A survey on enhancement of motor vehicle safety features using smart sensors

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***Abstract*—In this modern era people are seeking more comfort and using bikes frequently rather than cars, due to which bike accidents are increasing rapidly every year. As we are moving on more advanced, convenient technologies are being introduced. If the bike is crashed in an isolated area it is very difficult to locate it and nowadays we see three or more people riding in a bike and this may lead to accidents. So to avoid this our proposed model has a helmet detection module, crash detection module and GSM module. The helmet module detects whether the rider and pillion rider is wearing helmet or not and if not, then the engine gets turn off. It also detects if there are more than 2 people in a motor vehicle or not. It also checks whether the rider is removing the helmet during the journey and if so, then a beep sound will be generated. The GSM module provides the location of the motor vehicle in case of accident. Crash detection module automatically sends an SOS to the concerned authority which helps to save the life of the riders.**

***Index Terms*—GSM module, Helmet Detection, Crash Detection, SOS.**

I. Introduction

The recent studies shows that most of the motor vehicle accident victims dies due to fatal head injuries which cause the sudden death. Motor vehicle riders face the potential for severe injury every time they ride. Unfortunately, some collisions have the potential to result in death. While motor vehicle accidents may not be as common as motor vehicle crashes, it is worth noting that riders face a much higher rate of fatal injuries. The potential for severe injuries is also greater for those riders that survive a crash as compared to motor vehicle occupants. There are different causes of death in motor vehicle accidents. However, according to a study made available by the National Library of Medicine (NLM), more than 40 percent of fatal motor vehicle accidents result from some form of head trauma. Another major problem is if an accident occurs in an isolated area, its really difficult for the victim to get help. The victims may not find any place or anyone for help. Sometimes even victim's family member may not know about the victim's accident. There are cases where victims die due to the lack of immediate medication. Every vehicle whether it is a motor vehicle or not will have a maximum load that can be afforded by that particular vehicle. Nowadays we can see three people in a bike. This is also a reason for most of the motor vehicle accidents.

II. Literature Review

The literature survey includes the gist of the papers referred. The authors of paper [1] offer a method for spotting the helmet and give users access to a challan payment user interface. The suggested method first takes a real-time picture of

road traffic, separating the two-wheelers from other on-the-road vehicles. The next step uses OpenCV to determine whether the rider and pillion rider are wearing helmets or not. The vehicle number plate of any rider or pillion rider who is discovered to be without a helmet is analysed using optical character recognition (OCR). A challan will be generated against the appropriate car after the vehicle registration number is extracted, and all of the challan's details will be delivered to the appropriate individual through email and SMS.
The authors of paper [2] suggest developing a motorbike

accident detection system that alerts the wounded motorcyclist's emergency contact of their exact location so that urgent medical attention can be given. The suggested method is based on a tilt sensor that determines the motorcycle's angle of inclination and then sends an alert to the concerned parties via SMS and GPRS via an online server utilising a GSM module. The primary contribution of this paper is the rigorous real-world testing of the designed system and the data collection from 10 different bikes to identify the ideal tilt angle.

In their study [3], the authors primarily use an accelerometer and a microcontroller. It is essentially a smart helmet designed to track down and report two-wheeler incidents. The end goals of notification and reporting are accomplished by using cloud service infrastructures, an accelerometer, a GSM module, and a microcontroller interfaced with them. The helmet is designed to recognise two-wheeler accidents and transmit the accident's geographic coordinates to the appropriate authorities and the victim's emergency contacts. The helmet has a 6-axis accelerometer installed on it that continuously tracks the helmet's acceleration levels.

The authors of [4] suggest a technique that uses object segmentation and backdrop subtraction to identify bike riders in surveillance video. The binary classifier and visual cues are then used to determine whether or not the bike rider is wearing a helmet. Additionally, a consolidation strategy is used for reporting violations, which contributes to the approach's increased dependability. This is evaluated by comparing the performance of three popular feature representations for classification: the histogram of oriented gradients (HOG), the scale-invariant feature transform (SIFT), and local binary patterns (LBP).

The authors of [5] suggest extracting the picture properties using the Histogram of Oriented Gradients descriptor and the circular through transform. The findings of the MultiLayer Perceptron classifier were then compared to those of other algorithms. 255 photos from a database of traffic images were collected by cameras from public highways.

