

S-Car

Project Engineering

Year 4

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Project Graphic (Optional)

**Declaration**

This project is presented in partial fulfilment of the requirements for the degree of Bachelor of Engineering (Honours) in Software & Electronic Engineering at Galway-Mayo Institute of Technology.

This project is my own work, except where otherwise accredited. Where the work of others has been used or incorporated during this project, this is acknowledged and referenced.

Mohammad Otaki

**Acknowledgements**

Firstly, I would like to thank my lectures at GMIT for their hard work and commitment throughout the year. Secondly, my supervisor Michelle Lynch, who guided me in the right direction when ever I went of path. Thirdly, my colleagues, who continuously supported me and kept me focused during this time. Finally, I would like to thank my family and friends, who encouraged me throughout my time in college.

**Table of Contents**

[1 Summary 7](#_Toc71928270)

[2 Summary 8](#_Toc71928271)

[3 S-Car 8](#_Toc71928272)

[4 Poster 10](#_Toc71928273)

[5 Introduction 11](#_Toc71928274)

[6 Background 12](#_Toc71928275)

[7 Project Architecture 13](#_Toc71928276)

[8 Project Plan 14](#_Toc71928277)

[8.1 Research 14](#_Toc71928278)

[9 Testing 15](#_Toc71928279)

[10 Positing of components 15](#_Toc71928280)

[11 Assembly 15](#_Toc71928281)

[12 S-Car Features 18](#_Toc71928282)

[12.1 Subheading 18](#_Toc71928283)

[13 Core Board – ESP32 19](#_Toc71928284)

[14 Android Application 19](#_Toc71928285)

[14.1 Android Application Features 20](#_Toc71928286)

[15 Conclusion 21](#_Toc71928287)

[16 References 22](#_Toc71928288)

[17 Appendix 23](#_Toc71928289)

**Table of Figure**

[Figure ‎7‑1 Architecture Diagram 13](#_Toc71934633)

[Figure 2 ESP32 Positioning 16](#_Toc71934634)

[Figure 3 16](#_Toc71934635)

[Figure 4 - Motor Drive Code 17](#_Toc71934636)

[Figure ‎12‑1 A photograph is not a replacement for a circuit diagram 18](#_Toc71934637)

[Figure 6 - Single Responsibility Example 20](#_Toc71934638)

[Figure 7 - Open Closed Principle Example 21](#_Toc71934639)

# Summary

The summary should concisely summarise your whole project. Why? What? How? It should communicate:

* + The goal of the project.
  + The scope of the project.
  + The important features of the project.
  + The approach to the project.
  + The main methods & technologies used.
  + What was accomplished.
  + The main conclusions.

The length of the summary should be 200-300 words, or fit well on this page.

# Summary

This project consists of the development of the S-Car. It also outlines the challenges I faced, and I overcame them. This also outlines the achievements I made during this project.

The main goal of carrying out this project was to make driving safer and easier. Self-driving cars are more stable and safer on the road as they asses hazards and can react quicker then a human. Also, they are equipped with many sensors that contribute to the safety of driver and to the people outside.

Another goal of the S-Car is to make the environment cleaner. S-Car is ecofriendly as it uses renewable energy in results less carbon footprint. The S-Car has zero emissions and does not have any impact on the environment.

The main features the s-Car include autonomous driving by using advance lane detection code, this helps the car to steer its self on the road.

# S-Car

Self-Driving Car (S-Car) is a vehicle that can drive between destinations, avoid objects, and take decisions without a human operator. Self-driving cars are a great improvement in the automotive world as they help us to save our environment by eliminating CO2 and use renewable energy. It can help to reduce accidents that are caused by drunk drivers and drivers that use their phones while driving, also it provides high comfort and safety to the driver.

# Poster



# Introduction

Write a short introduction to the report.

Your introduction should state the goal of the project, and the motivation. Outline the scope of the project, i.e. the terms of reference.

# Background

You should change the title of this section to suit your own project subject. The aim of this section is to introduce to the reader any relevant background information that is required for your project.

You may have multiple ‘background’ sections. Think of any of the questions you had to answer during the research phases of your project – these likely should be addressed in a section like this.

