Pokhara University

Nepal Engineering College

A Project Report On

PRE-POST ACCIDENT ALERT SYSTEM

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Submitted to:

Department of Electronics and Communication Engineering

Nepal Engineering College

Bhaktapur, Nepal

January, 2016

PRE AND POST ACCIDENT ALERT SYSTEM

by

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Under the Supervision of

Asst.Prof.Dr Ramkaji Budhathoki

A project report submitted to the

Department of Electronics and Communication Engineering

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Department of Electronics and Communication Engineering

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Nepal Engineering College

Department of Electronics and Communication Engineering

CERTIFICATE

The undersigned certify that they have read and recommended to the Department of Electronics and Communication Engineering for acceptance, a Project report entitled "PRE and POST accident alert system", submitted by Prabin Giri and Roshan Basnet in partial fulfillment of the requirement for the Bachelor's degree in Electronics and Communication Engineering.

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DEPARTMENTAL ACCEPTANCE

The project report entitled "**PRE AND POST ACCIDENT ALERT SYSTEM**", submitted by Prabin Giri and Roshan Basnet in partial fulfillment of the requirement for the Bachelor's degree in Electronics and Communication Engineering has been accepted as a bonafide record of work independently carried out by the group in the department.

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ABSTRACT

The advancement of technologies has done a lot in the field of electronics and communication and automation. Our project is mainly focused to design and develop pre and post accident system to avoid collisions, fall, difficult situations and the consequences after such situations.

We use ultrasonic sensors to find the gapping between front and back vehicle to alert the driver. If collision occurs unknowingly, we use accelerometer to determine the shocks and collisions. Such information would be sent to the nearby police stations, hospitals and their relatives by locating the place using GPS module and sending information to the concerns by GSM system.

In our project, ATMEGA328 microcontroller is used to interface ultrasonic sensors, GPS module, GSM module and accelerometer. Here, tilting condition of the vehicle is detected by accelerometer. After certain threshold, the fall of vehicle will be detected and this information about the vehicle and its location will be sent to the concerns. In addition on this, emergency switch has been implemented in vehicle to rescue in difficult situation like robbery, running out of energy etc. so that the location can be sent to the concerns.

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CHAPTER1: INTRODUCTION

1.1 Background and statement of problems

The world is running with the rapid and huge development of technologies which is the brightest and positive part of the technology but with the increase in technology the living standards of individual continues to increase which leads to increase the road accidents every year. As we know that the traffic accident are one of the leading causes of fatalities in the world. An important indicator of survival rates after accident is the time between the accidents and when the medical personnel’s are dispatched to the accident site. With reference to the information collected from traffic police station, around 25782 accidents occurs in 3 years’ time, in which 5440 people died on the spot, 11520 people are badly injured, and 23690 people are simply injured. This is being the major problem for the country, overcoming & reducing such accidents are necessary and to reduce the rate of accidents is the major concern part of the world today. Hence we will implement our system to avoid collision & immediate rescue of people after this problem.

1.2 Objectives

- To design & develop the automatic system for the pre & post-accident alert system.
- To design a manual switch in case of emergency condition.
- To design a system to avoid collision.
- To track the geographical location of vehicles through GPS and relay the information through GSM module.

1.3 Applications

- The system can be used in security of vehicle.
- The system can be used for crash detection.
- This system can be used to locate the vehicle using GPS.
- The system can be used for the immediate rescue of the victims.

1.4 Overview of report

The report is organized as follows.

We introduce our system in Chapter 1. The objectives and applications of our system are also listed.

In Chapter 2, Literature review is included, which serves as the reference article for our projects.

In Chapter 3, we discuss the methodology we adopted for the project. It also includes the hardware and software used in our project.

In chapter 4, we basically discussed about the results and discussion of our projects along with the findings.

In chapter 5, conclusion for our projects along with the recommendation is include.

CHAPTER2: LITERATURE REVIEW

In the development of technology, the vehicular system cannot remain untouched. There are various researches ongoing for the avoidance of accident occurrence. In May 2014, a research paper named “microcontroller based accident detecting & warning system” was published International Journal of Advanced Research for Electrical, Electronics & Instrumentation Engineering[1].

In Jan. 6, 2014 a research based on “automatic accident alert & safety system” was published in International Journal of Computer Application [2].

Suzuki & Tata-motors have implemented some portion of avoiding accidents in their new models. But it doesn’t seem effective since it takes long time to replace existing vehicle. Meanwhile another paper named “A fully integrated accidents management system in vehicular system using Smartphone’s” was published by department of computer engineering of ETH Zurich, 8092 Zurich, Switzerland, Bahcesehir University, 34349 Istanbul, Turkey, & Abdullah Gul University, 38002, Kayseri, Turkey jointly[3].

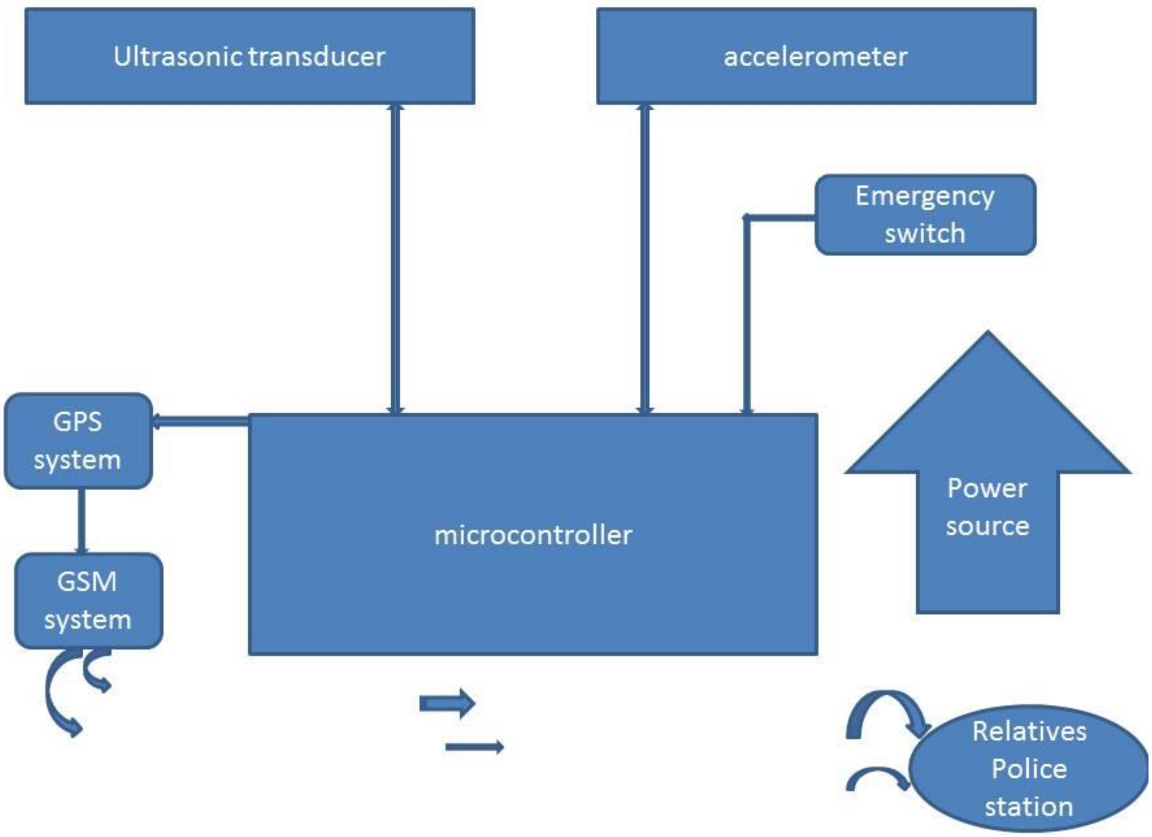
In 2013-14 another research paper named “Accident detection and Alert systems for immediate emergency services”, was published in International Journal of Science and Research (IJSR) [4].In this research paper basically GPS, Internet of things (IOT) and synchronization concept to enhance their paper.

In November and December 2013 another paper entitled “Prevention of train Accidents using wireless sensor network” by department of Electronics and Communication Engineering of Gudlavalleru Engineering College, Gudlavalleru, A.P India [5].

We are doing this system which will be compatible in existing vehicle. Here, we use obstacle detecting system, collision & fall detecting system, locating & messaging system by using ultrasonic transducer, accelerometer, GPS system, GSM system & microcontroller. In addition, we will use emergency switch for the people falling in dangerous situation like robbery, running out of money etc.

CHAPTER3: METHODOLOGY

3.1 Block diagram of pre- & post-accident system



<u>3.1 Block diagram of the proposed projects</u>

The overall block diagram for the pre and post accident alert system is shown in above figure, in which there is the vital use of ultrasonic transducer (HC-SR04) to avoid the accident. Here, the transducer helps to measure the distance between the two vehicles and warns the concern driver about the possible accident if the vehicle crosses the threshold distance. If the threshold distance is crossed, the information is relayed to the driver by red light indicator which implies the danger and probability of accident.

