FINAL YEAR PROJECT II: DISSERTATION

INTELLIGENT AND PORTABLE SEAT BELT REMINDER FOR VEHICLE

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CERTIFICATION OF APPROVAL

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By

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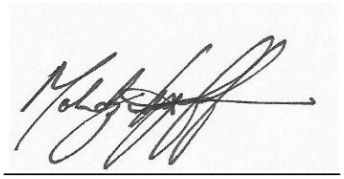

(DR. MOHD ZUKI BIN YUSOFF)

UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

September 2014

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

(MOHAMAD ZULRAHIMI BIN MOHAMAD ZAMRI)

Abstract

This project describes the design an intelligent and portable Seat Belt Reminder (SBR) for vehicle, which integrated with Peripheral Interface Controller (PIC) and use a Bluetooth technology in order to send data to user. The Bluetooth technology is one of the wireless technology that capable to transmit and receive data over the short range. In order to make sure intelligent seat belt reminder work as expected, all sensor should be measured and tested before implemented. The combination of microcontroller, Bluetooth technology, Android platform and sensors in seat belt reminder system will reduced the occupant's risk from being injure during crash when accident happen. A fully functioning embedded SBR prototype device has successfully developed which can alert the occupants of any vehicle if seat belts are not worn. By applying new concept of wireless technology and smart mobile device in the implemented system, we can reduce the risk of fatality.

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ABBREVATION AND NOMENCLARATUS

SBR – Seat Belt Reminder

FSR – Force Sensitivity Resistor

PIC – Programmable Integrated Circuit

SDK – Software Development Kit

ECU – Electronic Control Unit

LED – Light Emitting Diode

GPS – Global Positioning System

FTDI – Future Technology Devices International

WHO GSRRS – World Health Organization Global Status Report on Road Safety

Chapter 1: Introduction

1.1 Background

Motor vehicle are the main transport for human being to travel from one place to another place. In Malaysia, the second most uses of vehicle on the road is car which hold 40% from the total transportation medium, after the motorcycle. Based on past researches, in every year, about 41,000 occupants are died and 250,000 occupants are seriously injured in accident [1]. In term of fatal accident statistics, the driver commit about 9.0% and occupants constitute 13.6% of death. The side impact crashes are the main factor that resulting in fatal injuries.

Head injury is the major cause for occupant's fatality, which hold about more than half of the total fatalities (56.4%) [2]. Apart from that, the wrong positioning of body posture while crash happen is the main factor that leak this fatalities to happen. There are two types of safety system that use in vehicle. The first one is passive safety system which be able to protect the occupant after accidents occur and second one is active safety systems which be able to protect the occupant before the accidents occur [3]. The correct use of seat belts was proven to be most effective ways to reduce the total of fatal accident road in Malaysia. If occupants use seat belt while traveling, the risk of fatal injuries will be reduced drastically; decreased to 45% for cars and 60% for vans. With the enforcement by the law from government, each of the car must to have front and rear seat belt system starting on 2009.

The development of seat belt safety system has be improved for each generation of the vehicle. The existence Seat Belt Reminder (SBR) nowadays are the best way in avoiding fatal accidents. But, most of the driver and occupant still ignore the SBR while moving with vehicle, especially in car. They tend to ignore the use of the seat belt and claimed that seat belt constrains their movement while driving. Thus, this project is aim to develop new SBR which are intelligent and portable that comprises of PIC micro controller, sensor, Bluetooth application and Android platform.

1.2 Problem Statement

The existence of seat belt reminder that use in every vehicle now has coming to problem phase. It does not has a fix level of standard while operating, which mean in certain local vehicles, it just only come out warning signal on dashboard without buzzer sound meanwhile for import vehicles, it will come out both. Other than that, a vehicle that build before 1970 does not equipped with seat belt reminder system. This condition will prone to the lack of safety belt awareness among antique car's owner. For a certain cases, the beep sound that come from buzzer in commons SBR system disturbed driver focus and lead to serious accidents.

The combination of sensor mat and belt buckle sensor, PIC microcontroller, wireless technology and smart mobile phone can reduced the chances to get fatal injuries by improve the existence of SBR system.

1.3 Objective

The main objective for this project is to explore, design, develop and implement an intelligent and portable seat belt reminder which can be used in any car, or other vehicles.

1.4 Scope of Study

This project will involve in microcontroller board, which will be the "brain" for sensor to communicate each other. A deep knowledge about microcontroller need to have in order to choose the best PIC board that will give better result. The PIC board will communicate to user by using Bluetooth medium, which include communication system knowledge. The researches about the feasibility of Android Software Development Kit (SDK), as the platform for the last destination data transferring will be develop and simulate. The parameter for chosen the right sensor also need a deep study, because the sensors are the main sense for the board to detect the environmental changes. The parametric study will focus more on:

1.) Weight detection
2.) Seat belt detection
3.) The detection movement of the car

Chapter 2: Literature Review

2.1 Statistic of Accident in Malaysia

Road traffic accident is one of the major problem in Malaysia which increase year by year. Many action has been taken by government in order to minimize the total of accident in Malaysia, by held safety campaign among the drivers, traffic monitoring by police department, advertisement in electronic media and many more. But, the number still increase year by year. Based on the report from World Health Organization Global Status Report on Road Safety (WHO GSRRS), Malaysia hold the first ranking of road traffic death rate per 100 000 population in ASEAN countries.

As shown in table below, the statistic of road accident with total injury was recorded in past ten years which was from 2000 until 2009. The total number of the accident keep going increasing during that time from 250,429 cases in 2000 to 397,319 cases in 2009. Other than that, the fatal injuries also did not shown the drastically decreasing in term of number and still maintain at 6,745 death in 2009. These accidents mainly happened due to human errors, over speeding while on the road, losing control over the vehicle, drowsiness, bad environmental condition and lastly bad vehicle condition [11].

YEAR		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
ACCIDENT INJURY TYPE	Fatal Accidents	5,440	5,230	5,378	5,634	5,674	5,604	5,711	5,672	5,952	6,218
	Serious Injury	8,067	6,942	6,696	7,163	7,444	7,600	7,375	7,384	7,020	6,978
	Minor Injury	28,778	30,684	30,259	31,357	33,413	25,928	15,596	13,979	12,893	12,072
TOTAL ACCIDENT INJURY		**42,285**	**42,856**	**42,333**	**44,154**	**46,531**	**39,132**	**28,682**	**27,035**	**25,865**	**25,268**
TOTAL ACCIDENT WITHOUT INJURY		208,144	222,319	237,378	254,499	280,283	289,136	312,550	336,284	347,182	371,926
TOTAL ACCIDENT		250,429	265,175	279,711	298,653	326,814	328,268	341,232	363,319	373,047	397,194
Injury Type	Fatal	6,035	5,854	5,891	6,286	6,228	6,188	6,287	6,282	6,527	6,745
	Serious Injury	9,790	8,689	8,425	9,040	9,229	9,397	9,254	9,273	8,866	8,849
	Minor Injury	34,375	35,974	35,236	37,415	38,631	31,429	19,884	18,444	16,901	15,823
TOTAL INJURY		**50,200**	**50,517**	**49,552**	**52,741**	**54,088**	**47,014**	**35,425**	**33,999**	**32,294**	**31,417**
FATALITIES INDEX	10 000 registration vehicle)	**5.70**	**5.17**	**4.88**	**4.88**	**4.51**	**4.18**	**3.98**	**3.73**	**3.63**	**3.55**
	Every 1 Billion VKT	**26.25**	**23.93**	**22.71**	**22.77**	**21.1**	**19.58**	**18.69**	**17.6**	**17.2**	**17.28**

Table 1: Road accident fact from 2000 to 2009

2.2 Seat Belt Systems

About 100 years ago, an engineer from England, George Cayley has invented one of the best device that can save millions live of occupant, easy and practically; called the seat belt. A seat belt, or known as safety belt is a device that have been designed to reduce the impact that can secure the occupant when external environmental changes in result during collision or an emergency brake. Nowadays, all the vehicle including car, lorry, air plane and van equipped with safety belt to ensure the all the occupant safe during travelling.

Seat belt is a primary safety features that will avoid major injuries in traffic collision by reducing the force of impact when crashing [4]. It also will hold the positioning of occupants at seat correctly inside the car and preventing them being ejected from the vehicle in a collision or if the vehicle rolls over. If the occupants refuse to use seat belt when travelling, the chances of accidental injuries will be increase and lead to death [4]. Report that have been carried out from Department of Transportation stated that car occupants commit about 22.6% of the deaths and 17.9% of the causalities out from 5,849 traffic accidents in 2001.

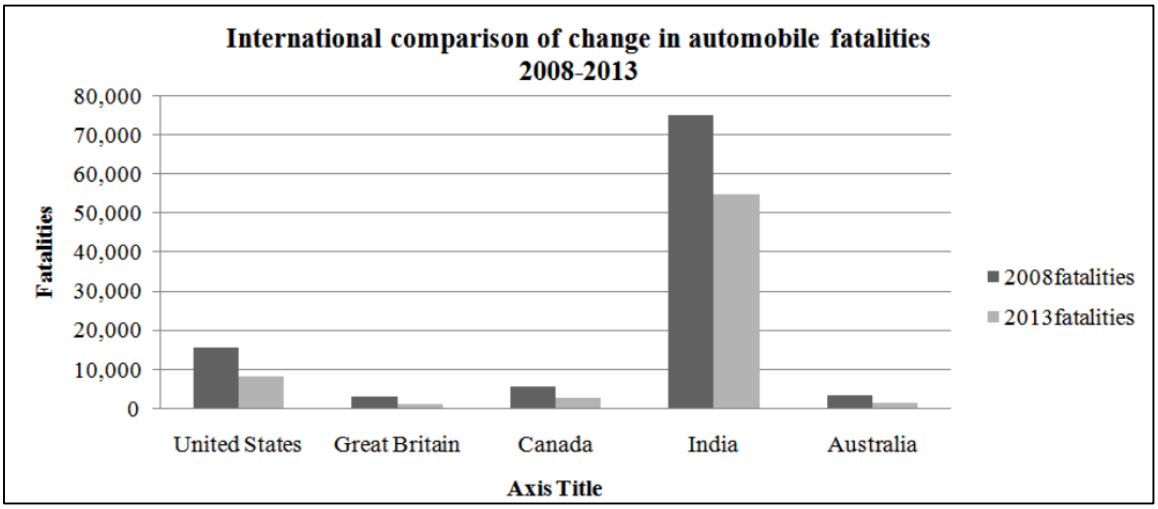

Figure 1: Automobile fatalities around the world from 2008 to 2013.

