



ACCIDENT DETECTION AND NOTIFICATION SYSTEM USING AWS

Prof.CH G V N PRASAD Professor,
U.ANUSHA, Y.LOKESH, S.SAI CHARAN,
T.GEETHANJALI

SRI INDU COLLEGE OF ENGINEERING AND TECHNOLOGY

Shreiguda (V), Ibrahimpatnam (M), Rangareddy Dist. – 501510

ABSTRACT

With the constant advancements in the automotive industry and the increase in traffic volume, chances of fatality in road accidents have increased. This poses a dire need to develop a good and reliable solution to reduce the fatalities. One way to achieve this goal is to build a system that detects road accidents and notifies medical services as soon as possible. The aim of this research paper is to provide a robust accident detection and notification system where the data collected from the accident site is communicated to an emergency medical service provider as well as the victim's emergency contacts such as family members or close friends. The system described in this paper successfully takes values from accelerometer, detects a crash and sends a notification, a text message and an email using AWS to the concerned parties with the latency of approximately 20 seconds and this was achieved by using an internet connection with a speed of 3.76 MBPS. Since AWS is reliable, scalable and fast, the cloud infrastructure provides a better platform for the system.

1.INTRODUCTION

According to WHO's Global Status report on road safety - 2018, every year, 1.35 million people lose their life in road accidents. Road traffic injuries cause considerable economic losses for the families of those involved. As per a report published by the Ministry of Road Transport and Highways (Government of India), the total number of accident - related deaths reported in the year 2019 was 1,51,113. It can be seen from the data that road accidents still remain a primary cause of death, disabilities, and hospitalization in India. India is ranked first in the number of accident-related deaths out of 199 countries and around 11% of accident-related deaths in the world happen in India.

The pie-chart shown in Fig. 1 provides details of persons killed in accidents, classified by the type of impacting vehicles. Buses, auto rikshaws, trucks and lorries etc. can be categorized as four-wheelers with a little tweak in the acceleration threshold of the algorithm. With a robust accident detection and notification system (ADNS), the number of fatalities and serious injuries can be

decreased substantially. By calling and notifying as quickly as possible, such a system will be useful to the emergency centres to take action on their Medical Services. And hence, the chances of death in accidents due to delay in medical treatment can be reduced as much as possible and the casualty rate in road accidents can be significantly decreased.

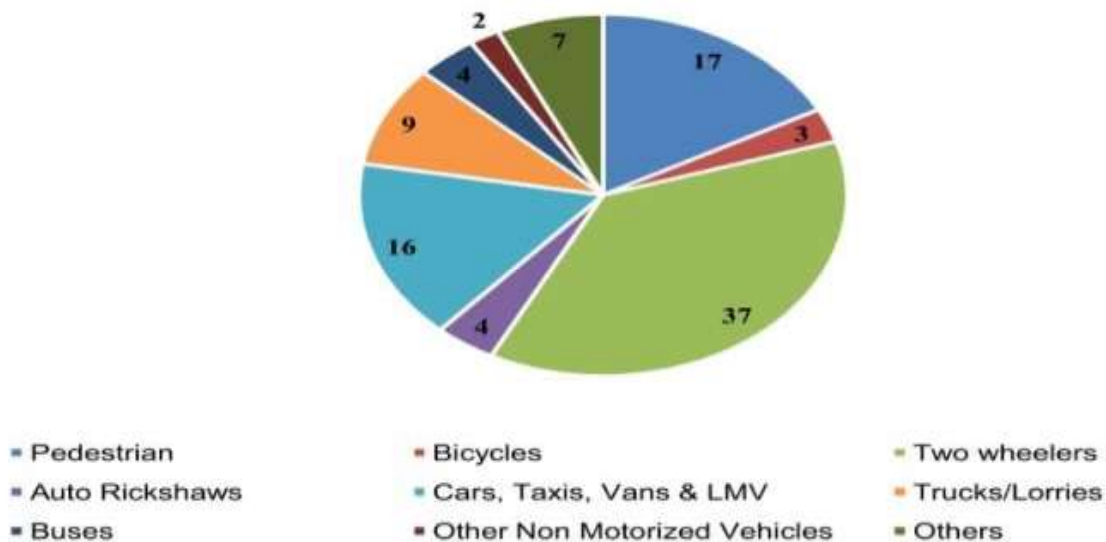


Fig – 1.1

In a situation of a severe accident, the first few hours are really critical; if the victim is given essential emergency treatment within this period, then the possibility of saving the victim increases to a significantly higher point. One such system that is proposed in this work uses cloud infrastructure (AWS) and IoT technology. This system is useful in many secluded areas like mountain range, villages, interior roadways; even in night time where there’s almost noone around. In such cases, if an accident occurs due to any reason, the system could be proven lifesaving. In order to reduce the fatality rate, there is a strong need for a system which is robust, generic and can be installed in any vehicle.