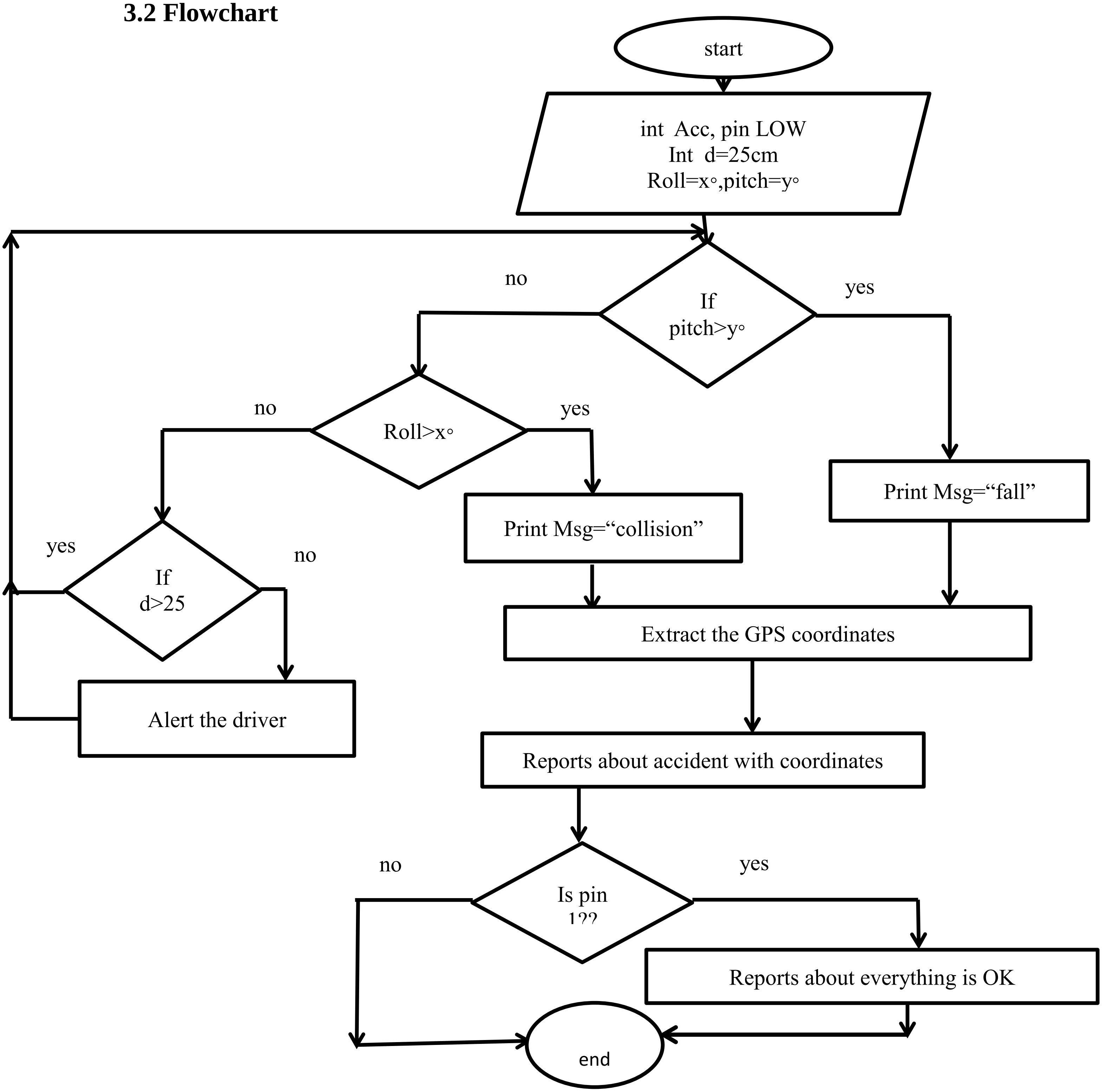
This project designs the scene of the accident avoiding and reporting system based on Arduino, GSM and GPS. Vehicles location will be transmitted to the treatment center and traffic control. After receiving related information, the treatment center and police control display this information on their respective cell phone. After receiving information, the treatment center staffs who are on duty will notice the handler who is the nearest to the scene of the accident in time, in order to reach the scene of accident in the first time, and gain more treatment time for the accident injured, and lower the accident mortality, as well as reduce incidents impacting time on the traffic. And parallel traffic control can operate its investigation for the cause of accident and also can know the cause of accident; either it is caused by certain obstacles or due to the poor visibility.

In this project, when a vehicle met with an accident, at that time the accident will be detected by the accelerometer sensor. When a vehicle meets with an accident, vibration sensor will detect the signal immediately and sends it to microcontroller. The microcontroller sends the signal to GPS module to give the exact value of the geographical coordinates which contains the value of longitude, latitude and altitude.

After that the microcontroller sends the alert message through the GSM MODEM including the co-ordinates value of GPS to the medical rescue team and police control room and family members. Then the medical help Centre will confirm the location of the accident by analyzing the co-ordinates value of GPS on a map. Once the medical help Centre gets the location of accident, it will inform the medical rescue team near to the location of the accident so that the victim can get the treatment as fast as possible.

Our system sends the message to the police control room so that their required investigation can be done in very less time and the medical rescue team is allowed to provide the treatment to the victim. If the person meets with a small and minor accident or if there is no serious threat to anyone`s life, then the alert message can be terminated by the driver by a switch provided in order to avoid wasting the valuable time of the medical rescue team.

3.2 Flowchart



3.2 Flowchart of pre- & post-accident alert system

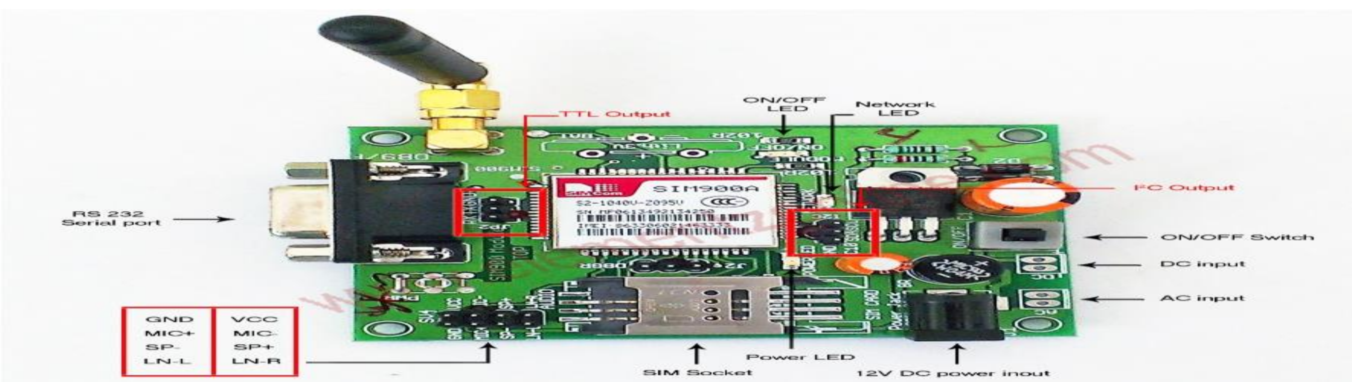
3.3 Assumption

Telecommunication network is assumed be working properly. And every vehicle is assumed to be implemented with this system. We also assume that the road must be smooth one.

3.4 Hardware & software required

3.4.1GSM (Global System for Mobile Communication)

GSM module used in this project is SIMCOM'S SIM 900. It works on frequencies EGS900MHZ, DCS1800MHZ, and PCS1 1900MHZ. The module is fitted with standard interface for a powersupply, an antenna, a pc and a headset with its plug and play technology. It uses SIM Card and canbe controlled by means of AT Commands. GSM (Global System for Mobile Communications, originally Groupie Special Mobile), is a standard set developed by the European Telecommunications Standards Institute (ETSI) to describe protocols for second generation (2G) digital cellular networks used by mobile phones.



3.3 GSM module (SIM 900)

(source : https://www.bing.com/images/search?q=SIM+900A+module&FORM=HDRSC2)

The GSM standard was developed as a replacement for first generation (1G) analog cellular networks, and originally described a digital, circuit switched network optimized for full duplex voice telephony. This was expanded over time to include data communications, first by circuit switched transport, then packet data transport via GPRS (General Packet Radio Services) and EDGE (Enhanced Data rates for GSM Evolution or EGPRS). Further improvements were made when the 3GPP developed third generation (3G) UMTS standards followed by fourth generation (4G) LTE Advanced standards.

