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| Deadline Date:**2022/03/18** | Member of staff responsible for coursework: **Mr. Pramudya Hashan Tilkaratne** |
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# ASAP Caller

## Driver Rescue System

Interim Report Group 60

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# Chapter 1 – introduction

## Introduction

In modern days, traffic accident has become a common thing in day to day life. The amount of damage that an accident can cause is un measure.

Among those accidents most of them are vehicle accidents. With the modern technology people can reduce theses kinds of accident to. But still they might not save all the lives. But it can reduce the number of damages significantly. Because of that as a group of students, we thought to design a system to help people who faced those accidents. As to the knowledge, we know there are a lot of systems to avoid accidents before it happens but what about the after?

In this document we discuss about how technology can save a life after a fatally accident on a vehicle. Our goal is to automatically call an emergency service as soon as possible when the driver fatally injured or lost conscious. Cases like these, time is very important, because an one second is enough to save someone's life.

## Definition of the problem

After an accident, no one can say what happened to the driver and the passengers. Maybe they can be seriously injured and that can cost their life or Maybe they can't get help because they are in a lonely place they need help. With this kind of problem, they need a system to contact the medical team or police, or both. Through this system we can help both sides as a driver who faced an accident and need help he or she can get help and as police or medical team they can get the location.

## Project Objectives

As explain in the problem definition part this project is about helping person who faced an accident. After an accident most of the time it can be serious and they need emergency help with experienced person to rescue in this project system detect the accident and it gives an emergency alert to the driver through a mobile app if the driver doesn't respond to the alert within the time system define, system decide it as an emergency situation and through the system it automatically calls to the emergency service numbers police station and medical team with location.

## Scope of project

When it comes to Scope of project main process is with the sensor, with this sensor it can detect if the vehicle roll, yaw and pitch. Let's get through these three words first in the vehicle coordinate system,

rotation along the longitudinal x-axis is called roll.

rotation along the lateral y-axis is pitch.

rotation along the vertical z-axis is the yaw.

**rotation along the longitudinal x-axis(roll)**

roll is the rotation of the car about the longitudinal axis it is also referred as side to side motion of a car about the longitudinal axis passing through the cg of the vehicle its also defines that how well car can distribute its weight while turning role is experienced in response to the cornering centrifugal forces whenever there is sharp turning maneuver roll comes into act but if it is excessive the literally the car swing into a drift in general positive roll angle is measured when the vehicle poses an upward movement on the right side while the upward movement on left side termed is negative roll angle.

**rotation along the lateral y-axis (pitch)**

It is the rotation of the car about the traverse axis it is also referred as the front and rear motion of the car about the transverse axis passing through the cg of the vehicle it's also defines that how well car can distribute its weight during the active acceleration and deceleration pitch is experienced in response to acceleration and deceleration forces so when a car is underbracing vehicle decelerates where the weight of the car is transferred to the front making the car body to lean forward similarly when it accelerates the lean's back transferring its weight on rear wheels proper pitching of a vehicle leads to maintains correct altitude and ensures comfortable ride in general positive pitch angle is measured when the vehicle nose is in upward movement while the downward movement of vehicle nose is negative pitch angle.

**rotation along the vertical z-axis (yaw)**

it is the rotation of the car about the vertical axis it is also referred as the left to right motion of a car about the vertical axis passing through the cg of the vehicle yaw is experienced in response to cornering and also sometimes induced by the side wind so whenever there is a turning maneuver the car wheels rotate at different speed when the car turns left the right wheels rotate faster than the left wheel this is because the right wheel covers the maximum distance than the left wheel which in turn creates an imbalanced force and vehicle turn is influenced by this force leading to yaw to be more precise more the sharper the turn in general positive yaw angle is measured when the vehicle's front end rotates towards right while the negative yaw angle is measured as the vehicle's front end rotates towards left.

And also, with this sensor it can detect quick accelerations, quick decrease in speed with this sensor system can detect those variables and system detect if the situation is bad or not if the situation bad it gives alert to the person through the application.

## Summary

This system is for vehicles and it can be help to saving people life or getting seriously injured. With the sensor in the system detect if there any accident and it gives an emergency alert to driver through the mobile app if the driver doesn't respond to the emergency alert within the time system automatically inform to the police and medical team for help with the location. This sensor detect roll, yaw, pitch, speed increase and speed decrease this data helps to the system to define the situation.

# Chapter 02

## Facts Gathering Techniques

Mainly in this project, we are focusing on a solution for one specific type of user. So there we need a good understating in this kind of environment.  In this system we have two aspects because of that we need two perspectives as a driver and medical team and police. To get these knowledge our main source is internet. Through the google and You tube we got an idea how often and what kind of situation they have being experienced. Depend of that information from the google and you tube we are building our system.

In our system we have step we need to access through a cellular network as the provide GPS support. In the system have ability to call and track the vehicle. Present days most of the companies included cellular network for various purposes and we can access that network to implement our system. But when it comes to calling a nearby emergency services we need industry support. To this we thought we can use Online conference or an interview with a experienced person in the industry.

