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Vehicle Accident Tracking and Reporting System using GPS and GSM

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Abstract - *The enormous growth of population has lead to a superfluous use of vehicles which has increased the accident rates and in turn resulted in a huge loss of property and human life. An accident is an unexpected and an unintended action which occurs in a particular time and place, with no prior and deliberate cause but with its disastrous effects. Carelessness of the driver and the poor emergency facilities are the major factors behind leading to such accidents. The literature survey shows that India has the highest number of road accidents in the world out of which 22.4% are due to the crashes of two wheelers, 30% accidents at the crash site majorly lead to the on spot death, 14% in ambulance due to the poor emergency facilities and rest in hospital (according to the statistics shown in chart **1**).Many lives could be saved if emergency service could get accident information and can thus reach the accident spot in time. Our proposal is to detect the accident spot using the GPS system and accordingly inform the nearby ambulance service, the police station and the relatives concerned using the GSM system which helps in preventing any further loss to the human life. The main aim is to utilize the capability of a GPS receiver and a GSM to track the location of the accident and thus send the accident location to an alert service center. The system mainly focuses on a device that senses any accident in the vehicle and intimates pre-programmed numbers like the owner of the vehicle, ambulance, police etc. The GSM technology is used to send the position of the vehicle as an SMS to those numbers. The GPS module is used for locating the vehicle coordinates. An accident is detected by the vibration sensor, which generates an electrical signal and sends to the Arduino. The Arduino then takes the overall control by activating the GPS and the GSM module. The international road Federation, Geneva program center reported that approximately 2.4 million people have died in road accidents across the world, with a yearly record of 1.3 million deaths and a daily record of 3000 deaths **[8]**. Thus this article mainly proposes to reduce the number of deaths occurring at the crash site and on the way to the hospital due to the poor emergency trauma care services.*

***Key Words*: GPS (Global positioning system), GSM (Global system for mobile communication), SMS (Short message service), Vibration sensor, Android phone**

1. INTRODUCTION

Every minute, on average, at least one person dies in a vehicle accident. It is approximated that the loss to the human life along with the huge damage in property adds up to 1-3 percent of the world's gross domestic product **[9]**. With the motto of reducing injury and loss of property, pre crash sensing is becoming an area of active research among automotive manufacturers, suppliers and universities. Various national and international projects to investigate new technologies for improving safety and accident prevention have been successfully launched over the past several years. Vehicle accident statistics disclose that the main threats a driver is facing are the delay in the emergency facilities. Prevention of a complete accident is unavoidable but at least repercussions can be reduced to a large extent. The main proposal of the system is to make a considerable effort to provide the emergency facilities to the victims in the shortest time possible. In various large organizations the illegal use of vehicle by the drivers results in financial as well as time loss of the organization. Apart from these purposes, the system has a wide number of applications and thus it can be used for tracking of stolen vehicle, tracking of travelling luggage, fleet management, vehicular sales etc. The system incorporates an Arduino Uno board system which has GPS and GSM modems connected with it **[1]**. The entire system is installed in the vehicle. A vibration sensor is used which measures the vibration at the location at which it is placed and thus helps in detecting whether the accident has occurred or not. The signal is further compared with the standard values which in-turn confirms the accident of the car, unnecessary shock or trash or vibration produced by machines, the tilt of the car with respect to the earth's axis can be measured with the acceleration level. Global positioning system (GPS) is used for locating the coordinates of the accident spot and Global system for mobile communication (GSM) is used for informing the exact vehicular location to the nearby emergency services, the relatives concerned as well as the police stations. The GSM message gives the longitude and the latitude values which helps in determining the location of accident. GSM modem provides a two way communication by using a SIM card and such module works in a quite efficient manner in a regular phone. The main aim of this project is to have an intelligent security system which provides situational awareness and agile safety.

2. WORKING

Vehicle Accident tracking and reporting system is quite easy to implement. The fundamental component which is used is vibration sensor, which detects the accident and in turn sends the signal to Arduino. At this point the control is transferred to Arduino which then starts collecting the coordinates of the accident spot, received from the GPS which are later sent to the nearby trauma care emergency monitoring services by using the GSM module .In this project we are using a vibration sensor having a fixed range of detection that operates at a particular frequency **[2]**. When the vehicle is dashed with any other object or vehicle, the vibration sensor detects whether the vibration is in the

range or not. If the range of detection is more it reports as accident and activate GPS module which will start collecting the coordinates of that particular location .it comprises of a keypad which is kept at convenient place controlled by the person .The vibration sensor then waits for a certain duration that is for one minute to confirm the accident. If the person inside the car is not met with the accident then he is able to press the keypad and stop the GSM from sending the location which was earlier tracked by GPS and avoid calling the ambulance, police station and family members. If the range is greater than the threshold then the person who has met with accident will not be able to press the keypad. This further confirms that a major accident has occurred. This will activate GPS to collect the coordinates of that particular accident spot and GSM will then send the latitude and longitude to the respective family members and the nearby police station followed by the ambulance.

