PROJECT PHASE-2 REPORT

ON

SMART BIKE

Submitted by

TONEY G JOLLY (SJC19CS119)

to

the APJ Abdul Kalam Technological University

in partial fulfillment of the requirements for the award of the degree

of

Bachelor of Technology

in

Computer Science and Engineering

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St. Joseph's College of Engineering and Technology, Palai

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Declaration

I undersigned hereby declare that the project report on "SMART BIKE", submitted for partial fulfillment of the requirements for the award of degree of Bachelor of Technology of the APJ Abdul Kalam Technological University, Kerala, is a bonafide work done by me under supervision of Prof. Jibin Philip. This submission represents my ideas in my own words and where ideas or words of others have been included, I have adequately and accurately cited and referenced the original sources. I also declare that I have adhered to ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in my submission. I understand that any violation of the above will be a cause for disciplinary action by the institute and/or the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously formed the basis for the award of any degree, diploma or similar title of any other University.

Name and Signature of Student

Toney G Jolly (SJC19CS119)

Place: Choondacherry

Date: 20-05-2023

ST. JOSEPH'S COLLEGE OF ENGINEERING AND TECHNOLOGY, PALAI

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CERTIFICATE

This is to certify that the project report entitled "**SMART BIKE**" submitted by **TONEY G JOLLY (SJC19CS119)** to the APJ Abdul Kalam Technological University in partial fulfillment of the requirements for the award of the Degree of Bachelor of Technology in Computer Science and Engineering is a bonafide record of the project work carried out by them under my guidance and supervision.

Project Guide
Prof. Jibin Philip
Assistant Professor
Department of CSE

Project Coordinator
Dr. Praseetha V M
Associate Professor
Department of CSE

.
.
Place : Choondacherry
Date : 20-05-2023

Head of Department
Dr. Joby P P
Professor & Head
Department of CSE

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TONEY G JOLLY

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.

Contents

List of Abbreviations

AI - Artificial Intelligence

CPU - Central Processing Unit

GPS - Global Positioning System

GPU - Graphics Processing Unit

GSM - Global System for Mobile communication

IoT - Internet of Things

MVD - Motor Vehicle Department

NMEA - National Marine Electronics Association

TTFF - TimeTo-First-fix

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Chapter 1

Introduction

Smart Bike is a customized motor vehicle which focuses on the safety of the passengers. The main objective of the concept is to reduce the impact that might be caused due to an accident.
Smart Bike mainly consist three modules:

- Helmet detection module

  The helmet detection module checks whether the rider and the pillion ride is wearing the helmet or not. If any one of rider or the pillion rider are not wearing the helmet then the engine will automatically turn off.

- GSM module

  If the rider met with an accident in some isolated area, its very difficult to find a place and get help. There are situations where the victims maybe unconscious. So its really a threat to the riders.

  When the accelerometer detects accident then GPS-GSM Module will get activated. This module mainly consists of a microcontroller, GPS modem and 9V DC power supply. Here the GPS module gets the location information from satellites in the form of latitude and longitude. The microcontroller processes this information and sends it to the GSM modem. Then the GSM Modem sends the information to the concerned authorities and also to the emergency contacts of the victim.

- Crash detection module

  If the rider met with an accident in some isolated area, its very difficult to find a

place and get help. There are situations where the victims maybe unconscious. So its really a threat to the riders.

Smart Bike provides a Crash Detection Module. Smart Bike contains special sensors called accelerometer sensor that detects accidents. There are signals from the accelerometer and through these signals, it recognize whether the collision is severe or not. Then the vibration sensor will send a signal to the microcontroller which in turn will activate GPS-GSM Module.

- Triple Detection Module

  Nowadays three people in a motor vehicle is so common especially teenagers. Due to which bike accidents are common among teenagers. There are authorities to check this and still it continues to happen. Since the Technologies are moving forward and more reliable techniques can be used for this.

  Smart Bike has a Triple Detection Module. When the motor vehicle gets start, it checks whether there are more than two people in a it. If there are more that two people in it, then the engine will turn off automatically. A camera sensor is used for this purpose.

The main goal of smart bike is to reduce the impact of an accident that might caused due to an accident. Smart bike ensures the safety of the passengers by providing the above mentioned modules so that most of accidents can be reduced or completely taken away to a great extend.

1.1 Background

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.

1.2 Objective and Scope

The main objective of Smart Bike is to reduce the impact that might cause due to an accident. Smart Bike mainly consist of a Helmet Detection Module where it ensures that the rider and the pillion rider are wearing helmet or not. So that to an extend major impact due to an accident can be reduced. Then there is a GSM Module where it provides the correct location of the motor vehicle in the case of an accident. The Crash Detection Module sends an SOS to the concerned authorities and also to the emergency contact of the victim.

Chapter 2

Literature Review

2.1 Research Works

At first we decided to look for the causes of a motor vehicle accident. For that we checked the recent news papers and various social media platforms. This helped us to get more idea about it. Since for a risk or for an event there will be many sources as well as consequences. So we took the more repeated causes and thought of technologies so as to reduce the impact caused by it. From our research we found out that most of the motor vehicle accident victim dies due to fatal head injuries and so we thought of a helmet detection module. Then we found out that most of the victims dies due to improper medical attention that is when the victim met with an accident in some isolated area and for that we thought of a crash detection module. Then we found out that nowadays there are people especially teenagers riding bikes in triples. So for that we decided to bring features that ensures that there are only 2 people in a bike.

2.2 Raspberry Pi

The Raspberry pi is a single computer board with credit card size, that can be used for many tasks that your computer does, like games, word processing, spreadsheets and also to play HD video. It was established by the Raspberry pi foundation from the UK. It has been ready for public consumption since 2012 with the idea of making a low-cost educational microcomputer for students and children. The main purpose of designing the

raspberry pi board is, to encourage learning, experimentation and innovation for school level students. The raspberry pi board is a portable and low cost. Maximum of the raspberry pi computers is used in mobile phones. In the 20th century, the growth of mobile computing technologies is very high, a huge segment of this being driven by the mobile industries. The 98% of the mobile phones were using ARM technology.

The raspberry pi board comprises a program memory (RAM), processor and graphics chip, CPU, GPU, Ethernet port, GPIO pins, Xbee socket, UART, power source connector. And various interfaces for other external devices. It also requires mass storage, for that we use an SD flash memory card. So that raspberry pi board will boot from this SD card similarly as a PC boots up into windows from its hard disk.Essential hardware specifications of raspberry pi board mainly include SD card containing Linux OS, US keyboard, monitor, power supply and video cable. Optional hardware specifications include USB mouse, powered USB hub, case, internet connection, the Model A or B: USB WiFi adaptor is used and internet connection to Model B is LAN cable. The Figure 2.1 is the Raspberry-pi board, it consist of memory, CPU, GPU,Ethernet Port,XBee Socket and display[1].

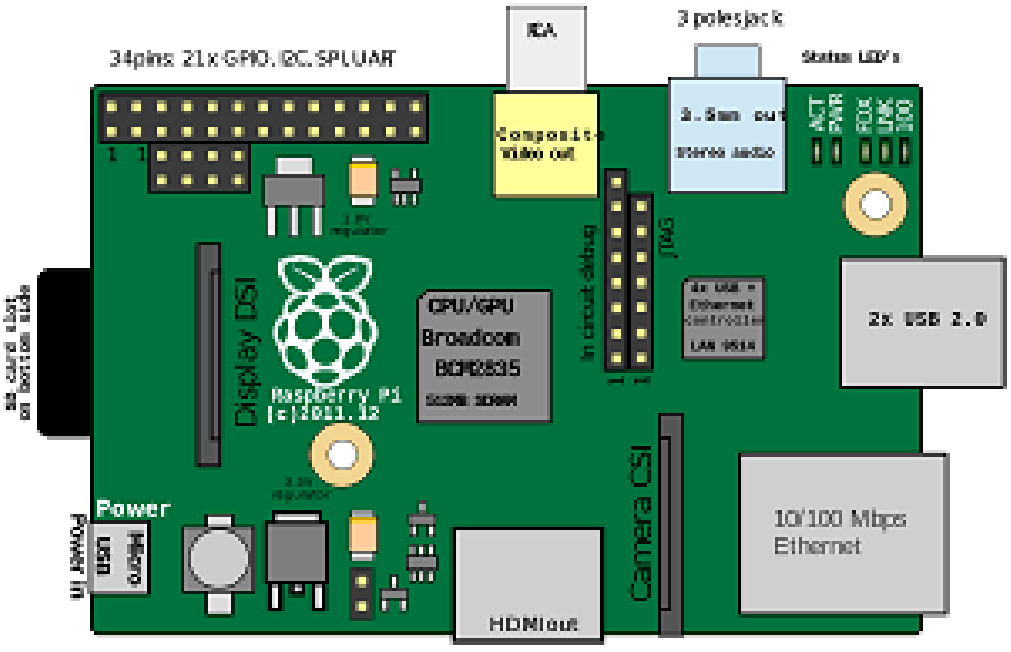

Figure 2.1: Raspberry-pi

2.3 Accelerometer

An accelerometer is a device that measures the vibration, or acceleration of motion of a structure. The force caused by vibration or a change in motion (acceleration) causes the mass to "squeeze" the piezoelectric material which produces an electrical charge that is proportional to the force exerted upon it. Since the charge is proportional to the force, and the mass is a constant, then the charge is also proportional to the acceleration. These sensors are used in a variety of ways from space stations to handheld devices, and there's a good chance you already own a device with an accelerometer in it. An accelerometer works using an electromechanical sensor that is designed to measure either static or dynamic acceleration. Static acceleration is the constant force acting on a body, like gravity or friction. These forces are predictable and uniform to a large extend. For example, the acceleration due to gravity is constant at 9.8m/s, and the gravitation force is almost the same at every point on earth. Accelerometers find many applications in industries. As already discussed, you can find them in the most complex machines to your handheld devices. Let's look at some of the real-world applications of accelerometers. Digital Devices: Accelerometers in smartphones and digital cameras are responsible for rotating the display based on the orientation you hold it. The Fig 2.2 represent the model of the accelerometer[2].