2. LITERATURE SURVEY

TITLE: “Car accident detection and notification system using smartphone”

ABSTRACT: This report shows the outcome by applying large scale data mining techniques on the Finnish roads. From the research study it is very difficult task to perform because the collected data have uncertainty, incomplete and error values. So the data exploration is a challenging task. The data



used in the process have been collected from Finnish road administration data sets. The data used in the process have been collected from Finnish road administration data sets. The main target of our project is to look into practicability of Robust clustering, to find the associations and repeated item sets and applying apprehend methods for the analysis of road accidents. While the results display the selected mining techniques and methods were capable to the understandable patterns. To calculate the accident frequency count as a parameter /c-means algorithm is used to cluster the locations. To characterize the surface conditions association rule mining is used. data mining skills disclosed different environmental reasons associated with road accidents. Intersection on highways have been identified as a dangerous for fatal accidents.

TITLE: "iBump: Smartphone application to detect car accidents."

ABSTRACT: Traffic accidents are a fact of life. While accidents are sometimes unavoidable, studies show that the long response time required for emergency responders to arrive is a primary reason behind increased fatalities in serious accidents. One way to reduce this response time is to reduce the amount of time it takes to report an accident. Smartphones are ubiquitous and with network connectivity are perfect devices to immediately inform relevant authorities about the occurrence of an accident. This paper presents the development of a system that uses smartphones to automatically detect and report car accidents in a timely manner. Data is continuously collected from the smartphone's accelerometer and analyzed using Dynamic Time Warping (DTW) to determine the severity of the accident, reduce false positives and to notify first responders of the accident location and owner's medical information. In addition, accidents can be viewed on the smartphone over the Internet offering instant and reliable access to the information concerning the accident. By implementing this application and adding a notification system, the response time required to notify emergency responders of traffic accidents can reduce the response time and perhaps help in reducing fatalities.

TITLE: "Mobile application for automatic accident detection and multimodal alert."

ABSTRACT: This paper presents HDy Copilot, an Android application for accident detection integrated with multimodal alert dissemination, both via eCall and IEEE 802.11p. The proposed accident detection algorithm receives inputs from the vehicle, via ODB-II, and from the smartphone sensors, namely the accelerometer, the magnetometer and the gyroscope. The Android smartphone is also used as human machine interface, so that the driver can configure the application, receive road



hazard warnings issued by other vehicles in the vicinity and cancel countdown procedures upon false accident detection. A prototype implementation was validated via laboratory tests.

TITLE: "Delay-Aware Accident Detection and Response System Using Fog Computing."

ABSTRACT: Emergencies, by definition, are unpredictable and rapid response is a key requirement in emergency management. Globally, a significant number of deaths occur each year, caused by excessive delays in rescue activities. Vehicles embedded with sophisticated technologies, along with roads equipped with advanced infrastructure, can play a vital role in the timely identification and notification of roadside incidents. However, such infrastructure and technologically-rich vehicles are rarely available in less developed countries. Hence, in such countries, low-cost solutions are required to address the issue. Systems based on the Internet of Things (IoT) have begun to be used to detect and report roadside incidents. The majority of the systems designed for this purpose involve the use of the cloud to compute, manage, and store information. However, the centralization and remoteness of cloud resources can result in an increased delay that raises serious concerns about its feasibility in emergency situations; in life-threatening situations, all delays should be minimized where feasible. To address the problem of latency, fog computing has emerged as a middleware paradigm that brings the cloud-like resources closer to end devices. In light of this, the research proposed here leverages the advantages of sophisticated features of smartphones and fog computing to propose and develop a low-cost and delay-aware accident detection and response system, which we term Emergency Response and Disaster Management System (ERDMS). An Android application is developed that utilizes smartphone sensors for the detection of incidents. When an accident is detected, a plan of action is devised. Initially, a nearby hospital is located using the Global Positioning System (GPS). The emergency department of the hospital is notified about the accident that directs an ambulance to the accident site. In addition, the family contacts of the victim are also informed about the accident.

TITLE: "Accident Detection and Notification System Using Android."

ABSTRACT: In Thailand, approximately ten thousand people die each year from 2007 to 2016 because of the accident on the road side. One of the causes of death was the lack of access to the scene. In this paper, we propose the Android application which automatically notifies the emergency or accident. When an emergency or accident occurs to the people who install this application on their phone, the application will be automatically activated by the immediate change to zero of the



acceleration of the smartphone. It means that their moving was stopped suddenly, then an emergency message which contains the location of the scene that obtained from GPS sensor of the smartphone will be sent to the most available first emergency or accident responder. There are two modes of emergency notification in this application. First, the message will be delivered via the Internet connection; if it is available. Second, it will be sent via SMS if there is no the Internet connection. In view of the recipients of the emergency message, they can view the map and direction to the scene. This application can help users to improve the fast and accuracy of the severity of the accident by offering perfect facts to emergency services as soon as possible and saves precious life of peoples.

TITLE: “Design and development of accelerometer-based system for driver safety.”

ABSTRACT: Abstract: Security in travel is primary concern for everyone. IOT based monitoring of vehicle parameters is described of effective information system that can monitor an automotive / vehicle / car condition in traveling. This project is designed to inform about the location of vehicle, vibration and temperature information that is occurred to a vehicle. This project uses accelerometer sensor which can detect the unevenness of vehicle and if vibrations occurred then a threshold limit. The signal send by the sensor are received by the microcontroller. Vehicle monitoring system uses wifi-module to send information over IOT. This monitoring system is composed of a GPS receiver, ARM-7, ACCELEROMETER, HEAT SENSOR and GPS Receiver who gets the geo satellite information in the form of latitude and longitude. The ARM -7 processes this information and this processed information is sent to the user/owner using WIFI-MODULE modem. A wifi modem is interfaced to the MCU. Heat sensor used to detect temperature level.

