Sudan University of Science and Technology
College of Engineering
Electrical Engineering

Design and Implementation of Smart Car With Accident Avoidance and Detection

تصميم و تنفيذ سيارة ذكية مع تجنب و كشف للحوادث

A Project Submitted in Partial Fulfillment for the Requirements of the Degree of BEng (Honors) in Electrical Engineering

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الآية

قال تعالى:

والله أخْرجكم مّن بطون أمّهاتكمْ لا تعْلمون شيْئا وجعل لكم السّمْع والْأبْصار والْأفْئدة ۙ لعلّكمْ تشْكرون
(٧٨) ألمْ يروْا إلى الطّيْر مسخّرات في جوّ السّماء ما يمْسكهنّ إلّا الله ۗ إنّ في ذٰلك لآيات لّقوْم يؤْمنون
(٧٩)

سورة النحل

DEDICATION

Every challenging work needs self-efforts as well as guidance of elders especially those who were very close to our hearts, to our beloved parents who gave us their support, affection, love, encouragement and prays to complete this dissertation work.

To those who helped us behind the seen and those who help us in the shadow, our families, our friends, cheerleaders and everyone who values our research and sees it as new way of improvement.

Along with all hard working and respected
Teachers

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Profusely thanks to Sudan University of Science and Technology, the deep-rooted educational institute for providing us with the entire infrastructure to proceed with our research and extremely thanks to the school of Electronics Engineering for their kind help and co-operation throughout our study period. Last but not least, thanks to all who paved the path before us.

ABSTRACT

The Rapid growth of technology has made our life easier. This advancement in technology also increased the traffic hazards. Hence the ratio of road accidents which take place frequently increases causing immense loss of life due to poor emergency facilities. Main causes behind these road accidents include: lack of training institutes, unskilled drivers, poor road conditions, use of cell phone during driving, over loading and poor governmental plans in this regard. Our research provides a solution for accident detection and prevention for human life safety. It enables intelligent detection of an accident at any place and reports about the accident on predefined numbers.Our system consists of two parts, alarming part and messaging part. The hardware includes ultrasonic sensor, vibration sensor, glopal positioning system(GPS) module,arduino Uno,glopal system mobile(GSM) modem (SIM 900D) and a buzzer. When distance is too short between the vehicle and obstacle then the buzzer will be ON as an indicator to move vehicle in other direction which is safer but when a vehicle faces accident despite of alarm, immediately vibration sensor will detect the signal and then the arduino Uno sends a message through the GSM modem including the location to predefined numbers that can be reserved for a rescue team. Our designed system has been tested at different locations and found to be effectively working by sending alert messages to mobile phone user.

المستخلص

التقدم السريع في التكنولوجيا جعل حياتنا اسهل وزاد من مخاطر الإزدحام ، إلي الأن نسبة حوادث الطريق التي تحدث مرارا وتكرارا وبزيادة كبيرة تسبب خسائر بشرية كبيرة مع ضعف تسهيلات الطوارئ. السبب الرئيسي خلف الحوادث المرورية المروعة هو ضعف معاهد التدريب وقلة خبرة السائقين واستخدام الهواتف أثناء القيادة بلإضافة الى إفتقار الطرق لظروف السلامة المرورية،مع ضعف الخطط الإستراتيجية الحكومية. لكل ما سبق بحثنا يقدم حلول لإكتشاف الحوادث والوقاية منها للحفاظ على سلامة الحياة البشرية وهذا النظام الذكي يكشف الحادث في اي مكان ويرسل تقرير(مكان الحادث) إلي المشفى ومركز الشرطة ،النظام يحتوي على وحدة إنذار ووحدة إرسال الرسالة اذا حدث الحادث، المكونات المادية تشمل حساس الموجات الفوق صوتية وحساس الإهتزاز و وحدة النظام العالمي لتحديد المواقع بالإضافة إلى جهاز الأردوينو و وحدة النظام العالمي للهاتف و جهاز إنذار عندما تكون المسافة قصيرة بين السيارة والجسم عندها سيعمل جهاز الإنذار لينذر السائق للتوقف او سحب السيارة لليمين او الشمال واذا حدث الحادث علي الرغم من ذلك حالا حساس الإهتزاز يرسل إشارة إلي جهاز الأردوينو والذي يقوم بدوره بإرسال الرسالة إلي المستشفى و مركز الشرطة عن طريق جهاز النظام العالمي للهواتف تحتوي على مكان الحادث بالتحديد،تصميمنا تمت تجربته من أماكن مختلفة و كان فعالا بإرسال الرسالة الى أرقام الهواتف المذكورة

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List of Abbreviations

AICC	Autonomous Intelligent Cruise Control
ARM	Advanced RISC Machines
CWWAB	Collision Warning with Auto Brake
DC	Direct Current
ECU	Electric Control Unit
GPS	Global Positioning System
GSM	Global System Mobile
GDP	Gross Domestic Product
IDE	Integrated Development Environment
LCD	Liquid Crystal Display
LIDAR	Light Distancing and Ranging
MEMS	Micro-Electro-Mechanical Systems
PCB	Printed Circuit Board
RF	Radio Frequency
RFID	Radio Frequency Identification
SDC	Smart Display and Control
SMS	Short Message Service
TTL	Transistor-Transistor Logic
USB	Universal Serial Bus

Chapter One
Introduction

1.1 Overview

Road accidents and traffic congestion are the major problems in urban areas. Currently there is no technology for accident detection and avoidance. There is a need of introducing a system to reduce the loss of life due to accidents and the time taken by the ambulance to reach the hospital. The accident victim is dependent on the mercy of others to rush him to hospital. Many times an accident goes unnoticed for hours before help comes in. Due to all these factors there is a high rate of mortality of the accident victims.

To overcome the drawback of existing system we will implement the new system in which there is an automatic detection of accident through sensors provided in the vehicle and avoidance unit. A main server unit houses the database of all hospitals in the city. A GPS and GSM module in the concerned vehicle will send the location of the accident to the main server which will rush an ambulance from a nearest hospital to the accident spot also it sends the location to the nearst traffic police station. This system is fully automated, thus it finds the accident spot [1].

1.2 Problem Statement

The accident victim is dependent on the mercy of others to rush him to hospital. Many times an accident goes unnoticed for hours before help comes in. Due to all these factors there is a high rate of mortality of the accident victims

1.3 Proposed Solution

We will implement a system in which there is an automatic detection of accident through sensors provided in the vehicle and avoidance unit . when an accident happen the control unit will send a message to hospitals. A main server unit houses the database of all hospitals and police station in the city

1.4 Objectives

The major objectives are to reduce accidents and save people, and therefore protecting the human from chronic disabilities resulting from delay of the ambulance.

1.5 Methodology

First, an extensive literature review will be performed. Second, the software and hardware parts will be implemented. This system consists of two parts, which are accident avoidance and accident detection.

1.5.1 Accident Avoidance

Ultrasonics are a great solution for clear object detection. Ultrasonic sensors generate high frequency sound waves at regular time intervals. These propagate in the air at the velocity of sound. If they strike an object, then they are reflected back as echo signals to the sensor. This reflected echo signals further processed to decrease the vehicle speed.

1.5.2 Accident Detection

For accident detection we are using a vibration sensor which immediately sends a message to the hospital and police station When the vehicle collides with any another or to any objects.by GSM and GPS technologies

1.5.3 Software Tools

The software tools are

- LaTeX for scientific writing
- Protus for hardware simulation
- The Arduino IDE

1.6 Project Layout

The rest of this thesis is organized as follows. Chapter two provides a preliminary background and literature review. Chapter three presents the proposed system model, describing its functionalities. Chapter four presents the implementation steps and outcomes. Finally, chapter five concludes the thesis.

Chapter Two
Literature Review

2.1 Background

Every year, approximately 1.25 million people are killed as a result of traffic accidents. Between 20 million and 50 million others are affected by non-fatal injuries and many are disabled as a result. Road traffic injuries cause significant economic losses to individuals, their families and to entire States. These losses arise from the cost of treatment and the loss of productivity of persons who die or become disabled due to injuries, and family members who are forced to absent from work or school to care for the injured. Traffic accidents in most countries cost 3% of gross domestic product(GDP) [1]. Figure 2.1 represents the statistics of road death by car accidents.

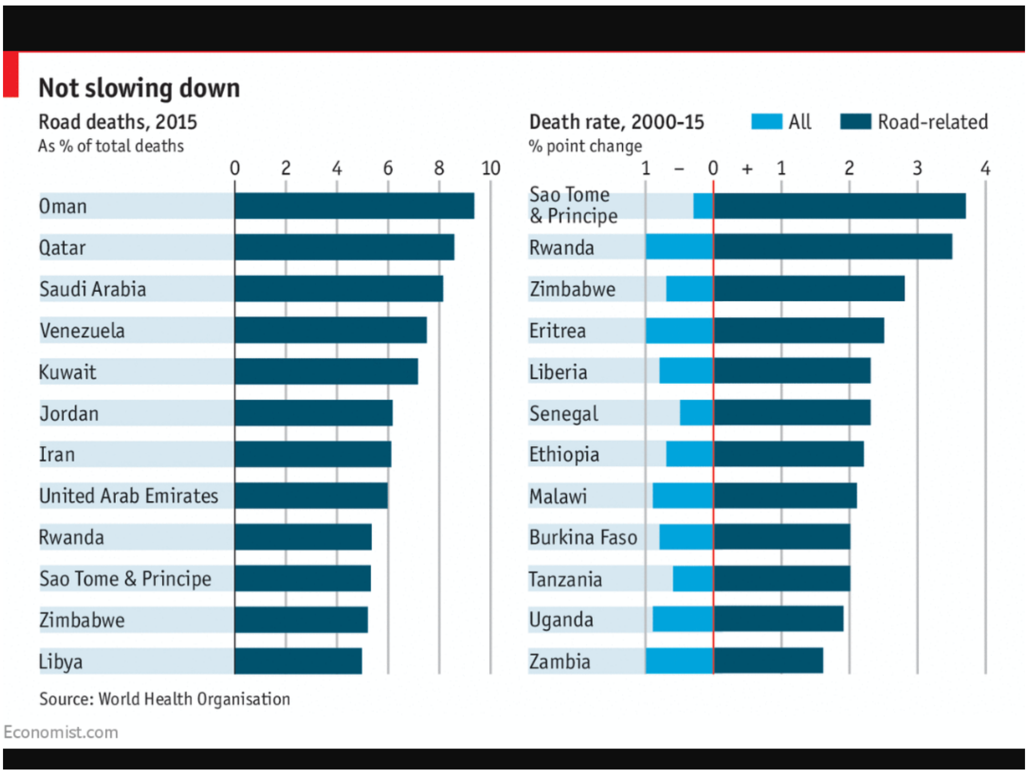

Figure 2.1: Death Statistics by Car Accident

2.2 Related Studies

The study in [1] considered the car consist vibration sensor and LPC2148 controller, GPS and GSM technology. When accident occurred the system transmit the location of the accident to the hospital through SMS. According to this project when the car meets with an accident immediately vibration sensor will detect the signal and sends it to ARM controller then it will send the location to a registered mobile number.

