ADV MATH SCI JOURNAL
Advances in Mathematics: Scientific Journal **9** (2020), no.9, 6599–6608
ISSN: 1857-8365 (printed); 1857-8438 (electronic)
https://doi.org/10.37418/amsj.9.9.17 Spec. Issue on CAMM-2020

AN INTERNET OF THINGS(IOT) BASED SMART IMPACT DETECTION AND RESPONSE SYSTEM

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ABSTRACT. In this modern world, automobile industry is one of the sector which is experiencing a constant growth. As a result of this, In recent days there is increase in the number of vehicles in the society. Along with this, the number of road accidents also got increased tremendously. Though different safety measures are adopted by the automobile industry and the individuals to avoid such accidents, It is also necessary to adopt some effective post accident measures. In this paper, we have proposed a system through which the individuals involved in an accident can be easily identified and respective measures can be taken immediately. Whenever the accident happens, the piezo disk is used to sense the collision. Based on the threshold limit, alert message along with the vehicle's accident location which was tracked using GPS system is sent to the emergency contacts. If the collision is minor, then it can be switched off manually, so that transmission of the alert message can be avoided.

1. INTRODUCTION

In our country, according to a report by States and Union Territories, approximately 5 lakhs road accidents happened in the year of 2017. In that nearly 1,50,000 persons lost their lives and 4 lakhs persons have been severely injured [1]. These figures depict that, on an average, 1300 accidents and 410

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2010 *Mathematics Subject Classification.* 68M11, 68M14.

Key words and phrases. GPS, GSM, IoT, Piezo Disk.

deaths happens every day or 54 accidents and 17 deaths every hour in the country. Almost in all accidents, the main reason behind the road accident is rash and careless driving. And also the reason behind the loss of countless lives is they were not able to get the proper medical care at the appropriate time. To save those lives, they need to be given immediate medical care. But in many cases this is not possible as the information about the accident is not immediately reaching the concerned persons. If we make that possible then we can save lot of lives and number of deaths due to accident will also get reduced tremendously [2].

The project is based on IoT. Internet of Things is basically the interconnection of multiple physical devices which will communicate among themselves without the intervention of human. It's the system's ability to transfer data without human intervention. The IoT is developed with the help of many technologies like embedded system, wireless technology, sensors and internet. Using the sensors, the IOT devices can collect the respective data. Then based on these data, the device should be able to make a decision and then the corresponding actions can be performed. One simple application of IOT is smart home in which light will get switched off when there is no one in the home. Here sensors are detecting the presence of the person and based on that it is automatically taking the decision to switch of the light without the intervention of human. Therefore the IOT based system should have the ability to read the sensor data then it should process the data and then it should be able to trigger actions based on the data read or event occurred. In our proposed system, collision is detect using the sensor and the corresponding action is triggered to ensure the safety of the travelers. Here, the main focus is on the safety of passengers by sensing and detecting the collision.

2. Literature Survey

A. Real-Time, Automated and Privacy-Preserving Mobile Emergency-Medical-Service Network for Informing the Closest Rescuer to Rapidly Support Mobile-Emergency-Call Victims.

SHIN-YAN CHIOU AND ZHEN-YUAN LIAO [3] in their article have proposed two systems: (1) mobile emergency system (MES) and (2) secure mobile emergency system SMES) with privacy and authentication. The two systems involve

two phases, namely, the normal operation phase and emergency phase. Further the emergency phase involves establishing and uploading the rescue coordinates. This is in accordance with the Srinivasan et al. scheme that uses RFID matrixes, Wi-Fi AP, Bluetooth Beacon, hand-held radars, etc.

B. Location-Aware Authorization Scheme for Emergency Response.

HAMIDREZA GHAFGHAZI, AMR ELMOUGY, HUSSEIN T. MOUFTAH AND CARLISLE ADAMS [4] in their paper they have discussed about effective emergency response and collecting information from critical situations. This paper proposes location-aware authorization system and communication with the help of encryption and decryption. In the literature, two main kinds of access authorization is used, namely Direct Authorization (DA) and Indirect Authorization (IA). They have used m-bilinear Diffie-Hellman exponent assumption.

C. Time and Location-Critical Emergency Message Dissemination system for Vehicular Ad-Hoc Networks

YANYAN ZHUANG, JIANPING PAN, YUANQIAN LUO AND LIN CAI [5] proposed a system Time/location critical framework that makes use of VANET to send Emergency Message(ED) Dissemination using Smart Modulation and Coding scheme(SMC) to send messages to vehicles in zone of interest(accident) they can be short messages over long distances or long messages over short distances, to give advice to nearby vehicles to take appropriate actions(change lane, reduce speed, etc).