Based on the graph in *Figure 1*, we can see the graph bar indicate automobile fatalities in several country decrease after five years later. United States successfully decrease about 50% from previous data, followed by Canada, Australia and Great Britain. But in India, the total automobile fatalities still high compare the rest, and we can conclude that most of automobile in India does not have SBR systems.

Based on survey, the driver or occupants that ignore the important of using a seat belt, when reminded by special devices, they will change their mind and buckle up [5]. The use of special device that warns the occupant is reported the most effective way in avoiding fatal injuries. This shown an evidence that Seat Belt Reminder (SBR) systems have a great potential in order to reduce death and injuries during crash.

Figure 2: Buckle Up Sign on Dashboard

Past researches have been done in order to determine the effectiveness of SBR systems in vehicle. The existing system for the seat inside a vehicle consist a detector wire at belt buckle that connected to an Electronic Control Unit (ECU) [5]. Therefore, it just only activate the warning sign when the occupant occupied the seat and unbuckled. As shown in figure above, the standard sign for unbuckled will activated on the dashboard to give a warning to a driver. Experienced from past research paper indicates the sound that produce from warning system in existing SBR effect the driver's focus that can lead to traffic accidents [4].

Based on the survey, most of vehicle that produced before 1970 does not equipped with SBR system. This amount include import vehicle and local vehicle, which now currently use on the road nowadays in Malaysia. For the drive especially, they do not have special system inside their car that warn them to buckle up during travelling. The installation of existing SBR is not practical to them, by the time being, they need something intelligent system, incorporate with new technology that can remind them through smartphone.

Some vans and trucks have special characteristics to change their internal space by equipped with removable seat. It is look flexibility in arranging space but fix wiring system for this type of seat with occupancy sensor are not practical [5].This system maybe will give some error by the same time, will activated wrong signal to the driver. Therefore, the new SBR need to be develop in order to solve this problem, which mainly portable and can be bring it everywhere in anytime.

2.4 Factors Non-Use of Seat Belt

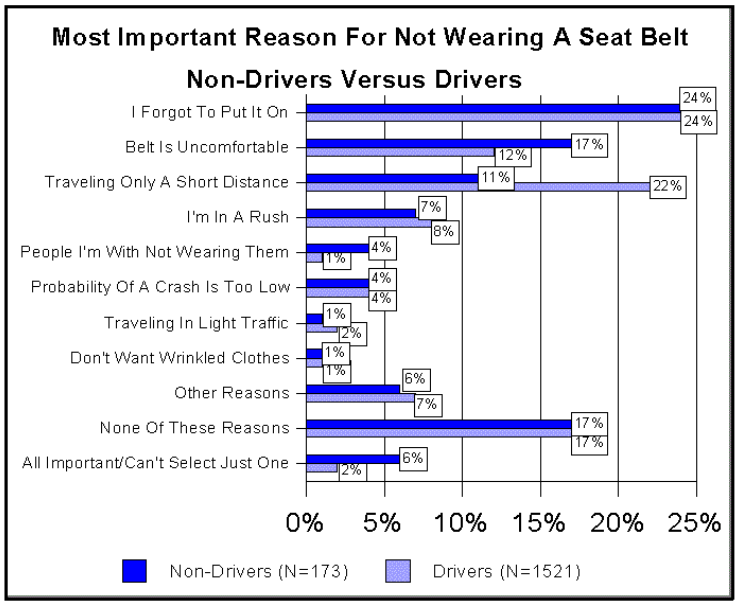

Figure 3: Tabulation data non-use seat belt among drivers & non-drivers.

There are many factors that contribute the non-use of seat belt problems. As shown in figure above, the most important reasons given for not wearing seat belt among non-drivers and drivers were they actually forgot to buckle up (24%) and then followed by travelling in short distance (11% and 22%). Other than that, the belt that provided from manufacturer that is uncomfortable also get the high intension, each of them hold about 17% for non-driver and 12% for driver. They also claimed that by avoid wearing a seat belt, they can make sure their clothes not wrinkle until they reach the destination.

From the first respond which is forget to put seat belt on, it has been indicated as "low-risk" perception. Although it has been categorized as the low risk, but it hold the highest percent among the other factors. Forgetting issue is likely easy to be solved, which can reminded by special devices in a vehicle such as seat belt reminder system. In a past researches, it has been approved that when the driver or occupants that ignore the important of using a seat belt is reminded by special devices, they will change their mind and buckle up [5].

2.3 Bluetooth Technology

Bluetooth is a one of the wireless technology, mostly use in smartphone, personal laptop and other devices. Bluetooth start to get attention since 2007, replacing the infrared wave that have been used before in most device. It provide a communication over the short distance, operating over unlicensed and has standard frequency around the globe which is 2.4 GHz [6]. The Android platform widely adopted by industry and includes the support of Bluetooth network stack, which allows two devices to exchange the data without using cable simultaneously.

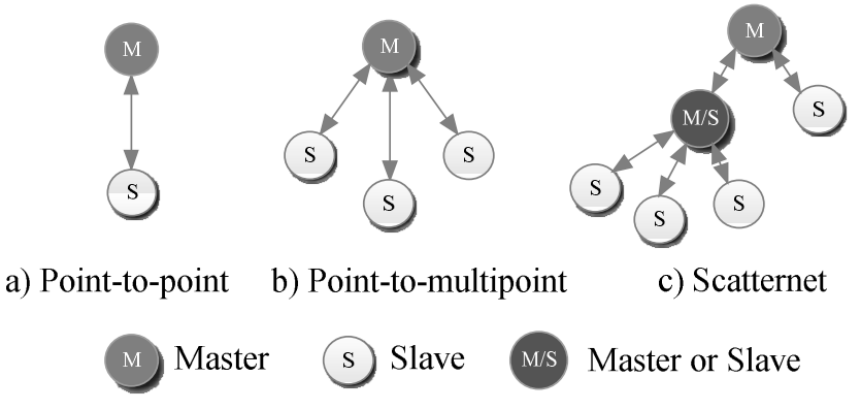

Figure 4: Bluetooth Topology

As shown in figure above, Bluetooth topology has been characterized into three types of connection; point-to-point, point-to-multipoint and scatternet [8]. Bluetooth standard is based on two types of operational mode, which are slave mode and master mode. The slave modules can only accept the connection from other Bluetooth device but cannot be able to establish a connection. Different from master modules, it can initiate a connection to other Bluetooth devices surrounding. The term of "piconet" that use in the communication system mean a network connection that created by one device and most of all devices found within it ranges. A master mode can be simultaneous connected up to seven active slave devices.

Chapter 3: Methodology

3.1 Project Methodology

The flow chart below is the brief overview of the project methodology for a given time period.

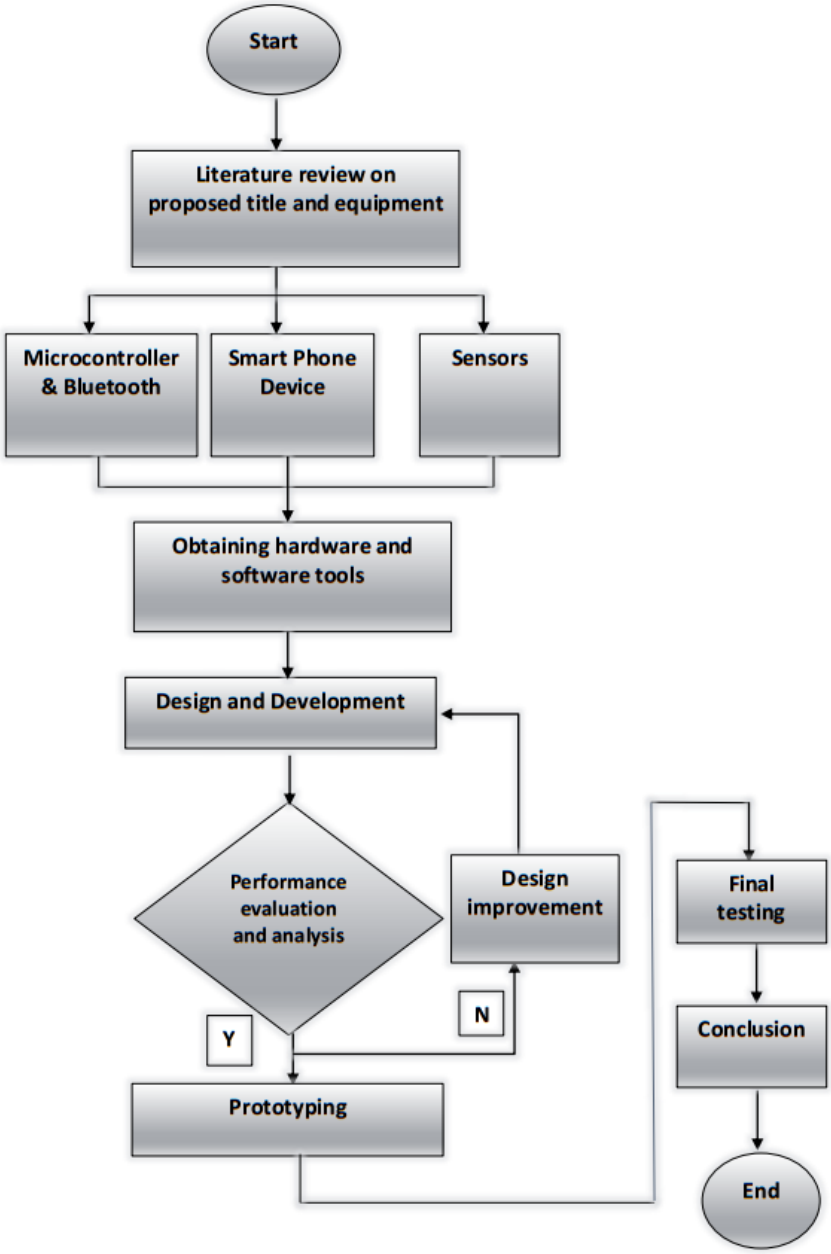

Figure 5: Flow Chart of SBR Project

3.2 Project Activities

In this section**,** the table below will described in detail each step of the project methodology's flowchart in previous section.

Literature Review	• Get the information from the past reseaches about seat belt reminder system in a vehicle. • Narrowing down the scope of the project by determine the minumum requiremnet of the project. • Additional information about the device and equipment that will be used in this project such as microcontroller board and sensors.
Design & Development	• Designing the intelligent and portable seat belt reminder system. • Selecting the best equipment, tools, hardware and software needed in order to build a prototype. • Develop a programming code that match with the specific function
Perforamance Evaluation & Analysis	• In this section, the prototype will be testing with a various variable • To determine whether the prototype achive a minimum requirement that has been standardise.
Design Improvement	• If the prototype did not achieve the minimum requirement, redesign the coding system. • Modified the prototype if there a need certain additional features.
Final Testing	• After a full prototype has been completed, it will be testing with real world application to get the feedback from user. • The prototype should be able to give a reminder to the driver if seat belt is not use while driving. • Make a recommendation for any improvment or additional features for prototype.

