

GPS and GSM based Automobile Crash Diagnosis and Rescue System

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Abstract-- The basic concept behind the proposed system is alerting the nearest ambulance service centre regarding the occurrence of a vehicular crash using ARM7 microcontroller, GSM and GPS modules. The ARM7 microcontroller detects the airbag deployment that takes place during any major collision and sends emergency panic signal to the GSM and GPS modules interfaced with it. The GPS and the GSM modules in turn help in sending location of the accident and the panic text message respectively, to the nearest ambulance service hub and the pre-stored mobile numbers of the kin of the victims for swift rescue.

Index Terms-- ARM microcontroller, GSM, GPS

I. INTRODUCTION

Nearly, thousands of people lose their lives owing to road accidents. With the advent of technology in the road safety and the automobile design domains, the occurrence of major road accidents has been minimized, drastically. Self Restraint System (SRS) airbags is one of the smart vehicular safety devices that improve occupant protection by deployment of airbag according to the crash intensity. However, in the event of an accident, by passers have to call the ambulance which may prove to be fatal if there is no mobile network surrounding the area. By the implementation of the proposed technology, ambulance may reach the accident spot at the right time due to an automated mechanism so that survivors may be transported to the nearest hospital for treatment without any further delay. This system will prove to be very helpful due to the fact that the ambulance service centre is automatically alerted regarding the occurrence of accident and more importantly, the precise latitude and the longitude of the accident spot is sent through GPS channels without any human intervention as the later is a time consuming process. Moreover, this is a cost effective scheme and the practical implementation is facile.

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II. SRS AIRBAG SYSTEM

SRS Airbag System [1] is the backbone of the proposed scheme. It is an occupant restraint system consisting of a flexible fabric envelope or cushion designed to inflate rapidly during an automobile collision. Its purpose is to cushion occupants during a crash and provide protection to their bodies when they strike interior objects such as the steering wheel or a window. Modern vehicles may contain multiple airbag modules in various sides and frontal locations of the passenger seating positions, and sensors may deploy one or more airbags in an impact zone at variable rates based on the type, angle and severity of impact; the airbag is designed to only inflate in moderate to severe frontal crashes. Airbags are normally designed with the intention of supplementing the protection of an occupant who is correctly restrained with a seat belt.

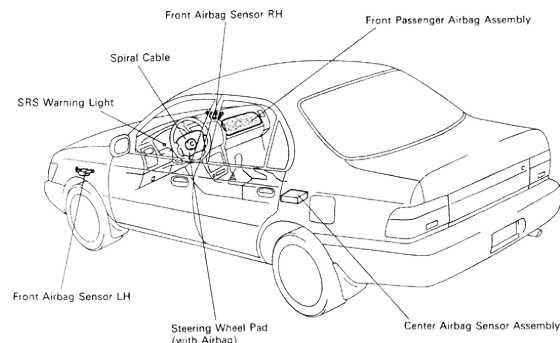


Fig.1 SRS Airbag implementation.

III. TERMINOLOGY

A. ARM7 Microcontroller

Arm7 [2] is a versatile processor that is designed for the mobile devices and other low power electronics.. It is based on Von Neumann architecture. This processor is capable of up to 130 MIPS on the typical 0.13 μm process. The specialty of 128 bit wide interface/accelerator enables with the high speed. It is a low power consumption device. It supports the

power saving mode and includes the idle and power down option.

