ISSN 2278-3091

International Journal of Advanced Trends in Computer Science and Engineering, Vol.5 , No.1, Pages : 106 -109 (2016)
Special Issue of ICACEC 2016 - Held during 23-24 January, 2016 in Institute of Aeronautical Engineering, Quthbullapur, Telangana-43, India

Vehicle Tracking and Detection by Using GPS, GSM and MEMS – A Prototype Model

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Abstract*:* The safety and rescue are the primary concern in every part of fast moving world. There are many accidental event occur due to an unavoidable reasons. The aim of this project 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. It can be used to detect any unusual acceleration and tilting of vehicles which indicates that the vehicle is out of control and could have suffered an accident. The accelerometers output can be analyzed by the microcontroller to find if it has crossed the threshold.

Key words: MEMS Accelerometer, Global Positioning System (GPS), Global System for Mobile (GSM), Vehicle tracking.

INTRODUCTION

A vehicle tracking system combines the installation of an electronic device in a vehicle, or fleet of vehicles, with purposed-designed computer software to enable the owner or a third party to track the vehicle's location, collecting data in the process. Modern vehicle tracking systems commonly use Global Positioning System (GPS) technology for locating the vehicle, but other types of automatic vehicle location technology can also be used. GSM and GPS based vehicle location and tracking system will provide effective, real time vehicle location, mapping and reporting this information value and ads by improving the level of service provided.

A GPS-based vehicle tracking system will inform where your vehicle is and where it has been, how long it has been. The system uses geographic position and time information from the Global Positioning Satellites. Vehicle information can be viewed on electronic maps via the Internet or specialized software. Existing System: In the previous system only latitude and longitudes are available. In the proposed system, a GPRS module is used to locate the place and send a text message. This GPS will be location the position of vehicle and transmit that data to the microcontroller. Receiver unit send the signal to the microcontroller, from that we can identify the theft. If the vehicle is theft it automatically sends location of the vehicle to its owner as a SMS through GSM modem. This will be a much simpler and low cost technique compared to others.

LITERATURE REVIEW

Vehicle Tracking System

A vehicle tracking system combines the installation of an electronic device in a vehicle, or fleet of vehicles, with purposed designed computer software at least at one operational base to enable the owner or a third party to track the vehicle's location, collecting data in the process from the field and deliver it to the base of operation. Modern vehicle tracking systems commonly uses GPS technology for locating the vehicle, but other types of automatic vehicle location technology can also be used. Vehicle information can be viewed on electronic maps.

GSM Overview

Global System for Mobile Communications or GSM (originally from *Groupe Spécial Mobile*), is the world's most popular standard for mobile telephone systems. The GSM Association estimates that 80% of the global mobile market uses the standard [1]. GSM is used by over 1.5 billion people [2] across more than 212 countries and territories [3]. This ubiquity means that subscribers can use their phones throughout the world, enabled by international roaming arrangements between mobile network operators. GSM differs from its predecessor technologies in that both signaling and speech channels are digital, and thus GSM is considered a second generation (2G) mobile phone system. The GSM standard has been an advantage to both consumers, who may benefit from the ability to roam and switch carriers without replacing phones, and also to network operators, who can choose equipment from many GSM equipment vendors.

GPS Overview

The Global Positioning System (GPS)[4] is a space-based global navigation satellite system (GNSS) that provides reliable location and time information in all weather and at all times and anywhere on or near the Earth when and where there is an unobstructed line of sight to four or more GPS satellites. It is maintained by the United States government and is freely accessible by anyone with a GPS receiver. The GPS project was started in 1973 to overcome the limitations of previous navigation systems, integrating ideas from several predecessors, including a number of classified engineering design studies from the 1960s.A sample gps module is depicted as shown in fig.1.

Figure 1. GPS Module

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GPS was created and realized by the U.S. Department of Defense (USDOD) and was originally run with 24 satellites. It became fully operational in 1994.

GSM MODEM

Global system for mobile communication (GSM) is a globally accepted standard for digital cellular communication. GSM is the name of a standardization group established in 1982 to create a common European mobile telephone standard that would formulate specifications for a pan-European mobile cellular radio system operating at 900 MHz. A sample GSM module is shown in fig.2.

Figure 2. GSM Modem

A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem. The main difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves. The working of GSM modem is based on commands, the commands always start with AT (which means ATtention) and finish with a <CR> character. For example, the dialing command is ATD <number>; ATD3314629080; here the dialing command ends with semicolon. The AT commands are given to the GSM modem with the help of PC or controller. The GSM modem is serially interfaced with the controller with the help of MAX 232.