TITLE: "Smart Car: An IoT Based Accident Detection System,

ABSTRACT: The Internet of Things (IoT) offers limitless possibilities to both the public and private sectors. Automobile manufacturers are interested in IoT applications to increase the safety of their vehicles, to meet customers' demands and ultimately to offer cutting-edge products which maximize profit. The healthcare industry is concerned with how the IoT can improve the speed and accuracy of communication. This paper describes the feasibility of equipping a vehicle with technology that can detect accident and immediately alert emergency personnel. When there is a car accident someone has to actively seek help such as calling 911 for emergency services. There is no automatic notification to the police, ambulance, friends, or family. The Internet of Things (IoT) can be used to produce an automatic notification and response to the scene. A signal from an



accelerometer and a GPS sensor are automatically sent to the cloud and from there, an alert message will be received by whoever is subscribed to that car. The signal will indicate the severity of the accident and the GPS location. The ambulance will use the GPS coordinates to get to the scene quickly.

TITLE: "Automatic Accident Detection and Rescue System using Image Processing and IOT."

ABSTRACT: Generally, now-a-days growth of population increasing day by day leading to high demand of automobiles, leading to congestion, traffic hazards and resulting in road accidents and deaths. Majority of deaths occurred due to drowsiness and failure of reaching ambulance to the location on time which increases the chances of death of the victim. Therefore, life of victim is under high risk. This abstract proposes a system which consists of alerting system as well as rescue system. Alerting system alerts the driver with a buzzer using image processing if driver is feeling drowsy. Even if an accident occurred it is detected through vibration sensors which are connected to raspberry pi which collects information from the nature of the driver's eye as well as from sensors. And the location details of accident area are transmitted to the servers' using IoT. The "Ubidots" cloud is used to store the obtained results into the server and is used to envision results in its platform, whereas "IFTTT" named cloud is used and its applets sends a message to the parents of the victim. An MSS mobile application is used for the internal communication of the ambulance drivers. In this way by utilizing this accident alert and rescue system diminishes the death rate and also saves not only lives but families.

TITLE: "Accident Detection Using Convolutional Neural Networks."

ABSTRACT: Accidents have been a major cause of deaths in India. More than 80% of accident-related deaths occur not due to the accident itself but the lack of timely help reaching the accident victims. In highways where the traffic is really light and fast-paced an accident victim could be left unattended for a long time. The intent is to create a system which would detect an accident based on the live feed of video from a CCTV camera installed on a highway. The idea is to take each frame of a video and run it through a deep learning convolution neural network model which has been trained to classify frames of a video into accident or nonaccident. Convolutional Neural Networks has proven to be a fast and accurate approach to classify images. CNN based image classifiers have given accuracy's of more than 95% for comparatively smaller datasets and require less pre-processing as compared to other image classifying algorithms.



TITLE: “Vision-based real-time traffic accident detection.”

ABSTRACT: Recently, traffic accident detection is becoming one of the interesting fields due to its tremendous application potential in Intelligent Transportation Systems. In this paper, we present a vision-based real time traffic accident detection method. We intend to extract foreground and background from video shots using the Gaussian Mixture Model (GMM) to detect vehicles; afterwards, the detected vehicles are tracked based on the mean shift algorithm. Then the three traffic accident parameters including the changes of the vehicles position, acceleration, and the direction of the moving vehicles are gathered to make the final accident decision. The experimental results on real video demonstrate the efficiency and the applicability of the proposed approach.

3. PROBLEM STATEMENT

There are several other research papers published on this topic. The algorithm mentioned in the current paper was tested on data from NHSTA, USA’s crash- data for accuracy of accident severity, which is mentioned in the later part. The work published in utilized Android smartphone sensors for car crash detection. Ahirrao et al suggested a separate collision detection circuit installed in the car and a separate notification system using Android App. The circuitry utilizes LDR and photodiode as the sensors for collision detection. The work presented in and explains an accident detection and notification system using an accelerometer and Raspberry Pi. Various approaches can be seen in research papers published on this topic recently. One of the solutions is e-Notify which aids in detecting and notifying traffic accidents. An onboard unit (OBU) is required for this system. This can be costly and it’s difficult to equip every vehicle with an OBU. There is also an eCall system developed by The European Commission and its deployment is, by law, necessary in all vehicles that are manufactured after the year 2015. This system detects an accident and then the emergency services like 112 (or 999 in UK) are informed.