# Project Architecture

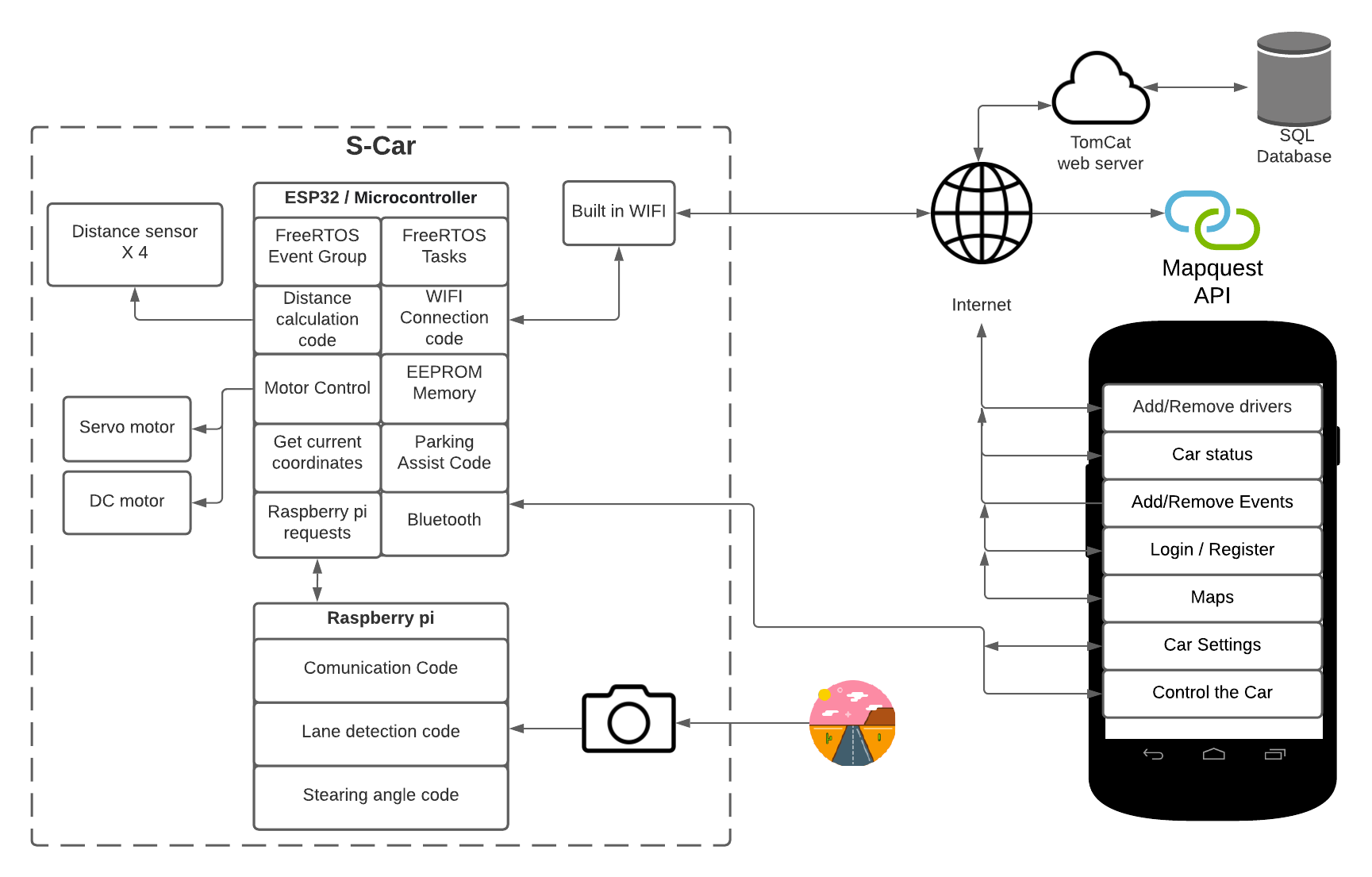


Figure ‎7‑1 Architecture Diagram

# Project Plan

As part of my final year in college, I had to do a project of my choice. I decided to build a Self-driving car (S-Car). I decided to work on this project as this will impact the betterment of the society.

## Research

The research was the easy part of the project. Most of the information was widely available online. Firstly, I had chosen a chassis for the car. I had a number of options available to me. I choose the RC Car Chassis as it portraits a real car. Then, I had to select the components they would require for the operational of the car. There are a number of components. This is when I faced my first challenge.

While I was doing research, I came to realise that I would require two boards as one board was not efficient enough. Using one board will disrupt the operational efficient of the S-Car and it will cost more.

The S-Car required computer vision, which was new to me. This required me to learn new set of programming skills before I officially start working on my project, I had to make sure that I understand all the aspects of phyton programming language.

