GSM and GPS-based Vehicle Accident Detection System using Arduino Microcontroller

A. Shiva Kumar[1], Akeleshwar Rao V[2], Shiva Teja Reddy[3], Teja Rajakumta[4]

[1]Assistant Professor, [2,3,4]UG Student, Department of EEE
Kommuri Pratap Reddy Institute of Technology, Ghatkesar, Hyderabad, Telangana, India.

ABSTRACT

The Rapid growth of technology and infrastructure has made our lives easier. The advent of technology has also increased the traffic hazards and the road accidents take place frequently which causes huge loss of life and property because of the poor emergency facilities. Nowadays we can track vehicles using many applications which helps in securing personal vehicles, public vehicles, feet units and others. Furthermore, there is a rapid increase in the occurrence of the Road accident . This paper is about a system which is developed to automatically detect an accident and alert the nearest hospitals and medical services about it. This system can also locate the place of the accident so that the medical services can be directed immediately towards it. The goal of this paper is to build up a Vehicle accidental monitoring system using GPS and GSM Technology. The system comprises MCU, GPS and GSM module support in sending message. Short Message will contain GPS [Latitude, Longitude] which helps in locating the vehicles.

Keywords: Vehicle tracking, accident detection, Arduino UNO, GSM, GPS

1. INTRODUCTION

In the twentieth century, the number of vehicles exponentially increases due to growth in the automobile industry. As the number of vehicles increases, the accident also increases. The reason of most of the road accidents are heterogeneous traffic and lack of traffic separation. According to World Health Organization (WHO), India is the leading country in the road accident deaths. In India, 13 million peoples were dead in road accident in the year of 2014-15. These statistics are reported accidental records but there are numbers of accident, which are unreported. Hence, the numbers of actual accident are more than the statistic of World Health Organization (WHO). The existing system mostly focuses on the safety of the passenger but not on the immediate help after accident. India has earned the dubious distinction of having a greater number of fatalities due to road accident in the world. Road safety is emerging as a major social concern around the world, especially in India. The system implemented by us aims at automatically detecting an accident and alerting the nearest hospital or medical services about the exact location of the accident. This system sends the basic information to the medical rescue team within a few seconds of an accident. This device can detect accidents and sends an alert message to rescue teams in significantly less time which will help in saving the lives of the people. The alert message contains the geographical coordinates, time, and angle in which the accident has occurred. When an accident occurs, it is detected with help of a sensor which activates the device, the sensor gives its output to the microcontroller. The microcontroller sends the alert. We have used GPS and GSM module for our project. GPS (Global Positioning

System) is a satellite navigation system used to determine the ground position of an object. It is a global navigation satellite system that provides geo location and time information to a GPS receiver anywhere on or near the Earth. Here GPS is used for both tracking and navigation. This enables a base station to keep track of the vehicles and navigation system helps the driver to reach the destination. GSM is an open, digital cellular technology used for transmitting mobile voice and data services. The GSM system is the most widely used cellular technology in use in the world today. It has been a particularly successful cellular phone technology for a variety of reasons including the ability to roam worldwide with the certainty of being able to operate on GSM networks. It is also highly economic and less expensive.

2. PROBLEM DEFINITION

From the past event and the existing approach, the below drawbacks have been noted:

- Manual system is adopted.
- Tracking of accident is a crucial process in the system.
- Required medical attention cannot be given to the needed person.
- Life loss and property loss were not stopped in large scale.

Considering all the drawbacks into account we have formulated a proposed system which covers all the above-mentioned drawbacks.

- ❖ An Automated system is used once the accident occurs.
- ❖ This system gives the latitude and longitude of the system accident occurred area without any delay.
- ❖ More human life can be saved using this auto mated system.