Table 2: Description of each step in Project Methodology

3.3 Hardware Development

The hardware development is divided into several parts:

3.2.1 Arduino Uno

Figure 6: The Front & Back of Arduino Uno

One of the best microcontroller is Arduino Uno board. For this type of board, it based on ATmega 328 microcontroller. Introduced in 2005, it has special characteristics; consist of an open-source hardware board [7], with USB interface, 6 analog inputs and 14 digital input/output pins (6 pins can be used as Pulse Wave Modulation (PWM) outputs) which allow user to connect with various extension board. Other than that, it also equipped with a 16 MHz crystal oscillator for clock speed, an ICSP header, female connection power jack and lastly a reset button.

In order to power up Arduino Uno, the user is given by two choices of way, one is by simply connect it with computer through USB cable or connect it with A/C to D/C adapter or 9V battery. Different from other type of Arduino board, Arduino Uno come with friendly user characteristic, which are not equipped with Future Technology Devices International (FTDI) USB-to-serial driver chip.

The function of this Arduino Uno is to receive the signal from Reed Switch sensors and sensor mat which are located at belt and vehicle seat. Then it will process the data and determine the exact condition of the user, whether the occupant occupied a seat and use a seat belt while driving or not. Lastly, it will send the signal to smart phone by using BlueBee through Bluetooth communication. The schematics of the Arduino board is shown in figure below which include all the possible connection of the ATmega 328 microcontroller.

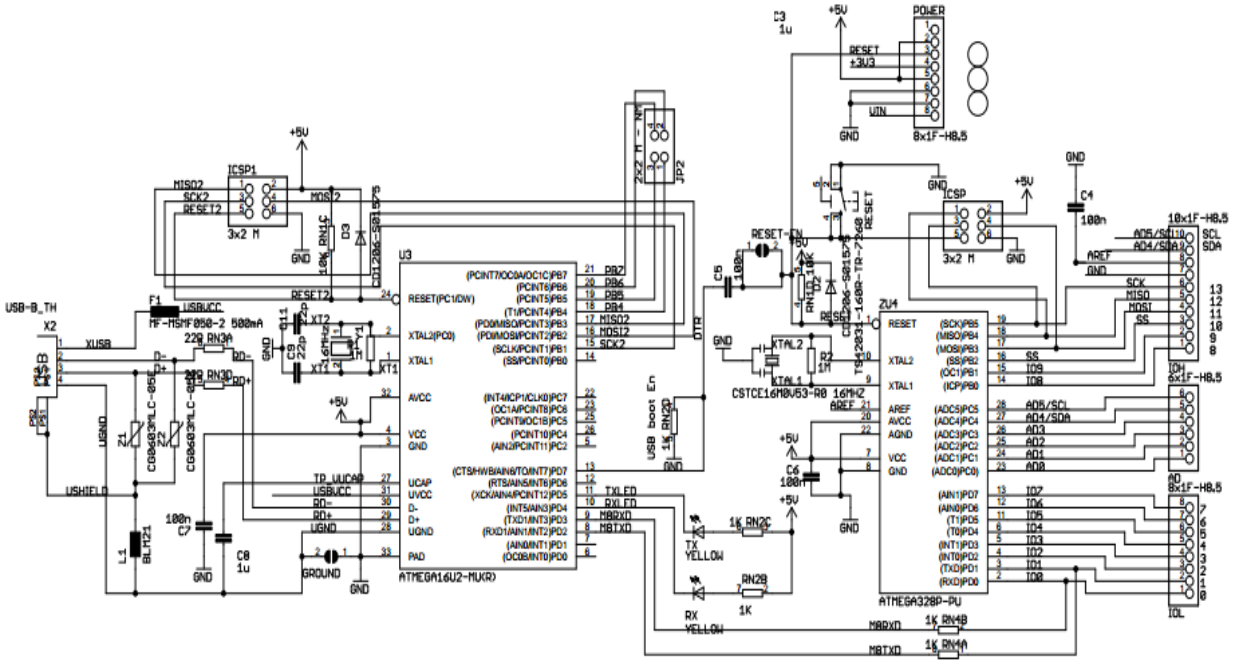

Figure 7: The schematics of the ATmega 328 microcontroller with I/O ports

In this project, we will propose a new solution of seat belt reminder that combine all the element of technology that will make it as intelligent, compact and portable device to use in each of vehicle especially in a car.

3.3.2 Bluetooth Module BlueBee

Figure 8: BlueBee Bluetooth module

BlueBee is the one of the device that have able to send signal and receive signal using Bluetooth wireless technology. It has 20 pins, but only 9 pins are available for connection to microcontroller board. This kind of the device is suitable for all type of microcontroller system that have 3.3 Volt pin power out. Moreover, the criteria of chosen Arduino Uno as main programming board is very suitable and applicable because it has 3.3 Volt power pin output.

Move into working modes, Bluebee has two default modes which are AT mode and Trans mode. AT mode is differs from Trans mode, which it is used when to set or inquire control parameter and have baud rate about 38,400 bps while Trans mode is used to transmit or receive data and signal from other Bluetooth device. In term of baud rate, Trans mode has default value which is 9600.

Symbol	Parameter	Min	Max	Unit
3.3	Operating voltage	3.0	3.6	V
RX	Receiver pin of BlueBee module	0	3.3	V
TX	Transmit pin of BlueBee module	0	3.3	V
Reset	Reset pin of BlueBee module	0	3.3	V
GND	Ground	0	0	V

Table 3: Absolute maximum rating for BlueBee Bluetooth Module

The next hardware that complete the functional of Bluetooth module is the XBee Shield. BlueBee need XBee Shield device to attach on the Arduino Uno board. It is one of the product from Cytron and it has special feature which is stackable side headers. By having this feature, it allows more shield to be stacked on top of it.

3.3.3 Sensor

3.3.3.1 Force Sensitive Resistor

Figure 9: FSR

Force sensitive resistor (FSR) was chosen to be seat occupancy sensor in the vehicle. FSR come with 0.5 inch diameter for sensing area, it has ability to detect how much pressure that have been applied in sensing area, in the range of 100g to 10kg. When pressure applied, it will send the value to Arduino Uno board and determine that the car seat is now being occupied by user. It can be interface with various analog input of any microcontroller especially Arduino type.

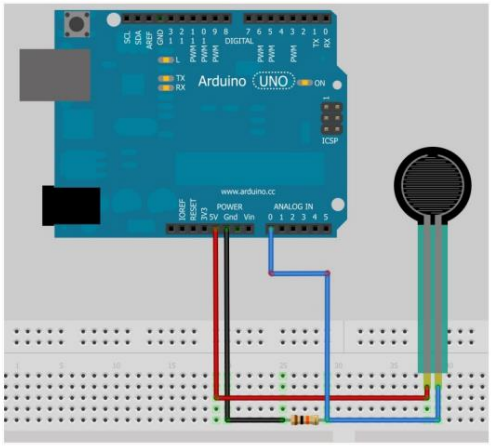

Figure 10: Interface Arduino UNO and FSR

The figure above shows the connection between Arduino and FSR. A right pin of FSR is connect to a pull-down 10K Ohm resistor direct to the ground and a left pin to power supply 5V.

3.3.3.2 Reed Switch

Reed switch, use the magnetic principal used to detect whether the occupant buckle up or not while driving. When the user buckle up, the reed switch inside the buckle casing will turn ON the circuit, thus it will send "LOW" data to the Arduino Uno. It consist a NOT gate, which change the 1 (HIGH) input to 0 (LOW) output and 0 (LOW) input to 1 (HIGH) output as shown in table below.

NOT

X	$Z = \overline{X}$
0	1
1	0

Table 4: NOT (Inverter) gate truth table

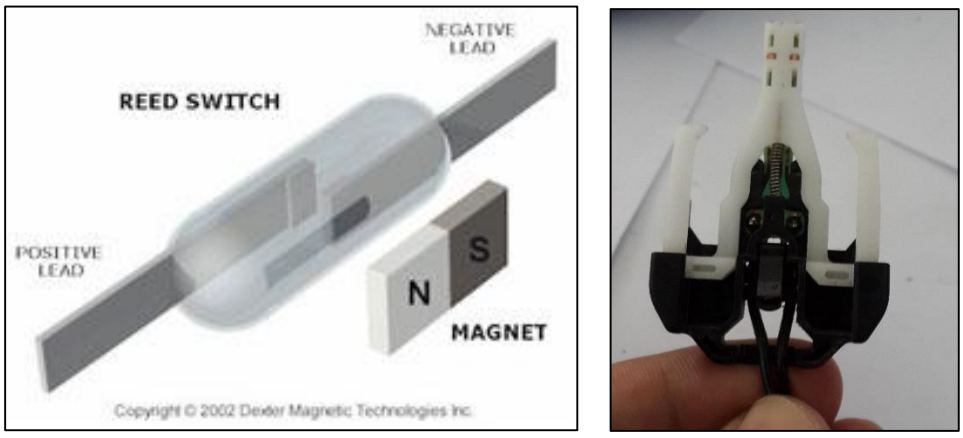

Figure 11: Reed Switch

3.3.4 Android Platform

A smart phone that installed with Android operating system is chosen to be the output of this project. It will send the signal to the user from the microcontroller the current situation, whether the driver buckle up or not. Android and microcontroller will communicate each other by using Bluetooth medium, since Android has built in with Bluetooth driver

MIT App Inventor web service is been chosen to develop a new application for smartphone instead of use Software Development Kit (SDK). This is because MIT App Inventor provide the users with easy programming code, most of them are in block based programming language. Different with current programming code that provide by other software development, block based programming tool ensure the developer to understand the code easily and troubleshooting the error in short time. This web service has been developed by Professor Hal Abelson and Google Education's team and this service is accessible to wide range of users, consist of 195 countries worldwide.

