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Vehicle Accident Detection and Reporting System Using GPS and GSM

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Abstract- In highly populated Countries like India, everyday people lose their lives because of accidents and poor emergency facilities. These lives could have been saved if medical facilities are provided at the right time. This paper implies system which is a solution to this drawback. Acceleratometer sensor can be used in car security system to sense vibrations in vehicle and GPS to give location of vehicle, so dangerous driving can be detected. When accident occurs, Acceleratometer will detect signal and will send signal to AVR controller, microcontroller will enable airbag to blow and message with accident location is sent to preprogrammed numbers such as ambulance, police station, etc via GSM.

Keywords:- Accident; Acceleratometer; Microcontroller; Global positioning system; GSM**.**

I. INTRODUCTION

Transportation has great importance in our daily life and it's development has made many of our chores much easy. But it can cause disaster to us and even can kill us through accidents. During 2008, Road Traffic Injuries ranked fourth among the leading causes of death in the world. Nearly 1.3 million people die every year on the world's roads and 20 to 50 million people suffer non-fatal injuries, with many sustaining a disability as a result of their injury. Road traffic injuries are the leading cause of death among young people aged 15-29 years and cost countries 1-3% of the gross domestic product (GDP). If no action is taken, road traffic crashes are predicted to result in the deaths of around 1.9 million People annually by 2020. [1]

Thus accident detection system using GPS and GSM has gained attention. This system automatically informs accident to the preprogrammed numbers.

In this system Acceleratometer and GPS tracking system are used for accident detection. When accident occurs, this system sends short message to mobile number via GSM modem. Message will give longitude and latitude values. From these values location of accident can be determined.

II. SYSTEM STRUCTURE

This system consists of AVR microcontroller. Acceleratometer sensor is used whose output values will be along X, Y and Z axes. Output of Acceleratometer is input to the microcontroller. Output of microcontroller is given to relays. Load shown in diagram refers to motor of vehicle and airbag. Relays used are SPDT (single pole double throw). Normally closed contact of 1st relay is connected to motor of car that means supply is applied to motor and engine of vehicle is on. When accelerometer detects the collision of vehicle and if it's values are above specific limits then output of microcontroller is high, supply of motor goes to the ground which opens the relay contact and engine will stop.

2nd relay contractor is connected to air compressor which is further connected to air-bag. Initially this relay contact is open. When output of microcontroller is high, this activates air compressor and airbag blows. GPS receiver gives location of vehicle to microcontroller in each second. Message with location of accident is sent using GSM to preprogrammed numbers. GSM is connected to microcontroller through MAX232. MAX232 IC synchronizes baud rates of microcontroller and GSM modem. Data is given to

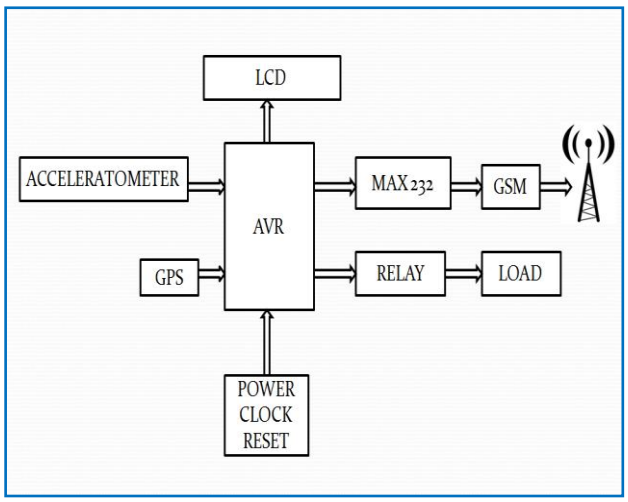

Figure 1 Block Diagram

MAX232 through RS232 cable. Microcontroller supports TTL voltage levels. MAX232 is used to convert TTL voltage levels into RS232 voltage levels and vice versa.

III. HARDWARE DESIGN

A. Global System for Mobile Communication(GSM):

GSM is global system for mobile communication and used to send message to pre-programmed number. The modulation technique used is GSMK. The protocol used by GSM modem for setup and control is based on the Hayes AT- Command set. AT is the abbreviation of Attention. GSM AT commands are extension commands. For example, +CMGS (Send SMS message), +CMGL (List SMS messages), and +CMGR (Read SMS messages) are extended commands.The main objective of this application is whenever accident occurs it will send message and position of vehicle which is accessed using GPS to pre-programmed number. [5]

GSM Air Interface specifications: [4]

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

B. GPS Receiver

The System (GPS Global Positioning) is a space age navigational system that can pinpoint your position anywhere on the globe, usually within a few yards or meters. GPS uses a constellation of 24 satellites in precise orbits approximately 12,000 miles above the earth. The satellites transmit data via high frequency radio waves back to Earth. GPS uses satellite ranging to triangulate your position. In other words, the GPS unit simply measures the travel time of the signals transmitted from the satellites, then multiplies them by the speed of light to determine exactly how far the unit is from every satellite it's sampling.

