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Analytical Study of an IOT-based Accident Detection and Information Management System

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Abstract: Accidents wreak havoc on victims, costing them valuable time and money. After thorough investigation, it has been shown that the majority of accidents result in fatalities as a result of poor communication with the relevant medical authorities and the ensuing dearth of prompt medical attention. Several sensor nodes are combined in a single system to forecast likely accident combinations. Lab view-based simulation was used to handlepossible conditions for an accident to happen. With the IoT Interface, theproposed design would enable a novel model in the vehicular communication system to recognize various accident situations and provide associated information to the needy. The proposed model would handle all potential combinations and comparative analyses from low to high end cars, as well as provide a strategy framework for future IoT enabled v2v communication networks.

Keywords: IoT, LabVIEW, Sensors, v2v Communication.

I. Introduction

According to International Labour Organization estimates, 120 million occupational accidents occur each year in workplaces throughout the world. 210,000 of them are fatal accidents. These are dramatic figures that have received little public recognition. Accidents receive little attention, despite the fact that they have a significant economic impact on governments, businesses, and individuals. Traditionally, accident prevention has been focused on learning from accidents. Disaster prevention is exceedingly difficult in the absence of a thorough understanding of the causes of accidents. Many attempts have been made to create a theory of accident cause prediction, but none have been widely accepted. Researchers from several sectors of science and engineering have been attempting to build a theory of accident causation that would aid in identifying, isolating, and eventually eliminating the elements that contribute to or cause accidents. [1]

A collision avoidance system (CAS), also referred as a pre-crash framework, FCW or collision mitigation system is a sophisticated driver-assistance system that is meant to prevent or mitigate the severity of a collision. A forward collision warning system, in its most basic form, tracks a vehicle's speed, the speed of the automobile ahead and the distance in between automobiles so that it may alert the driver if the cars approaches too near, possibly preventing a crash. The road transportation system not only allows commuters to get to their destination, but it also allows tones of commodities to get there. When an accident occurs on the highways, it has an impact on the transportation system. The reasons for this might vary, however the majority of the time it is due to drunk and drive. Detecting a collision and pinpointing the exact location of the car using multiple sensors such as GPS, GSM, and IoT. GPS retrieves the car's Geo-Coordinates, and the position of the vehicle involved in the collision may be traced using the Google Maps API. It will allow the ambulance to get at the spot faster and save lives. The ignition of the engine can also be regulated using the Alcohol sensor to prevent accidents[2].

II. Literature Survey:

Abdulkadir Shehu Bari et.al, [3] proposed Vehicle Accident Notifying and Sensing framework model .It has the potential to save about two-thirds of the lives lost in severe road accidents, particularly in isolated locations with little human activity. The GPS tracker linked to the system provides information about the precise geographical location, including latitude and longitude. The SMS notice is quickly transmitted to surrounding hospitals, ambulances, and police stations, as well as to the victim's family members. Using the location information, the ambulance might arrive at the accident site promptly and give emergency medical assistance to the victim involved in the accident. Thus, a simple method of reducing the incidence of accidents and quick alarm systems is obtained, a low-cost method of saving high-cost lives.In addition, the implications,

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problems, and implementation components are thoroughly examined in this research article.

S. Uma, R. Eswari et.al, [4] proposeda driver accident prevention and safety support system is presented in this research. Several algorithms were used to identify the driver's tiredness. The continuous observation of the driver and his activities contributes to the formation of a stronger dataset, which is kept in the cloud. By retrieving the driver and his parameters from the cloud; the suggested system employs machine learning techniques to categorize the driver's state. This enables driving-based organizations to pick or ignore drivers depending on their cloud-stored status. A driver's driving pattern may be produced using this method by supplying the driver's identity. In coming years, this work may aid traffic or police departments in warning sleepy and intoxicated drivers who have been identified as dangerous. More criteria can be added to the dataset in future study to attain high accuracy in predicting the driver status as risky or safe.C. K. Gomathyet.al, [5] recommended accident detection system that has the potential to save people's lives. The suggested method is quite simple to grasp, and even a non-specialized person may use it without difficulty. The system is made up of hardware and programming components. The equipment unit, which is installed in the car, contains collision detecting sensors limited by an Arduino board.