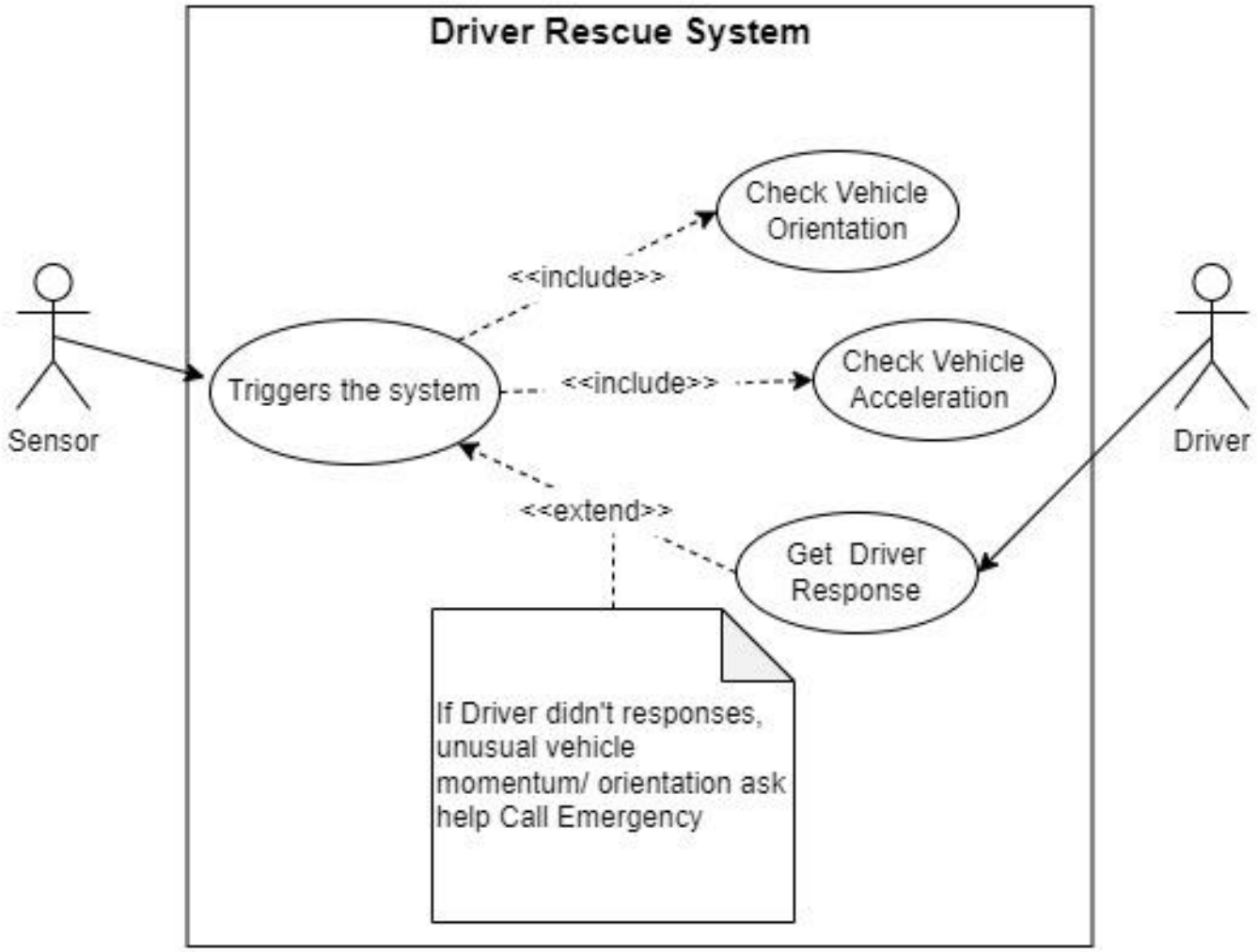
To demonstrate final goal of this project we provide prototype of this system. That is greatest way to explain and present the idea to user. So, we can demonstrate the prototype to stakeholders and improve the solution more before the implementation.

Finally we need industry support  when it comes to the optimal position to place the system in the vehicle. To do that we thought online research  and to be more effective our system we thought to get industry support through an interview or online conference.

## Current system

The system we are developing is straightforward in terms of functionalities. It detects and interact with user to get a response in case of an accident. The raw raw values sent by the sensors and modules are calculated on Arduino controller unit and provides meaningful values to interact with WPF application. From WPF application it will compare the minimum threshold values to trigger the event. This will also works when the driver is not in the vehicle but also outside the vehicle, but it will only notify the driver and would not message to emergency service.

## Overall use case diagram for the current system




## Summary

This system is for a specific type of users, that are drivers. The main roles in this system are, driver itself and emergency service. So we need a good understanding about the procedures and terms when it comes to these kind of situation. We can directly involved between these two roles and gather information. And internet is also a good source to gather information about building the system. Analyzing an existing system would be benefited so we can add and improve those features as well.

# Chapter 3

## Functional requirement

1. when an accident occurs in the related vehicle then activate MPU6050 Gyroscope Accelerometer Sensor after 10 seconds this signal goes to the Arduino board then it will go to the GSM Module and finally GSM module true deliver the massage emergency line.
2. ASAP caller must have a battery. because this device must always be on, we use the battery for continual power on our device and this moment is a critical moment so if this device.
3. 3. ASAP caller must have a good GSM module also this module can assure massage to cloud connection.

## Non-Functional requirement

1. ASAP caller should have a good casing because ASAP caller should have a good shield
2. And also it will help to protect
3. ASAP caller must store-related place in the vehicle. because if ASAP caller doesn't store wright place sometime ASAP caller can't detect whether vehicle accident or not so that's why ASAP caller must store wright place.
4. ASAP caller should have a good user interface because customer taking action or control our device (user's access only) if not work properly our device, user and ASAP caller connection will drop out after customer get disappointed our device but the user interfaces simple and clear interface then the user has a good idea for our device.
5. programmed should optimize because if programmed craze or over-loading customer disclaim so that's why the program should optimize.
6. Hardware should be optimized because each part should be shoutable ASAP caller device and some parts are highly cost so we should select part related our device. especially sell this device to the customer it should reasonably prize to the customer and also when we build this devise low cost and affection manner it should be good for both sides.

