

**ACCIDENT IDENTIFICATION & ALERTING SYSTEM (AiA)**

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# **Accident Identification & Alerting System**

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Diploma Electronic Engineering (Communication)

Jabatan Kejuruteraan Elektrik  
Politeknik Sultan Salahuddin Abdul Aziz Shah

**JUN 2017**

## ENDORSEMENT

**“I hereby acknowledge that I have read this report and I find its contents meet the requirements in terms of scope and quality for the award of the Diploma in Electronic Engineering (Communication)”**

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## **ABSTRACT**

Malaysia noted the high mortality rate caused by road accidents. In 2016, total of 7,152 people died in road accidents in Malaysia, an alarming jump from 6,706 deaths in the year before. Furthermore, some obstacle experienced by emergency unit to get the information of the accidents to approach the victims. Thus, the objective of this project which is to give the exact location of the accident and to accelerate the rescue period implemented indirectly. This is done by using a shock sensor to detect the frontal impact experienced by the car and the vibration sensor to evaluate the collision impact. The GPS and GSM technologies are interfaced in the system using Arduino to link the accident information to the emergency unit. The results are the needed information such as longitude, latitude of the location, date and time, current speed of the car, the impact value detect by the sensors were sent to the smartphone. So, this accident identification and alerting system have accomplished the objectives successfully.

## **ABSTRAK**

Malaysia mencatatkan kadar kematian yang tinggi disebabkan oleh kemalangan jalan raya. Pada tahun 2016, sebanyak 7152 orang mati dalam kemalangan jalan raya di Malaysia, melompat dari 6,706 kematian pada tahun sebelumnya. Selain itu, beberapa halangan yang dialami oleh unit kecemasan untuk mendapatkan maklumat kemalangan untuk mendekati mangsa. Selain itu, beberapa halangan yang dialami oleh unit kecemasan untuk mendapatkan maklumat kemalangan untuk mendekati mangsa. Oleh itu, objektif projek ini adalah untuk memberikan lokasi sebenar kemalangan dan mempercepatkan tempoh menyelamatkan mangsa. Ini dilakukan dengan menggunakan sensor kejutan untuk mengesan kesan frontal yang dialami oleh kereta & sensor getaran untuk menilai kesan perlanggaran. Teknologi GPS & GSM dihubungkan dalam sistem menggunakan Arduino untuk menghubungkan maklumat kemalangan ke unit kecemasan. Hasilnya adalah maklumat yang diperlukan seperti longitud, latitud lokasi, tarikh & waktu, kelajuan semasa kereta, nilai impak perlanggaran oleh sensor telah dihantar ke telefon pintar. Oleh itu, sistem pengesanan dan amaran kemalangan ini berjaya mencapai matlamat dengan jayanya.

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# **CHAPTER 1**

## **INTRODUCTION**

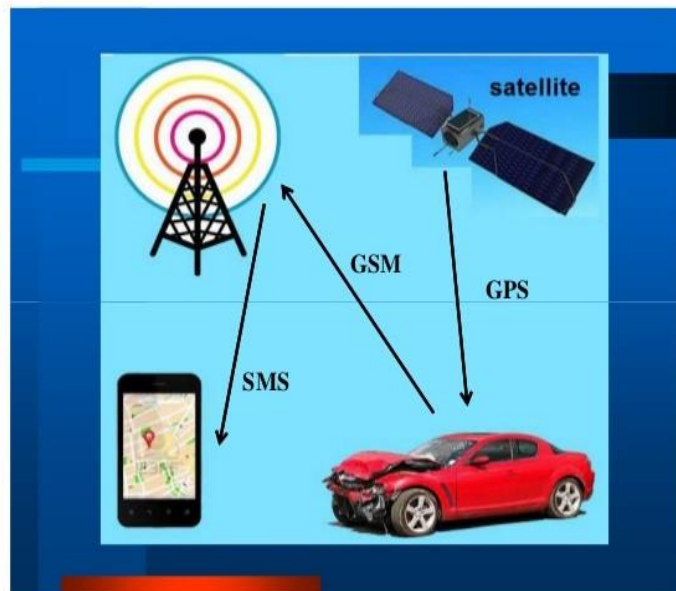
This chapter will discuss about the introduction of this project, which includes the project background ideas and the problem statements. The aims and objectives of this project will be discussed too as well as the research scopes and limitations.

### **1.1 BACKGROUND**

Malaysia's accident rate is ranked as the one of the highest in the world. The bad habits of Malaysian drivers who like to speed without considering the risks is one of the contributory factors for the high accident rate in the country. On the average, there are 18 deaths each day due to road accidents and that 300 000 children are made orphans because this trend. This situation is very worrying and that the government is confident that the best way to handle the issue is to educate the public and create awareness of the importance of road safety and road courtesy at grassroot levels. There are many causes of accidents. This includes dangerous driving, technical faults, weather, road signage and design of the roads. However, the improvements in term of automobile technology in term of safety have achieved certain level. Road signage and road designs have also being improved, where various blackspots have been identified and studies have been carried out to mitigate the causes of the road accidents. However, it was found that the accident rates still keep increasing year by year.

### 1.1.1 PROJECT IDEAS

Thus, in our final year project, we innovate the system using a shock sensor & vibration sensor which is acting as a high-impact collision detector. When some car driver, drive the car with high speed then meets with an accident, there is a chance that the individual may suffer from a serious injury or fatal instantaneously and there is no one around to help him. The car drove with high velocity will result on high momentum. Well this system is a solution to the problem. The system known as “Accident Identification & Alerting System” is the conceptual of the uses of communication system to transmit information to the emergency unit. This is done by using a shock sensor to detect the frontal impact experienced by the car and the vibration sensor to evaluate the collision impact. The GPS and GSM technologies are interfaced in the system using Arduino to link the accident information to the emergency unit. The result are the needed information such as longitude, latitude of the location, date, time, current speed of the car ,the impact value detect by the sensors were sent to the smartphone. The emergency unit will read the message info send by the GSM & respond to it, reach the accident location and help the needful. The figure 1.1 below illustrate the basic concept of communication system.



**Figure 1.1 : The concept of accident information sent through the communication system**



## **1.2 PROBLEM STATEMENTS**

There are some of the problems that we have identified before proceed to another process in order to come out with a significant of project development.

### **1.2.1 DETERMINATION OF CONSUMERS' TOWARDS SAFER CAR PURCHASING**

In Malaysia, car safety level has been elevated through regulation and consumer based approach. Customer has many choices of cars but they must be encouraged consumer to buy safer cars. They are many factors contributing to consumers' purchasing decisions of specific cars. Among those are price, brand, safety aspects, fuel economy, maintenance, reliability, interior and luggage space, performance, resale value and vehicle size. [1].

It is understood that consumers' need for safer vehicle is promising in Malaysia [2]. Hence, the author wanted to investigate how consumers decided/intended which safe car to purchase and what factors influenced this purchase decision process. The problem behind this car purchasing perhaps some consumers' choose the lesser price car instead consider a safety features. .In a customers' view the high specifications of car, the more the price should they have to paid on.

However, the current situation shows that the industry is facing intense competition from foreign brands which would threaten the sales and performance of the national car brands; Proton and Perodua. Sadoi (2000) reported that the automotive industry of Malaysia has, until now, not reached the level of international competitiveness. Particularly, the automotive industry still suffers from a lack of quality and high prices. The author added that low quality and high costs of production are largely due to the high dependence on imports. [3]

### **1.2.2 AMBULANCE RESPONSE DELAY**

Ambulances are late to a third of life-threatening emergencies, shocking figures reveal. In the year to August, more than 1.1million critically ill patients were left waiting for an ambulance longer than the target of eight minutes.

They included victims of cardiac arrests, strokes and road traffic accidents. Some had to wait for nearly two hours.[4]. Often we heard complaints from the public that the ambulance service is slow. When these things happen, people will easily judge angrily to the government hospital ambulance service.

For the information of all ambulance response delay are based on the following :

1.2.2.1 The caller gave inaccurate information.

1.2.2.2 The other cause is damage to road signs or unreadable due to many illegal advertisement sticker and covered with trees branches.

1.2.2.3. The caller outside the reach of the area. (no networking/signal)

1.2.2.4. The caller did not know the area.

### **1.3 OBJECTIVES**

The main objective of this project is to develop a low cost, safety & practical in-vehicle system that can be applied to all types of car. Several others objectives that we want to achieve during the development of this project are :

1.3.1 To develop a system that can report the accident by give the exact location of the accident.

1.3.2 To design the system that can evaluate the collision impact faced by the car during accident.

### **1.4 LIMITATION**

As the findings, the factor of the vehicles accident caused by speeding. It will be there a limiting rule or circumstance in every product or project The limitation of this project is :

1.4.1 Does not cover the presence of fire during events occur.

1.4.2 The system cannot send a message when outside the reach of the coverage area. (no networking/signal)

## 1.5 SCOPE

The scopes of this project are :

1.5.1 The system are focusing on major road accident.

1.5.2 Cover the frontal car crashes (full overlap or small overlap).

1.5.3 Focused on a road vehicles such as car (compact, sedan, MPV, SUV and 4x4 ).



Sedan Car



MPV Car



SUV Car



4x4 Car



Compact Car

**Figure 1.2 : The type of cars**

## **CHAPTER 2**

### **LITERATURE REVIEW**

In order to complete this project, several journals or articles that use similar methods are selected as a reference. All the theories behind this project will be mentioned, such as the relationship between the speed and the severity of injuries that can cause many effect during the accident.

#### **2.1 ACCIDENT ARE THE MAIN CAUSE OF DEATH**

Road accident is one of the major causes of death and injuries in Malaysia. In the year 2001, the total number of road accidents was 265,175 with fatalities of 5230, seriously injured 6942, and slightly injured 30,684. It is a shocking fact that road accidents kill more people in other developing countries too, every year, than war and disease. In Asia alone, 400,000 people are killed on the roads annually and more than four million injured. According to WHO, every year, nearly one million people are killed, three millions are severely disabled for life and thirty millions are injured in road traffic accidents. The social and economic, economical cost of these accidents is also so high that it would be sufficient to buy the world total production of cereals each year! Furthermore, the number of accidents is in constant increase throughout the world. In 1990, death on road accidents remained in 9<sup>th</sup> rank; and by 2020 road accidents will be the third leading cause of death worldwide [5].

## **2.2 CAR SPEEDING AMONG DRIVER**

Many road accidents caused by driving a car at high speed even if there are some other contributing factors as well. The higher the speed of a vehicle, the shorter the time a driver has to stop and avoid a crash. A car travelling at 50 km/h will typically require 13 metres in which to stop, while a car travelling at 40 km/h will stop in less than 8.5 metres. Travelling at 5 km/h above a road speed limit of 65 km/h results in an increase in the relative risk of being involved in a casualty crash that is comparable with having a blood alcohol concentration of 0.05 g/dl. For car occupants in a crash with an impact speed of 80 km/h, the likelihood of death is 20 times what it would have been at an impact speed of 30 km/h.[6]

## **2.3 IN-VEHICLES SYSTEM FOR SAFETY**

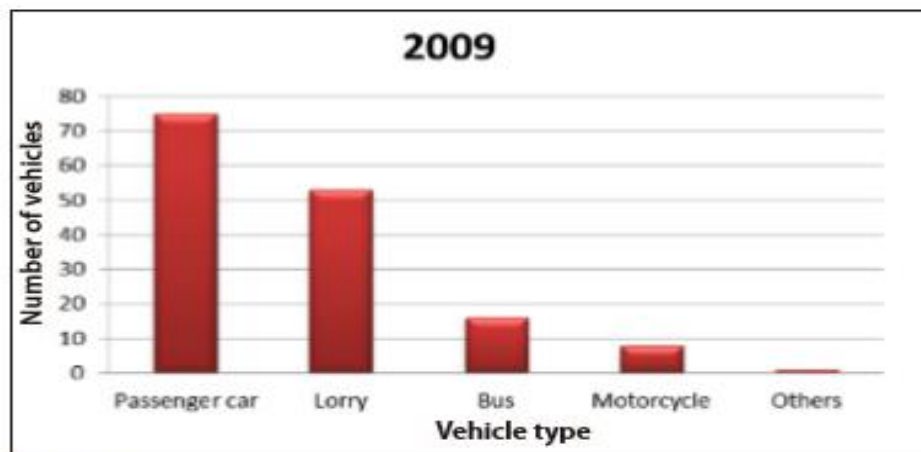
In Malaysia, the existence or knowledge of the car driver toward in-vehicle system still under surface layer (not commonly used) which it is truly expose at the other countries in a period of time ago. Technology in vehicles is growing rapidly in communities around the world with the establishment of numerous research on a system that can provide accident information to the emergency unit. For instance, some researchers from United States, South Australia, & India have done their thesis toward the in-vehicle technologies generally known as Automatic Collision Notification (ACN).[7] The potential objectives of this ACN system are almost the same which is to fast the time of rescue, detect the vehicles location, estimates the crash severity & the probability of serious injury or fatal. In-vehicle systems are fast becoming a key instrument in encouraging the adoption of eco-driving practices and have the potential to lead to reduction in fuel consumption and improved road safety by providing eco-driving advice to drivers [8].