3. PROPOSED SYSTEM

This Project presents an automotive localization system using GPS and GSM-SMS services. The system permits localization of the automobile and transmitting the position to the owner on his mobile phone as a short message (SMS) at his request. The system can be interconnected with the car alarm system and alert the owner on his mobile phone. This tracking system is composed of a GPS receiver, Microcontroller, and a GSM Modem. GPS Receiver gets the location information from satellites in the form of latitude and longitude. The Microcontroller processes this information and this processed information is sent to the user/owner using GSM modem. The presented application is a low-cost solution for automobile position and status, especially useful in case of car theft situations, for monitoring adolescent drivers by their parents as well as in car tracking system applications. The proposed solution can be used in other types of application, where the information needed is requested rarely and at irregular period (when requested).

3.1. Working

Step 1: A sensor will sense the occurrence of an accident and give its output to the microcontroller. Here a button sensor is used for detection which will get pressed when the vehicle meets with an accident.

Step 2: A buzzer is present in this system with starts beeping indicating that the system is now activated.

Step 3: The GPS detects the latitude and longitudinal position of the vehicle. It is essential to locate the position to provide medical assistance.

Step 4: The phone numbers are pre saved in the EEPROM by the user. These numbers can be changed at any point of time.

Step 5: The microcontroller sends an alert message to these pre saved numbers using the GSM module. Any message can be pre entered in the system by the user.

Step 6: LCD screen displays the status of the output.

Step 7: In case there is no casualty, the sending of the message can be terminated with the help of a switch. The switch will restart the microcontroller and its function will start from the beginning.
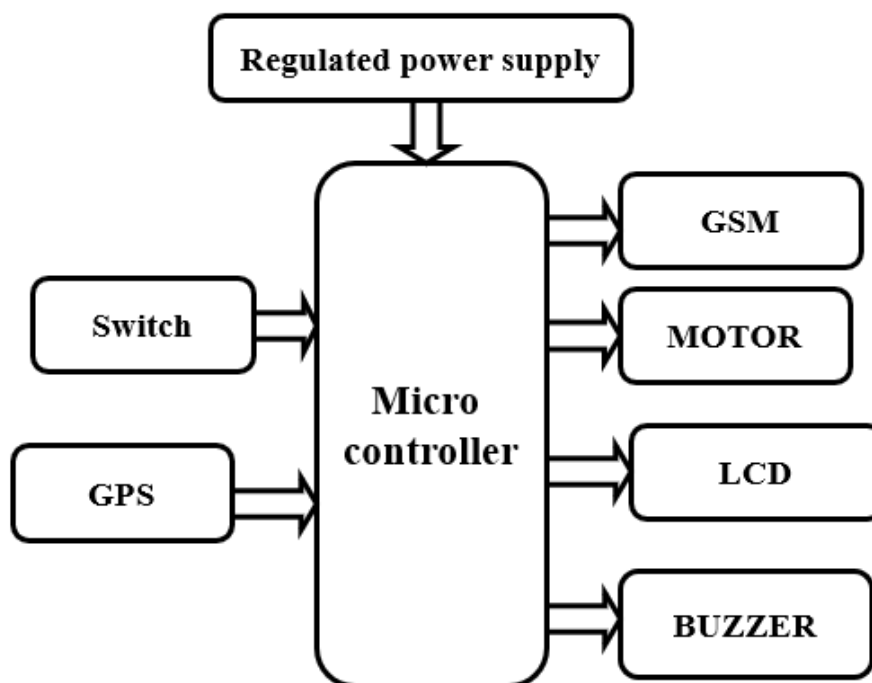

Figure 1. Proposed block diagram of vehicle accident detection system.

3.2. Features

➢ Remote communication using GSM modem.
➢ Sends location in the form of latitude and longitude.
➢ Reliable for remote tracking

3.3. Software Tools

• ARDUINO IDE for Embedded C programming.
• ARDUINO IDE for compiler, dumping code into Micro controller.

3.4. Applications

➢ Stolen Vehicle Recovery: In case of theft, the vehicle can be tracked by using vehicle positioning system. The GPS system allows the tracking of vehicle from anywhere.

➢ Airbag System: This system can be interfaced with vehicle airbag system for safety. When an accident occurs both the systems will be activated for the safety of the victim.

