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GPS & GSM Based Accident Detection And Auto Intimation

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ABSTRACT

The high demand of automobiles has also increased the traffic hazards and the road accidents. Life of the people is under high risk. This is because of the lack of best emergency facilities available in our country. An automatic alarm device for vehicle accidents is introduced in this paper. This design is a system which can detect accidents in significantly less time and sends the basic information to first aid centre within a few seconds covering geographical coordinates, the time and angle in which a vehicle accident had occurred. This alert message is sent to the rescue team in a short time, which will help in saving the valuable lives. A Switch is also provided in order to terminate the sending of a message in rare case where there is no casualty, this can save the precious time of the medical rescue team. When the accident occurs the alert message is sent automatically to the rescue team and to the police station. The message is sent through the GSM module and the location of the accident is detected with the help of the GPS module.

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1. INTRODUCTION

The development of a transportation system has been the generative power for human beings to have the highest civilization above creatures in the earth. Automobile has a great importance in our daily life [1]. We utilize it to go to our work place, keep in touch with our friends and family, and deliver our goods. But it can also bring disaster to us and even can kill us through accidents. Speed is one of the most important and basic risk factors in driving [2]. It not only affects the severity of a crash, but also increases risk of being involved in a crash. Despite many efforts taken by different governmental and non-governmental organizations all around the world by various programs to aware against careless driving, yet accidents are taking place every now and then [3]. However, many lives could have been saved if the emergency service could get the crash information in time. As such, efficient automatic accident detection with an automatic notification to the emergency service with the accident location is a prime need to save the precious human life [4].

This system proposes to utilize the capability of a GPS receiver to monitor the speed of a vehicle and detect an accident basing on the monitored speed and send the location and time of the accident from the GPS data processed by a microcontroller by using the GSM network to the Alert Service Centre. The block diagram of proposed system is shown in Figure 1.

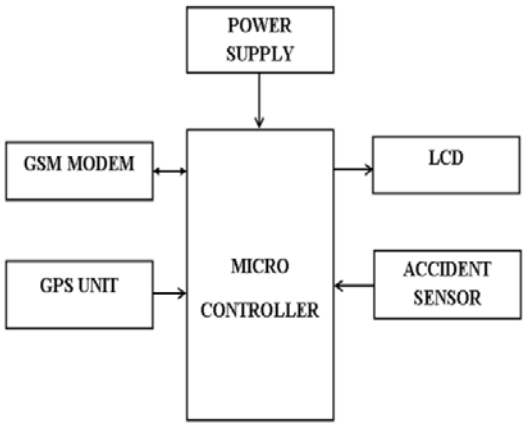

Figure 1. Block Diagram of Proposed System

2. GPS & GSM SYSTEM

Global Positioning System was developed by the United States Department of Defence. It uses between 24 and 32 Medium Earth Orbit satellites that transmit precise microwave signals. This enables GPS receivers to determine their current location, time and velocity. The GPS satellites are maintained by the United States Air Force. GPS is often used by civilians as a navigation system [5]. On the ground, any GPS receiver contains a computer that "triangulates" its own position by getting bearings from at least three satellites. The result is provided in the form of a geographic position - longitude and latitude - to, for most receivers, within an accuracy of 10 to 100 meters. Software applications can then use those coordinates to provide driving or walking instructions. Getting a lock on by the GPS receivers on the ground usually takes some time especially where the receiver is in a moving vehicle or in dense urban areas. The initial time needed for a GPS lock is usually dependent on how the GPS receiver starts is shown in Figure 2.

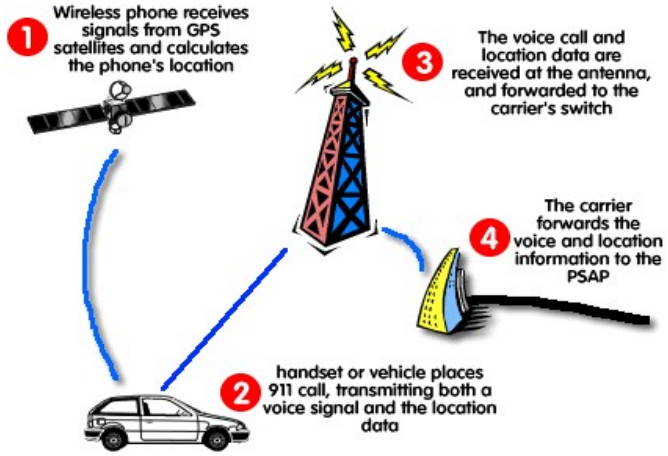

Figure 2. GPS System.