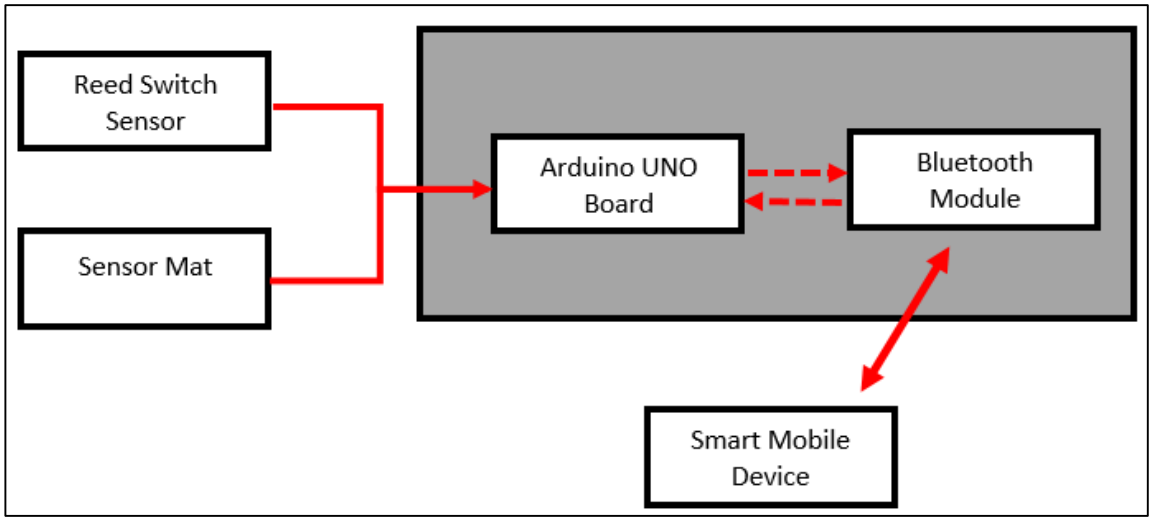

Figure 12: Block Diagram of Intelligent & Portable Seat Reminder

3.3.5 Circuit Diagram

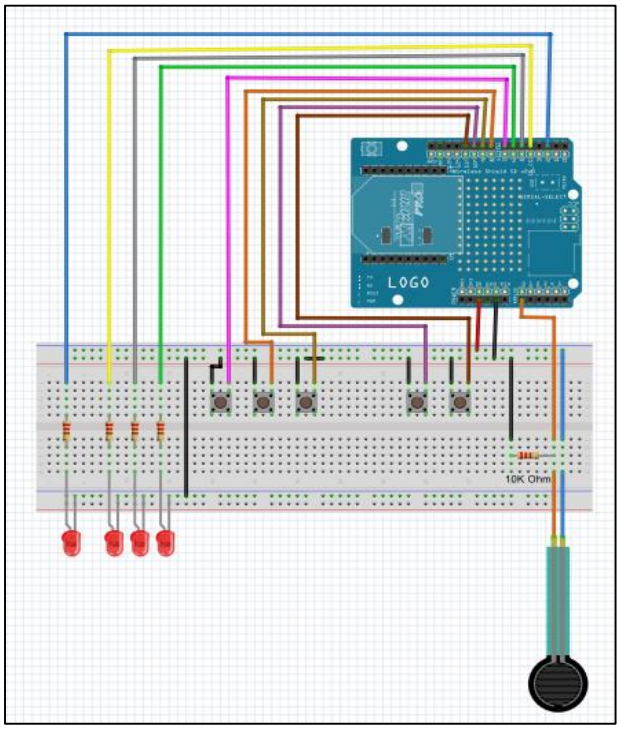

Figure 13: Seat Belt Reminder system circuit diagram

The diagram above shows all the connection that required to build intelligent and portable seat belt reminder system. The circuit contain two main parts; reminder system for a driver and also for a passenger. As shown in figure, there are 3 push buttons at left side for passenger and other two push buttons at the right side with FSR for driver. The input pull-up serial principle is used because it monitors the state of pushbutton by establishing serial communication between Arduino and Android by Bluetooth medium.

The input pull-up serial principle explained that when the pushbutton is pressed, it will connect the two points in the circuit and when unpressed, there are no connection between them. This is because the internal pull-up on digital pin is active and connect to 5 Volts, it will send HIGH signal when the pushbutton is open and LOW signal when the button is closed.

The FSR will detect the user at driver's seat, with minimum weight of 10 kg, then follow the other two push buttons that act as reed switch that will place later in final design. Same goes to passenger side, the first button act like FSR, and the other two buttons as the indicator for buckle up. The three LEDs that place at the edge of the circuit are acts as indicator, which give different sequence of light to the driver and passenger. About eight digital input pins and one analog input are used to demonstrate the working principle. The Bluebee, a Bluetooth module is being placed at the top of Arduino.

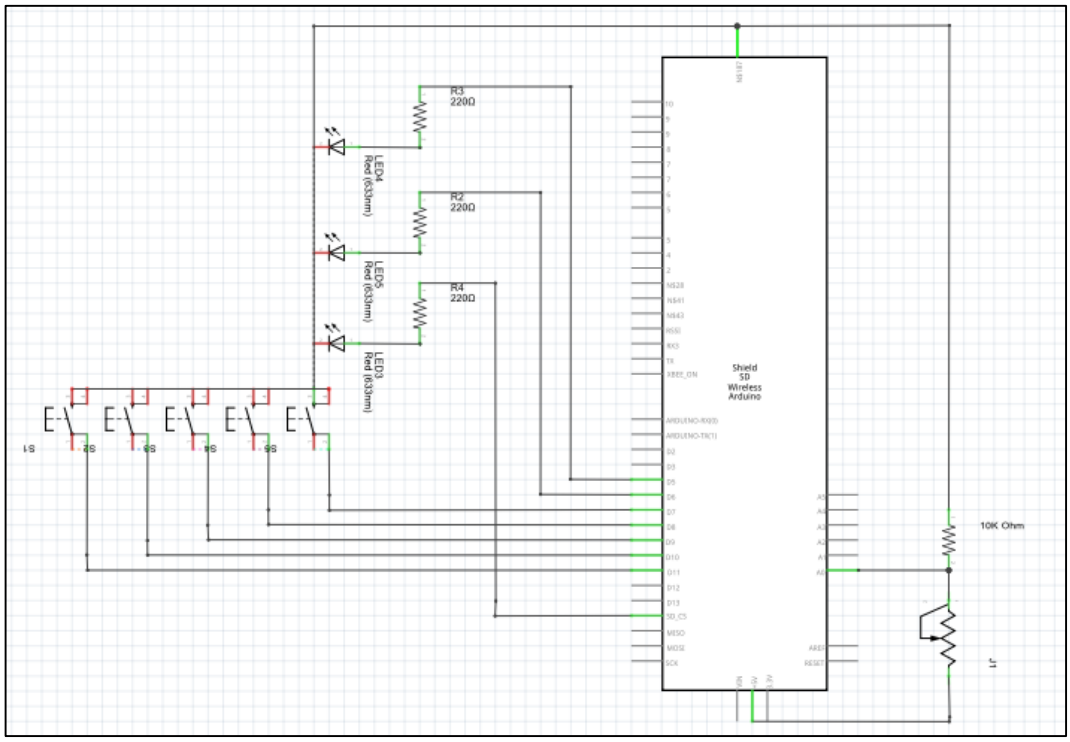

Figure 14: Schematic Circuit Design

3.4 Software Development

For software development stage, it has been classified into two main component which are Arduino Programming Code and Android Software Development.

3.4.1 Arduino Programming Code

Arduino programming language is an open source programming code environment, thus it allows a user to write code and program it into the board with easiest way. This type of programming program has been divided into three main parts started with Structure, Values and lastly, Functions. The latest version Arduino compiler version 1.0.6 is used to program the code.

Structure

- void setup()
- void loop()

```
void setup()
{
  pinMode(ledPin1, OUTPUT);
  pinMode(ledPin2, OUTPUT);
  pinMode(ledPin3, OUTPUT);
  pinMode(buttonA1pin, INPUT_PULLUP);
  pinMode(buttonB1pin, INPUT_PULLUP);
  pinMode(buttonC1pin, INPUT_PULLUP);
  pinMode(buttonA2pin, INPUT_PULLUP);
  pinMode(buttonB2pin, INPUT_PULLUP);
  pinMode(buttonC2pin, INPUT_PULLUP);
  pinMode(fsrReading, INPUT);
  Serial.begin(9600);

}
```

Values

- HIGH | LOW
- INPUT | OUTPUT | INPUT_PULLUP

```
 if (analogRead(fsrReading) < 800 && digitalRead(buttonBlpin) == HIGH &&
 digitalRead(buttonClpin) == HIGH ) //(0,0,0)
{
    digitalWrite(ledPin2, LOW);
}

if (analogRead(fsrReading) < 800 && digitalRead(buttonBlpin) == HIGH &&
digitalRead(buttonClpin) == HIGH ) //(0,0,1) = 1
{
   Serial.print(" " );
   Serial.println(1);
   delay(6000);
   blinkLED2();
}
```

Functions

- pinMode()
- analogRead()
- digitalWrite()

```
void blinkLED1(){
  //function body
  digitalWrite(ledPin1, HIGH);   // sets the LED on
  delay(100);                   // waits for a second
  digitalWrite(ledPin1, LOW);    // sets the LED off
  delay(100);                   // waits for a second

  //return returntype;
  //implied by closing curly bracked
}
```

3.4.2 Android Software Development

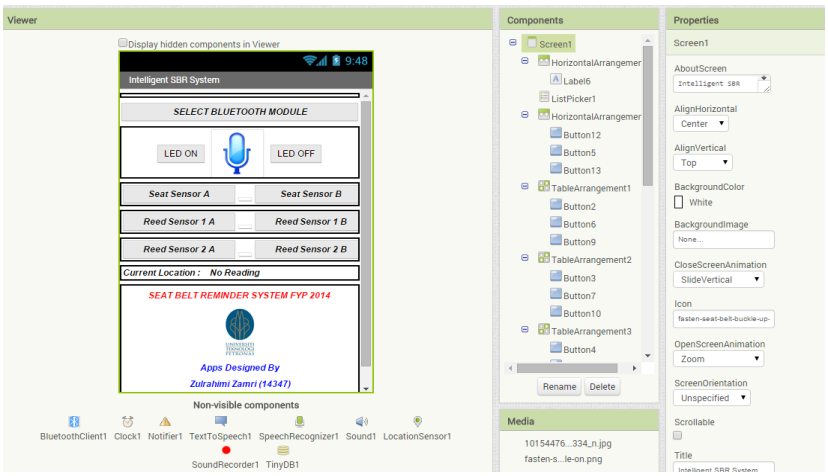

Figure 15: Design the user interface

The application is developed by using MIT App Invertor 2, one of the web service that provide a block of programming code that make programming task more easily. By using the available features such as button, layout, media and Bluetooth client and Bluetooth server, the user can simply use them to design the user interface and be able to relate each of the features with block diagram.