GSM Network

GSM [5] provides recommendations, not requirements. The GSM specifications define the functions and interface requirements in detail but do not address the hardware. The reason for this is to limit the designers as little as possible but still to make it possible for the operators to buy equipment from different suppliers. The GSM network is divided into three major systems: the switching system (SS), the base station system (BSS), and the operation and support system (OSS).

The fig.3 shows the operations and maintenance center (OMC) is connected to all equipment in the switching system and to the BSS. The implementation of OMC is called the operation and support system (OSS). The OSS is the functional entity from which the network operator monitors and controls the system. The purpose of OSS is to offer the customer cost-effective support for centralized, regional and local operational and maintenance activities that are required for a GSM network. An important function of OSS is to provide a network overview and support the maintenance activities of different operation and maintenance organizations.

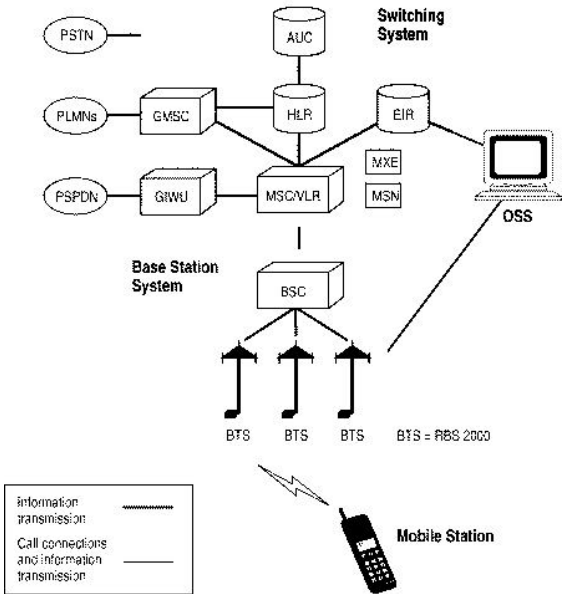

Figure 3. GSM Network Elements

MEMS Technology

Micro-Electro-Mechanical Systems, or MEMS [6], is a technology that in its most general form can be defined as miniaturized mechanical and electro-mechanical elements (i.e., devices and structures) that are made using the techniques of micro fabrication. A MEMS module is shown in below fig.4

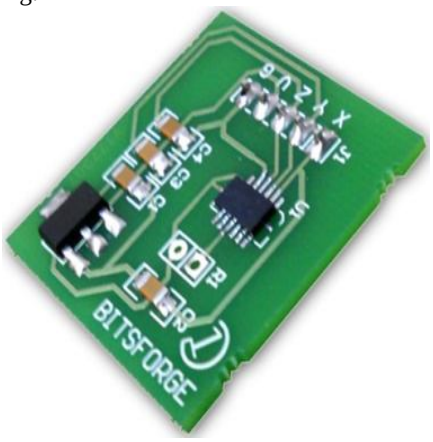

Figure 4. MEMS

The one main criterion of MEMS is that there are at least some elements having some sort of mechanical functionality whether or not these elements can move. The term used to define MEMS varies in different parts of the world. In the United States they are predominantly called MEMS, while in some other parts of the world they are called “Microsystems Technology” or “micro machined devices”.

8051 MICROCONTROLLER

The microcontroller incorporates all the features that are found in microprocessor. The microcontroller has built in ROM, RAM, Input Output ports, Serial Port, timers, interrupts and clock circuit. A microcontroller is an entire computer manufactured on a single chip. The pin diagram of 8051 MC is shown below fig.5. Microcontrollers are usually dedicated devices embedded within an application. For

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example, microcontrollers are used as engine controllers in automobiles and as exposure and focus controllers in cameras. In order to serve these applications, they have a high concentration of on-chip facilities such as serial ports, parallel input output ports, timers, counters; interrupt control, analog - to-digital converters, random access memory, read only memory, etc.

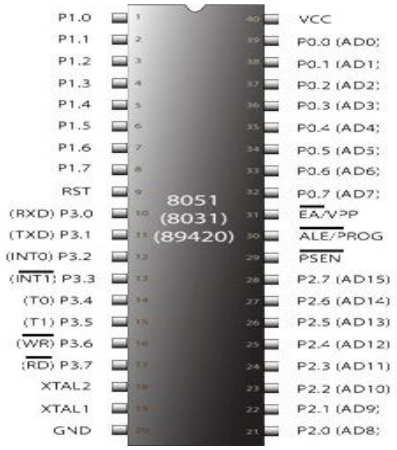

Figure.5 8051 MC

RS232 Serial Communication Port

An RS-232 serial port was once a standard feature of a personal computer, used for connections to modems, printers, mice, data storage, uninterruptible power supplies, and other peripheral devices. The fig. 6 below is a RS232 port.

