versatile u-blox 6 GPS modules 2011))

3.1.4.7 Ultrasonic Ranging Module (HC-SR04)

Ultrasonic sensor uses sonar to determine the distance to an object. It can provide good non-contact range of detection with high accuracy and stable readings.



VCC = 5V

Trig = Trigger input of sensor

Echo = Echo output of sensor

GND = ground

Figure 3.1.4.7-F1: Ultrasonic sensor

When operation, the ultrasonic sensor must first receive a pulse of high (5V) for at least 10us. Then it will initiate the sensor to transmit out 8 cycle of ultrasonic burst at 40kHz and wait for the reflected ultrasonic to reflect back by an obstacle. The timing diagram is shown below.

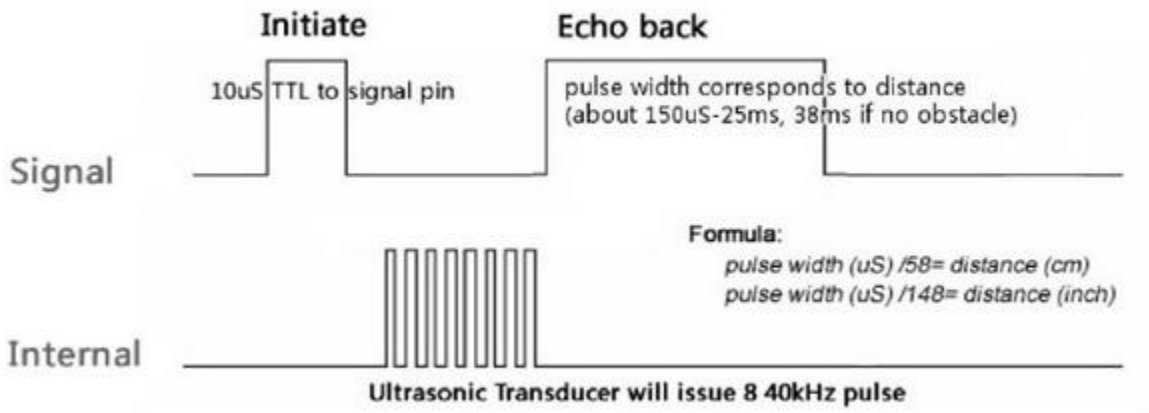


Figure 3.1.4.7-F2: Ultrasonic sensor timing diagram

3.2 Tools: Software

3.2.1Arduino IDE

In order to program the Arduino boards, we will be using an open-source Arduino software (IDE) that makes it very easy to write, upload to the board and open a serial port to observe some data. The IDE environment is mostly written in Java and based on other open-source software.

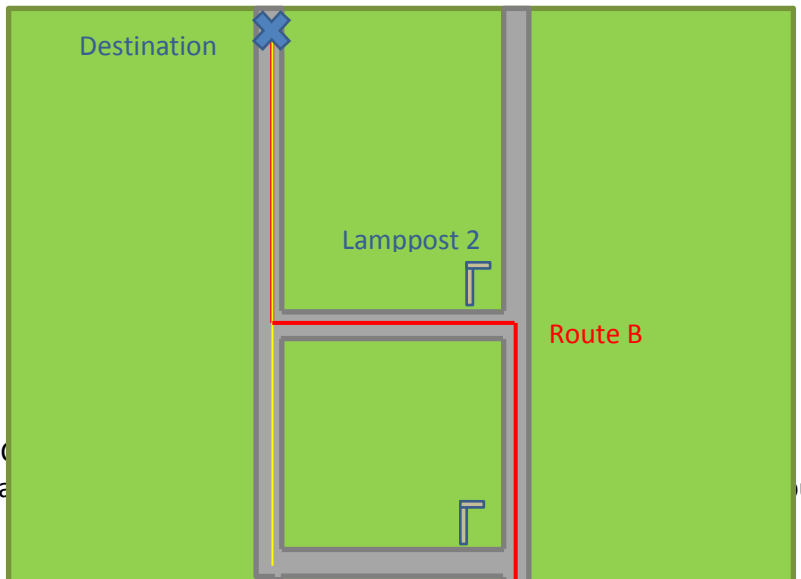
3.2.2 MySQL Database

The database software to be used is MySQL by Oracle. SQL stands for structured query language which is used to communicate with a database. SQL is the most popular language for adding, managing and accessing the contents in a database. We have chosen MySQL for its flexibility and ease of use, proven reliability and quick processing.

Chapter 4.0 Implementation

4.1 System Design / Overview

The GPS coordinates that is desired is first programmed into the autonomous car with the number of points it should arrived at. We will set 2 routes for the car. The first route will be the shortest route to a destination while the second route is an alternative route when route 1 has traffic congestion.