Stephanie G. Prattet.al, [6] Proposed a comprehensive analysis of nonfatal work-related motor vehicle events.Majority of earlier research has been on fatal MVCs, this study addressed gaps in the literature by analyzing the risk for non-fatal work-related crashes. Additionally, it employed a group of occupational drivers who were rarely studied in earlier studies light-vehicle fleet drivers as the study population. In addition, real vehicle miles driven were used in this study to determine accident risk rather than using the number of employees as an exposure metric. The results point to the need for additional research to examine crash risk for female light-vehicle drivers, as well as for both younger and more experienced employee drivers.José Terán, Loraine Navarro et.al, [7] Proposedapplication of driver assistance system with intelligence.The construction of an intelligent driving assistant based on vehicle telemetry and analysis of road accident risk maps is described in this study. Its job is to alert the driver to potentially dangerous circumstances so they can be avoided and prevent accidents. As a result, a fuzzy reasoning-based intelligent assistance agent was created, which correctly assisted the driver in real-time in accordance with telemetry data, the vehicle's environment, the rules of safe driving, and the road transportation rules and regulations.

Amir Bahador Parsaa et.al,[8] Proposed performance analysis of two common machine learning models. The primary data sources for this study are weather conditions, accidents, and loop detector data. Furthermore, the Synthetic Minority Oversampling Technique (SMOTE) is employed to solve the problem of unbalanced data. The findings reveal that, while SVM achieves greater overall accuracy, PNN surpasses SVM in terms of detection.P. Ramya Sree et.al, [9] suggested a study on Accidents in Hyderabad city, both within and outskirts of the city are increasing at an alarming rate, and proper precautions are not being implemented. The research of road accidents may be conducted on particular area of Cyberabad and one region of Hyderabad. This study discusses a variety of factors of traffic accidents in Hayathnagar and Saifabad. For three years, accident data were collected from police stations (i.e.2012-2014). The total number of accidents in Hayathnagar is 654 and in Saifabad is 477. Pedestrians are the most common victims of car accidents.

Fanny Malin et.al, [10] suggested a study of accidents under various climatic conditions. The technique considers accident risks from a single driver's perspective and relates them to the amount of time spent in the circumstances. The findings showed that relative accident risks were greater for snowfall than for other forms of less intense precipitation. The relative accident risk for the precipitation intensity was greater than it was for the other intensities of precipitation. The relative accident risk was highest when there was ice rain and when the roads were slick or very slick.

Kumar Molugaram [11] recommended Various Road Safety Aspects in Indian Metropolitan Cities like Hyderabad. A large number of traffic fatalities and injuries are not a by-product of motorization or a basic rule of nature. This indicates that the speed of cars in the Cyberabad region is much greater. The following are stated as causes of traffic collisions:
i. Motorists {drivers & pedestrians} ii) Car-related factors iii) Traffic-controlling equipment.
Road geometrics, such as pavement width and condition and shoulder width and condition, have a significant impact in the occurrence of traffic accidents.

Arsalan Khan et.al [12] Proposed Accident Detection and Smart Rescue System using Android Smartphone with Real-Time Location Tracking System. The goal of this research article is to speed up the emergency services' reaction to events like car accidents and other emergencies like fires,

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break-ins, and medical crises. The likelihood of survival for emergency victims will be greatly increased by using a Smartphone's onboard sensors to detect vehicle accidents, report them to the closest emergency responder available, and provide responders and emergency victims with real-time location tracking. This will also help emergency services save time and resources.

The authors of [13-15] have assessed and configured the latest variant of the CNN termed as capsule network. This architecture maintains the relationships of learned features which gives best performance in learning and testing phases. This architecture is useful in machine learning based processing involved in cloud centers in IoT.

III. Design Methodology:

We provided a LabVIEW framework for demonstrating the possibilities of V2V communication by modeling a variety of event patterns. National Instruments' Lab VIEW software was used to run the code in simulation environment. Controls and indicators were included accordingly. We used the LabVIEW tool to construct a simulated environment for accident prevention and detection. The parameters causing accidents were separated into two components based on the sensors employed in the developed framework.

Controls are user inputs presented in the front panel for some purpose, whereas indicators are outputs that are exhibited in the block diagram panel. We created an automobile simulation environment with three tab controls.

- Road Geometry: Hilly Area
- Climatic Conditions :Precipitation
- Geographic Area: Remote Area

Under these 3 conditions, there are 7 different parameters that are prone to accidents.

- Condition of the Car: Engine RPM, Brake Fluid Pressure
- Condition of the Driver: Alcoholic ,Driver Fatigue (Drowsiness), Heart Rate (low or High),O2 Concentration levels
- Traffic violations: Over Speed

Output values are displayed in the block diagram window based on the input values provided by the user.

