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CAN COMMUNICATION BASED ACCIDENT EMERGENCY SUPERVISORY SYSTEM

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ABSTRACT: The better the technology, the more user friendly it becomes. An emergency is a deviation from planned or for expected behavior or a course of event that adversely affects people, property, or the environment. This paper reports a complete research work in accident (automobile) emergency alert situation and emergency service provider. They were able to programmed a GPS / GSM module incorporating a crash detector to report automatically via the GSM communication platform (using SMS messaging) to the nearest agencies such as police station, hospitals, fire services, neighbour, etc, giving the exact position of the point where the crash had occurred. This will allow early response and rescue of accident victims; saving lives and properties. A special Controller Area Network (CAN) bus application layer protocol is designed for the high reliable and high real-time control network of the beam control system. In this paper, messages on the network are classified and the identifier coding, data coding, network management mechanism and physical interface are defined. Basically CAN used in many areas in industry, medical equipments, instrumentation, and any other field. These protocol are used to perform operation in the automotive industry and it plays important role in transmission and receiving unit. These system are used for debugger, editor, compiler and assembler. Then network load analysis for the real-time control network is introduced. Experiment results indicate that the developed CAN control network for the beam control system is very reliable and has good real-time performance and real time low network load rate.

Keywords: Accident Alert, Application Layer Protocol, CAN Bus, Crash Detector, Emergency service Provider, GPS/ GSM , Location Based Services.

I. INTRODUCTION

CAN communication is widely used in vehicle automation. The proposed project has two main parts. 1) Unit within a car 2) An emergency service provider. Unit within a Car will continuously monitor accelerometer sensor and speed sensor to detect an accident condition; at the same time it will monitor GPS modem to read current vehicle position. Whenever it detects accident condition, it will automatically connect to emergency service provider using GSM modem (SMS).

***A.* CAN bus** (for **controller area network**) is a vehicle bus standard designed to allow microcontrollers and devices to communicate with each other within a vehicle without a host computer. CAN bus is a message-based protocol, designed specifically for automotive applications but now also used in other areas such as industrial automation and medical equipment. Development of CAN bus started originally in 1983 at Robert Bosch Gmbh.

The car accident is a major public problem in many countries like India. Therefore, several research group and major car manufacturers including Volkswagen have developed safety devices to protect riders from accidental injuries. However, good safety device for car is difficult to implement and very expensive. Alternatively, intelligence sche54mes such as fall or incident detection with tracking system have also recently been devised to notify the accident to related people so that quickest assistance can reach people who got the accident. In this work, wireless accelerometer and GPS tracking system is developed for accidental monitoring. In the event of accident, this wireless device will send mobile phone short massage indicating the position of vehicle by GPS system to family member, emergency medical service (EMS) and nearest hospital so that they can provide ambulance and prepare treatment for the patients.

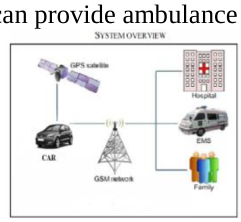

Fig: 1 System Overview

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II. LITERATURE SURVEY

B. Accident – Major Problem:

The Car accident is a major public problem in many countries, particularly In India. Despite awareness campaign, this problem is still increasing due to rider's poor behaviors such as speed driving, drunk driving, riding without sufficient sleep, etc. The numbers of death and disability are very high because of late assistance to people who got the accident. These cause huge social and economic burdens to people involved. Therefore, several research group and major Car manufacturers have developed safety devices to protect riders from accidental injuries. However, good safety device for Car is difficult to implement and very expensive. Alternatively, intelligence schemes such as fall detection or incident detection with tracking system have also recently been devised to notify the accident to related people so that quickest assistance can reach people who got the accident [09]

C. Need at Automotive Industry for Accident locator:

A modern automobile may have as many as 70 electronic control units (ECU) for various subsystems. Typically the biggest processor is the engine control unit (also engine control module/ECM or Power train Control Module/PCM in automobiles); others are used for transmission, airbags, antilock braking/ABS, cruise control, electric power steering/EPS, audio systems, windows, doors, mirror adjustment, battery and recharging systems for hybrid/electric cars, etc. Some of these form independent subsystems, but communications among others are essential. A subsystem may need to control actuators or receive feedback from sensors. The CAN standard was devised to fill this need [07].

The CAN bus may be used in vehicles to connect the engine control unit and transmission, or (on a different bus) to connect the door locks, climate control, seat control, etc. Today the CAN bus is also used as a field bus in general automation environments, primarily due to the low cost of some CAN controllers and processors.

Bosch holds patents on the technology, and manufacturers of CAN-compatible microprocessors pay license fees to Bosch, which are normally passed on to the customer in the price of the chip. Manufacturers of products with custom ASICs or FPGAs containing CAN-compatible modules may need to pay a fee for the CAN Protocol License.