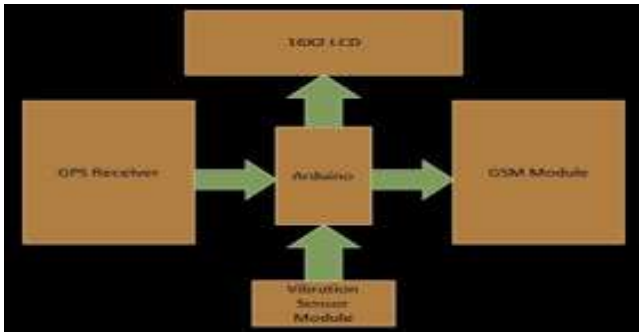
2.1 Arduino Uno Board

Arduino Uno is a microcontroller board which is based on the ATmega328P. It has in total 14 digital input/output pins out of which 6 can be used as PWM outputs, 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It can directly be attached to a computer with a USB cable with a AC-to-DC adapter or battery to get started. Arduino Uno is a modular device, there is the power system that chooses between the power jack and the USB power and produces 5v and 3v3 respectively for the rest of the system. It consists of a USB to serial controller which has a boot loader for loading the programs into the ATMEGA28P.

2.2 The Power Supply

If there is a power supply connected to the power jack, it should be within 9v and 15v. The two chips are voltage regulators that produce 5v.

Table -1: Block Diagram



2.3 USB to Serial controller

The USB controller is implemented with the ATMEGA8U2-MU.It is used to load the code into the ATMEGA328P.it has an in built support circuitry like the silicon crystals and the pull-up resistors. There is also an ICSP interface which is to program the chip. The ICSP connects to the microcontroller SPI interface.

2.4 The ATMEGA328P

This is the main controller. The code we write for the Arduino Uno board is executed by this controller and it is directly connected to the I/O pins. The controller is programmed via the TX, RX pins which are connected to the USB to serial controller and contains boot loader code, it can also be programmed via the ICSP pins.

3. GLOBAL POSITIONING SYSTEM (GPS)

The global positioning System is a navigational system that uses a 24-32 satellites network for determining the exact position of any object on earth. The satellites are located in orbits at an altitude of 12,000 miles from the earth surface. GPS receivers collect the microwave signals sent by the satellites which are further used to infer the distance using velocity and time. The system provides necessary information to military, civil and commercial users around the globe which can be accessed by anyone using a GPS receiver. GPS system works in any weather circumstances and at any position around the world. Once the vehicle is tracked, the GPS unit can determine other factors like, speed, destination distance, time etc. Hence GPS receiver can be used to carry out research work to locate the vehicle and provide information to concerned people through GSM technology.

3.1 Function of GPS:

The Global Positioning System satellites transmit signals to equipment on the ground. These signals are passively received by the GPS receivers. GPS receivers require an unblocked sky view, so they are used only outdoors. They often do not function well within forest areas or near tall buildings. Accurate time reference, which is provided by atomic clocks on board is one of the major factor for carrying out the various GPS operations.

The location and the current time of an individual satellite is indicated by the data transmitted by each GPS satellite. For the signals to be transmitted at same instant, the operations are synchronized by all GPS satellites. Since some satellites are located far away as compared to others, the signals travelling with the speed of light arrive at slightly different times at the GPS receivers. The distance to the GPS satellites can be calculated by determining the amount of time it takes for their signals to reach the receiver. When the receiver approximates the distance to at least four GPS satellites, it can calculate its position in three dimensions. This part of GPS operations is referred to as Selective Availability, was eliminated in May 2000. There are at least 24 operational GPS satellites at all times plus a number of spares. The satellites which are operated by the U.S. Department of Defense, maintain an orbit period of 12 hours (two orbits per day) at a height of about 11,500 miles travelling at about

2,000mph. Each satellite's orbit is precisely tracked by using the Ground stations.

3.2 Accuracy of GPS:

Depending up on the type of receiver, an accuracy of a position is determined with GPS. Most hand-held GPS units have about 10-20 meter accuracy. Differential GPS (DGPS) method is widely used by the other types of receivers to obtain much higher accuracy. An additional receiver is required in DGPS method, which is to be fixed at known nearby location. When the system was formed, timing errors were inserted into GPS transmissions in order to limit the accuracy of non-military GPS receivers to about 100 meters.