The network is structured into a number of discrete sections:

- The Base Station Subsystem (the base stations and their controllers).
- The Network and Switching Subsystem (the part of the network most similar to fixed network). This is sometimes also just called the core network.
- The GPRS Core Network (the optional part which allows packet based Internet connections).
- The Operations support system (OSS) for maintenance of the network.

3.4.1.1 Features:

- Highly Reliable for 24x7 operation with Matched Antenna
- Status of Modem Indicated by LED
- Simple to Use & Low Cost
- Quad Band Modem supports all GSM operator SIM card

3.4.1.2 Frequency Band

GSM networks operate in a number of different carrier frequency ranges (separated into GSM frequency ranges for 2G and UMTS frequency bands for 3G), with most 2G GSM networks operating in the 900 MHz or 1800 MHz bands. Where these bands were already allocated, the 850 MHz and 1900 MHz bands were used instead (for example in Canada and the United States). In rare cases the 400 and 450 MHz frequency bands are assigned in some countries because they were previously used for first-generation systems.

3.4.1.3 Short Message Services

Short Message Service (SMS) is a text messaging service component of phone, web, or mobile communication systems, using standardized communications protocols that allow the exchange of short text messages between fixed line or mobile phone devices. SMS text messaging is the most widely used data application in the world, with 3.6 billion active users, or 78% of all mobile phone subscribers. The term SMS is used as a synonym for all types of short text messaging as well as the user activity itself in many parts of the world.

SMS is also being used as a form of direct marketing known as SMS marketing. SMS as used on modern handsets originated from radio telegraphy in radio memo pagers using standardized phone protocols and later defined as part of the Global System for Mobile Communications (GSM) series of standards in 1985 as a means of sending messages of up to 160 characters, to and from GSM mobile handsets. Since then, support for the service has expanded to include other mobile technologies such as ANSI CDMA networks and Digital AMPS, as well as satellite

3.4.1.4 AT Commands

Many mobile and satellite transceiver units support the sending and receiving of SMS using an extended version of the Hayes command set, a specific command language originally developed for the Hayes Smart modem 300-baud modem in 1977. The connection between the terminal equipment and the transceiver can be realized with a serial cable (e.g. USB), a Bluetooth link, an infrared link, etc.

Common AT commands include AT+CMGS (send message), AT+CMSS (send message from storage), AT+CMGL (list messages) and AT+CMGR (read message). However, not all modern devices support receiving of messages if the message storage (for instance the device's internal memory) is not accessible using AT commands. Unreliability SMS messages are generally treated as lower-priority traffic than voice, and various studies have shown that around 1% to 5% of messages are lost entirely, even during normal operation conditions, and others may not be delivered until long after their relevance has passed.

3.4.1.5 Subscriber Identity Module (SIM)

One of the key features of GSM is the Subscriber Identity Module, commonly known as a SIM card. The SIM is a detachable smart card containing the user's subscription information and phone book. This allows the user to retain his or her information after switching handsets. Alternatively, the user can also change operators while retaining the handset simply by changing the SIM. Some operators will block this by allowing the phone to use only a single SIM, or only a SIM issued by them this practice is known as SIM locking

3.4 SIM CARDS

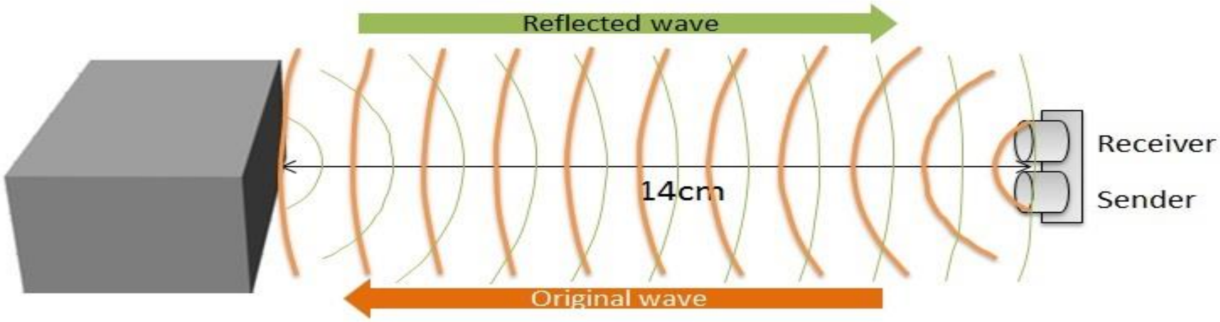
(source: https://www.bing.com/images/search?q=SIM+cards&FORM=HDRSC2)

3.4.2 Ultrasonic Transducer (HC-SR04)

3.4.2.1 Working Principle

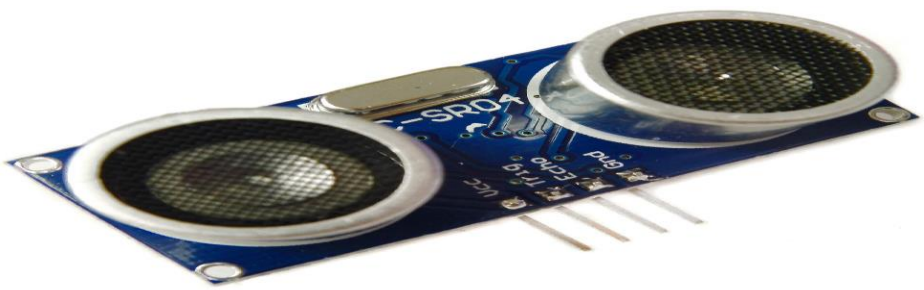
Ultrasonic transducers are transducers that convert ultrasound waves to electrical signals or vice versa. Those that both transmit and receive may also be called ultrasound transceivers many ultrasound sensors besides being sensors are indeed transceivers because they can both sense and transmit. These devices work on a principle similar to that of transducers usedin radar and sonar systems, which evaluate attributes of a target by interpreting the echoes from radio or sound waves, respectively. Active ultrasonic sensors generate high-frequency sound waves and

evaluate the echo which is received back by the sensor, measuring the time interval between sending the signal and receiving the echo to determine the distance to an object.



3.5 Working of ultrasonic sensor

(source: https://www.bing.com/images/search?q=ultrasonic%20sensor%20hc-sr04&qs=SC&form=QBIR&pq=ultrasonics%20sensor&sc=8-18&sp=5&sk=SC4)



3.6 HC-SR04

(source: https://www.bing.com/images/search?q=ultrasonic%20sensor%20hc-sr04&qs=SC&form=QBIR&pq=ultrasonics%20sensor&sc=8-18&sp=5&sk=SC4)

3.4.2.2 Description and Specification

The HCSR04 takes DC input 5V and operates on 15mA current. Likewise, the working frequency is 40Hz and the maximum range is 4m whereas the minimum range is 2cm whereas the measuring angle is 15 degrees. The pins of the HCSR04 are:

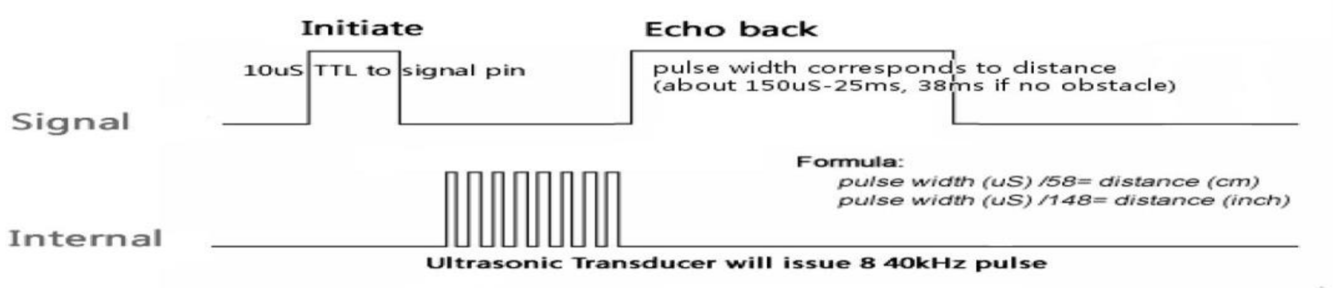
- 5V supply
- Trigger pulse input
- Echo Pulse output
- 0V Ground

The basic principle of making HCSR04 to work is:

- 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 is back, through high level, time of high output IO duration is the time from sending ultrasonic to return.

  Test distance = (high level time* velocity of sound (340M/S) / 2

3.4.2.3 Timing Diagram



3.7 Pulse of Ultrasonic sensor

(source:https://www.bing.com/images/search?q=timing%20diagram%20of%20ultrasonic%20sensor&qs=n&form=QBIRMH&pq=timing%20diagram%20of%20ultrasonic%20sensor&sc=0-23&sp=-1&sk=)

A short ultrasonic pulse is transmitted at the time 0, reflected by an object. The senor receives this signal and converts it to an electric signal. The next pulse can be transmitted when the echo

is faded away. This time period is called cycle period. The recommend cycle period should be no less than 50ms.