In [2], the proposed system contain two units alerting unit and messaging unit, the hardware include sonar ranging modules, vibration sensor three modules GPS receiver, micro controller (AT89S51), GSM modem (SIM900D) and alarm. When then distance between the vehicle and obstacle is too short the alarm will turn on , when vehicle faces accident despite of alerting the vibration sensor will detect the signal and then the microcontroller sends the alert message through the GSM modem including the location to predefined number.

The study in [3] implemented a system in which there is an automatic detection of accident there is a GSM and GPS unit inside the vehicle to detects the accident and sends the accident location to server unit. which contain data base of all nearest hospital and police station. The ambulance and police rushed to the location of the accident and simultaneously monitors the vital parameters. to overcome the drawback of existing system we will implement the new system in which there is an automatic detection of accident. The system consists of three main units: the vehicle unit, the ambulance and traffic unit and the control unit.

Also, the study in [4] presented a design that focuses on providing basic information on the accident site to the hospital and police station as a result of this sudden help precious life may get saved in this work a three axis accelerometer and GPS tracking system work for accidental monitoring this design detects accident in less time and sends this information to the required authorities. In this case GSM will read the short massage and the geographical co-ordinates of accident spot with the help of GPS to the hospital or police station and as now the location has been traced by the GPS, emergency medical service can be given as soon as possible. This system had a key for the driver, if the accident is very normal then the driver will press the key this will inform the micro controller that is very normal accident.

Furthermore, the study in [5] defined a complete solution for detecting the all types of accident that occurred on roads. the system had been implemented to avoid accident occurred due to adverse weather condition by decreasing the speed. When accident occurred the vibration or micro electrical mechanical systems(MEMS) sensor will turn on GPS to find the location and further short messaging service (SMS) will send to the nearest hospital this will optimize accidents and human death ratio. also there is fire sensor to detect fire accidents. the system provides a vital informations about accident. When the driver start engine it check whether the driver has wear the seat belt or not. if the seat belt is not on the car will not start and a message appears on the display. While the vehicle is moving if there is an obstacle it will decrease the vehicle speed by using ultrasonic sensors to detect obstacle. The vibration sensor will activate the GPS to locate accident spot. if there is no dangerous injuries then the driver press the safety switch within 40 sec. then the GSM will send the location and persons vital monitors. Even through the accident occurred also it will send a message to emergency center.

The study in [6] discussed creating a smart display and control (SDC) which will monitoring the zone and maintains the specified in the zone levels, which runs on an embedded system. This system includes three module includes RF transmitter placed in specific location and RF receiver in the vehicle. And the accident identification include GPS and GSM technology Security enabling module includes sensory unit which ensures the condition of seat belt and the driver. This study solved the problems like automatic speed control mechanism, accident detection and information sending this system will reduce the accidents and save the human lives this system is very cost effective and efficient

The study in [7] discussed a system contains vibration sensor, GPS and GSM technology. When the vehicle meets with an accident immediately vibration sensor will detect the signal and the MEMS sensor will detect the signal and send it to ARM controller. The microcontroller sends alert message through the GSM modem including the location to police and hospital control. The police and ambulance will trace the location through the GPS modem after receiving the information if there is no serious threat to any on life. The alert message can be canceled or terminated by the driver.

The study in [8] had discussed that this technology recommends cars to be affixed with radio frequency identification (RFID) readers and tags. Considered two cars A and B which are equipped with an RFID system. When the tag component of the RFID system of car B comes along with the range of car A, the RFID reader of car A receives information from it through electromagnetic waves. This information includes the location and speed of car B. also car B receives data from car A. The RFID reader has access to a computing device3, which helps it to provide data from the reader as visual information to the driver. An active RFID system which depends on an external power source had been used in this application.

Moreover, in [9], the authors discussed how to monitor speed of vehicles using RFIDs and how to take necessary action like fining based on over speeding and violation of rules. In this research paper it is suggested that RFID can be used other purposes like managing database of vehicles speed, locations, car identity etc. Considered Vehicles speed monitoring system stations, consisting of RFID reader, speed checking camera and snap camera are there. These monitoring system stations are placed on different locations .On this highway each car has its RFID tag. In each station through RFID reader and cameras system is saving information of vehicles like vehicle identity, time when it is crossing, speed, picture etc. Here it is important to mention even car speed is lower than the speed limit, RFID reader will save information for all these vehicles which are passing through this RFID reader. Another station is doing the same task at some distance. Every station is connected to main data base station which is collecting data from all these stations. In signal highway there may be different speed limit as on some location highways is straight, curve, crossing and intersection of cities, fog areas and construction area. Speed monitoring system stations are fitted on starting and ending part of different part of highway to monitor speed on this specific area, like one station is there at the start of Straight area of and one at the end of straight area of highway.

The study in [10] had discussed and showed Traffic violations and problems. Monitoring these traffic violations by human intervention over a wider area is too complicated due to the increasing population. The main motive behind that paper is to reduce these reckless accidents for which we propose a system that governs and controls the speed of the vehicle without any direct inconvenience to the driver. There are instances where the speed of the automobile is beyond the expected speed limit or the driver does not obey the traffic signals. An RFID reader present in the vehicle senses the RFID tag linked with a red traffic light or senses the vehicle speed limit on the tag attached to the speed limit signboard. The Electronic Control Unit (ECU) present in the vehicle will then decide upon the required control measure by comparing the tag information with real time speed of the automobile. Finally the proposed speed control simulation techniques and electro-hydraulic braking system is explained in detail.

The study in [11] had discussed the number of vehicles subsequently increasing in the last two decades, as it spreads drastically in every level of the society hence, safety becomes the main concern. Road accidents account a severe threat to the lives in both ways, physical as well as financial, even after digital control of vehicles. Many people lost their lives every year in vehicle collision majorly due to driver's inability to keenly observe the vehicles' vicinity while driving and in traffic condition. It was reported that vehicle collisions are a result of human error due to faulty decisions and actions by drivers. And these faulty decisions that result in motor vehicle crashes are attributed to ignorance of traffic regulations and procedures.

It is also reported in [11] that collisions have three causes : the vehicle, the driver or environmental conditions. But, 77 percent of all traffic collisions are caused by driver error leaving 23 percent for vehicle malfunction or environmental conditions, such as light, weather, road or traffic. The most common errors committed by drivers are excessive speed, failure to yield the right of way, following too closely, improper turns, improper passing and improper backing.

Hence, the driver is the most important safety feature in any vehicle. Hence, the Vehicle Anti Collision Detection and Avoidance system is significant in improving safety design of vehicle and reduce driver error.

The study in [12] discussed the significant problems in the present society are robbery, theft and crime that increasing. This raises the security system issue. Basically, almost available security systems are personal monitoring by security guards. The disadvantages of these systems are some security guards to serve the increasing problems and low efficiency due to unprofessional guards. Therefore, several of security types have studied, applied and implemented automatic systems and modern technologies to secure assets against theft RFID (Radio Frequency Identification), one of the promising technology, which has been widely applied into the access control and security systems. RFID is a technology that helps to identify the animate or inanimate through radio waves. A typical RFID system consists of a reader and transponder. RFID is a leading automatic identification technology. RFID tags communicate information by radio wave through antennae on small computer chips attached to objects so that such objects may be identified, located, and tracked.

Chapter Three
Design Model

3.1 System Description and Functionalities

The considered system model consist of two main units, the vehicle unit and the hospital and police station unit. Figure 3.1 illustrates the contents of the system.

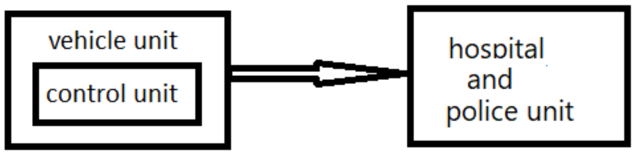

Figure 3.1: System Block Diagram

3.1.1 The Vehicle Unit

Vehicle unit should be installed in every vehicles, it consist of arduino uno, GPS, GSM, ultrasonic and detection (vibration sensor). informations about the accident send to the main server this information consist of location of accident detected by GPS installed in vehicle. The GPS system find out current position of vehicle , which is the location of accident spot and gives that data to GSM as shown in figure 3.2

1 GPS Module

The global positioning system (GPS) is space based navigation system that provides location and time information in all weather conditions, any where on or near the earth where there is an un abstracted of user around the world. Figure 3.3 represnts a GPS module. GPS satellites circle the earth twice a day in a very precise orbit and transmit signal information to the earth. GPS receiver take this information and use triangulation to calculate user's

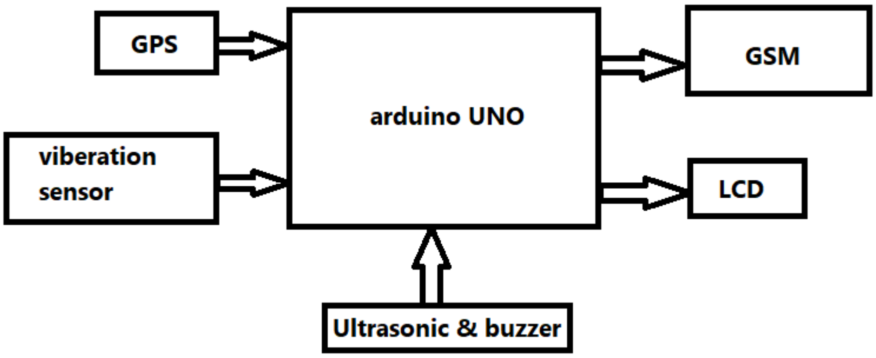

Figure 3.2: Vehicle Unit Block Diagram

Figure 3.3: GPS Module

exact location. GPS applications include agriculture, military, automotive, surveying, aviation and mapping software.

