IoT Based Safety System for Smart and Eco-Friendly Transportation

Mr. Srinidhi B K[1], Mr. Sachin M Shetty[2], Ms. Sangeetha N[3], Ms. Tushara J[4], Mr. Vinay M Ambiger[5]

[1]*Assistant Professor, Dept. Of Computer science & Engineering, Cambridge Institute of Technology*

[2,3,4,5]*B.E, Dept. Of Computer science & Engineering, Cambridge Institute of Technology*

---***---

Abstract - Internet of Things (IoT) is an ecosystem of connected physical objects that is accessible through the network. The 'thing' in IoT can be a person or an object with built-in-sensors. These objects are assigned with an IP address and these sensors have the ability to collect and transfer data over the network without manual assistance or human intervention. The proposed safety system involves the concept of IoT with roads, in which it helps to detect accidents in a smarter way and aims to take appropriate measures. When the vehicle is met with an accident the sensor detects and then the information is immediately sent to the registered number to inform that the concerned person is met with an accident. So that appropriate measures can be taken spontaneously. This system also involves detection of harmful gases released by the vehicle and also to update the status of the pollutants (harmful gases) to the owner of the vehicle.

*Keywords***:** Internet of Things, sensors, safety system, accident detection, harmful gas detection.

1. INTRODUCTION

IoT is a system which is interrelated with mechanical, computing devices, objects, digital machines, animals or people that are provided with UID's. In the Internet of Things all things are connected to the internet. Transportation plays a vital role in every human's day to day life. Voice-controlled devices, sensor-based electronics and even the gadgets can be controlled by making use of programming. IoT is all about digitally connecting devices and analyzing data to predict future. It is interesting to know how the Internet of Things (IoT) is contributing to smarter transportation systems. IoT in transportation uses a network of central connected devices with GPS, sensors, electronic monitors etc. In day-to-day life people are meeting with accidents and losing their lives because of negligence of surrounding people or in driving patterns. So taking precautionary measures like informing the concern people like their family members can be helpful so that they might be noticed that the person is met with an accident. People must be responsible while driving the vehicle where people often lag. The important factor of transportation is safety. The important role of road transportation is smooth and comfort travel for passengers. Mainly passengers' safety is more important. Transportation provides transparent information which helps in analytics so it can lead to better planning of resources. Huge number of vehicles ends up with accidents because of irregular driving patterns. Sometimes inexperiences drivers, teenage passengers, distraction while driving like using phone, drink and drive cases, driving at excessive speeds can be one of the reasons for accidents to happen. Road traffic injuries around the world happen between 1.25 million death upto 50 million injuries each year. Number of accidents is taking place in India where the recovery is delayed. Measuring how many people die each year and why they died is one of the most important issues. India has reported around 467,044 road accidents that has taken place. Around 15.5 percent accidents take place over a decade. According to the research the death related to traffic rose by 10 percent in 2019.The rate of accidental death taken place in India is around 34.2 percent. India ranks first in road accident deaths in the world according to International Road Federation (IRF). In addition nowadays due to transportation huge amount of pollutants are let into the atmosphere which is dangerous. So, controlling the pollutants by reducing the usage of vehicle which is impossible. So precautionary measures can be taken like informing the owner about the harmful gases let by their vehicle. With the help of real-time data, route management eliminates about 175 grams of carbon emission produced by extra mile travelled by any vehicle. Harmful gases released by vehicle are very dangerous. The major pollution is due to different types of harmful gases such as nitrogen oxides, carbon monoxide, hydrocarbons and so on let into the atmosphere, due to this there is a serious threat to human health. The gases like Nitrogen oxides cause irritation in the lungs and weaken the body's defenses against respiratory infections. Car pollution is one of the major cause for global warming, they emit gases like carbon dioxide and other greenhouse gases to the environment which is harmful. On the other part carbon monoxide is also a harmful pollutant which produces incomplete combustion of carbon, containing other elements such as oil, wood, natural gas etc where breathing such high concentration of carbon monoxide reduces oxygen level in the body and also lead to other symptoms like headaches, high risk of chest pain where these are very dangerous to human body. So detecting these type of pollutants is very important. Thus the above proposed system mainly involves informing the owner of the vehicle and updates about the gases let by the vehicle, by doing these practices the vehicle condition can be kept in track. So the percentage of carbon emission can be calculated. According to the survey about 9 percent of India's emissions were from transportation. In India two thirds of deaths are only caused due to pollution. The global health reports that PM 2.5 and ozone impacts of all tailpipe emissions, and 68 percent higher than estimated emissions. The air pollution led by vehicles scales the impact in 100 major urban areas. The risk factor is around 3.4 million deaths worldwide.