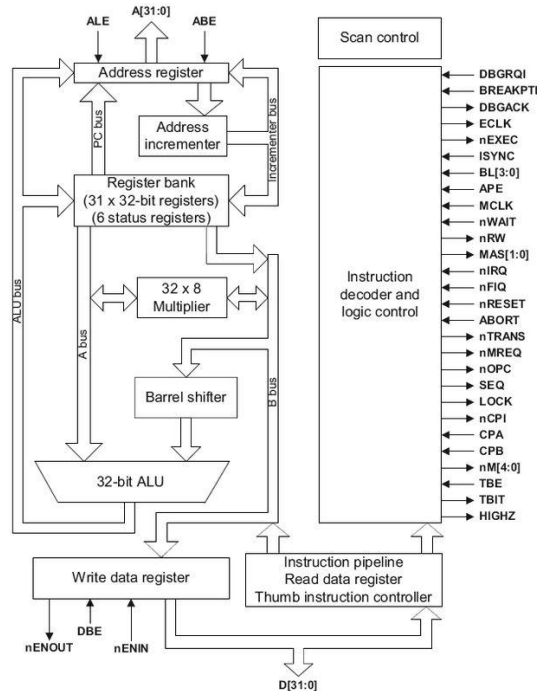


Fig. 2 ARM7 microcontroller architecture

B. Global system for mobile communication (GSM)

GSM[3] was developed with a moderate level of service security the GSM system is designed to authenticate the user with the previously shared key and the challenge response. Communications between the sender of system and the base station can be encrypted. The security model is therefore used to provide confidentiality and authentication but it has limited authorization and it is non-repudiation.

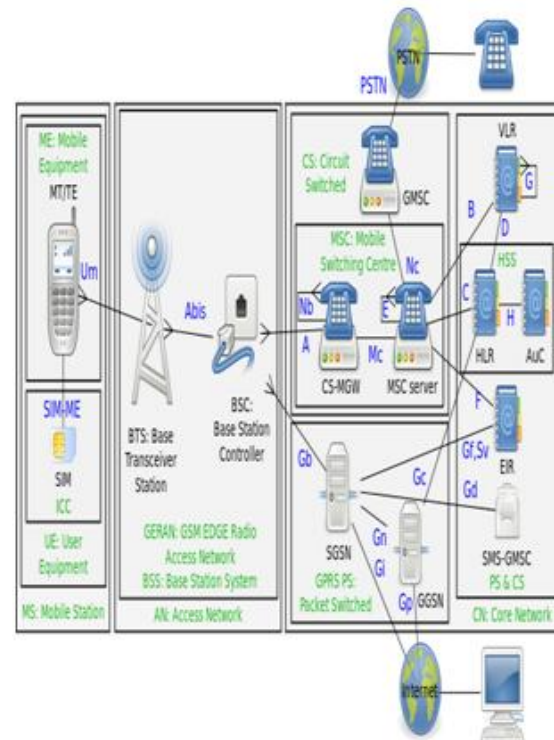


Fig. 3 GSM Topology

C. GPS (Global Positioning System)

The Global Positioning System (GPS)[4] is a space based satellite navigation system that provides location and time information in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites. The system provides critical capabilities to military, civil, and commercial users around the world. GPS possesses twenty four satellites that revolve orbit of earth in twelve hours, the ground stations and the receivers. The receiver measures the TOAs (according to its own clock) of four satellite signals. From the TOAs and the TOTs, the receiver forms four time of flight (TOF) values, which are approximately equivalent to receiver-satellite range differences. The receiver then computes its three-dimensional position and clock deviation from the four TOFs. In practice the receiver position (in three dimensional Cartesian coordinates with origin at the Earth's center) and the offset of the receiver clock relative to GPS system time are computed simultaneously, using the navigation equations to process the TOFs. The receiver's Earth-centered solution location is usually converted to latitude, longitude and height relative to an

ellipsoidal Earth model. These coordinates may be displayed, e.g. on a moving map display and/or recorded and/or used by other systems such as vehicle guidance.

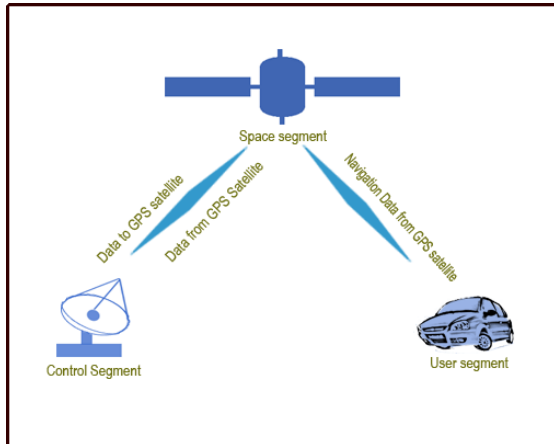


Fig. 4 Schematic working of GPS

IV. BLOCK DIAGRAM

The basic block diagram of the Crash Diagnosis module is given below. The ARM 7[5] microcontroller acts as the central hub and activates the GSM and GPS modules on receiving the signal from the sensor which gets activated during the air bag deployment.