2 GSM Module

GSM work frequencies 850 MHz, 900 MHz, 1800 MHz and 1900 MHz it very compact in size and easy to use as plug in GSM modem. The modem is designed with 3V and 5V DC TTL interfacing circuitry, which allow user to directly interface with 5 V microcontrollers . the baud rate can be configurable from 9600 – 115200 BPS through at commands GSM modem is similar to mobile phone (as a hospital and police station) without any display, keypad and speaker. This accepts a SIM card and operates over asubscription to mobile operator as shown in figure 3.4.

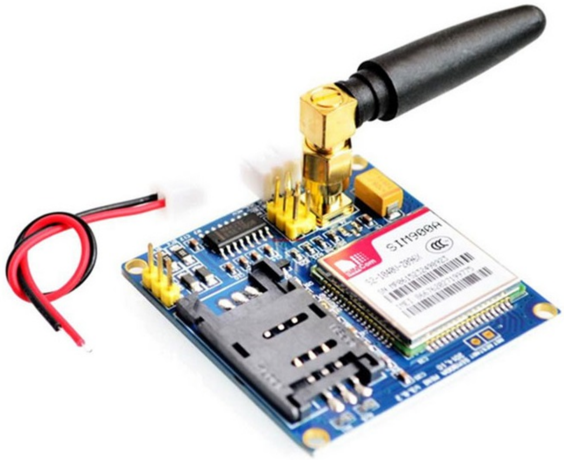

Figure 3.4: GSM Module

3 Vibration Sensor

Vibration sensor is connected with arduino. When collision of vehicle occurs, vibration sensor will sense the immense vibration and send the signal to GPS to exact location, 3.5 represents the vibration sensor

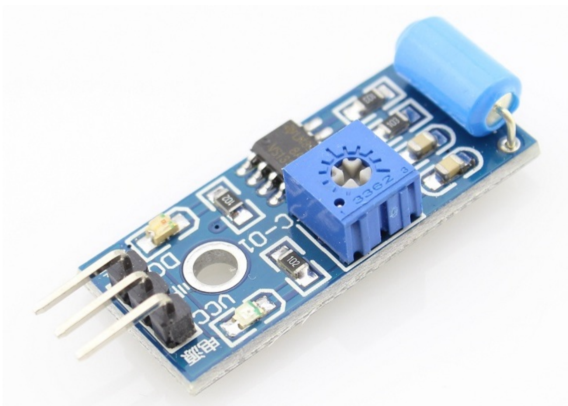

Figure 3.5: Vibration Sensor

4 Arduino Uno

Control unit is the brain of our system, practically the control unit will house all the database of all the nearest hospital and police station in order to send an ambulance to the accident spot it's receives the message about accident location from the GPS and GSM module installed in vehicle unit and responds accordingly, figure 3.6 represents the Arduino Uno

Figure 3.6: Arduino Uno

5 Ultrasonic Module

Ultrasonic transducers or ultrasonic sensor are a type of acoustic sensor divided into three broad categories: transmitters, receivers and transceivers. Transmitters convert electrical signals into ultrasonic receivers convert ultrasound into electrical signals and transceivers can both transmit and receive ultrasoud. In a similar way to radar and sonar ultrasonic transducers are used in system which evaluate targets by interpreting the reflected signals, figure 3.7 represents the ultrasonic module.

Figure 3.7: Ultrasonic Module

6 LCD

To display interactive messages we are using LCD Module. We examine an intelligent LCD display of two lines, 16 characters per line that is interfaced to the Arduino. The protocol (handshaking) for the display is as shown. Whereas D0 to D7th bit is the Data lines, RS, RW and EN pins are the control pins and remaining pins are +5V, -5V and GND to provide supply. Where RS is the Register Select, RW is the Read Write and EN is the Enable pin, figure 3.8 represents LCD unit.

Figure 3.8: Vehicle Unit Block Diagram

7 Buzzer

the piezoelectric emits a high-pitch beep that is sure to capture every on attention, figure 3.9 represents the buzzer.

Figure 3.9: Buzzer

8 Wiring Types

We use male to male and male to female wires to connect the components together, figure 3.10 represents kinds of the wires.

Figure 3.10: Wiring Types

3.1.2 Hospital and Police Station Unit

The vehicle unit sends a message to the hospital and police station contains the accident location. Ambulance collects the victim from the accident location. While in the ambulance the vital parameters of the patient temperature and pulse rate are continuously monitored and conveyed to the concerned hospital. Normally there is delay in ambulance reaching the hospital and the police men do there job.

Chapter Four
Simulation, Hardware Implementation and Outcomes

4.1 Software Utilization

4.1.1 Arduino IDE

The Arduino integrated development environment (IDE) is a cross-platform application written in Java, and derives from the IDE for the Processing programming language and the Wiring projects. It is designed to introduce programming to artists and other newcomers unfamiliar with software development. It includes a code editor with features such as syntax highlighting, brace matching, and automatic indentation, and is also capable of compiling and uploading programs to the board with a single click. A program or code written for Arduino is called a ”sketch”.

Arduino programs are written in C or C++. The Arduino IDE comes with a software library called ”Wiring” from the original Wiring project, which makes many common input/output operations much easier. The users need only to define two functions to make an executable cyclic executive program:

- `setup()`: a function that runs once at the start of a program and that can initialize settings.
- `loop()`: a function called repeatedly until the board powers off.

4.1.2 Proteus Simulations

The Proteus program is used to simulate system. Figure 4.1 represents the simulation. The figure shows the connection of the system. the Figure shows the basic components (Arduino Uno, LCD screen, ultrasonic sensor, buzzer, vibration sensor, GPS module,GSM module) and shows the connection of the component together, explaining that the LCD is output device. Arduino Uno is the drive and controlling the system it contains the code, vibration and ultrasonic sensors are input devices.

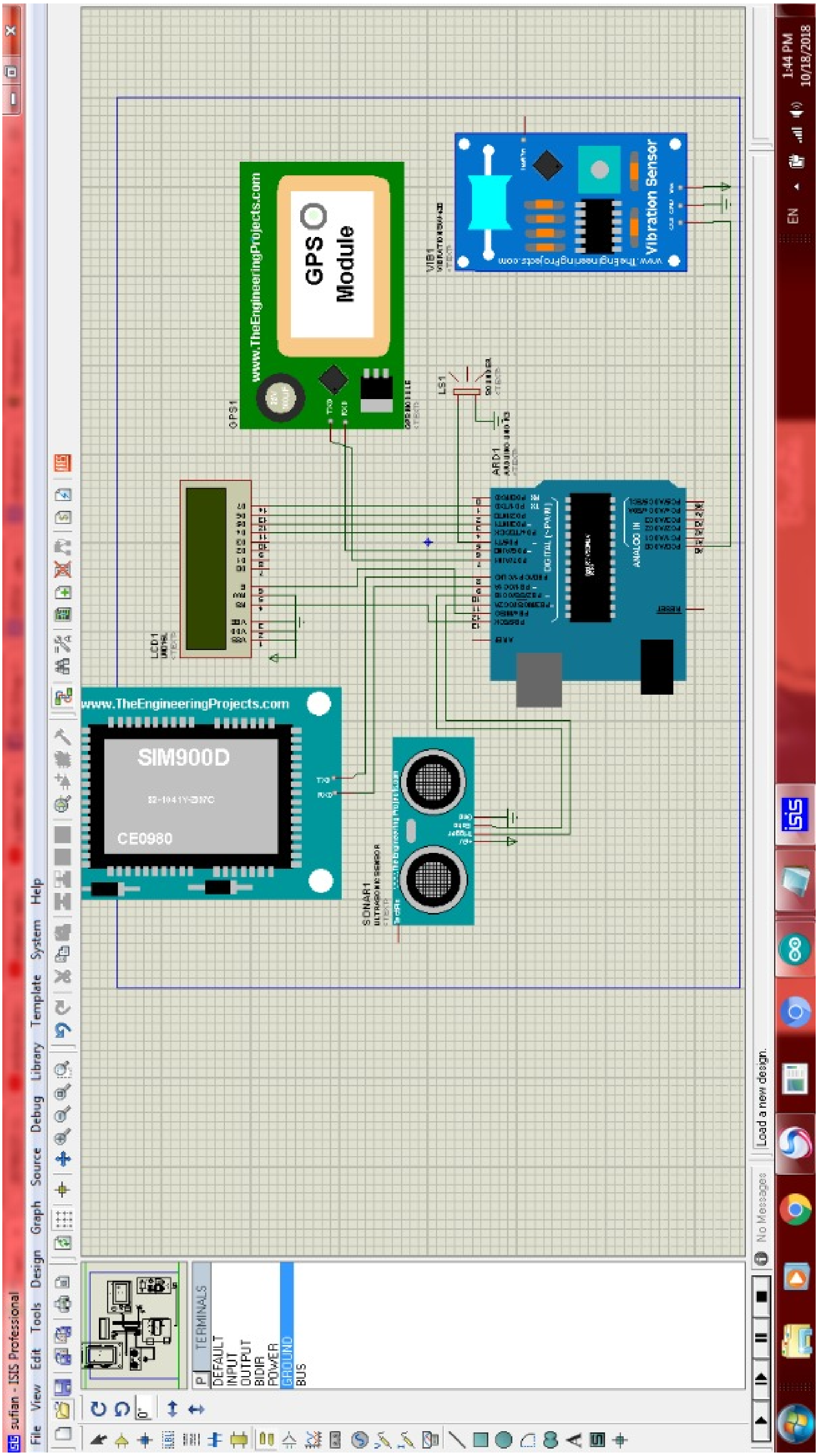

Figure 4.1: Simulation with Proteus

4.2 Hardware Implementation

The Arduino uno is the basic component in the control circuit it contents the code and receive the signal from the ultrasonic sensor and vibration sensor and send the signal of the ultrasonic sensor to the buzzer and the signal of vibration sensor to the GPS and GSM modules. The ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function, the ranging accuracy can reach to 3mm. The modules includes ultrasonic transmitters, receiver and control circuit, as shown figure 4.2.