If a 10μs width trigger pulse is sent to the signal pin, the Ultrasonic module will output eight 40 kHz ultrasonic signal and detect the echo back. The measured distance is proportional to the echo pulse width and can be calculated by the formula above. If no obstacle is detected, the output pin will give a 38ms high level signal.

3.4.3 Accelerometer (ADXL345)

The ADXL345 is a small, thin, ultralow power, 3-axis accelerometer with high resolution (13-bit) measurement at up to ±16 *g*. Digital output data is formatted as 16-bit twos complement and is accessible through either a SPI (3- or 4-wire) or I2C digital interface.

The ADXL345 is well suited for mobile device applications. It measures the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion or shock. Its high resolution (3.9 m*g*/LSB) enables measurement of inclination changes less than 1.0°. Several special sensing functions are provided.

Activity and inactivity sensing detect the presence or lack of motion by comparing the acceleration on any axis with user-set thresholds. Tap sensing detects single and double taps in any direction. Free-fall sensing detects if the device is falling. These functions can be mapped individually to either of two interrupt output pins.

An integrated memory management system with a 32-level first in, first out (FIFO) buffer can be used to store data to minimize host processor activity and lower overall system power consumption. Low power modes enable intelligent motion-based power management with threshold sensing and active acceleration measurement at extremely low power dissipation.

3.8 ADXL-345

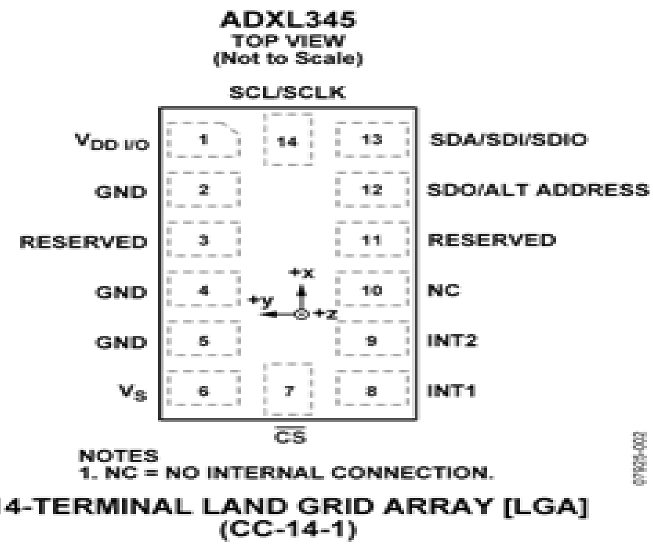
(source:https://www.bing.com/images/search?q=Accelerometer%20adxl345&qs=n&form=QBIR&pq=accelerometer%20adxl345)

3.4.3.1 Features

- Ultralow power: as low as 23 µA in measurement mode and 0.1 µA in standby mode at VS = 2.5 V (typical)
- Power consumption scales automatically with bandwidth
- User-selectable resolution
- Fixed 10-bit resolution
- Full resolution, where resolution increases with *g* range, up to 13-bit resolution at ±16 *g* (maintaining 4 m*g*/LSB scale factor in all *g* ranges)
- Embedded memory management system with FIFO technology minimizes host processor load
- Single tap/double tap detection
- Activity/inactivity monitoring
- Free-fall detection
- Supply voltage range: 2.0 V to 3.6 V
- I/O voltage range: 1.7 V to VS
- SPI (3- and 4-wire) and I2C digital interfaces
- Flexible interrupt modes map able to either interrupt pin
- Measurement ranges selectable via serial command

- Bandwidth selectable via serial command
- Wide temperature range (−40°C to +85°C)

3.4.3.2 Pin description



<u>3.9 Pin Configuration of adxl345</u>

(source:https://www.bing.com/images/search?q=Accelerometer%20adxl345%20pin%20description&qs=n&form=QBIR&pq=accelerometer%20adxl345%20pin%20description&sc)

Table 3.1: Pin function description

Pin no.	Mnemonics	Description
1	VDD I/O	Digital Interface Supply Voltage.
2	GND	This pin must be connected to ground.
3	Reserved	Reserved. This pin must be connected to VS or left open.
4	GND	This pin must be connected to ground.

5	GND	This pin must be connected to ground.
6	VS	Supply Voltage.
7	$\overline{CS}$	Chip Select.
8	INT1	Interrupt 1 Output.
9	INT2	Interrupt 2 Outputs.
10	NC	Not Internally Connected.
11	Reserved	Reserved. This pin must be connected to ground or left open.
12	SDO/ALT ADDRESS	Serial Data Output (SPI 4-Wire)/Alternate I2C Address Select (I2C).
13	SDA/SDI/SDIO	Serial Data (I2C)/Serial Data Input (SPI 4-Wire)/Serial Data Input and Output (SPI 3-Wire).
14	SCL/SCLK	Serial Communications Clock. SCL is the clock for I2C, and SCLK is the clock for SPI.

3.4.4 Arduino Uno (ATMEGA328)

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, 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 an AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDIUSB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter.

"Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version1.0 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.

Here in our project the microcontroller ATMEGA328 is the main heart of our designed system. This helps for analyzing, Comparing and interpreting the different values coming form the different components that we used throughout our projects. Later it also helps to interface and provide ease to communicate with different module likes GSM, GPS, Accelerometer and

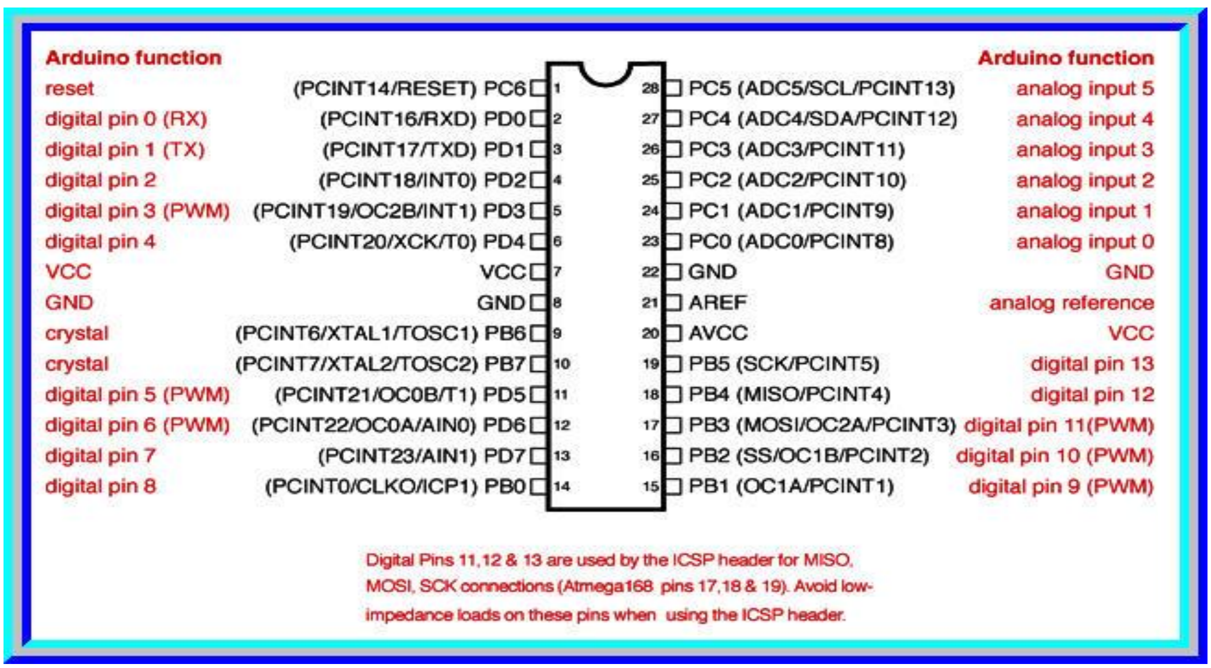
Ultrasonic sensor. Since the baud rate of the Arduino ATMEGA328 is found to be 9600bps which helps for the easy and convenient connection to the GSM module.

3.10 Arduino Uno ATMEGA328

(source:https://www.bing.com/images/search?q=atmega328&qs=OS&form=QBIR&pq=atmega%20&sc=8-7&sp=2&sk=OS1)

3.4.4.1 Specification and Pin Description

- 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 of which 0.5 KB used by boot loader
- SRAM 2 KB,EEPROM 1 KB, Clock Speed 16 MHz



3.11 Pin configuration of ATMEGA328

(source:https://www.bing.com/images/search?q=pin%20diagram%20of%20ATMEGA328&qs=n&form=QBIRMH&pq=pin%20diagram%20of%20atmega328&sc=0-15&sp=-1&sk=)

3.4.4.2 Power Source for ATMEGA328

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 or battery. The 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 5Vpin 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 to5 volts from the USB connection or other regulated power source). We can supply voltage through this pin.
- **5V:** The regulated power supply used to power the microcontroller and other components on the board. This can come either from VIN via an on-board regulator, or be supplied by USB or another regulated 5V supply.

