An IoT Based Automatic Vehicle Accident Detection and Rescue System

K. Gayathri Devi, K. Yasoda, B. Rajesh, R. Sowmiya, and S. S. Vishalidevi

Abstract A large variety of precious lives are lost because of road traffic accidents each day that may occur due to the mistake of driver and delayed response from the place of accident to the emergency services. The most important aspect of driver is to own a good road accident detection and data communication system in place to save injured persons. A system that sends information messages to close emergency services regarding the accident location for timely response is completely essential. The accident detection process uses raspberry pi, in detection of the data from the vibration sensor and accelerometer during accident. The process of rescue system uses GSM, in the process of sending message to the neighboring medical Centre or relatives. GPS is used to track the location of the vehicle and used in the calculation of the speed of the vehicle based on the position of (latitude, longitude) and time difference. GSM in the system is used to send the location of accident through message. Vehicle ad-hoc network (Wi-Fi) is used to transfer of the data from the controlling unit to the application server in the later retrieval of data. Hyper Text Transfer Protocol is used to transfer web page from remote server after internet connection is established. The FireBase database is used in the storage of collected data, and uploads over in the web-page and in the process informing the accident location and in alerting.

Keywords Accident detection · Human rescue system · Global positioning system (GPS) · Global system for mobile (GSM) · Vehicle ad-hoc network

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1 Introduction

Nearly 1.25 million individuals die in road crashes annually, on average 3287 deaths on a daily basis. An additional 20–50 million are injured or disabled. Over 1/2 all road traffic deaths occur among young adults ages 15–44. There are 1012 deaths in 2019. This can be 74 deaths (+7.9%) over an equivalent amount in 2018. Within the 12 months complete October 2019 there have been 1209 road deaths. Throughout calendar 2018 there have been 1135 road deaths, 7% not up to in 2017. A recent World Health Organization (WHO) report showed that each year 1.35 million people die and 50 million place get injured. Road accidents are ranked because the eighth leading reason behinds deaths (up from ninth its previous report in 2015), with the Association for Safe International Road Travel (ASIRT) predicting that it's going to rise to the fifth leading reason behind deaths within close to future, unless forceful changes occur. Moreover, because the social damage caused by road traffic accidents, there is a big price. ASIRT estimates that between one and two percent of the annual budget of each country is spent on road accidents. Now-a-days, it has become terribly troublesome to understand that an accident has occurred and to find the position wherever it's happened. There is no system of identification and intimation relating to an accident in the past. For intimation purpose messaging services is used. GPS makes use of identification of location and GSM is built for the usage of intimation. The most intention of an accident detection is to locate the accident spot anywhere and intimating the emergency through the GPS and GSM networks. The GPS based vehicle accident identification module contains Mostly of different sensors such as accelerometer, MEMS etc., GSM module and a GPS modem connected to the microcontroller. Global System for Mobiles (GSM) technology is employed for a proper cellular mobile communication. Position of the vehicle accident location is traced down by GPS.

2 Literature Survey

The self-collision detection sensor is used to detect the accident and the information is uploaded to cloud based database server collision vehicle accident recognition, and a connected emergency notification is provided [1]. The detection of accidents supported by monitored speed and send the accident location acquired from the GPS together with the time by GSM and therefore the speed by utilizing the GPS network [2], sent to a OpenGTS server, providing a time period OpenStreetMap visualization of traffic scenario. MongoDB appraise the close mobile APPs with alert messages [3]. Auto continuous collision accident collision mechanism, exploitation physical phenomenon preview iterative algorithm, trace examination reconstruction algorithm, serial collision contact position reconstruction localization algorithm [4], self-tuning iterative hard thresholding (ST-IHT) algorithm for learning distributed spatio-temporal features and a weighted extreme learning machine (W-ELM) [5], Sudden