Figure 2.2: Accelerometer

2.4 GPS Module

The NEO-6 module series is a family of stand-alone GPS receivers featuring the high performance u-box 6 positioning engine. These flexible and cost-effective receivers offer numerous connectivity options in a miniature 16 x 12.2 x 2.4 mm package. Their compact architecture and power and memory options make NEO-6 modules ideal for battery operated mobile devices with very strict cost and space constraints. The 50 channel u-box 6 positioning engine boasts a TimeTo-First-Fix(TTFF) of under 1 second. The dedicated acquisition engine, with 2 million correlates, is capable of massive parallel time/frequency space searches, enabling it to find satellites instantly. Innovative design and technology suppresses jamming sources and mitigates multipath effects, giving NEO-6 GPS receivers excellent navigation performance even in the most challenging environments.

To find the location on the earth the whole is divided into some coordinates where the location can be easily captured by a module called GPS module. Here the GPS used is SIM28ML. This GPS module will find the location of the vehicle and the information fetched by the GPS receiver is received through the coordinates and the received data is first sent to Arduino and the information is transmitted to the saved contact through GSM module. The frequency is operated in the range of 1575.42 MHz and the output of the GPS module is in NMEA format which includes data like location in real time[4]. The figure 2.3 represent the gps module[3].

Figure 2.3: GPS

2.5 GSM Module

GSM is a mobile communication modem; it stands for global system for mobile communication (GSM). The idea of GSM was developed at Bell Laboratories in1970. It is a widely used mobile communication system in the world. GSm is an open and digital cellular technology used for transmitting mobile voice and data services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands. GSM system was developed as a digital system using time division multiple access-+ technique for communication purposes. A GSM digitizes and reduces the data, then sends it down through a channel with two different streams of client data, each in its own particular time slot. The digital system has an ability to carry 64 kbps to 120 Mbps of data rates. There are various cell sizes in a GSM system such as macro, micro, Pico and umbrella cells. Each cell varies as per the implementation domain. There are five different cell sizes in a GSM network macro, micro, Pico and umbrella cells. The coverage area of each cell varies according to the implementation environment[3]. The figure 2.4 represent the GSM Module[4].

Figure 2.4: GSM

2.5.1 Features

1. Improved spectrum efficiency
2. International roaming
3. Compatibility with integrated services digital network
4. Support for new services. SIM phonebook management
5. Fixed dialing number(FDN)
6. real time clock with alarm management
7. High quality speech
8. Uses encryption to make phone calls more secure
9. Short messages services(SMS)

2.6 Existing solutions

The following are some of the existing system currently available:

2.6.1 MVD AI Camera

The Kerala Motor Vehicle Department (MVD) has bolstered its surveillance system with Artificial Intelligence (AI) poweres camera to make road safer. The MVD has procured 726 cameras as part of its 'Safe Kerala Project', at a cost of Rs 225 crore. More than 40 cameras each have been installed in every district. The AI-enabled cameras would be initially used to enforce helmet, seat belt and mobile phone use norms. Violators once caught on camera, would be notified of the penalty by a text message to their mobile phone registered with the MVD on the second day, followed by a challan by post to their address[5]. The figure 2.5 is the model of a MVD AI cameras that is currently used.

Figure 2.5: MVD AI Camera

2.6.2 iPhone or Apple watch

When a severe car crash is detected, your iPhone or Apple Watch sounds an alarm and displays an alert. Your iPhone reads the alert, in case you can't see the screen. If you have only your phone, the screen displays an Emergency Call slider and your phone can call emergency services. Your Apple Watch chimes and taps your wrist, and checks in with you on the screen. If you have only your watch, the screen displays an Emergency Call slider. If you have a watch with cellular or your watch is connected to Wi-Fi, it can call emergency services. If you have your iPhone and Apple Watch, the Emergency Call slider appears only on your watch, and the call is connected and the call audio plays from your watch. If you're able, you can choose to call emergency services or dismiss the alert[6]. If you're unable to respond, your device automatically calls emergency services after a 20-second delay. If you've added emergency contacts, your device sends a message to share your location and let them know that you've been in a severe car crash. If you've set up your Medical ID, your device displays a Medical ID slider, so that emergency responders can access your medical information. The figure 2.6 is the model of apple products that is used for detection.

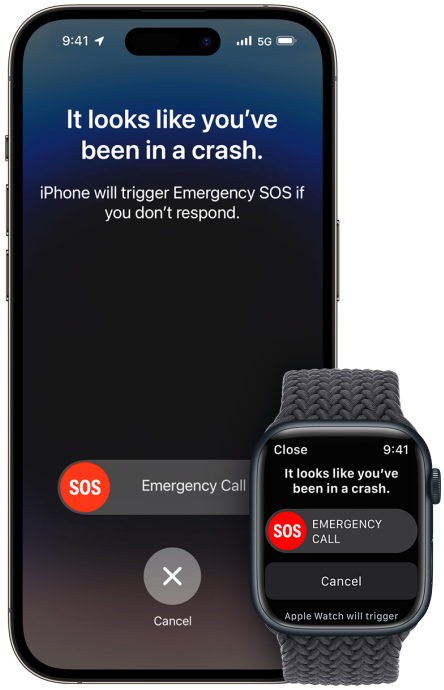

Figure 2.6: iPhone and Apple

2.6.3 IoT-based Accident Detection and Emergency Alert System

This is an IoT-based system where it notifies the emergency contact of the injured motorcycle driver about their precise location so that necessary medical help can be provided timely. The system is based on a tilt sensor that calculates the inclination of the motorcycle and then transmits notification to the concerned people through SMS and GPRS via an online server using a GSM module. The main contribution of this paper is that the developed system has extensively been tested in real time scenario and data has been collected from ten different bikes to determine an optimum tilt angle[7].

2.6.4 Smart Helmet

It mainly use microcontroller and accellerometer. It is basically a smart helmet which aims to detect and report accidents occurring in two wheelers. Microcontroller interfaced with accelerometer and GSM module and cloud service infrastructures are utilized to

achieve the final objectives of notification and reporting. The helmet is developed in a way to detect an accident in two wheelers and send the geographical co-ordinates of the accident to the emergency authorities and the emergency contacts of the victim. A 6-axis accelerometer is mounted on the helmet which continuously monitors the acceleration levels of the helmet. When an accident is detected due to inconsistent acceleration levels and exceeds the threshold, it gathers the GPS co-ordinates from the GPS module and sends a message to the emergency authorities web server which then sends an emergency message to the assigned emergency contact of the victim[8].

2.6.5 Helmet Detection Using ML & IoT

It detects two-wheeler riders without helmet with the help of machine learning and provide them with a user interface to pay challans. The system first captures the real time image of road traffic and then differentiates the two wheelers from other vehicles in the road. It then processes to check whether the rider and pillion rider are wearing helmet or not using OpenCV. If any one of the riders and pillion rider found not wearing the helmet, their vehicle number plate is processed using optical character recognition (OCR). After extracting the vehicle registration number, a challan will be generated against respective vehicle and all the details of the challan will be sent via E-mail and SMS to the concerned person. An user interface (an app and a website) will also be provided to pay their challans[9].

2.6.6 Automatic Detection of Bike-riders without Helmet

Here it first detects bike riders from surveillance video using background subtraction and object segmentation. Then it determines whether bike-rider is using a helmet or not using visual features and binary classifier. Also, a consolidation approach for violation reporting is present which helps in improving reliability of the approach. In order to evaluate this, it provides a performance comparison of three widely used feature representations namely histogram of oriented gradients (HOG), scale-invariant feature transform (SIFT), and

local binary patterns (LBP) for classification[10].

2.6.7 Helmet Detection-Image Descriptors and Classifiers

In this it applied the circular though transform and the Histogram of Oriented Gradients descriptor to extract the image attributes. Then, the MultiLayer Perceptron classifier was used and the obtained results were compared with others algorithms. Traffic images were captured by cameras from public roads and constitute a database of 255 images[11].

2.6.8 Automatic Crash Detection

In this concept, three different inertial measurement units are attached to head of the motorist, torso of the motorist and to the rear of the motor cycle. Crash dummy tests are done by throwing the dummy with different altitudes to simulate the effect of crash to the motorist and real data is collected by driving the motorcycle. A maximum a posteriori classifier is trained to classify the crash and normal driving[12].

2.6.9 ML based Surveillance System

Here the system takes a video of traffic on an open street as an information and recognizes the moving items inside the scene. This work proposes a system based on the location of individual or different riders taking a trip on bikes with no helmets. Inside the proposed approach, from the beginning stage, bike riders are recognized with the use of YOLOv3 model which is a consistent type of YOLO model, the forefront methodology for object distinguishing helps as such in distinguishing the riders with and without helmet. The vertical projection of binary image is used for counting the number of riders if it exceeds two[13].

2.6.10 Machine Vision Techniques for Motorcycle Safety Helmet Detection

Here it proposes a system which automatically detect motorcycle riders and determine that they are wearing safety helmets or not. The system extracts moving objects and classifies them as a motorcycle or other moving objects based on features extracted from their region properties using K-Nearest Neighbor (KNN) classifier. The heads of the riders on the recognized motorcycle are then counted and segmented based on projection profiling. The system classifies the head as wearing a helmet or not using KNN based on features derived from 4 sections of segmented head region[14].

2.6.11 Helmet Detection on Public Roads

Here the system proposed an approach which would detect fall & helmet detection of a two wheeler driver run-time. Our system would inform nearby hospitals, family members & law enforcement agencies in case of emergency. Hence it ensures safety of the drivers while driving. Automatic accident detection and reporting system is the motivation of this project. To prevent road accidents, our approach is very useful. Thus safety of bike riders is ensured[15].

2.6.12 Helmet Detection using CNN

Here the system proposes a framework for detection of single or multiple riders travel on a motorcycle without wearing helmets. In the proposed approach, at first stage, motorcycle riders are detected using YOLOv3 model which is an incremental version of YOLO model, the state-of-the-art method for object detection. In the second stage, a Convolutional Neural Network (CNN) based architecture has been proposed for helmet detection of motorcycle riders. The proposed model is evaluated on traffic videos and the obtained results are promising in comparison with other CNN based approaches[16].