The Interstate highway system in the U.S. is one of the world's biggest engineering feats. Beginning with construction in the late 1950s, most of the interstate system construction has been completed. Now, the aging interstate system requires us to focus on maintenance, reconstruction, and rehabilitation of this facility. Additionally, growth in traffic has necessitated the reconstruction and regular maintenance of these highways and freeways. Increased reconstruction and maintenance activities on freeways and highways have implications on traffic safety and traffic control in terms of accidents, delays, and congestion, especially at highway work zones. Highway work zones pose an impediment to travelers who are accustomed to a clear, unobstructed roadway. Several work zones require partial lane closures to carry out construction and maintenance activities, leading to reduced roadway capacity. This results in unwanted delays and congestion, adding to motorist frustrations. Thus, work zone safety and traffic control will continue to be a major concern. Several departments of Transportation (DOTs) face work zone-related problems and challenges in their daily efforts to provide better and more efficient transportation facilities. A survey conducted by the Federal Highway Administration (FHWA) on work zone-related problems experienced by DOTs lists the major problems and challenges faced by transportation departments as follows (Ha & Nemeth, 1995)

· Urban freeway reconstruction

· Lack of training of contractor personnel

· Need for specialized equipment, such as changeable message signs

· Motorists speeding within work zones

· Management of both construction or maintenance and traffic control, and

· Increasing number of liability suits

This chapter is an effort to compile as much information as possible on prevailing traffic conditions and characteristics on highways and freeways, with specific emphasis. It also gives an insight into the nature and magnitude of the problems experienced at highway work zones.

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III. METHODOLOGY

D. **This flowchart indicates the general idea about project.**

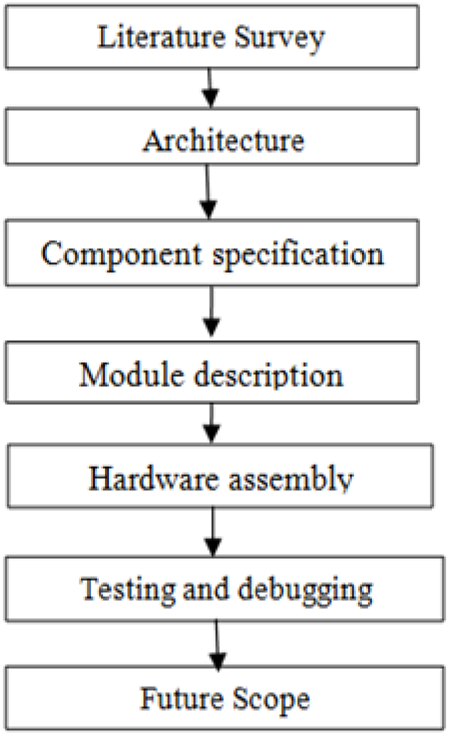

Fig 2. General Flow Chart

E. **This flow chart indicates the genaral discription of hardware and software.**

Our signal processing goal is to classify the original data into two classes, fall and not fall. In this system, the input data from 3 axis accelerometer was kept and processed in real-time with sampling rate of 60 Hz or higher. The signal from MEMs accelerometer was converted by 10 bits ADC into integer range between 0 and 1023. The sensor was embedded in a car seat to fix the accelerometers axis so that the response of acceleration data is well defined. The classification of the fall detection utilized the 3-axis acceleration signal from MEMs accelerometer and the ground speed from GPS module. In general, car fall can be classified as linear fall and non-linear fall. The linear fall is concerned about fall without external force, which is free falling condition that only z-axis acceleration changes. The non-linear fall occurs by the external force. The nonlinear fall detection is decided by all 3-axis acceleration data from accelerometer and the ground speed from GPS module.

To determine the accelerometer output, two frames of acceleration data, which include 3-axis acceleration at present time (t) and prior time (t-1), are used for analysis. For a linear fall, the z-axis acceleration follows free falling condition which is given by

$$\left| A_z \right| \geq 9.7\ \text{mls}^2 \qquad (1)$$

Where, the Az is the z-axis acceleration. In a non-linear fall, two frames of acceleration data are used. From non-linear fall experiments under most likely situations, we found that the change of acceleration between two consecutive frames should be more than 15. 5mls2. Thus, the non-linear fall condition is given by

$$\left| A_{n,t} - A_{n,t-1} \right| \geq 15.5\text{mls}^2 \qquad (2)$$

Where, the An,t is acceleration from x, y or z coordinate at the present time frame and An,t-l is acceleration parameter from x, y or z coordinate in the previous time frame. From equation, if the difference of acceleration in two time frames is more than 15. 5 mls^2, the first condition of non-linear fall accident of car is met. The ground speed from GPS module then used to decide whether actual non-linear fall accident occurs. If ground speed becomes zero after detection of large acceleration change as indicated in equation (2), non-linear fall detection in car is detected and fall alert message will