3.4.4.3 Memory of ATMEGA328

The Atmega328 has 32 KB of flash memory for storing code (of which 0,5 KB is used for the boot loader) It has also 2 KB of SRAM and 1 KB of EEPROM.

3.4.4.4 Input/ Output of ATMEGA328

Each of the 14 digital pins on the Uno can be used as an input or output, using pinMode(), digitalWrite(), anddigitalRead()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 kΩ.

3.4.5 U-blox GPS module

We use the Ublox NEO-6M gps module for this project.NEO-6 module series brings the high performance of the u-blox 6 position engine to the miniature NEO form factor. u-blox 6 has been designed with low power consumption and low costs in mind. Intelligent power management is a breakthrough for low-power applications. These receivers combine a high level of integration capability with flexible connectivity options in a small package. This makes them perfectly suited for mass-market end products with strict size and cost requirements.

GPS in the project produces the output in NMEA (National Marine Electronics Association) format and then parsed only the GPGGA (Global Positioning System Fixed Data) which are the character's block containing the longitude, latitude and altitude which are parsed using different language and the bit streams is communicated by using UART (Universal Asynchronous Receiver Transmitter) protocol.GPS is a worldwide radio-navigation system formed from the constellation of 24 satellites and their ground stations. The Global Positioning System is mainly funded and controlled by the U.S Department of Defense. The system was initially designed for the operation of U. S. military. But today, there are also many civil users of GPS across the whole world. The civil users are allowed to use the service without any kind of charge or restrictions.

A GPS receiver monitors multiple satellites and solves equations to determine the exact position of the receiver and its deviation from true time. At a minimum, four satellites must been view of the receiver for it to compute four unknown quantities (three position coordinates and clock deviation from satellite time). The current GPS consists of three major segments. These are the space segment, a control segment, and a user segment.

a) Control Segment

A control segment comprises of the following components:

- a master control station (MCS)
- an alternate master control station
- four dedicated ground antennas and

- six dedicated monitor stations

Satellite maneuvers are not precise by GPS standards. So to change the orbit of a satellite, the satellite must be marked unhealthy, so receivers will not use it in their calculation. Then the maneuver can be carried out, and the resulting orbit tracked from the ground. Then the new ephemeris is uploaded and the satellite marked healthy again. The Operation Control Segment (OCS) currently serves as the control segment of record. It provides the operational capability that supports global GPS users and keeps the GPS system operational and performing within specification.

b) User segment

In general, GPS receivers are composed of an antenna, tuned to the frequencies transmitted by the satellites, receiver-processors, and a highly stable clock (often a crystal oscillator). They may also include a display for providing location and speed information to the user. A receiver is often described by its number of channels: this signifies how many satellites it can monitor simultaneously

c) Space Segment

The space segment (SS) is composed of the orbiting GPS satellites or Space Vehicles (SV) in GPS parlance. The GPS design originally called for 24 SVs, eight each in three approximately circular orbits, but this was modified to six orbital planes with four satellites each. The orbits are centered on the Earth, not rotating with the Earth, but instead fixed with respect to the distant stars. The six orbit planes have approximately 55° inclinations (tilt relative to Earth's equator) and are separated by 60° right ascension of the ascending node (angle along the equator from a reference point to the orbit's intersection). The orbital period is one-half a sidereal day, i.e., 11 hours and 58 minutes. The orbits are arranged so that at least six satellites are always within line of sight from almost everywhere on Earth's surface. The result of this objective is that the four satellites are not evenly spaced (90 degrees) apart within each orbit. In general terms, the angular difference between satellites in each orbit is 30, 105, 120, and 105 degrees apart which, of course, sum to 360 degrees.

3.4.5.1 General Operation of GPS

At any point of times, there are about 24 operational GPS satellites orbiting around our globe, which takes a period of 12 hours to orbit complete one full round. At any one point of time, only 12 satellites can be detected as another 12 is at another side of the earth. Thus, the satellite orbits the earth twice in a day. Ground stations are used to precisely track each and every satellite's status and health.

Theoretically, the satellites broadcast microwave radio signal to earth to determine positioning in the Ultra High Frequency band. The GPS receiver will pick up the GPS signal. The GPS signal is made up of 3 different bits of data which are known as pseudo random code, almanac data and ephemeris data as follows:

Pseudo random code

ID code that detect which satellites are broadcasting information. The ID code can be viewed from the GPS's unit satellite information screen. We used a string of binary numbers to differentiate which satellite the signal is from. It also tells the time difference between the transmitter and receiver. GPS satellites are around 20,000,000 meters above the Earth. The shift, which due to propagation delay is the so called "Time difference". Time difference can be computed using the formula as shown below:

Time Difference (in seconds) * 2.99792458 108 meters/second = Distance (in meters)

Almanac data

Data which has orbital parameters to differentiate between which satellite is to be seen on the GPS receiver in the unobstructed sky. As such, the receiver will know which satellite to follow. However, this Almanac data is not accurate as it can be valid for several months.

An Ephemeris data

It allows the receiver to know where the GPS satellite is at any point of time in the day. Conversely, this Ephemeris data can be only valid for 2 to 4 hours. Essentially, it is quite accurate as the GPS receiver receives the signal to provide the orbital information that interprets the path which the satellite is following as its orbits around. With the aid of pseudorandom code, almanac data and ephemeris data, the GPS receiver can easily determine the time, date, distance from satellite, velocity and satellite status and coordination. For the GPS receiver's location, a process called triangulation is used. And there will a shift in frequency called Doppler Effect.

Frequency information

Every satellite transmits at two different frequencies called L1 and L2 frequencies. L1 has a frequency of 1575.2MHz (19cm wavelength) and L2 a frequency of 1227.6MHz (24cm wavelength). These carrier frequencies were chosen for GPS because the atmosphere is transparent to them. Also, two frequencies are used instead of one because this allows easy correction for the effect of the ionosphere on the signal propagation. The ionosphere slows the signals and bends their path. However, ionosphere slows down the lower frequencies more than the higher ones. Comparing the difference in signals' delay times allows removing the effect of the ionosphere. The two carriers are modulated by various signals. Both L1 and L2 frequencies carry and broadcast satellite messages which are a low frequency data stream containing information about the satellites' position. In addition to that two more signals are transmitted. They are clear access or coarse acquisition C/A, and precise or private code P. Code C/A is available to all the users. It is carried only on the L1 frequency. The P code is available in both L1 and L2 frequencies, and is used by the US army. The C/A code allows the position fixes accurate to within 100m whereas, P code gives the accuracy to within 15m.

Standard

Due to GPS manufacturers using their own format for GPS data representation it would be difficult to use the data due to format differences. To overcome this problem various standards has been made. Some of them are RINEX, RTCM SC-104, NMEA 0813.

The NMEA 0183 NMEA 0183 standard is discussed here as it is the format used by the GPS device from used in our project. Also it is the most widely used standard by GPS devices. NMEA 0813 is data stream in ASCII format, transmitted at a rate of 4,800 bps, from the GPS receiver to the listener device. The NMEA 0183 data steam may include information on position, datum, water depth and other variables. The data is sent in the form of sentences; each starting with a dollar sign “$” and terminates with a carriage return line feed<CR><LF>. The dollar sign “$” is followed by five-character address field, which identifies the talker, the data type and the string format of the successive fields. The last field in any sentence is a checksum field, which follows a checksum delimiter character “*”. The maximum total number of characters in any sentence is 82.A number of these sentences is dedicated to the GPS and GLONASS system while the remaining sentences support other devices such as echo sounders, gyros, and others. Our sentence of interest is the GGA; Global Positioning System fix data. This sentence represents the time and position, and solution-related information. The structure of the sentence is written below:

$GPGGA,hhmmss.ss.llll. ll,a,yyyyy.yy,a.x,xx,.x.x.x.x,M,x.x,xxxx*hh<CR><LF>

Table 3.2 GPS description

$	Talker identifier (GPS in this case)
GP	Talker identifier (GPS in this case)
GGA	Data identifier (GPS fix data in this case)
,	Data field delimiter
hhmmss.ss	Time of position in UTC system (hours minutes seconds .decimal)
llll.ll	Latitude (degrees minutes. decimal)
A	N/S(North or South)
yyyy.yy	Longitude (degrees minutes .decimal)
A	E/W (East or West)
X	GPS quality indicator (1=points positioning with C/A-code)
Xx	Number of satellites used in producing the solution

x.x	HDOP
x.x	Ortho metric Height
M	Meters (units of orthometric Height)
x.x	Meters (units of Geoidal Height)
Xxxx	Age of DGPS data in seconds (time since last RTCM message type 1 or 9 was received; null field when DGPS mode is not used
*	Checksum delimiter character
Hh	Checksum field (last field in the sentence)
<CR><LF>	Sentence termination

Here for the GPS data parsing purpose we basically use the tiny gps library. Which the dedicated library for to extract the GPS coordinate from the NMEA format data. Once the GPS module is powered, MMEA is sent out through the serial transmit pins. For our purpose we only parsed the GPGGA (Global Positioning System Fixed Data). Which are the character blocks containing the Latitude, Longitude, and Altitude.

