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Intelligent Vehicular Safety System: A Novel Approach using IoT and CNN for Accident Detection and Rapid Rescue

Riya Kapadia[1] , Jash J. Joshi[2]

[1]Computer Engineering, K.J. Somaiya Institute of Technology, Sion, Mumbai, India
[2]Computer Engineering, K.J. Somaiya Institute of Technology, Sion, Mumbai, India

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Abstract - *Road accidents have become a serious issue for the public. This paper offers a method for preventing accidents that incorporates alcohol detection using a MQ3 alcohol sensor, followed by a message alert to a rescue worker or family members. An SW-420 vibration sensor is employed by the detecting component to recognize any unexpected vibrations that might come from a collision. Supervised deep learning CNN methods go along with this. The front camera of the automobile is utilized to obtain a picture of the accident site for the deep learning accident prediction model. After a collision is discovered, notification is delivered to the closest evacuation facility via GPS and GSM devices. Once the Vehicle gets engaged in a collision, the following vehicle will be alerted via VANET. The alcohol sensor will then determine whether the driver has ingested alcohol or not and if they need to operate the car in an emergency while they are impaired. Then, as a consequence of driving too rapidly, multiple accidents happened. So, when the automobile exceeds the speed limit, an instant warning will be transmitted by GSM Module. Finally, Accident analysis device may be employed for smart cities using supervised deep learning CNN algorithms.*

Key Words: **Internet of Things (IOT), speed limit, MQ3 Alcohol Sensor, GSM, GPS, CNN and Accident Detection.**

1. INTRODUCTION

In contemporary society, anything and everything is now reachable, particularly through transportation. Transportation has varied over time, evolving since the middle Ages carts towards the space vehicles of the 20th millennium and beyond. Its swift development can be ascribed to either fostering commerce or the demand for speedy transit. Although many individuals believe that transportation is a major advantage to humanity, others are concerned that it can become a problem because of excessive vehicle speeds and a lack of regard for traffic safety rules.

In our everyday lives, we notice that the frequency of accidents globally is escalating the fatal toll. According to government estimates, accidents are believed to be the cause of 140,000 recorded fatality cases every year. According to statistics, rescue activities that are delayed are the leading cause of mortality for accident victims. We thus employed GSM and a MQ3 alcohol detector in our suggested system to keep a watch on the automobile in order to tackle this issue.

Accident fatality rates are decreased as well as the amount of time an ambulance needs to travel to the hospital thanks to IOT-based accident detection systems. Today, since we have the Internet and there have been technological developments in this sector, we are now in a position to adopt IoT more efficiently and effectively. Along with the usage of an IoT device in a car, we are also in a good position to put technologies like machine learning for sensor data and deep learning techniques like CNN for image processing on the IoT board to deliver significantly superior results. This powerful combo may be perfectly utilized for road accidents and determine accurately whether there has been an accident or not. Once an accident is detected, GPS sensors can get the actual location of the car. Once the accident data is sent to a server, the server reads the GPS location of the vehicle and spots the nearest hospital and emergency service. Meanwhile, it sends a notification through an automated call to the registered phone numbers by the user.

When a vehicle is engaged in an accident, an immediate notification will be issued to the registered contact details. Once an unplanned incident occurs the following car will be alerted through VANET. If the driver is inebriated, the notice will show promptly to the owner or the emergency services. In parallel, the notice will be provided if the automobile is involved in another collision. A prompt SMS given to the registered mobile phone number when the car exceeds the predetermined limit.

2. EXISTING METHODOLOGY

This study describes studies on the detection, localization, reporting, modeling, and analysis of traffic accidents. Accident detection systems based on smart phones have been reported in various research. This study, Rajesh, G. et al [1], offers a system that truly can identify traffic problems and promptly communicate an emergency SMS to the appropriate control center. It suggested Bhakat, A. et al [2], a smart accident detection and rescue technology that combines the IoTs (Internet of Things) and a system with artificial intelligence to simulate the intellectual processes of the human brain (AI). Choi, J.G and Kong [3],

suggested a smart accident detection and rescue solution that employs an artificial intelligence system and the Internet of Things (IoTs) to imitate the intellectual processes of a human brain (AI). A combination of an accelerometer and an ultrasonic sensor is proposed for accident investigation Zou. X et al [4].