2.6.13 IMU Sensors

The MPU6050 is a great motion sensor, very cheap, with a complex motion processor which is able to offer very accurate data and also to filter vibrations in case of using it near an engine. However due to the low price of this sensors, an automotive sensor is a good choice. The automotive sensors are made to reduce the vibrations and also to be very accurate in readings. The algorithm which uses the data fusion between acceleration, deceleration and tilt angles has a great success rate. Until now, in the test which were made, no false positive or missed crash was recorded. The crash detection is a very important feature for the motorcycle riders and being used in a system with E-call, it can decrease the time between the accident and emergency service arrival with 50%[17].

2.6.14 Accident Detection and Reporting Framework

Here it presents an inexpensive but intelligent framework that can identify and report an accident for two-wheelers. This paper targets two-wheelers because the mortality ratio is highest in two-wheeler accidents in India. This framework includes a microcontroller-based low-cost Accident Detection Unit that contains a GPS positioning system and a GSM modem to sense and generate accidental events to a centralized server. The Accident Detection Unit calculates acceleration along with ground clearance of the vehicle to identify the accidental situation. On detecting an accident, Accident Detection Unit sends accident detection parameters, GPS coordinates, and the current time to the Accident Detection Server . ADS maintain information on the movement of the vehicle according to the historical data, current data, and the rules that you configure in the system. If an accident occurs, Accident Detection Server notifies the emergency services and the preconfigured mobile numbers for the vehicle that contains this unit[18].

2.6.15 Method of Freeway Incident Detection Using wireless Positioning

Here a new method of incident detection was brought forward in this paper based on an in-car terminal which consists of GPS module, GSM module and control module as well as some optional parts such as airbag sensors, CPS module, etc. A driver or vehicle initiating an alarm report would be automatically located by GPS, CPS or both, followed by zooming in with a closed-circuit television (CCTV) to confirm the accident. An information feed- back mode was put forward to stimulate driver's reporting propensity. Finally, feasible means to improve detection rate,time to detect and FAR (false alarm rate) was described after t analyzing the detection performance[19].

2.6.16 Mobile vehicle crash detection system

Conventional in-vehicle ACN can provide emergency respondents with more important and detailed information but is constrained by the portability and high costs. Smartphone is the most ideal platform since almost everyone has it and the on-board functions are enough to build an accident detection system. In an extreme case of accident, the smartphone may be destroyed but the server site is able to analyze the last known location before the GPS is turned off. Smartphones may also surpasses the standard In-Vehicle in certain way such that the smartphone sensors can measure forces closer to those that have been experienced by the victims. As future works, optimization can be done to the User detection page, instead of using main thread to run sensor service[20].

2.6.17 Smartphone application to detect car accidents

In this system it 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 and the

Hidden Markov Models 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 potentially reduce the response time which may help in reducing fatalities[21].

2.6.18 Recognition of driving manoeuvres using smartphone-based inertial and GPS measurement

on which to implement sensor networks for ITS applications. In this paper we show how the embedded sensors and GPS of a smartphone can be used to recognize driving manoeuvres. Smartphone-based driving behaviour monitoring has applications in the insurance industry and for law enforcement. The proposed solution is suitable for real-time applications, such as driver assistance and safety systems. An endpoint detection algorithm is used on filtered accelerometer and gyroscope data to find the start- and endpoints of driving events. The relevant sensor data is compared against different sets of manoeuvre signal templates using the dynamic time warping (DTW) algorithm. A heuristic method is then used to classify a manoeuvre as normal or aggressive based on its speed and closest matching acceleration and rotation rate templates[22].

2.6.19 Safety Monitoring System Using IoT

Here the main aim was to create a system utilizing IoT concept to detect the accident in a bike. We are using microcontroller, accelerometer, position sensor, and Android application using in IOT, and also accident happen send message by hospital, family, friends, using GPS, GSM location[23].

2.6.20 IoT Application for Complete Safety of the Vehicles

Here the main aim is to give a brief review on several methodologies that has been given for road accident avoidance and detection of accident based on various parameters and provide medical help. It will include two perspectives as firstly it include pre accident detection system where various methods are applied to detect the accident prior to its occurrence so that it can be avoided. Methods like V2V communication between vehicles or VANET for the inter vehicular communication are described in order to pre alert about the accident. Secondly about the post alert system which uses several methods to detect the accident cause and confirms the occurrence of accident and later alerts the rescue teams to provide medical facilities to the victims. Also the combined system containing both the modules is included in the paper[24].

2.6.21 Motorcycle Safety Solution using the IoT

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, entertainment system for the

long run, etc. There are multiple possible features that can be embedded if there is the required hardware[25].

Chapter 3

Methodology

3.1 Modules

The system is divided into three modules :

(1) Helmet detection module

(2) Crash detection module

(3) GSM module

(4) Triple Riding Detection Module

3.1.1 Helmet Detection Module

The helmet detection module checks whether the rider and the pillion ride is wearing the helmet or not. If any one of rider or the pillion rider are not wearing the helmet then the engine will automatically turn off.

3.1.2 Crash Detection Module

If the rider met with an accident in some isolated area, its very difficult to find a place and get help. There are situations where the victims maybe unconscious. So its really a threat to the riders.

Smart Bike provides a Crash Detection Module. Smart Bike contains special sensors called accelerometer sensor that detects accidents. There are signals from the accelerometer and through these signals, it recognize whether the collision is severe or not. Then the vibration sensor will send a signal to the microcontroller which in turn will activate GPS-GSM Module.

3.1.3 GSM Module

If the rider met with an accident in some isolated area, its very difficult to find a place and get help. There are situations where the victims maybe unconscious. So its really a threat to the riders.

When the accelerometer detects accident then GPS-GSM Module will get activated. This module mainly consists of a microcontroller, GPS modem and 9V DC power supply. Here the GPS module gets the location information from satellites in the form of latitude and longitude. The microcontroller processes this information and sends it to the GSM modem. Then the GSM Modem sends the information to the concerned authorities and also to the emergency contacts of the victim.

3.1.4 Triple Riding Detection Module

Nowadays three people in a motor vehicle is so common especially teenagers. Due to which bike accidents are common among teenagers. There are authorities to check this and still it continues to happen. Since the Technologies are moving forward and more

reliable techniques can be used for this.

Smart Bike has a Tripple Detection Module. When the motor vehicle gets start, it checks whether there are more than two people in a it. If there are more that two people in it, then the engine will turn off automatically. A camera sensor is used for this purpose.

Chapter 4

System Design

4.1 Activity Diagram

Activity diagram is basically a flowchart to represent the flow from one activity to another activity. The activity can be described as an operation of the system. The control flow is drawn from one operation to another. This flow can be sequential, branched, or concurrent. Activity diagrams deal with all type of flow control by using different elements such as fork, join, etc. The basic purposes of activity diagrams is similar to other four diagrams. It captures the dynamic behavior of the system. Other four diagrams are used to show the message flow from one object to another but activity diagram is used to show message flow from one activity to another. Activity is a particular operation of the system. Activity diagrams are not only used for visualizing the dynamic nature of a system, but they are also used to construct the executable system by using forward and reverse engineering techniques. The only missing thing in the activity diagram is the message part. It does not show any message flow from one activity to another. Activity diagram is sometimes considered as the flowchart. Although the diagrams look like a flowchart, they are not. It shows different flows such as parallel, branched, concurrent, and single.

The activity diagram of helmet detection module is depicted in figure 4.1. First event is to initialize the sensor and start the system. Then the camera sensor will get activated and checks whether the rider or the pillion rider are wearing helmet or not. If the sensor found that anyone of them is not wearing the helmet then the ignition is cut off automatically. If the sensor detects helmet then it checks the number of people in the motor vehicle. If there are more than 2 people in it, then the ignition is cut off. If there are only two people or less than that, then it works as it is. Then second event is to initialize the crash impact sensor and GPS Module. If any sort of crash is detected then the GPS-GSM module gets activated. Then message will be send to the concerned authorities and also to the emergency contacts of the victims. The message will be sent along with the victims location.

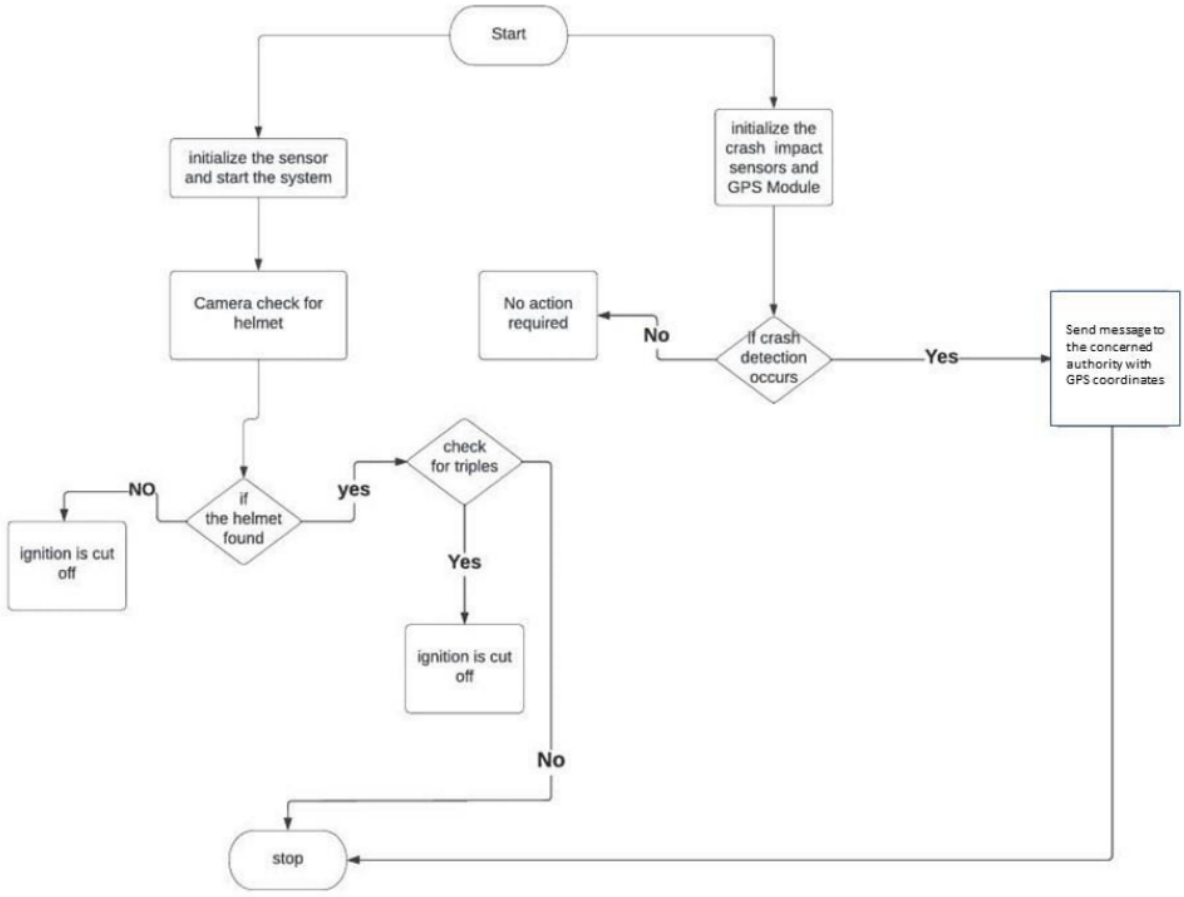

Figure 4.1: Activity Diagram

4.1.1 Crash Detection Module

The activity diagram of Crash Detection module is depicted in figure 4.2. The first event is for the user to register in the corresponding two wheeler accident detection system. After registering, when the user takes the motor vehicle it monitors and check whether the vehicle is undergoing with any sort of crash. If the accident detection system detects any kind of crash, then it sends an alert to the concerned authorities regarding the accident.