➢ Bomb Detection: This system can be used for bomb detection by connecting it to a bomb detector. The buzzer can be used to alert the presence of a bomb in the vehicle.

➢ Fleet Management: When managing a fleet of vehicles, knowing the real-time location of all drivers allows management to meet customer needs more efficiently. Whether it is delivery, service or other multi-vehicle enterprises, drivers now only need a mobile phone with telephony or Internet connection to be inexpensively tracked by and dispatched efficiently.

4. HARDWARE DESCRIPTION

4.1. Arduino controller

The Arduino Uno is a microcontroller board based on the ATmega328P. 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. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter.

The Arduino Uno has in built ADC components and can process both analog and digital signals. The Atmega328 has 32 KB of flash memory for storing code (of which 0.5 KB is used for the bootloader). It has also 2 KB of SRAM and 1 KB of EEPROM. The Arduino Uno has an operating voltage of 5V; a recommended input of 7V-12V can be applied to it. However, the Arduino Uno does not have a current driving capacity to drive all the DC motors attached to it-thereby requiring an intermediate motor driver circuit.

Each of the 14 digital pins on the Uno can be used as an input or output, using pin Mode(), digital Write(), and digital Read() functions. 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. The Bluetooth interface to the Arduino is achieved with the help of the Serial in-out pins of the Arduino namely: 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. The Arduino Uno is programmed using the Arduino IDE software using a set of C/C++ functions.

4.2. DC Motor

Almost every mechanical movement that we see around us is accomplished by an electric motor. Electrical machines are used for the converting energy. Motors take electrical energy and produce mechanical energy. Electric motor is used to power hundreds of devices we use in everyday life. An example of small motor applications includes motors used in automobiles, robot, hand power tools and food blenders. A motor driver Integrated circuit (L293D) chip is designed to control and regulate motors. It is a dual H-bridge motor driver Integrated Circuit. They are generally used in mechanics and robotics. It acts as an interface between motor and Arduino microprocessor in the circuit. L293D, L293NE are most used motor driver Integrated circuits from L293 series. L293D is designed to control up to maximum of two direct current motors simultaneously when they are integrated with Arduino Uno. It helps to regulate the flow of current before it finally reaches the motor. It becomes a necessity and need to use IC L293D due to different requirement of current and voltages by microprocessors (low) and 5V DC motor (high) as it acts as a moderator and balances the flow of current. It protects the circuit from

overload current and provides protection against overload temperature. Current should not be directly supplied to the motor because it can damage the motor or even the microcontroller. It has an output capability and provides bidirectional current of 600 mA per channel. The maximum or peak current which can flow through per channel as output is 1.2 Amp. It has Enable facility and internal clamp diodes. Input voltage is up to 1.5V-36V which is also high noise immunity (logical "0"). Various and un-similar PWM signals are received because a motor driver IC interfaces with the microcontroller. A motor driver IC is also responsible for achieving required outputs for the speed variation of the DC motor.

4.3. GPS Module

GPS stands for Global Positioning System and is used to detect the latitude and longitude of any location on the earth, with the exact UTC time. GPS module is used in our project to track the location of the accident. This device receives the coordinates from the satellite for each second, with time and date. In our project, we have used GPS module SKG13BL, which is a Ultra High Sensitivity and Low Power GPS Receiver Module.

4.4. GSM Module

GSM/GPRS module is used to establish communication between a computer and a GSM-GPRS system. Global System for Mobile communication (GSM) is an architecture used for mobile communication in most of the countries. It is an open, digital cellular technology used for transmitting mobile voice and data services. The GSM system is the most widely used cellular technology in use in the world today. It has been a particularly successful cellular phone technology for a variety of reasons including the ability to roam worldwide with the certainty of being able to operate on GSM networks. It is also highly economic and less expensive.