## **2.4 THE TRAFFIC MORTALITY RATES INCREASES**

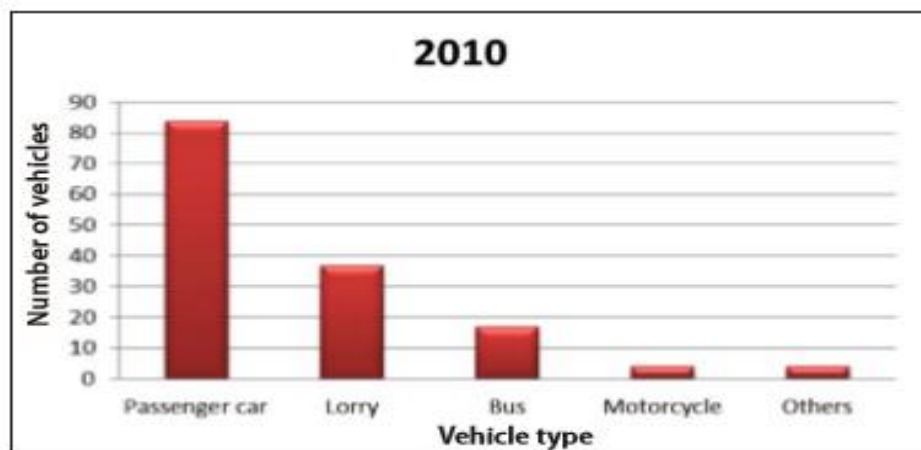
Increasing rate of accidents is actually associated with an increased number of vehicles on the road. Malaysia also noted the high mortality rate caused by road accidents. Transport Minister, Liow Tiong Lai said the number of vehicles increased to 19 million, also contributed to the accident rate in the country. "Every year, there

are about 400,000 to 500,000 new driver and also cause increased accident rates and we need to contain it.". Passenger cars, which include vans, multi-purpose vehicles (MPVs), sports utility vehicles (SUVs) and four-wheel drives (4WD), are the most common types of vehicles involved in the overall investigated cases for 2009 through 2010

According to MIROS statistics on investigated cases by crash type, head-on collision is the most common type of crash referring to the year of 2009 & 2010.



**Figure 2.1 : Investigated cases by vehicle type,2009**

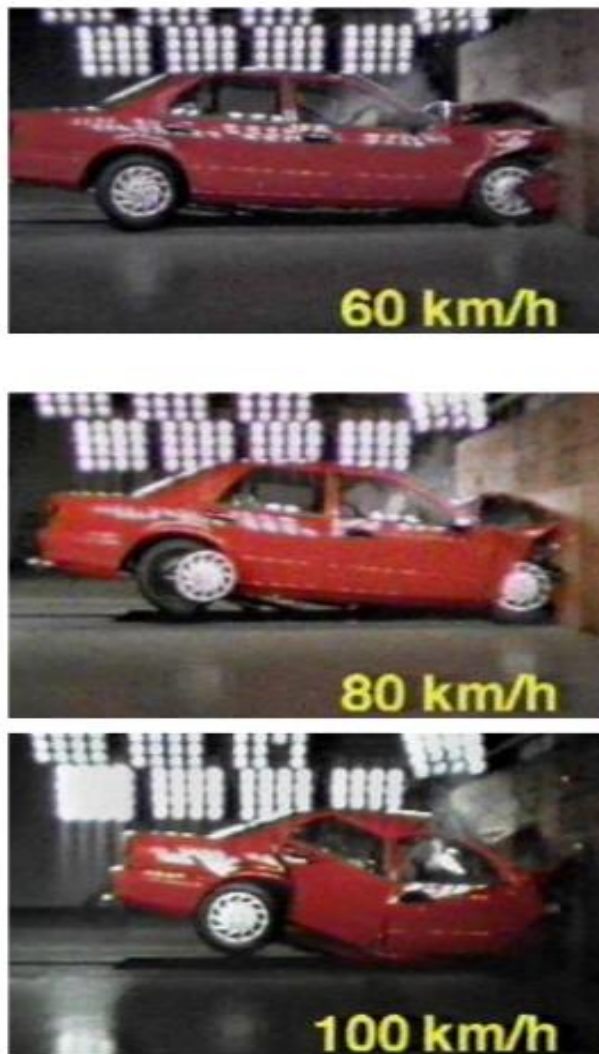


**Figure 2.2 : Investigated cases by vehicle type.2010**

Government take a serious action toward this accident statistics and to address the issue of road safety in a holistic manner, the government has taken various measures to adopt intervention approaches 5E. This approach encompasses education, enforcement, engineering, the environment and assessment.

## 2.5 HIGH IMPACT FACED BY THE CAR

The NSW Roads and Traffic Authority carried out a series of full-frontal crash tests using the same model of vehicle at increasing speeds. The pictures (and dummy injury measurements) confirm that an impact speed of 60km/h is a very severe crash. Higher speeds result in collapse of the passenger compartment and a grave risk of life-threatening injury. Even the most crashworthy vehicles available today are unable to safely protect occupants at frontal impact speeds greater than 70km/h

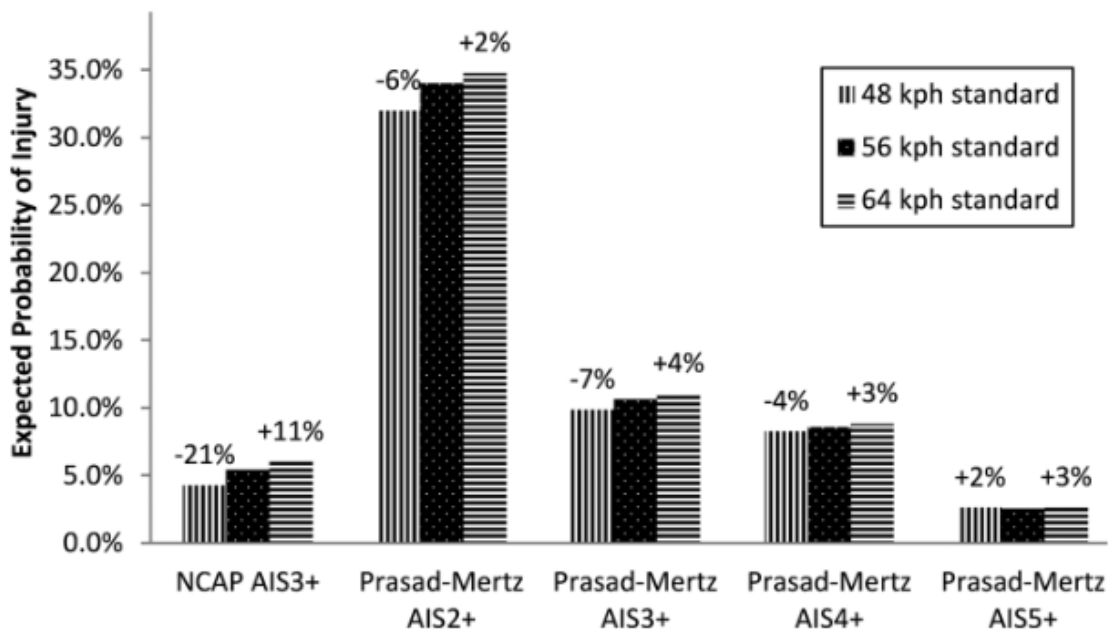


**Figure 2.3 : The severity of impact by a different speed**

## 2.6 SEVERITY OF INJURY BASED ON DIFFERENT SPEED

One possible concern arising from these results is the impact on more severe injuries. While serious injuries may occur frequently at relatively low crash speeds, fatal injuries are rare at these low speeds and much more likely at high, less frequently occurring crash speeds. For the same three vehicles, the four rightward bar groupings in Figure below show the expected probability of four different injury severities from the AIS:

1. moderate (level 2),
2. serious (level 3),
3. severe (level 4)
4. critical (level 5)



**FIGURE 2.4 : The expected probability of four different injury severities from the AIS:**



## **2.7 HIGHER SPEEDS CAUSE MORE ACCIDENTS**

Higher speeds mean that drivers have less time to identify and react to what is happening around them, and it takes longer for the vehicle to stop. It removes the driver's safety margin and turns near misses into crashes.

Around two-thirds of crashes in which people are killed or injured occur on roads with a speed limit of 30 mph or less. At 30 mph vehicles are travelling at 44 feet (about 3 car lengths) each second. One blink and the driver may fail to see the early warning brake lights; a short glance away and the movement of a child behind a parked car will be missed. Even in good conditions, the difference in stopping distance between 30 mph and 35 mph is an extra 21 feet, more than 2 car lengths.

## **2.8 HIGHER SPEEDS CAUSE MORE SERIOUS INJURIES**

The risk of injury in any collision is influenced by many factors, including the vehicle's speed, its design, strength and occupant protection systems, whether the occupants were wearing seat belts, the nature of the other vehicle(s) or object(s) struck, and the medical care received by the victims.

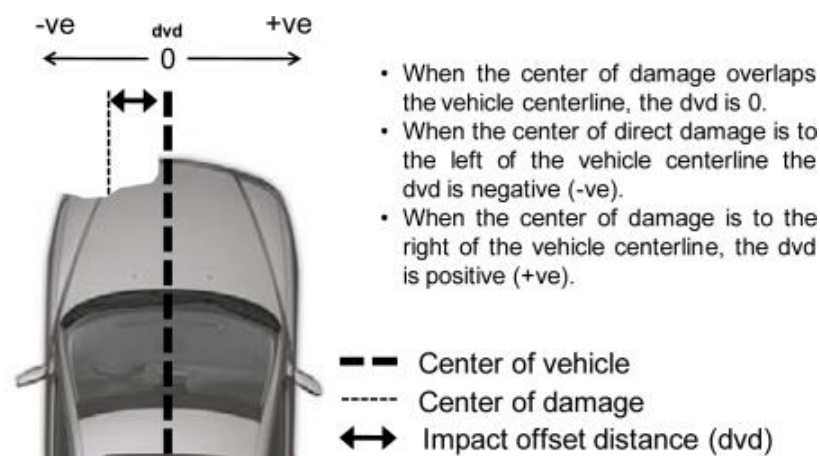
However, car drivers are much more likely to be injured in collisions at higher speeds. On average, in frontal impacts, belted drivers have a 17% risk of being fatally injured in impacts at 40 mph and a 60% risk at 50 mph. Having said that, half of drivers who were fatally injured, were in an impact of 34 mph or less.

## **2.9 METHOD FOR REAL-WORLD CRASH DATA**

The NASS-CDS is a nationally representative sample of police-reported crashes tow-away crashes that occur within the United States [9]. Each year, a sample of approximately 4,500–5000 detailed crash case reports are compiled by trained NASS crash investigators. These reports contain a wide range of data related to the overall crash, the vehicles involved (including exterior and interior damage measurements), as well as occupant biometric and injury profiles.

As NASS-CDS is a representative sample, each case in the sample is assigned a weighting factor that approximates the frequency to which a given crash occurs. The weighing factor is the inverse probability of a sampled crash occurring within the overall population of police reported tow-away collisions.

In addition to the CDC, NASS-CDS crash investigators will document specific vehicle crush measurements for each of the involved vehicles [9]. These measurements include both the direct damage width (DIRDAMW), and the impact offset distance (DVD). In frontal collisions, the DVD is the distance between the center of direct damage and the centerline of the vehicle (Figure 2.5).

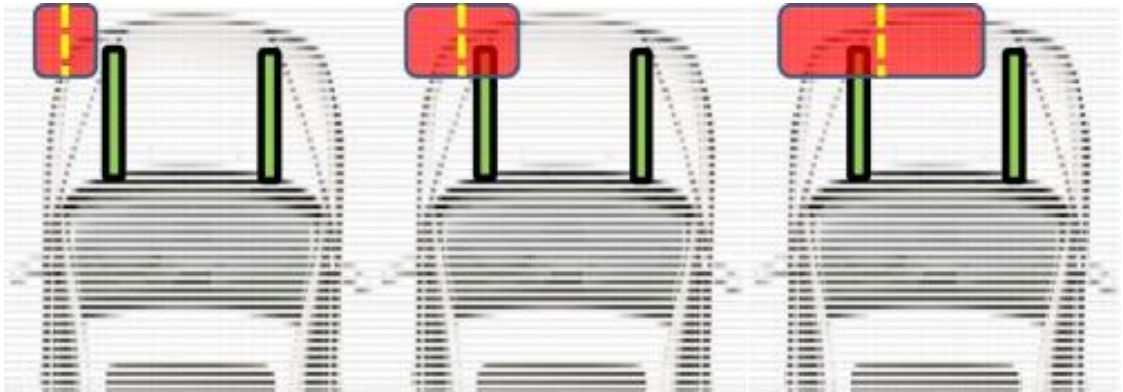


**Figure 2.5 : Impact offset distance (DVD) [9].**

## 2.10 OFFSET, MODERATE OFFSET, AND SMALL OVERLAP COLLISION

Sherwood et al. assessed the characteristics of “small-overlap” frontal crashes that resulted in serious injuries [10]. Using NASS-CDS data Small-overlap vehicles were identified using the Collision Deformation Classification as well as an in-depth case review of damage profiles and crash images from NASS-CDS cases. A total of 21 cases were selected for analysis. In each of the cases analyzed there was intrusion to the occupant seating position. Of all small-overlap serious injury cases, impacts to narrow fixed objects and oblique angled collisions were found to be the most commonly occurring crash. This study concluded that “despite structural improvements prompted by offset crash tests, vehicle structures must improve if they are to prevent occupant compartment intrusion when a vehicle is loaded outboard of the longitudinal structural members.”