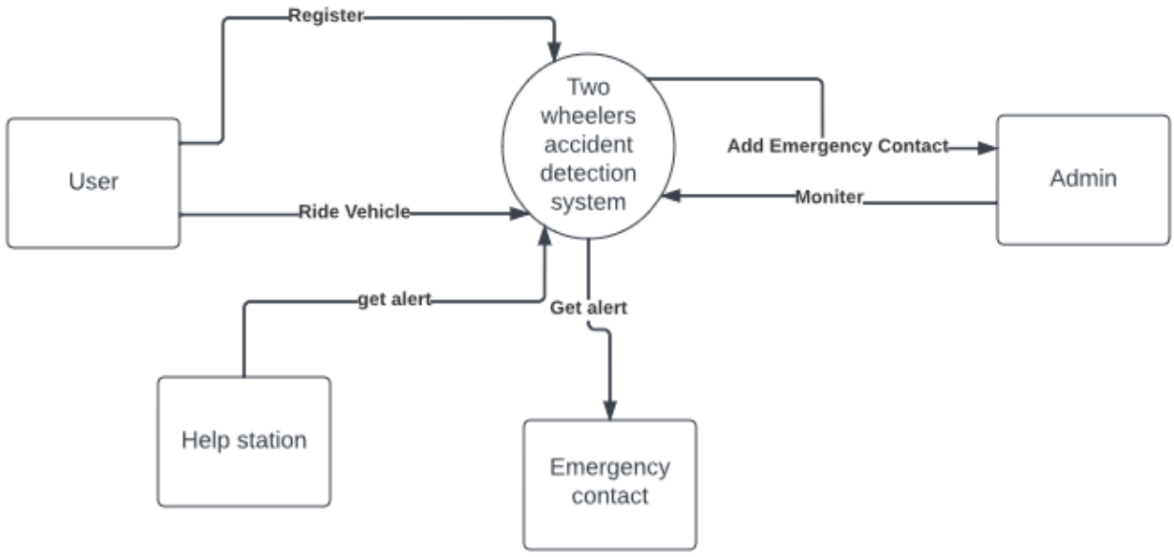

Figure 4.2: Helmet Detection Module

4.2 Sequence Diagram

A sequence diagram, in the context of UML, represents object collaboration and is used to define event sequences between objects for a certain outcome. A sequence diagram is an essential component used in processes related to analysis, design and documentation. A sequence diagram is also known as a timing diagram, event diagram and event scenario.

The figure 4.3 depicts the sequence diagram of Smart Bike. When the motor vehicle starts the sensors get activated and the process begins. Then the camera is turned on and checks

whether the rider and the pillion rider are wearing the helmet or not. If any one of them are not wearing the helmet then the ignition will turn off automatically. If the helmet is found then it checks for the number of people. If there are more than two people then the ignition will turn off automatically. If not, then it proceeds. In GPS module, when it detects crash, It sends an SOS to the concerned authorities and also to the emergency contacts of the rider.

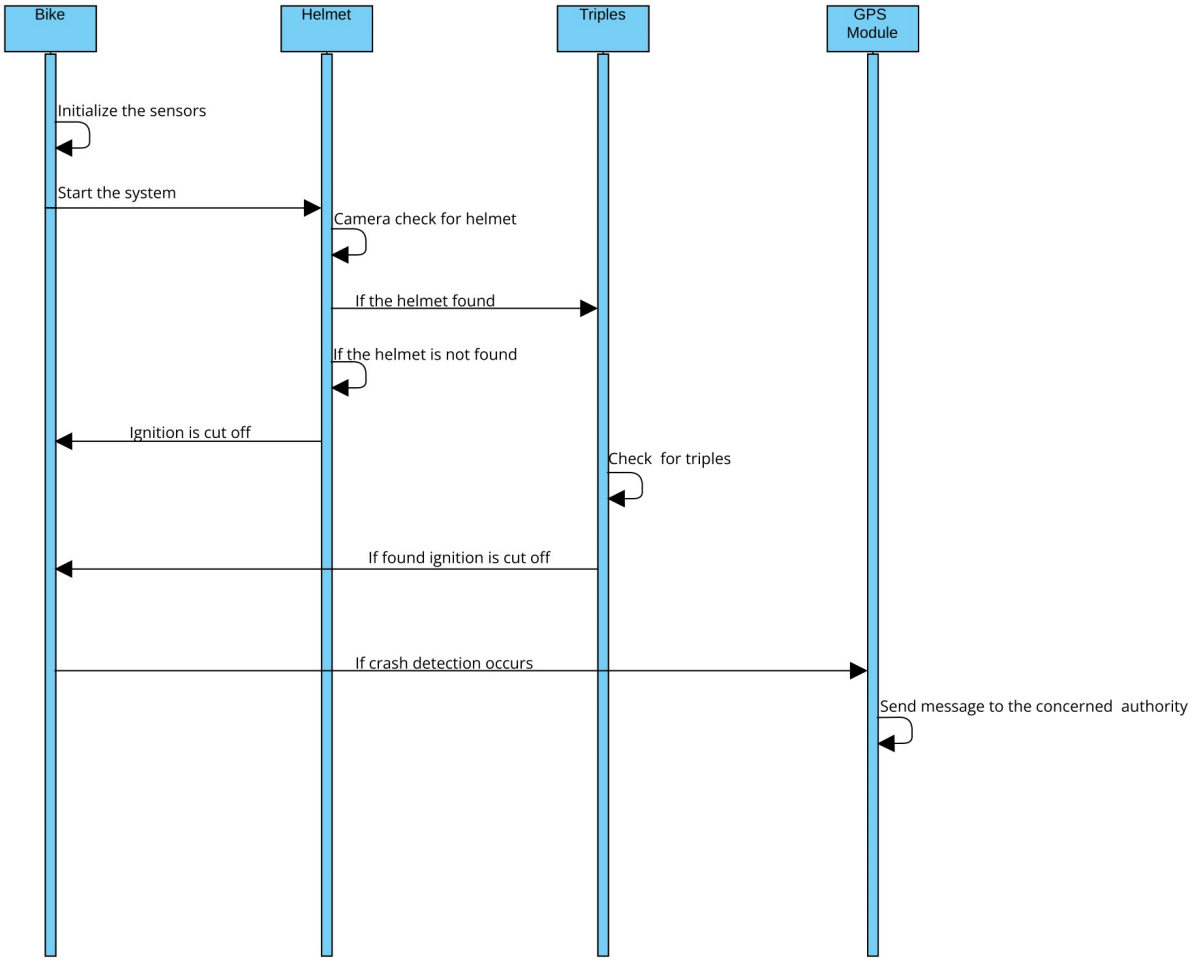

Figure 4.3: Sequence Diagram

4.3 Use Case

A use case diagram is a way to summarize details of a system and the users within that system. It is generally shown as a graphic depiction of interactions among different elements in a system. Use case diagrams will specify the events in a system and how those events flow, however, use case diagram does not describe how those events are implemented.

A use case is a methodology used in system analysis to identify, clarify, and organize system requirements. In this context, the term "system" refers to something being developed or operated, such as a mail-order product sales and service Web site. Use case diagrams are employed in UML (Unified Modeling Language), a standard notation for the modeling of real-world objects and systems. There are a number of benefits with having a use case diagram over similar diagrams such as flowcharts. The figure 4.4 depits the use case diagram. There are two actors involved here,User and the Concerned Authority.The user will interact with the bike System to turn on the ignition ,if the camera detects no helmet or Triple Riders,then the ignition will cut off.If the camera detects helmets and No triple riders are found then the riders can start the engine and ride the bike. If any one of them are not wearing the helmet then the ignition will turn off automatically. If the helmet is found then it checks for the number of people. If there are more than two people then the ignition will turn off automatically. If not, then it proceeds. In GPS module, when it detects crash, It sends an SOS, with the geo dimensions/locations to the concerned authorities.