3.1 LIMITATIONS OF EXISTING SYSTEM

costly and it’s difficult to equip every vehicle. No Information available of riders or drivers. Not able to notify beloved ones. Requires Police action for Information which will be time consuming

4. PROPOSED SYSTEM

The system described in this paper successfully sends notifications, a text message and an email using AWS to the concerned parties with the latency of approximately 20 seconds and this was



achieved by using an internet connection with a speed of 3.76 MBPS. Since AWS is reliable, scalable and fast, the cloud infrastructure provides a better platform for the system. Our system uses cloud infrastructure (AWS). This system is useful in many secluded areas like mountain range, villages, interior roadways; even in night time where there's almost no-one around. In such cases, if an accident occurs due to any reason, the system could be proven life-saving. In order to reduce the fatality rate, there is a strong need for a system which is robust, generic and can be installed in any vehicle. A simple web application is developed. This application is useful for receiving push notifications i.e., "An accident is detected!!!" whenever the algorithm triggers AWS SNS. The app receives notifications using AWS SNS. More features like displaying details of accident and owner can be added. A website is developed using HTML, CSS, JavaScript. The purpose of this website is preliminary to be the software at the hospitals and the medical centers. The website shows the last accident's details as well as all the records of the accidents that have happened. Entire system is implemented using python with Django framework and MySQL as database.

4.1 ADVANTAGES OF PROPOSED SYSTEM

No cost and efficient. No separate installation of any hardware. Any person can scan and send notification to their beloved ones from anywhere. Within 20sec information can be passed. Nearby Hospital gets information about accident. Can pass information about type of accident, persons onboard, dead or alive, location

5. IMPLEMENTATION

I. Calibrating the Accelerometer

(MPU-6050) MPU-6050 needs to be calibrated first since every module will have different offset errors and they need to be checked and edited in the source code accordingly for every system that is developed. These offset-errors are present in the accelerometers due to misalignment caused during manufacturing process. For that, the accelerometer needs to be placed on a flat surface and measure the acceleration values in each direction i.e., x-axis, y-axis and z-axis. The acceleration values for x-axis, y-axis and z-axis ideally should be 0g, 0g and 1g respectively. But practically, there would be offset errors and they need to be added or subtracted accordingly to get the desired output with minimized error.

II. Accident Detection and Severity Algorithm



The flowchart of the basic working of the algorithm. If the acceleration/deceleration value exceeds 5g (where $g=9.8 \text{ m/s}^2$) then it needs to be considered as an accident [22]. To take an estimation of the severity, the acceleration values can be broken down as follows: if the acceleration is between 5g and 13g, it's considered High and for 13g and above, it's considered extreme. The acceleration values can directly be obtained by the accelerometer i.e., MPU6050. However, to estimate the severity, the change in velocity is also required. The duration for which deceleration exists determines the change in velocity. The longer the duration, the larger the change in velocity i.e., v or Δv . Just like acceleration, there are two ranges of Δv to estimate the severity. If the Δv ranges from 12.8 kmph to 22.5 kmph, it's considered High and above 22.5 kmph, extreme. These velocities can be obtained by performing integration on the acceleration values. One such approach is to pass the acceleration values through a Butterworth Low-Pass Filter of order '2'. MPU-6050 has such a filter inbuilt. So, the values obtained thus are the filtered values and they can be directly integrated to get values of Δv (v) and now steps can be taken to estimate severity. The pseudo code for detection and severity estimation is mentioned below:

Get acceleration/deceleration values. Integrate values and calculate velocity. Get P_i = magnitude of maximum deceleration in i th direction. ($i = x,y$)

III.ADS Hardware

The most important part of the system is detection and computation of severity. AWS Command Line Interface (AWS CLI) is installed on the Raspberry Pi's Raspbian operating system so that AWS can be accessed and the credentials can be verified. The algorithm is implemented in Python3 and will run locally on Raspberry Pi. The algorithm will constantly run on the system and the accelerometer (MPU-6050) will measure acceleration values and the algorithm along with pressure sensor will detect if there was an accident and then start buzzer and send notifications accordingly. Since the computation for severity and detection runs locally on Raspberry Pi, it takes about 6-8 seconds to do it (considering the 3b model). When the algorithm detects an accident, AWS services i.e., SNS, DynamoDB and PinPoint are triggered. All of which use boto3 client which is a library to help us integrate AWS functionalities locally in the main program. Boto3 clients fetch AWS credentials from the installed AWS CLI or they can be passed as parameters manually. In addition to this, additional parameters like weight of the vehicle could be added. Also, the system can be customised according to the different types of terrains like slippery, rocky etc. However, that would require testing in a standard facility with different real vehicles.