In this study, the term “small overlap” is defined as the vehicle damage profile that occurs as the result of a frontal collision, with damage localized outside of the frame rail structure. Some of the studies referenced in the introduction may define the small overlap crash differently, allowing for partial engagement with the longitudinal rail on the struck side.



**Figure 2.6 : Diagram of small overlap, moderate-offset, and offset classification**

The diagram in Figure 2.6 illustrates the taxonomy definition for small overlap, moderate offset, and offset damage respectively. For this study, if the direct damage was located entirely outside the vehicle frame rails, the collision was classified as a small overlap frontal crash. For moderate offset damage, the direct damage overlaps the vehicle frame rails, with the center of damage outside of the frame rails. In offset damage the direct damage overlaps the vehicle frame rails, with the center of direct damage between the frame rails. The crush pattern does not have to begin at the outermost edge of the vehicle.

## CHAPTER 3

### METHODOLOGY

This chapter will describe the methods that used in this project. Describes the rationale for the application of specific procedures or techniques used to identify, select, and analyze information applied in order to make everything more systematic, manageable and easier to troubleshoot. Gantt chart is one of the important things to make sure to manage this project properly and it's simple to understand and easy to construct. Gantt charts are a project planning tool that can be used to represent the timing of tasks required to complete a project or other research. Gantt chart of this project will be attached as well.

#### 3.1 HARDWARE AND SOFTWARE

The project hardware and software of this project were identified when we do the research on a several articles or journal that related to our project. Read others articles is one of the first step for us to do a project in order to get a eligible references and information about the project. Furthermore, to know the new ideas that we should innovate from any kind of existing project.

**Table 3.1 : Hardware specifications**

NO	COMPONENTS	QUANTITY
1	Shock sensor	1
2	Vibration sensor	1
3	Arduino microcontroller	1
4	GSM modules	1
5	GPS modules	1

### **3.2 THE IMPORTANCE OF GSM MODULES IN COMMUNICATION SYSTEM**

GSM (Global System for Mobile communication) is a digital mobile telephony system that is widely used in Europe and other parts of the world. GSM uses a variation of time division multiple access (TDMA) and is the most widely used of the three digital wireless telephony technologies (TDMA, GSM, and CDMA).

Since many GSM network operators have roaming agreements with foreign operators, users can often continue to use their mobile phones when they travel to other countries. SIM cards (Subscriber Identity Module) holding home network access configurations may be switched to those with metered local access, significantly reducing roaming costs while experiencing no reductions in service.

### **3.3 THE IMPORTANCE OF GPS MODULES TO DETECT THE EXACT LOCATION**

Global Positioning System (GPS) is a space-based navigation system that uses a constellation of satellites to determine the location of the receiving unit on Earth. GPS satellites circle the globe in a precise orbit, transmitting coded radio signals; at least four of their signals can reach any given point on Earth at one time. These signals can pass through clouds, glass, and plastic; the signals weaken when passing through solid objects such as buildings and cannot pass through objects that contain high levels of metals. For land conservation purposes, it is important to note that a GPS unit will not receive satellite signals when under thick forest canopies, underground, or underwater.

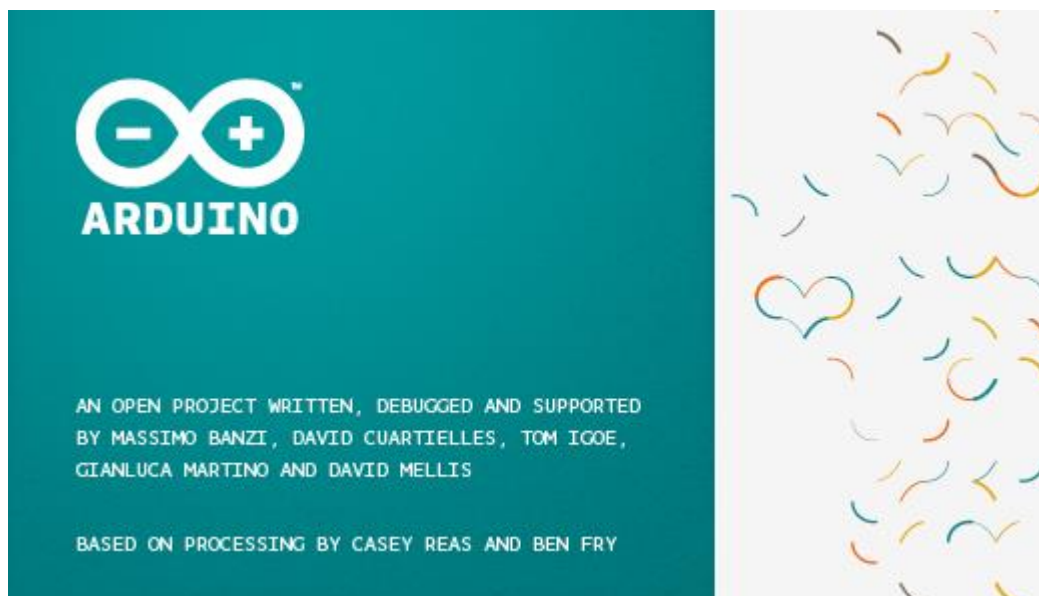
Although GPS was originally developed in the 1980s for military purposes, today the technology provides positioning, velocity, and navigation information for a wide range of users. GPS enables users to map the location of a wide variety of features in the field, such as mature forest, specimen trees, invasive species, soil erosion, fire-disturbed areas, riparian buffers, and waterways. Users can also map human-made features like trails, benches, buildings, roads, driveways, and fences. Once mapped, these features can be easily located with a GPS device on return visits to the property.

### 3.4 ARDUINO SOFTWARE FOR CODING AND TROUBLESHOOTING

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board – you can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the microcontroller into a more accessible package.

The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on Processing and other open-source software. This software can be used with any Arduino board. Arduino board that we use is Arduino R3.

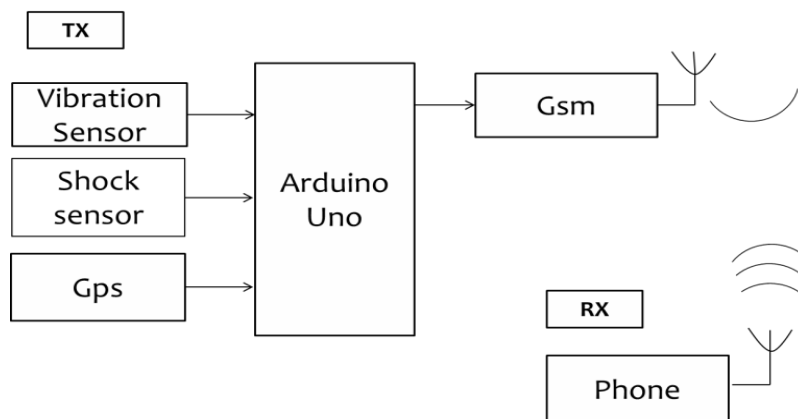


**Figure 3.1 : Software of Arduino programming**

### 3.5 BLOCK DIAGRAM OF THE SYSTEM

At the transmitter the shock sensor and GPS act as input to the arduino. The shock and vibration sensor will detect the collision impact while the GPS will identify the location of the accident. The output of the Arduino is GSM which is send a signal to the receiver (phone).Alerting message will send and display the accident information.

Well this system is a solution to the problem statements. The system acts as an accident identification system that gathers and sends this vehicle information that met with an accident, give the exact location of the accidents and conveys it to the emergency unit. Refer the block diagram below



**Figure 3.2 : The block diagram**

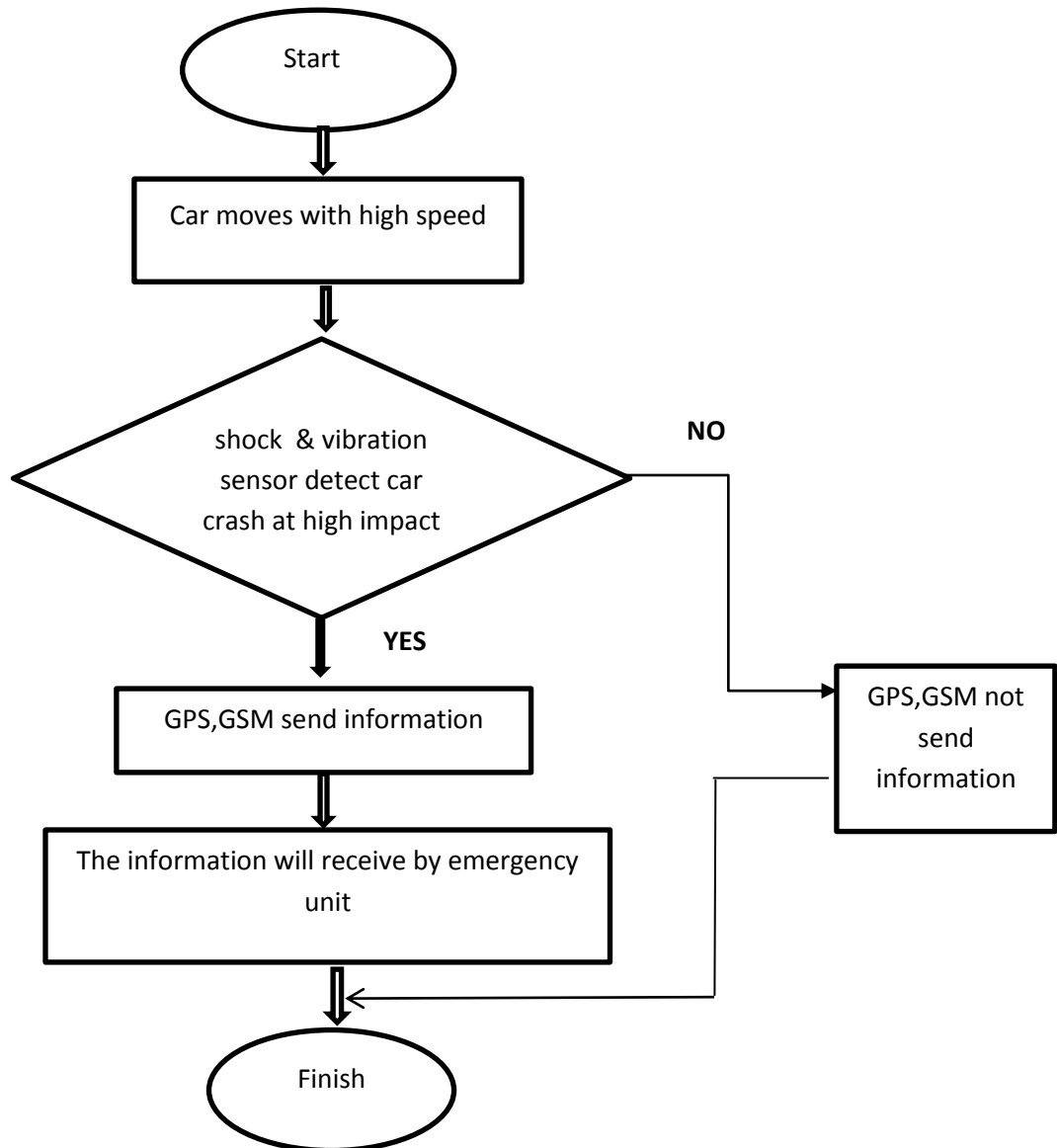
According to Figure 3.2, the methodology used in Global Positioning System (GPS) is a U.S. space based radio navigation system that provides reliable positioning, navigation, and timing services to civilian users on a continuous worldwide basis freely available to all. For anyone with a GPS receiver, the system will provide location and time. GPS provides accurate location and time information for an unlimited number of people in all weather, day and night, anywhere in the world.

Then, GSM was originally defined for the 900 MHz range but after some time even the 1800 MHz range was used for cellular technology. The 1800 MHz range has its architecture and specifications almost same to that of the 900 MHz GSM technology but building the Mobile exchanges is easier and the high frequency Synergy effects add to the advantages of the 1800 MHz range. All of this communication system components have gave many good contributions in accident identification systems.[11].

### 3.6 FLOWCHART OF THE SYSTEM

The system flow chart shows the sequenced processes and steps taken to carry out specific action with the application. This employs a number of symbols for representing entities, decisions, conditions, processes and so on.

When some car driver, drive the car with high speed then meets with an accident, there is a chance that the individual may suffer from a serious injury or fatal instantaneously and there is no one around to help him. Since the system detect the collision by the shock and vibration sensor, the GPS will detect the current accident location. The results is the message will receive by the emergency unit through GSM. The system will continue loop to finish if the input were not triggered.