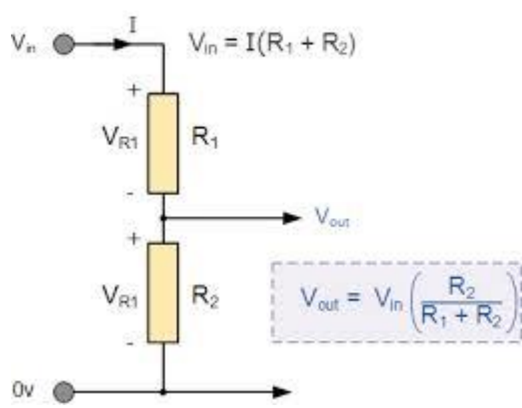
CHAPTER4: RESULTS AND DISCUSSIONS

4.1: Descriptions and Findings

4.1.1: Interfacing ATMEGA28 with GSM module

A GSM modem is used in the data acquisition section of the project for transmitting the measured GPS data to the central server or the logging section via SMS. The modem is given the appropriate AT commands by the microcontroller to which it is interfaced through a serial port.

Here, we use the SIM900 module which supports communication in 900 MHz band. Firstly, we checked the power requirement for the module and found that it requires 12v, 1A d.c power supply. There are two types of interfacing available in SIM900 which are TTL and RS232 respectively among which we preferred the TTL mode to avoid the use of TTL to RS232 converter and to its reads its overheads. For the TTL connections we simply use a level shifter from 5V device to 2.8 devices and vice versa by using the voltage divider rule.



4.1 Voltage divider rule

(source:https://www.bing.com/images/search?q=voltage%20divider%20rule&qs=n&form=QBIR&pq=voltage%20divider%20r&sc=8-3&sp=-1&sk=)

Now, the interfacing has been done in three different processes:

- Initializing the GSM module
    - ✓ SIM card was inserted on the module
    - ✓ The module was turn on
    - ✓ After waiting some time the blinking rate of status lead took some times to be locked with mobile networks
    - ✓ After establishing the connection the status led started to blink continuously for every three seconds, showing that it connected to the network
- Connecting GSM module to Arduino
    - ✓ Since the communication is serial we use the serial pins of arduino for transmitting and receiving data such that GSM TX was connected to the RX of Arduino and vice versa.
    - ✓ Ground terminal of both GSM and arduino were connected together
    - ✓ To avoid the problem in connection while programming we preferred other two PWM(pulse width modulation) rather than TX and RX of arduino for the ease and efficient operation.
    - ✓ This was possible by using the software serial library of arduino, which enables the serial data communication of digitals pins.

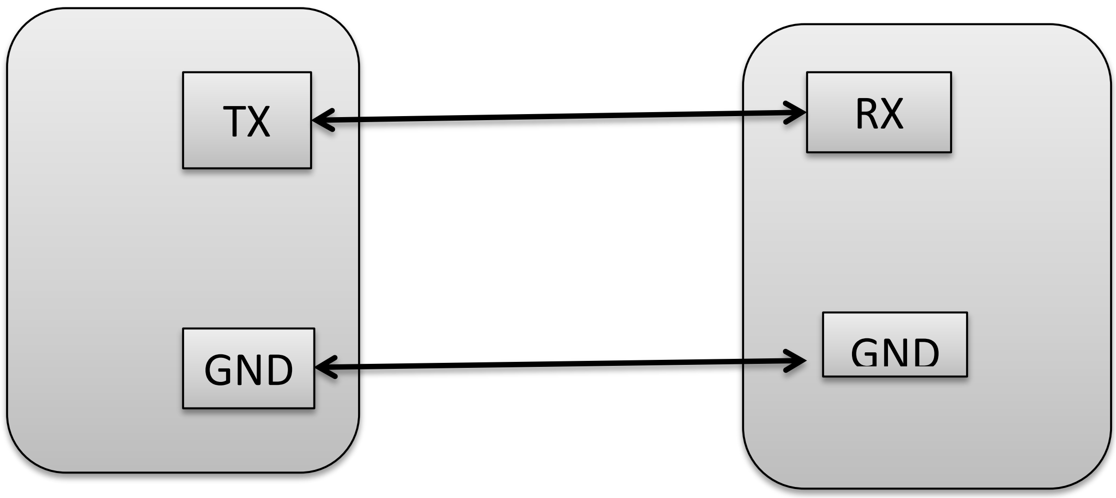
Here, we had created the constructor of software serial library to define the pins then the baud rates were stated to communicate with GSM modules by using .begin function. By default the baud rate SIM900 is 9600bits per seconds.

AT commands used to send SMS in text mode.

- AT+CPIN=to check sim
- AT+CMGF=1 +carriage return
    - ✓ To achieve this we used constructor.println(),that writes data to software serial port that is the TX pin. The data will be captured by GSM module

through RX pin. After setting the GSM module in text mode, the mobile number which was used send SMS was defined.

- AT+CMGS=" mobile number" carriage return
- Once The AT commands is given' >' prompt will be displayed on the screen.
- Type the message to send via SMS. After this, press "ctrl+Z" to send the SMS.
- If the SMS sending is successful, "ok" will be displayed along with the message number



<u>3.2 Interfacing GSM with ATMEGA328</u>

4.1.2 Interfacing ATMEGA328 with HC-SR04

While interfacing the Ultrasonic sensor with the arduino atmega328,we defined the trigger pin and echo pin.5v dc supply was given to the ultrasonic sensor to communicate with the arduino. After the proper connection had been established, the threshold value for obstacles detection was defined by using the formula:

Distance =c*t/2

Where;

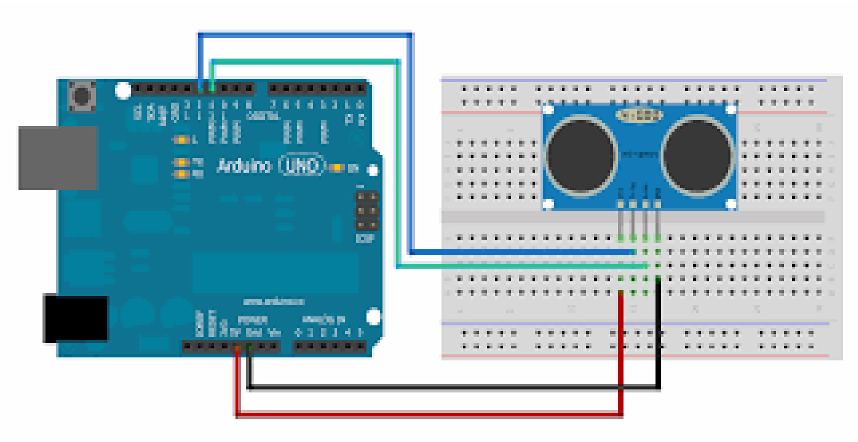
C=331.4+0.606*T+0.0124*H

331.4=Speed of sound at 0 degree Celsius and 0% humidity

T=temperature in Celsius

H=% humidity

To initiate the distance measurement we send the 5v signal to the trigger pin for 10µs.When the module received the signal it emits the 8 pulses of ultrasonic sound at the frequency of 40khz from the transmitting transducers, then it waits for a while at the receiving transmitter for the reflected signal. If the object is within the range the pulses would be reflected back to the sensor. When the pulse hits the receiving transducer the echo pin were puts a high voltage signal. The length of high voltage signals is equal to the total time, the 8 pulses took the time to travel from transmitting transducer reflected on the object and travel back.