Lane Departure Avoidance Module and Rear-End Collision Avoidance Module [6] is used over in the process of detection of accident. The accident is detected by the in-Vehicle sensor and updates in database, verifies and compares the severity of accident supported to different accident data [7] and notifies the emergency services, uses remote cut off mechanism [8] and using GPS and GSM intimates the emergency services [9, 10] and provides over an crash path reconstruction using Kalman filter and GPS [11]. Data continuously collected from the smartphones accelerometer and analyzed using Dynamic Time Warping (DTW) [12], inputs from the accelerometer, magnetometer, gyroscope and on vehicle crash detection [13] are analyzed and intimated as e-Call with owner's information. The local prediction is exchanged from each sensor with neighboring vehicles aggregates the native predictions it receives using a weighted majority aggregation rule to get a final prediction [14], crash signals at different locations of a vehicle and their implications on crash analyzes the severity of accident [15], the system also sends a warning message. The system uses CAD-CVIS consists of varied sorts of accident types, atmospheric conditions and accident location, a deep neural network model YOLO-CA supported CAD-CVIS and deep learning algorithms to detect accidents and in alerting [16]. The system detects and assesses the severity of accidents with the assistance of an on-board unit and the TestBed analyses different accident scenarios and helps in rejecting false alert and serially detects the rollover and force [17]. Besides over these many systems, they are costly and not applicable in every cars and lacking over in the process of saving location for later use.

3 Proposed Model

This works focuses on designing and developing an accident detection using vibration sensors and wireless modules. The block diagram of the proposed system is shown in Fig. 1. In order to enhance real time accident detection and monitoring, the system has Vibration sensor SW-420, GPS and GSM module, which is connected to Raspberry pi controller, which works with Wi-Fi in transfer of data. The Vibration sensor SW-420 produces an digital output, on the detection of any collision or accident. GPS is used to track over the location in which the vehicle travels. GSM is used to send the location of accident as an URL link with the latitude and longitudinal information on the place of accident. Raspberry pi controlling unit is used to sense the information and to perform the entire controlling functions with database through Wi-Fi. For the enhancement of real time accident monitoring, the system with sensors which works on IoT basis [18, 19]. By using IoT, status on speed and the location of accident is recorded and the database manages over the data and uploads over in the webpage, in tracking of vehicle and its speed.

The connection and the flow diagram of the Vibration Sensor SW420 with Raspberry pi is given in Figs. 2 and 3. The accident detection system operates with the vibration sensor producing digital pulse output on the detection of any accident or collision. It produces over an output based on the threshold which is been set over