## Performer's requirement

Asus thinker bord

Asus thinker bord, it like a mini-computer. when an accident the vehicle should quick response and it's a critical decision so our device should more speed, processing power also it should accurate.so that's why we use thinker bord for ASAP caller

MPU6050 Gyroscope Accelerometer Sensor

We should know exactly vehicle accident or not, it depends on our device sending porous value. If it is not properly working, then we risk His/they live. So that's why we should get Porosis value, according to that MPU6050 Gyroscope Accelerometer Temperature Sensor output exact value.

Arduino UNO board

When considering Arduino boards, we use Arduino UNO board because it is the price to performance-related Arduino bord. it has 64 analog inputs, direct 16 LED outputs.

## Security requirement

When we talk about the security side of ASAP caller if someone steals the vehicle, we can find out the vehicle according to ASAP caller because it's also a taker and we use anti-theft technology for our device it means him to break out our device already derived the message user and emergency line.

## Networking Requirement

Azure is a variety of online services. It is an open and flexible cloud platform that assists in development, data storage and service management . Azure tool handles web applications online with the help of Microsoft data centers.  .there are many categories of azure. Network is one of the azure categories . some of the azure communication services included in our project are

1) WAF-Web Firewall applications
2) Peek - Virtual network view

This is the way to the Azure cloud to connect the windows app .first go to the C # app at the top corner you will see a connected service bar and select a SQL server that displays the local DB and configure the express DB server

Benefits of using windows Azure

- Windows azure connect allows remote administration and debugging of windows azure services
- Windows azure connect makes it simple to set up and utilize a distributed application that connects cooperate networked resources to windows azure roles

Another Network requirement is a web application connect to Azure cloud .Azure web application provides hosting service that  can use to improve mobile and web applications. A web application is an application that is usually stored on a remote server, and users can access it through Software known as a web browser. It is a type of computer program that usually works with the help of a web browser and also uses many web technologies to perform various tasks online.

# Hardware Requirement

In this project, we have used Arduino as the controller unit, a ____ sensor, a shock detection sensor and a GSP module. As discussed in the pernicious topics, these are the only hardware tools that are used in the project.

## *Arduino Board*

The Arduino board we are using is Arduino Uno. This board is enough to integrate all the sensors and modules to work with.

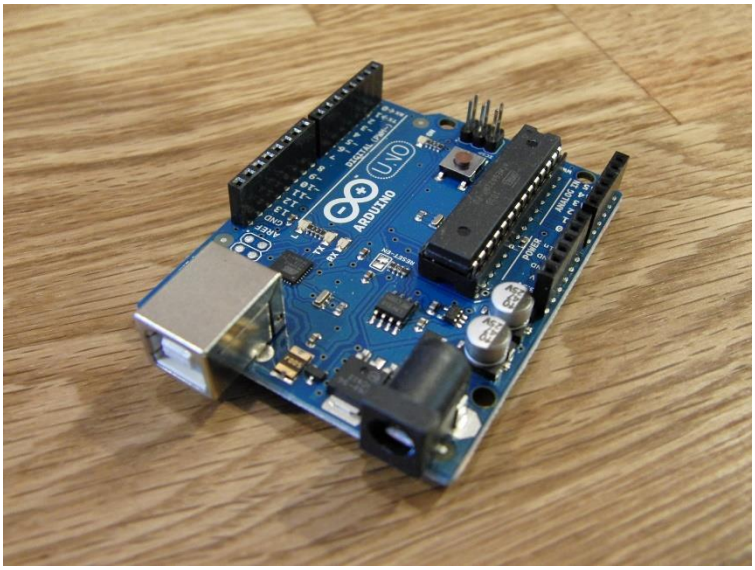



FIGURE 3 2 ARDUINO UNO


FIGURE 3 1 ESP3266 NODE MCU

For any optimization purpose, we might be using ESP8266 NodeMCU

## *MPU6050 Sensor*

This sensor detects any rotation of the sensor. This is used to detect if a vehicle is flip over by an accident. Sometimes a shock might not happen to detect by the shock sensor. So, this sensor is more like a backup sensor. This sensor will read the values in X, Y, Z axis.

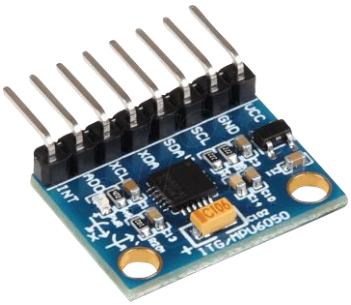



FIGURE 3 3 MPU6050

### *Vibration sensor SW-420*

This is the main sensor of the project. Most of the accident cause a shock. This sensor will detect any shocks that will caused by a crash

FIGURE 3 4 SW-004

### *GSM GPRS MODULE*

This module is used to send a message to any near by emergency service including the current location.

SIM800L V2.0 5V

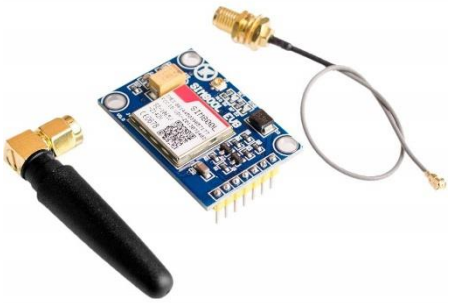


FIGURE 3 5 GSM

### *PIR Sensor*

This sensor is used to detect whether the driver is inside the car or not.