Distance= velocity (speed) x time

Then locking onto signal from minimum 3 different satellites, GPS can calculate a latitude and longitude and track movement. With four or more satellites in view, the receiver can determine the user's latitude, longitude and altitude. [2]
GPS receiver uses NMEA -0183 protocol as defined by the National Marine Electronics Association (NMEA). It gives output messages as follows. So we get 7-8 different messages.
GGA-Global positioning system fixed data.
GLL- Geographic position – latitude/longitude.
GGA contains message ID, UTC position, latitude, longitude, north-south, east-west.
Message ID- $GPGGA that is called as protocol header. [3]
These all data retrieve into software microcontroller. Then this date (location) is send to preprogrammed number using GSM system.

C. Avr Controller

The ATmega16 microcontroller is used in this system. ATmega16 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. It executes instructions in a single clock cycle, thus achieves throughputs approaching 1 MIPS per MHz.

The AVR core combines an instruction set with 32 general purpose working registers. All the 32 registers are directly connected to Arithmetic Logic Unit, allowing two independent registers to be accessed in one single instruction executed in one cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers.

D. Acceleratometer:

An accelerometer is a Micro-Electro Mechanical System (MEMS) sensor which measures static (earth gravity) or dynamic acceleration in all three axes. It measures level of acceleration where it is mounted which enable us to measure acceleration/deceleration of object like car, or tilt of a platform with respected to earth axis, or vibration produced by machines. Accelerometers measure in terms of 'g' ('g' is acceleration measurement for gravity which is equal to 9.81m/s²). Acceleratometer converts mechanical motion into electrical output. Schematic of Acceleratometer is shown in figure below.

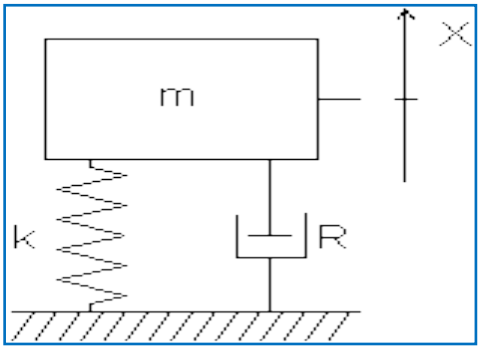

Figure 2 Schematic of Acceleratometer

Mass is a sensing element which is connected to system through spring K and damper R. when system is subjected to acceleration, mass deflects. This deflection of mass is converted to electrical signal.
Summation of all the forces on mass is 0.
$ma + R(dx/dt) + Kx = 0$
$ma = -R(dx/dt) - Kx$
$a = -(R/m)(dx/dt) – (K/m)x$ ….[6]
where m= mass of the body, x=relative movement of mass with respect to the frame, R= damping coefficient, K= spring coefficient
Thus by knowing x, R, K for a specific sensor, acceleration can be determined.

E. Airbag and Alcohol sensor:

Airbag can be fixed below steering of the vehicle. When accident occurs, airbag blows due to which vehicle user is prevented from major injuries.

Alcohol sensor can be fixed in vehicle near the steering. When vehicle user is drunk, it is sensed by sensor and vehicle is automatically stopped.

IV. SOFTWARE DESIGN

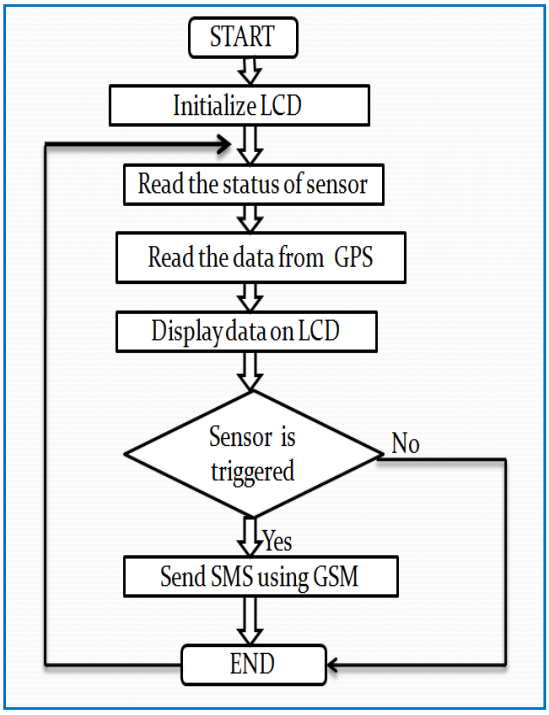

Figure 3

V. CONCLUSION

Automatic accident detection and reporting system is designed in this paper. When accident occurs, it is sensed by Acceleratometer. Short message including location of accident obtained using GPS, is sent via GSM network.

It provides more than 70% safety for four wheelers. It is the fact that implementation of system will increase cost of vehicle but it is better to have some percent safety rather than having no percent of safety.

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