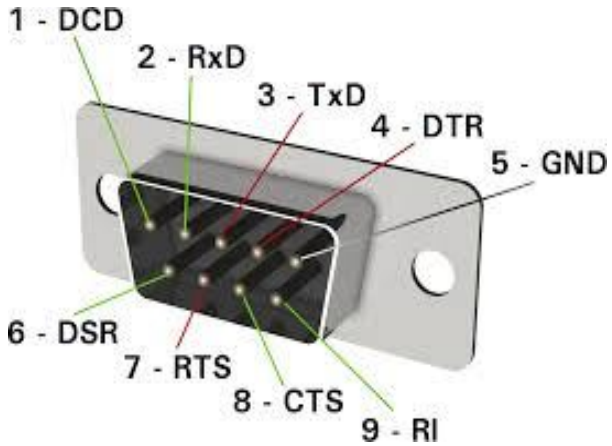

Figure.6. RS232 Communication Channel

However, RS232 is hampered by low transmission speed, large voltage swing, and large standard connectors. In modern personal computers, USB has displaced RS-232 from most of its peripheral interface roles. Many computers do not come equipped with RS232 ports and must use either an external USB-to-RS-232 converter or an internal expansion card with one or more serial ports to connect to RS232 peripherals. Nevertheless, RS-232 devices are still used, especially in industrial machines, networking equipment and scientific instruments.

Implementation Methodology

Interfacing of RS232 with controller

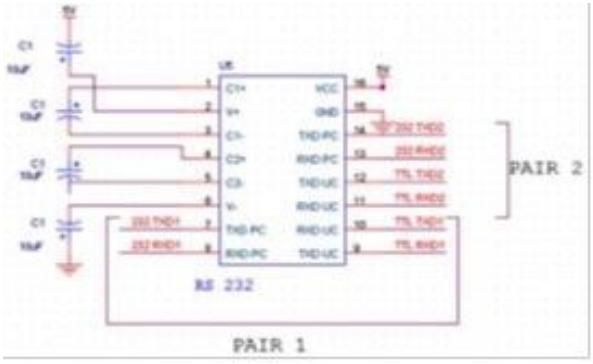

Figure.7: Interfacing of RS 232 with Microcontroller

In Fig.7 we see RS 232 IC is a driver IC to convert the µC TTL logic(0-5) to the RS 232 logic (+-9v).Many device today work on RS 232 logic such as PC, GSM modem, GPS etc. so in order to communicate with such devices we have to bring the logic levels to the 232 logic (+/-9v). Here as we can see the RS 232 have 2 pairs of TTL and 232 logic, pair 1: Pin 7, 8,9,10 of RS232 and Pair 2: pin 11,12,13,14 of RS232. We can use any one pair in our project 7, 8, 9, 10 pair or 11,12,13,14 pair. If we require 2 serial ports then depending on the requirement of the project we may have to use both the pair in the same project. The microcontroller works on TTL logic (0-5 V). So to convert the TTL logic to RS 232 logic we use the 4 capacitors connected to the RS232 IC. These capacitors are called charge pumps used to convert the TTL voltage to the $\pm$ 9 V swing required by the 232 IC.

Interfacing of GPS and GSM with Micro Controller

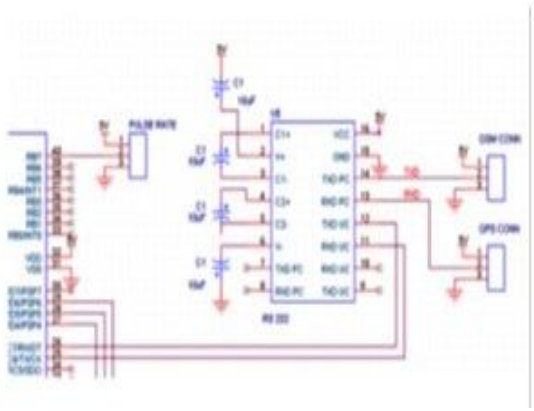

Figure.8 Interfacing of GPS and GSM with Microcontroller

Here in fig. 8, we have One RS232 through which we can connect 2 pairs of serial Devices .So in our project we have 2 Devices that work on serial VIZ, GSM modem and GPS receiver. So we connect the GPS receiver to the RXD pin of RS 232 as shown and the GSM to the TXD pin of RS 232.