D. Konnect: An Internet of Things (IoT) based Smart Helmet for Accident Detection and Notification

SREENITHY CHANDRAN, SNEHA CHANDRASHEKAR, EDNA ELIZABETH N [6] have introduced a smart helmet that detects accidents and reports immediately. Various sensors, Wi-Fi enable processor, and cloud computing infrastructures are utilized. Quick and reliable delivery of real-time accident's information is delivered. The challenges they faced were (1) Need to prevent false positives from being triggered. (2) Detection of the accident forces accurately (3) Delay in notification reaching the emergency contacts.

E. Smart Road Accident Detection and communication System

NAGARJUNA R VATTI, PRASANNA LAKSHMI VATTI, RAMBABU VATTI, CHANDRASHEKAR GARDE [7] In this paper, they have proposed a system in which

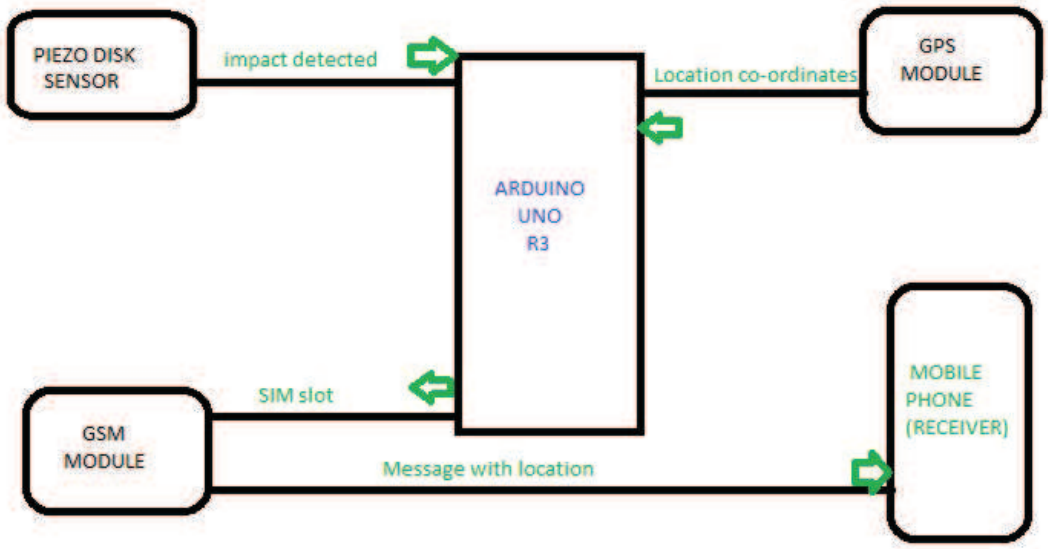

FIGURE 1. SYSTEM ARCHITECTURE

the accident is detected by the vibration and gyroscope sensors and immediately a message is sent to the emergency contact numbers using GSM module along with the location identified by the GPS module.

3. SYSTEM ARCHITECTURE

This project makes use of the following components: Arduino UNO, GPS module, GSM module, Piezo disk, Mobile phone as shown in Figure 1.

A. GPS Modem

The Global positioning system(GPS) is a satellite based radio navigation system. It was first started to be used by U.S military. But later it was used throughout the world for other commercial purposes also. It is used to locate the geographic location of an particular object. To use this resource, the user no need to have any special device for data transmission, instead if they have GPS receiver then they can get the geographic location of that device at the particular time. The Global positioning System is working with the help of 24 satellites and the GPS receiver. These 24 satellites will revolve around the world. To predict the location, the GPS receiver will receive signal from each of the satellite. Then it calculates the location information like longitude, latitude, altitude based on

the time taken to receive the signal from the satellite. This will be calculated based on the signal from at least four satellites so that the location information is accurate. Based on the GPS receiver the accuracy of the location will differ. Sometimes there may be weak signal due to some obstacles like mountain, tree. And also there is a possibility of the change in satellite orbit, In such cases, GPS control station will calculate the difference and update the information to the GPS receivers.

The GPS works by providing necessary information about the exact location. The GPS receiver can be used in many ways. The GPS receiver can be installed in vehicles to track the vehicles. It is used in aircrafts and submarines. It can be also used to find the vehicle in the case of theft. It can also be used by shipping companies to track their goods and helps them to find the fuel and time efficient route. Also it is used in vehicles to find the destination location. It is also capable of tracking the movement of an elderly person or the children and helps us in taking care of them. It will also be used for women and younger persons while they are travelling alone. Now-a-days many of the public transports are having GPS with which we can track our loved ones. Further it can be used by police department to enforce law and order by tracking the vehicles of the criminals.