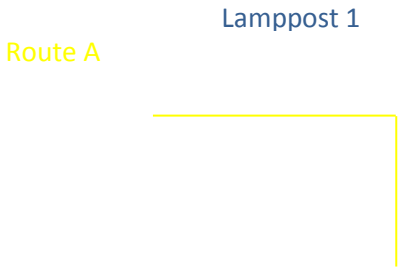


Figure 4.1-F1: Map Scenario

As we can see from the figure above, there are 2 routes leading to the destination. The default route to take in order for the car to reach its destination is route A. In case 1 where lamppost 1 does not detect any slow moving traffic or heavy traffic, the car will take route A to reach its destination. But if lamppost 1 detect that there is traffic congestion, it will inform the server about its condition. The server will then store the condition into a database for further analyzing and inform any other vehicle to take route B to get to its destination.

The lamppost detects whether what is the traffic condition by applying an algorithm to get how many vehicles have pass in a given time. For example in a smooth flowing traffic, whenever a car is passed by the ultrasonic, the car count will increase. But if there is more traffic and causing it to be slow moving, the car count will not increase as much as the car count in the smooth flowing traffic. The lamppost will then transmit the traffic condition to the server so that it can inform any other vehicles that should take route A.

The server will get all the traffic condition data from lamppost 1 and 2. It will then send the data through a PHP script then store it into a database. If any cars intend to use route A but route A is currently in a traffic congestion, the server will order the car to divert its route to B to avoid the jam.

4.2 Implementation Issues and Challenges

One of the challenges faced when doing this project is when working on the autonomous robot. We have to set the robot to the correct heading or else it won't reach its destination just by

following the GPS coordinates. By doing this, we must slow down the DC motors when turning because we don't want the robot to overturn its correct heading.

Besides, combining the whole system together may be a challenging task. In order to allow the Arduino to interface with the database, we must first set up all the perquisites for example setting up a MySQL server, writing a PHP script in order to get the data from Arduino then sending the data and saving the data into the database.

Next challenge we faced was to organize the flow of the whole system. We want to organize the tables in the database to be neat and easy to analyze. Choosing a suitable place to setup the whole scenario may also be challenging because it must be outdoor and the pavement must be clear of obstacle as we do not have any onboard sensors to avoid any obstacles.