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be sent. However, false detection may occur in case of a severe brake because data are not kept and processed over a long time frame. Normally, there is noise in z-axis while car rides over knotty 848 surface. The noise is filtered by averaging acceleration data all of three axes over five time frames. The fall detection and alarm system for car accident operates according to the flowchart as shown in Fig. 3.2 After system start, microcontroller periodically gets 3-axis acceleration data from the accelerometer. If acceleration in z-axis satisfies the free falling condition in equation (1), a linear fall is identified. If the system detects a linear fall, the position of accidental place will be saved and sent via SMS. If the condition of linear fall is not met, the system will check for non-linear fall from 3-axis acceleration data. If data from each axis is in line with equation (2), speed from GPS module and posture of car will be monitored. If car is still running (ground speed is more than zero) after 10 seconds or posture are not lying down on the ground, no car accident is assumed. Otherwise, nonlinear fall is detected and position data from GPS module will be sent via SMS. While no fall condition is met, the system will always return to starting point of the program.

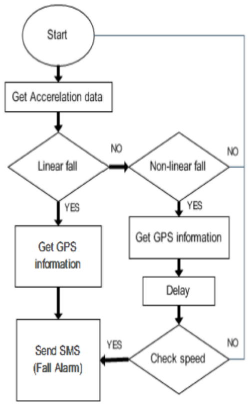

Fig: 3 System Flow Chart

IV. ROBUST SYSTEM DESIGN

The system for car fall detection using a tri axial accelerometer is shown in Fig.4.1 The system was packed in robust aluminum case and embedded under car seat. The basic concept of the proposed system is to detect car accident from car fall or from collision with another car or motorcycle. The car fall detection system is based on a tri-axial accelerometer. The accelerometer provides analog acceleration output in three axes (x, y and z). The acceleration sensor was positioned so that its z axis was aligned vertically and the co-ordinate was fixed when installed under car seat. A high performance 16 bits microcontroller was chosen as a control unit. The controller processed real-time car fall detection using A/D signal converted from accelerometer output at 60 Hz sampling rate. The box was GPS module that provided the location of accident. The GSM module is quad band 800, 900, 1800 and 1900 MHz and it was controlled by AT-command from microcontroller. The basic AT-command was used to send instant massage, check signal strength and get system commands and basic GSM parameters. The short massage shows position of car, time of accident and type of accident (fall by themselves of crashed by other person). The whole system was packed in aluminum box with Li-ion backup battery. The power from backup battery was periodically charged from car battery. In case of accident, backup battery may operate alone and its backup power is enough for signal processing and short message service.

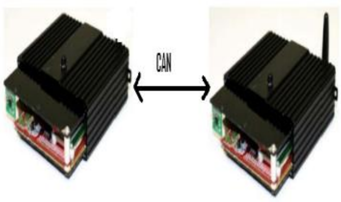

Fig 4 Robust Case

F. MATERIALS AND METHODS

In this research work, we made use of M2M technologies and GPS/GSM module which is a device that operates mostly under M2M platform. M2M simply involves devices that can communicate over a network without human interference. Telit GM862-GPS wireless system is the main choice for the automobile GPS/GSM module used.

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1. Crash Survivability

The Mobile Unit must be capable of surviving and properly functioning after a crash. The Enhanced Emergency Locator Transmitter was designed requirements for crash survivability of Emergency Locator Transmitter. The fig shows following mobile unit.

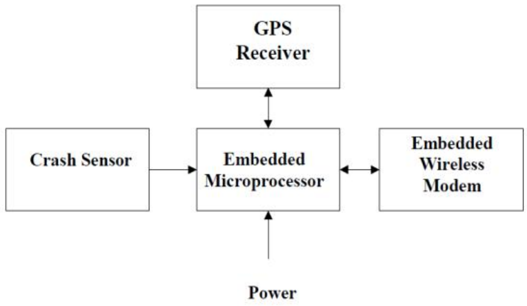

Fig:- 5.MOBILE UNIT ARCHITECTURE

V. HARDWEAR AND SOFTWARE DISCRIPTION

H. HARDWARE DISCREPTION

1] Accident Locator Unit

Internally within car Accident Locator Unit has two separate kits/units. One unit continuously check for accident sensors input and informs accident condition to second unit over CAN (Control Area Network) bus. Second unit reads car location using GPS and communicates with emergency service provider.