FIGURE 3 6 PIR SENSOR

## Safety Requirements

Safety requirement is the part of the machine control system that prevents a dangerous situation from happening. It can be a separate dedicated system or it can be integrated with a standard machine control system

The key is the security and security requirement .Device and data security that includes device authentication and data privacy, integrity and other requirements that cover our project. another security requirement for the device is durability. a car is an accident we are identified where and when the car is an accident .let's think about this device tolerance we know nothing about a car accident .

that's durability adds a safety requirement. Part of the aircraft metal box is used to make our device . because the greatest damage is a car that protects the device

## Summary

The summary of network requirement is Network  is a technical requirement can be understood as technical aspects of network infrastructure that they must provide in terms of security, availability, and integration. These requirements are often referred to as non-functional requirements and summary of the safety requirement is mainly  focus in device security and durability. On the functional side, we thought about delivering the message, power consumption, and GSM module and non-function side also talked about security side, protection, software, and hardware optimization. Next, we talk about the performance side of parts

# Chapter 4

## Economic feasibility

When we talk about the economic feasibility of our project known as ASAP caller, we are going to use low cost yet better performance sensors. Our goal is to give a customer or the user a better- and top-quality price to perform an IoT device. To achieve this low cost to save our and our customers' money we carefully analyzed the readings of our sensors and removed the unwanted parts from our IoT device. Also after thinking about prices, we decide to make two versions of this device using Raspberry Pi and Arduino, when talking about Arduino, it is very cheap yet not much powerful but when we take the Raspberry Pi it is powerful yet has a very high price range. After consideration of these topics, we planned to do our project using Arduino to reduce the cost of the end product because even this is a prototype, we need to make this device work fine and cost low on both sides

When we handle the investments in this project, we collected a little bit of money from each member to get sensors, tools and mainboards for this device. As we talked about above to minimize this cost, we studied our sensors and removed the unwanted parts from our budget so everyone can give a fair part of the cost. We have done this part at the project planning so we would not use our money and resources without some reason. Like this we achieved economic feasibility in our project at this point.

## Operational feasibility

When we talk about the Operational feasibility of our device at this movement, the ASAP caller is halfway done, on the hardware side we finished the sensor array and array mount. On the software side, we coded the vehicle orientation detection part and if the vehicle rolls or leans to the side it will send the message using the serial port. As we made this report, we started to build an interface that runs on the vehicle as well, it is in the prototype stage right now and it can show the user, is car rolled or not, our goal is to use this function to call emergency line using GSM module yet we didn't get the GSM module. after getting GSM module we are planning to finalize the prototype model of our ASAP caller device and make a casing to it and finalize the whole project as well.

At the current status, our project is not fully finished and we are ahead of our timeline at this point so we have more time to prototyping and test our device. This will give us time to improve the operational behavior of the device and troubleshoot the device if it has any problem at the operational level. When we talk about operational feasibility more, currently we are optimizing the algorithms to identify instances quickly if some accident occurs. Also, to make a prototype model of a car test the device if it works or not.

## Technical feasibility

When we talk about technical feasibility, we are currently implementing a gyroscope to get the pitch of the vehicle. The Arduino module is called MPU6050 and it can tell the pitch of itself using XYZ coordinates, we take the coordinates and calculate them to tell the current status of the vehicle and we are using a motion sensor to detect if the driver is in the vehicle or not. If the driver is not in the car and the car starts to move over the device will send a message to the user via the GSM module. This GSM module is using SIM card to send the data to the mobile device. also, this is the technology we are going to use if some accident occurs, to send the message to the emergency line like the police.

When we talk about technologies, we are going to use in this device these are some top tire sensors to detect movement pitch and location. We are going to use GSM technology to send data as output and take data from the motion sensor and gyroscope sensor. to process data, we use Arduino or raspberry pi. If the processing power of the device or algorithm exceeded the Arduino boards' power, we are going to use a more powerful raspberry pi signal board computer to power our device

## Organizational feasibility

Our team has 5 members and we carefully divided our work load accordingly to our role. likewise,

| | | | |
|---|---|---|---|
| R.M.R.M.L.Rathnayaka | -19365(NSBM) | - 10747919(PLY) | -Programming Leader (GL) |
| R.M.H.C. Rathnayake | -19412(NSBM) | -10747887(PLY) | -Technical leader |
| R.M.L.P.Sandaruwan | -19491(NSBM) | -10747909(PLY) | -Testing and Maintenance Leader |
| R.B.I.K.Subasingha | -19270(NSBM) | - 10747883(PLY) | -Planning leader |
| Y.M.S.K.Y.Bandara | -19369(NSBM) | -10749057(PLY) | -Quality Leader |

- Group Leader(GL) is the one who manages the project and organizes the project and he is handling the projects' basic stuff.
- The programming Leader is the one who is writing the algorithms for the sensors and handle hardware as well.
- The technical leader is the one who is managing the GUI companion app to handle the user side data and handle hardware as well.
- The testing and Maintenance Leader is the one who tests each version and reports any problem in the program.
- The planning leader is the one who manages the data collected from each leader of the project and he handles the GUI app as well.
- Quality Leader is the one who checks the product is qualified for the task that it made for and give help to test the project.