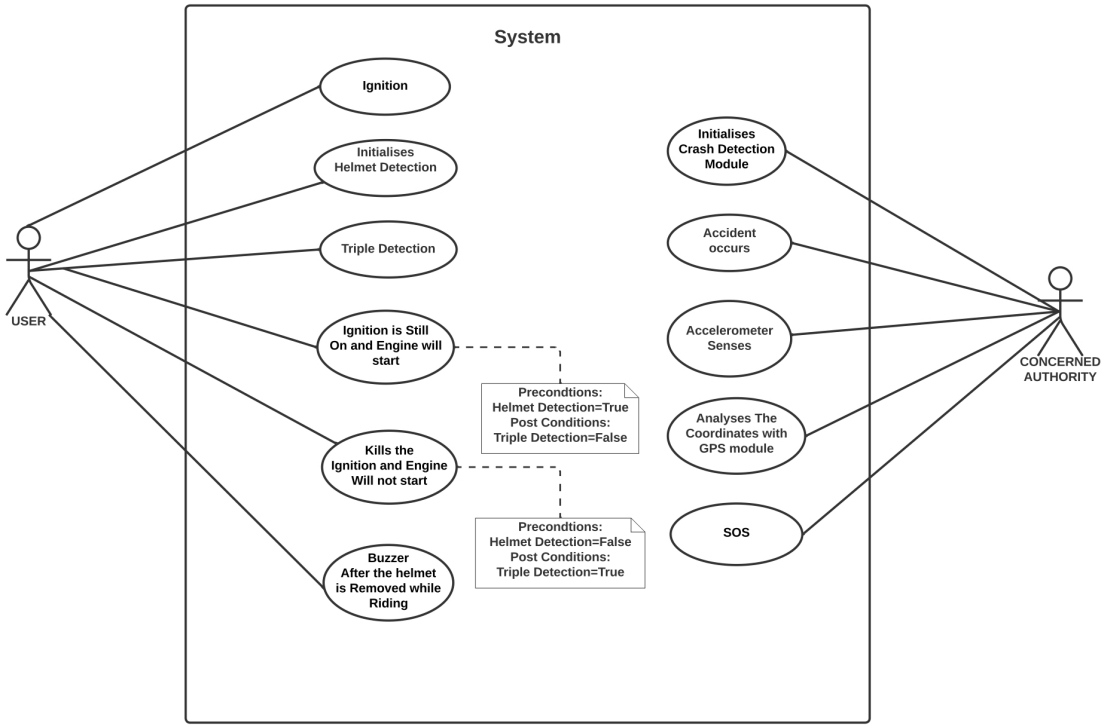

Figure 4.4: Use Case Diagram

Chapter 5

System Implementation

5.1 Technology Stack

5.1.1 Firebase

Firebase is a versatile cloud-based platform developed by Google, designed to empower developers in building and managing robust web and mobile applications. With its extensive array of services, Firebase simplifies the development process and enhances application scalability. At the core of Firebase lies its real-time database, which enables seamless data synchronization across multiple devices in real time. This NoSQL database facilitates efficient storage and retrieval of data, making it ideal for applications that require instantaneous updates and collaboration.

5.1.2 Raspberry pi4(8 GB RAM)

The Raspberry Pi 4 is a compact and powerful single-board computer that has gained immense popularity among technology enthusiasts and hobbyists. With its impressive capabilities and versatility, the Raspberry Pi 4 offers a range of possibilities for various

projects and applications. Equipped with a quad-core ARM Cortex-A72 processor and up to 8GB of RAM, the Raspberry Pi 4 delivers significant processing power in a small form factor. It supports various operating systems, including Linux distributions, allowing users to customize and tailor their computing environment to suit their specific needs. The Raspberry Pi 4 features multiple USB ports, Ethernet connectivity, and built-in Wi-Fi and Bluetooth, providing flexible options for connecting peripherals and devices. Its HDMI output allows for seamless integration with displays, making it suitable for multimedia applications and even as a home media center.

5.1.3 GSM Module

A GSM module, also known as a Global System for Mobile Communications module, is a hardware device that enables communication over the GSM network. It provides a means of integrating mobile communication capabilities into various electronic devices, such as microcontrollers, single-board computers, and embedded systems. GSM modules utilize the GSM network infrastructure to establish voice calls, send and receive SMS (Short Message Service) messages, and access mobile data services. They typically come in a compact form factor and feature an onboard SIM card slot for cellular network connectivity. With a GSM module, developers can add wireless communication capabilities to their projects, enabling remote control, monitoring, and data exchange. These modules support standard AT commands, which allow for easy integration and control via serial communication protocols such as UART.

When the accelerometer detects accident then GPS-GSM Module will get activated. This module mainly consists of a microcontroller, GPS modem and 9V DC power supply. Here the GPS module gets the location information from satellites in the form of latitude and longitude. The microcontroller processes this information and sends it to the GSM modem. Then the GSM Modem sends the information to the concerned authorities and also to the emergency contacts of the victim.

5.1.4 GPS Module

A GPS module, also known as a Global Positioning System module, is a device that utilizes satellite signals to determine precise geographic location and provide accurate time information. It enables electronic devices to receive and process data from GPS satellites, making it possible to track and navigate based on latitude, longitude, and altitude. GPS modules typically consist of a receiver chip, an antenna, and supporting circuitry. The receiver chip communicates with GPS satellites orbiting the Earth, receiving signals that contain information about the satellite's location and the precise time the signal was transmitted.

When an accident is detected by the accelerometer the GPS module turns on and it gets the location information from the satellites in the form of latitude and longitude. Then this information will be send to the GSM module.

5.1.5 OV5647 camera

The OV5647 camera module is a compact and popular camera module designed for capturing still images and videos. It is commonly used in various applications, including robotics, surveillance systems, drones, and embedded vision projects. The OV5647 camera module features a 5-megapixel OmniVision CMOS image sensor. It supports high-resolution image capture with a maximum resolution of 2592 x 1944 pixels. This allows for detailed and sharp image quality, suitable for a wide range of applications.

For the smart bike we used OV5647 camera to capture the heads of the riders and pillion riders to check whether is helmet for both the riders and pillion riders and it also checks whether there is more than two riders. if both the conditions are violated then the ignition will turn off.

5.1.6 Accelerometer

An accelerometer is a sensor that measures acceleration forces in three-dimensional space. It is commonly used in various electronic devices, such as smartphones, fitness trackers, gaming controllers, and motion-sensitive devices. The accelerometer detects changes in velocity and acceleration along three axes: X, Y, and Z. It measures these forces using microelectromechanical systems technology or piezoelectric sensors. When the device moves or experiences acceleration, the accelerometer detects the change and provides corresponding output signals. Accelerometers are often used to determine the orientation of a device in relation to the Earth's gravitational field. They enable features like screen rotation on smartphones and tablets, as well as tilt-based gaming controls. Additionally, accelerometers play a vital role in activity tracking devices, providing data on steps taken, distance traveled, and even sleep patterns.

The accelerometer detects the accident and send the information to GPS-GMS module. After several survey and analysis a default angle is set. The accelerometer checks whether the inclination of the bike is more than the default inclination. If the inclination is more that the default inclination, then it consider as an accident and send signal to the GPS-GSM module.

5.2 System Architecture

5.2.1 Helmet Detection

The figure 5.1 is the helmet detection module and the main purpose of Helmet detection module is to detect whether the rider and the pillion rider is wearing the helmet or not. So for this we used YOLO V3. YOLO is a real-time object detection algorithm that identifies specific objects in videos, live feeds, or images. So hear Yolo helmet weights are used. We had trained Yolo with some datasets. So once the camera is on, it detects the face and compares with the dataset provided. After checking, if the image captured

by the system and the datasets are equal then the ignition will turn on. If the image captured by the system and the datasets are not equal, then the ignition will not turn on until the rider and the pillion rider wears the helmet.

Figure 5.1: Helmet Detection Module

5.2.2 Triple Detection

The figure 5.1 is the tripple detection module and the main purpose of Triple Detection is to check whether there are more than 2 riders. According to the India law in Motor vehicle only two passengers are allowed to travel. So for this we used YOLO V3. YOLO is a real-time object detection algorithm that identifies specific objects in videos, live feeds, or images. So hear Yolo helmet weights are used. We had trained Yolo with some datasets. So once the camera is on, it detects the number of faces and checks the number of heads captured by the system. After checking, if the number of heads is less than 2,

then the ignition will turn on. if the number of heads is greater than 2, then the ignition will not turn on.

5.2.3 Crash Detection

The figure 5.2 is the crash detection module and this module helps to detect any sort of crash and helps to inform the concerned authorities and about it. The main concern of smart bike is to save the life of the riders incase of any accidents. So here, once the crash is detected it sends a message to the firebase. The message will be send to firebase only if the GPS is on. The accident will be detected only if the bike's inclination is less than degree. After that through GSM module it sends the message to the concerned people. The message consists of the exact location of the accident and so it will be easy for the people to track it.

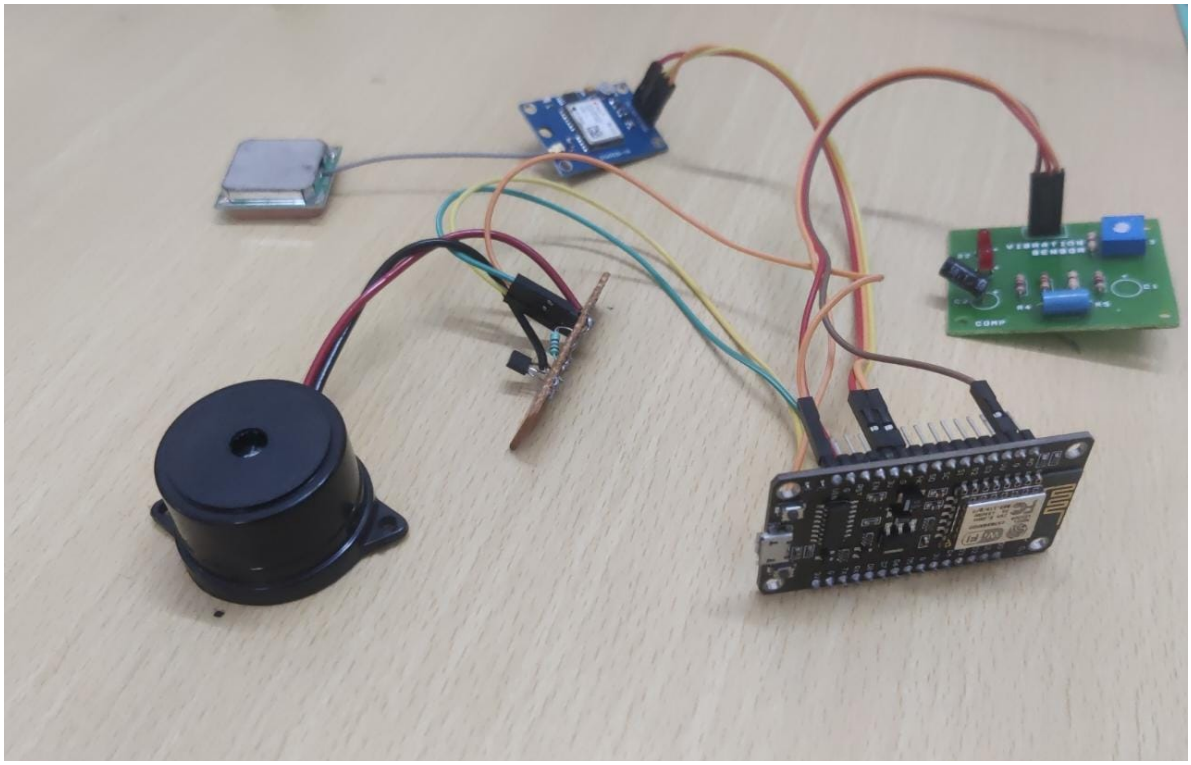

Figure 5.2: Crash Detection Module

5.2.4 App

The main purpose of the application is to change the number of the concerned people. Our phone numbers may not be same throughout our life. So it is necessary to have an option to change the numbers when ever we want. So an application was made to accomplish it. The app consist of a sign-up screen and a login screen. If it is a new user then the user can take sign-up page and give the users details accordingly. If it was an already existing user, then the user can go for Login page. Once the authentication is over, it gets diverted to a home screen and fro their further editing can be made. The user can go to the admin page from the home page and can select an option for adding the concerned peoples number. The user can add more than one number and once the accident is detected then the message will be send to all the numbers that are saved in the add. The users can also edit the saved numbers whenever the user wishes for.

