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A Survey of Mobile Application Based Collision Detection Alert System for Motor Vehicles

China Ramu S[1], Ram Charan Reddy[2], Sai Vishal Uppala[3]

[1,2,3]Department of CSE, Chaitanya Bharathi Institute of Technology, Gandipet, Hyderabad, Telangana-500075, India.

ABSTRACT: Accidents involving motor vehicles are a big problem on a global scale, and they frequently result in terrible deaths. Responding to emergencies in a timely manner is absolutely necessary in order to improve survival rates in instances like these. Alternatively, this reaction time is dependent upon the presence of automatic in-vehicle crash detection and reporting approaches, which are commonly seen in high-end or luxury automobiles. Due of this, there is a gap in safety, particularly in low-end automobiles, which are widespread in developing nations. Original equipment manufacturers (OEMs) do not often install such devices in their vehicles. This research provides a unique way to solve this important issue, which is an autonomous collision detection system which uses smartphones. Our method makes use of the sensor capabilities of cellphones, such as Accelerometer, Gyroscope,GPS and GSM , in order to correctly detect collisions. This is accomplished despite the limits of the sensors, which includes range and sensitivity. As a result of this, this system presents an option that is more cost-effective than the expensive collision detection systems that are combined with the premium automobiles. In addition, this method eliminates the cost barrier, which enables it to be compatible with Android devices whereas it was previously only compatible with iPhones. The focus of this approach is mainly placed on the significance of minimising reaction times in the event of traffic accidents. It highlights the disparity between different car categories in terms of safety features and provides the solution that is based on smartphones.

KEYWORDS: Crash Detection, GSM, Accelerometer, Gyroscope, GPS, Android Application.

1 INTRODUCTION

Nearly 1.4 Million individuals lose their lives in accidents annually. So, immediate action is required in order to minimise the terrible effects of delayed emergency response. A critical time exists between the crash and the arrival of emergency assistance, and the increase in the number of cars necessitates the development of innovative methods to bridge this gap. There are advanced in-vehicle automatic accident detection systems available for high-end automobiles; however, the popularity of these systems is limited due to the expenses connected with them.

A smartphone-based collision detection system is the alternative that is suggested in this paper. It is a realistic and cost-effective solution.As smartphone usage continues to rise, implementing a system based on these devices is becoming both feasible and affordable. In many cases, the existing methods requires the installation of sensors or hardware in cars before they can be used. This creates financial obstacles and restricts the scalability of the system. By utilising the sensors that are already present in smartphones, our suggested solution, on the other hand, liminates the requirement for extra hardware.

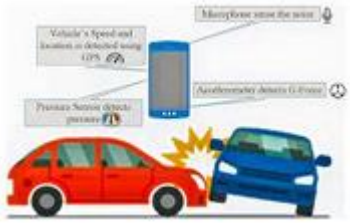

Fig. 1 Collision Detection

The purpose of this paper is to propose a revolutionary solution in a context where road safety is of the utmost importance. The solution is one that makes use of the availability of smartphones to develop an automatic crash detection system which is user-friendly, accurate and portable.

2 LITERATURE SURVEY

This research paper proposes an Internet of Things-based car tracking system. The system is designed to monitor vehicle speed by utilising Raspberry Pi microprocessor and GPS, GSM/GPRS with on-board diagnostics (OBD) equipment. It sends the location and speed to a control centre if the speed limits are violated. The control centre then issues penalties to those who violate the speed limit based on a database that is kept up to date. This system, which is both cost-effective and

efficient, intends to reduce fraud, efficiently restrict speeding, and reduce the number of accidents. [1]

This research paper proposes a strategy for improving road safety. This strategy involves the adoption of intelligent transport infrastructure, which makes use of the latest developments in Artifical Intelligence technology and strong computer equipment. Within the framework of the suggested model for collision detection, the dependable and precise StrongSort and YOLOv5 are incorporated, hence simplifying the process of vehicle locating and tracking. Accidents are evaluated by the model with the help of vehicle's acceleration, speed,trajectory anomalies and area anomalies. The model places an emphasis on simplicity without compromising accuracy. Detection of vehicles, tracking of vehicles, and extraction of features are the three primary processes that comprise the approach, which culminates in the detection of collisions. Accident detection is accomplished through the utilisation of an algorithm that employs threshold levels of a number of parameters. The model exhibits excellent performance, which is especially clear in the fact that it was successfully evaluated using test crash recordings under a variety of ambient settings, at all times.[2]