4.2.1 Ultrasonic sensor : Basic Principle of Operation

Using IO trigger for at least 10μs high level signal, The Module automatically sends eight 40 kHz and detect whether there is a pulse signal back. If the signal back, through high level, time of high output IO duration is the time from sending ultrasonic to returning. The time from sending ultrasonic to returning is given by

$$\text{Test distance} = \frac{1}{2}\,\text{high level time} \times \text{velocity of sound.} \tag{4.1}$$

If there is signal back the buzzer will turn on. The wire connecting is as follows: connection for +5V supply, connection for trigger pulse input, connection for echo pulse output and connection for 0V Ground.

4.2.2 Vibration Sensor

The vibration sensor outputs a logic `HIGH` when vibration was detected. We can use any of Arduino pins to read the data. Here is an example of Piezo vibration sensor controlling LED. When the vibration was detected, this sensor outputs a logic high signal (the sensitivity can be changed by adjusting the

Table 4.1: Ultrasonic Sensor Interaction With Arduino

ultrasonic	arduino
GND	GND
vcc	+5 v
trig	pin11
echo	Pin10

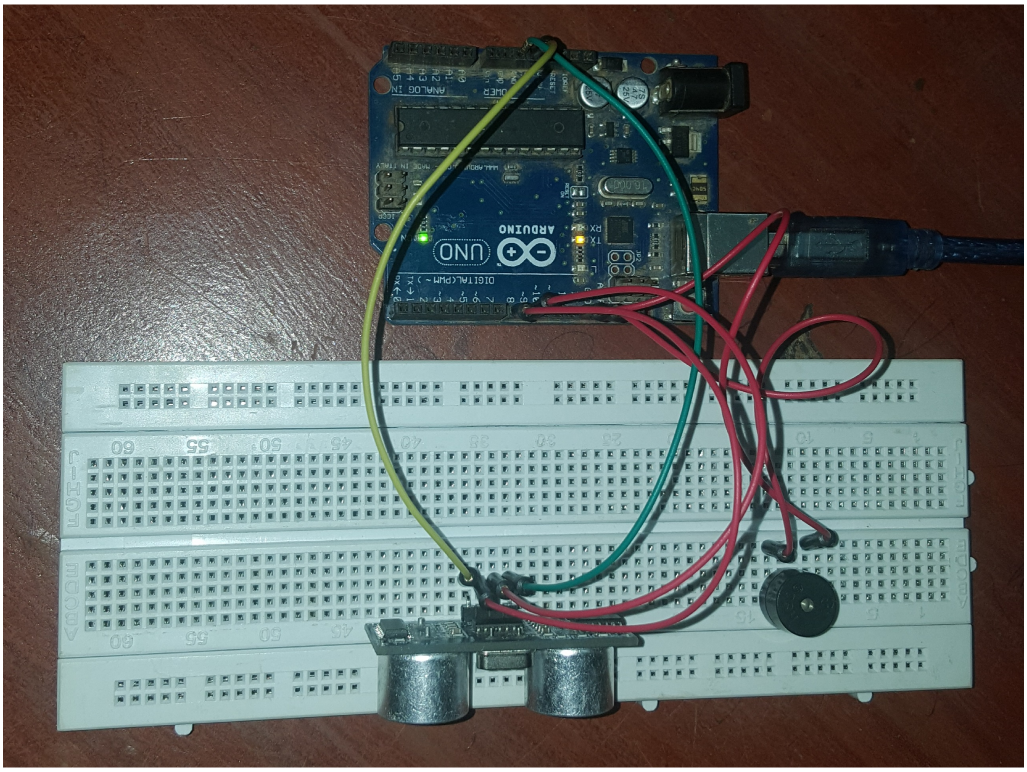

Figure 4.2: Implementation: Ultrasonic Sensor and Buzzer

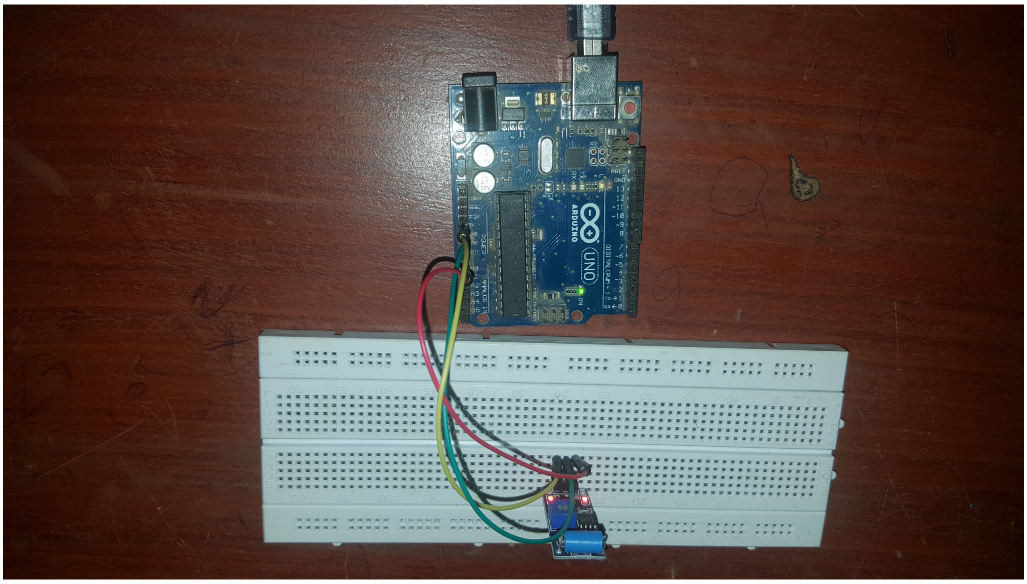

Figure 4.3: Connection of Vibration Sensor

potentiometer), an LED lights up. The module is connected to the Analog port 0, as shown in figure 4.3. Furthermore, figure 4.4 represents results of ultrasonic and vibration sensor that appeared when we have tested them.

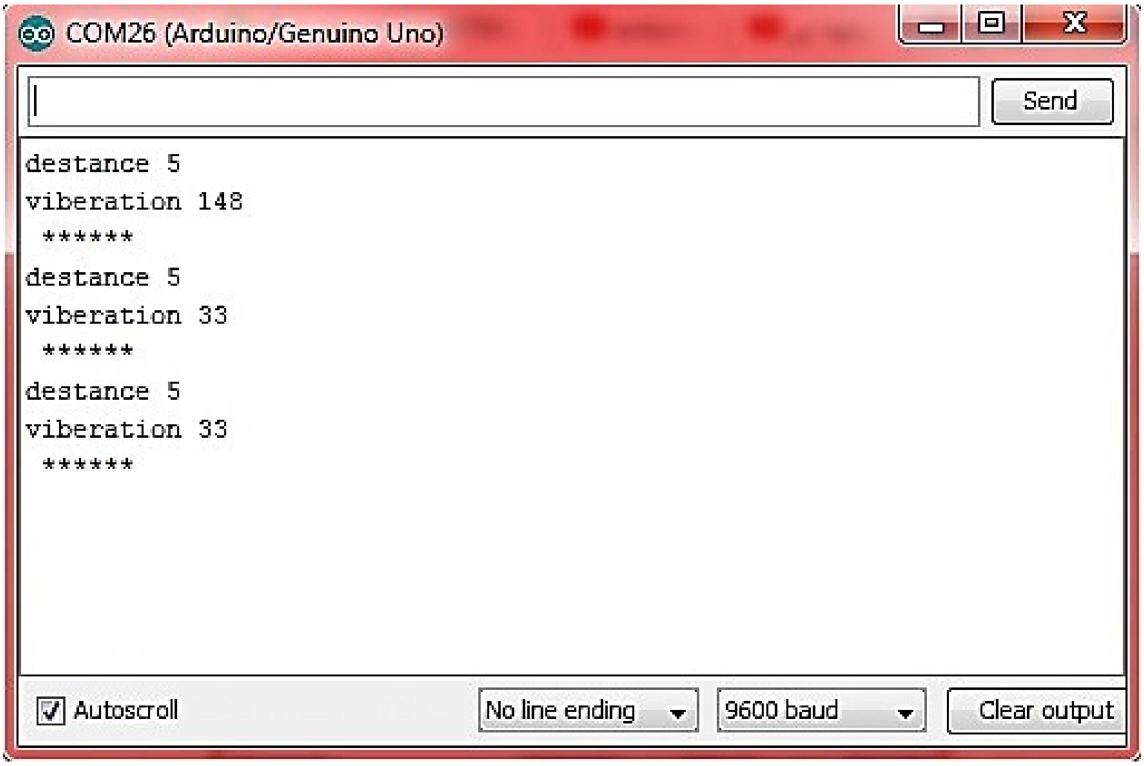

Figure 4.4: Ultrasonic and Vibration Sensor Test

4.2.3 GSM Interaction with Arduino

When Arduino Uno receives interrupt signal from vibration sensor it will enable the GSM modem. It will send SMS on predefine numbers already store in Arduino. When information will send through message "sending SMS statement will be showed on LCD, it connected as in table 4.2, figure 4.5 represents the connection