The figure 5.3 and figure 5.4 depicts the authentication of the app. It Provide the user with sign-in facilities to access the app. First-time users must register with required credentials to sign-up and once that is done, then log in with their email id and password. The figure 5.5 is the homepage of the app. From this page there is an icon on the top were the user can get the access to the admin page.From the home page it diverts to the admin page. Admin screen is basically a profile page where the details of the rider will be seen. The figure 5.6 is the admin module. Here there is plus button, if the plus button is clicked, then a new subscreen will be shown and this subscreen is the add new relative module. The figure 5.7 depicts the add new relative module where the user can actually add the numbers of his choice. The alert message will be send only to the numbers that are added in the app. More than 1 contact can be saved in the app and the alert message will be send to all those numbers. The figure 5.8 is the add new relative screen. All the numbers added can be seen here. And if user wants to edit those number that are added, there is an option to edit it as well. These numbers can also be edited so that the user can change the number whenever the user wishes for. The figure 6.7 is the edit relative screen.

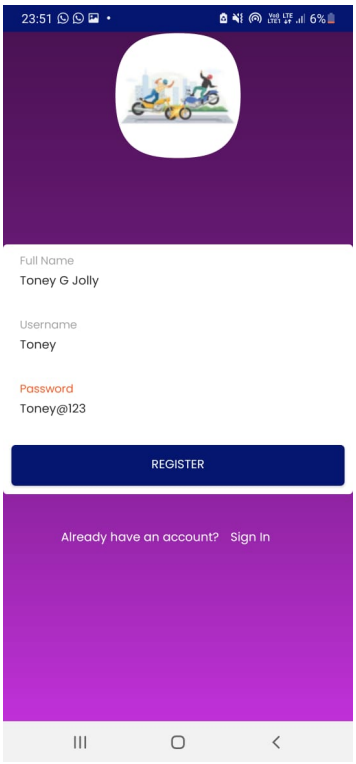

Figure 5.3: Sign-Up Screen

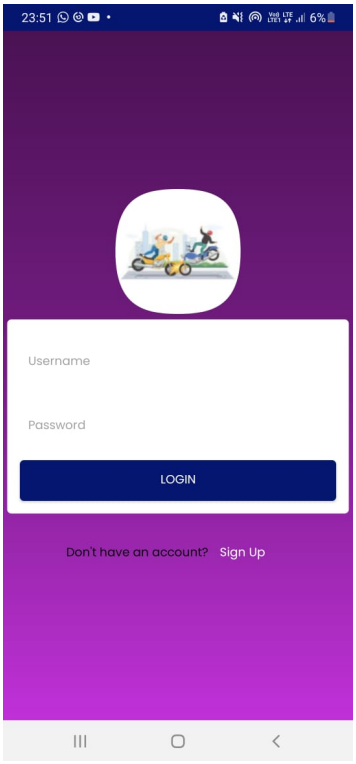

Figure 5.4: Login Screen

Figure 5.5: Home Page

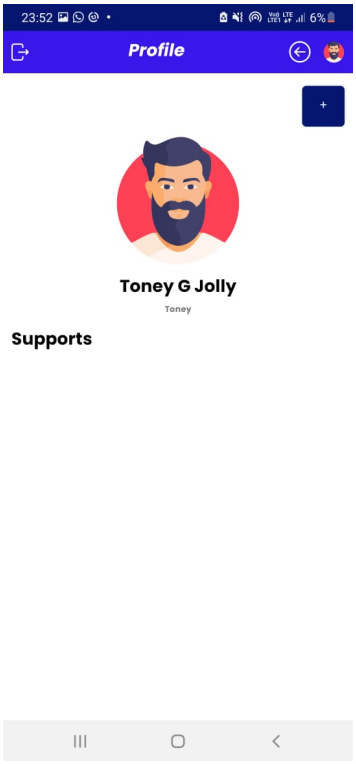

Figure 5.6: Admin Page

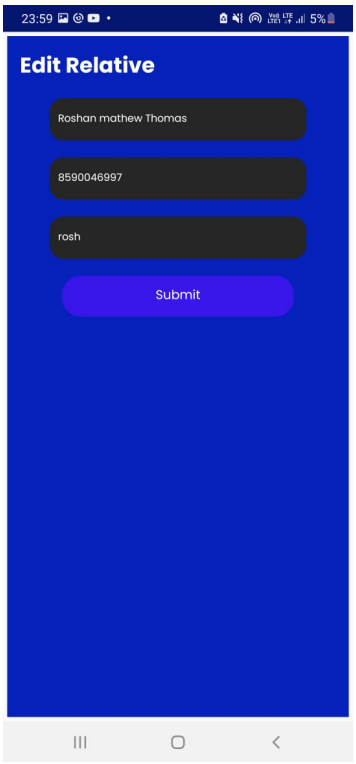

Figure 5.7: Edit relative screen

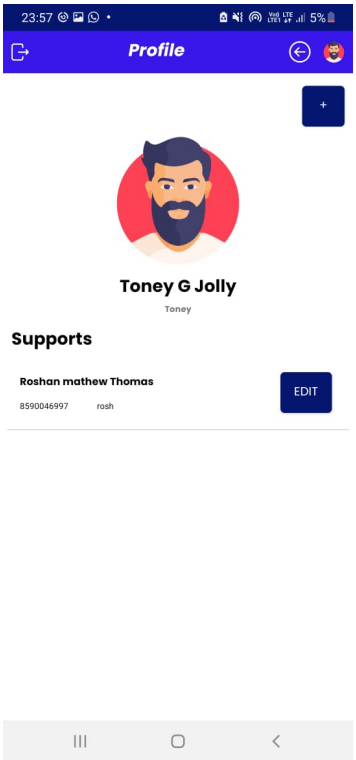

Figure 5.8: Add new relative page

Chapter 6

Result and Evaluation

6.0.1 Helmet Detection

Once the helmet detection module confirms that a helmet is being worn, it sends a signal to the motorcycle's ignition system, allowing it to be activated. This means that the motorcycle can only be started if the rider is wearing a helmet. If the module detects the absence of a helmet or improper helmet placement, it will prevent the ignition from turning on, thus discouraging riders from riding without proper head protection. It detects whether there is helmet or not like in figure 6.1. and figure 6.2. The helmet detection module represents a significant step forward in promoting responsible riding habits and improving road safety.This innovative solution not only protects riders from potential head injuries but also creates a culture of safety and compliance on the roads. With the widespread adoption of helmet detection module, we can make significant strides in reducing motorcycle accidents and their associated consequences. The figure 6.3 shows that the engine will get off when the helmet is not detected and figure 6.4 shows that the engine will turn on when the helmet is detected.

6.0.2 Triple Detection

The triple detection module incorporates a Raspberry Pi with an attached camera to capture real-time images of the motorcycle's riders. These images are analyzed using

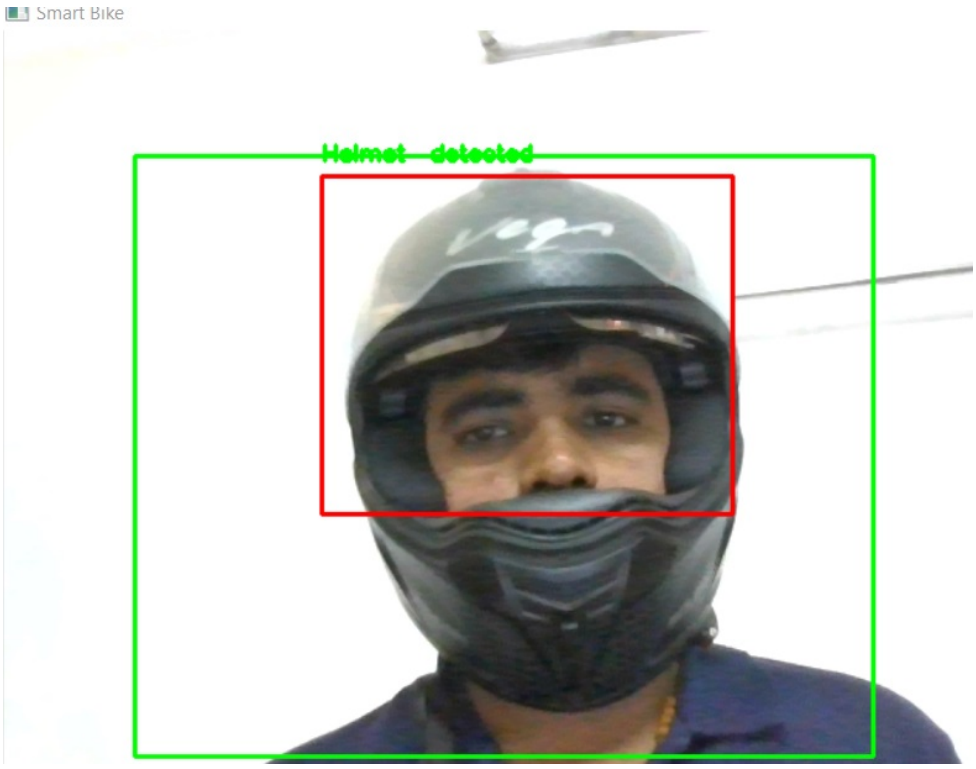

Figure 6.1: Helmet Detection

advanced computer vision algorithms to detect the presence of riders and determine their count. The Raspberry Pi camera captures images of the motorcycle's seating area, utilizing computer vision techniques to analyze the image data. The captured images are processed by algorithms that detect and identify individuals within the frame. Once the image analysis algorithm detects three riders, the triple detection module sends a signal to the motorcycle's ignition system, initiating an automatic shutdown. This safety feature prevents the motorcycle from operating when carrying an excessive number of passengers, ensuring stability, maneuverability, and reducing the risk of accidents. The figure 6.5 shows that the engine gets off when it detects three people on a bike. the figure 6.6 shows that the engine get off when it detect more than 2 people.