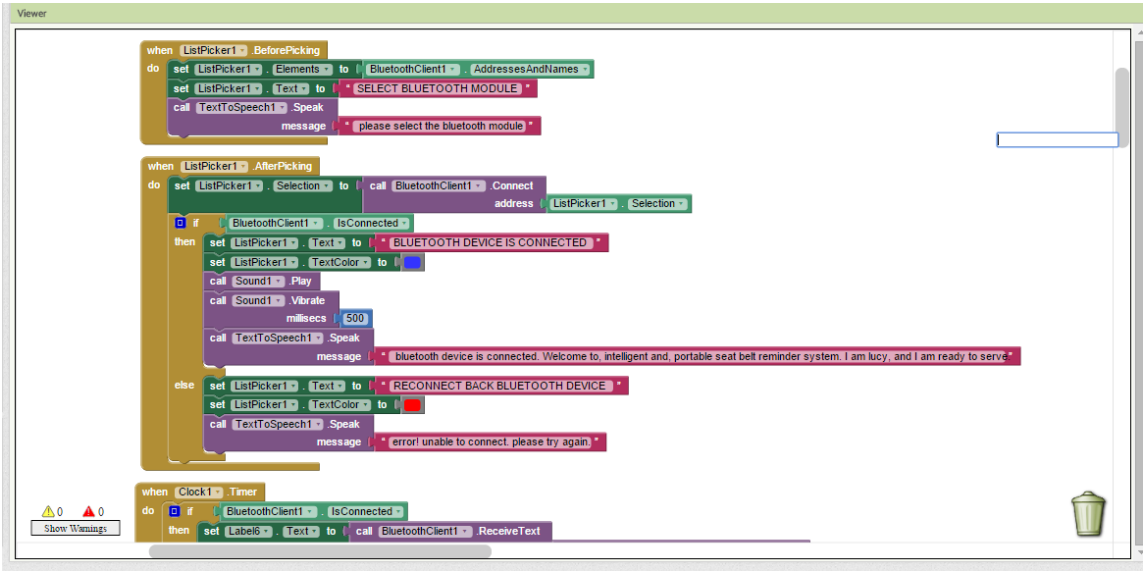

Figure 16: Block of programming code

3.4.3 Testing Arduino Uno Board with programming code

All the hardware will be going test phase procedure in order to check whether it working as expected. The first hardware that going through this procedure is the Arduino Uno board. Arduino Uno board is the main part for this project, thus it need to test first before proceed to next hardware. Here are the step how to test microcontroller board.

1.) Connect the Ardunio board to a computer by using USB cable.
2.) Upload a program to light up LED in each of the digital port.
3.) All the result is observed and recorded.

3.4.4 Testing BlueBee with XBee Shield

Then, BlueBee Bluetooth module is tested with XBee Shield. Both of hardware is tested in order to know whether it compatible with programming board. Three pins from BlueBee is used which are RX, VCC and GND. Smart phone that install with Android operating system also been used to complete the test. This test mainly about to switch ON and switch OFF the LED by using Bluetooth wireless communication. Below is the procedure how to test both hardware.

1.) BlueBee and Xbee Shield is connected with Arduino Uno board.
2.) Allow the Bluetooth from smart phone connect Bluetooth receiver from hardware.
3.) Open application bluetooth_for_android and start to play with LED by push the symbol LED ON and LED OFF at the screen.
4.) All the data is observed and recorded.

3.4 Gantt Chart

No	Description of Activities	Period Of Planning (Week)																										
		01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
1	Allocation Project Title																												
2	Research Work & Literature Review																												
3	Design of the Prototype																												
4	Finding the Hardware																												
5	Hardware Testing & Simulation																												
6	Establish Prototype																												
7	Software Design																												
8	Software Testing with Hardware																												
9	Final Completion Prototype																												
10	Report/Thesis Project																												

Table 5: Gantt chart

3.5 Key Milestone

No	Activities	(Week)																										
		01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
1	Project Topic Confirmation																												
2	Extended Proposal																												
3	Proposal Defense Presentation																												
4	Progress Evaluation																												
5	Submission Draft Interim Report																												
6	Submission Final Interim Report																												
7	Progress Report																												
8	ELEXTREX																												
9	Submission Draft Final Report																												
10	Submission Final Report & Technical Paper																												
11	Final Viva Presentation																												

Table 6: Key Milestone

Chapter 4: Result & Discussion

4.1 Hardware Testing Result

4.1.2 Android Uno Board Result

The programming board working as expected. All the pins are in good condition and functioning well when testing with LED by using example simple coding and also tutorial that provided by manufacturer. This can be shown in the figure below:

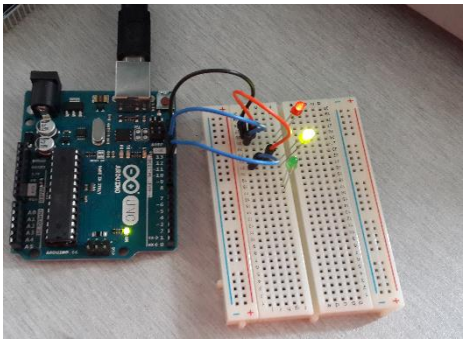

Figure 17: Testing Arduino Board with LED

4.1.3 BlueBee with XBee Shield

The BlueBee with XBee Shield functioning well and manage to switch ON LED exactly on time when the button is pressed. Meanwhile by using voice command, it takes some time to process the input from user because it want to detect the input key word and match it with the programming code.

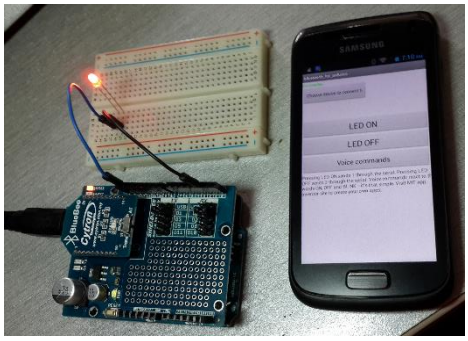

Figure 18: Testing BlueBee and XBee Shield with Android

4.2 Hardware & Software Result

Based on this project, all the equipment has been tested such as reed switch, Force Sensitive Resistor (FSR), programming board, Bluetooth module and Android platform. The results are shown in table below:

Condition	FSR	Reed Switch Sensor 1	Reed Switch Sensor 2	Warning Sign	Indicator In Smart Phone
Vacant seat (W<10kg), Unbuckled	0	0	0	Off	No
Vacant seat (W<10kg), Unbuckled	0	0	1	On	No
Vacant seat (W<10kg), Unbuckled	0	1	0	On	Yes
Vacant seat (W<10kg), Unbuckled	0	1	1	Off	No
Occupied Seat (W>10kg), Unbuckled	1	0	0	On	Yes
Occupied Seat (W>10kg), Unbuckled	1	0	1	On	Yes
Occupied Seat (W>10kg), Unbuckled	1	1	0	On	Yes
Occupied Seat (W>10kg), Buckled Up	1	1	1	Off	Yes

Table 7: The result from sensor and Arduino.

All the push button work as expected, same goes to FSR sensor. The combination of two push buttons with FSR sensor created a complex programming code, thus a few proper actions has been taken to overcome this problem. One of the way by declaring the input before void setup () in order to create global declaration. By using if statement in the Arduino programming code, an accurate value must be put in before compiling to avoid error.

SBR application that have been developed work in the best condition. The author use Samsung Galaxy S4 to demonstrate the application. This application has a few special characteristics; act as Global Positioning System (GPS) that provides current location to the user, voice detection as one of the input and human voice as the reminder. The interface also will inform the user which part of the seat belt system that are not complete yet by showing red and green button at the screen.

The three sensors will give the input HIGH (1) if the user fulfill the requirement. The input LOW (0) means that the user currently did not use a seat belt or they used seat belt but not in proper way. The soft reminder will start when the user at the condition below:

First condition: (Medium Priority)

- (001), (010), (101) and (110)
- The voice command will come out, “Sir, you are not proper wearing a seat belt. Please do so.”
- Yellow LED will blinking and red symbols will appear on the smart phone screen.
- It will be repeated until the seat belt is properly used.

Second condition: (High Priority)

- (100)
- The voice command will come out, “Sir, please buckle up immediately!”
- Red LED will blinking and red symbols will appear on the smart phone screen.
- It will be repeated until the seat belt is properly used.

Third condition: (Fulfill Requirement)

- (111)
- The voice command will come out, “Thank you for buckle up and have a safe journey”.
- Green LED will blinking and green symbols will appear on the smart phone screen.

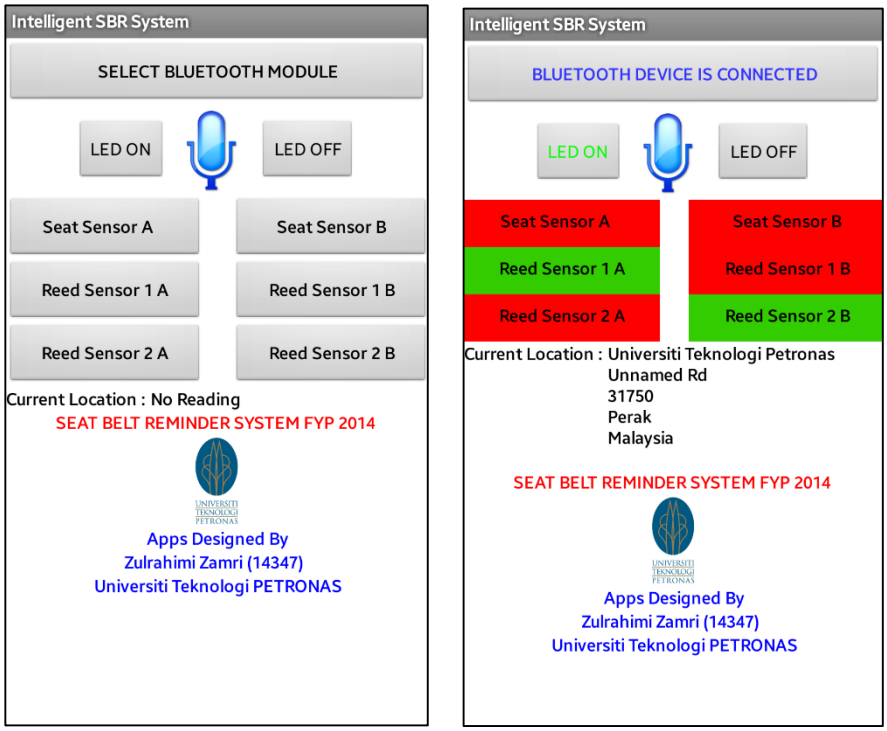

Figure 19: The user interface before and after Bluetooth device is connected.

Instead receiving signal from Arduino to Android platform, it also has ability to function vice versa. From Android platform, it can control LED by switch ON and OFF wirelessly. This shows that this prototype can communicate well in two ways without any problems. Instead using command Serial.read to retrieve the data from Android, we used readString command that able to read characters from a stream into a string.