Table 4.2: GSM With Arduino Connection

GSM	arduino
GND	GND
vcc	+5 v
TX	pin9
RX	Pin8

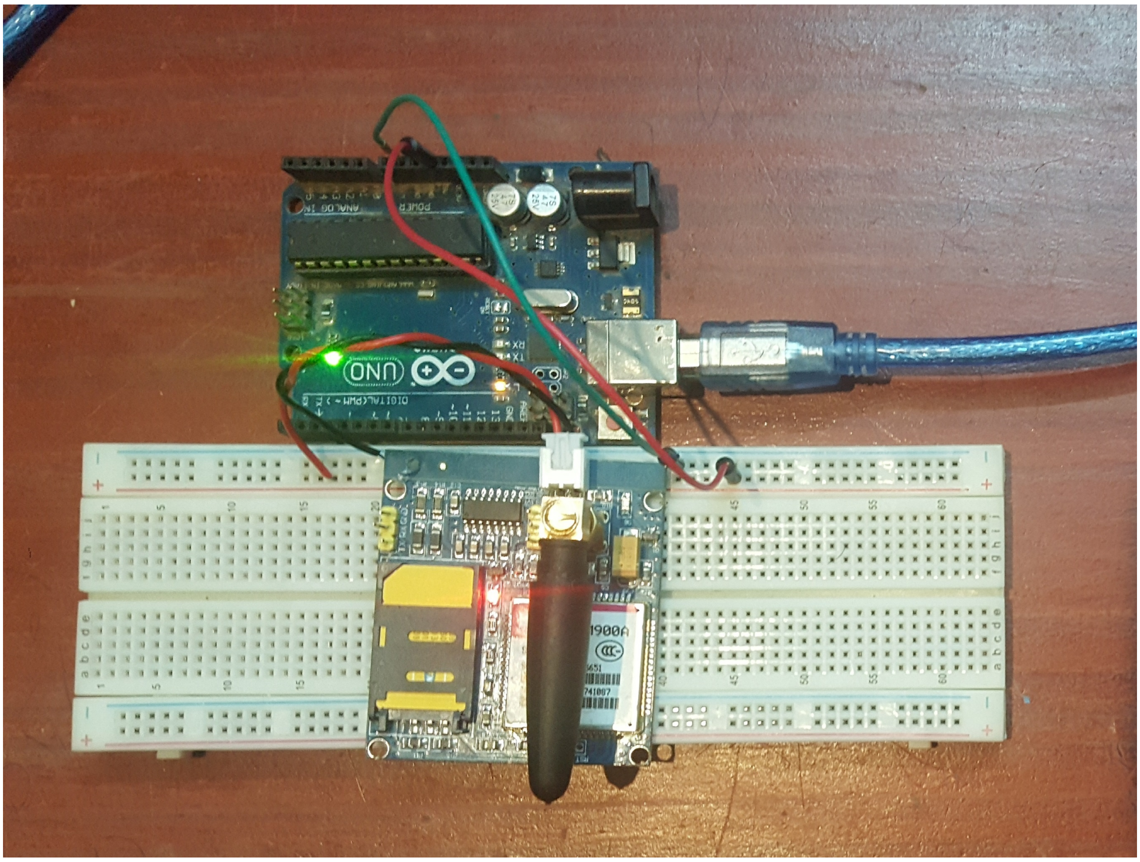

Figure 4.5: GSM With Arduino Connection

4.2.4 GPS with Arduino Connection

We interfaced GPS into breadboard. The GPS has six pins, we use just four pins, GND to arduino GND rail, VCC to arduino +5V , TXD to arduio pin 6, RXD to arduio pin 7, as shown in figure 4.6.

4.2.5 LCD with Arduino

We interfaced the LCD into breadboard . The LCD (16×2) has 16 pins ,the connection of LCD and Arduino is shown in the table 4.3, and figure 4.7 represents the connection.

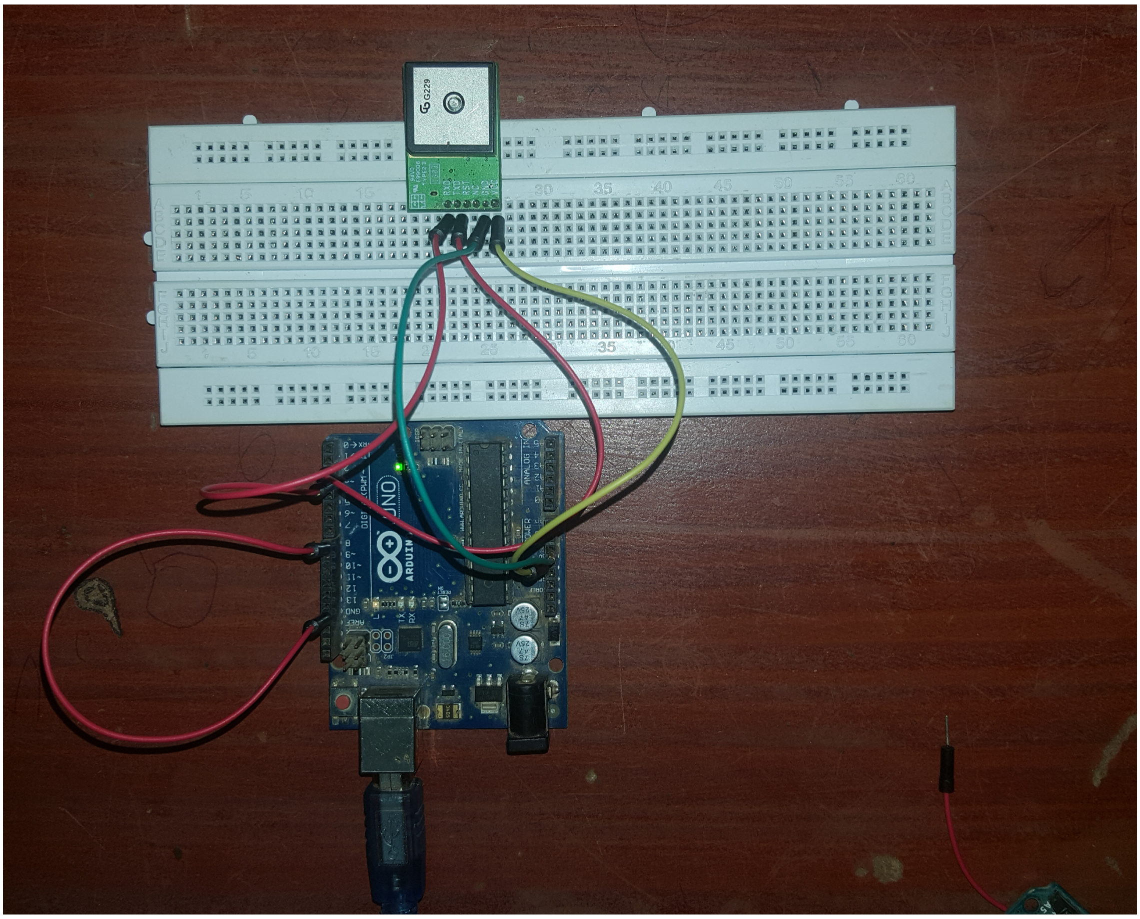

Figure 4.6: GPS with Arduino Connection

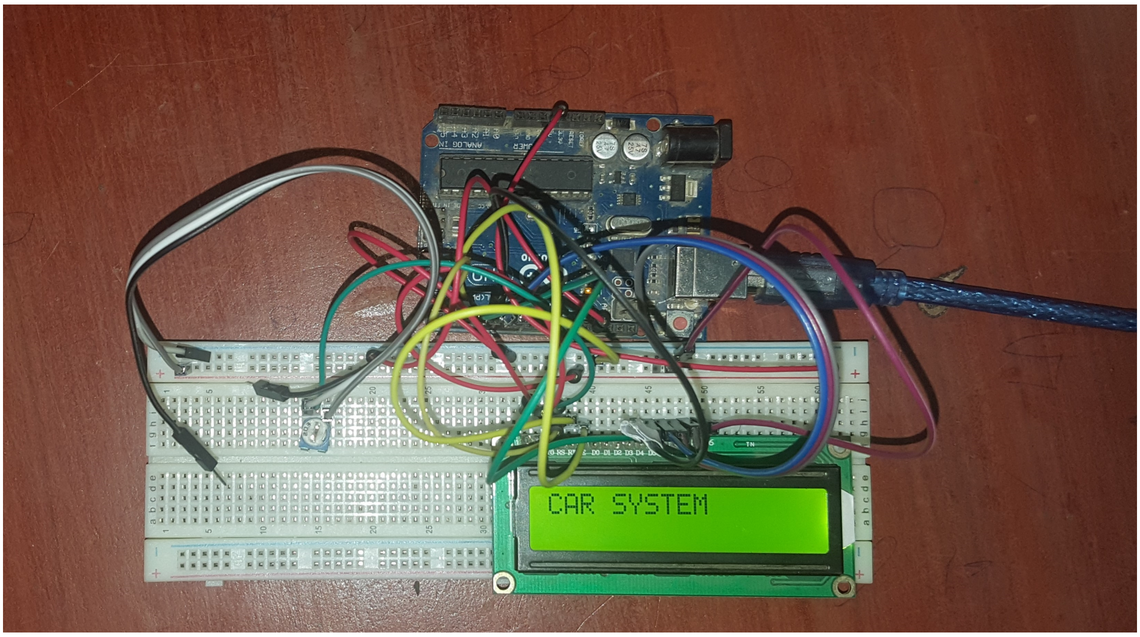

Figure 4.7: LCD Connection With Arduino

Table 4.3: LCD With Arduino Connection

LCD screen	Arduino
V_{ss}	GND
V_{dd}	+5 V
Vo contrast	Potentiometer center pin
RS	Pin
Rw	GND
Enable	Pin
D0	Not used
D1	Not used
D2	Not used
D3	Not used
D4	Pin
D5	Pin
D6	Pin
D7	Pin
A Bcl+	+5V
K Bcl-	GND

4.3 Control Flow Chart

The flow chart explaining the methodolgy of the system, the system starts with car starting if there is an obstacle the arduino determines the distance between the car and obstacles and turn on the buzzer to avoid crash. If an accident happen the Arduino will send a message contains the location of the accident which has been provided by the GPS to the hospital and police by using the GSM module, as shown in figure 4.8.