4.3 interfacing arduino with ultrasonic sensor

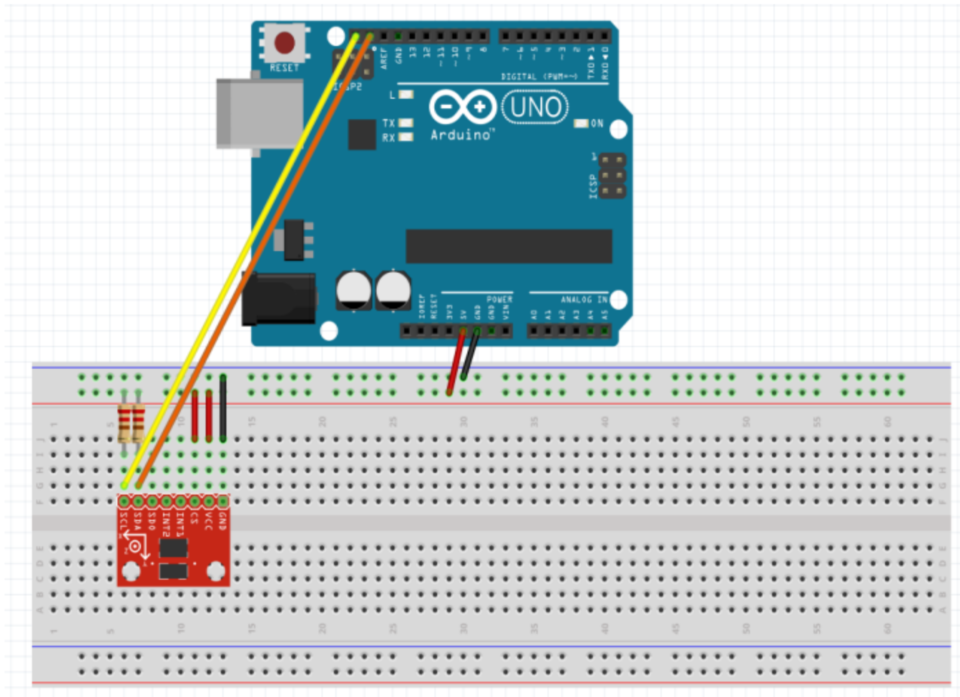
(source:https://www.bing.com/images/search?q=interfacing%20ATMEGA328%20with%20ultrasonic%20sensor&qs=n&form=QBIR&pq=interfacing%20atmega328%20with%20ultrasonic%20sensor&sc=0-0&sp=-1&sk=)

4.1.3 Interfacing ATMEGA328 with ADXL345

During the communication between the accelerometer and the arduino, We had connected the following pins.

- ✓ Vcc -3.3 v
- ✓ GND-GND
- ✓ Chip select(CS)-3.3v
- ✓ SCL- analog pin 5

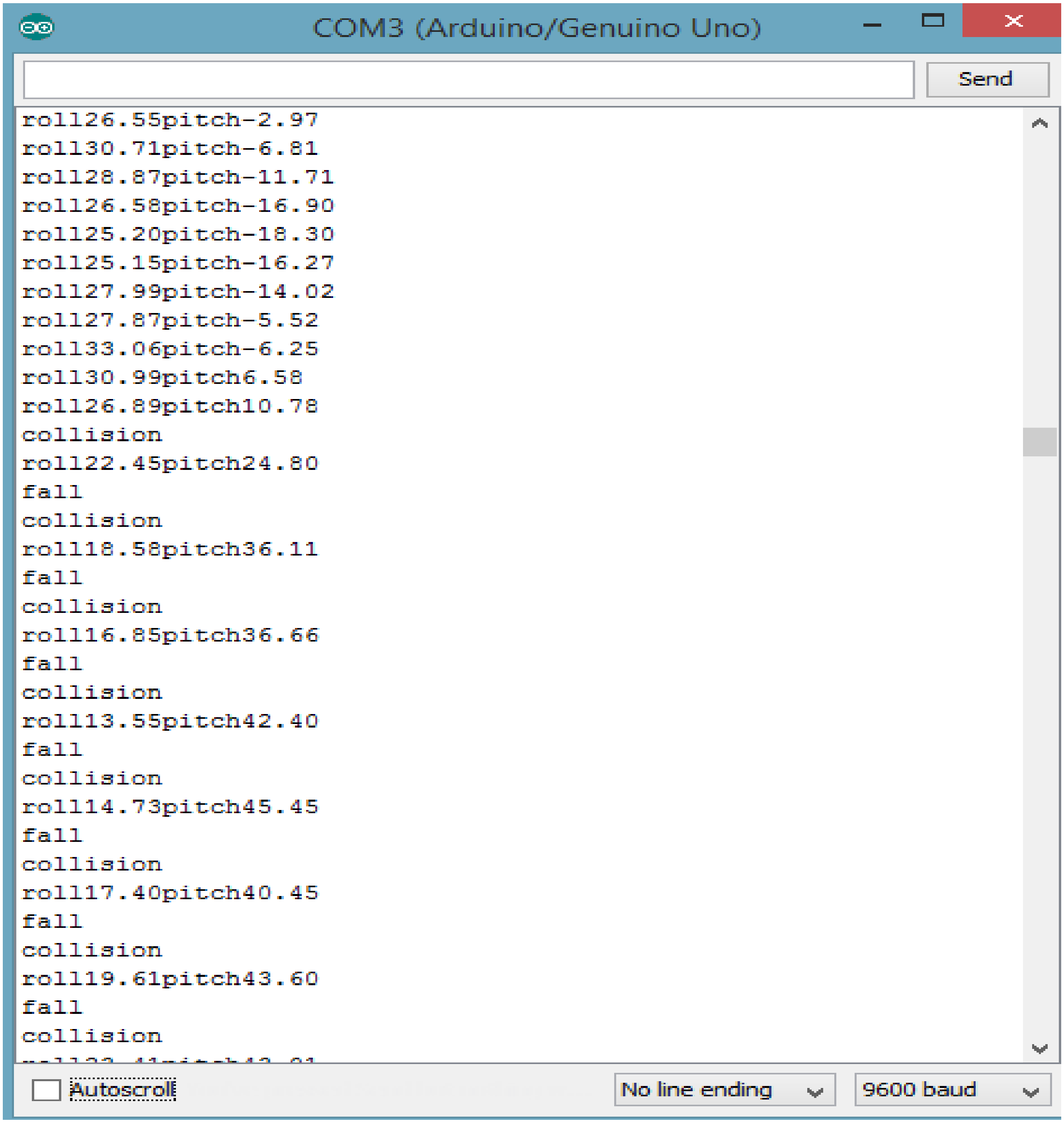
- ✓ SDA-analog pin 4
- ✓ SD0 open



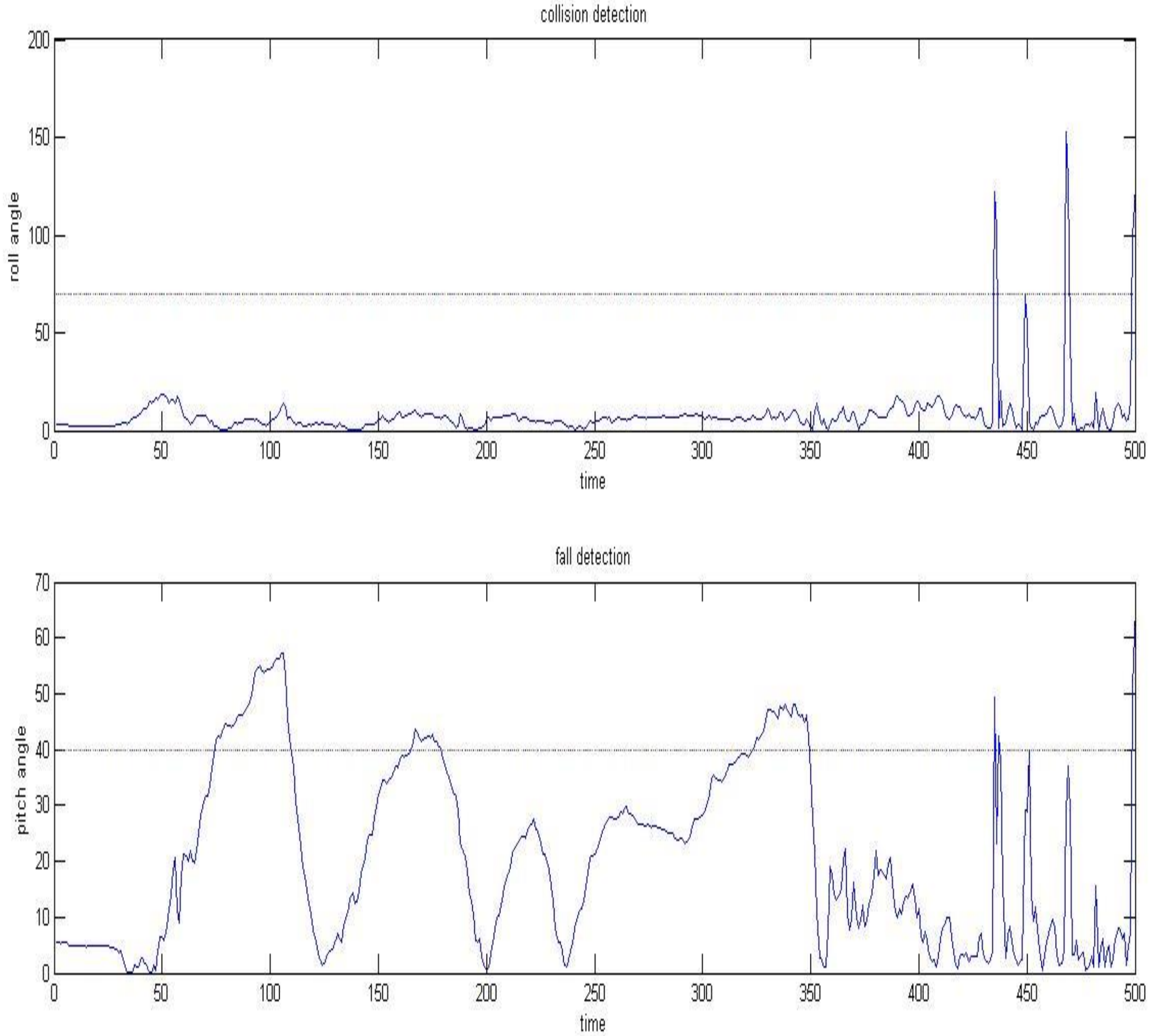
4.4 interfacing arduino with accelerometer