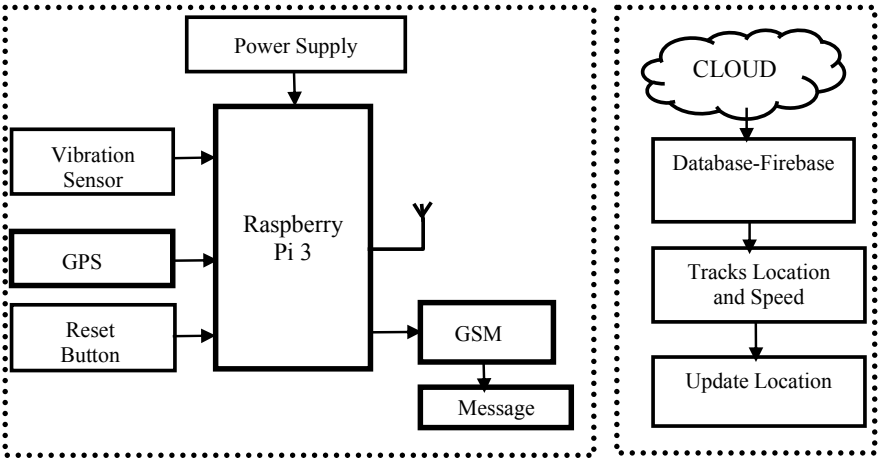


Fig. 1 Block diagram of proposed system

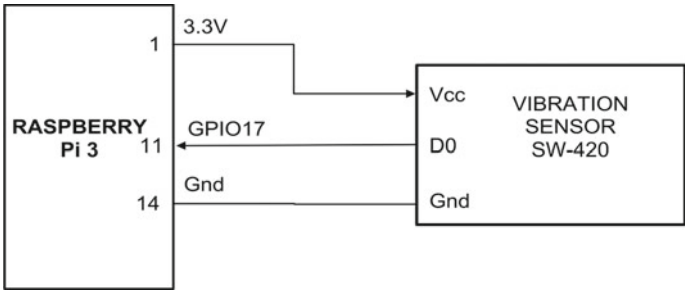
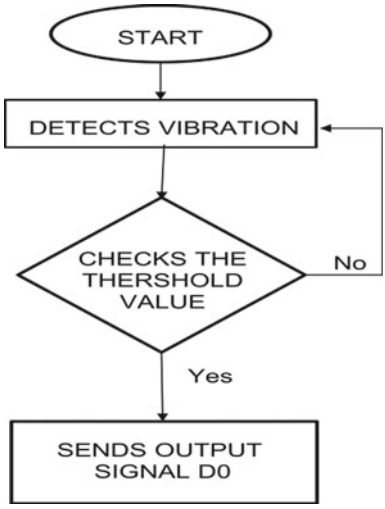


Fig. 2 Connection of the vibration sensor SW420 with Raspberry pi

Fig. 3 Flow diagram of the vibration sensor SW420 with Raspberry pi



in the potentiometer. The sensor is tightly fitted over in any part of the car. The variations in the output of the sensor are trapped and those are fed as input to the micro-controller.

GPS is commonly used for both tracking and navigation in vehicles. Tracking systems helps the base station to keep track of the vehicles in the way of travel without the intervention of the driver whereas, the system also helps the driver to reach the destination by navigation. The architecture of navigation or tracking system is more or less similar. The connection and the flow diagram of the GPS with Raspberry pi is given in Fig. 4. During the occurrence of accident in any place, tracking on the position of the vehicle by GPS system and send the information by alerting person through call or SMS by using GSM.

The connection and the flow diagram of the GSM with Raspberry pi is given in Fig. 5. Now based on these variations, the micro-controller is programmed to take decision which in turn.

- Sent as an message an through the GSM to relative or nearby emergency service.
- Data is updated over in the database through wireless transmission.
- Webpage provides over the alert message and update the location in the map.

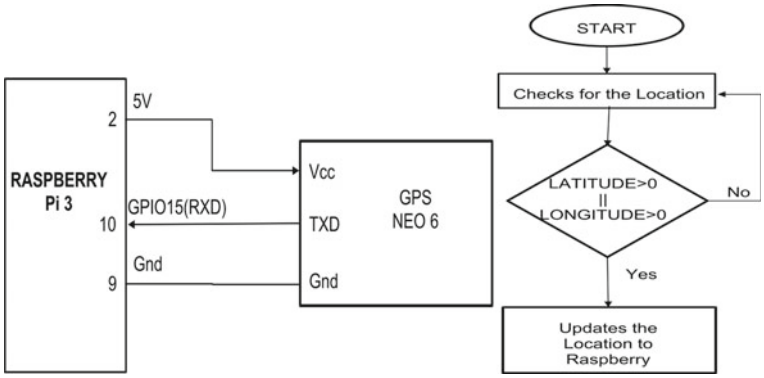


Fig. 4 Connection and flow diagram of GPS with Raspberry pi

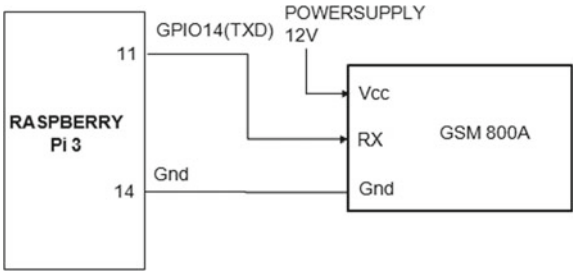


Fig. 5 Connection diagram of GSM with Raspberry pi

3.1 Wireless Transmission in IoT

Wireless communication system acts as a bridge for duplex communication for data collection and control message delivery and is an essential part for IoT infrastructure. Various IoT applications can be applied using Wireless communication system, which includes health care monitoring and home automation etc. and gains a lot of attention in connecting devices to internet.