A modified Haddon matrix is offered to offer various insights on the future wave of road safety studies during the intelligent, networked, and automated vehicular technology. In order to report a traffic collision more quickly, the proposed operational concept of the system is based on Convolutional networks and deep learning techniques Harikrishnan. A et al [5]. Many lives could be saved by implementing this approach. Whenever an accident is detected, the method utilizes GPS to find and alert a nearby hospital. In this research Wegmeth L et al [6], they suggest a machine-learning (ML) framework based on multiple in-vehicle sensors for autonomous car accident detection. Their study centers on the identification of actual driving collisions utilizing cutting-edge feature extraction algorithms and ordinary automobile sensors.

Inter-vehicle communication solutions like VANET (Vehicular Ad-hoc Network) and IoV (Internet of Vehicles) may be able to aid vehicles in reporting incidents via each other when a reliable Internet connection is only accessible to some nearby vehicles. It suggested Comi, A et al [7], a descriptive statistic would be used to decide which methods of data mining are appropriate for evaluating road accidents, as well as to identify their most important root causes and frequent trends. They presented M. U. Ghazi and M. A. Khan Khattak et al [8], the system efficiently distributing emergency alerts is a huge difficulty as a result of the several issues generated by this high traffic density. The dynamic character of the network makes employing VANETs for data transfer especially difficult.The proposed approach T. Yuan et al [9], based on the GIS and Firefly Clustering algorithms, can aid in the detection of city road "black spots' ' other than the contributes to minimizing car accidents and preserving sustainable urban growth. It indicates that B. Du, L. Yu, X. Hu et al [10], timely accurate traffic accident prediction has a great deal of potential to preserve public safety and reduce financial losses. That depicts Z. Huang and S. Gao et al [11], the recommended method gives considerable benefits for large-scale urban passenger hotspots in terms of clustering speed, accuracy, and visualization. They have used Fang and D. Yan [12], the prediction of driver attention is growing into a major research topic for driving systems that are similar to human people.

This research is aiming to forecast the driver's focus in scenarios that entail crashes (DADA). A method suggests, Singh, G. Pal, M et al [13], a descriptive analysis will be performed to find which data mining approaches are ideal for evaluating road accidents, as well as to highlight their most significant underlying causes and common patterns. It proposes Zhang, X. Rane et al [14], have employed Regular monitoring permits early machine failure identification, which is offering advantages for industrial automation superior process control. The proposed Goerlandt.F,Li and Reniers [15], indicates that it is vital to provide realistic accident prevention techniques in this paper in accordance with the pertinent safety protection criteria and the existing status of every industry. The Proposed method M. Mythili et al [16], is to present an elegant and safe biometric attendance technique for smart classrooms utilizing fingerprint sensors. If the instructor is not present in the classroom through the GSM module, an SMS alarm is dispatched to the relevant class incharge. The suggested methodology R. Sathya et al [17], is built upon a distinct image processing method for detection stage and identification system using support vector machine for offline signature verification. Author Sathya et al., [18] proposed a strong SSVM+Hybrid LUCNN idea that has been designed to recognize vehicle number plates for intelligent transportation systems. By observing machine tool status, the suggested study Sathya et al [19] built an intellectual (IoT) tool state supervising scheme to find construction tradeoffs connected to sustainability and the best machining settings.

3.PROPOSED ACCIDENT ANALYZING SYSTEM

The fundamental purpose of this Proposed System is to design a real-time application that leverages GSM and MQ3 Alcohol sensors to identify and decrease accidents. This aims to incorporate three parts in this study. When a vehicle is engaged in an accident, an SMS alert is immediately sent via GSM to the registered phone number. The novel proposed Accident Analyzing scheme Architecture is exposed in Fig. 1. Some accidents happened as a consequence of drunk driving. So, we can swiftly detect whether a person has consumed alcohol or not with the assistance of a MQ3 Alcohol Sensor.

As soon as alcohol is detected, the information is sent to the rescue officer or the victim's family. to caution them from driving near their family. Lastly, going too fast might sometimes result in accidents.

As a result, we have to establish an 80 km/h speed restriction. Through the use of engine control module sensors and vehicle speed sensors, the registered cellphone number will be alerted as soon as the speed limits are exceeded. This endeavor will help to reduce accidents, which in turn will reduce the number of deaths.