The next step of this project was to make sure that the components are inline with the feasibility and a viability of the S- Car. It was difficult to pick the right component which is compatible with the rest of car. For example, I had issues with the motor. The main issue with the DC motor I ordered was not able to carry the load of the car, so I decided to pick another motor. This forced me to go back to the research stage of the project and select a new motor that met my requirements. This affected the timeline of my project because of Covid it was hard to get fast delivery.

# Testing

When I received all the components, I had to check that they all were operational, and they were compatible with the S car. The main components I had to test were the ultrasonic sensors, DC Motor, Server motor, the ESP32, Raspberry Pi and the Electronic Speed Control. After I was stratified, I moved on the next stage, but this phase did encounter challenges.

The Ultrasonic sensors were tested by writing enough code, this getting the distance value. I measured it in intervals of 30cm making sure the distance was correct. I double checked the figured by measuring it with a measuring-tape.

The DC Motor and the ESC, the process was the same as the ultrasonic sensors, write enough code for to spin the motor in each direction.

# Positing of components

After the testing stage was completed, I had to assemble the car making sure all the components worked with each other. Finding the right position on the car for the components was one of the hardest parts of the project. It required me to fix the components in the exact place. If I did not get it in the exact position the reading from the sensors would not be accurate. One advantage of locating the position the components on the car was that it made the wiring easier and tidier. It saved me a lot of time as it only required me to attach the wires from the components to the boards.

The ultrasonic sensor was the most difficult part to place on the car. The ultrasonic sensor had to be a certain distance apart so it would not interfere each other. Also, the positioning of this was very important as this was a main feature it would have a major impact of the performance on the car.

# Assembly

The first step was to fix the ESP32 position on the top of the chassis. This made it easier for me to have access to all ESP32 pins and hide the wires as it is showing in Figure 6-1. I powered up the ESP32 by connecting 7.2V NI-MH battery to the Vin pin.

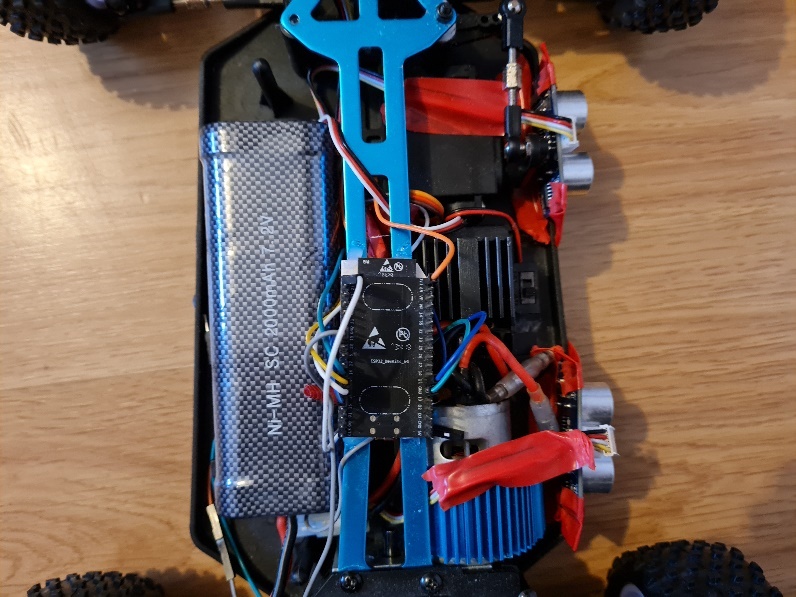


Figure 2 ESP32 Positioning

The next step was to put in the DC motor and the ESC on the car chassis. The DC motor is responsible for the movement and ESC controls the speed of the car. I powered the ESC with 7.2V direct from the battery. These components were vital as they carried out the main functions of the car.

After each step I was testing the components and taking notes. To control the speed of the DC Motor, Pulse Width Modulation (PWM) had to be used. This is a method to create a square wave to switch the motor between on and off and as a result the speed can be controlled. To use the PWM on the ESP32 a channel must be configured with the frequency and the resolution. Then attach the channel to the required pin as showing in figure 3.

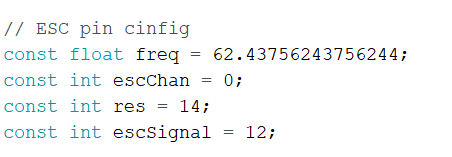
 

Figure 3

The next step was to create functions to control the operation of the DC motor. I created serval functions for the DC motor as each function control the motor differently.

**Servo Motor**

The servo motor is responsible for the steering of the car. The coding concept of the servo motor is similar to the DC motor as I had to use the PWM. After the coding and assembly of these components, I tested them out. The results were both functioning as it should be.