3.2 Device-To-Cloud Communication

Internet cloud services like an application service provider is used to exchange data and manage the traffic of messages that will be connected directly to IoT devices in a device-to-cloud communication model. There are numerous advantages when a connection is established between the device and the IP network through cloud service when compared with the existing communications mechanisms like Ethernet or Wi-Fi connections.

The Device-to-cloud communication model that is proposed in our work is shown in Fig. 6 and maintained by more consumer IoT devices like the nest labs learning devices and many SmartTv and Smart phones. The Nest Learning Thermostat uses the devices to broadcast data to a cloud database where the data can be used to analyzed and problems can be identified. Cloud connection may help or enable user to obtain remote accessing of data through smartphones or web interface and supporting in some software updates to device.

The SmartTV technology make use of the Internet connectivity for the process of transmitting the information viewed by the user to do further analysis by the service provider and this enables the voice recognition features. The user can expand capability of device further than its original features to device-cloud module with respect to certain cases. Interoperability problem exist when there is an amalgamation of device detail from many diverse manufacturer it can be avoided if the authorized

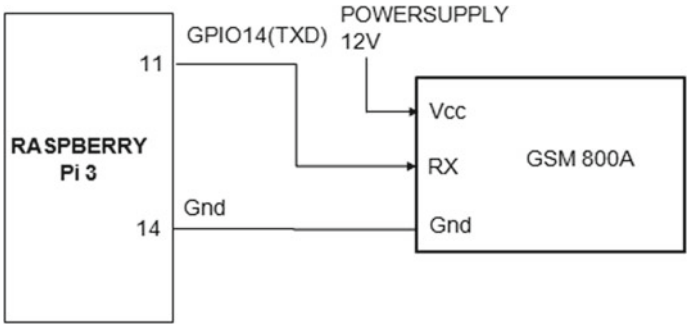


Fig. 6 Device-to-cloud communication model diagram

data protocols are used between the device and the cloud services. The device owner or user can be coupled to a precise cloud service in order to prevent them the usage of alternative service providers. This is referred to as "vendor lock-in", a term the compasses other facts of the relationship with the provider such as ownership of and access to the data. In mean time, users can have confidence that devices can be integrated based on the design for the specific platform.

IoT has made the change in the evolution today's world by connecting things over the Internet, which makes very much easier remote access. IoT is the emerging and trending technology that can be implemented over in the safety and security monitoring systems and in rescuing.

4 Results and Discussion

The Raspberry pi controls the functionality of the above mentioned sensor and modules. Programming for the controller is done using Python coding. After completion of the entire program, debugging is carried out. Finally, the program is dumped to the controller. Then, the working mechanism is verified. Figure 7 gives the snapshot of the prototype developed with major components. IoT plays a major role in collection of database, from the user. Each user can reach the server using their own e-mail id. This is achieved by means of mobile-to-cloud communication. When the user access the server, any variation in sensor detection is updated in form of database with the date and time. Therefore, real time accident detection is achieved by the implementation of IoT.