IV. AWS Credentials, DynamoDB, SNS and PinPoint

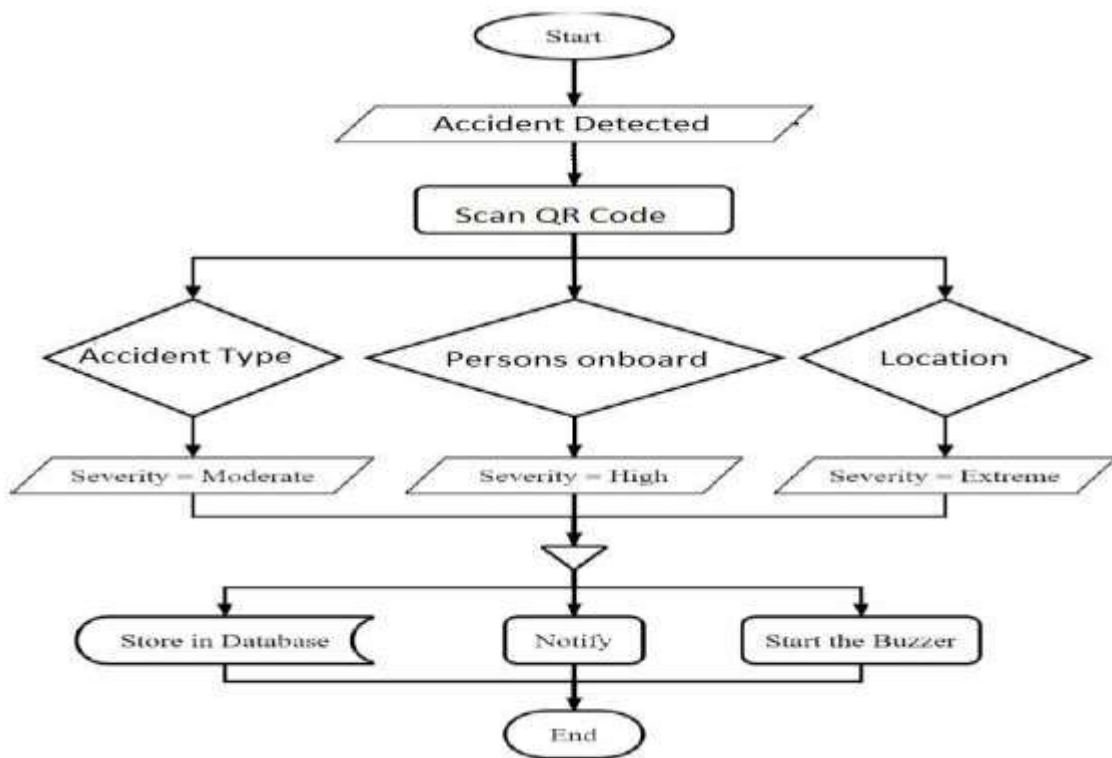
AWS Command Line Interface is installed on the Raspberry Pi so that basic AWS commands can be run locally as well since important and essential credentials can be set in a separate hidden file which AWS client would read from. These credentials contain three details: 'AccessKeyID', 'SecretAccessKey' and 'Region'. Each of these is different for different users and need to be configured while developing the system to maintain reliability and security. Setting up AWS cloud credentials needs to be done for every user. AWS DynamoDB provides a scalable and easy to use NoSQL database. This database has two tables named Accidents and Vehicle. The Accidents table contains 'AccTime', 'Impact Area', 'Impact Type', 'Overall Severity' and 'OwnerID'. The Vehicle table contains 'OwnerID', 'Name', 'Vehicle', 'Plate No.', 'Insurance ID' and 'License No.'. The Accidents table is triggered when the algorithm detects the accident and the data computed by the algorithm is sent to the appropriate field in the table accordingly. The Vehicle table is also triggered at the same time and is used to show the owner's details in the notification in the Android app, email and website. AWS SNS (Simple Notification Service) comes handy when you want to send a notification to the user on their phone. When the accident is detected, the boto3 client of SNS is invoked and two types of notifications are sent. One using the Firebase Cloud Messaging and the android app as push notification which basically shows that an accident is detected with severity. The second notification goes as an email containing the accident details and the owner's details i.e., all the fields from both the DynamoDB tables - Accidents and Vehicle. AWS PinPoint is a service to send voice messages. Along with the push notification, a voice-note saying "An accident has occurred" is sent to the contacts.