Chapter 5: Conclusion and Recommendation

A lot of improvement need to be done to make this system more user friendly. A two way communication between the user and Arduino need to be integrate in future research. A combination of sensors with microcontroller still need further clarification and research in order to produce a better reminder system. A human behavior is one of the hardest thing to change in our world. A lot of effort need to spend in order to increase the awareness among driver. As a conclusion, hopefully this project will give benefits to human being and reduce the risk of fatality to the occupants when traffic accidents occur. By full utilizing this proposed device in each of the car around the world, millions lives can be save just only one step; buckle up.

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APPENDICES

Figure Appendix 1: Fully functioning prototype

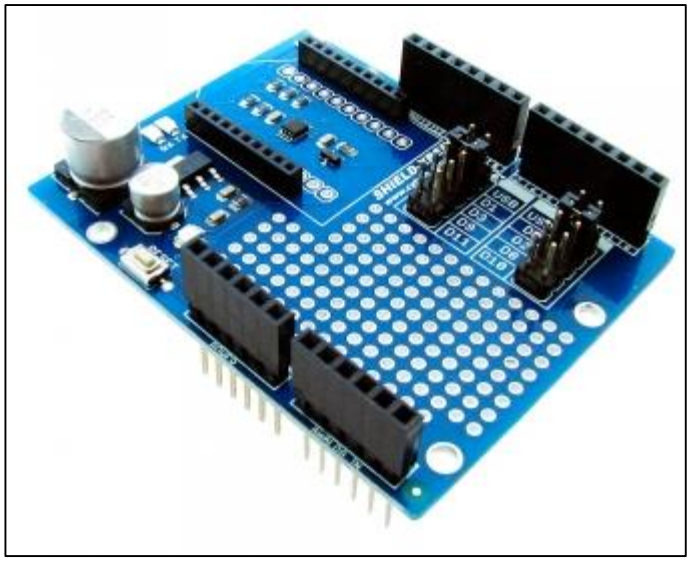


Figure Appendix 2: XBee Shield from Cytron

Arduino Programming Code

```
/*
Adafruit Arduino - Lesson 6. Inputs
*/

#include <SoftwareSerial.h>

const int buttonA1pin = 12;
const int buttonB1pin = 11;
const int buttonC1pin = 10;
const int buttonA2pin = 9;
const int buttonB2pin = 8;
const int buttonC2pin = 7;
const int ledPin1 = 6;
const int ledPin2 = 5;
const int ledPin3 = 4;
int fsrReading;

int val1 = 0;
int val2 = 0;
int val3 = 0;
byte serialA;
byte leds = 0;

void setup()
{
  pinMode(ledPin1, OUTPUT);
  pinMode(ledPin2, OUTPUT);
  pinMode(ledPin3, OUTPUT);
  pinMode(buttonA1pin, INPUT_PULLUP);
  pinMode(buttonB1pin, INPUT_PULLUP);
  pinMode(buttonC1pin, INPUT_PULLUP);
  pinMode(buttonA2pin, INPUT_PULLUP);
  pinMode(buttonB2pin, INPUT_PULLUP);
  pinMode(buttonC2pin, INPUT_PULLUP);
  pinMode(fsrReading, INPUT);
  Serial.begin(9600);   //baud rate - make sure it matches that of the module you got:

}

void loop()
{
   delay(6000);

   if (analogRead(fsrReading) < 800 && digitalRead(buttonB1pin) == HIGH &&
   digitalRead(buttonC1pin) == HIGH ) //(0,0,0)
  {
      digitalWrite(ledPin2, LOW);
  }
```

```
if (analogRead(fsrReading) < 800 && digitalRead(buttonB1pin) == HIGH &&
digitalRead(buttonC1pin) == HIGH ) //(0,0,1) = 1
{
   Serial.print(" " );
   Serial.println(1);
   delay(6000);
   blinkLED2();
}

if (analogRead(fsrReading) < 800 && digitalRead(buttonB1pin) == LOW &&
digitalRead(buttonC1pin) == LOW ) //(0,1,0) = 2
{
   Serial.print(" " );
   Serial.println(2);
   delay(6000);
   blinkLED2();
}

if (digitalRead(buttonA1pin) == HIGH && digitalRead(buttonB1pin) == LOW &&
digitalRead(buttonC1pin) == HIGH ) //(0,1,1)
{
  digitalWrite(ledPin2,LOW);
}
```

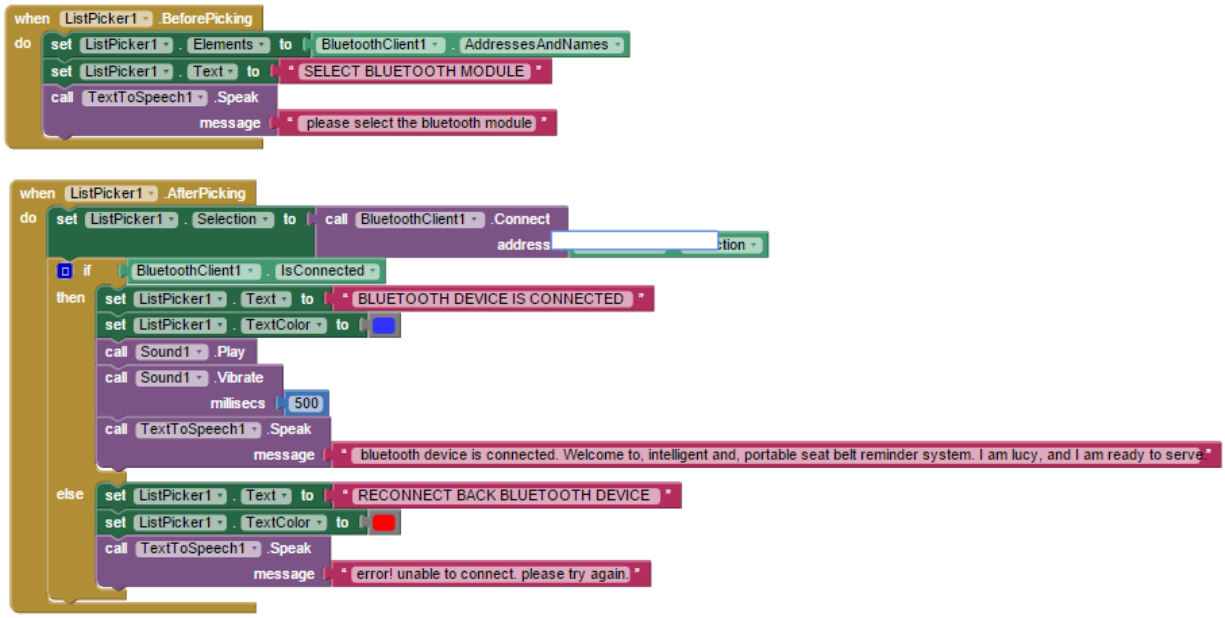
```
if (analogRead(fsrReading) > 800 && digitalRead(buttonB1pin) == HIGH &&
digitalRead(buttonC1pin) == LOW )//(1,0,0) = 3
{
  delay(6000);
  Serial.print(" " );
   Serial.println(3);
  delay(6000);
  blinkLED1();
}

if (analogRead(fsrReading) > 800 && digitalRead(buttonB1pin) == HIGH &&
digitalRead(buttonC1pin) == HIGH )//(1,0,1) = 4
{
 delay(6000);
 Serial.print(" " );
 Serial.println(4);
 blinkLED2();
}

if (analogRead(fsrReading) > 800 && digitalRead(buttonB1pin) == LOW &&
digitalRead(buttonC1pin) == LOW )//(1,1,0) = 5
{
  delay(6000);
  Serial.print(" " );
  Serial.println(5);
  blinkLED2();
}

if (analogRead(fsrReading) > 800 && digitalRead(buttonB1pin) == LOW &&
digitalRead(buttonC1pin) == HIGH )//(1,1,1) = 6
{
 delay(6000);
 Serial.print(" " );
 Serial.println(6);
  blinkLED3();
```

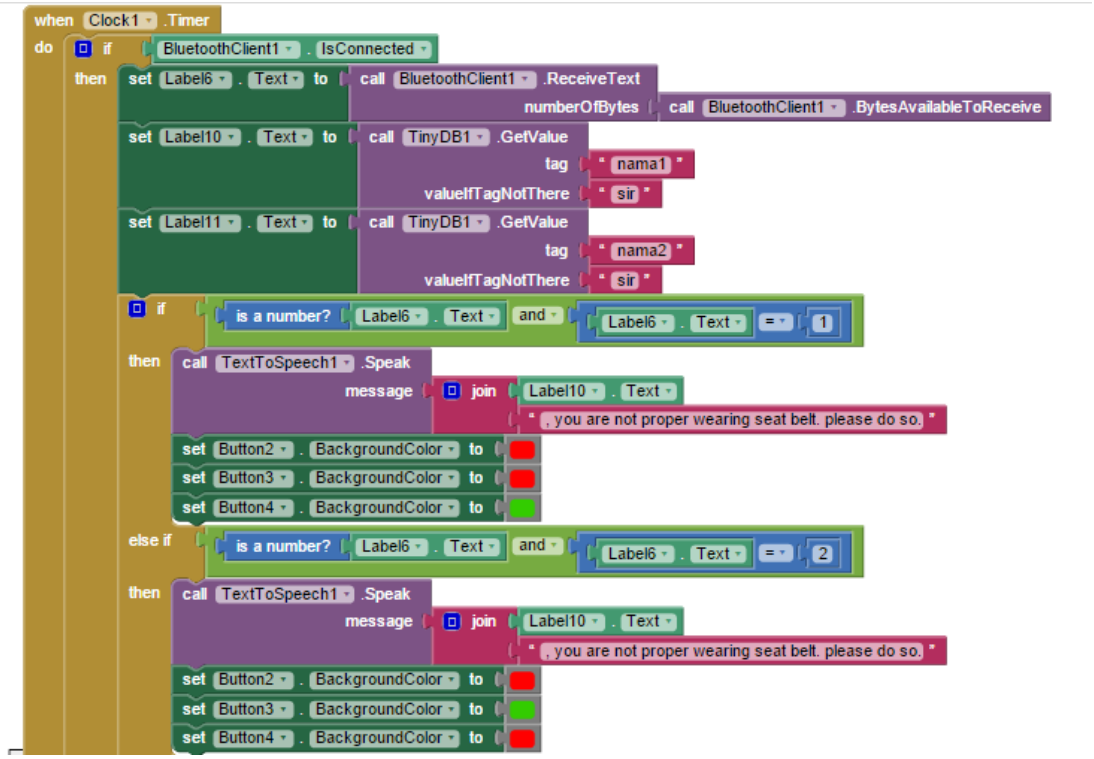
```
if (digitalRead(buttonA2pin) == HIGH && digitalRead(buttonB2pin) == HIGH &&
digitalRead(buttonC2pin) == HIGH ) //(0,0,0)
 {
     delay(6000);
     digitalWrite(ledPin2, LOW);
 }

 if (digitalRead(buttonA2pin) == HIGH && digitalRead(buttonB2pin) == HIGH &&
 digitalRead(buttonC2pin) == LOW ) //(0,0,1) = 7
 {

    delay(6000);
    Serial.print(" " );
    Serial.println(7);
    blinkLED2();
 }

 if (digitalRead(buttonA2pin) == HIGH && digitalRead(buttonB2pin) == LOW &&
digitalRead(buttonC2pin) == HIGH ) //(0,1,0) = 8
 {
    delay(6000);
    Serial.print(" " );
    Serial.println(8);
    blinkLED2();
 }

 if (digitalRead(buttonA2pin) == HIGH && digitalRead(buttonB2pin) == LOW &&
 digitalRead(buttonC2pin) == LOW ) //(0,1,1)
 {
   digitalWrite(ledPin2,LOW);
 }

 if (digitalRead(buttonA2pin) == LOW && digitalRead(buttonB2pin) == HIGH &&
 digitalRead(buttonC2pin) == HIGH )//(1,0,0) = 9
 {
    delay(6000);
    Serial.print(" " );
    Serial.println(9);
    delay(6000);
    blinkLED1();

 }

 if (digitalRead(buttonA2pin) == LOW && digitalRead(buttonB2pin) == HIGH &&
 digitalRead(buttonC2pin) == LOW )//(1,0,1) = 10
 {
    delay(6000);
    Serial.print(" " );
    Serial.println(10);
   blinkLED2();
 }
```