**Ultrasonic Sensors**

Ultrasonic sensors are used to get the distance of the objects around the car. I used four sensors in my car one at each side, so they do not interfere with each other. After positioning all the sensors on the chassis, I powered them with 3.3V from the ESP32

**RaspberryPI**

**Camera**

Figure 4 - Motor Drive Code

I wrote enough code for the ultarasonic for them to be working.

The electronic speed control unit although it came with the car but the main issue was to get the desired integration with the rest of components especially other programming sensors

# S-Car Features

* Parking assist:
* Autonomous driving
* Android application:
* Auto braking system:

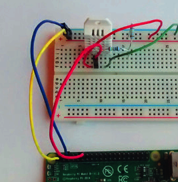
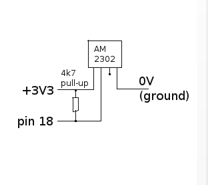
This is an example heading for a section in a project. You choose your sections to suit your project.

## Subheading

This is a subheading, use subheadings to break up a large topic into smaller sections.

Notes on content:

Photographs are not technical diagrams and are not a good substitute for professional technical diagrams. Use photographs to enhance a report, but not as a replacement for diagrams.



V

Figure ‎12‑1 A photograph is not a replacement for a circuit diagram

In describing software, you need diagrams and/or summaries of software design & layout. It is not sufficient to just paste some code. You should describe what your code is designed to do, in English. If you decided to put your code in functions or libraries or objects, describe this architecture. One good layout is to include a snippet(s) of code alongside an explanation. You do not have to explain every part of your code, pick the important parts.

Write out any mathematical equations or calculations that are important in your project and explain them.

Include details of any major problems or challenges you encountered in an area, and how you solved them.

IEEE referencing style is recommended a the default style to choose, however if you are familiar with a different referencing style then you can use that.

When you need to reference add a citation in the relevant sentence, usually at the end, before the full stop [1]. Then have this numbered citation referenced in the list of references at the end of the document.

# Core Board – ESP32

# Android Application

S-Car application was built to help the owners to have full control of the car using their phones. The application allows the owners to add additional drivers that want to barrow the car for specific period of time, the owner can specify the period while adding the additional driver. The additional driver will not have access to the car when the specified period is passed.

The owners can also add, update, or remove events using the S-Car application. This feature will allow the car to turn on before the event happens in few minutes to get the car ready and to get the destination.

have easy access to the car, manage the car settings and control it through Bluetooth connection.

The S-Car application was built using android studio and Java as the main coding language.

## SOLID Principles

While coding the application I have followed two of the SOLID principles:

**Single Responsibility Principle**

Single Responsibility Principle mean that every class or function in an application should have one responsibility. Figure 6 shows the Event class and as seen the class is only responsible for storing an event detail.