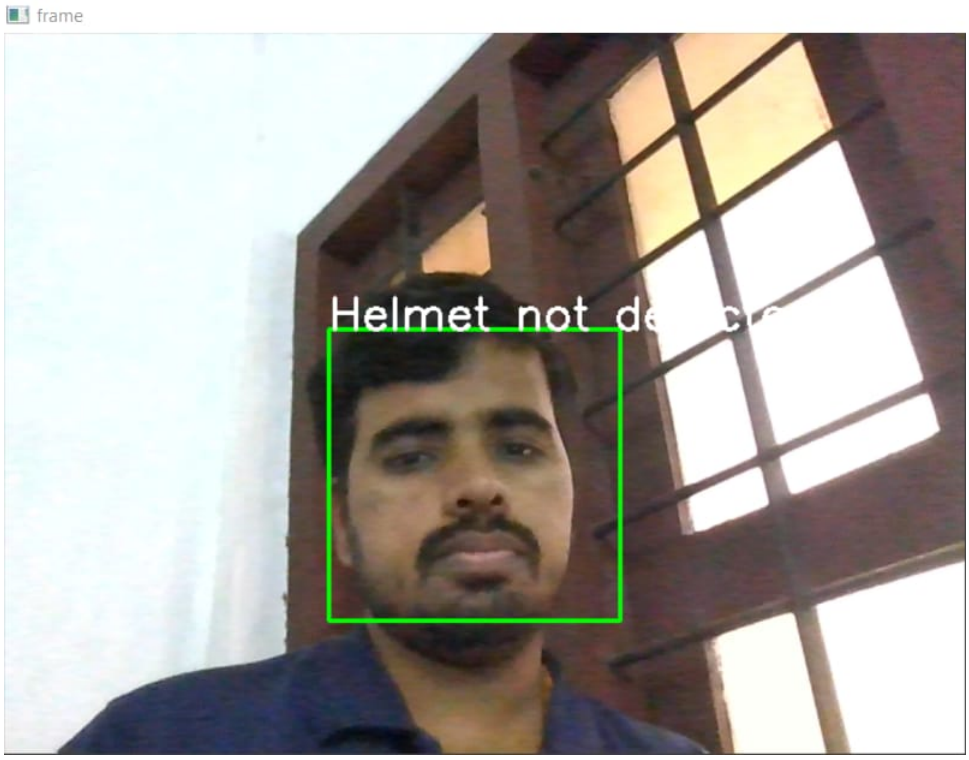

Figure 6.2: No Helmet

```
In [ ]: Engine off
        Data sent to ThingSpeak
        Warning:  Helmet not detected!
```

Figure 6.3: Helmet not Detected

```
In [ ]: Engine on
        Data sent to ThingSpeak
        Warning:  Helmet detected!
```

Figure 6.4: Helmet Detected Alert

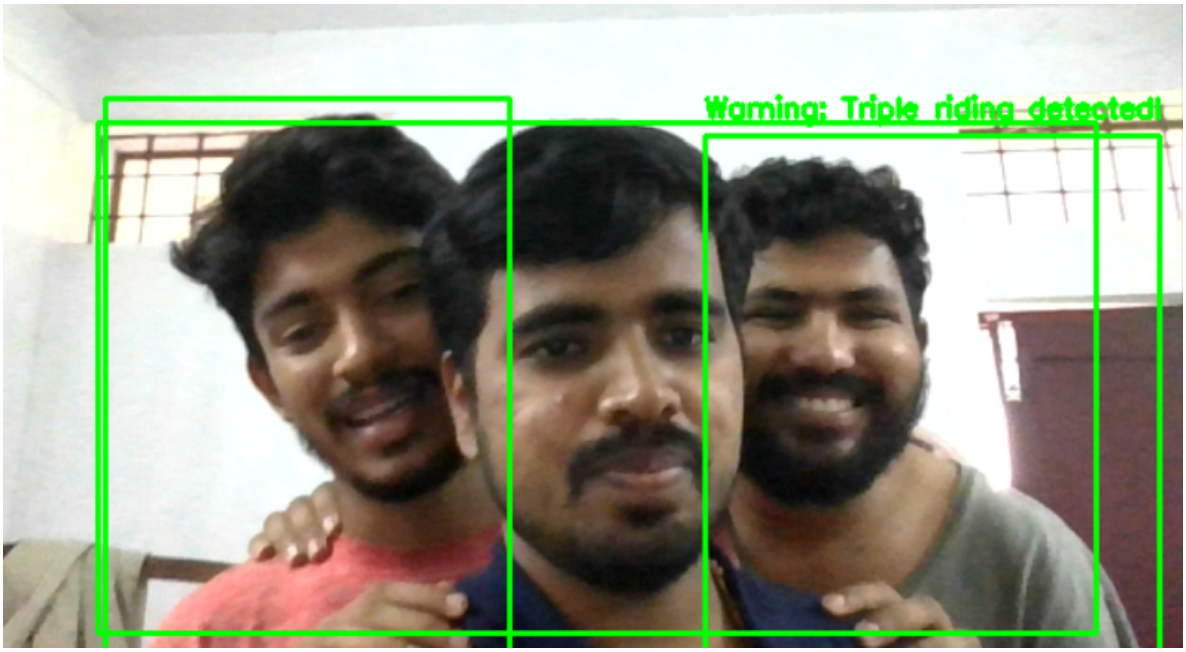

Figure 6.5: Triple Detection

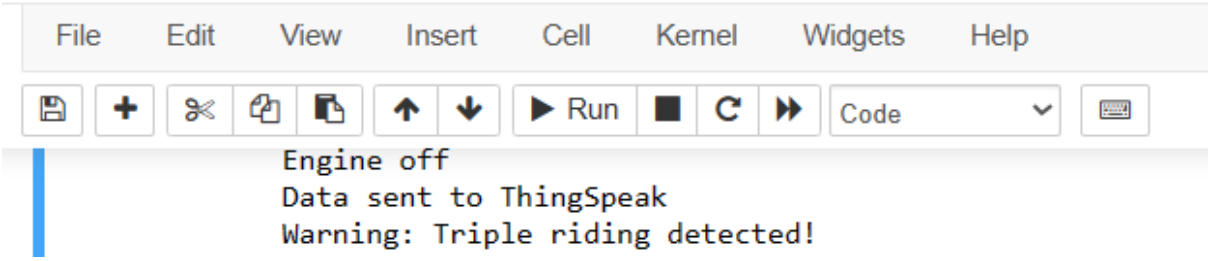

Figure 6.6: Triple Detection Warning

6.0.3 Crash Detection

The accelerometer continuously analyzes the motorcycle's acceleration patterns and compares them to predefined thresholds. If the acceleration exceeds these thresholds, indicating a crash, the crash detection module is activated.Once a crash is detected, the crash detection module immediately activates the GPS-GSM module. The GPS component determines the motorcycle's precise location, while the GSM component establishes a connection with cellular networks for data transmission.The crash detection module sends automated alert messages to the concerned authorities, such as emergency response teams. These messages contain crucial information, including the motorcycle's location

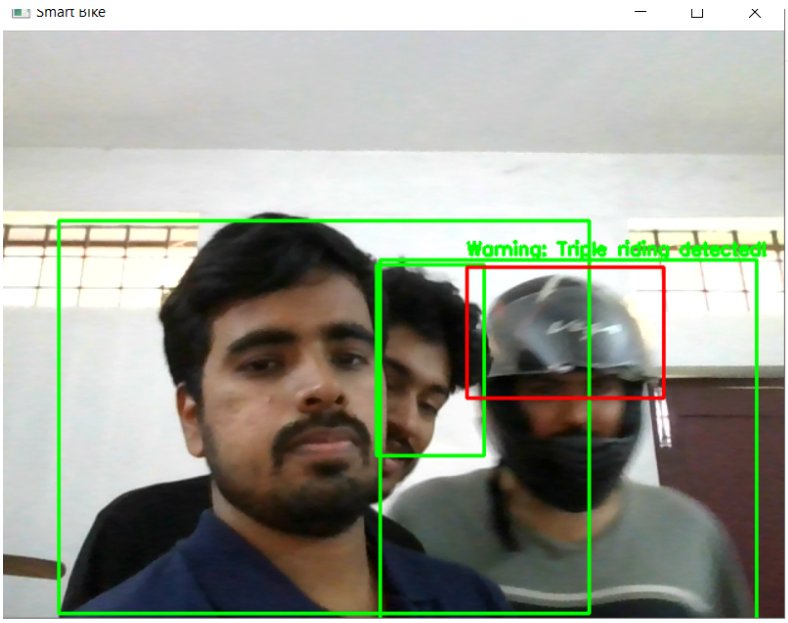

Figure 6.7: Triple Detection Warning

coordinates. Simultaneously, the module also alerts the emergency contacts of the motorcycle rider. This could include family members, friends, or pre-designated individuals who can provide assistance or support during an emergency. The notifications may be sent via telegram. The figure 6.7 shows the emergency message that is send via telegram.