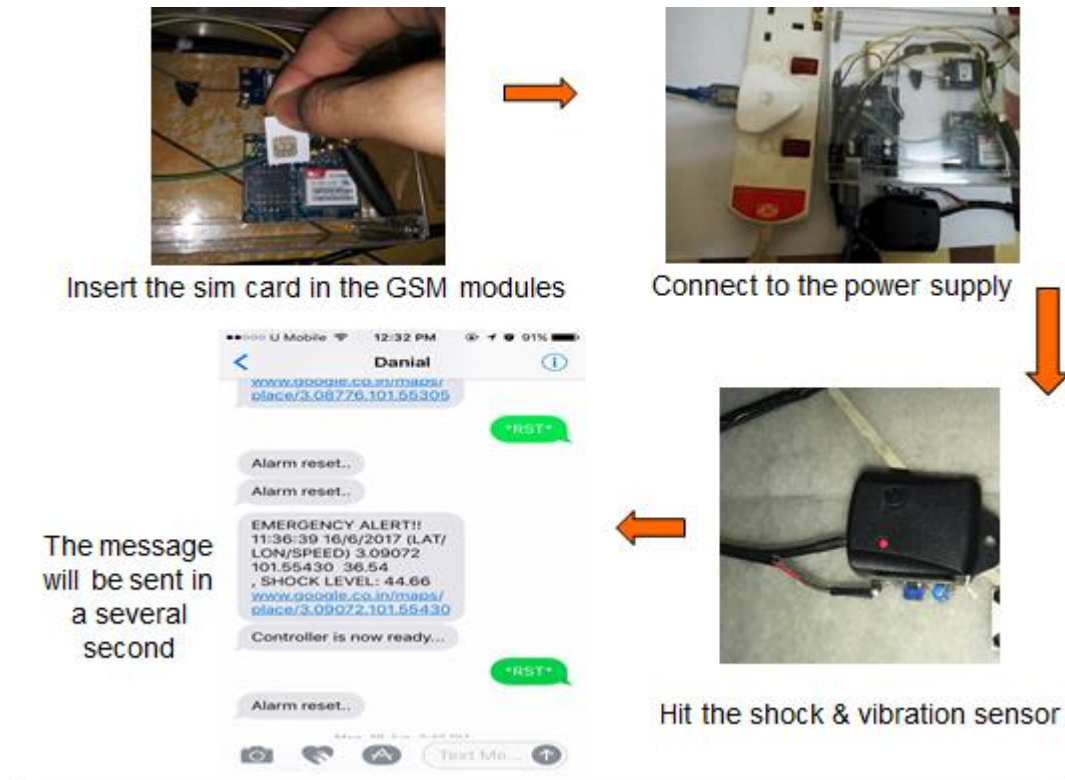


**Figure 3.3 : Process of flowchart**



### 3.7 APPLICATION

The application below must be followed to run this system.



**Figure 3.4 : The flow of the application**

### 3.8 TESTING AND TROUBLESHOOTING

The inspection after the installment of hardware and software of the project should be made to ensure the condition is perfect and function properly. There are a few things to look for when checking, such as :-

3.8.1 Examine the connection of the circuit correct or not, because sometimes the short circuit occurs on the project.

3.8.2 Make sure all wired component solder properly on their pins at the board.

3.8.3 The coding should be compiled to scan an error, before upload it in the Arduino board. GPS are the sensitive component that need to troubleshoot and sometimes it cause of the signal loss (satellite cannot detect)

Every inspection is done with caution because every error cannot be seen. Therefore, patience should be there to ensure the circuit works.

### 3.9 LAYOUT DESIGN

The hard cover to protect the system, we use perspective board. Its height is 4.5 cm, the length is 15 cm, width is 12.5 cm.

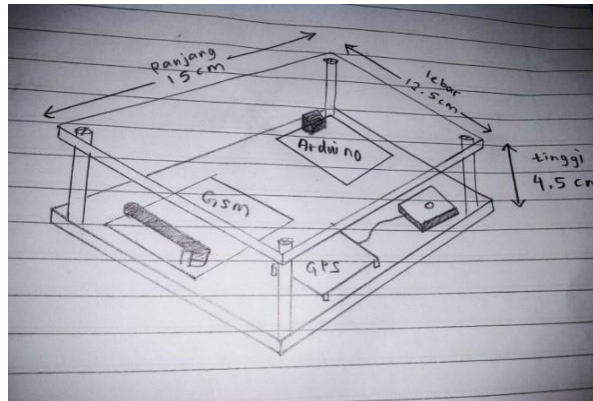


Figure 3.5 : The dimension of height, width & length of design

### 3.10 CIRCUIT DIAGRAM AND COMPONENTS

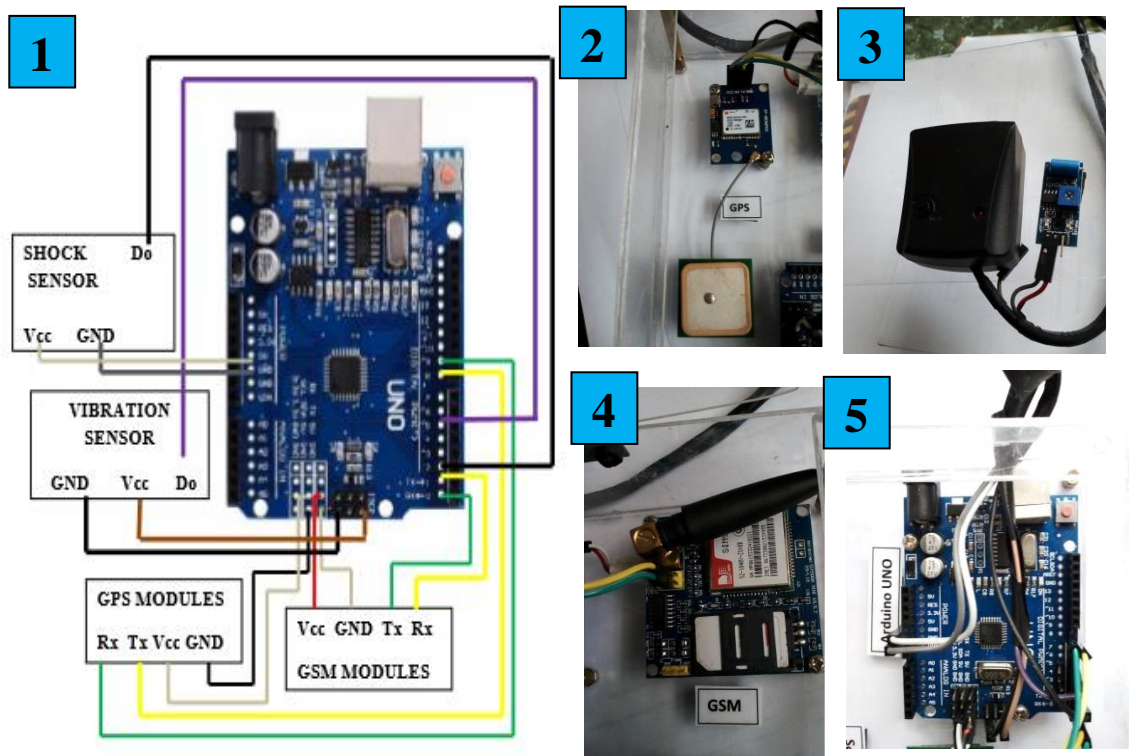


Figure 3.6 : Circuit connection (1) and components (2),(3),(4),(5)

The picture 1 is the overall connection of the Accident Identification and Alerting (AiA) system circuit. While picture 2 is the GPS, picture 3 is the shock sensor(left) and vibration sensor(right), picture 4 is the GSM modules, picture 5 is the Arduino microcontroller board.

### 3.11 EXPLANATION OF THE CIRCUIT DIAGRAM

In the block diagram, the whole process of the system were explained briefly. Through this circuit explanation, the overall connection of wire will be explained in details. To ease our understanding the explanation will be in the form of table. Refer Table 3.2 :

**Table 3.2 : Wire connection of the circuit**

TERMS	COMPONENTS	CONNECTION
INPUT	Shock Sensor	<ul style="list-style-type: none"> <li>- the black wire were connected to Arduino Pin 2</li> <li>- the grey wire were connected to Arduino Pin GND</li> <li>- the white wire were connected to Arduino Pin 5V</li> </ul>
	Vibration Sensor	<ul style="list-style-type: none"> <li>- the purple Digital Output wire were connected to Arduino Pin 5</li> <li>- the brown (Vcc) and black (GND) wire were connected to Arduino Pin ICSP (In-Circuit Serial Programming)</li> </ul>
	GPS Modules	<ul style="list-style-type: none"> <li>- Tx yellow wire were connected to Arduino Pin 8</li> <li>- Rx green wire were connected to Arduino Pin 9</li> <li>- Vcc white wire were connected to Arduino Pin 5V</li> <li>- GND black wire were connected to Arduino Pin GND</li> </ul>
OUTPUT	GSM Modules	<ul style="list-style-type: none"> <li>- Tx green wire were connected to Arduino Pin 1</li> <li>- Rx yellow wire were connected to Arduino Pin 0</li> <li>- Vcc red wire were connected to Arduino Pin 5V</li> <li>- GND white wire were connected to Arduino Pin GND</li> </ul>

Arduino compatible board will have 2x3 pin ICSP header on them. It breaks out three Serial Peripheral Interface (SPI) pins (SCK, Power, GND, Reset) SPI use to send data between microcontroller and sensor. The uses of different colour of wire are need to distinguish their components part. Most of the components are operating in 5 Volt of directing current. Datasheet of the components are very important to study first before doing the wire connection. While dealing with electrical part, the safety precaution should be not take for a granted to prevent short circuit or any consequences.

### 3.12 GANTT CHART

*Session* : Dis 2016  
*Department* : Jabatan Kejuruteraan Elektrik  
*Code/Course* : DEE 5081 PROJECT 1

**Table 3.3 : Gantt Chart 1**

PROJECT ACTIVITIES	STATUS	WEEKS														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Selecting a group members	R	█														
	L	█														
Drawings and simulate the mini power supply project using proteus	R		█													
	L		█													
Solder the power supply	R			█												
	L			█												
Find & design the casing	R				█											
	L				█											
Evaluation on the mini project by the lecturers	R					█										
	L					█										
Discussion session with lecturers on project research and findings	R						█	█	█							
	L						█	█	█							
Form a complete Proposal in hardcopy	R									█	█	█	█			
	L									█	█	█	█			
Final Year Project 1 presentation	R														█	
	L															█

**Notes : R-Rancang**  
**L-Laksana**

Session : June 2017  
 Department : Jabatan Kejuruteraan Elektrik  
 Code/Course : DEE 6032 PROJECT 2

**Table 3.4 : Gantt Chart 2**

PROJECT ACTIVITIES	STATUS	WEEKS														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Find the suitable sensor for impact detection	R	█														
	L	█														
Build the project hardware properly	R		█													
	L		█													
Compile all coding using Arduino Software	R			█												
	L			█												
Find & design the casing	R				█											
	L				█											
Install the hardware into the finalize design	R					█										
	L					█										
Test & troubleshoot the (software+hardware) interface	R					█	█	█								
	L					█	█	█								
Data analysis & findings	R							█	█							
	L							█	█							
Write a digest paper with a correct format	R								█							
	L								█							
Demonstrate the full project model & presentation in front of supervisors	R									█	█	█	█			
	L									█	█	█	█			
Present for EEEiC	R													█		
	L													█		
Writing a final report	R														█	█
	L														█	█

Notes : R-Rancang  
 L-Laksana

## CHAPTER 4

### RESULTS AND DISCUSSIONS

The discussion of results & data analysis of the project is a theoretical written which is several formula used in this project were described and through the spread of questionnaires to the public in relation of the functions, uses of the circuit and the operation of the Accident Identification & Alerting System (AiA). All the data needed were compiled and analyzed in the form of table and graph.

#### 4.1 RELATED FORMULA

These formula are used to find out the speed by relate the manipulated variable such as height into the formula to get the value of speed.

$$\begin{aligned} \text{Potential energy} &= \text{Kinetic energy} \\ mgh &= \frac{1}{2} mv^2 \\ gh &= \frac{1}{2} v^2 \end{aligned}$$

#### 4.2 APPLICATION OF POTENTIAL ENERGY

Gravitational potential energy is the energy stored in an object as the result of its vertical position or height. The energy is stored as the result of the gravitational attraction of the Earth for the object.

There is a direct relation between gravitational potential energy and the mass of an object. More massive objects have greater gravitational potential energy. There is also a direct relation between gravitational potential energy and the height of an object. The higher that an object is elevated, the greater the gravitational potential energy.

**Gravitational Potential Energy**

$$\text{P.E.} = m \times g \times h$$

**m : mass**  
**g : Gravitational Acceleration**  
**(9.8 m/s<sup>2</sup>)**  
**h : Height**

Buzzle.com

**Figure 4.1 : Formula of gravitational potential energy**

### **4.3 APPLICATION OF KINETIC ENERGY**

Kinetic energy is the energy of motion. An object that has motion - whether it is vertical or horizontal motion - has kinetic energy. There are many forms of kinetic energy - vibrational (the energy due to vibrational motion), rotational (the energy due to rotational motion), and translational (the energy due to motion from one location to another). This equation reveals that the kinetic energy of an object is directly proportional to the square of its speed.

$$E_k = \frac{1}{2}mv^2$$

*E<sub>k</sub> = kinetic energy of object*  
*m = mass of object*  
*v = speed of object*

**Figure 4.2 : Formula of kinetic energy**

#### 4.4 DATA ANALYSIS

This is the collected data that we get to know the capability of the system input which is shock sensor and vibration sensor. The main components that we want to observe is the value of the vibration sensor. While the manipulated variables is the different height to hit the both sensors. As we can see the value of speed will comes out through the formula by the different height.