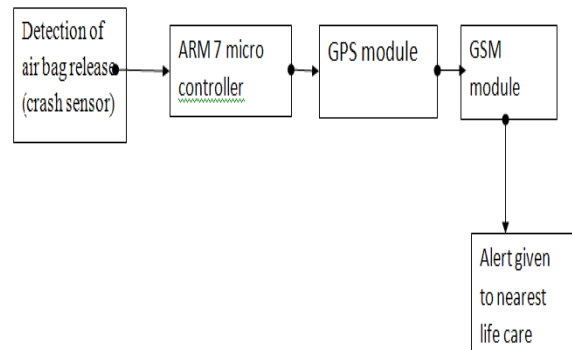


Fig. 6 Block Diagram



Fig. 5 Functional diagram of GPS

V. INTERFACING GSM AND GPS WITH THE MICROCONTROLLER

The microcontroller is interfaced with the GPS and GSM modules using MAX 232 integrated circuit. It is a serial communication IC that converts the TTL level logic to RS 232 logic and vice versa. The microcontroller is programmed in such a way for two way data communication with the GSM and GPS modules. Similarly, the sensor that detects the air bag deployment is interfaced with the LPC2148 ARM microcontroller. When the sensor input becomes HIGH, the microcontroller code is written in such a way that the GSM and GPS modules get activated and start sending panic message and the precise location to the pre-stored mobile numbers and the nearest ambulance center through common helpline number.

VIII.CONCLUSION

This paper proposed the utilization of ARM 7 microcontroller to send emergency signal to nearest ambulance centre through GSM and GPS modules, so that victims may be rescued in an optimized time. The advantage of this system is that the emergency signal is sent automatically without any manual intervention. If this technology is employed by the automobile manufacturers, many lives may be saved from fatal accidents which are a very common scenario in the continents like Asia and Africa.

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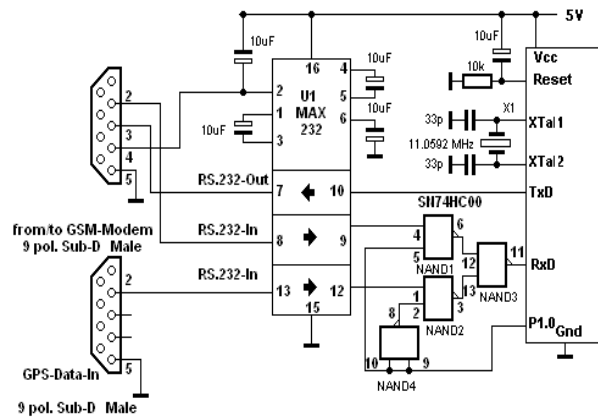


Fig. 7 Microcontroller Interfacing

VI.WORKING

The system is based on interfacing the ARM 7 microcontroller with airbag crash sensor, GSM and GPS modules. The ARM7 microcontroller constantly checks the airbag system status by a looping mechanism. When the automobile undergoes a major collision, the airbag crash sensor detects the vibrations and deploys the airbag, thereby safeguarding the passengers with minimal injuries. When the microcontroller receives the crash signal pings from the airbag crash sensor, it automatically activates the GPS and the preprogrammed GSM module [6]. GSM module alerts the preprogrammed ambulance service dialing channels while GPS provides the accurate location of the accident. The ambulance service centre, on receiving the panic message sends the ambulance to the accident spot in a short span of time [7].

VII.FUTURE DEVELOPMENT

This system is easy for implementation and it can be further sophisticated by the augmentation of a camera unit. This will be helpful to send the image of the vehicle along with location so that identification becomes easier as the ambulance crew will have prior knowledge regarding the nature and cause of the accident.