# Outline budget

| PROJECT COST AND RESOURCE ESTIMATE | |
|---|---|
| OVERVIEW | Because of the hardware needs and some physical objects, we need invest to some resources. |
| **NEEDS / INVESTMENT** | **COST** |
| RaspberryPi | Rs.10000 |
| Other Hardware | Rs.3000 |
| Mount | Rs.500 |
| Software | - |
| Case | Rs.2000 |
| | |
| | |
| **Total** | Rs.15500 |

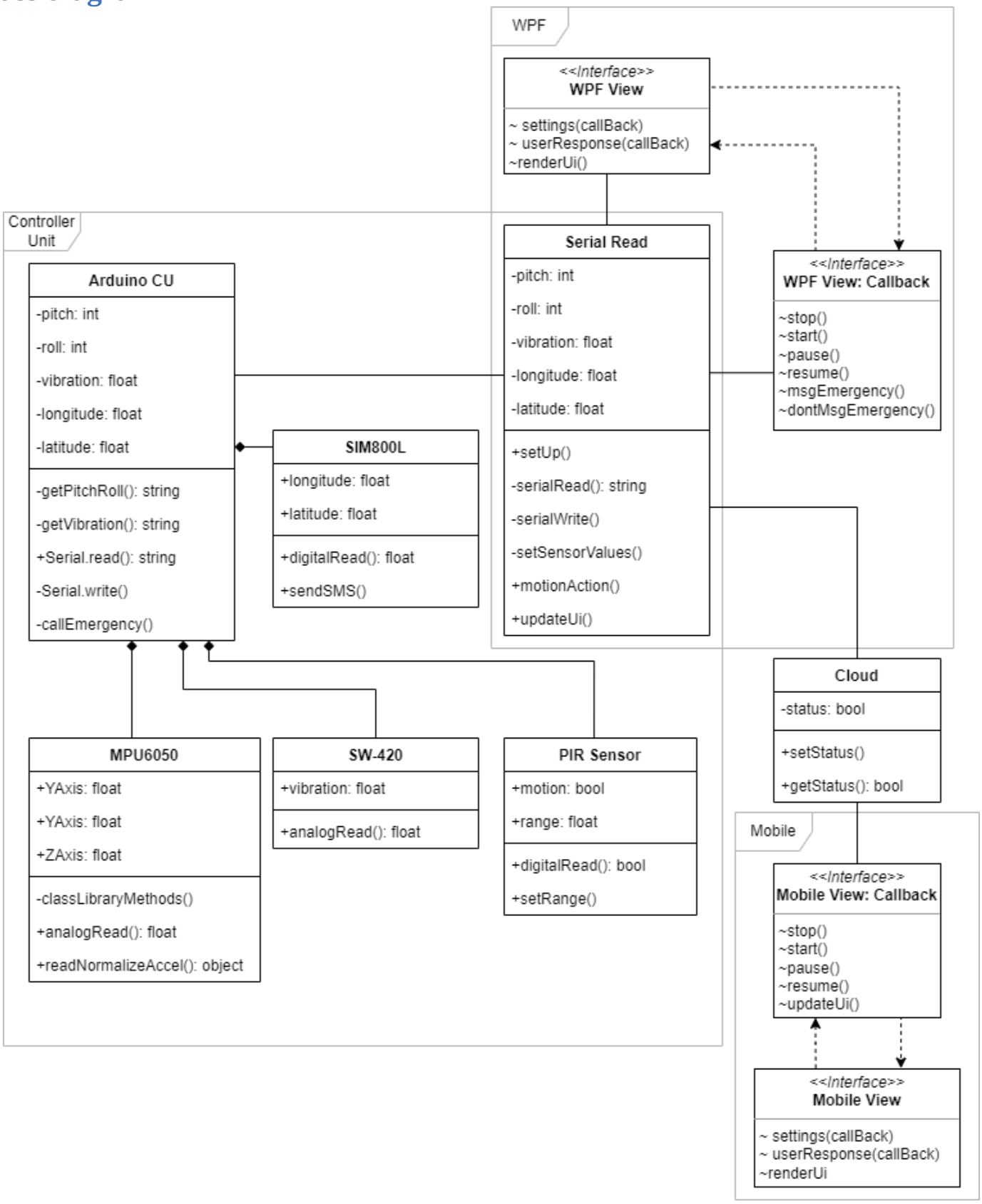
TABLE 4 1 OUTLINE BUDGET

# Summary

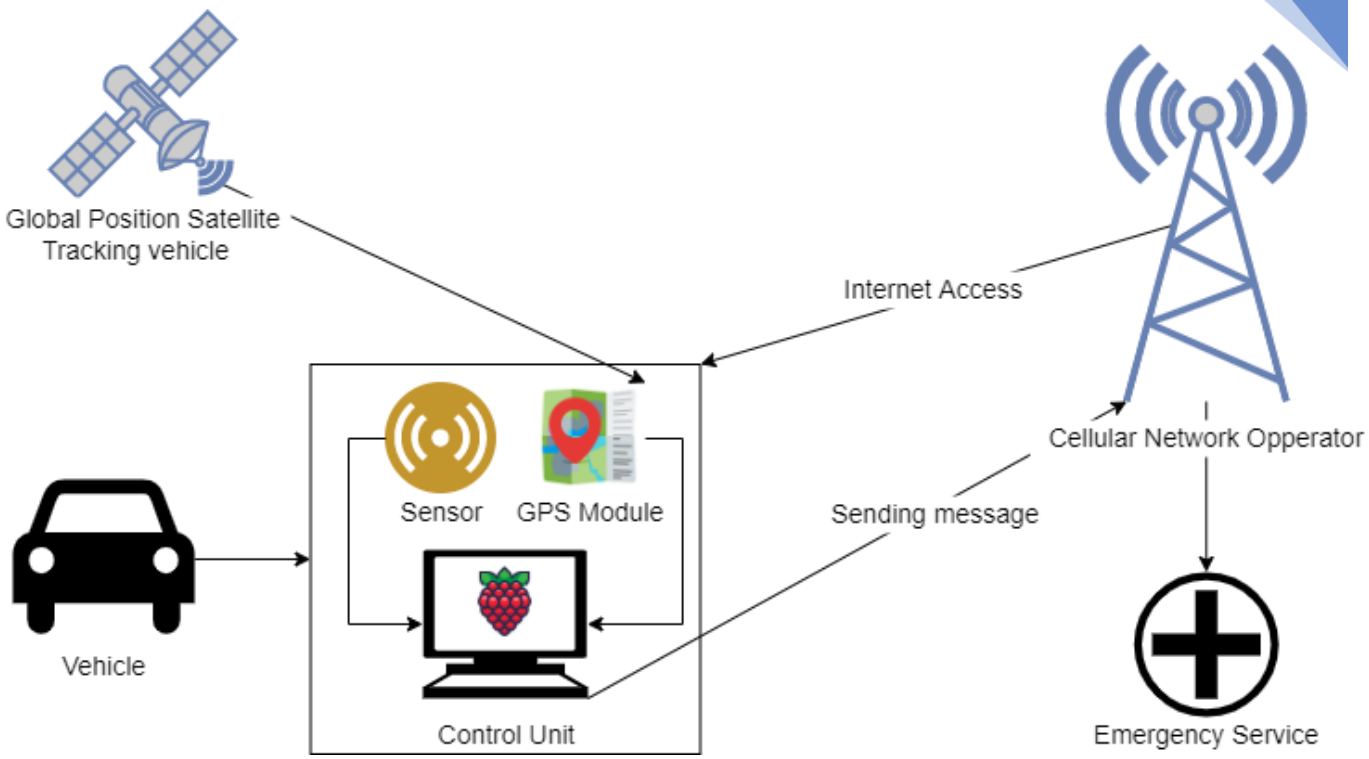
The current status of our project is talked about here. Our investments are not low but enough for the project. operational status of the project is going well. technologies we are using are more than enough to make our project possible yet we didn't implement the GSM module yet And project organization is going well thanks to all members of the group. The budget didn't exceed as we planed