GSM (Global System for Mobile Communications, 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 is shown in Figure 3. General packet radio service (GPRS) is a packet oriented mobile data service on the 2G and 3G cellular communication system's global system for mobile communications (GSM) where protocols means set of invisible computer rules that govern how an internet document gets transmitted to your screen and 2G is short for second-generation wireless telephone technology and provides advantages like to provide the services such as text messages, picture messages and MMS [6].

Figure 3.GSM System

3. ACCIDENT DETECTION ALGORITHM

Speed is one of the most important and basic risk factors in driving. It not only affects the severity of a crash, but also increases risk of being involved in a crash. People need some processing time to decide whether or not to react and then to execute an action. At high speeds the distance between starting to brake and a complete stand still is longer. The braking distance is proportional to the square of speed. Therefore, the possibility to avoid a collision becomes smaller as speed increases. A moving body contains kinetic energy according to (1). When an accident occurs, kinetic energy is transformed into destructive forces [9] cause injury to occupants as well as to the vehicle.

$$\text{Kinetic Energy} = (1/2)\, mv2 \quad (1)$$

Where m = mass of object and v = speed of the vehicle.

When brake is applied, two forces work on the vehicle to decelerate the speed. One is the gravitational force (g) and the other one is the friction force (f). Considering the friction coefficient 0.8 for a plain road surface and standard gravitational force (9.8 metres per square second), from the Equation 2, we can get the final speed of a vehicle (u) after one second once the brake is applied. This is the maximum speed after considering the deceleration factors. Table 1 shows the maximum speed starting from the initial speed of 160 kph after one second once the brake is applied. As such, if the speed is less than these maximum speed, than it would be assumed that some other deceleration force worked on the vehicle to reduce the speed and an accident has occurred.

$$t = (v-u)/a \quad (2)$$

where v = initial speed, u = final speed, a= acceleration or deceleration.

4. ACCIDENT DETECTION AND REPORTING PROCEDURE

4.1 Speed Measurement

Many techniques can be used to measure vehicle speed. The most common is the car speedometer. But analog to digital converter is required to acquire speed from the Speedometer. Laser speed guns are limited to single point and instantaneous measurements. But a GPS receiver provides speed information in every second. Therefore, it is more convenient to monitor the speed with a GPS receiver. GPS receiver communication is defined by National Marine Electronics Association (NMEA) specification [10]. The idea of NMEA is to send a line of data called a sentence that is totally self-contained and independent from other sentences. Out of these sentences, GPRMC is the most common sentence transmitted by the most GPS devices. This sentence contains nearly everything a GPS application needs.

Detection Procedure

The GPS receiver acquires the GPRMC sentence in every second. From the GPRMC sentence, the speed information will be extracted by counting the number of comma (,) by the MCU. Two memory spaces will be allocated for the speed, one memory space for the time and another for the latitude and longitude. The latest time and latitude/longitude will be always saved in the memory overwriting the previous values. The

last two speed information will be always kept in memory. The latest speed information will be stored in the first memory space and will move to the second memory speed once new speed information is acquired. The MCU will compare the latest speed with the previous speed by utilizing the Equation (2). If the speed is less than the maximum speed found from Equation (2), the MCU will raise a flag to indicate that an accident took place.

4.2 Reporting Procedure by MCU

When a flag is raised for accident, the MCU will initiate an emergency situation automatically. The MCU will wait for 5 seconds for the driver to press a button to cancel the accident reporting procedure. This will enable to reduce the false alarm to the Alert Service Centre. Once the 5 seconds waiting time is over, the accident information containing the location, time and the speed along with the contact number of relative of the occupant will be sent as a GPRS data to the Alert Service Centre through the GPRS modem by the MCU. However, GPRS coverage is not always available in every place. As such, simultaneously an SMS will also be initiated containing the same information. After the SMS is sent, the MCU will also initiate a voice call to the Alert Service Centre. This will enable the vehicle occupant to describe the emergency situation if they are in a condition to describe. Besides automatic accident detection system, b pressing the Manual Detection Switch, the vehicle occupant will also be able to initiate an emergency situation and it will report like the automatic accident detection system.