**Table 4.1 : The data collection**

Height (m)	Speed (m/s)	Speed (km/h)	Value of vibration
0.5	3.13ms <sup>-1</sup>	11.27km/h	5.00
1	4.4ms <sup>-1</sup>	15.84km/h	26.00
1.5	5.42ms <sup>-1</sup>	19.51km/h	0.00
2	6.3ms <sup>-1</sup>	22.68km/h	2.00
<b>2.5</b>	<b>7ms<sup>-1</sup></b>	<b>25.2km/h</b>	<b>9.00</b>

**Example of the calculation at the height of ( 2.5 m ) :**

$$mgh = \frac{1}{2} mv^2$$

$$gh = \frac{1}{2} v^2$$

$$9.81 \times 2.5 = \frac{1}{2} v^2$$

$$24.52 = \frac{1}{2} v^2$$

$$49.05 = v^2$$

$$(49.05)^{1/2} = v$$

$$v = 7ms^{-1}$$

The value of vibration sensor are vary because of it is analog read. So this table of data only valid for our project system. There are not for open references. The data collection is needed for this project because the accident event mostly effect by the speed of the car that can lead to several severity of impact and injuries. By the uses of the related formula have ease us to analyze the relationship between the different height and the reading of the vibration sensor. So, the hypothesis is the higher the speed of the car, the higher the collision impact faced by the car during accident.



#### 4.5 RESULTS OF THE MESSAGE SENT TO THE SMARTPHONE

Figure below show the alerting message that would be sent by the GSM after detect the collision impact. The displayed components consist of the date, time, latitude & longitude, current speed & vibration level. The message that will send to the emergency unit as below.

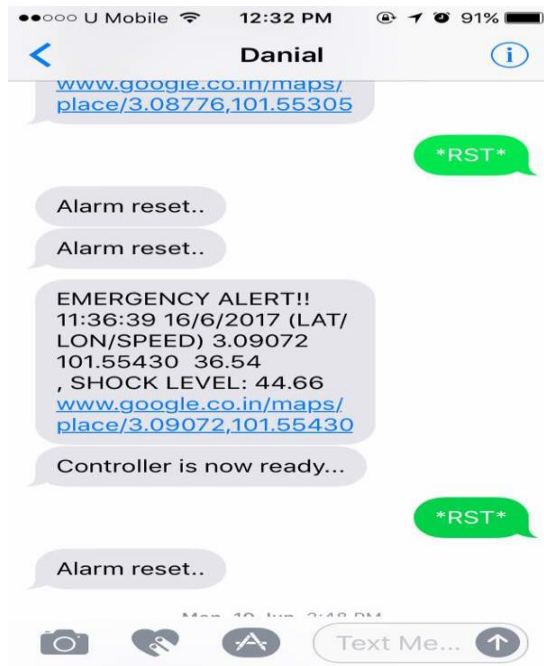


Figure 4.3 : The message sent displayed on the phone

#### 4.6 COST OF THE PROJECT DEVELOPMENT

The total cost for overall development of this project is RM 375.20.

Table 4.2 : The list of cost

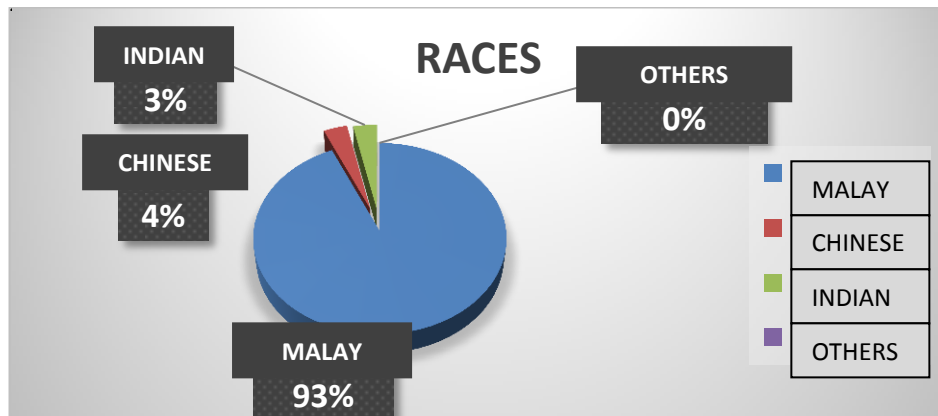
No.	Components	Quantity	Per Unit	Price
1	Arduino Uno	1	RM 30.00	RM 30.00
2	GPS	1	RM 106.00	RM 106.00
3	GSM 900A	1	RM 120.00	RM 120.00
4	Shock Sensor	1	RM 68.00	RM 68.00
6	Bread Board	1	RM 7.80	RM 7.80
7	Jumper wire	30	RM0.23	RM 7.00
8	Vibration sensor	1	RM20.00	RM20.00
9	Perspective board	1	RM10.00	RM10.00
10	Stand	1	RM6.40	RM6.40
<b>TOTAL</b>				<b>RM375.20</b>

## 4.7 FINDINGS & DISCUSSIONS

We already have distribute 30 of questionnaires to the public. Then we analyze all the collected data in the form of graph. At the below of the graph have a graph description to make us understand easily the information given. Refer Appendix A.

### 4.7.1 SECTION A : DEMOGRAPHY

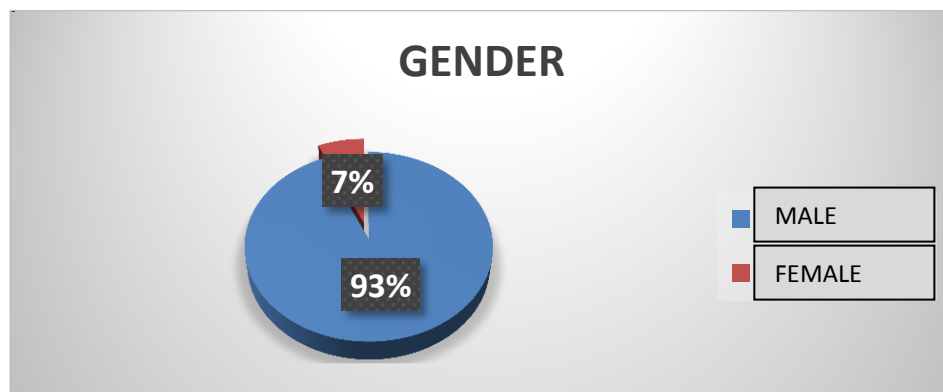
#### 4.7.1.1 Percentages of races among respondents



**Figure 4.4 : Graph of races.**

The chart above shows the percentages for the races of our respondents. Most of our respondents are Malay which hold 93% from our respondents. Next, 4% of our respondents are Chinese and others 3% are Indians. Finally, there are no recorded for others races among our respondents.

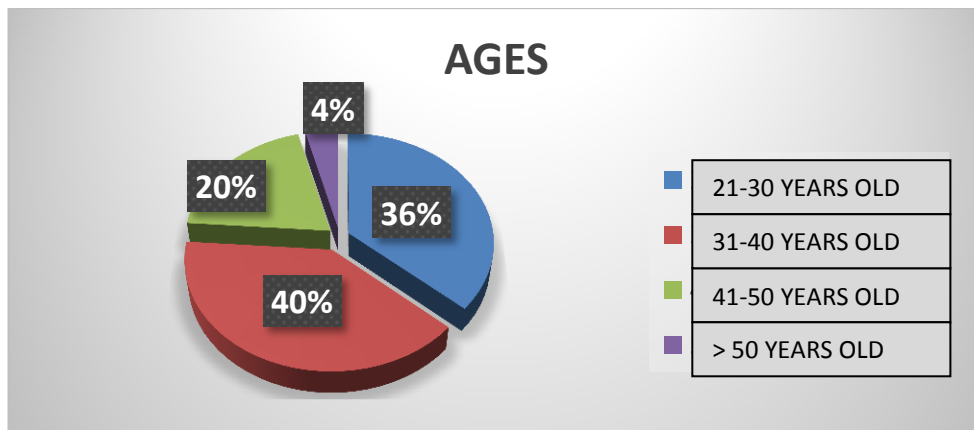
#### 4.7.1.2 Percentages of gender of the respondents



**Figure 4.5 : Graph of gender.**

The pie chart above shows the percentages for gender of our respondents. There are 93% of respondents are males & other 7% are females.

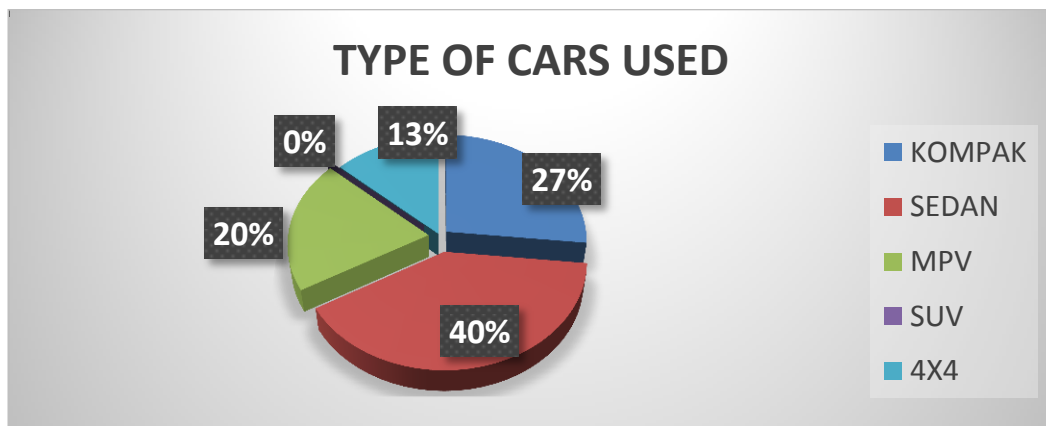
#### 4.7.1.3 Percentages of ages among respondents



**Figure 4.6 : Graph of ages.**

The chart above shows the percentages for the ages of our respondents. Majority of our respondents which is 40% are 31-40 years old. Next, a total of 36% from our respondents ages 21-30 years old. While 20% of our respondents are from 41-50 years old & finally the least ages recorded of our respondents which is 4% are above 50 years old.

#### 4.7.1.4 Percentages of type of cars used among the respondents

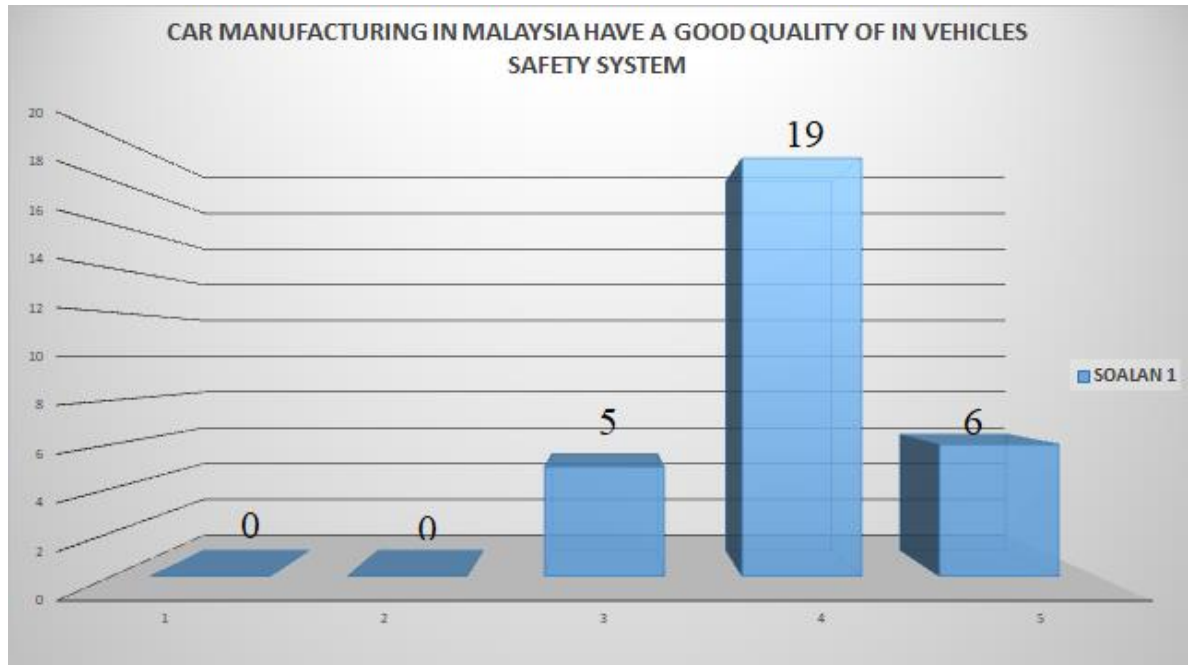


**Figure 4.7 : Graph of type of cars used.**

The pie chart above shows the percentages for the type of car used by the respondents. The result shows that 40% of our respondents used Sedan car. It followed by 27% that used Compact car. Next, MPV car holds 20% of our respondents. Respondents that used 4x4 car are 13% & finally there are no respondents that used SUV cars.