4.3 Timeline

4.3.1 Gantt Chart

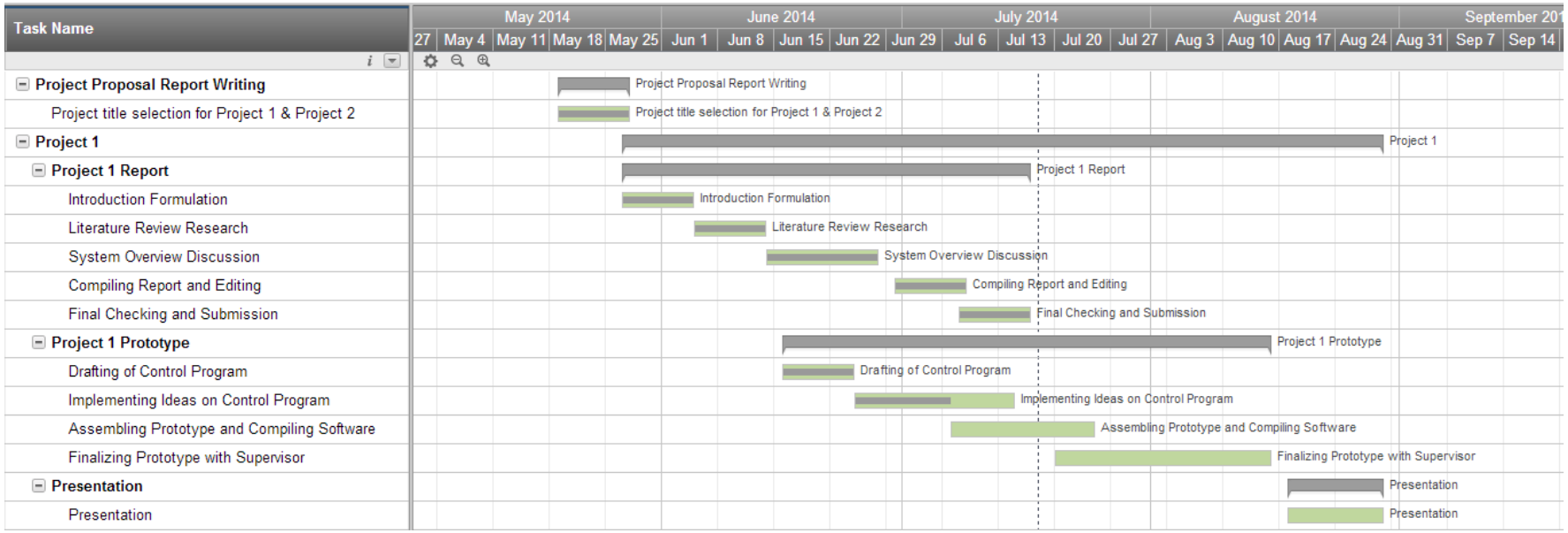


Figure 4.3.1-F1: Project 1 Gantt chart

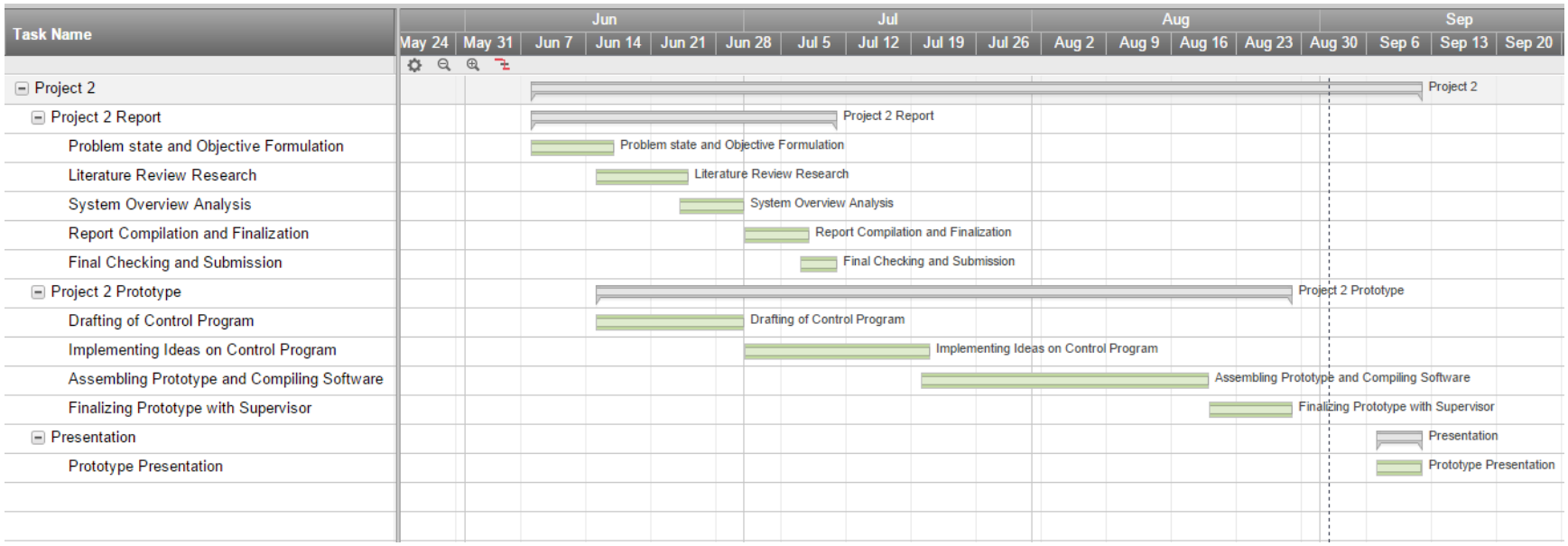


Figure 4.3.1-F2: Project 2 Gantt chart

Chapter 5.0 Conclusion

In a nutshell, autonomous vehicle technology is not a technology out of reach anymore. It can be used on the road in a few years' time and the benefits that will be brought with this technology can ease us in many ways. At the moment we can only develop technology to assist autonomous cars because this technology still does guarantee 100 percent safety to be implemented on the roads, but the enhancement of hardware and software to achieve guaranteed safety is not far away.

Bibliography

[1] Autonomous System, Autonomous Cars Advantages and Disadvantages,2011, Available from:

https://sites.google.com/site/autonomoussystemsmw/autonomous-cars/advantages-and-disadvantages

[2] Wikipedia Google Driverless Car, Available from:

https://en.wikipedia.org/wiki/Google_driverless_car

[3] Cytron 3-Axis Digital Compass Breakout Board 2009, Available from:

http://www.cytron.com.my/viewProduct.php?pcode=SN-HMC-5883L&name=3-Axis%20Digital%20Compass%20Breakout%20Board

[4] Arduino/Genuino MEGA 2560, Available from:

https://www.arduino.cc/en/Main/arduinoBoardMega2560

[5] Arduino/Genuino UNO Available from:

https://www.arduino.cc/en/Main/arduinoBoardUno

[6] Sparkfun WiFi Module-ESP8266, Available from:

https://www.sparkfun.com/products/13678

[7] Cytron Technologies 2Amp Motor Driver Shield, Available from:

http://www.cytron.com.my/p-shield-2amotor

[8] Jenni Bergal(2015,March 13) How Cities and States Use Technology to Reduce Traffic Congestion. Retrieve from URL:

http://www.governing.com/topics/transportation-infrastructure/how-cities-and-states-are-using-technology-to-reduce-traffic-congestion.html