2. ALGORITHMS AND FLOW DIAGRAM

This section discusses the algorithms used to implement the model and a detailed explanation of its flow.

A. Algorithms

The proposed system works based on two different algorithms which are executed simultaneously. The Arduino board is programmed using these algorithms.

1) The accident detection is done according to Algorithm 1:

ALGORITHM-1: Accident detection

STEP1: Initialize the accelerometer, GPS Module, GSM Module.
STEP2: Fetch the continuous X, Y and Z values from accelerometer and GPS location from GPS Sensor.
STEP3: IF accelerometer value greater than Threshold value.
    STEP 3.1: Accident is detected, Buzzer starts beeping.
    STEP 3.2: IF SWITCH is pressed within 30 sec buzzer stops beeping- which means false accident detected, reinitialize the system.
    STEP 3.2: ELSE
        Send message along with GPS Location to emergency contact.

2) The harmful gas detection is done based on Algorithm 2:

ALGORITHM-2: Harmful gas detection

STEP 1: Initialize the MQ7 CO Gas Sensor
STEP 2: Fetch the continuous output value of Gas sensor
STEP 3: IF detected CO value is greater than Threshold value
    STEP 3.1: Send alert message to vehicle owner for vehicle emission test.

B. Flow of the model

This system's operational flow is depicted in the Fig.1. The steps involved in algorithms used for detecting accident and toxic gas is shown in the Fig. 1.

C. Use Case Diagram

The use case diagram helps in representing the interaction between the user and the system in a simpler way. Fig. 1a shows the IoT interaction which involves detecting accident and CO level, finding the location and sending sms alert. Fig. 1b shows the interaction with user such as receiving the notification and location details.
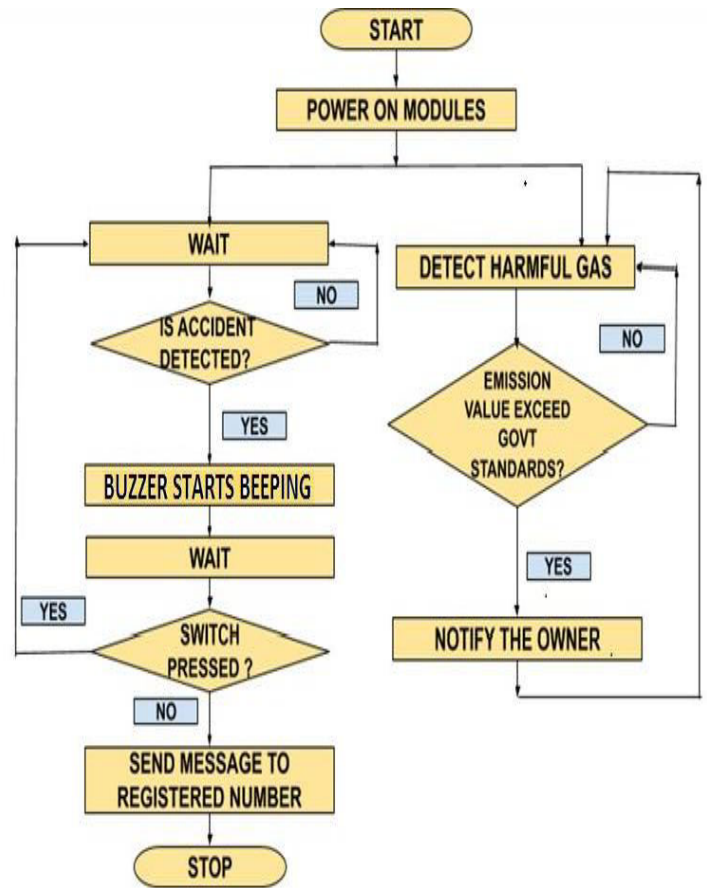