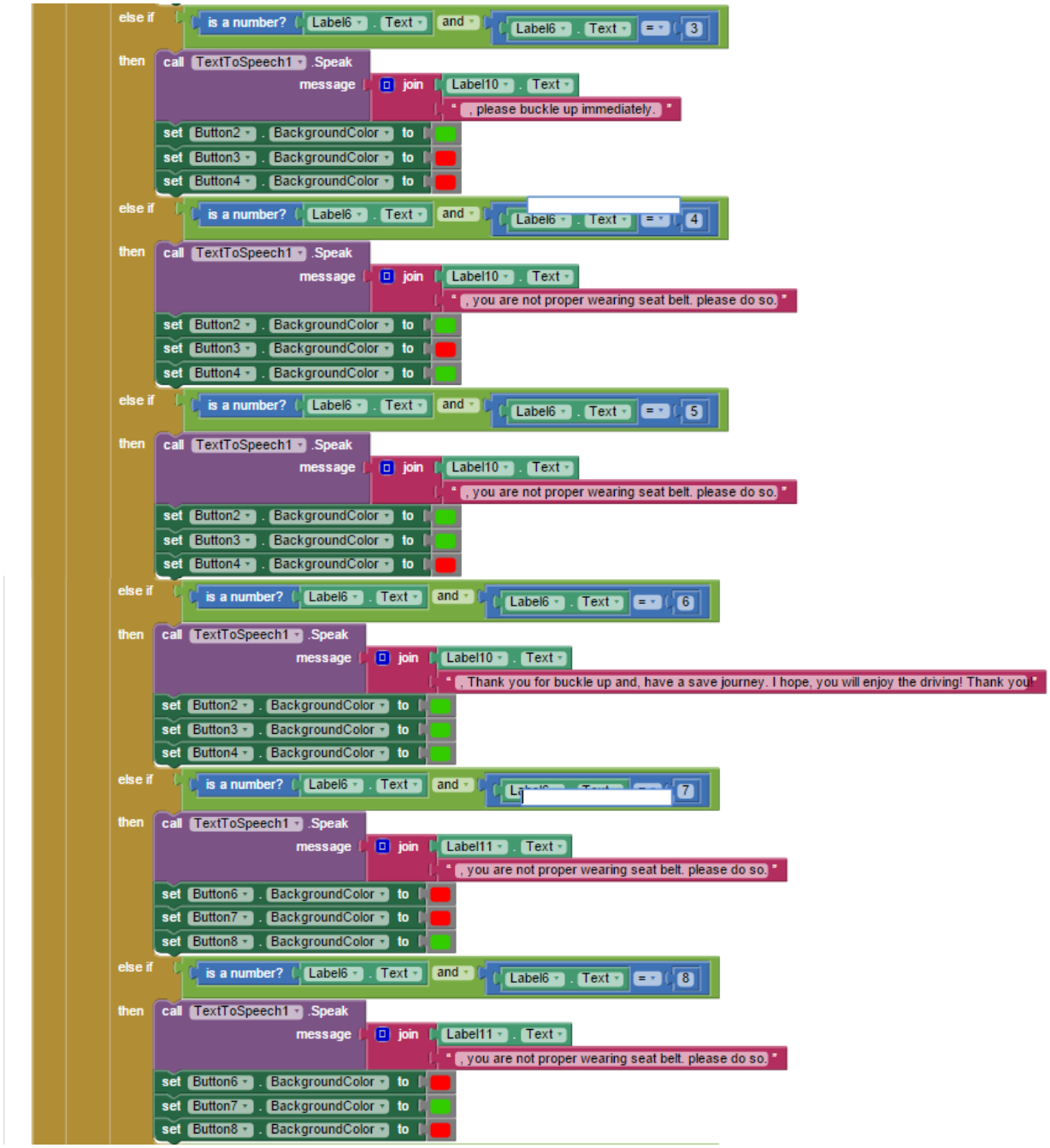
```
  if (digitalRead(buttonA2pin) == LOW && digitalRead(buttonB2pin) == LOW &&
  digitalRead(buttonC2pin) == HIGH )//(1,1,0) = 11
  {
     delay(6000);
     Serial.print(" " );
     Serial.println(11);
    blinkLED2();
  }

  if (digitalRead(buttonA2pin) == LOW && digitalRead(buttonB2pin) == LOW &&
  digitalRead(buttonC2pin) == LOW )//(1,1,1) = 12
  {
    delay(6000);
    Serial.print(" " );
    Serial.println(12);
    delay(6000);
    blinkLED3();
  }

 if (digitalRead(buttonA2pin) == LOW && digitalRead(buttonB2pin) == LOW &&
 digitalRead(buttonC2pin) == LOW && digitalRead(buttonA1pin) == LOW &&
 digitalRead(buttonB1pin) == LOW && digitalRead(buttonC1pin) == LOW )//(1,1,1,1,1,1) = 13
  {
    delay(6000);
    Serial.print(" " );
    Serial.println(13);
    delay(6000);
    blinkLED3();
}
}


//returntype functionName( arguments ){

void blinkLED1(){
  //function body
  digitalWrite(ledPin1, HIGH);   // sets the LED on
  delay(100);                  // waits for a second
  digitalWrite(ledPin1, LOW);    // sets the LED off
  delay(100);                  // waits for a second

  //return returntype;
  //implied by closing curly bracked
}
```

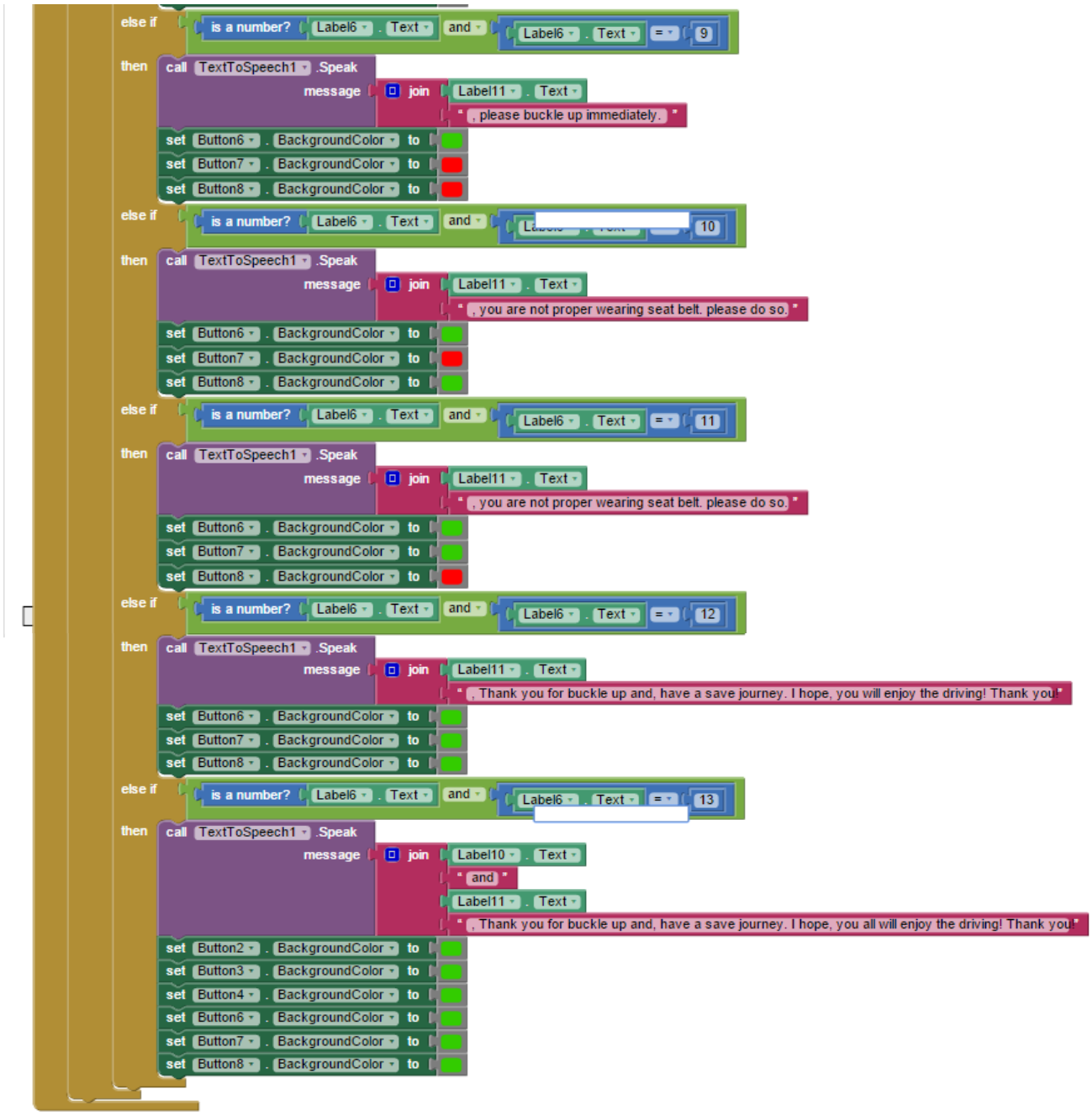
```
//returntype functionName( arguments ){
void blinkLED2(){

  //function body
  digitalWrite(ledPin2, HIGH);   // sets the LED on
  delay(500);                  // waits for a second
  digitalWrite(ledPin2, LOW);    // sets the LED off
  delay(500);                  // waits for a second

  //return returntype;
  //implied by closing curly bracked
}

void blinkLED3(){

  //function body
  digitalWrite(ledPin3, HIGH);   // sets the LED on
  delay(1000);                  // waits for a second
  digitalWrite(ledPin3, LOW);    // sets the LED off
  delay(1000);                  // waits for a second

  //return returntype;
  //implied by closing curly bracked
}
```