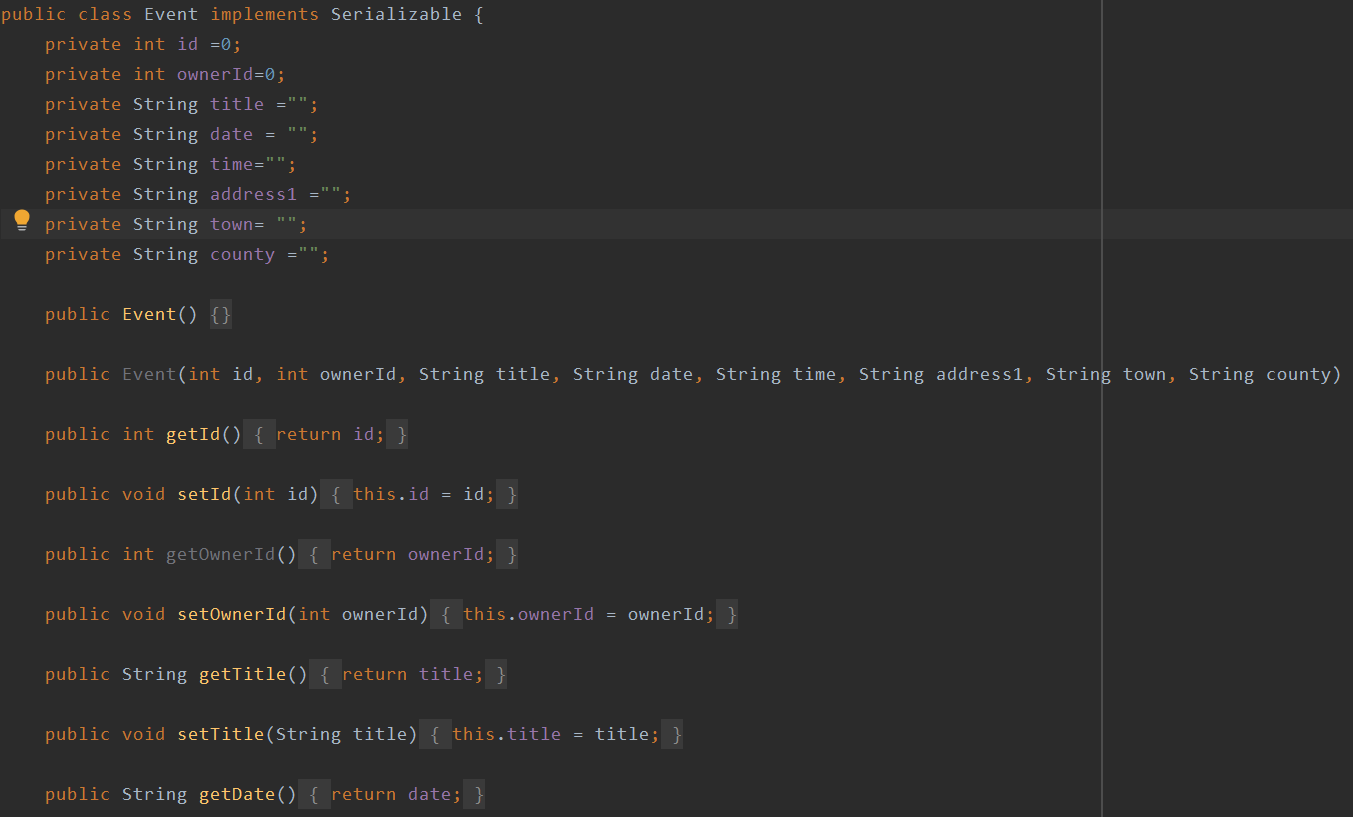


Figure 6 - Single Responsibility Example

**Open Closed** **Principle**

Open Closed Principle means that the classes should be open for an extension but closed for modification. This allow the classes to be extended without modifying their source code. In my application I used the Open Closed Principle as its showing in figure 7. The driver class extends the user as the additional drivers have time limit to their accounts. This helped me to treat the driver as a user and write less code.

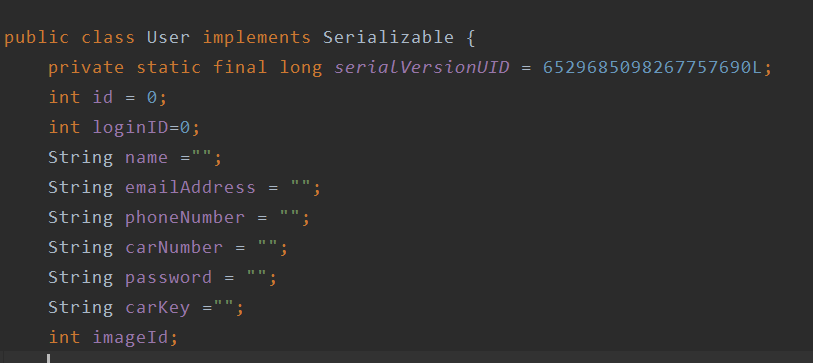
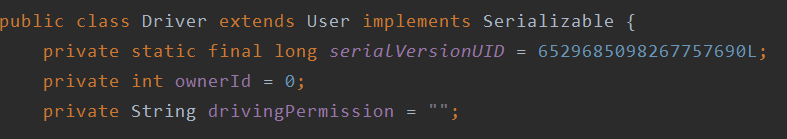
 

Figure 7 - Open Closed Principle Example

## Server

I used Apache Tomcat to build my server. The reasons I picked Tomcat were its lightweight, open source, high security and stable. My server will handle all the requests that coming from the app and the car. The content type that I am using to communicate with the app is octet-stream. This type is more efficient as it has less space and remove the need to encode and decode the data. The other content type that I am using is Json, I used Json to communicate with the car as its easer to extract it in C++.

## Data Store

### SQL Database

### SQLite Database

## Android Application

* Add/Remove drivers
* Add/Remove events
* Live sensors update
* Maps

# Conclusion

Write a short conclusion. What is the outcome of the project? Perhaps you have a product prototype, or some results, or a demonstratable system.

Do not use your conclusion to tell the reader what you might have done if you had more time, but keep it focussed on what you actually have done. You can mention future opportunities for further development of the work, but keep this part short.

# References

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# Appendix