4. GSM

GSM is digital mobile telephone system used for communication and sending message to pre-programmed number. The modulation technique used here is GSMK. It uses a variation of Time Division Multiple Access (TDMA) which is the most widely used of the three digital wireless telephone technologies (TDMA, GSM, and CDMA). Digitization as well as compression of data is carried out by GSM. It operates at either the 900 MHz or 1,800 MHz frequency band. .There are over one billion GSM users worldwide and is available in 190 countries. In the project we use force sensor module. It utilizes the SIMCOM Make SIM900 Quad-band. The various working frequencies of the modem are 850 MHz, 900 MHz, 1800 MHz and 1900 MHZ. The modem works in an Auto band mode with the starting baud rate ranging from 960-11520. This GSM/GPRS modem is having an internally available TCP/IP stack can be used to provide internet connectivity of the modem using GPRS. It can be used both for DATA, and SMS transfers. An extended set of AT commands for reading, editing messages, monitoring the charging status etc is also supported by the GSM modem. It also facilitates various functions such as manipulation of phone book entries, SIM Phonebook management etc. The GSM modem protocol for setup and control is based on the AT- Command set, **AT** is the abbreviation of Attention hence, modem **commands** are called **AT commands**. GSM AT commands are extension commands. For example the various extended commands are +CMGS (Send SMS message), +CMGL (List SMS messages), and +CMGR (Read SMS messages).The primary objective of this application is whenever accident occurs it will send SMS and coordinates of the position of vehicle which is accessed using GPS to pre-programmed number **[7]**.

5. VIBRATION SENSOR

In order to protect a door or a window, a simple vibration sensor is used. Whenever somebody tries to break the door or window, the vibration sensor generates a loud beep sound. The alarm stops automatically after three minutes. The vibration sensor is used as the piezoelectric element in the circuit. It proposes the piezoelectric property of the piezoelectric crystals. The piezoelectric effect may be direct piezoelectric effect where an electric charge develops with the mechanical stressor or Converse piezoelectric effect) in which a mechanical force such as vibration develops due to the application of an electric field.

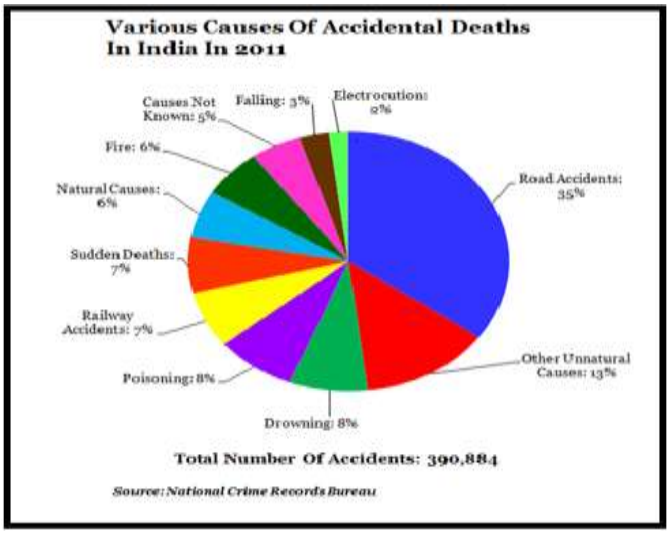


Chart 1 [1]

Table 2 - Circuit Diagram

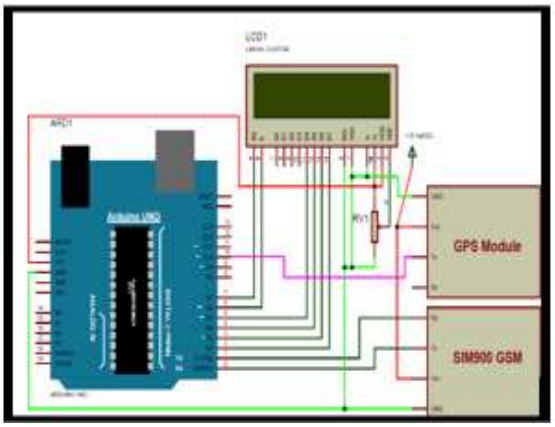


Table-3 GSM Features

Parameter	Specifications
Forward Channel Frequency	935-960MHz
Reverse Channel Frequency	890-915MHz
Tx/Rx Frequency Slotting	45MHz
Tx/Rx Time Slot Spacing	3 Time slots
Frame Period	4.615ms
Users per Frame	8
Time Slot Period	576.9µs
Bit Period	3.692µs
Modulation	0.3GMSK
Modulation Data Rate	270.833333kbps
ARFCN Number	0 to 124 and 975 to 1023
ARFCN Channel Spacing	200KHz
Interleaving	40ms

6. CONCLUSIONS

This paper proposes a design which has many benefits like low cost, portability, small size. This system uses an Arduino in conjunction with vibration sensor; GPS and GSM interfacing which helps in reducing the alarm time to a large extent and gives the location of accident accurately. It can also overcome the issue of lack of advanced automotive system for the detection of the site of accident. As a result, the time for detecting the accident site is reduced which helps in treating the injured person as soon as possible which will save many lives. As per the above survey, the scope of the work can be listed as follows:

1. A wireless webcam can be fitted in this application for capturing the images which will help in providing driver`s assistance.

2. This can also be bettered by locking all the brakes automatically in case of accident. Mostly in accidents, it becomes serious as the drivers lose control and fail to stop the vehicle. In such cases, the vibration sensor will be triggered because of the vibrations received and also processed by the processor. The processor has to be linked to the devices which can lock the brakes when triggered. With this improvement, we can stop the vehicle and can weaken the impact of the accident.

3. This system can also be utilized in fleet management, food services, traffic violation cases, rental vehicle services etc.

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