The authors of [6] suggest a system that includes three distinct inertial measuring devices that are mounted to the motorcyclist's head, chest, and back. The dummy is thrown at various altitudes to simulate the impact of a collision on the driver, and actual data is gathered while the motorcycle is being driven. For the purpose of classifying the crash and normal driving, a maximum a posteriori classifier is developed.

The authors of [7] suggest a system that recognises moving objects in a scene by using footage of traffic on an open street as information. This piece of work suggests a system based on the location of specific or several riders travelling by bike without a helmet. The YOLOv3 model, a consistent variant of the YOLO model, is used from the starting stage of the proposed method to identify bike riders. The leading object-discrimination methodology aids in this distinction between helmet-wearing and helmet-less cyclists. If there are more than two riders, the vertical binary projection is utilised to count them.

The authors of [8] suggest developing a system that can recognise motorcycle riders and assess whether or not they are wearing safety helmets. Using the K-Nearest Neighbour classifier, the system gathers information from moving items' region properties and categorises them as motorcycles or other moving things. Following that, projection profiling is used to count and segment the heads of the riders on the identified motorcycle. Based on data extracted from 4 portions of the segmented head region, the system uses K-Nearest Neighbour to determine if the head is wearing a helmet or not.

The authors of [9] proposed a method for running helmet and fall detection systems for two-wheeler drivers. In the event of an emergency, our system would alert surrounding hospitals, relatives, and law enforcement. Therefore, it ensures the drivers' safety while driving. The goal of this project is to develop an automated accident detection and reporting system. Our method is quite helpful in preventing traffic accidents. Bicycle users' safety is therefore guaranteed.

The author of [10] suggests a methodology for identifying motorcycles being driven by one or more riders who are not wearing helmets. The state-of-the-art method for object recognition, YOLO model, and its incremental version, YOLOv3, are used in the proposed approach's initial step to detect motorbike riders. A Convolutional Neural Network (CNN) based architecture has been suggested for the second stage of motorbike rider helmet recognition. When compared to existing CNN-based techniques, the suggested model's evaluation on traffic recordings yielded encouraging results.

The MPU6050 is a superb motion sensor, extremely affordable, with a comprehensive motion processor that may deliver very accurate data and can filter vibrations in the case of using it close to an engine, according to the author of [11]. However, an automobile sensor is a suitable option because of its inexpensive cost. The vehicle sensors are designed to have very accurate readings while also reducing vibrations. The method that combines data from tilt angles, acceleration, and deceleration has a high success rate. No missed crash or false positive has yet been noted in any of the tests that have been conducted. Crash detection is a crucial function for motorbike riders, and when combined with an E-call system, it can cut the time between an accident and the arrival of emergency services by 50

The author of [12] offers a simple but clever framework that can recognise and report a two-wheeler collision. Because two-wheeler accidents in India have the greatest mortality percentage, this research focuses on two-wheelers. This framework includes a low-cost, microcontroller-based Accident Detection Unit that has a GSM modem and a GPS positioning system for detecting accidents and sending them to a central server. The Accident Detection Unit determines the accidental circumstance by calculating acceleration and the vehicle's ground clearance. Accident Detection Unit provides GPS coordinates, the current time, and accident detection characteristics to the accident detection server when it detects an accident. According to historical data, current data, and the rules you specify in the system, ADS maintains information on the movement of the vehicle. Accident Detection Server alerts

the emergency services and the vehicle's preloaded mobile numbers in the event of an accident.

In this study, the author of [13] offered a brand-new technique of incident detection that is based on an in-car terminal that includes a GPS module, GSM module, and control module in addition to certain optional components like airbag sensors, a CPS module, etc. A motorist or vehicle that reports an alarm would be found automatically using GPS, CPS, or both. A closed-circuit television (CCTV) would then be used to zoom in and confirm the collision. To encourage drivers to report more, an information-feedback mode was proposed. After analysing the detection performance, practical ways to increase detection rate, time to detect, and FAR (false alarm rate) were provided..