The basic Outlook representation of the Proposed Simulation model is as shown in the fig i) below.

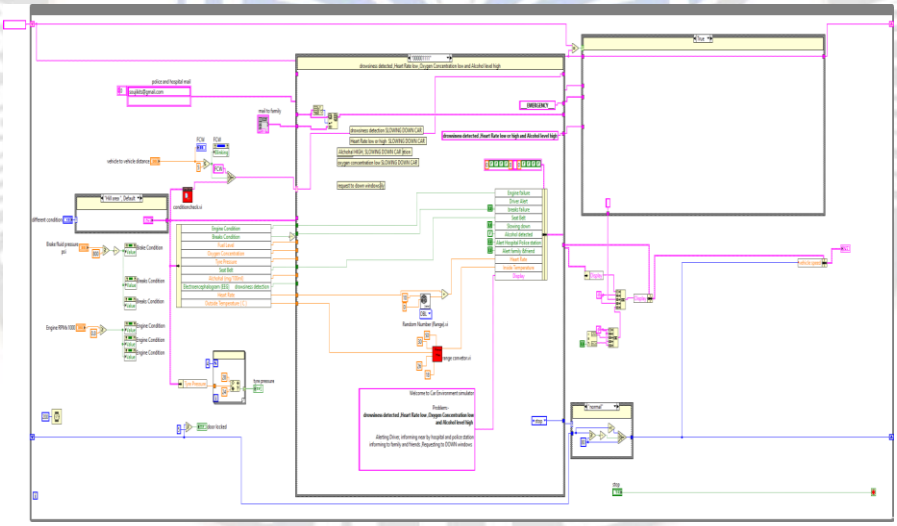

Fig i) Outlook of Proposed Simulation model using LabVIEW Tool

IV. Results and Discussions:

We developed a system for demonstrating the potential of v2v communication by modeling various case patterns. National Instruments' Lab VIEW software was used to run the simulation. To obtain the datasets, 72 distinct combinations of different accident situations were explored by changing input variables.If condition prone to accident is severe (life threatening) and indeed for any assistance to the victim, this proposed system will generate a voice alert based on the condition prone to accident severity.

Case 1: All Parameters are within the threshold limit. The display of Car Simulation Environment exhibits as: All are in good condition, Happy Journey with time stamping. Fig ii)

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Fig ii) All parameters are in good condition.

Case 2: Drivers fatigue i.e., Drowsiness of the driver is detected. Fig iii)

Fig iii) Drowsiness Detected

Case 3: Drowsiness detected, Heart rate is higher than threshold value (112), Oxygen concentration is at lower side(18%), Alcohol level of the driver is high (90 mg/100ml)& Fuel level of the car is low (10). It's an alarming situation. So Firstly alerting the driver by slowing down the vehicle speed, Informing nearby hospital and police station, Informing to family and friends, Requesting driver to down the windows to enter to stabilize the 02 con levels inside the car and searching nearby fuel and air stations. A voice based alert is generated. Fig iv)