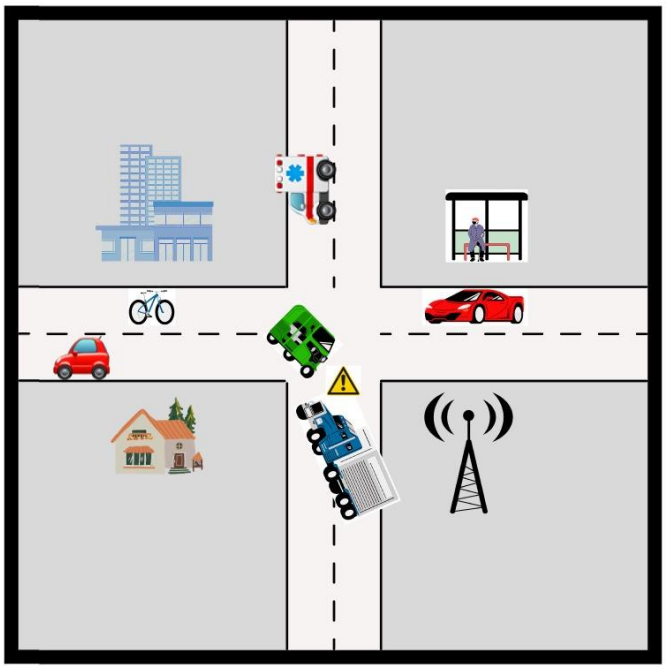

Fig. 1. The entire suggested Accident Analyzing System Architecture

3.1 Hardware Elements Included in the Accident Detection Phase and Sensing Phase.

1. MQ3 Alcohol Sensor: The presence of alcohol gas is detected [21], using this low-cost semiconductor sensor. This sensor's sensitive SnO2 has a conductivity that is lower than that of pure air. Its conductivity rises when alcohol content is observed. Both analogue and digital output are supplied by this module. It can simply be connected to microcontrollers like the Raspberry PI, Arduino boards, and others. If the individual is boozed while driving then the quick message will be sent to the rescue officers or family.

2. Radio Frequency Identification: RFID employs electromagnetic combination in the radio range zone of the electromagnetic spectrum to globally recognize a thing or human individual. It will be delivered the signal via the Radio Waves. Each and every automobile will have a unique RFID Tag to receive the signals from the accident vehicle to alert the incoming vehicle.

3. VANET: A vehicle ad hoc network approach is made up of numerous moving or stationary automobiles that are connected by a wireless network (VANET). VANETs were mostly employed until recently to increase driver comfort and safety in moving autos. Through the VANET, the cars on the road were connected to a wireless medium. The function of VANET will be demonstrated in Fig.2.

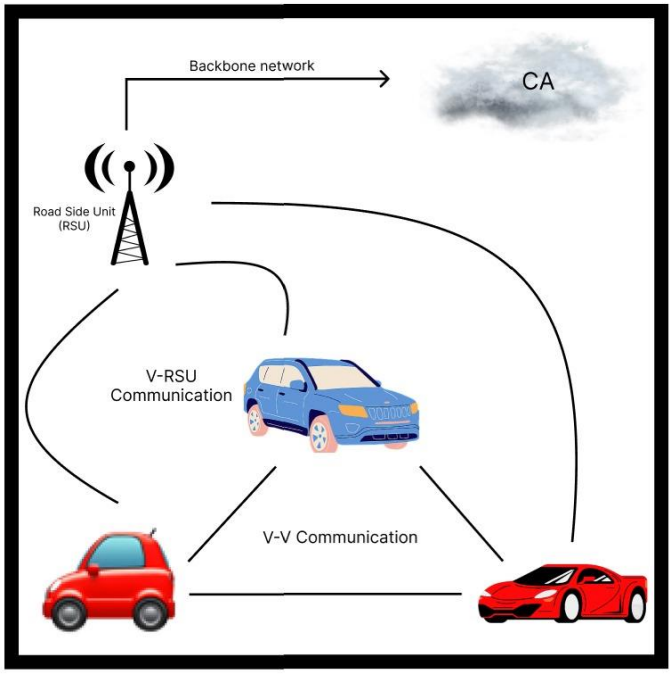

Fig. 2. The role of VANET

This will assist us to deliver the alarm signal through waves. The VANET will be coupled with the RSU (Road Side Unit). Once the motor begins VANET will be activated through RSU.