#### **4.7.2. SECTION B : PRODUCT SIGNIFICANT STUDY**

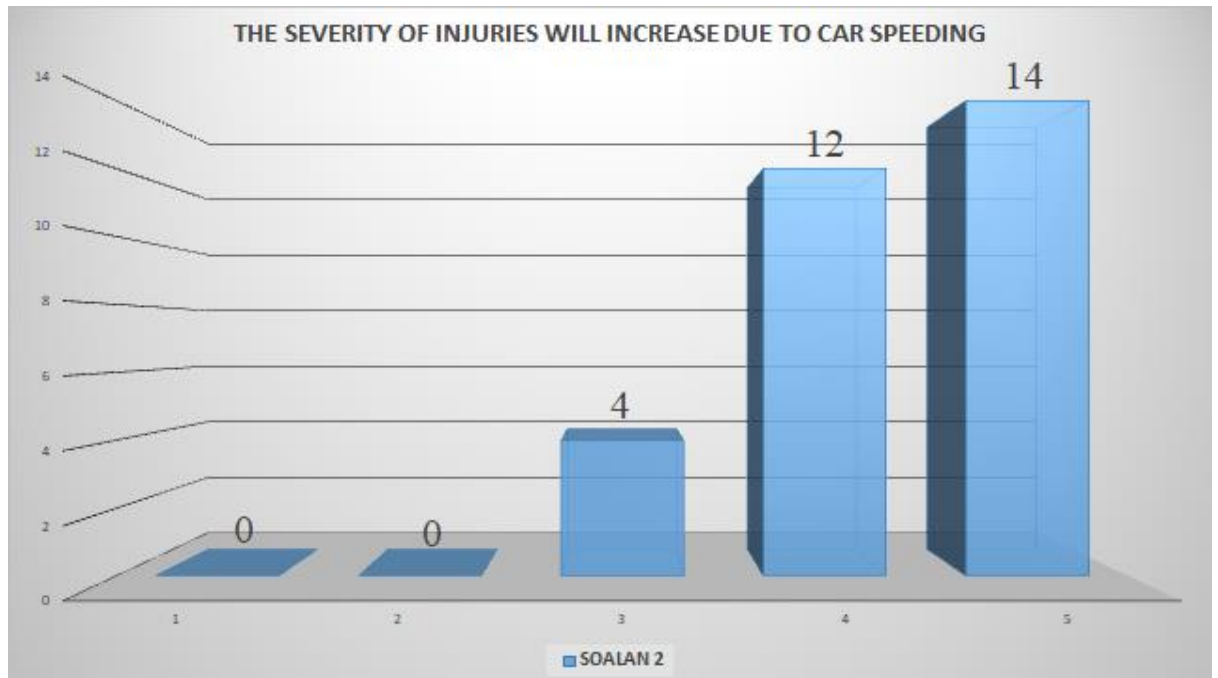
**4.7.2.1** Statement 1 : Car manufacturing in Malaysia have a good quality of in vehicles safety system



**Figure 4.8 : Graph of number of respondents answered statement 1**

The graph comprises the respondent's responds for the statement of car manufacturing in Malaysia have a good quality of in vehicles safety system. Total of 19 respondents agree to our statements. Next, 6 respondents strongly agree that car that manufactured in Malaysia have good quality of safety system. There are 5 respondents stated neutral to the statements and no respondents disagree or strongly disagree with the statements.

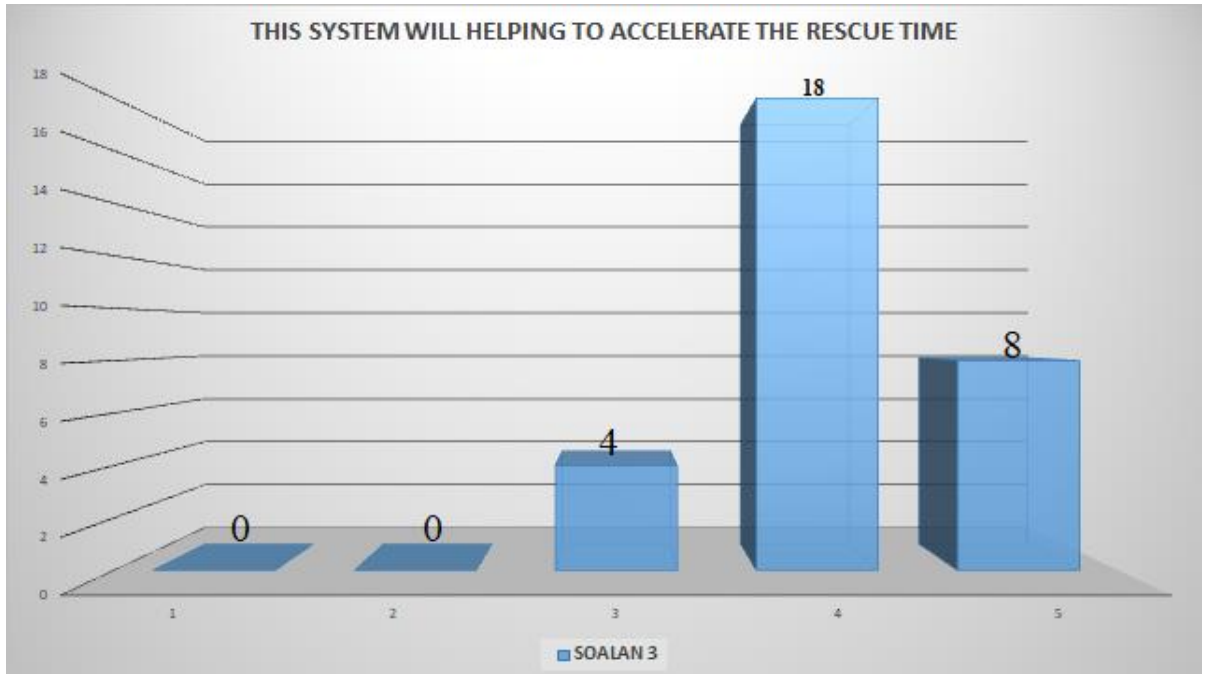
**4.7.2.2 Statement 2 : The severity of injuries will increase due to car speeding**



**Figure 4.9 : Graph of number of respondents answered statement 2**

The graph above shows the related statements of the severity of injuries will increase due to car speeding. A total of 14 respondents are strongly agree with the statements. Next, 12 respondents stated agree to the statements. There are 4 respondents answered neutral. Finally, there are no respondents disagree or strongly disagree toward this statements was recorded.

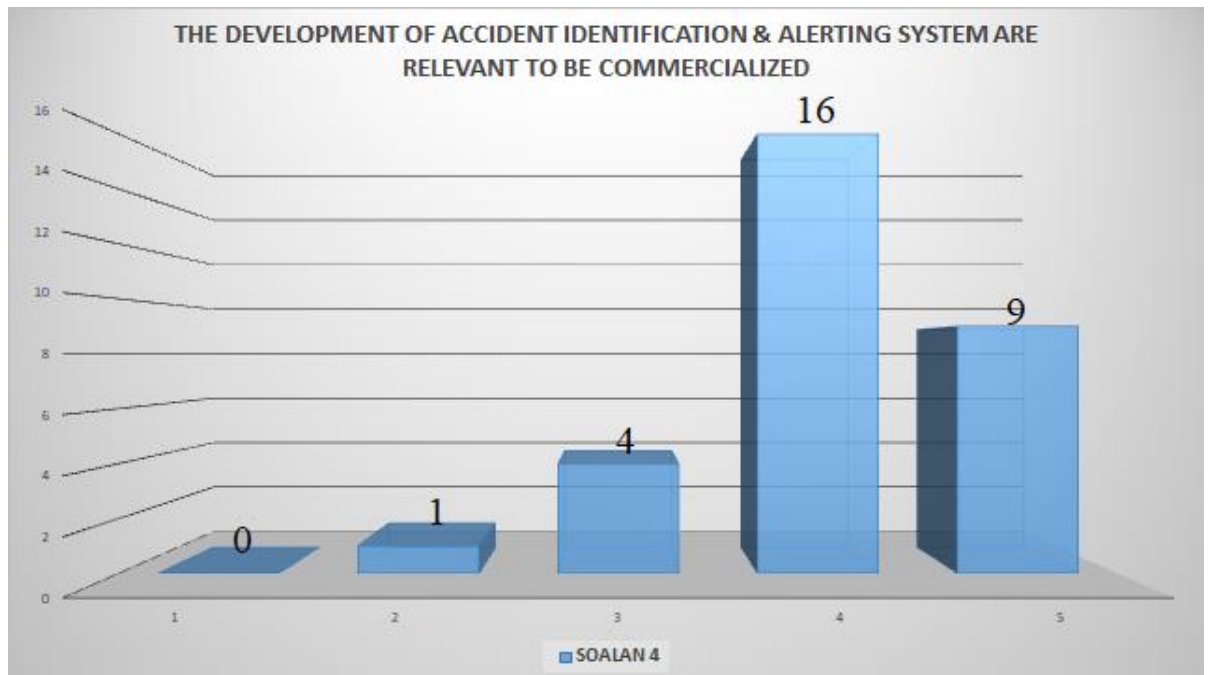
**4.7.2.3 Statement 3 : This system will helping to accelerate the rescue time**



**Figure 4.10 : Graph of number of respondents answered statement 3**

The results of the bar graph above shows the number of respondents answered the statements of this system will helping to accelerate the rescue time. Majority of our respondents agree with the statements which is 18 of them. Next, 8 peoples are strongly agree to the system and the other 4 answered neutral. Finally, there are no respondents answered disagree or strongly disagree.

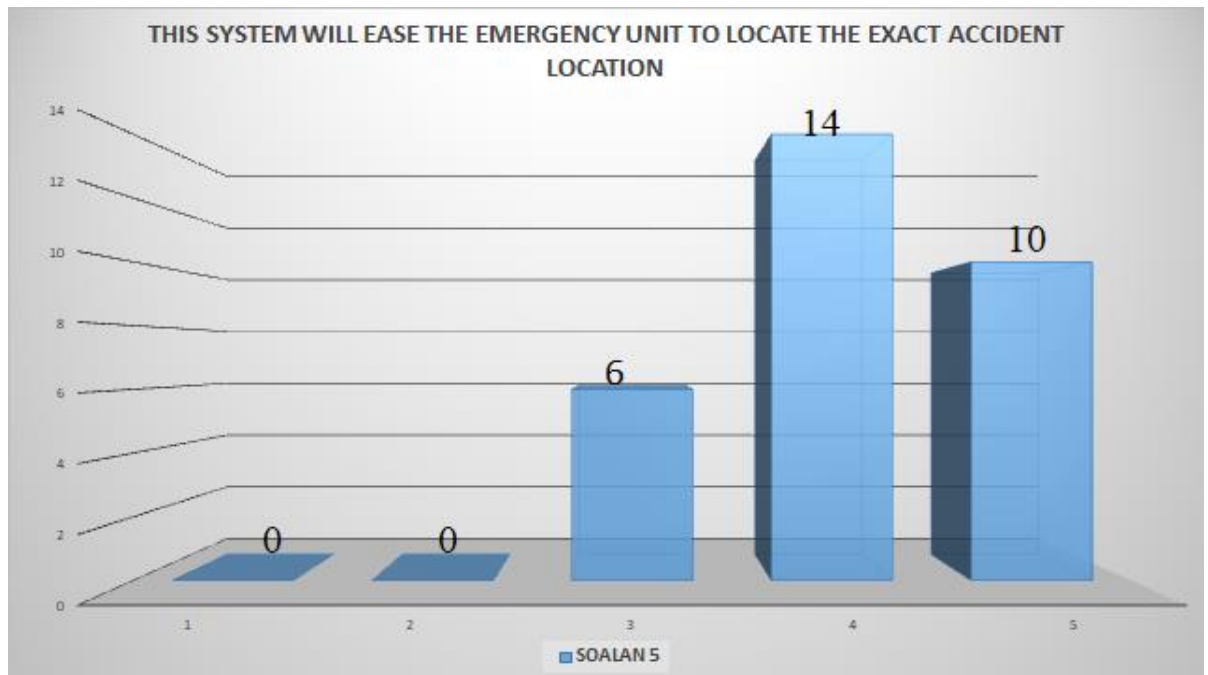
**4.7.2.4 Statement 4 : The development of accident identification and alerting system are relevant to be commercialized**



**Figure 4.11 : Graph of number of respondents answered statement 4**

The graph above shows the number of respondents answered on the statements that the development of accident identification and alerting system are relevant to be commercialized. There are 16 respondents are agree and the other 9 are strongly agree with the statements. Only 1 respondents stated disagree. While the remaining 4 respondents answered neutral.

**4.7.2.5 Statement 5 : This system will ease the emergency unit to locate the exact accident location**

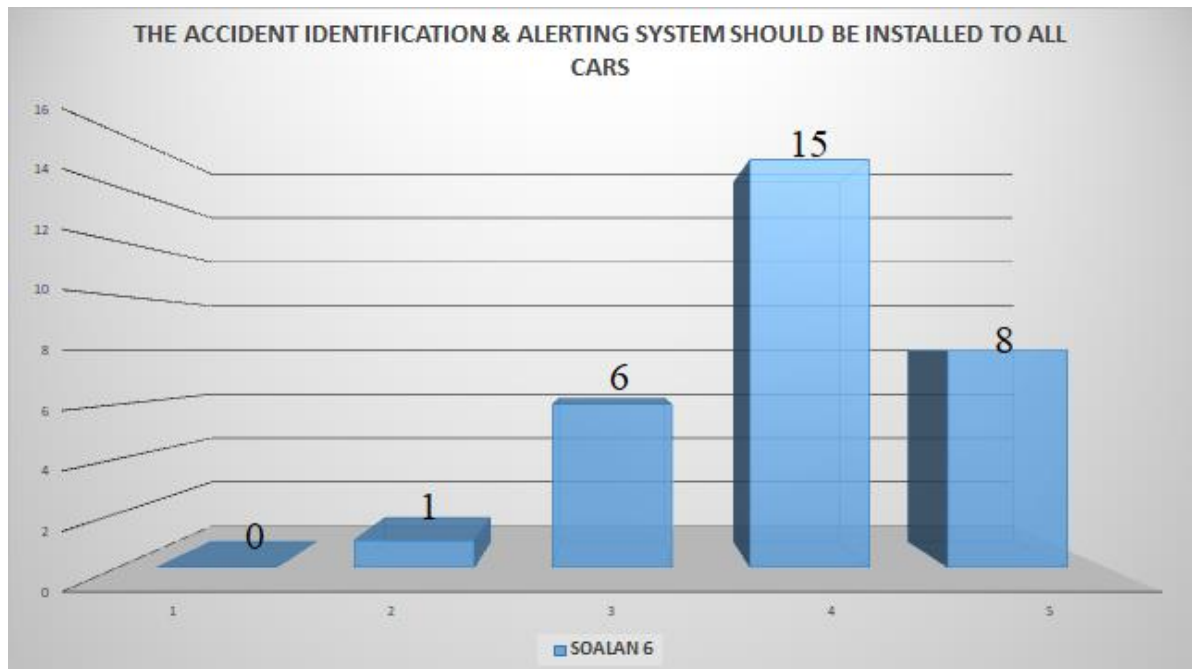


**Figure 4.12 : Graph of number of respondents answered statement 5**

The bar graph above shows the number of respondent's respond toward the statements of this AiA system will ease the emergency unit to locate the exact accident location. There are 14 of the 30 respondents stated agree with the statements. Several 10 peoples choose strongly agree to the statements. Next, a number of 6 respondents answered neutral. Finally, there are no respondents answered disagree or strongly disagree.