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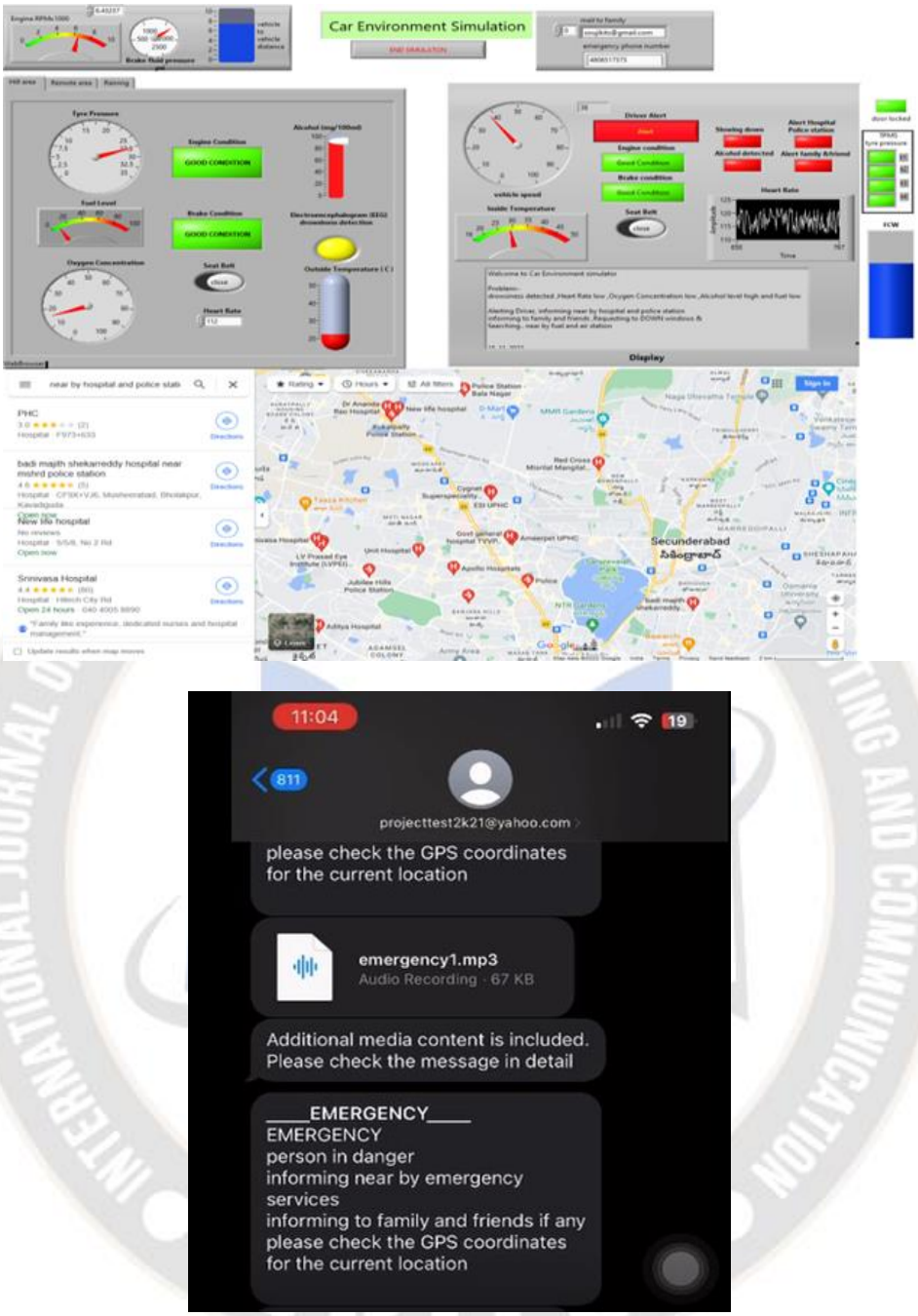

Fig iv) Drowsiness detected, Heart rate Low or High, O2 con Low, Alcohol level High, Fuel Low with voice based alert to Emergency Number.

Case 4: Drowsiness detected, Heart rate is higher than threshold value (102), Oxygen concentration is at lower side (18%), Alcohol level of the driver is high (90 mg/100ml) ,Seat Belt is not fastened,Tyre Pressure is low (13psi),& Fuel level of the car is low (10), Brake Fluid Pressure of the car is less than threshold value(300 psi) & Engine rpm is less than threshold value. It's an alarming situation. So Firstly alerting the driver by slowing down the vehicle speed, Informing nearby hospital and police station, Informing to family and friends, Requesting driver to down the windows to enter to stabilize the 02 con levels inside the car and searching nearby fuel and air stations .A voice based alert is generatedFig v)