There are two different types of GPS systems. One is passive tracking system and the other is active tracking system. The passive GPS tracking system will just track the location information and store them in the internal or external memory. Those information can either be downloaded from the system directly or in some system, on request these information will be transmitted directly with the help of modem. The active GPS tracking system will periodically update the location information. This system will be more useful in many cases like monitoring children or valuable assets, whereas passive system from which we can get all the past data will be useful for analysis purpose.

B. GSM Modem

A GSM modem is a wireless modem which uses global system for mobile communication technology for transmitting data. GSM modem can be used either as a separate equipment connected to computer through USB cable or it can be inserted in the PC card slot of computer. Like a mobile phone, it requires a SIM card from the network operator. It will work within the range provided by network operator. GSM modem supports some set of commands and also an

interface through which we can read, write, send and receive messages. And also it supports commands to maintain contacts.

C. Arduino UNO Board

The Arduino Uno is microcontroller board based on ATmega328P. The board has 14 digital io pins and 6 analog input pins. It contains everything that's needed to support the microcontroller. It can be powered up by connecting it to a computer with a USB cable or with a AC-to-DC adapter or an external battery. One can tinker with your UNO without worrying too much about doing something wrong, in the worst case scenario the chips can be replaced for a few rupees and start over again. In the proposed system, the Arduino Uno microcontroller is acting as a motherboard via which the data will be passed to the GSM modem and the GPS modem. The input voltage usually ranges from 5v to 12v, but 5v is recommended. It is easy to program arduino through Arduino IDE by connecting to computer through USB cable. For programming in Arduino, the developers need the knowledge of C.

D. Piezo Disk Sensor

The piezo sensor provides precise analog value for vibration, tilting. Also, the thought process is mainly focused on the feasibility. During the literature survey, it was found that there were lots of sensors available in the market, that were quite expensive. As optimization is the major target, use of such a material which is not expensive can be served as an good sensor. Usually, a piezo-disk is used for detecting vibrations and is a little expensive as a module. But, in this project a piezo disk that is very economical is used. The piezo-disk alone is made available commercially. Connecting wires are drawn from its insulating material. Such an assembly provides analog output with high sensitivity to the impact created on the vehicle. This analog output is given as an input to the Arduino system, and later to determine threshold of the accident.

4. Proposed System

The proposed system describes the prototype of the smart system called "Impact Detection and Response system". The proposed system is used to detect the accident using sensors and information about the emergency situation is notified to the concerned person. The impact generated due to the collision is detected by the piezo disk. Two threshold values are set in the system. Threshold value is

set to assess the severity of the accident. Two threshold values are set. The first one is of a lower range and the second is of the higher range. When the lower threshold is reached the victims is asked about his condition and for the higher threshold, the alert message along with the location of the incident is sent to all the emergency contacts via GSM module as SMS. Acquiring location of accident is done with the help of GPS module. Whenever the higher threshold is reached, location of the incident will be automatically detected with eh help of GPS module and geographic location is shared with the contacts stored with the help of GSM modem. The emergency contacts include numbers to contact ambulance, police station and other pre-defined contact list in the driver's phone.

This proposed system consist of three modules:

1. Detection of accident using in-vehicle sensors.
2. Acquiring the location of the incident.
3. Transmission of the alert message.

A. DETECTION OF ACCIDENT USING IN-VEHICLE SENSORS

An impact is created when a collision or accident occurs. The piezoelectric sensors are used to detect this impact and pressure created on the frame of the vehicle at the time of the accident. The piezoelectric disc converts mechanical energy into electrical energy. The sensor attached to the vehicle, generates varying signals depending upon the impact created. To measure the impact created, two threshold values are defined in the code. Different actions are initiated depending upon the threshold values as shown in Figure 2. B. ACQUIRING THE LOCATION OF THE INCIDENT This system uses a GPS module to acquire the location of the vehicle. The GPS module is wired to the Arduino which acts as a power supply. During transit, the system enters a travel mode where it constantly acquires the location information. The location information is stored in a buffer so that the location coordinates can be accessed quickly as shown in Figure 3. C. TRANSMISSION OF THE ALERT MESSAGE In this module, as soon as the accident happens, the actions are taken depending upon the change in the threshold value. There are two threshold values: Lower and upper threshold values.

Functions:

Lower threshold value - A message is sent to the victim asking for their condition.