(source:https://www.bing.com/images/search?q=interfacing%20ATMEGA328%20with%20accelerometer%20adxl345&qs=n&form=QBIR&pq=interfacing%20atmega328%20with%20accelerometer%20adxl345&sc=0-0&sp=-1&sk=)

Two pull down resistor are used from SDA and SCL pins for the power control purpose of accelerometer. The output of the accelerometer was obtained in the serial monitor and the values were analyzed and thus the threshold was maintained. The obtained values were plotted in the matlab for easy analysis. When the values of the accelerometer are found to be above the mentioned threshold value, then the condition is defined as abnormality of vehicles, Where as if the obtained value is below the threshold, which defines the normal condition of the vehicles.



4.5 Serial monitor data of accelerometer

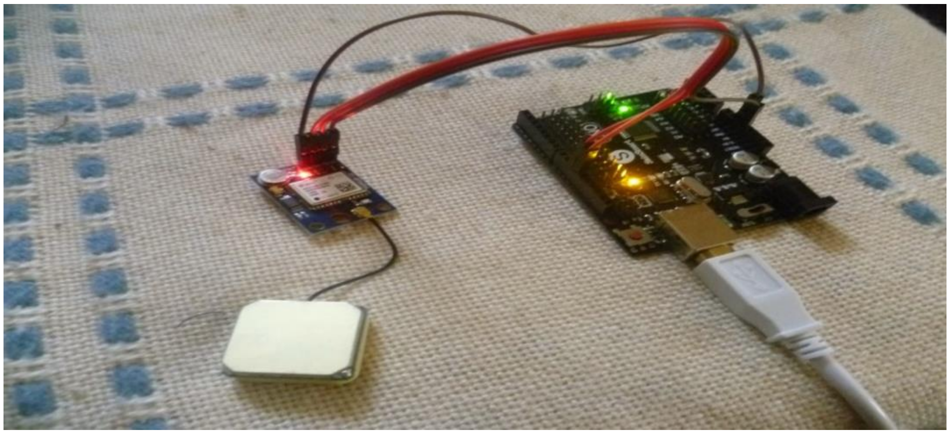


4.6 Matlab plot of accelerometer data

This matlab plot basically shows the plot of all the value obtained from accelerometer. Here the obtained value is analyzed and the threshold is maintained for both fall and collision. As per the plot, the straight line shows the threshold for fall and collision and the curve below the each threshold indicates the normal condition of the vehicles and the curve above it represents the abnormal condition of vehicles which indicates either the fall or collision of vehicles. Here the pitch and the roll value is given for both the fall and collision cases.

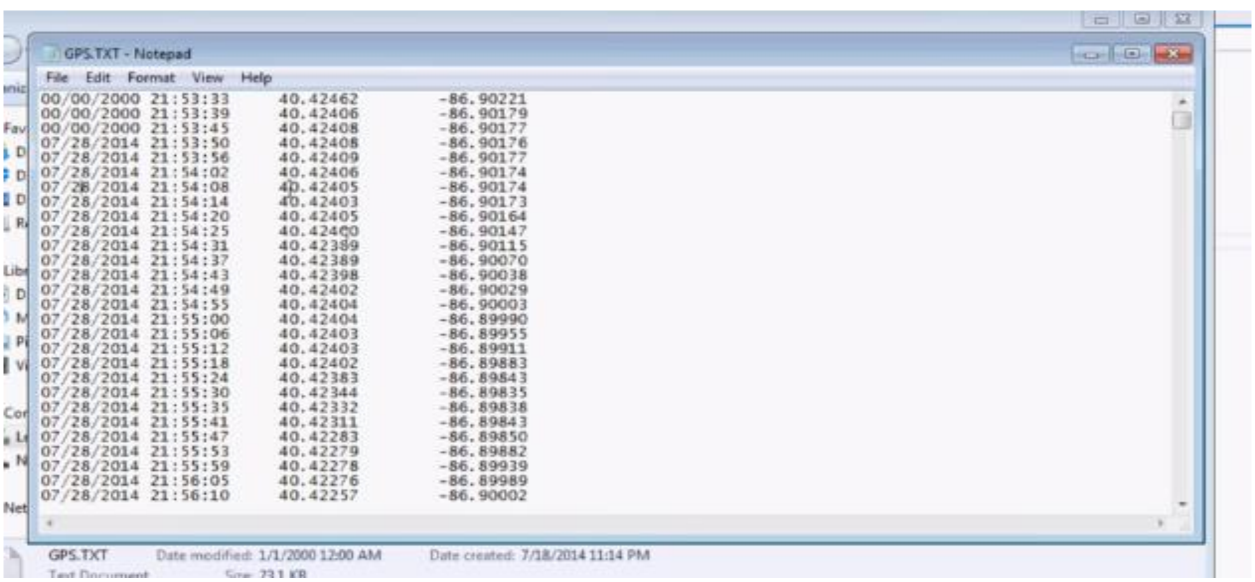
4.1.4 Interfacing ATMEGA328 with GPS

The TX pin of GPS is connected to Rx of microcontroller and vice versa. After GPS extracts the geographical location through satellites, it transmits the data to the microcontroller.



4.7 interfacing of GPS with arduino

(source:https://www.bing.com/images/search?q=interfacing%20ATMEGA328%20with%20GPS&qs=n&form=QBIR&pq=interfacing%20atmega328%20with%20gps&sc=0-0&sp=-1&sk=)



00/00/2000	21:53:33	40.42462	-86.90221
00/00/2000	21:53:39	40.42406	-86.90179
00/00/2000	21:53:45	40.42408	-86.90177
07/28/2014	21:53:50	40.42408	-86.90176
07/28/2014	21:53:56	40.42409	-86.90177
07/28/2014	21:54:02	40.42406	-86.90174
07/28/2014	21:54:08	40.42405	-86.90174
07/28/2014	21:54:14	40.42403	-86.90173
07/28/2014	21:54:20	40.42405	-86.90164
07/28/2014	21:54:25	40.42400	-86.90147
07/28/2014	21:54:31	40.42389	-86.90115
07/28/2014	21:54:37	40.42389	-86.90070
07/28/2014	21:54:43	40.42398	-86.90038
07/28/2014	21:54:49	40.42402	-86.90029
07/28/2014	21:54:55	40.42404	-86.90003
07/28/2014	21:55:00	40.42404	-86.89990
07/28/2014	21:55:06	40.42403	-86.89955
07/28/2014	21:55:12	40.42403	-86.89911
07/28/2014	21:55:18	40.42402	-86.89883
07/28/2014	21:55:24	40.42383	-86.89843
07/28/2014	21:55:30	40.42344	-86.89835
07/28/2014	21:55:35	40.42332	-86.89838
07/28/2014	21:55:41	40.42311	-86.89843
07/28/2014	21:55:47	40.42283	-86.89850
07/28/2014	21:55:53	40.42279	-86.89882
07/28/2014	21:55:59	40.42278	-86.89939
07/28/2014	21:56:05	40.42276	-86.89989
07/28/2014	21:56:10	40.42257	-86.90002

GPS.TXT Date modified: 1/1/2000 12:00 AM Date created: 7/18/2014 11:14 PM

4.8 Serial monitor data of GPS

CHAPTER5: CONCLUSION

This system basically shows the embedded system design & its effective use in accident cases. Our system can be used to avoid collision by finding and warning about the obstacle. This system locates the accident using GPS system & this information is send to the concerns. Our system may be used for the reduction of frequently occurring accidents and the passenger rescue operation during accidents. This system is an automated that will avoid and detect the accidents. It also detects the people. Up to now we have interfaced the each component individually with the arduino and simulated them individually. Here, we have interfaced ultrasonic transducer that detects the obstacles which warns the driver to take the necessary action, which consider as the pre part of our entire project.

5.1 RECOMMEDATIONS

Despite the findings and simulation part that we have obtained from our project entitled " pre- and post accident alert system", it can be designed and implemented by various renowned motor companies to add additional features in their products. Our team recommends the following points for the better performance.

- Any other microcontroller can be embedded for economical and efficient performance.
- Image processing can be implemented for the perfect scenario of the accident.
- The live updates tweets can be send in social sites using GPRS.
- Automatic braking and engine off of vehicle during emergency condition can be embedded.

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