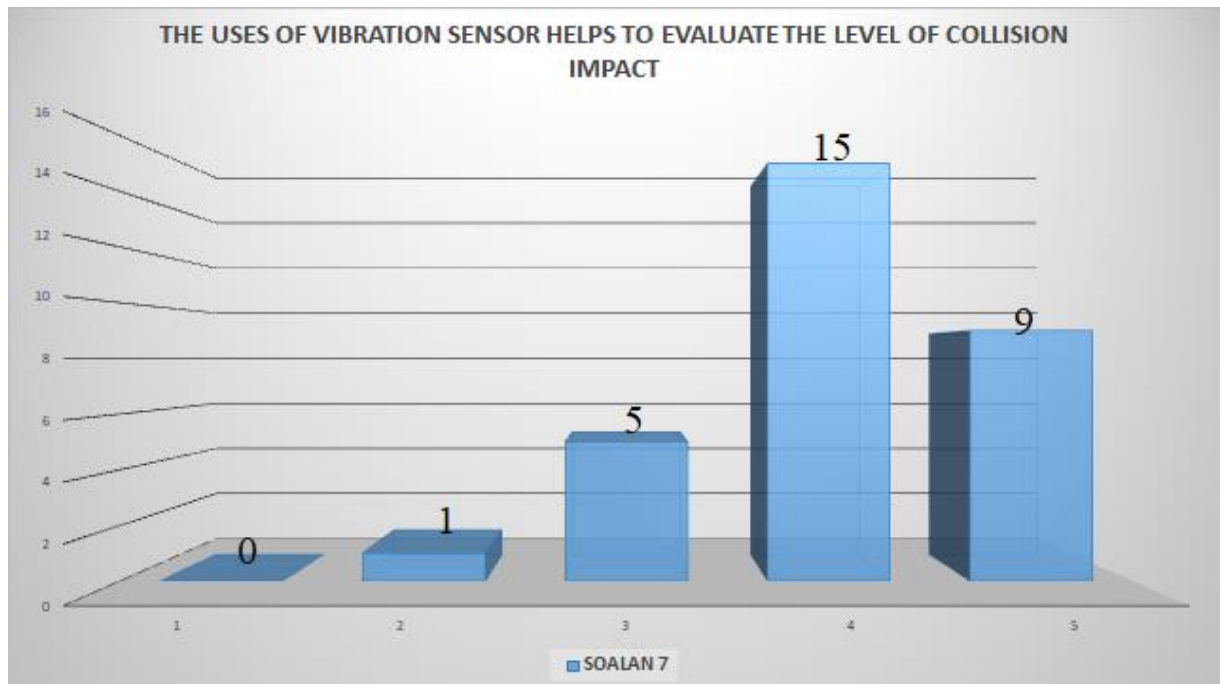
**4.7.2.6 Statement 6 : The accident identification and alerting system should be installed to all cars**



**Figure 4.13 : Graph of number of respondents answered statement 6**

The bar graph comprises the respondent's responds for the statements of the accident identification and alerting system should be installed to all cars. Majority of the respondents answered agree toward the statements which is 15 number of responds. Next, results of 8 respondents choose strongly agree. The rest 6 and 1 respondents answered disagree and neutral with this statements. Lastly, there are no respondents answered strongly disagree.

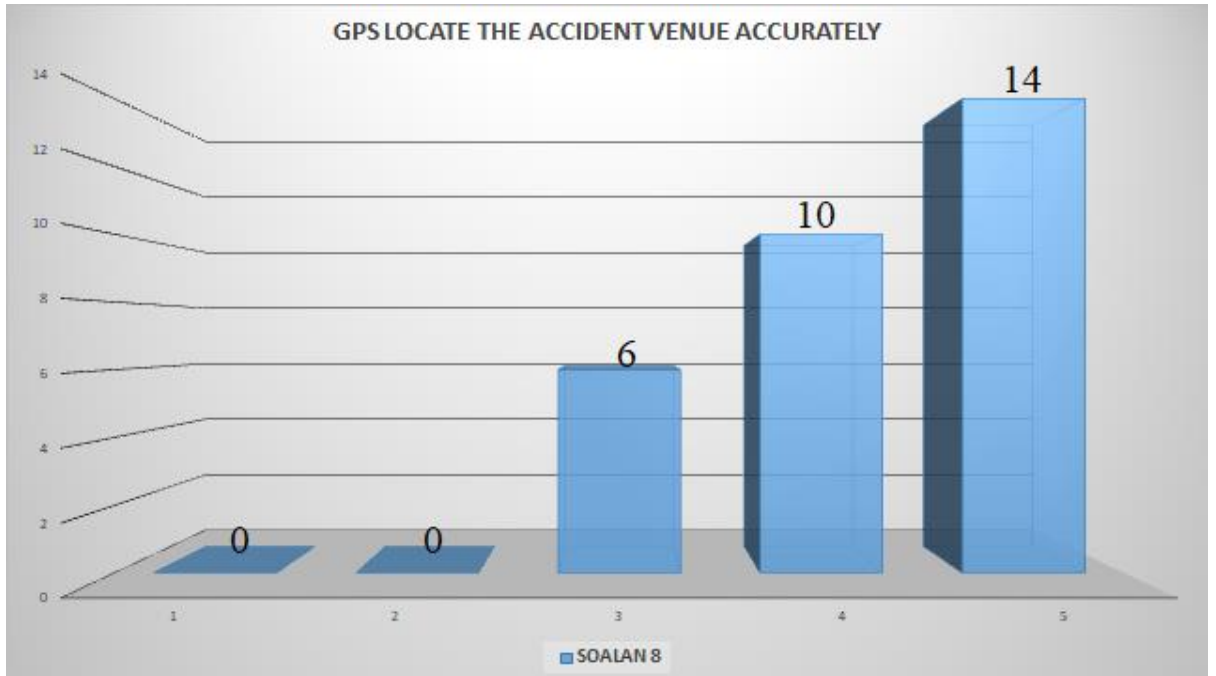
**4.7.2.7 Statement 7 : The uses of vibration sensors helps to evaluate the level of collision impact**



**Figure 4.14 : Graph of number of respondents answered statement 7**

The graph above shows the number of respondents answered the questionnaires on the statements of the uses of vibration sensor helps to evaluate the level of collision impact. Most of the respondents agree toward our statements which recorded 15 of them. The other 9 respondents strongly agree. There are 5 respondents recorded neutral as their answered. Finally, only 1 respondent disagree with the statements and zero respondent for strongly disagree.

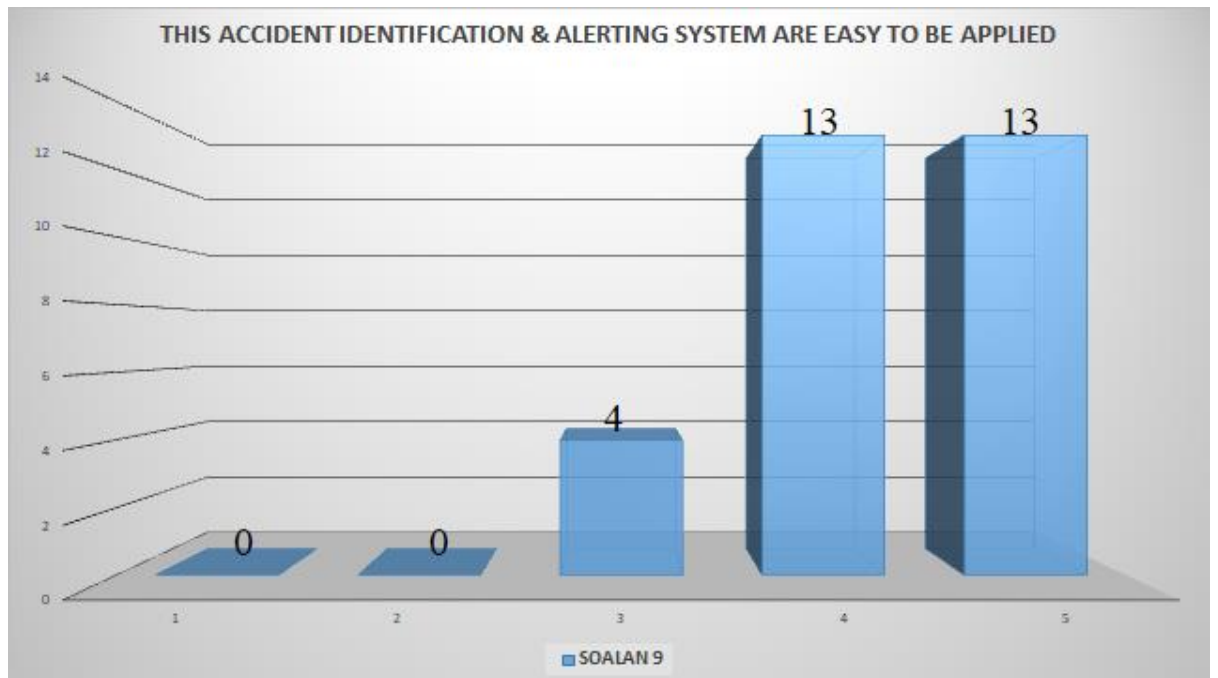
**4.7.2.8 Statement 8 : GPS locate the accident venue accurately**



**Figure 4.15 : Graph of number of respondents answered statement 8**

The bar graph above shows the result of respondent's responds to the statements that GPS locate the accident venue accurately. As we can see, there are 14 number of respondents answered strongly agree toward the statements. Followed by 10 respondents choose agree with the statements. Finally, 6 respondents answered neutral for the statements.

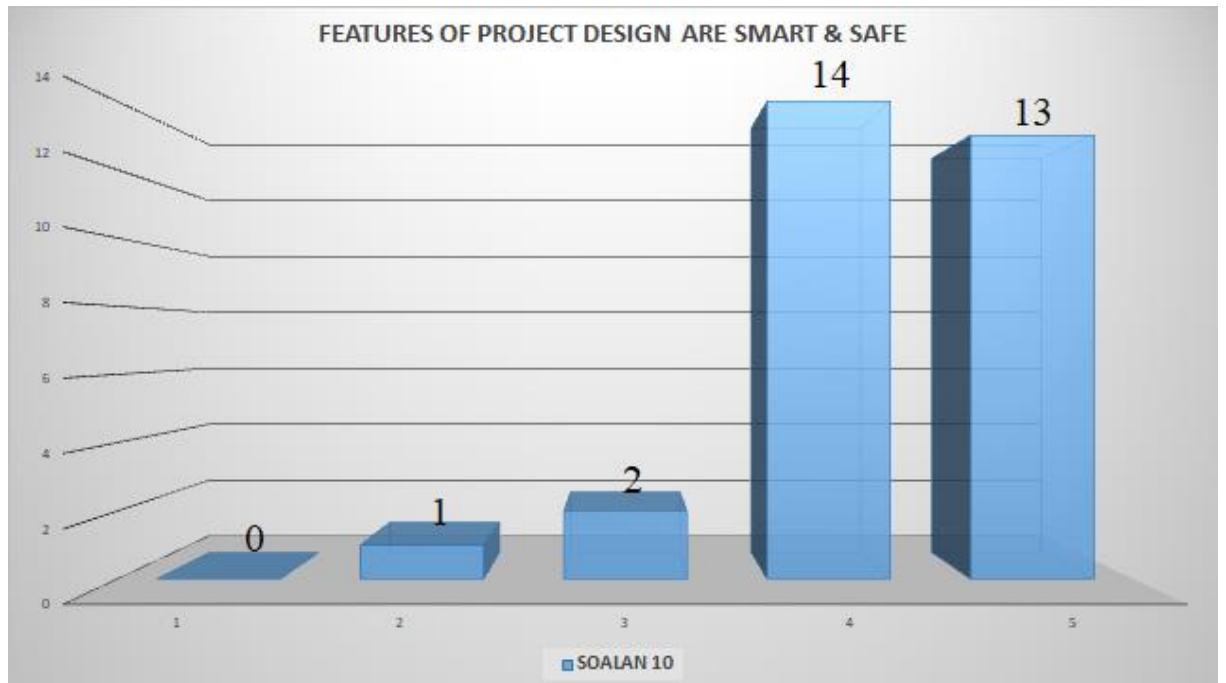
**4.7.2.9 Statement 9 : This accident identification and alerting system are easy to be applied**



**Figure 4.16 : Graph of number of respondents answered statement 9**

The bar graph above shows the recorded of the number of respondents answered the statements of this accident identification and alerting system are easy to be applied. Total of 26 respondents agree and strongly agree with the statements. The rest 4 respondents recorded a neutral answered for the statements. So, there are no respondents answered disagree or strongly disagree.