V. Android Application and Website

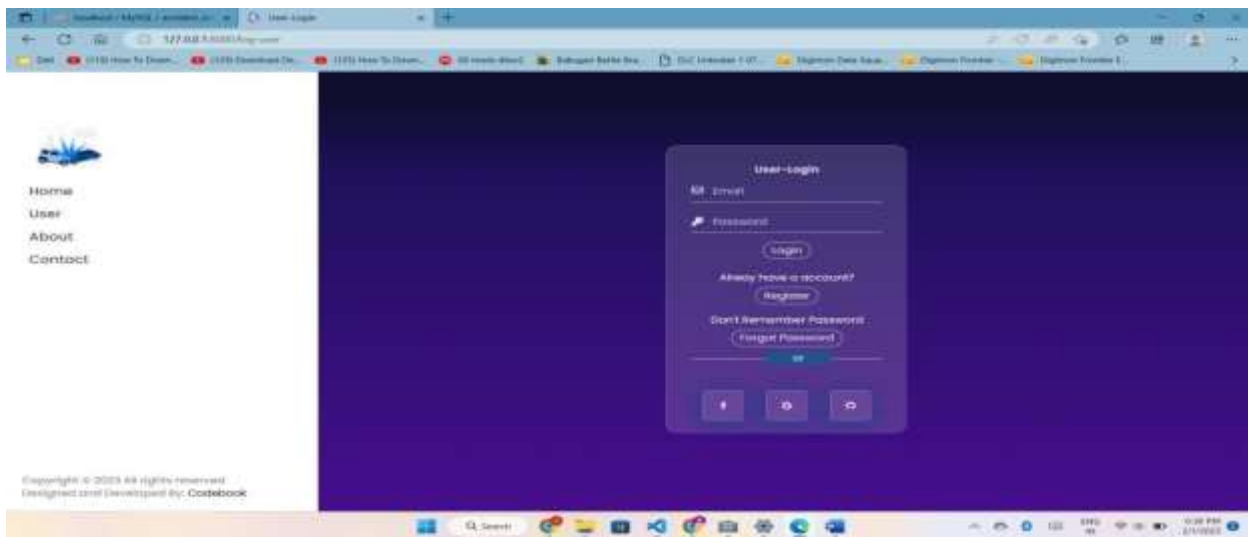
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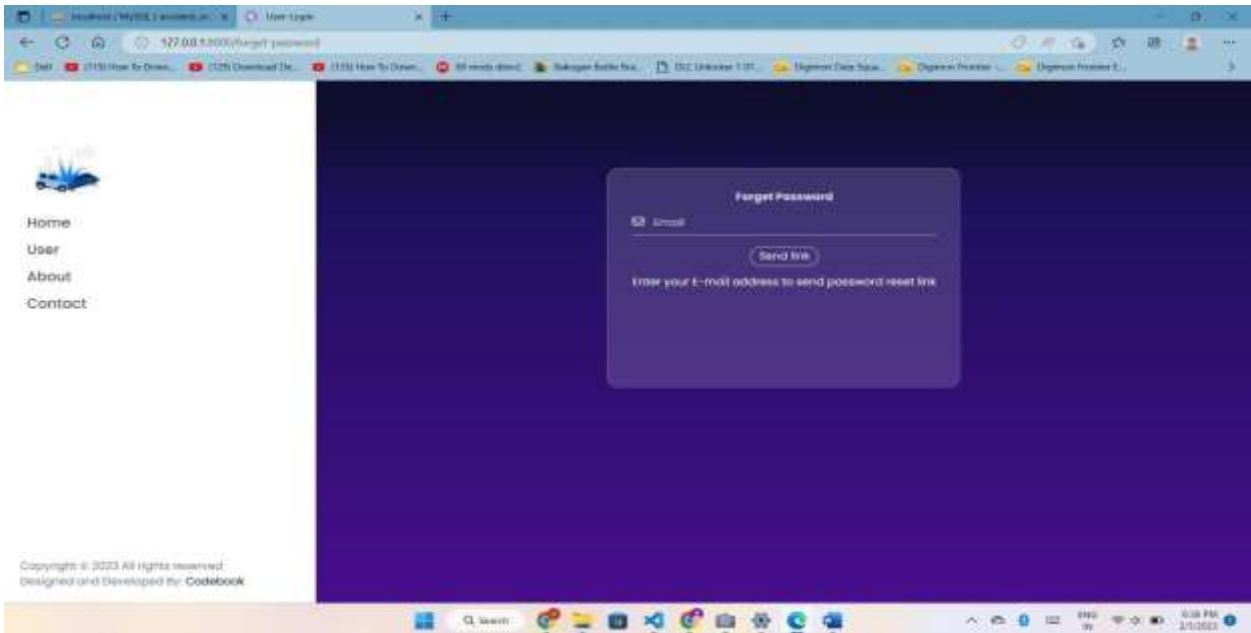
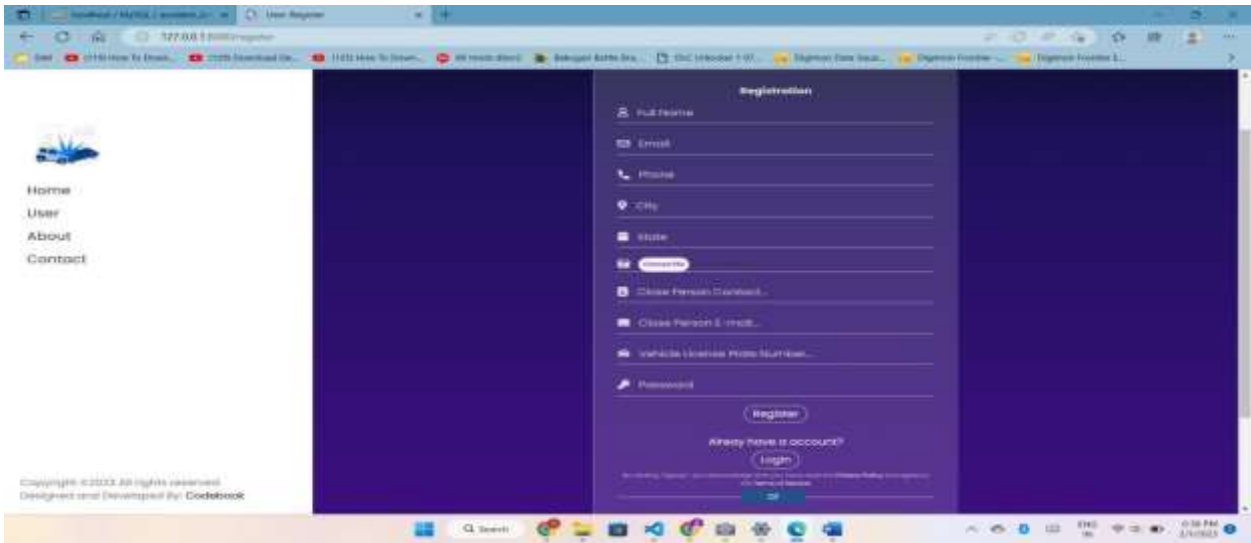
detection possible. The accelerometer and pressure sensor are interfaced to the Raspberry Pi and the system is rigidly tied to the trolley. The algorithm in Raspberry Pi takes real time data from the accelerometer and sends the output to the assigned output device. Different accident scenarios were replicated on these prototype models. After 78 seconds of one collision, the accident is detected and a notification, a text message, an email and a voice note are received through AWS showing the impact area and severity. The results are shown in the following section. However, the proposed work is to be extended by including camera, microphone, GSM module, some more AWS services and enhanced web application and android application