4.3.1 Operating the Circuit

An automatic accident prevention and reporting system is designed and implemented it works according to the flow chart in figure 4.7. We used wireless technologies like ultrasonic to prevent accident, GPS modem for finding the location of vehicle in terms of latitude and longitude, as well as GSM for sending a message on mobile at the receiver. Figure 4.11 shows The snapshot indicates the messages alerts when our accident alert system is tested at two

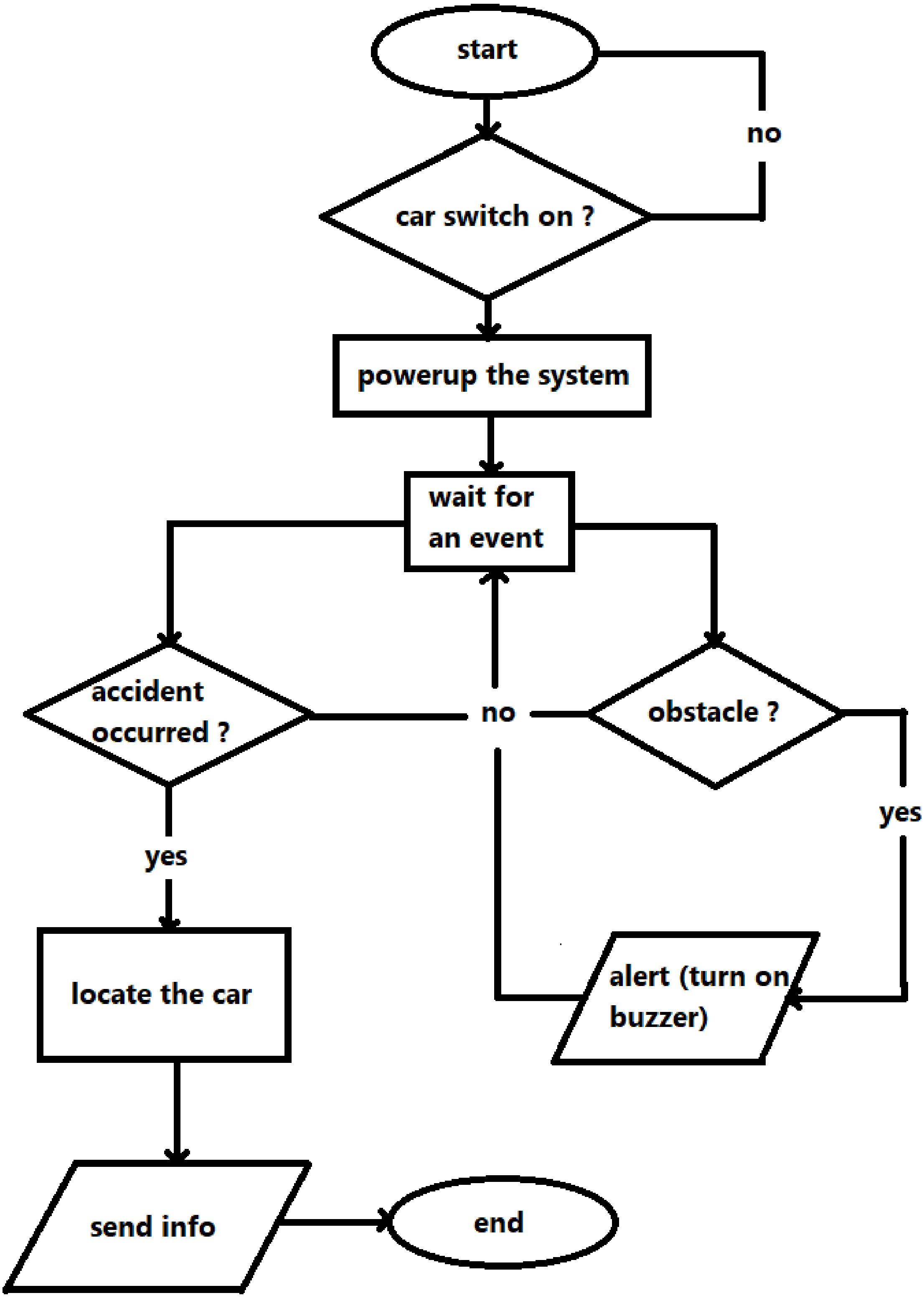

Figure 4.8: Control Flow Chart

different locations near to one another. Hence, there is a small different in the coordinates, the initial value of latitudes and longitudes are same but the fractional value changes with small difference. The first SMS shows that the testing accident has occurred at latitude of value(1533.39) along North direction and longitude of value (3232.13) along East direction. The second SMS is representing the values of latitude and longitude as (1533.29) North and (3232.15) East respectively, figure 4.12 shows the operating circuits.

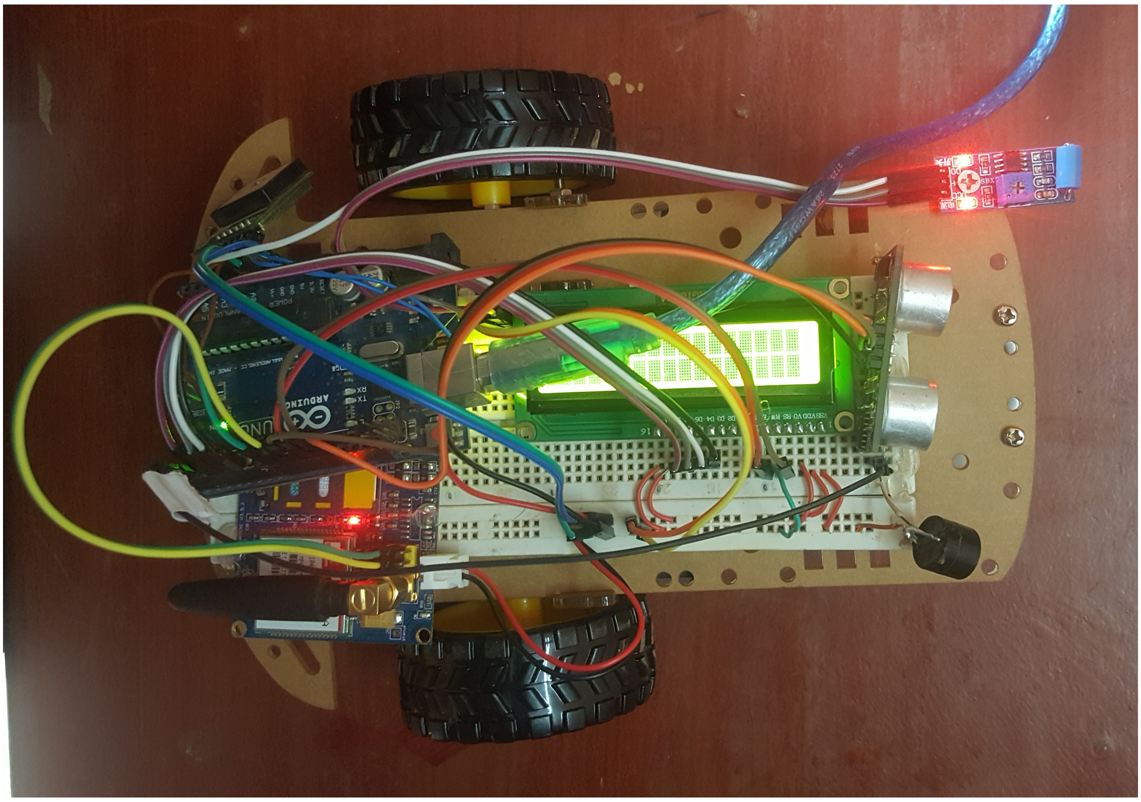

Figure 4.9: Final Circuit

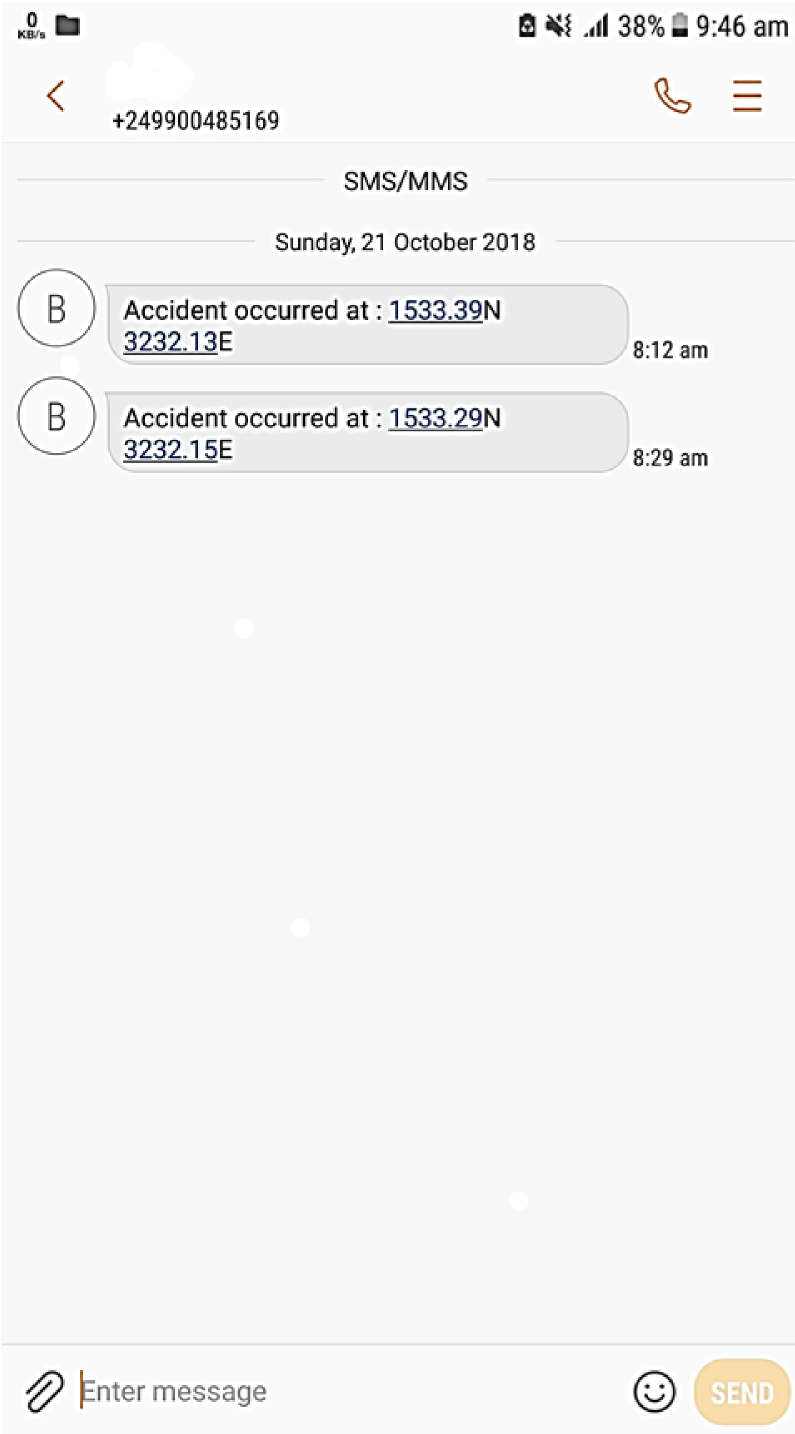

Figure 4.10: The received messages in the predefine number

Chapter Five
Conclusion and Recommendations

5.1 Conclusion

car accidents are a big problem nowadays a lot of people lost their life's due this accidents, the delay in reaching of the ambulance to the accident location and the traffic congestion between accident location and hospital increases the chances of death of the victim .Because of this we designed and implemented this system to reduce the loss of human life's, it contains Arduino Uno which presents the heart of the system, Ultrasonic sensor for avoidance, when accident occurred despite of alarming we used vibration sensor to detect the accident by sending the location to emergency stations (hospital and police station) by using GPS and GSM technologies ,Simulations were established by using the Proteus software, this system had been tested and it was active and worked successfully.