Interfacing of LCD with controller

LCD has 8 / 4 data lines and 3 control lines .The 4 data lines of LCD (pin 11 to pin 14 of LCD) are connected to port 0 of

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the µC (0.26 , 0.27 , 0.28 , 0.29). The control lines are LCD RS, LCD R/W, and LCD E. In this we are connecting only 2 lines, viz, LCD E and LCD RS. The LCD RD/WR is grounded, since we only write into the LCD and never read from LCD. These 2 lines are connected to the port 0 (0.21, 0.22) of the ARM micro controller. The LCD RS is for selecting the data or the code register .The LCDR/W is for choosing between reading and writing on LCD. LCDE is for enabling or disabling the LCD

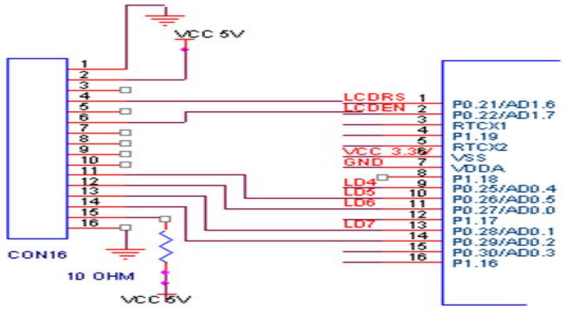

Figure.9 Interfacing of LCD with controller

Circuit Diagram & Architecture

Typical Architecture of system

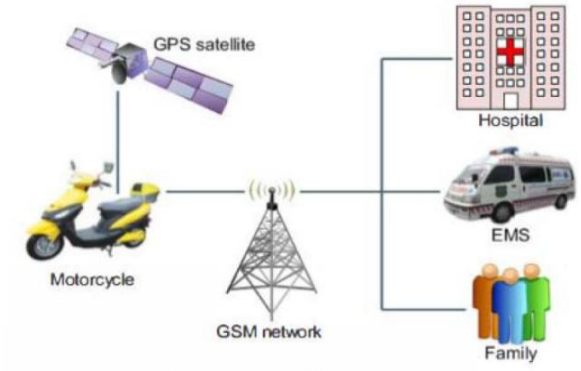

Figure.10 System Architecture

Circuit Diagram

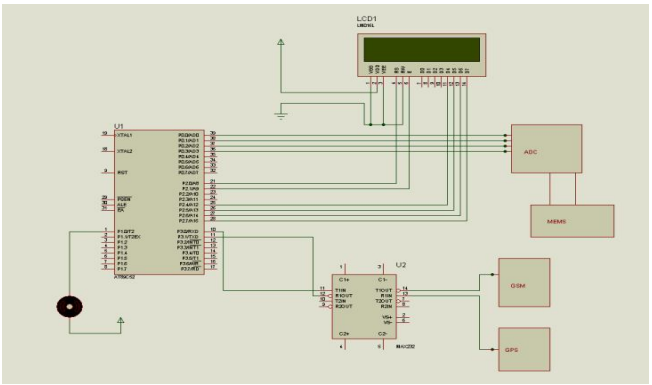

Figure.11 circuit diagram

Conclusion

The occurrence of accident is quite unavoidable. The proposed method is challengingly undertaken to make the changes in worst scenario by providing the required alarms and necessary information to the nearby emergency centers. It also monitors and tracks the location where emergency service is required. In this process a quick response system is proposed and tested by interfacing GPS, GSM and MEMS. The results are conformed and tested under different medical and other emergency services. A prototype hardware model is designed and used to test the results. This model can be placed just beneath the seat of a driver which provides the complete security to the passengers and conveys the necessary communication to the nearest hospitals and other emergency contacts.

Flow chart of Process

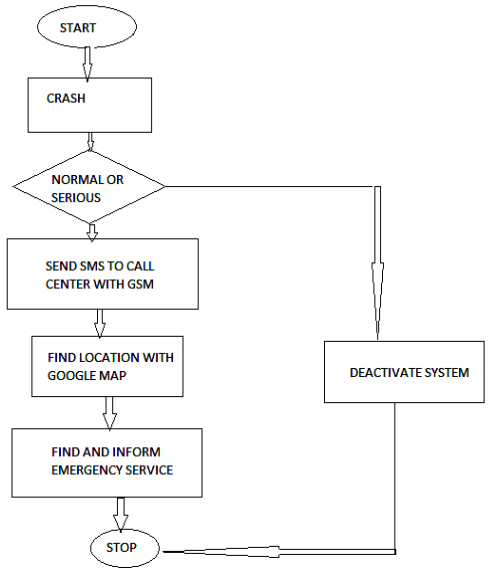

Figure.12 Flow chart

Acknowledgements

The authors would like to acknowledge the management, Director, Principal and faculty members of Electrical and Electronics Engineering department for their continuous support in the completion of this paper.

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