Fig. 1 Flowchart of accident and CO detection and alarming system.
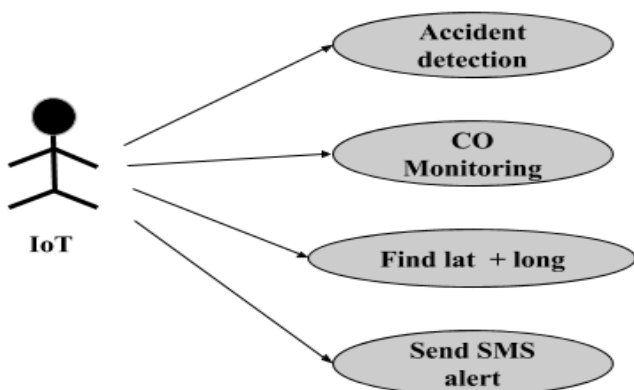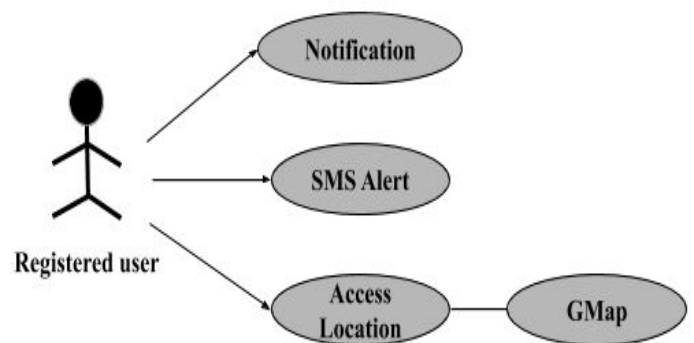

Fig. 1a Interaction with IoT

Fig. 1b Interaction with Registered user

3. ACCOMPLISHMENT

The hardware implementation setup of proposed system is shown in Fig.2. The Architecture of the proposed system is represented in the fig. 2a. Arduino IDE 1.8.10 is used for programming the Arduino board to simulate this proposed model. The values received from the accelerometer sensor are continuously monitored by Arduino UNO as shown in Fig.3 to detect an accident. When the received values cross the threshold values set, this change in velocity translates to an accident for Arduino UNO as shown in Fig.4. This was done by tilting the prototype model, which mimics the rear collision [1],[2]. When the impact is detected, the GPS sensor collects the location details as shown in Fig.4. Then, a text message is sent to the registered emergency contact number of the ward met with an accident and ambulance informing about the same. The message sent to the emergency contact number contains a Google map link as shown in Fig.5 which is sent with the help of GSM module [1],[3] . This link redirects to Google map application as shown in Fig.6 with which the location of accident can be known, so that someone can reach out for help. To avoid unnecessary notification to the registered phone number, an abort switch is provided to the driver of vehicle. This means that this switch can be pressed when the impact of accident is not severe; the driver is safe and doesn't require any help. Pressing this switch stops the GSM module from sending the alert message to emergency contact. It also resets the component reading values. Thus, Arduino UNO starts to monitor the values sent by accelerometer sensor again. The GSM module will be in idle state until an accident occurs. Only in case of an accident, it sends the location details to emergency contact.

CO is a major toxic gas found in vehicle exhaust. So, the system also includes MQ7 gas sensor fixed at the end of vehicle exhaust pipe or silencer pipe to detect the toxicity of vehicle exhaust gas. The values from the gas sensor are used by Arduino UNO to check if threshold value set is crossed as shown in Fig.7. When the threshold value of CO gas is crossed, the vehicle owner is notified with an alert text message suggesting him/her to get the vehicle serviced or get the emission test done as shown in Fig.8.
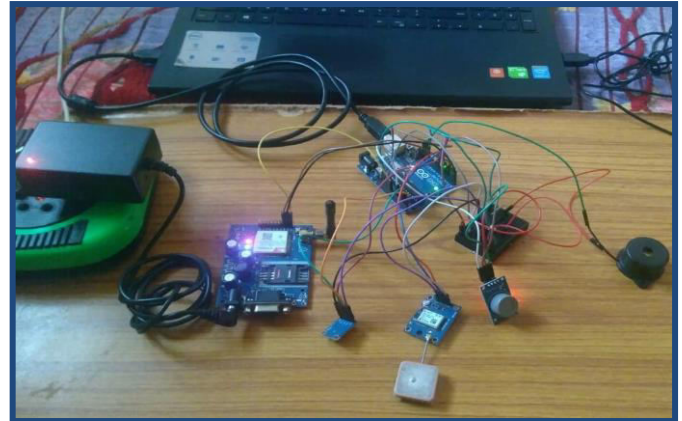