5.2 Recommendations and Future Work

To enhance the idea developed in the project, the following issues can be considered.

1. Adding a security enabling module, that includes sensory units which ensures the condition of seat belt and the driver This module includes alcohol sensor and eye sensor.
2. Adding an automatic speed control module includes RF transmitter placed in specific location and RF receiver in the vehicle.
3. Make a safety switch If there is no affect to anyone then the person involved in accident has to press it before end of the delay time in this case no SMS will send to emergency care centre.
4. Register phone number of a relative for any emergency cases.

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Appendix A
Arduino Code

```
#include <SoftwareSerial.h>      // GPS
#include <TinyGPS.h>
#include<LiquidCrystal.h>
LiquidCrystal lcd(12,13,2,3,4,5);
TinyGPS gps;
int z ;
SoftwareSerial gsm_Serial(7,6);

SoftwareSerial ss(9,8);

static void smartdelay(unsigned long ms);
 static void print_float(float val, float invalid, int len, ...
   int prec);
  static void print_int(unsigned long val, unsigned long ...
   invalid, int len);
   static void print_date(TinyGPS &gps);
    static void print_str(const char *str, int len);


  const int trigPin = 11;                  // ultrasonic
  const int echoPin = 10;

  long duration;
  int distance;
int x;
void setup() {
  lcd.begin(16,2);
```

```
Serial.begin(9600);
 ss.begin(9600);    // GPS

   gsm_Serial.begin(9600);

   pinMode(trigPin, OUTPUT); // Sets the trigPin as an ...
   Output
 pinMode(echoPin, INPUT); // Sets the echoPin as an Input


 pinMode(A3,OUTPUT);       // buzzer

 pinMode(2,OUTPUT);

lcd.setCursor(0,0);
 lcd.print("car controll :");
 delay(1000);

analogWrite(2,122);
}




void destance()
{




digitalWrite(trigPin, LOW);

delayMicroseconds(2);

// Sets the trigPin on HIGH state for 10 micro seconds
digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);

// Reads the echoPin, returns the sound wave travel time in ...
   microseconds
duration = pulseIn(echoPin, HIGH);
distance =  duration*0.034/2 ;
```

```
        lcd.print(distance);
}



void get_pos()
    {
     Serial.println("location:");
Serial.print(x);
Serial.print("   ");
Serial.print(z);
     float flat, flon;
  unsigned long age, date, time, chars = 0;
  unsigned short sentences = 0, failed = 0;
  static const double LONDON_LAT = 51.508131, LONDON_LON = -...
   0.128002;

  print_int(gps.satellites(), TinyGPS::...
   GPS_INVALID_SATELLITES, 5);
  print_int(gps.hdop(), TinyGPS::GPS_INVALID_HDOP, 5);
  gps.f_get_position(&flat, &flon, &age);
  print_float(flat, TinyGPS::GPS_INVALID_F_ANGLE, 10, 6);
  print_float(flon, TinyGPS::GPS_INVALID_F_ANGLE, 11, 6);
  print_int(age, TinyGPS::GPS_INVALID_AGE, 5);
  print_date(gps);
  print_float(gps.f_altitude(), TinyGPS::...
   GPS_INVALID_F_ALTITUDE, 7, 2);
  print_float(gps.f_course(), TinyGPS::GPS_INVALID_F_ANGLE, ...
   7, 2);
  print_float(gps.f_speed_kmph(), TinyGPS::...
   GPS_INVALID_F_SPEED, 6, 2);
  print_str(gps.f_course() == TinyGPS::GPS_INVALID_F_ANGLE ?...
    "*** " : TinyGPS::cardinal(gps.f_course()), 6);
  print_int(flat == TinyGPS::GPS_INVALID_F_ANGLE ? 0...
   xFFFFFFFF : (unsigned long)TinyGPS::distance_between(...
   flat, flon, LONDON_LAT, LONDON_LON) / 1000, 0xFFFFFFFF, ...
   9);
  print_float(flat == TinyGPS::GPS_INVALID_F_ANGLE ? TinyGPS...
   ::GPS_INVALID_F_ANGLE : TinyGPS::course_to(flat, flon, ...
   LONDON_LAT, LONDON_LON), TinyGPS::GPS_INVALID_F_ANGLE, 7...
   , 2);
  print_str(flat == TinyGPS::GPS_INVALID_F_ANGLE ? "*** " : ...
   TinyGPS::cardinal(TinyGPS::course_to(flat, flon, ...
```

```
    LONDON_LAT, LONDON_LON)), 6);

  gps.stats(&chars, &sentences, &failed);
  print_int(chars, 0xFFFFFFFF, 6);
  print_int(sentences, 0xFFFFFFFF, 10);
  print_int(failed, 0xFFFFFFFF, 9);
  Serial.println();

  smartdelay(1000);
}

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

static void print_float(float val, float invalid, int len, ...
   int prec)
{
  if (val == invalid)
  {
    while (len-- > 1)
      Serial.print('*');
    Serial.print(' ');
  }
  else
  {
    Serial.print(val, prec);
    int vi = abs((int)val);
    int flen = prec + (val < 0.0 ? 2 : 1); // . and -
    flen += vi >= 1000 ? 4 : vi >= 100 ? 3 : vi >= 10 ? 2 : ...
   1;
    for (int i=flen; i<len; ++i)
      Serial.print(' ');
  }
  smartdelay(0);
}
```

```
static void print_int(unsigned long val, unsigned long ...
    invalid, int len)
{
  char sz[32];
  if (val == invalid)
    strcpy(sz, "*******");
  else
    sprintf(sz, "%ld", val);
  sz[len] = 0;
  for (int i=strlen(sz); i<len; ++i)
    sz[i] = ' ';
  if (len > 0)
    sz[len-1] = ' ';
  Serial.print(sz);
  smartdelay(0);
}

static void print_date(TinyGPS &gps)
{
  int year;
  byte month, day, hour, minute, second, hundredths;
  unsigned long age;
  gps.crack_datetime(&year, &month, &day, &hour, &minute, &...
   second, &hundredths, &age);
  if (age == TinyGPS::GPS_INVALID_AGE)
    Serial.print("********** ******** ");
  else
  {
    char sz[32];
    sprintf(sz, "%02d/%02d/%02d %02d:%02d:%02d ",
        month, day, year, hour, minute, second);
    Serial.print(sz);
  }
  print_int(age, TinyGPS::GPS_INVALID_AGE, 5);
  smartdelay(0);
}

static void print_str(const char *str, int len)
{
  int slen = strlen(str);
  for (int i=0; i<len; ++i)
    Serial.print(i<slen ? str[i] : ' ');
  smartdelay(0);
```

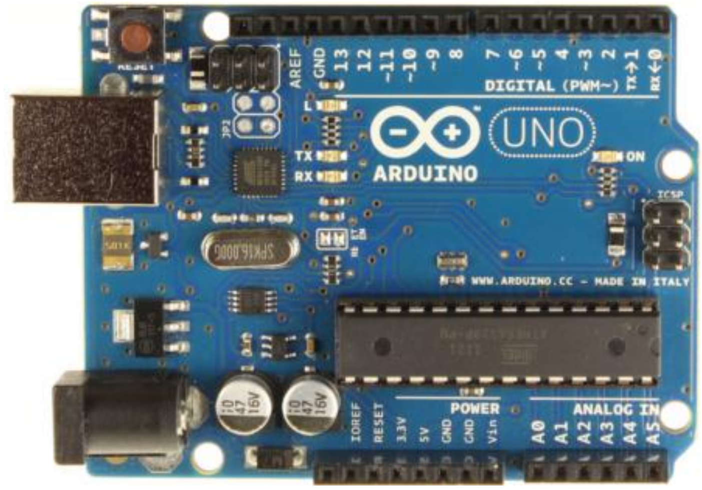
```
    }


void SendMessage()
{

  gsm_Serial.println("AT+CMGF=1");                    //  ...
   Sets the GSM Module in Text Mode
    delay(1000);
  gsm_Serial.println("AT+CMGS=\"+249924259034\"\r"); // ...
   Replace x with mobile number
    delay(1000);
  gsm_Serial.println("the location of me : ");     // The SMS...
    text you want to send
    delay(100);
    gsm_Serial.println(x );     // The SMS text you want to ...
   send
    delay(100);
     gsm_Serial.println(z );     // The SMS text you want to...
    send
    delay(100);
  gsm_Serial.println((char)26);                       // ...
   ASCII code of CTRL+Z
    delay(1000);
  Serial.println("message was send ... ");
}



void loop() {

  destance();

     lcd.setCursor(12,0);

     Serial.println(analogRead(0));
 lcd.print(distance);

   if(distance <=20)
   {
```

```
        digitalWrite(A3,HIGH);
          delay(700);
       digitalWrite(A3,LOW);
          delay(100);

    }


    digitalWrite(A3,LOW);



    if(analogRead(0)>=100)     // GPS

    {
        get_pos();
          delay(10);
        SendMessage();

    lcd.setCursor(1,1);
      lcd.print("send mesage...");
          delay(2000);
      }
lcd.setCursor(1,1);
      lcd.print("                    ");


}
```