**4.7.2.10** Statement 10 : Features of project design are smart and safe



**Figure 4.17 : Graph of number of respondents answered statement 10**

The graph above shows the number of respondents answered the statements of the features of project design are smart and safe. There are 14 number of respondents answered agree toward this statements. Another 13 respondents choose strongly agree as their answered. The remaining 2 and 1 respondents answered neutral and disagree to the statements. While there are no respondent answered for strongly disagree.

## **CHAPTER 5**

### **CONCLUSIONS AND RECOMMENDATIONS**

#### **5.1 CONCLUSIONS**

As a conclusion, there are many creations and ideas that we can do in exploring the field of electrical and electronic. Through the completion of the final year project by each student has embodied all the knowledge of students since elementary school until the diploma level. We are also able to think critically and creatively, have strong leadership skills and able to communicate effectively by the implementation of this projects.

The developed accident identification and alerting system achieved its objectives to give the information to the emergency unit. The GPS & GSM technologies are interfaced in the system using Arduino to link the accident information to the emergency unit. The results are the needed information such as longitude, latitude of the location, date and time, current speed of the car, the impact value detect by the sensors were sent to the smartphone. The ability to detect traffic accidents using smartphones has only recently become possible because of the advances in the processing power and sensors deployed on smartphones.[12]

Hopefully, the construction of this accident identification prototype will be a turning point to the industrial of car manufacturing in Malaysia to have a great quality in vehicle safety specifications. Some idea for the application of this system can be used for taxi or rental car companies and also private transport services.

## **5.2 RECOMMENDATIONS**

Adding an idea to an existing project can be characterized as a positive innovation. Which means that improvements are necessary to make that item or product relevant and widely used for future generations.

We have identified some suggestions for improving our project such as adding a camera which can record accident events and send the recording to the phone. Furthermore, interfaced the AiA system with the audio system of the car. So, that the driver can communicate with the emergency unit whether minor or major accident have been occurred. Last but not least, adding a fire sensor which is the sensor will detect the existence of the fire during the accident and sent the information to the emergency unit.

We hope that this project can be innovated by other students so it can be commercialized.

## REFERENCES

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Published: 00:22 BST, (18 October 2016)
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## APPENDIX A



### JABATAN KEJURUTERAAN ELEKTRIK

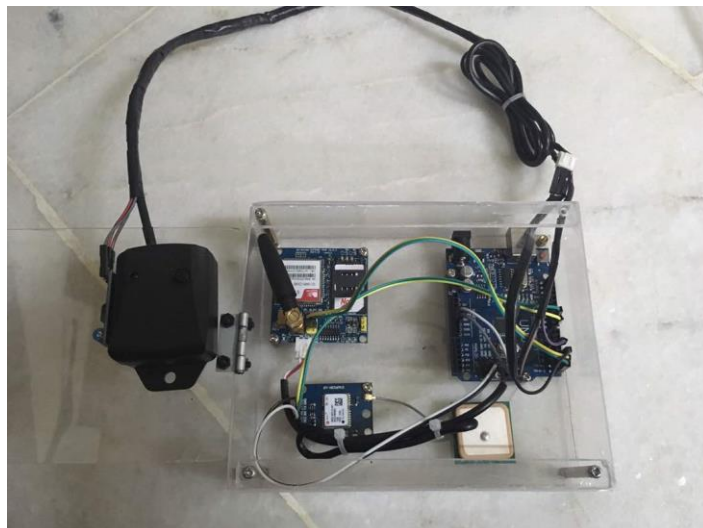
Pelajar: Muhammad Adib Aiman Mohd Suhaimi, Muhammad Fauzan Ab Jalil,  
Danial Ridzduan

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#### *Pengenalan :*

Tajuk projek tahun akhir kami ialah “**Accident Identification & Alerting System**”. Ia merupakan sistem pengesanan kemalangan yang diinovasikan yang mana maklumat seperti longitud & latitud lokasi, tarikh & waktu, kelajuan semasa kereta, nilai impak perlanggaran oleh sensor gegaran akan dihantar ke telefon pintar. Borang kaji selidik ini dilakukan adalah untuk mendapatkan maklumat & data yang diperlukan daripada pihak umum. Borang kaji selidik ini dijalankan bertujuan untuk memenuhi kelengkapan projek tahun akhir. Sila jawab semua soalan dengan lengkap berdasarkan arahan yang diberi.

---



**Bahagian A : Kajian Demografi**

Sila tandakan ( / ) pada jawapan yang paling sesuai pada setiap soalan :

1. Jantina :   
Lelaki

2. Bangsa :  
Melayu   
Cina   
India   
Lain-lain

3. Umur :  
21-30 tahun   
31-40 tahun   
41-50 tahun   
50 tahun keatas

4. Jenis kereta yang digunakan :

Kompak   
Sedan   
MPV   
SUV   
4x4

## Bahagian B : Kajian Tentang Signifikan Produk

Sila **bulatkan** pada pilihan jawapan anda mengikut skala yang diberikan.

1	2	3	4	5
<b>Sangat tidak setuju</b>	<b>Tidak setuju</b>	<b>Tidak pasti</b>	<b>Setuju</b>	<b>Sangat setuju</b>

Bil.	Pernyataan	Skala				
		1	2	3	4	5
1.	Pembuatan kereta di Malaysia mempunyai spesifikasi sistem keselamatan dalam kereta yang berkualiti.	1	2	3	4	5
2.	Risiko kecederaan parah atau maut akan meningkat apabila kelajuan kereta meningkat.	1	2	3	4	5
3.	Sistem ini membantu mempercepatkan tempoh menyelamatkan mangsa.	1	2	3	4	5
4.	Kewujudan sistem pengesan & amaran kemalangan ini relevan dipasarkan.	1	2	3	4	5
5.	Sistem ini akan memudahkan pencarian lokasi kemalangan oleh pihak unit kecemasan.	1	2	3	4	5
6.	Sistem pengesan & amaran kemalangan ini perlu dijadikan sebagai komponen tambahan dalam setiap kereta.	1	2	3	4	5
7.	Nilai kekuatan hentaman pelanggaran yang dikesan oleh sensor gegaran membantu menjangka tahap keparahan kemalangan tersebut.	1	2	3	4	5
8.	GPS mengesan lokasi kemalangan dengan tepat sekali.	1	2	3	4	5
9.	Sistem pengesan & amaran kemalangan ini mudah digunakan.	1	2	3	4	5
10.	Reka bentuk projek sangat menarik dan selamat.	1	2	3	4	5

## Bahagian C : Komen & Cadangan

Sila nyatakan komen/cadangan/idea anda bagi penambahbaikan sistem “**Accident Identification & Alerting System**” ini pada masa akan datang ( jika ada ) :

---

---

---

## APPENDIX B

```
#include <TinyGPS.h>

//criteria

//gps must function properly for program to function

#include <AltSoftSerial.h>
#include <TinyGPS.h>
#define speed_limit 100.00 // ubah had laju
long debouncing_time = 15; //Debouncing Time in Milliseconds
volatile unsigned long last_micros;
const int ShockPin = 2;
const int ledPin = 13;
const int vibrationPin = 5;

int state;

float velocity, last_velocity, measurement;
char event_detail[60];
char location_detail[80];
char message[162];
char vibration[6];
char speedalert[7] = " Vib:";
char nullchar[2] = "\0";
```

```

TinyGPS gps;
AltSoftSerial ss;

static void smartdelay(unsigned long ms);

void setup() { // put your setup code here, to run once

  Serial.begin(9600);
  //Serial.println("Accident Tracker");
  pinMode(ShockPin, INPUT_PULLUP);
  pinMode(vibrationPin, INPUT); //set EP input for measurment
  pinMode(ledPin, OUTPUT);
  attachInterrupt(0, debounceInterrupt, LOW);

  ss.begin(9600); // baud rate for gps
  state = LOW;
  digitalWrite(ledPin, state);
}

void loop() { // put your main code here, to run repeatedly:

  memset(message, '\0', 162);
  Getgps();
  measurement =(TP_init()/1500);
  delay(50);
  dtostrf(measurement,4,2,vibration);
}

```

```
strcat(message, event_detail);
strcat(message, location_detail);
strcat(message, speedalert);
strcat(message, vibration);
strcat(message, nullchar);
//Serial.println(measurement); // klu nak check valu vibration
//Serial.println("Waiting for command");
```

```
if(state == HIGH){
    digitalWrite(ledPin,state);
    //Serial.println("Please wait");
    //Serial.println(event_detail);
    //Serial.println(location_detail);
    //Serial.println(message);
    //Serial.println("Sent Msge");
    SendMessage();
    smartdelay(5000);
    state= LOW;
    digitalWrite(ledPin,state);
}
```

```
smartdelay(1000);
} // end void loop
```

```
////////////////////////////////////
```

```
// interpt function
```

```
////////////////////////////////////
```

```
void debounceInterrupt() {  
    if((long)(micros() - last_micros) >= debouncing_time * 1000) {  
        Interrupt();  
        last_micros = micros();  
    }  
}
```

```
void Interrupt() {  
    state = HIGH;  
}
```

```
////////////////////////////////////
```

```
// gsm function
```

```
////////////////////////////////////
```

```
void SendMessage(){  
    Serial.println("AT");  
    delay(1000);  
    Serial.println("AT+CMGF=1"); //Sets the GSM Module in Text Mode  
    delay(1000); // Delay of 1000 milli seconds or 1 second  
    Serial.println("AT+CMGS="+60173580949+"\r"); // Replace x with mobile number  
    delay(1000);  
    Serial.println(message);// The SMS text you want to send  
    delay(100);  
    Serial.println((char)26);// ASCII code of CTRL+Z  
    delay(1000);
```



```
}
```

```
////////////////////////////////////
```

```
// gps function
```

```
////////////////////////////////////
```

```
void Getgps(){
```

```
    static const double LONDON_LAT = 51.508131, LONDON_LON = -0.128002;
```

```
    byte month, day, hour, minute, second, hundredths;
```

```
    unsigned long age, date, time, chars = 0;
```

```
    unsigned short sentences = 0, failed = 0;
```

```
    int year;
```

```
    float flat, flon;
```

```
    char alert[17] = "EMERGENCY ALERT ";
```

```
    char date_info[22];
```

```
    char speedalert[7] = "Speed:";
```

```
    char latitude[15];
```

```
    char longitude[15];
```

```
    char web[30] = " www.google.co.in/maps/place/" ;
```

```
    char coma[2] = ",";
```

```
    char speedo[5];
```

```
    char impactlow[13] = " LOW IMPACT";
```

```
    char impacthigh[14] = " HIGH IMPACT";
```

```
    memset(event_detail, '\0', 60);
```

```
    memset(location_detail, '\0', 80);
```

```

gps.f_get_position(&flat, &flon, &age); // dapatkan gps dan tukar kepada strg
if((flat == TinyGPS::GPS_INVALID_F_ANGLE)&&(flon ==
TinyGPS::GPS_INVALID_F_ANGLE)){
    Serial.println("AT");// sedang check gps
}
else{
    dtostrf(flat,8, 6, latitude);
    dtostrf(flou,10, 7, longitude);
    smartdelay(300);
}

gps.crack_datetime(&year, &month, &day, &hour, &minute, &second,
&hundredths, &age);
if (age == TinyGPS::GPS_INVALID_AGE){
}
else{
    sprintf(date_info, "%02d/%02d/%02d %02d:%02d:%02d ",
day, month, year, hour, minute, second);
    strcat(event_detail, alert);
    strcat(event_detail, date_info);
    velocity = gps.f_speed_kmph();
    if(velocity <= 0.00){
        velocity = 0.00;
    }
    dtostrf(last_velocity, 2, 2, speedo);
    smartdelay(300);
    strcat(event_detail, speedalert);
    strcat(event_detail, speedo);
}

```

```
}  
if(velocity >= 45.00){  
    strcat(location_detail, web);  
    strcat(location_detail, latitude);  
    strcat(location_detail, coma);  
    strcat(location_detail, longitude);  
    strcat(location_detail, impacthigh);  
}  
else{  
    strcat(location_detail, web);  
    strcat(location_detail, latitude);  
    strcat(location_detail, coma);  
    strcat(location_detail, longitude);  
    strcat(location_detail, impactlow);  
}  
last_velocity = velocity;  
smartdelay(300);  
}
```

```
////////////////////////////////////
```

```
// vibration sensor function
```

```
////////////////////////////////////
```

```
long TP_init(){
```

```
    delay(10);

    long measurement=pulseIn (vibrationPin, HIGH); //wait for the pin to get HIGH
    and returns measurement

    return measurement;
}
```

```
////////////////////////////////////
```

```
// other function
```

```
////////////////////////////////////
```

```
static void smartdelay(unsigned long ms)
{
    unsigned long start = millis();
    do
    {
        while (ss.available())
            gps.encode(ss.read());
    } while (millis() - start < ms);
}
```