Fig. 2 Proposed system's hardware implementation setup

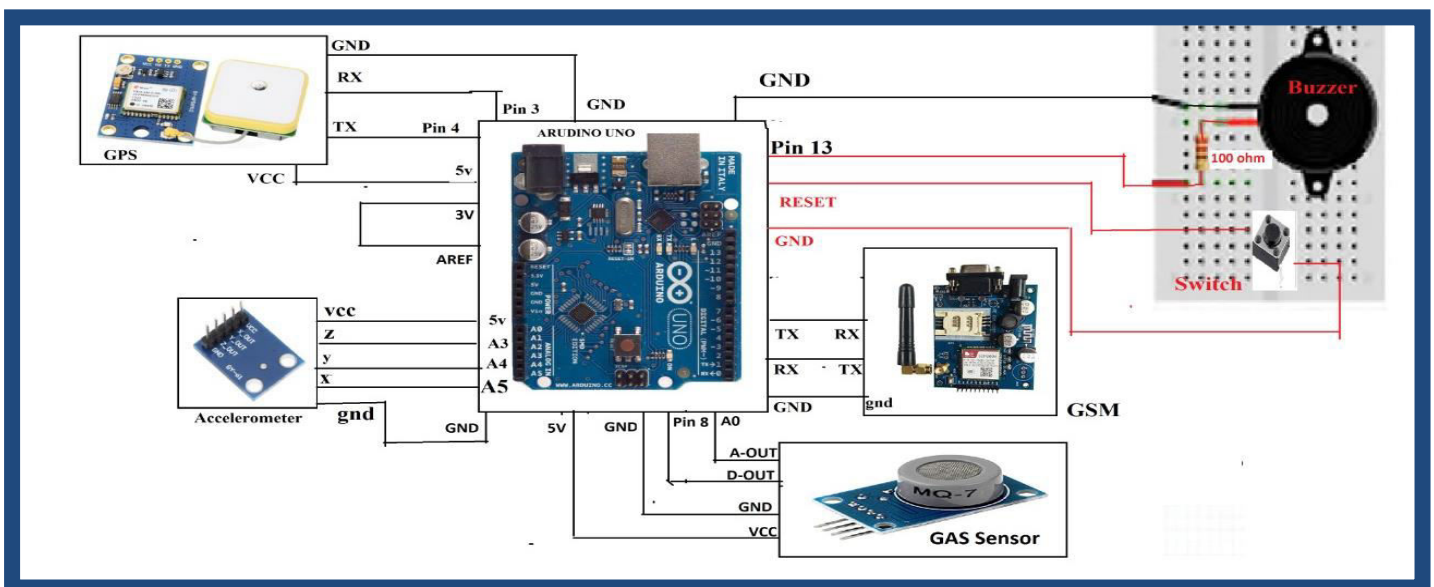Fig. 3 Continuous values from accelerometer sensor

Fig. 2a Architecture of the Proposed System

Fig. 4 Accelerometer values crossed the threshold being set. Thus detected as an accident.

Fig. 7 Values of MQ7 gas sensors crossed the threshold set. Thus, alert message sent to vehicle owner
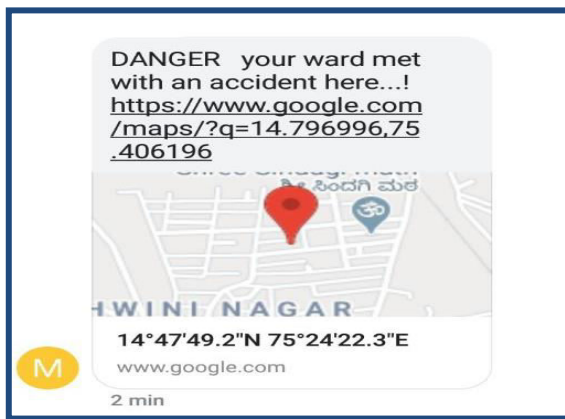

Fig. 5 Text message with the google maps link for tracking the location of

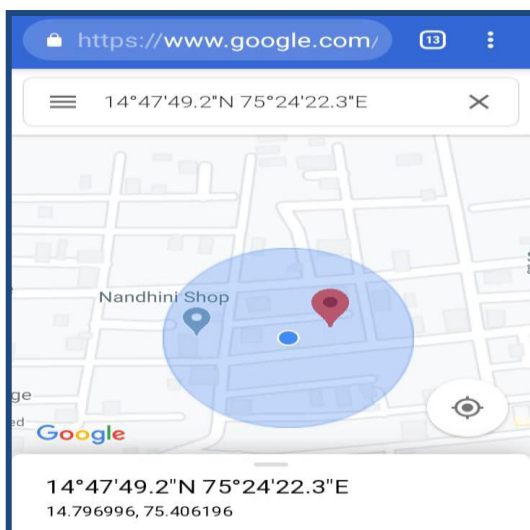Fig. 8 Text message alerting the owner to get the emission test done