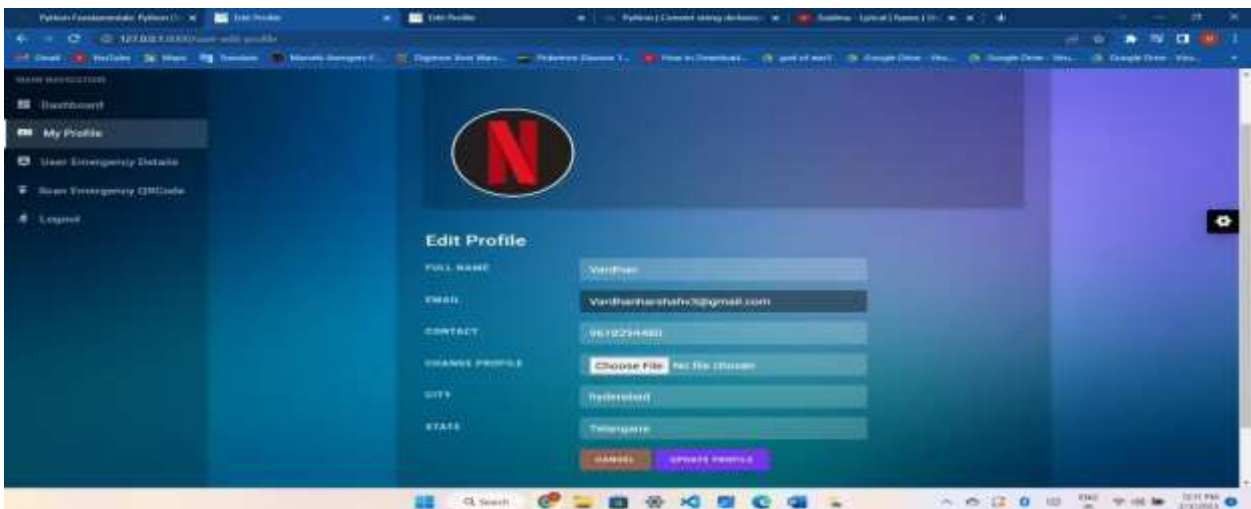
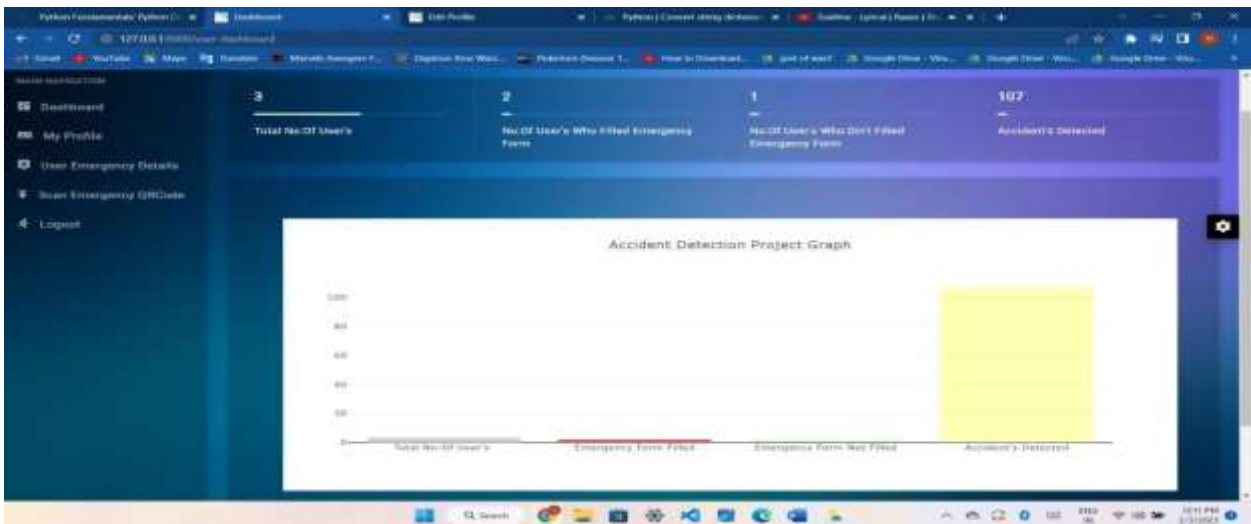
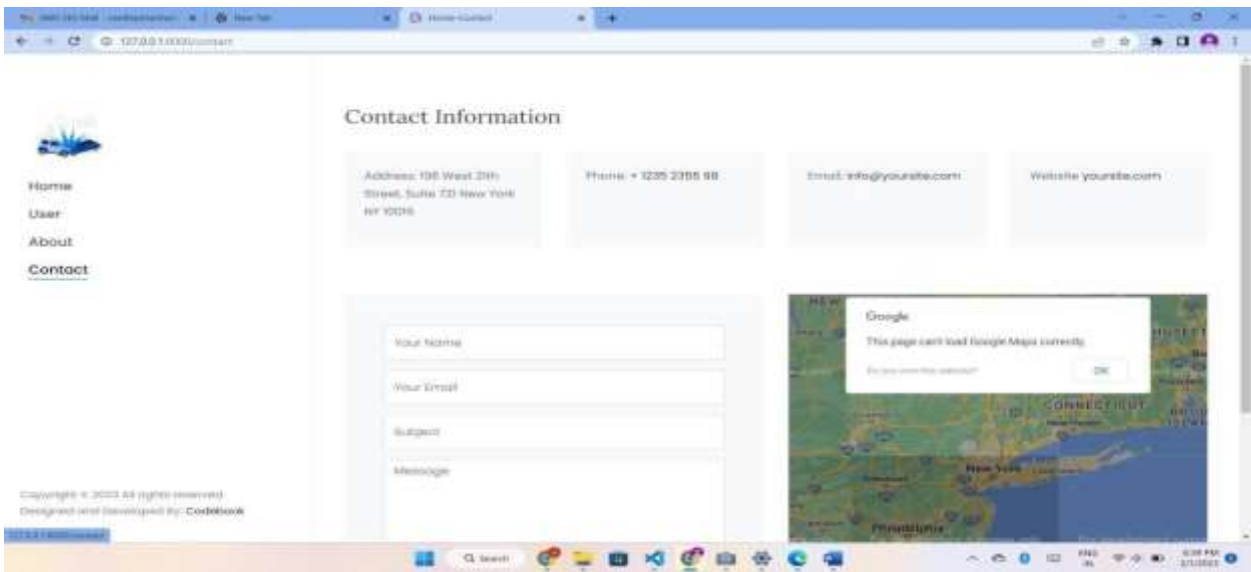
6. SYSTEM ARCHITECTURE