4.5. LCD

The LCD display is a display device which that is used to print text, make custom characters, bink text, and position text. The display is 20X4 matrix which means that the LCD has 4 rows and 20 columns. Thus, it can display 80 characters at once. LCD is a flat panel display that uses the light modulating properties of liquid crystals. Liquid crystals use a backlight or reflector to produce images in colour or monochrome. LCDs display arbitrary.

5. EXPERIMENTAL SETUP

The Arduino platform has a built-in Integrated Development Environment called IDE. It helps to program any project with various other devices . It supports C & C+ Language which are the foundation of all other programming . This board is particularly chosen as it provides the flexibility to communicate with more devices. The board is connected through a USB printer cable to the programming console. The Arduino IDE is the open-source software platform that connects to the Arduino hardware to upload programs and communicate with them. The board supports 54 digital I/O pins.

- 15 pins = PWM outputs.
- 16 pins = Analog.
- 4 USARTs hardware serial ports.
- One power jack.
- One USB connection.
- One 16 MHz Crystal oscillator.

- ICSP header and a reset button.

After successful compiling and uploading the program on Arduino IDE, the system is initialized successfully, the accelerometer is calibrated and the x, y, and z samples of the vehicle are displayed on the serial monitor. After receiving GPS signal, the latitude and longitude of the current position of the vehicle is displayed, also the speed is displayed in knots. When the switch sensor pressed, i.e., in case of an accident, SMS is sent to the mobile number mentioned in the code and the latitude and longitude is also sent in the form of Google maps. The message is received in the specified mobile number along with the specific location.
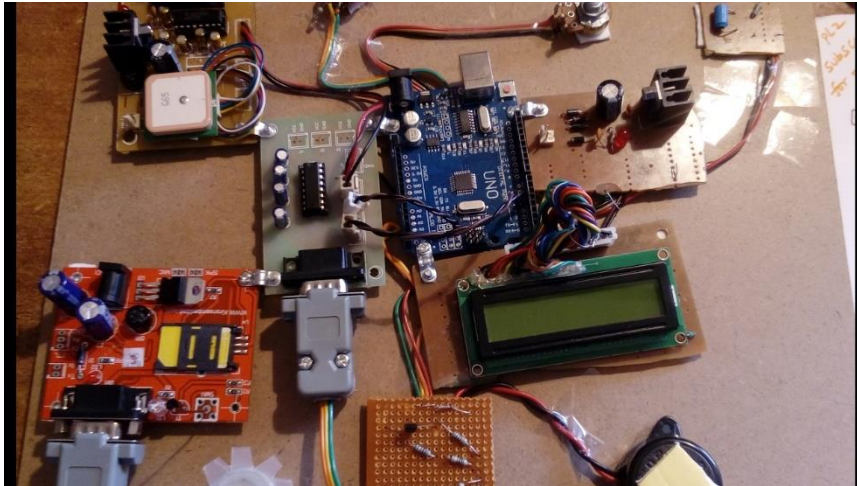

Figure 2. Complete hardware setup of proposed vehicle accident detection system.

6. CONCLUSIONS

Vehicle tracking system makes better fleet management and which in turn brings large profits. Better scheduling or route planning can enable us to handle larger loads within a time. Vehicle tracking both in case of personal as well as business purpose improves safety and security, communication medium, performance monitoring and increases productivity. So, in the coming years it is going to play a major role in our day to day living. The main motto of the accident alert and detection project is to decrease the chances of losing life in such accidents which we cannot stop from occurring. Whenever accident is alerted the paramedics can reach the location to increase the chances of life. This vehicle tracking and accident alert feature may play a more important role in day to day life in the future. However, in some places where there is no provision of GSM networks it is difficult for communication.

7. FUTURE SCOPE

In future they developed android application system will ensure the safety of the old aged people and reduce risk of physically challenged people by alerting the user fall detection and the abnormal health condition. The system supports independent living and confidence of the old aged people effectively. And, the system is greatly user interface. The sensors used in this project also wearable and light weight and the transmission range of the system is extremely high because of the GSM, is the major highlight of the project.

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