# Chapter 5 – System architecture

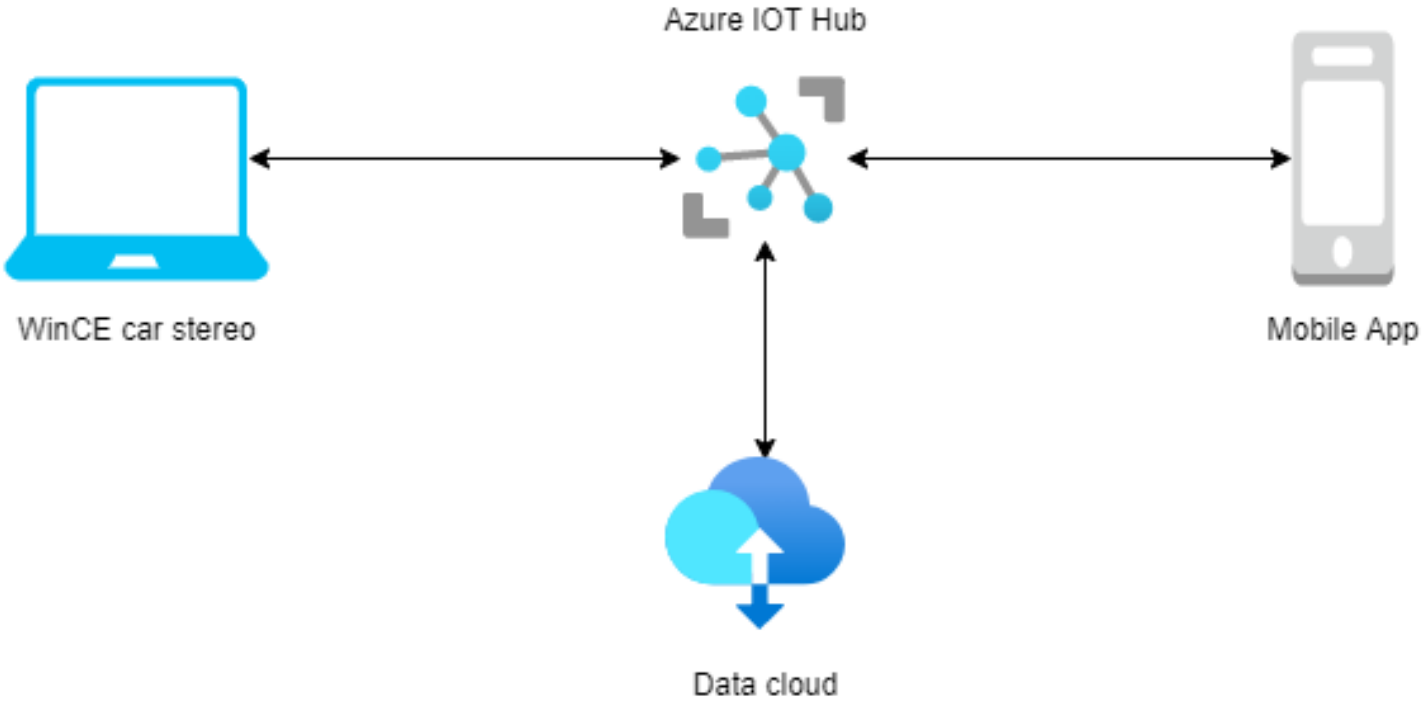
## Class diagram



## High-level architecture diagram




## Network diagram



# Chapter 6 - Development tools and technology

## Development methodology

During the project discussion we have decided to prototype the hardware side of the project by Arduino and Raspberry-Pie. We decided that because we wanted to check what is the most efficient and what is the most compatible with other requirement as well.

During the prototyping stage we decided to implement Arduino based protype to the finale build because of it can be configured and directly integrated with Windows OS systems which our GUI of the project will run on and it is easy to configure with Windows Presentation Foundation Applications.