4. GSM Module (SIM900A): The GSM module is switched on if the deep learning model identifies an accident, and employing location tracking, the data is provided as a text message to the neighborhood emergency centre. The message and collectively, the CGI is transmitted. This message is a base transceiver station's internationally unique identity. MNC, LAC, CI and MCC (Mobile Country Code) are its four component sections (Cell Identification). With the use of GPS, the CGI may be used to trace the location.

5. Engine Control Module and Vehicle Speed Sensors: The actuators in a combustion engine are governed by an ECU, also referenced as an ECM, to guarantee optimal engine performance. Then, the standard speedometer is replaced by a speed sensor. It rotates while being attached into an electrical connection that may provide a signal to a computer. In this way, the sensor sends data for calculating your car's speed. It also informs whether you need to alter the transmission speed or shift levels.

3.2 Software Elements.

In this case, Tensor Flow works as the backend while Keras serves as the neural network API. Tensor Flow is a complete open resource Artificial Intelligence framework. TensorFlow gives a large, complete network of procedures, databases, and group of people qualities that

allow researchers to overcome the restrictions of machine learning and implementers will promptly and efficiently develop and organize machine learning starts.

4.IMPLEMENTATION FLOW OF PROPOSED SYSTEM

The recommended idea comprises two steps, sensing stage and avoidance stage. An Arduino Uno is connected to the sensors for the preventive phase, according to the block diagram mentioned in Fig. 3.

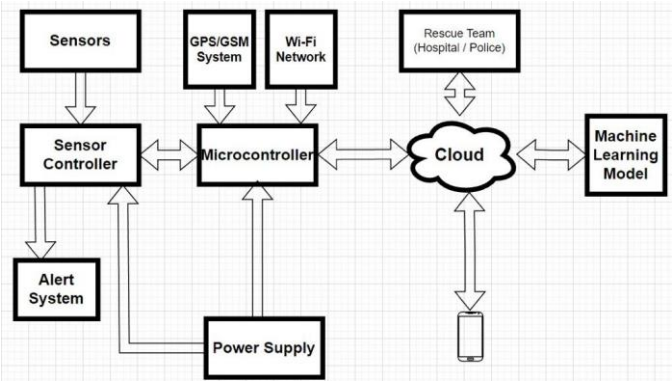

Fig. 3. Flowchart of accident detection and sensing.

Step 1: The Arduino Uno is interfaced with the alcohol Sensor (MQ3), the SW 420 range of vibration sensor, and the GSM module for delivering messages (L293D motor driver).

Step 2: Using a USB connection, the raspberry pi module receives the conclusion of the SW 420 range of this sensor.

If the output is designated as logic high, that will turn on because it is linked to the raspberry pi module. The scene is taken by this suggested module, and utilizing the deep network layer constructed in the component layer, the image is compared with the specified dataset.

Step 3: After the boozed individual rides a car and meets with an accident the quick communication will be sent to the rescue team.

Step 4: When the speed limit is outside the range the immediate Alert notice will be issued to the relatives or rescue squad.

5. RESULTS

1. Results of Vehicular Accident Detecting: The sensing phase involves accident identification, detection and tracking with utilizing a deep network layer and intimation of vehicle accident incidents to the nearby rescue center. The function of the system will be clearly depicted in Fig.4. The SW420 vibration sensor is utilized to establish collision detection. When an abnormal jerk or vibration is detected that exceeds the specified threshold, the sensor output spikes, triggering the buzzer. We have set the threshold value at 80000 for prototype demonstration purposes. The rescue team will then get the alert message quickly.