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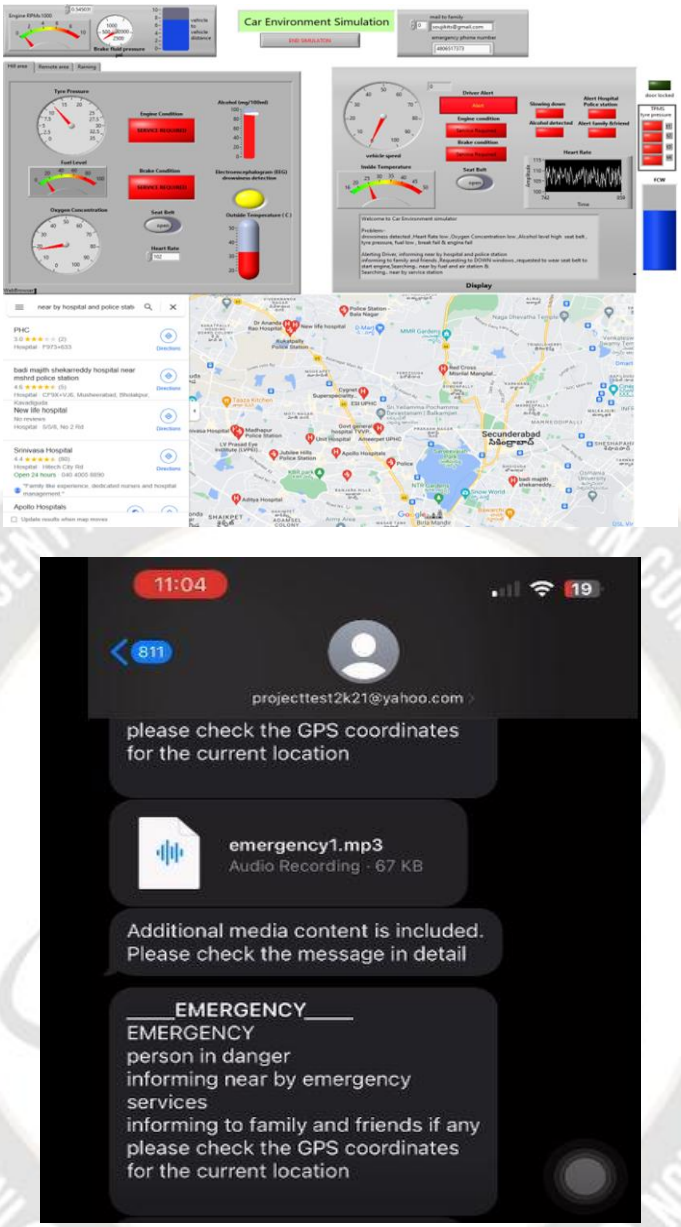

Fig v) Drowsiness detected, Heart rate Low or High, O2 con Low, Alcohol level High, Seat Belt Open, Tyre Pressure Low, Fuel Low, Brakes Fail, Engine Fail with voice based alert to Emergency Number.

V. Comparative Analysisof existing models and proposed model:

A proportional study is done for existing systems and proposed system by considering the sensors that are utilized in the models. This work is carried out by considering the response time of individual sensors that are being employed in the existing frameworks. To deduce the accuracy and potential benefits of the proposed model, we have taken the mean values of sensors response time therebycalculating the efficiency. Table 1)

Ref	Total no of sensors used	Avg Response Time
[16]	4	3.07
[17]	2	3
[18]	2	3
Proposed System	12	4.3

Table 1) Comparative Analysis between existing systems and Proposed System wrt Response Time

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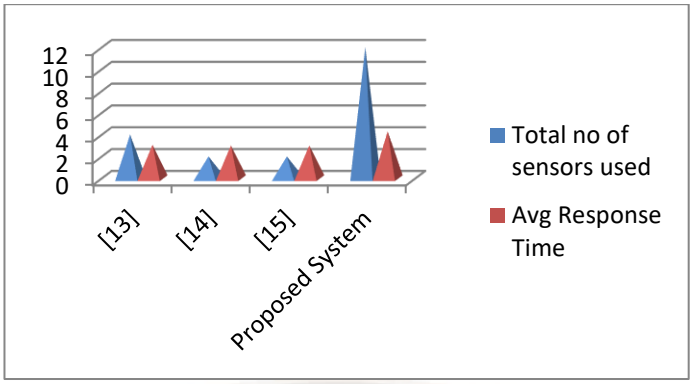

Fig vi) Graphical Representation of existing system and Proposed System based on their response time

VI. Conclusion:

We examined and presented accident prevention, detection based communication module with IoT that allows for information sharing and alarm system. We used lab VIEW simulation tool to determine different accident scenarios and identified other probable conditions. The suggested system will provide sensing capabilities for the development of a new communication module for accident prevention. During the study, we studied various situations and vehicle surroundings and presented the best feasible combinations based on current safety measures. To obtain the datasets, 72 distinct combinations of different accident situations were explored by changing input variables.If condition prone to accident is severe (life threatening) and indeed for any assistance to the victim, this proposed system will generate a voice alert based on the condition prone to accident severity.

A proportionate study is performed for present systems that are available in the market and proposed system wrt the sensors response time. To determine the accuracy and possible benefits of the proposed model, we have considered mean value of sensor response time thereby calculating the efficiency.

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