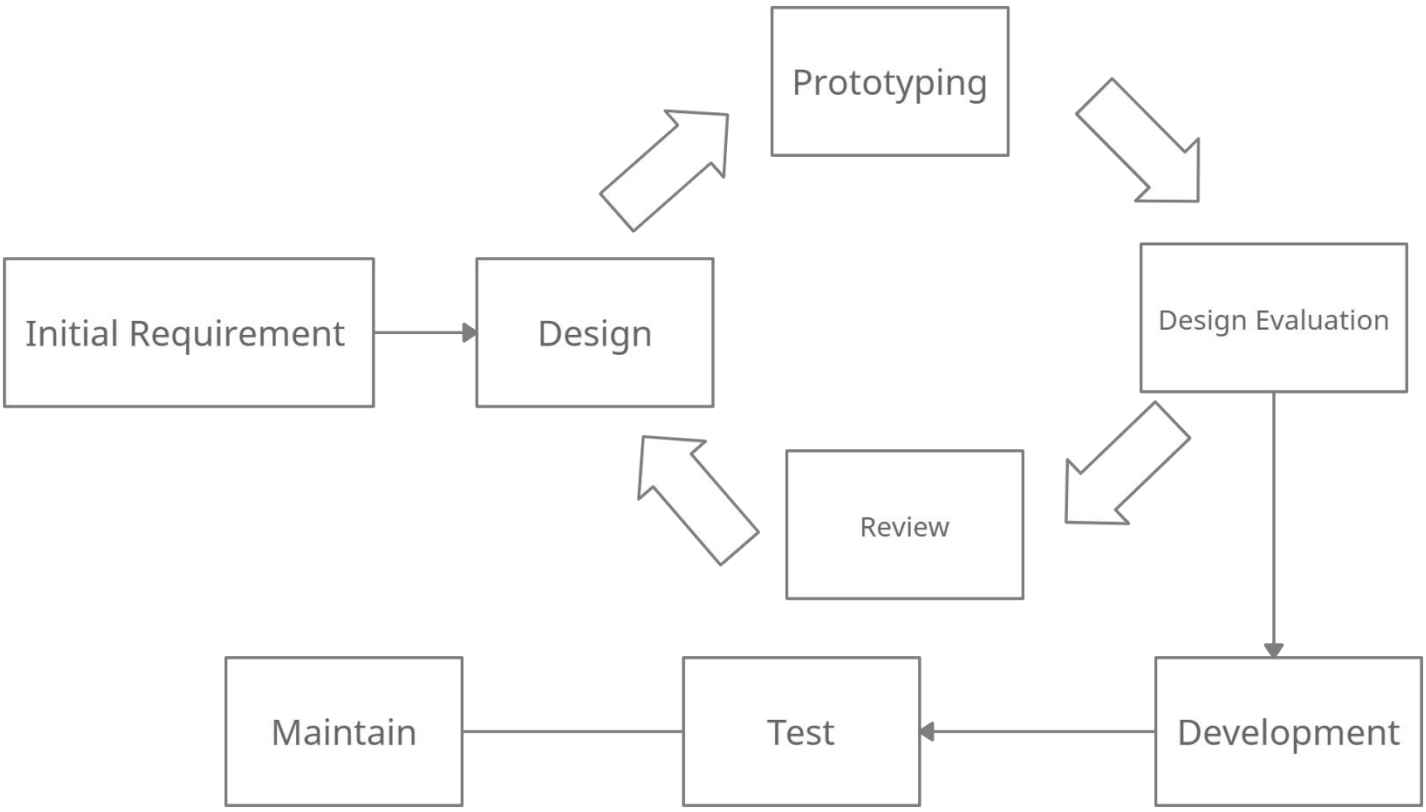



FIGURE 6 1 PROTOTYPING

When it comes to the software development of this project, we use a different development approach. We decided to use a different approach because we wanted to develop the applications, without being affected by the hardware like Arduino.

This project comes with two applications. One is a Desktop application and other one is for Mobile. To work this project, vehicle must have a prebuilt computer runs Windows OS. Most of the modern vehicles comes with a prebuilt minicomputers that are mounted on the dashboard of a vehicle. This desktop application runs on that minicomputer.

Both Desktop and Mobile applications are straight forward. They include UI and some triggers to detect any kind of unusual momentum of the vehicle like accidents and crashes. So, the approach is waterfall methodology.

Requirements for these two apps are simple. To send a message to the emergency services with the GPS location if there is no response from the driver incase of an accident. The optional features is to send a message to the driver when the drivers is outside, and something unusual momentum detected on the vehicle. There is no need to trigger the desktop application if the driver is outside.

To implement these applications, we do not have to wait until the hardware side which includes the sensors and control unit are build, to completed. The desktop application is build using Windows Presentation Foundation(WPF) and it includes the main triggers for the project. It will include the thresh values to trigger the event. When the event is triggered, UI will prompt to get the user response. If there is no any response, the WPF application will activates the GSM Model to send a message to the emergency services with location where it is triggers. When it comes to the mobile application, it will only triggers when the driver is outside the car. The scenarios are vehicle is hit by some other vehicle when it is parked or any attempt to a thievery is happening. The sensors install in the device will detect this kind of motion and alert the driver by sending message to the mobile application. These are the only requirements to be implemented in the project. There will be not any modifications to the project. So, the best approach to develop the software are by waterfall model.