According to the author of [14], a conventional in-vehicle ACN is limited by mobility and expensive prices, but it can give emergency responders more pertinent and detailed information. The most suitable platform is a smart phone because practically everyone has one and the built-in features are sufficient to create an accident detection system. Even if the smartphone is completely destroyed in a worst-case scenario catastrophe, the server site can still analyse the last known location before the GPS is turned off. Smartphone sensors may be able to measure forces that are more similar to those that the victims have experienced than the typical In-Vehicle sensors. In the future, the User detection page could use some optimisation.

Here, the author [15] suggested a method that outlines the creation of a system that makes use of smartphones to quickly and automatically detect and report automobile accidents. Dynamic Time Warping and Hidden Markov Models are used to analyse data continuously acquired from the smartphone's accelerometer and estimate the severity of the accident, minimise false positives, and alert first responders to the accident's location and the owner's medical information. Additionally, seeing accidents on a smartphone via the Internet provides immediate and trustworthy access to the information pertaining to the accident. The reaction time needed to alert emergency responders to traffic accidents can potentially be decreased by deploying this programme and adding a notification system, which may help to prevent fatalities.

Here, the author [16] demonstrated how a smartphone's inbuilt sensors and GPS can be used to identify driving moves. Monitoring driving conduct with a smartphone has uses for both law enforcement and the insurance sector. The suggested method is appropriate for real-time applications like safety and driver assistance systems. To determine the beginning and ending locations of driving events, filtered accelerometer and gyroscope data are employed in an endpoint detection method. The dynamic time warping (DTW) technique compares the pertinent sensor data to several sets of template manoeuvre signal sets. The next step is to utilise a heuristic method to categorise a manoeuvre as normal or aggressive based on its speed and the acceleration and rotation rate templates that are the closest matches.

The major objective, according to the author of [17], was to develop a system utilising the Internet of Things idea to identify bike accidents. In the Internet of Things, we use a microcontroller, an accelerometer, a position sensor, an Android application, and when an accident occurs, we can send a message to the hospital, family, and friends using GPS and GSM location.

The author of [18] suggested providing a quick overview of a number of approaches that have been presented for the prevention of traffic accidents, the detection of accidents based on several characteristics, and the provision of medical assistance. It will cover two angles: first, it will cover pre-accident detection systems, which use a variety of techniques to identify accidents before they happen so that they can be prevented. To pre-alert about the accident, techniques like V2V communication between vehicles or VANET for inter-vehicle communication are presented. Second, let's talk about the post-alert system, which employs a number of techniques to identify the origin of accidents, validates their occurrence, and then notifies the rescue teams to send out medical aid to the injured.

The author [19] proposed Statistics display that motorcycle rider is more at risk than any other type of road user. In addition, although the number of road accidents has decreased in recent years, the number of motorcycle fatalities has increased. The motorcycle market is huge, so is the number of motorcycle riders and the number of motorcycle accidents. Some situations might be avoided, but it is always better to be prepared for any mishap while driving or riding a motorcycle on the road. A helmet is a necessity while riding at a dangerous speed, exposing the whole body of the person riding the motorcycle other safety gears are also advisable but cannot be worn all the time because of the heavy weight and bulky sizes of the safety gear, a helmet can be taken anywhere and is not baggage to take care of even while not riding, and because the hands of a motorcycle rider are busy while riding, we cannot assign more controls in the hands of the person, we need to assign the controls to through voice commands. And to enable that we need a system within the helmet as there is too much wind and noise when one rides a motorcycle. The only safety for the head can also be designed to enable other features like navigation, voice communication, and entertainment system.

III. Conclusion

From the literature review, we understand that there are some motorcycles with helmet detection modules and some with crash detection modules but we could not come across any motorcycle with both these modules together. So we thought of introducing a bike that contains these features together to protect the rider and the pillion rider from accidents. We also found that there are no features or modules that detect three or more people in a motorcycle. So we decided to bring triple detection module as well. Apart from these three modules, we decided to bring features that provide a buzzer sound when any one of the riders removes their helmet while traveling. Hence our bike contains mainly 3 modules that is:

1) Helmet detection module
2) Crash detection module

3) Triple detection module

and also a special feature that provides a buzzer sound when any one of the riders removes their helmet while traveling. The main goal of our smart bike is to ensure the safety of both the rider and the pillion rider.

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