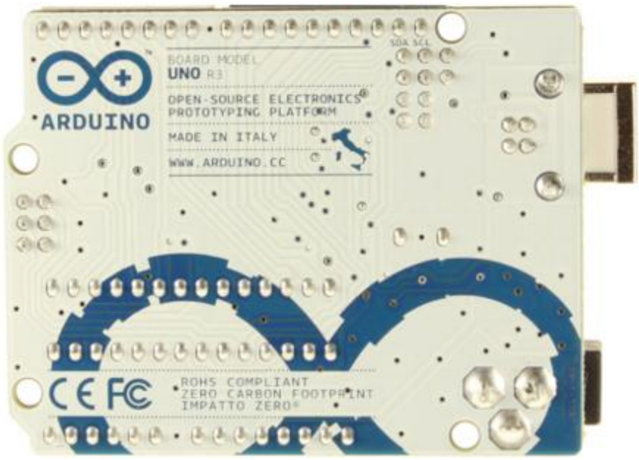
code/CAR_CRASH.ino

Appendix B
Data Sheets

Arduino Uno



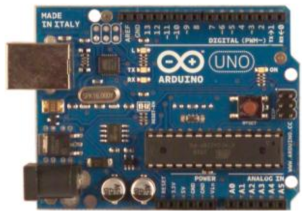
Arduino Uno R3 Front



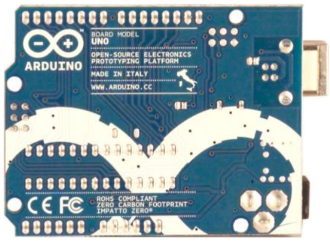
Arduino Uno R3 Back

Arduino Uno R2 Front

Arduino Uno SMD



Arduino Uno Front



Arduino Uno Back

Overview

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.
The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.
Revision 2 of the Uno board has a resistor pulling the 8U2 HWB line to ground, making it easier to put into DFU mode.
Revision 3 of the board has the following new features:

- 1.0 pinout: added SDA and SCL pins that are near to the AREF pin and two other new pins placed near to the RESET pin, the IOREF that allow the shields to adapt to the voltage provided from the board. In future, shields will be compatible both with the board that use the AVR, which operate with 5V and with the Arduino Due that operate with 3.3V. The second one is a not connected pin, that is reserved for future purposes.
- Stronger RESET circuit.
- Atmega 16U2 replace the 8U2.

"Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform; for a comparison with previous versions, see the index of Arduino boards.

Summary

Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage (recommended)	7-12V

Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock Speed	16 MHz

Schematic & Reference Design

EAGLE files: arduino-uno-Rev3-reference-design.zip (NOTE: works with Eagle 6.0 and newer)
Schematic: arduino-uno-Rev3-schematic.pdf
Note: The Arduino reference design can use an Atmega8, 168, or 328, Current models use an ATmega328, but an Atmega8 is shown in the schematic for reference. The pin configuration is identical on all three processors.

Power

The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically.
External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd and Vin pin headers of the POWER connector.
The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.
The power pins are as follows:

- **VIN.** The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.
- **5V.**This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 12V), the USB connector (5V), or the VIN pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board. We don't advise it.
- **3V3.** A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.
- **GND.** Ground pins.

Memory

The ATmega328 has 32 KB (with 0.5 KB used for the bootloader). It also has 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library).

Input and Output

Each of the 14 digital pins on the Uno can be used as an input or output, using pinMode(), digitalWrite(), and digitalRead() functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kOhms. In addition, some pins have specialized functions:

- **Serial: 0 (RX) and 1 (TX).** Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.
- **External Interrupts: 2 and 3.** These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attachInterrupt() function for details.
- **PWM: 3, 5, 6, 9, 10, and 11.** Provide 8-bit PWM output with the analogWrite() function.

- **SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK).** These pins support SPI communication using the SPI library.
- **LED: 13.** There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

The Uno has 6 analog inputs, labeled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the analogReference() function. Additionally, some pins have specialized functionality:

- **TWI: A4 or SDA pin and A5 or SCL pin.** Support TWI communication using the Wire library.

There are a couple of other pins on the board:

- **AREF.** Reference voltage for the analog inputs. Used with analogReference().
- **Reset.** Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

See also the mapping between Arduino pins and ATmega328 ports. The mapping for the Atmega8, 168, and 328 is identical.

Communication

The Arduino Uno has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The '16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a .inf file is required. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1).
A SoftwareSerial library allows for serial communication on any of the Uno's digital pins.
The ATmega328 also supports I2C (TWI) and SPI communication. The Arduino software includes a Wire library to simplify use of the I2C bus; see the documentation for details. For SPI communication, use the SPI library.

Programming

The Arduino Uno can be programmed with the Arduino software (download). Select "Arduino Uno from the **Tools > Board** menu (according to the microcontroller on your board). For details, see the reference and tutorials.
The ATmega328 on the Arduino Uno comes preburned with a bootloader that allows you to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol (reference, C header files).
You can also bypass the bootloader and program the microcontroller through the ICSP (In-Circuit Serial Programming) header; see these instructions for details.
The ATmega16U2 (or 8U2 in the rev1 and rev2 boards) firmware source code is available . The ATmega16U2/8U2 is loaded with a DFU bootloader, which can be activated by:

- On Rev1 boards: connecting the solder jumper on the back of the board (near the map of Italy) and then resetting the 8U2.
- On Rev2 or later boards: there is a resistor that pulling the 8U2/16U2 HWB line to ground, making it easier to put into DFU mode.

You can then use Atmel's FLIP software (Windows) or the DFU programmer (Mac OS X and Linux) to load a new firmware. Or you can use the ISP header with an external programmer (overwriting the DFU bootloader). See this user-contributed tutorial for more information.

Automatic (Software) Reset

SIM900D
GSM/GPRS Module

The SIM900D is a complete Quad-band GSM/GPRS solution in a SMT module which can be embedded in the customer applications.

Featuring an industry-standard interface, the SIM900D delivers GSM/GPRS 850/900/1800/1900MHz performance for voice, SMS, Data, and Fax in a small form factor and with low power consumption. With a tiny configuration of 33mm x 33mm x 3 mm, SIM900D can fit almost all the space requirements in your M2M application, especially for slim and compact demand of design.

- SIM900D is designed with a very powerful single-chip processor integrating AMR926EJ-S core
- Quad - band GSM/GPRS module with a size of 33mmx33mmx3mm
- SMT type suit for customer application
- An embedded Powerful TCP/IP protocol stack
- Based upon mature and field-proven platform, backed up by our support service, from definition to design and production

General featrues

- Quad-Band 850/ 900/ 1800/ 1900 MHz
- GPRS multi-slot class 10/8
- GPRS mobile station class B
- Compliant to GSM phase 2/2+
  - – Class 4 (2 W @850/ 900 MHz)
  - – Class 1 (1 W @ 1800/1900MHz)
- Dimensions: 33* 33 * 3 mm
- Weight: 6.2g
- Control via AT commands (GSM 07.07 ,07.05 and SIMCOM enhanced AT Commands)
- SIM application toolkit
- Supply voltage range 3.4 ... 4.5 VPWM
- Low power consumption
- Operation temperature: -30 °C to +80 °C

Specifications for fax

- Group 3, class 1

Specifications for data

- GPRS class 10: max. 85.6 kbps (downlink)
- PBCCH support
- Coding schemes CS 1, 2, 3, 4
- CSD up to 14.4 kbps
- USSD
- Non transparent mode
- PPP-stack

Specifications for SMS via GSM / GPRS

- Point-to-point MO and MT
- SMS cell broadcast
- Text and PDU mode

Drivers

- MUX Driver

Specifications for voice

- Tricodec
  - – Half rate (HR)
  - – Full rate (FR)
  - – Enhanced Full rate (EFR)
- Hands-free operation (Echo suppression)
- AMR
  - Half Rate(HR)
  - Full Rate(FR)

Interfaces

- Interface to external SIM 3V/ 1.8V
- analog audio interface
- RTC backup
- SPI interface
- Serial interface
- Antenna pad
- GPIO
- ADC
- Charge interface for LI battery

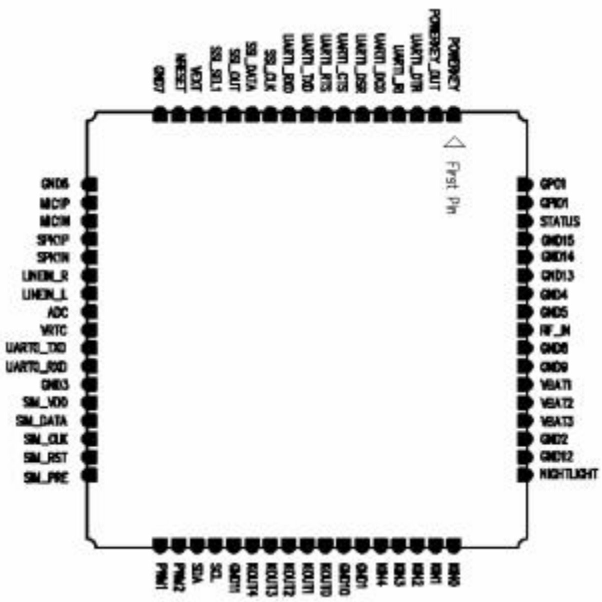
Compatibility

- AT cellular command interface

Approvals（in planning）

- CE
- FCC
- ROHS
- PTCRB
- GCF

Pin Assignment



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Ultrasonic Ranging Module HC - SR04

Product features:

Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function, the ranging accuracy can reach to 3mm. The modules includes ultrasonic transmitters, receiver and control circuit. The basic principle of work:
(1) Using IO trigger for at least 10us high level signal,
(2) The Module automatically sends eight 40 kHz and detect whether there is a pulse signal back.
(3) IF the signal back, through high level , time of high output IO duration is the time from sending ultrasonic to returning.
Test distance = (high level time×velocity of sound (340M/S) / 2,

Wire connecting direct as following:

- 5V Supply
- Trigger Pulse Input
- Echo Pulse Output
- 0V Ground

Electric Parameter

Working Voltage	**DC 5 V**
Working Current	**15mA**
Working Frequency	**40Hz**
Max Range	**4m**
Min Range	**2cm**
MeasuringAngle	**15 degree**
Trigger Input Signal	**10uS TTL pulse**
Echo Output Signal	**Input TTL lever signal and the range in proportion**
Dimension	**45*20*15mm**

Vcc Trig Echo GND

Timing diagram

The Timing diagram is shown below. You only need to supply a short 10uS pulse to the trigger input to start the ranging, and then the module will send out an 8 cycle burst of ultrasound at 40 kHz and raise its echo. The Echo is a distance object that is pulse width and the range in proportion .You can calculate the range through the time interval between sending trigger signal and receiving echo signal. Formula: uS / 58 = centimeters or uS / 148 =inch; or: the range = high level time * velocity (340M/S) / 2; we suggest to use over 60ms measurement cycle, in order to prevent trigger signal to the echo signal.