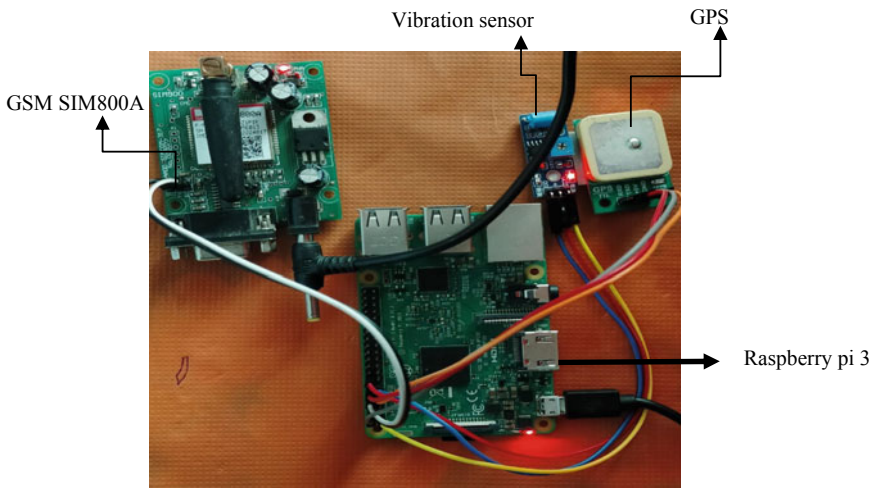


Fig. 7 Hardware implementation

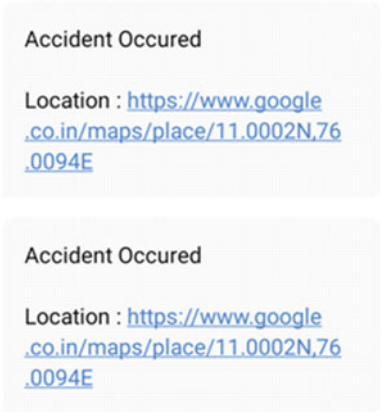


Fig. 8 Location of accident occurrence

Figure 8 gives the snapshots of the location of the accident that were transmitted through GSM. In this prototype firebase help in cloud based data storage and helps in easy retrieval of data. Firebase provides developers in the platform of mobile and web app development and which provides a plenty of tools and services which help in developing high-quality apps, grow their user base, and earn more profit without any back end server. Figure 9 gives the snapshot of the updation of location and speed in the database along with the information on accident occurrence through wi-fi using HTTP protocol. Webpage provides over the view in which location the vehicle travels,

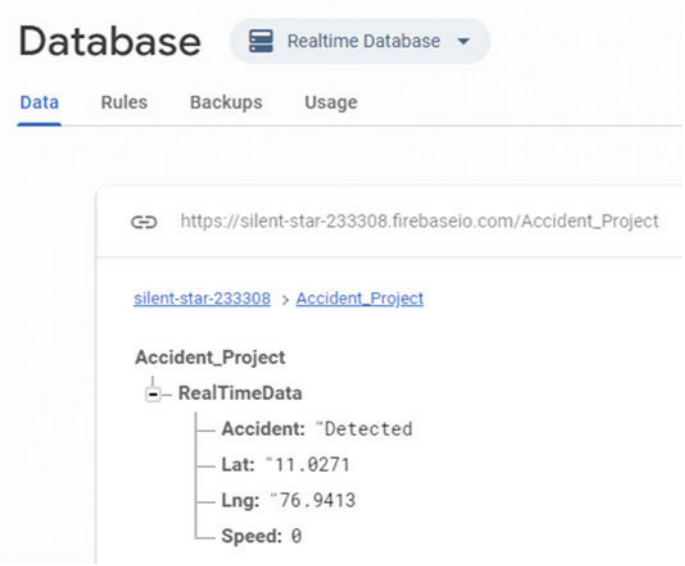


Fig. 9 Updation of accident occurrence in the database

Fig. 10 Accident detection message in webpage

Table 1 Result comparison between existing and proposed system

Parameter	Existing system [20]	Proposed system
Accident detector	Li-Fi system between cars	Vibration sensor in every car
System adaption	Hard	Easy
Alert system	Implemented using connected cars	Implemented using IoT
Data collection	Not implemented	Implemented and stores the data over in database

and provides over a pop-up information on the accident occurrence. Figure 10 gives the snapshot of the webpage during accident occurrence which gathers information from the database. The information based on the location helps in easy retrieval of victim people.

The Comparison between the proposed and existing system is given in Table 1. The existing system was designed with need to transmit the accident location using IoT technology to cater the needs of people who are undergoing accident.

5 Conclusion

This proposed system with advanced features reduces manual work and allows detecting the accident and reporting to the emergency services and updating data in database. The IoT technology used in this system helps in treating the victim people instantly in case of any emergencies and the route to the location of accident.

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