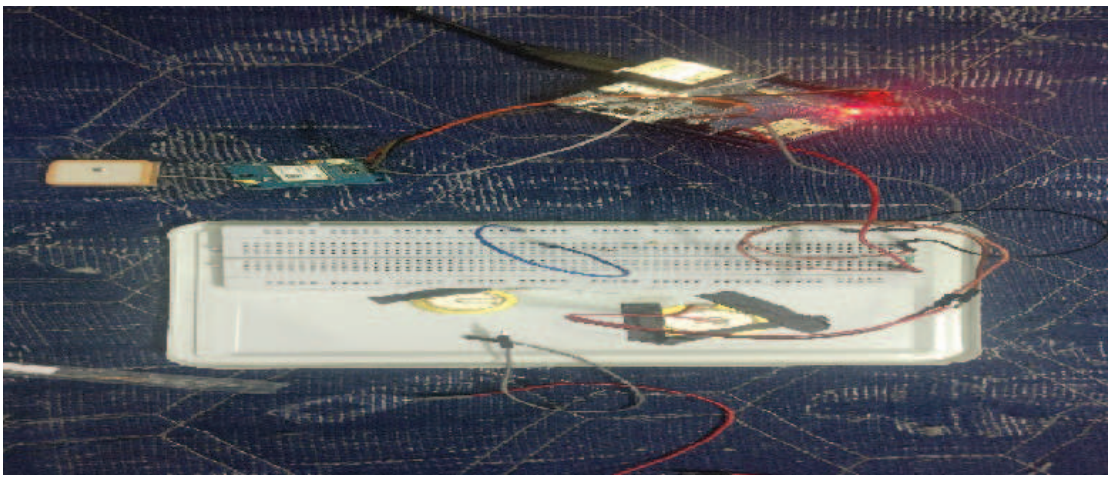

FIGURE 2. Experimental Setup

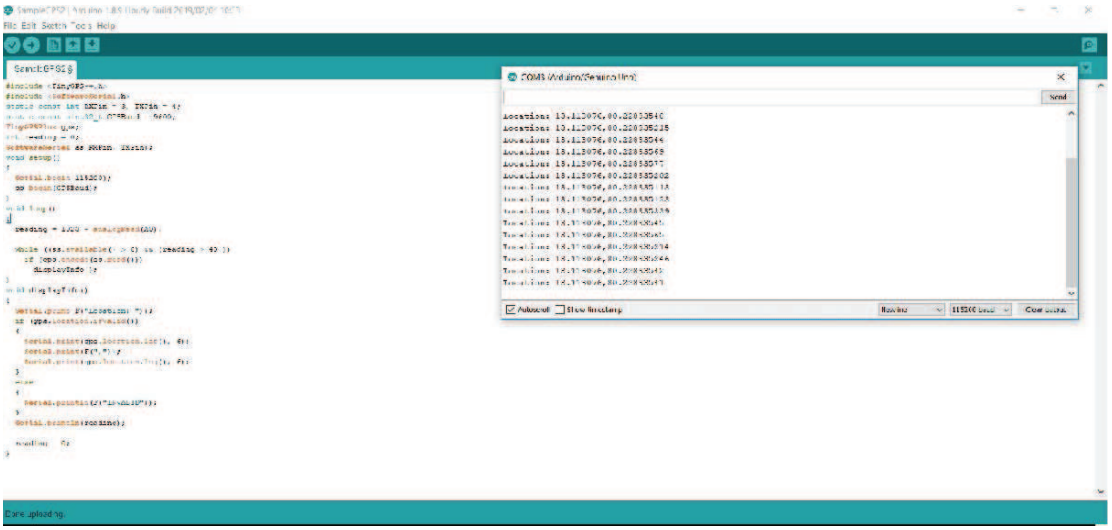

FIGURE 3. GPS Module

Upper threshold value - A message is directly sent to the emergency contacts along with geographic location.

5. CONCLUSION AND FUTURE WORK

Thus the system developed helps to detect the accidents immediately and the location information is tracked using GPS device and the same is shared with the emergency contacts, so that the persons involved in the accident can get

immediate medical care. It will also avoid sending false information by getting the confirmation from the driver when the impact is very low. And also this system is very cost effective without compromising the safety of the user. It can be used even in small vehicles. As a future implementation, an android app can be developed for this which can be used to point out the exact location of the incident instead of just receiving a message about the location. The victim can also be continuously monitored by the app to determine the their condition till the medical help arrives. Further these accident information like location, cause for incident, time etc can be stored and analysis can be done to find the frequent accident spot and the travelers can be alerted in prior to avoid accidents.

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