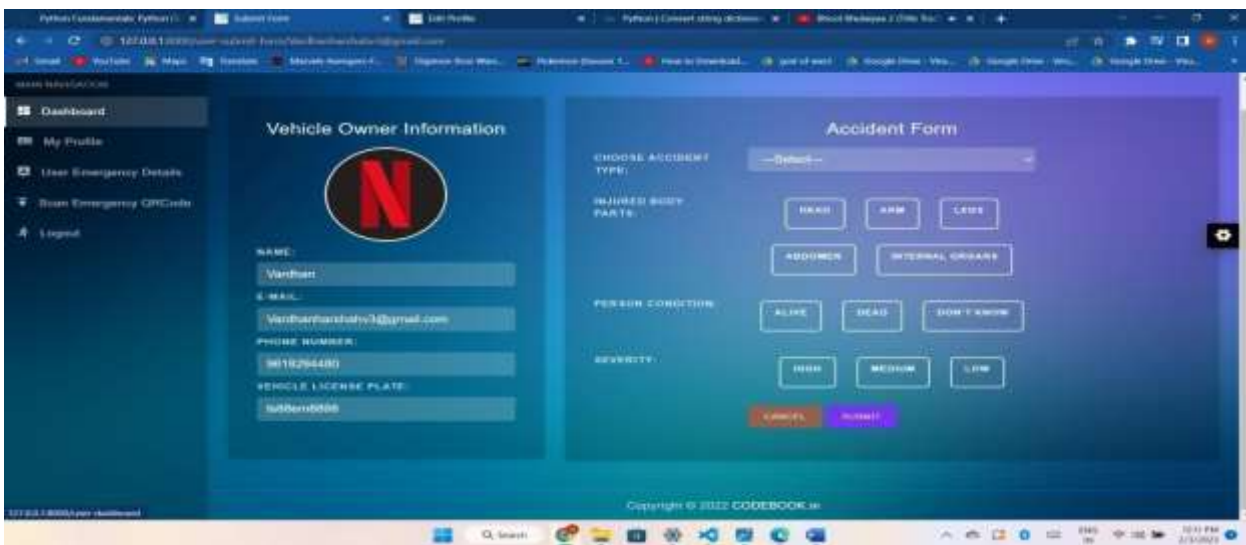


7. SYSTEM RESULTS











8. CONCLUSION

The increasing transportations are causing more and more road accidents resulting into people's deaths. It is crucial to get them immediate medical attention and the system described in this work provides just that. AWS is a reliable, scalable and easily maintainable cloud service. Also, since the sensors are rigidly mounted to the vehicle's body, the reliability isn't compromised, compared to the approaches involving smartphone sensors. Apart from that, unlike other approaches, the proposed model successfully estimates severity as well. As mentioned in the Results and Analysis section, the system successfully detects an accident and notifies the concerned within approximately 20 seconds and medical treatment can be started as soon as possible and hence, it increases chances of survival. The system was tested with internet speed of 3.76 MBPS; but this latency depends on factors like network connectivity, network-traffic etc. and may take longer to notify

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