This research paper proposes a comprehensive solution that includes a system for prevention and detection of vehicular accidents in order to meet the growing number of vehicular accidents that occur on highways. The system improves the safety of driving by utilising a number of different components, including sensors, a microprocessor, and an Android mobile application. A prevention subsystem is incorporated into the architecture of the system. Using an ultrasonic sensor, this subsystem determines the likelihood of a collision and notifies the user based on predetermined alert, safe and danger zones. In addition, the collision detection system makes use of computations and makes use of an MPU6050 module in order to estimate the movements of vehicles and identify rollovers or collisions. An Android application that is connected to the system is intended to provide notifications and detailed accident information to emergency contacts. The experiment results show that the system can precisely identify crashes, which results in improving road safety.[3]

This authors in this paper proposes the urgency for collision detection in a timely manner by the use of data from on-board sensors, with an emphasis on the ability to avert injuries and fatalities. The intention of the deep learning approach that has been developed is to analyse data obtained from GPS devices and Inertial Measurement Units (IMU)in order to determine whether or not an accident has occurred and also to evaluate the severity of the accident. Through the utilisation of a multimodal contrastive self-supervised training approach, the neural architecture is intended to make use of a variety of sensor streams like GPS acceleration and gyroscopeSeveral personalized data augmentation procedures have been implemented to improve generalisation and solve the notable class imbalance. Using a huge dataset that is imbalanced and consists of automobiles from the United States, validation against state-of-the-art approaches demonstrates the method's capabilities. In addition, the fact that it has a small footprint and a low latency makes it simple to deploy on embedded devices, which highlights the fact that it is practical for applications that are used in the real world.[4]

The authors in the paper a collision detection and alerting system that is designed in order to send a message to the emergency contacts as soon as the collision occurs, including the co-ordinates of the collision that was identified. It is given with a reset button so that it can prevent any unwanted alarms from being triggered in situations where everyone within the vehicle is safe. This approach aims to lessen the adverse impacts that auto accidents have on public health and facilitate access to quick medical assistance.[5]

The authors in the paper proposes the utilisation of sensors and computer equipment, the system that revolutionises the safety of vehicles. A highly developed microprocessor can assess events in real time and send out alert signals according on the vehicle's speed and closeness. This microcontroller can measure the speed, direction, impact angle, and velocity of objects in its immediate vicinity. A full emergency response system is provided by the system, which incorporates GPS, GSM, and Bluetooth modules. Location tracking and SOS transmission are both made possible by the GPS module, which ensures the dependability of the system in the event that GSM and Bluetooth fail to function properly. Furthermore, the Bluetooth module facilitates the transmission of information between vehicles and establishes a network for the purpose of facilitating joint SOS signalling in the event of an emergency. This multimodal approach guarantees that the crash jack will be helpful in improving the overall safety of passengers.[6]

This research paper proposes an eye blink sensor which is included in the Drowsiness and Accident Detection System, which also includes pulse rate sensor and vibration sensor for the purpose of detecting accidents. Additionally, the system is designed to recognise drowsiness in the driver. The primary goals of the system are to notify the emergency contacts in the event of a collision and provide information on the user's level of fatigue or sleepiness. The system uses GPS and GSM for location tracking and message transmission. Whenever the collision is detected, the message is sent to the emergency contacts that includes information about the user's location. Eye blink sensors are built into wearing glasses, and they are designed to sound an alarm if they detect that the wearer's eyes are closed. Within twenty seconds, if the alarm is not switched off, an abnormal state is presumed, and the emergency contacts receive a message informing them about the problem. This method addresses both the identification of accidents and the tiredness of drivers in real time, which

contributes to the proactive safety measures that are being implemented.[7]

This research paper proposes Internet of Things (IoT)-based ITS which offers potential ideas to improve road safety. ITS stands for Intelligent Transportation Systems. Reducing response time through the use of methods like Vehicular Ad-hoc Networks and ML algorithms is one method that has proven to be beneficial. These technologies monitor vehicle dynamics, user's behavior and the use of measures in order to not only identify accidents but also prevent them from happening in the first place. In spite of the abundance of published research on accident detection and prevention, this study attempts to fill in any gaps by providing a comprehensive analysis of the many strategies now in use. In addition to providing insights for the creation of effective systems that build on strengths, this study attempts to address weaknesses in the current accident detection and prevention tactics. A critical evaluation of the field's current state will be done in order to accomplish this. [8]