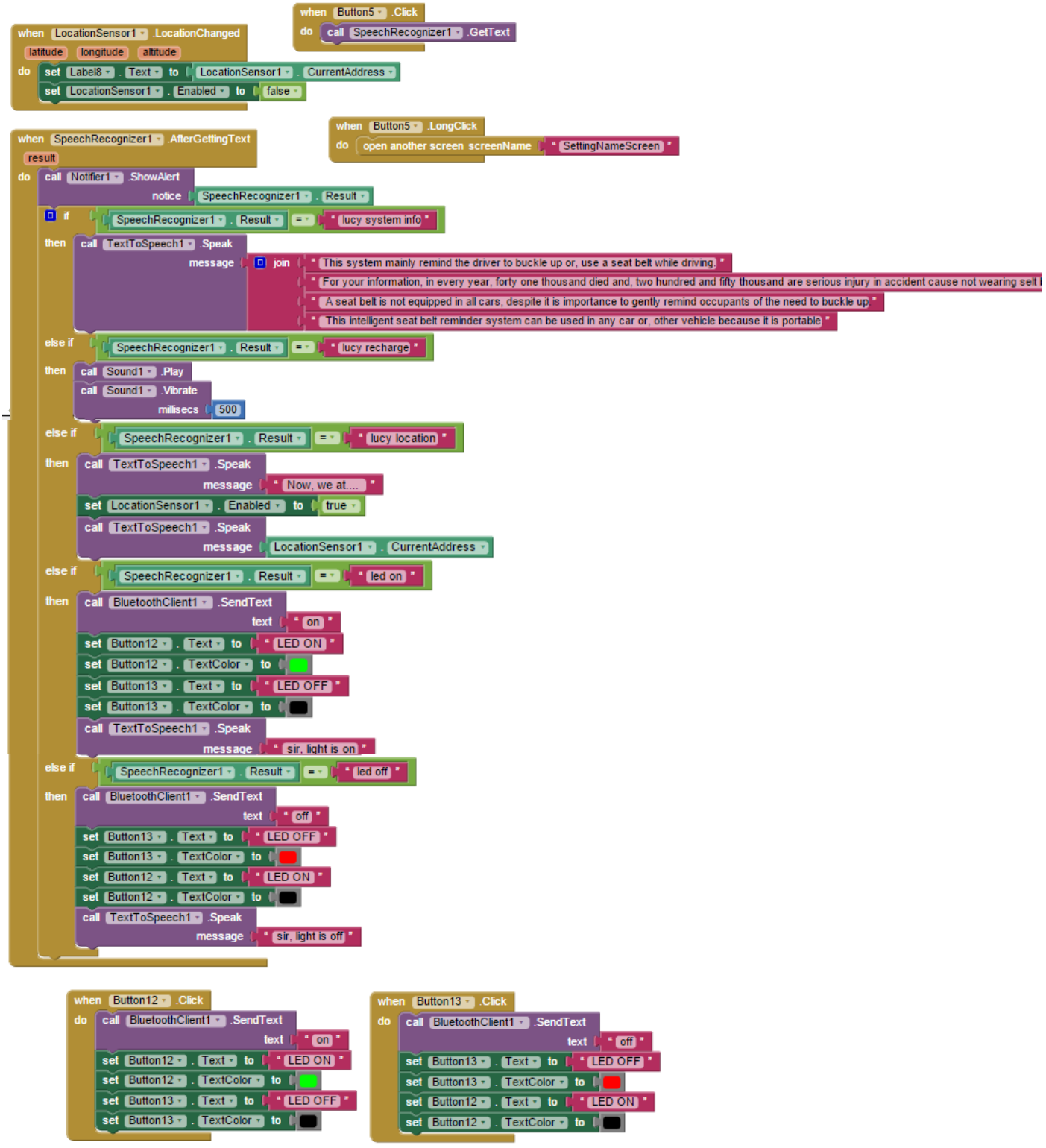
#Android Apps Block Diagram Codes






else if
is a number? Label6 . Text and Label6 . Text = 3
then
call TextToSpeech1 .Speak
message join Label10 . Text
" , please buckle up immediately. "
set Button2 . BackgroundColor to
set Button3 . BackgroundColor to
set Button4 . BackgroundColor to
else if
is a number? Label6 . Text and Label6 . Text = 4
then
call TextToSpeech1 .Speak
message join Label10 . Text
" , you are not proper wearing seat belt. please do so. "
set Button2 . BackgroundColor to
set Button3 . BackgroundColor to
set Button4 . BackgroundColor to
else if
is a number? Label6 . Text and Label6 . Text = 5
then
call TextToSpeech1 .Speak
message join Label10 . Text
" , you are not proper wearing seat belt. please do so. "
set Button2 . BackgroundColor to
set Button3 . BackgroundColor to
set Button4 . BackgroundColor to
else if
is a number? Label6 . Text and Label6 . Text = 6
then
call TextToSpeech1 .Speak
message join Label10 . Text
" , Thank you for buckle up and, have a save journey. I hope, you will enjoy the driving! Thank you! "
set Button2 . BackgroundColor to
set Button3 . BackgroundColor to
set Button4 . BackgroundColor to
else if
is a number? Label6 . Text and 7
then
call TextToSpeech1 .Speak
message join Label11 . Text
" , you are not proper wearing seat belt. please do so. "
set Button6 . BackgroundColor to
set Button7 . BackgroundColor to
set Button8 . BackgroundColor to
else if
is a number? Label6 . Text and Label6 . Text = 8
then
call TextToSpeech1 .Speak
message join Label11 . Text
" , you are not proper wearing seat belt. please do so. "
set Button6 . BackgroundColor to
set Button7 . BackgroundColor to
set Button8 . BackgroundColor to


else if
is a number? Label6 . Text and Label6 . Text = 9
then
call TextToSpeech1 .Speak
message join Label11 . Text
, please buckle up immediately.
set Button6 . BackgroundColor to
set Button7 . BackgroundColor to
set Button8 . BackgroundColor to
else if
is a number? Label6 . Text and 10
then
call TextToSpeech1 .Speak
message join Label11 . Text
, you are not proper wearing seat belt. please do so.
set Button6 . BackgroundColor to
set Button7 . BackgroundColor to
set Button8 . BackgroundColor to
else if
is a number? Label6 . Text and Label6 . Text = 11
then
call TextToSpeech1 .Speak
message join Label11 . Text
, you are not proper wearing seat belt. please do so.
set Button6 . BackgroundColor to
set Button7 . BackgroundColor to
set Button8 . BackgroundColor to
else if
is a number? Label6 . Text and Label6 . Text = 12
then
call TextToSpeech1 .Speak
message join Label11 . Text
, Thank you for buckle up and, have a save journey. I hope, you will enjoy the driving! Thank you!
set Button6 . BackgroundColor to
set Button7 . BackgroundColor to
set Button8 . BackgroundColor to
else if
is a number? Label6 . Text and Label6 . Text = 13
then
call TextToSpeech1 .Speak
message join Label10 . Text
and
Label11 . Text
, Thank you for buckle up and, have a save journey. I hope, you all will enjoy the driving! Thank you!
set Button2 . BackgroundColor to
set Button3 . BackgroundColor to
set Button4 . BackgroundColor to
set Button6 . BackgroundColor to
set Button7 . BackgroundColor to
set Button8 . BackgroundColor to


when LocationSensor1 .LocationChanged
latitude longitude altitude
do set Label8 . Text to LocationSensor1 . CurrentAddress
set LocationSensor1 . Enabled to false
when Button5 .Click
do call SpeechRecognizer1 .GetText
when Button5 .LongClick
do open another screen screenName " SettingNameScreen "
when SpeechRecognizer1 .AfterGettingText
result
do call Notifier1 .ShowAlert
notice SpeechRecognizer1 . Result
if SpeechRecognizer1 . Result = " lucy system info "
then call TextToSpeech1 .Speak
message join " This system mainly remind the driver to buckle up or, use a seat belt while driving. "
" For your information, in every year, forty one thousand died and, two hundred and fifty thousand are serious injury in accident cause not wearing selt
" A seat belt is not equipped in all cars, despite it is importance to gently remind occupants of the need to buckle up "
" This intelligent seat belt reminder system can be used in any car or, other vehicle because it is portable "
else if SpeechRecognizer1 . Result = " lucy recharge "
then call Sound1 .Play
call Sound1 .Vibrate
millisecs 500
else if SpeechRecognizer1 . Result = " lucy location "
then call TextToSpeech1 .Speak
message " Now, we at.... "
set LocationSensor1 . Enabled to true
call TextToSpeech1 .Speak
message LocationSensor1 . CurrentAddress
else if SpeechRecognizer1 . Result = " led on "
then call BluetoothClient1 .SendText
text " on "
set Button12 . Text to " LED ON "
set Button12 . TextColor to
set Button13 . Text to " LED OFF "
set Button13 . TextColor to
call TextToSpeech1 .Speak
message " sir, light is on "
else if SpeechRecognizer1 . Result = " led off "
then call BluetoothClient1 .SendText
text " off "
set Button13 . Text to " LED OFF "
set Button13 . TextColor to
set Button12 . Text to " LED ON "
set Button12 . TextColor to
call TextToSpeech1 .Speak
message " sir, light is off "
when Button12 .Click
do call BluetoothClient1 .SendText
text " on "
set Button12 . Text to " LED ON "
set Button12 . TextColor to
set Button13 . Text to " LED OFF "
set Button13 . TextColor to
when Button13 .Click
do call BluetoothClient1 .SendText
text " off "
set Button13 . Text to " LED OFF "
set Button13 . TextColor to
set Button12 . Text to " LED ON "
set Button12 . TextColor to