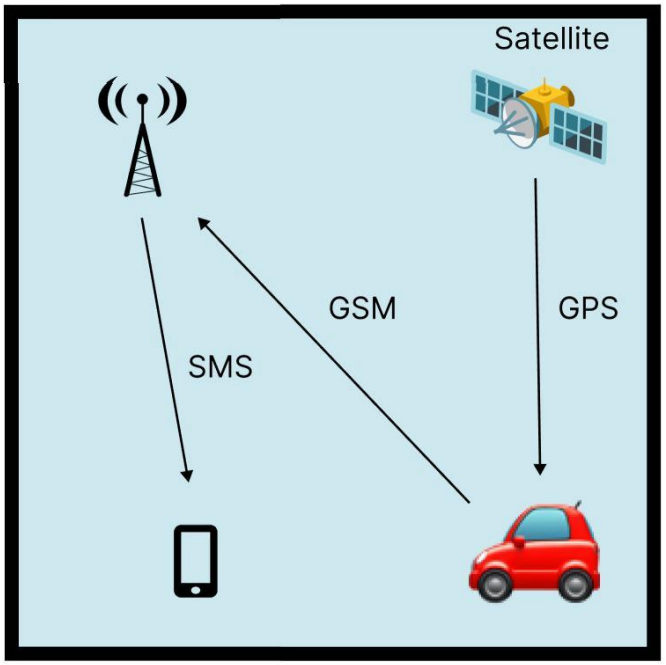

Fig. 4. Accident Detection using GSM.

2. Results of Vehicular Alcohol Sensing: Internal initialization has set the MQ3 sensor's threshold at 500 ppm. The GSM will be engaged by RSU once the alcohol concentration surpasses the threshold. The nominated cellphone number will thereafter get the alert message over GSM. The exact phenomenon has been proven using an L293D motor driver. An alcohol based hand sanitizer has been deployed for testing reasons; when it is discovered, a notification is sent.

3. Results of Accident Recognition using CNN: It is recommended that a deep learning Convolutional neural network be used for each frame of a motion picture that has been trained to discriminate between accident- and non-accident-related video frames. It has been established that Convolutional Neural Networks [20], offer a rapid and reliable way for identifying pictures. For considerably smaller datasets, CNN-based image classifiers have achieved accuracy levels of exceeding 95% and unnecessary preprocessing than other image classifying algorithms.

4. Results of Speed Alert Detection: The RSU will activate both the Engine Management Module and Vehicle Speed Sensor when the car exceeds the speed restriction 80km/h. The limit of the vehicle fixed is indicated in Fig.5.

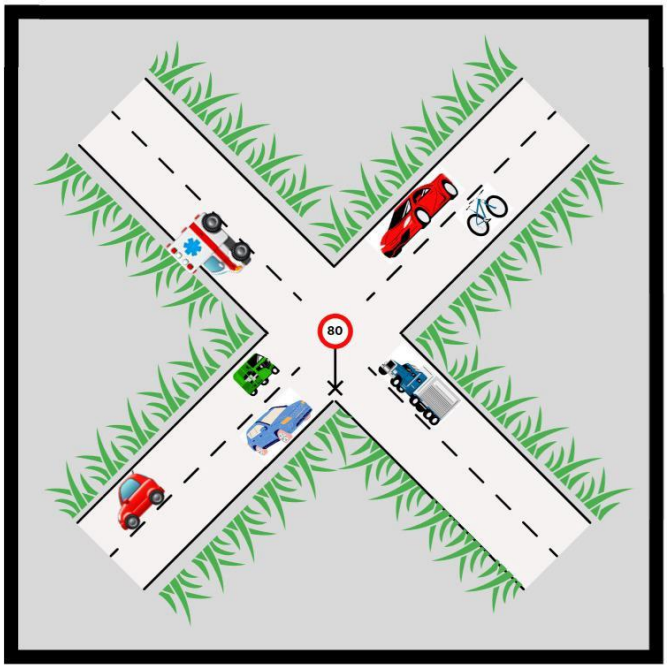

Fig. 5. Speed Guard.

The GSM Module will then activate the two sensors. The rescue squad will instantly get an alarm message if the GSM Module senses vibration.

6. CONCLUSION

In comparison to the present methods, the proposed solution is much more trustworthy and may be more efficient. We are able to track, monitor, and establish the whereabouts of both persons and vehicles. The primary benefit of this research is that it allows us to prevent the loss of life by stopping intoxicated drivers from driving automobiles and alerting them to a speed alert. When compared to the present methods, the innovative accident sensing and vehicle accident detection method delivers better accuracy. In the future, if a car is stolen, we will be able to follow its whereabouts in real-time using a GPRS module.

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