This research paper proposes to lower the number of fatal car accidents, there is an Automatic Accident Detection System. The system makes use of an accelerometer, an ARDUINO UNO board, a Global System for Mobile Communications module, a Global Positioning System module and a limit switch to detect accidents, turn on the GPS to record co-ordinates, and send out instant messages to family members, police, and hospitals in the occurrence of an accident. Embedded within the vehicle, this system guarantees prompt reaction, adaptability in contact updates, automated activation, and durability against damage to the vehicle for improved care following an accident. [9]

The authors in the paper proposes An Automated Car Accident Detection and Alerting System that uses an accelerometer to identify tilting and colliding vehicles. Unlike traditional rescue systems, the system ensures a quicker turnaround time by immediately sending the GPS position of the collision to selected emergency contacts. In order to lessen the catastrophic effects of accidents on human lives, this state-of-the-art technology aims to improve emergency response times and efficiency. [10]

The authors in the paper proposes the Android app Vehicle Crash Detection (VCD) system combines speed and acceleration data to determine the possible severity of an accident using OBD sensors (GPS, Accelerometer). The software, which is intended for drivers and service providers alike, works by having users enter travel information. Should an accident occur, the system will then instantly notify the nearest service providers. Accidents are confirmed by users, and the application looks for neighboring sources if no one responds in 20 seconds, an signal is transmitted. If a provider is found, notification is sent, accident information are recorded, and they are assigned. This method improves communication and accident response, which raises the bar for road safety in general. [11]

This research paper proposes the system which uses devices like gyroscope and accelerometer to identify sudden changes in velocity, rotation, and orientation characteristic of accidents involving two-wheelers. These sensors are integrated with a microcontroller unit programmed to analyze the sensor data in real-time. Additionally, GPS technology is employed to accurately pinpoint the location of the accident, enabling swift response from emergency services. In addition to that, the incorporation of cloud technology allows for the aggregation and analysis of data from multiple incidents, facilitating the detection of collision-prone areas. By utilizing machine learning algorithms on this data, policymakers can get valuable insights into the causes that lead to accidents and develop focused interventions aimed at improving road safety. Overall, this integrated approach aims to significantly reduce emergency response times and improve overall safety for two-wheeler riders. [12]

3 COMPARISON STUDY

3.1 On-Board Diagnostic Equipment (OBD)

The OBD equipment shown in fig. 2 interfaced with the Raspberry Pi microcontroller serves as the primary data source, capturing crucial vehicle metrics such as speed. Leveraging the integrated GPRS/GSM and GPS modules, the Raspberry Pi enables real-time tracking of the vehicle's location alongside speed monitoring. If the vehicle surpass the speed limit, the microcontroller swiftly transmits the speed data along with precise coordinates to the central control center via internet connectivity. Within the control center infrastructure, a robust database system is employed to store comprehensive vehicle information, including speed violations and corresponding location data. Upon detection of a speed violation, the control center initiates necessary actions, such as imposing fines, using the transmitted data from the vehicle's device. This automated process ensures swift and accurate enforcement measures, enhancing traffic safety and compliance with speed regulations.

Fig. 2. On-Board Diagnostic Device

3.2 Vehicle Crash Detection (VCD) System

To assess the potential for collisions, the Vehicle Crash Detection (VCD) mobile application shown in fig. 3 makes use of Accelerometer and GPS. The impact severity of the collision is then calculated by combining the data gathered from these sensors. As drivers enter journey details, the

application monitors their speed and acceleration, and it prompts them to confirm any accidents that may have occurred. In the event that there is no response, the details of the accident are saved, and an alert is relayed to the designated contacts of the user. Through the implementation of this streamlined method, a prompt response and effective management of potential incidents are ensured.

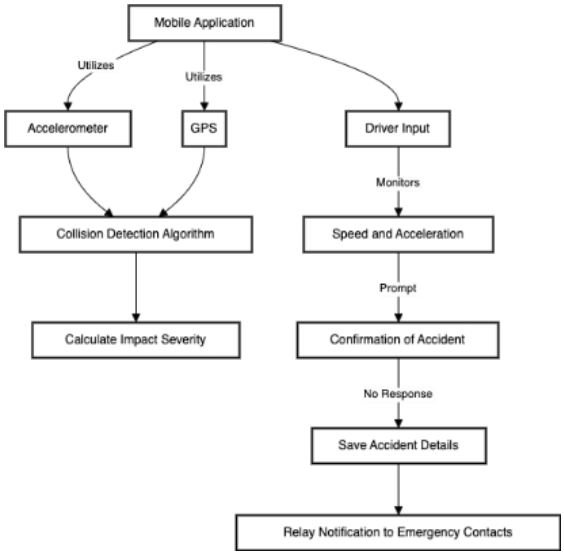

Fig. 3. VCD Architecture

3.3 Crash Detection on iPhone by Apple

A system that automatically responds to emergencies is built into Apple products like the iPhone and the Apple Watch. This system is designed to be activated in the case of a serious car accident. In the event that a collision is detected, an alarm will ring, and alerts will be presented on both components. If the user is able to do so, they have the option of either calling emergency services or dismissing the warning. Following a delay of twenty seconds, the device will automatically launch an emergency call in the event that it does not receive a response. In addition, if emergency contacts are configured, a message that shares the location is sent, and for individuals who have a Medical ID, the relevant information is made available to responders using a slider that is specifically designated for that purpose.