Fig. 6 Google map application showing the location of accident
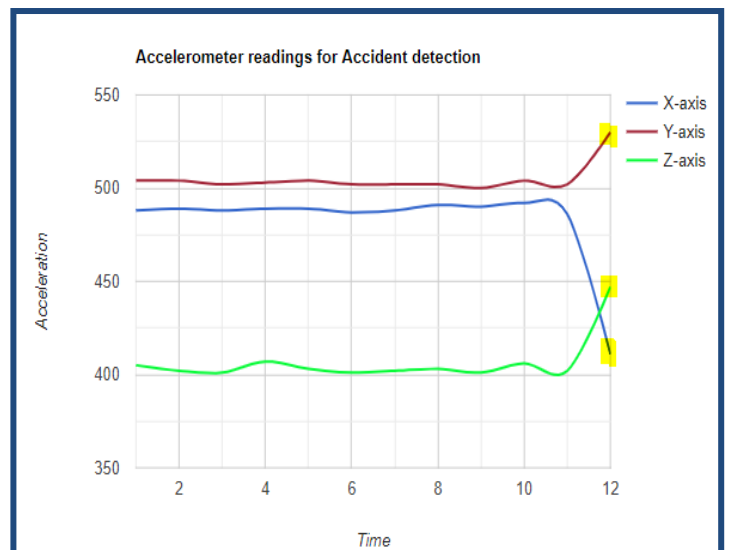

Fig. 9 Graph of Accelerometer reading for accident detection

4. RESULTS

A. Accident detection module

In this model if the x, y or z coordinate values of the accelerometer exceed the threshold being set, that means an accident has occurred. Hence accident alert will be sent to the registered number if the reset button is not pressed which confirms the event of accident.

As shown in Fig. 9, the x, y and z coordinates has exceeded the threshold, which means accident has occurred. Immediately the location details were collected from GPS and accident alert message with the link of Google map was sent to the registered number as shown in Fig. 5 and Fig. 6.

B. Carbon Monoxide Monitoring Module

When the concentration of the carbon monoxide being emitted by the vehicle reaches the threshold value, the owner will be notified with an SMS and will be asked to take appropriate measures as shown in the Fig. 8.

5. BENEFITS OF PROPOSED SYSTEM

IoT based automatic accident detection system helps in detecting the accident much effectively and alerts the emergency contacts when an accident is being detected. It finds an advantage where it doesn't explicitly require someone to inform regarding the accident and hence the delay can be avoided and also the information can reach on time to the appropriate person. Carbon Monoxide monitoring in vehicles helps in keeping track of the amount of CO being emitted so that the vehicle owner can take appropriate measures to get it back to control. It helps in controlling the harmful gas being emitted into the environment.

6. APPLICATIONS

i.   The proposed accident detection model can be embedded in four wheelers as a safety system.
ii. Integration of this model with air bag can be more efficient in saving life during an accident.
iii. CO monitoring module can be embedded in vehicles aiming for an environment friendly drive.

7. Conclusion

Nowadays IoT technology is growing rapidly and finds a wide range of applications. The proposed system was able to successfully detect the accident and send an alert to the emergency contact in less time using IoT. Also the accident location is being communicated so that the person met with an accident can avail the help as early as possible. The system was also able to keep track of the Carbon Monoxide being emitted which helps to have a control over the harmful gas being emitted to the environment. Hence the proposed system serves as a safety system as well as a precautionary measure to keep our environment less affected by the harmful gases.

REFERENCES

[1] Arif Shaik , Natalie Bowen , Jennifer Bole , Gary Kunzi , Daniel Bruce , Ahmed Abdelgawad , Kumar Yelamarthi (2018) *Smart Car: An IoT Based Accident Detection System*, Alexandria, Egypt, Egypt: IEEE Global Conference on Internet of Things (GCIoT).

[2] Dr. Sasi Kumar , Soumyalatha , Shruti G Hegde (2017) *IoT Approach to Save Life using GPS for the Traveller during Accident* , : IEEE International Conference on Power, Control, Signals and Instrumentation Engineering (ICPCSI-2017).

[3] Md. Syedul Amin , Jubayer Jalil ,M. B. I. Reaz (2012) *Accident detection and reporting system using GPS, GPRS and GSM technology*, Dhaka, Bangladesh: IEEE International Conference on Informatics, Electronics & Vision (ICIEV).

[4] Vivek Kinage , Piyush Patil (2019) *IoT Based Intelligent System For Vehicle Accident Prevention And Detection At Real Time*, Palladam, India, India: IEEE.

[5] T Kalyani, S Monika, B Naresh, Mahendra Vucha (March 2019) *Accident Detection and Alert System*, : International Journal of Innovative Technology and Exploring Engineering (IJITEE).

[6] Mochitha Vijayan , Chakshu Ishan Kaplas and Samhita Ganguly (2017) *Accident Detection and Response System with Error Avoidance* , ISSN 0973-4562 Volume 12, Number 13 (2017) pp. 3562-3565 edn., : International Journal of Applied Engineering Research .