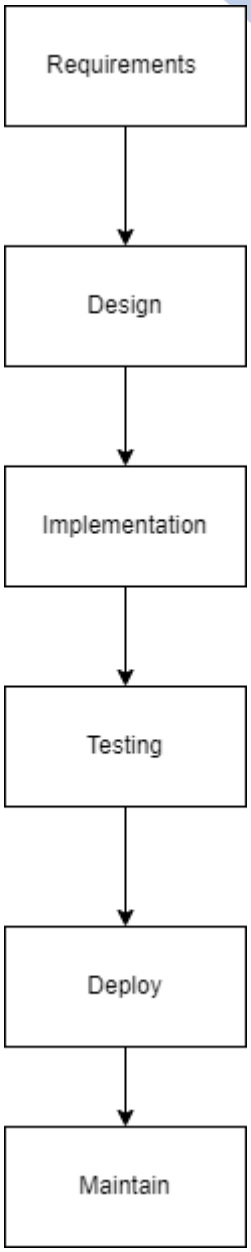



FIGURE 6 2 WATERFALL METHODOLOGY

## Programming languages and tools

The software development tool that is being used mostly is Visual Studio. Most of the main functionality is included in the WPF application, so it is built on Visual Studio. The language is being used in WPF code behind is Visual C#. To develop the GUI for the WPF, XAML is used. XAML is an Extendible Application Markup Langued that is used in many Windows environment. By using XAML developers get access to fully customize any element that are used in application. The framework used by WPF is .NET.

When it comes to the functionalities, C# is the programming language is used in WPF. All the business logics and functionalities are implemented by using C#. C# is an Object-Oriented Programming Language, so we can easily handle all the models used in the application.

All of these are used in Visual Studio Environment. Visual Studio is a user-friendly developer tool that comes with many features to use during the development.

When it comes to the Mobile Application Development, we have decided to use Kotlin programming language. Kotlin is also an Object-Oriented Programming Language. So, design of the mobile application is reliable as WPF. Most importantly, Kotlin is native for android development, so we can integrate and use to all the functionalities of an Android mobile phone. Kotlin is now Google's favorite Android development language. To develop the mobile application using Kotlin is done by Android Studio.

We are using Arduino Controller Unity to read the sensor values. So, C++ language is used to develop Arduino program to read sensor values. This program is developed in Arduino IDE.

## Third Party Components and Libraries.

One of the sensors we are using in the project is a accelerometer sensor. The sensor is MPU6050. To read the values from that sensor, we have used a library call, MPU6050.h. It is developed by "Korneliusz Jarzebski". This library will do most of the calculation to get somewhat meaning full values to use in the project. This library will return raw values of current momentum of the sensor.
https://github.com/jarzebski/Arduino-MPU6050

## Algorithms

The only algorithm that will be used in this project is to get a meaning full reading from the raw data that are returning from MPU6050 library. We do a small calculation to get the current momentum of the device and send the readings to the WPF application.

## Hardware tools

- Soldering iron
  - To solder sensors
- Breadboard
  - To build the prototype and demonstrate. We will not solder the components to a circuit board
- Pin headers
  - to connect data pins of modules and sensors.
- Jumper wires
  - To connect the modules and sensors with the controller unit

## Summary

In this chapter we have discus about the technologies and hardware/ software tools we are using to build this project. To integrate with sensors, we are using an Arduino based controller Unit (Arduino Uno/ ESP8266). Controller unit will read the sensors values. To do that first we need to connect them all together. Since the approach is prototyping, we use a breadboard for all prototyping and demonstration purpose. After calculating values from the connect modules and sensors and send them to the WPF Application through serial port and continue with any logics included in the application. From there, it will connect the mobile application that is built in Kotlin to interact with the user. The final build of this project is a working prototype that we will demonstrate all the functionalities and features.

# Discussion

## Overview

This project comes with a device to detect an accident, Desktop application to interact with user and a mobile application to get notify if the driver is outside the vehicle. This device will help a driver to survive a fatal injury because the time will be spared because of this project. The device consists of an Arduino board, and few sensor and module components to function this system. This device will connect to WPF application and handle any logic components need to be executed in order to work the system properly. And then it will be connected through Azure IOT Hub with a mobile device to send messages to the driver.

## Summary

In this report we have discus about how we are delivering the system. During the development time we have learnt different approaches to deliver the best out of it. In that case choosing "Prototyping" as a development methodology is a good decision taken from the planning leader. When it comes to the safety of the device not only the durability of the device, but also we need to safeguard the users' privacy since this system will send data about location.

## Challenges faced

When developing this project, we needed to identify a way to check the vehicle is rolled or not, that was the main problem we faced and there was a problem at sending data to the emergency line, fist we thought to send it via WIFI but the problem was sometimes WIFI will not be there when an accident occurs so we figured out GSM module will be a good way to send data to the emergency line. Ad for the first problem we faced we found out the digital gyroscope will help to solve our problem.

As Hardware problems depilated, huge software problems occurred in our system. We couldn't get the data out from the board to the PC so we implemented a way to monitor the serial port using Arduino and get the data to our GUI prototype program to see whether our device is working or not.

## Development task and future plans

To develop this project we need to build hardware and software. We devolved this software parallelly using Arduino and raspberry pi. We have a future plan to make this to the motorcycle as well and give this safety opportunity to every driver.

| Member | Plymouth index no | Name | Task carried out | Future plan | Comment by the group leader |
|---|---|---|---|---|---|
| 1 | 10747919 | Rathnayaka Rathnayaka | Hardware based algorithm and hardware deployment | Optimizing the current system | Group Leader |
| 2 | 10749057 | Bandara Yapa | Hardware testing and troubleshooting | Hardware troubleshooting | Very helpful with every task and help each other out to accomplish this common goal. couldn't ask for a better group |
| 3 | 10747887 | Rathnayake Rathnayake | GUI based algorithm and hardware connection | Optimizing the current system | |
| 4 | 10747909 | Sandaruwan Rajapaksha | Hardware testing and troubleshooting | Hardware troubleshooting | |
| 5 | 10747883 | Subasinghe Rajarama | GUI based algorithm and troubleshooting | Building the optimized hardware | |

TABLE X 1 TEAM PLAN AND RESPONSIBILITIES

# End of the paper