5. ACCIDENT DATA INTERPRETATION

The information sent as a GPRS data and SMS will be received by a GSM/GPRS modem connected to a computer. A middleware will be written to interpret the SMS and GPRS data. An appropriate program will be written so that Google Maps can be incorporated and the accident location is automatically plotted in the map utilizing the information from the interpreted SMS/GPRS data. It will also show the previous speed of the vehicle before committing the accident. This data will help the Alert Service Center to assess the severity of the accident basing on the speed. The modem will also establish a voice channel with the Alert Service Center. The flow chart is shown in Figure 4.

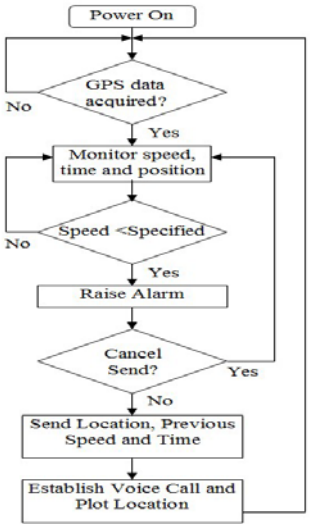

Figure 4. Flowchart of the Accident Detection and Reporting System

The Figure 5 shows the tracking system using GPS and GPRS data. The place where the accident was occurred, speed before accident, day, time etc. will be available through SMS.

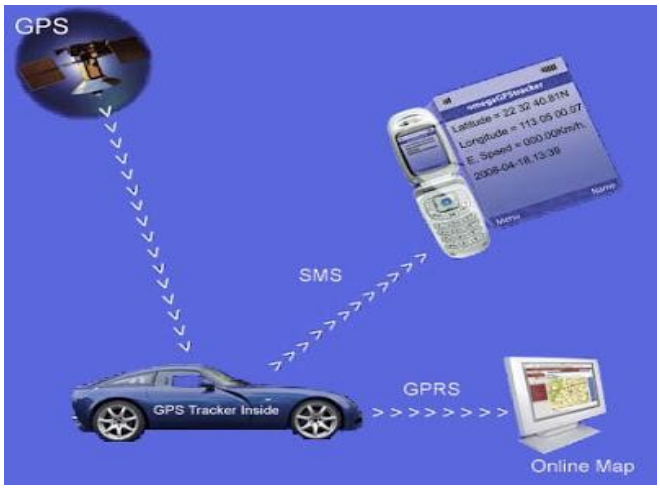

Figure 5.Tracking System.

6. MICROCONTROLLER UNIT

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 is shown in Figure 6. 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.

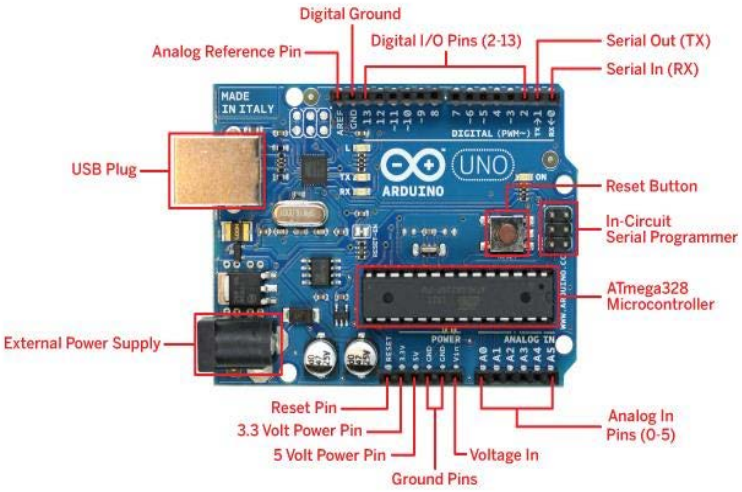

Figure 6. Micrzocontroller - ATmega328.

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.

Table 1. Index Anduino Boards

Parameaters	
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
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock Speed	16 MHz

7. CONCLUSION

This work Speed is one of the most significant causes of an accident. Nowadays, GPS receiver has become an integral part of a vehicle. Besides using in other purposes, the GPS can also monitor the speed and detect an accident. It can use a very cheap and popular GSM modem to send the accident location to the Alert Service Centre. It can also send the last speed before accident which will helps to assess the severity of the accident and can initiate a voice call. Beside the automatic detection system, the vehicle occupant will be able to manually send the accident situation by pressing the Manual Detection Switch. A rescue measures in time with sufficient preparation at the correct place can save many life. Thus, the proposed system can serve the humanity by a great deal as human life is valuable.

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