3.4 Video-based Road accident Detection

As shown in fig. 4 a traffic collision captured on video In order to identify an accident, detection makes use of the dependable and precise YOLOv5 and StrongSort algorithms for the purpose of vehicle tracking. For the purpose of accident detection, the model analyses acceleration, trajectory anomalies, and vehicle speed and area anomalies in order to develop a reliable framework. The process is broken down into three primary stages:

1. Identification of the vehicle
2. Tracking with feature extraction
3. Detection of the crash.

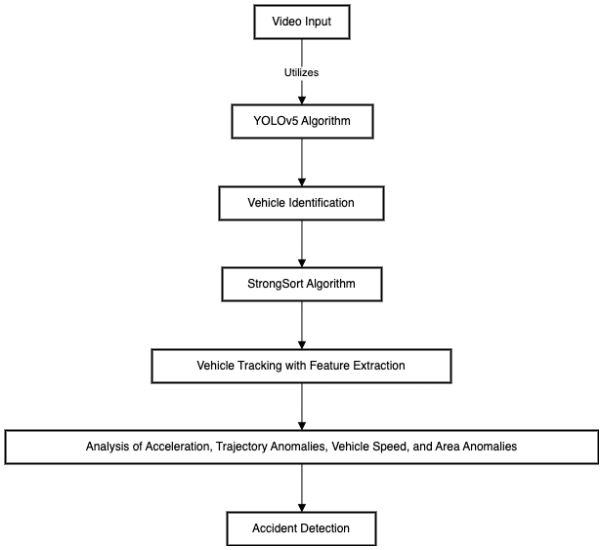

Fig. 4. Architecture of Accident Detection

4. COMPARISON ANALYSIS

The OB Device, the Vehicle Collision Detection, Crash Detection on iPhone by Apple and the Video-utilized collision Detection are all examples of systems that have their own unique characteristics and approaches. Additionally, OBD makes use of Global System for Mobile Communications /GPRS and GPS in order to maintain continuous position tracking. For speed monitoring, OBD relies on OBD equipment. It does this by retrieving data on vehicle speeds on a regular basis and communicating with a central station. It then uses this information to issue automated fines for speed limit infractions. To evaluate probable accidents, the VCD System, on the other hand, makes use of GPS and Accelerometer. It achieves this by combining information from several sources to estimate the impact's intensity. By urging users to confirm incidents and notify contacts if necessary, it emphasizes user engagement amongst drivers. In contrast, video-utilized road accident detection analyzes videos and uses computer vision techniques to detect accidents, track vehicles, and perform vehicle localization. The OBD system prioritizes speed monitoring and the associated fines for infractions, whereas the VCD system aims to provide efficient accident management through user participation. Conversely, video-based detection may be influenced by and requires advanced visual processing in order to completely identify accidents.

Compared to other methods, such as OBD, video-based systems and Crash Detection on iPhone by Apple, VCD technique has been shown to be more effective. On the other hand, VCD is not considerably affected by a variety of environmental conditions, in contrast to these options. Furthermore, when compared to the other methods, VCD stands out as a solution that is both cost-effective and efficient.

5. CONCLUSION

In conclusion, the ever-increasing demand for automobiles has resulted in a concerning rise in the number of accidents that occur on the roads, as well as an increase in the number of people who lose their lives. Clearly, the ability to save lives is contingent not only on taking safety procedures while driving but also on receiving prompt medical attention. Unfortunately, there are a number of variables that contribute to treatment delays. These problems include difficulties in communicating with local hospitals and high traffic that makes it difficult for ambulance services to operate. A new crash detection and alerting system that is based on smartphones and utilises Internet of Things technology was proposed by us in order to overcome these difficulties. Not only does this technology identify accidents, but it also sends rapid notifications to Emergency Contacts via emergency contacts' smartphones. The effectiveness of emergency reactions is improved by the system through the utilisation of GPS to analyse metrics such as speed, accelerometer data, and gyroscope.

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