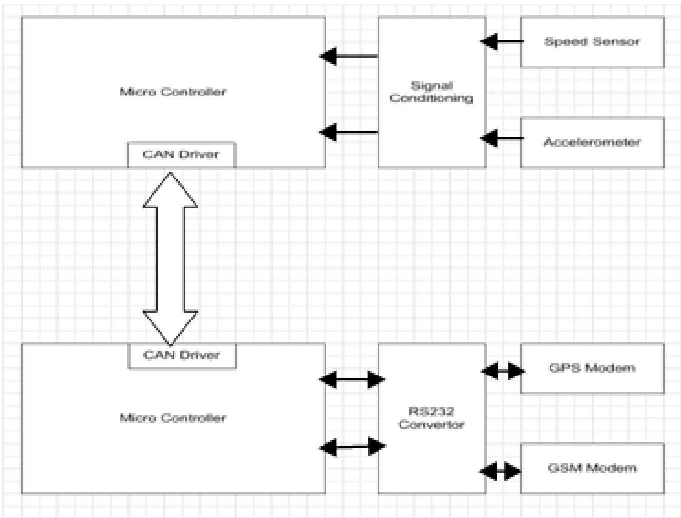

Fig :6 Transmitter and Reciver Unit

I. SOFTWARE DISCRIPTION

Proposed Project will have two main parts, accident detector unit within car and second is emergency service provider.

2] CAR Unit:-

Unit fitted in Car will continuously monitor accelerometer sensor and speed sensor to detect an accident condition; at the same time it will monitor GPS modem to read current vehicle position. Whenever it detects accident condition, it will automatically connect to emergency service provider using GSM modem (SMS).

1. Accident Locator Unit will have feedback of Vehicle Speed and Vehicle angular position using magnetic sensor and Accelerometer.

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2. From vehicle speed Accident Locator Unit will continuously calculate vehicle acceleration, if acceleration is negative and more than particular limit it will indicate very urgent braking by driver and there is possibility of an accident.
3. Accident Locator Unit will check angular position of vehicle, like if vehicle is rotating around axis, if it has changes its direction or if it gets flapped or meet an accident.
4. Accident Locator Unit then will read GPS – Location of car in the form of longitude and latitude.
5. Accident Locator Unit will send SMS to emergency service provider to inform about possibility of your accident.

J. Service Provider

Once accident information is received by emergency service provider, all responsibility of life and death race lies with service provider. Service provider will find out car location using GPS data received, it will call to ambulance, police and relatives of car owner. Service provider will also confirm accident situation by calling car owner/driver.

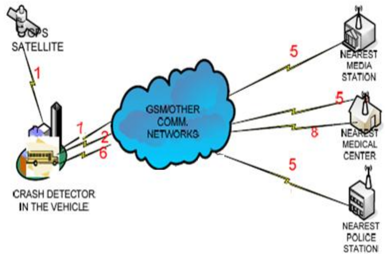

Fig: 7. Service Provider

K. Need of System:-

- To avoid possibility of accident.
- Accident Locator Unit then will read GPS – Location of car in the form of longitude and latitude.
- Accident Locator Unit will send SMS to emergency service provider to inform about possibility of your accident.
- It gives emergency service provider to inform about possibility of your accident

VI. FUTURE SCOPE

1. Using black box in car we add more and extra features.
2. Addition of extra sensors we can measure the tyre pressure and airbag.

VII. CONCLUSION

In conclusion, an innovative wireless accelerometer and GPS tracking system has been developed for car accidental monitoring. The system can detect type of accident (linear and nonlinear fall) from accelerometer signal using threshold algorithm, posture after crashing of car and GPS ground speed. After accident, short alarm massage data (alarm massage and position of accident) will be sent via GSM network. The test results show that it can detect linear fall, non-linear fall and nominal ride with no false alarm.

The automobile incorporating a machine-to-machine (M2M) device (GPS/GSM modem with a crash detector), the mobile operator and the emergency organizations, where all players are joined together by the geographic information network. In this research work, we have designed a platform for emergency rescue in case of an auto crash and developed a prototype and tested it. Therefore, the platform operates optimally in order to reduce the golden time of arrival when every micro-second counts.

VIII. ACKNOWLEDGEMENT

Education along with the process of gaining knowledge and stronghold of subject is a continuous and ongoing process. It is an appropriate blend of mindset, learnt skills, experience and knowledge gained from various resources.

This Project would not have been possible without the support of my Guide I like to express my gratitude and indebtedness to my guide Prof. D. U. Adokar, and its valuable presence for his kind and valuable guidance that made

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the meaningful completion of Project possible. New ideas and directions from him made it possible for me to sail through various areas of Embedded & VLSI techniques which were new to me.

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BIOGRAPHY

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Ms. Priti J. Rajput is currently working as Sr. Lect. at Electronics and telecommunication Department of IOK COE, Pune. She has done her B.E. in Electronics & Communication from S.S.V.P.S.COE in 2009 and M.E (II^{nd} year Appearing) in Digital Electronics from Shrama Sadhana Bombay Trust's College of Engineering & Technology Bambhori, Jalgaon in 2011. My area of interest are Communication, Signal Coding , Network Analysis And Synthesis.