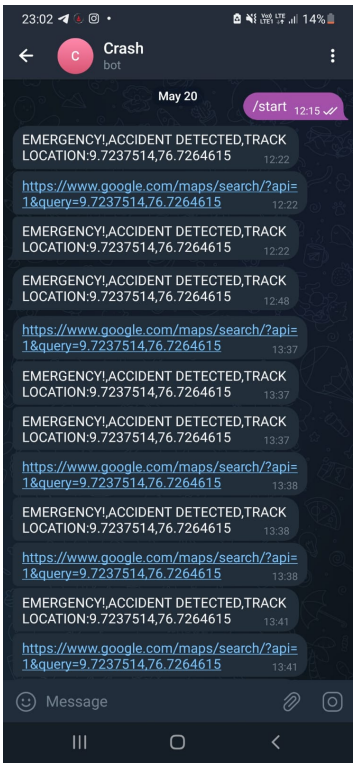

Figure 6.8: Emergency Message

Chapter 7

Conclusion

Smart Bike is a customized motor vehicle which focus mainly on the safety of the passenger. The Helmet Detection Module ensures that the rider and the pillion rider are wearing helmet or not. The GSM Module provides the correct location of the bike in the case of an accident. The Crash Detection module automatically sends an SOS to the concerned authorities and also to the emergency contacts of the victim. Detection of triples helps to reduce triple riding on bikes and thus avoid accident caused due to triple riding. Adding these special features in a motor vehicle can reduce the impact of the accident and can also save the life of the rider and the pillion rider. The riders can change the number of the concerned people whenever the rider wants to through an App.

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ANNEXURE-A

ST. JOSEPH'S COLLEGE OF ENGINEERING AND TECHNOLOGY, - PALAI -

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

CSD415 PROJECT PHASE 2

Final Review

Title:Smart Bike

Date :24/05/23

TEAM AND GUIDE DETAILS

TEAM NO:5

PROJECT GUIDE:

JIBIN PHILIP

TEAM MEMBERS:

KRISHNA PRABHA S (SJC19CS076)

ROSHAN MATHEW THOMAS (SJC19CS105)

TONEY G JOLLY(SJC19CS119)

TONY RAJU KUZHINJALIL(SJC19CS120)

COURSE OUTCOMES

Course Outcomes [COs] : After successful completion of the course, the students will be able to:

CO1	Model and solve real world problems by applying knowledge across domains (Cognitive knowledge level: **Apply**).
CO2	Develop products, processes or technologies for sustainable and socially relevant applications (Cognitive knowledge level: **Apply**).
CO3	Function effectively as an individual and as a leader in diverse teams and to comprehend and execute designated tasks (Cognitive knowledge level: **Apply**).
CO4	Plan and execute tasks utilizing available resources within timelines, following ethical and professional norms (Cognitive knowledge level: **Apply**).
CO5	Identify technology/research gaps and propose innovative/creative solutions (Cognitive knowledge level: **Analyze**).
CO6	Organize and communicate technical and scientific findings effectively in written and oral forms (Cognitive knowledge level: **Apply**).

CONTENTS

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 and convenient technologies are being introduced.
- Considering this importance towards motor vehicles we have proposed a smart bike which gives more preference to the safety of the riders when compared to other features of a bike.

INTRODUCTION

- Smart Bike is a customized motor vehicle which focuses on the safety of the passengers.
- The main objective of the concept is to reduce the impact that might be caused due to an accident.
- Smart Bike mainly consist of a helmet detection module which guarantees the passengers to wear helmet .
- The GPS module provides the location of bike in case of an accident.
- Crash detection module automatically sends an SOS to the concerned authority which helps to save the life of the riders.

PROBLEM STATEMENT

- The recent studies shows that most of the motor vehicle accident victims dies due to fatal head injuries which cause the sudden death. To ensure the safety of the riders we must ensure they wear the main protective gear i.e the helmet properly.
- If the bike gets crashed in some isolated area, it is very difficult to get the information and also to locate them.
- Motorcycles are not engineered for three people. There is maximum allowed load given for every vehicle, so that it would not be overloaded. Most of the vital accidents are caused due to riding a motorcycle with 3 passengers.

EXISTING SOLUTION

MVD AI CAMERA

CRASH DETECTION ON APPLE

Literature Review

TITLE with authors and year of publication	METHOD/technology	Accuracy / o/p	ADVANTAGE	LIMITATION
Accident Alert & Detection System Keshav Kunal, Nutan V Bansode et al[2017][1]	System consists of GPS, GSM, accelerometer and Arduino The system sends a google map link using GPS module and Arduino		Arduino activates the GSM module, which has a manually saved signal of the accident victim's emergency contact, and sends a pre-stored SMS to that contact.	the accident, the device sets the effective sensitive value for measuring instrument detectors, unless a crash is observed.
Helmet Detection Using ML & IoT. Varun Goel et al[2021]:[2]	Helmet detection OpenCV Machine Learning OCR	–	•Can get the vehicle number OCR. •An automatic challan is obtained. •A software is created so that the pay the challan	•it requires a very large amount of pictures from the cctv footage. •The text extraction using OCR is quite difficult if it's a bad weather.

TITLE with authors and year of publication	METHOD/technology	Accuracy / o/p	ADVANTAGE	LIMITATION
Smart Helmet for Accident Detection and Notification Merin Meleet et al [2017]:[3]	internet of things accident detection Reporting embedded systems	94.83%	•The helmet ensures that the rider wears the helmet. •If the helmet is not worn then the engine will not start.	• An additional sensor can also be incorporated to detect if the vehicle operator is under the influence of alcohol.
Method based on the cross-layer attention mechanism and multiscale perception for safety helmet-wearing detection. Hua Gao et al[2021]:[4]	• Object detection - SSD • Safety helmet detection • Attention mechanism • Multiscale perception	88.1%	• Has a high level fusion feature • An anchor box scale allocation strategy improved the	• Object detection with object tracking is absent

Literature Review

TITLE with authors and year of publication	METHOD/technology	Accuracy / o/p	ADVANTAGE	LIMITATION
SMART HELMET Yashi Thakur et al[2018][5]	• Helmet using GSM and GPS technology for accident detection and reporting system • ARM7, GSM and GPS module •	80%	•The rider won't be able to ride the bike if he is drunk •reduce the fatality of the accidents by sending a message to the riders relative about the accident. •without helmet ignition switch cannot ON.	The vehicle may be turn on or may be stolen by passing the ignition switch.
Smart Helmet for Accident Detection using IOT DivyasudhaN et al[2019][6]	• The system consists of micro controller, position sensor, alcohol sensor, piezoelectric sensor, RF transmitter, IOT modem, GPS receiver, power supply and solar panel..	85%	• Cost effective.	Technical Complexity and Power supply efficiency is a Limitation.

TITLE with authors and year of publication	METHOD/technology	Accuracy / o/p	ADVANTAGE	LIMITATION
Pre and Post Accident Detection and Alert System: an IoT Application for Complete Safety of the Vehicles Vaishali Shrivastava[2020][7]	• Internet of Vehicles (IOV),Vehicular Ad hoc Network(VANET),V2V communication which shares the data • Radio Detection And Ranging(RADAR), Light Detection And Ranging(LIDAR) to detect the collision.	90%	•It reduces the chances of mishappening occurrences, however protects everyone, counteracts harm to organization vehicles, and guarantees that the driver remains on track	LIDAR,RADAR,these sensors work well when the intervehicular space is more than 1m
Bike Rider Safety Monitoring System Using IoT T. H. Shrinivas[2021][8]	• GSM and GPS technology are used to track the accident occurred in a current location. • Blue-tooth receiver checks the wearing of helmet.	88%	• The helmets can be used as the key as without the helmet we cannot start the vehicle.	Bluetooth Reciever and transmitter are quite slower

TITLE with authors and year of publication	METHOD/technology	Accuracy / o/p	ADVANTAGE	LIMITATION
Crash Detection Using IMU Sensors George Casu et al[2017][9]	MPU6050 IMU sensors	95%	• IMU is an electronic device which is able to measure a body's force, angular rate or the magnetic field around it. • very cheap	New introduced Semiconductors, has a lower power consumption than the MPU6050
Automated Helmet Detection for Multiple Motorcycle Riders using CNN Sanjay Chatterji et al [2019][10]	• YOLOv3 model • Convolutional Neural Network (CNN)	95%	• The helmet ensures that the rider wears the helmet. • Detect the face with or without helmet	lane change detection

TITLE with authors and year of publication	METHOD/technology	Accuracy / o/p	ADVANTAGE	LIMITATION
Automatic crash detection for motorcycle Jarmo Takala et al [2014][11]	conventional crash pulse detection	95%	When the crash occurs automated system can send automated emergency call and the position of the motorist.	How to optimally combine data from several spatially distributed inertial measurement units.
Helmet Detection on Motorcyclists Using Image Descriptors and Classifiers Kelson Rômulo et al [2014][12]	circular Hough transform	91.37%	the detection of motorcyclists without helmet	The weakness of this work is that they only use geometric features to verify if any safety helmet exists in the scene

Literature Review

TITLE with authors and year of publication	METHOD/technology	Accuracy / o/p	ADVANTAGE	LIMITATION
Automatic Helmet Detection on Public Roads P Shilpa Gite et al[2015][13]	Hough transform descriptor.	95%	It would detect fall & helmet detection of a two wheeler driver run-time It would inform nearby hospitals, family members	• It does not check alcohol consumption • lane change detection
Recognition of driving manoeuvres using smartphone based inertial and gps measurement Engelbrecht et al[2018][14]	Endpoint detection algorithm	_	Detection of accidents and proper notification of the accidents to the concerned authority with gps	Dependent on a single smartphone

TITLE with authors and year of publication	METHOD/technology	Accuracy / o/p	ADVANTAGE	LIMITATION
IoT-based Accident Detection and Emergency Alert System for Motorbikes Arshia Arif et al **[2021]:[15]**	**IoT Tilt sensor** **GSM Module** **GPRS** **Accident detection**	97.33%	•the design is of a low-cost accident detection and alert system for motorcyclists. •Emergency services can reach the victim right on time.	**The location co-ordinate is not send during the time of crash detetction.**
Machine vision techniques for motorcycle safety helmet detection. Vasan timtong et al[2013][16]	K-Nearest NeighbourClassifier(KNN)	95%	• Quick calculation time • No training period	Errors in recognition of far lanes.When a moving object touches detection line it also touches other objects

Literature Review

TITLE with authors and year of publication	METHOD/technology	Accuracy / o/p	ADVANTAGE	LIMITATION
Automatic detection of bike riders without helmet using surveillance videos in real time; C.Krishna Mohan etal[2016][17]	Histogram of oriented gradients(HOG),scale-invariant feature transform(SIFT),Local Binary Patterns(LBP)	98.88%	• Less expensive • More accurate	Framework should be extended to detect number plate violators
Mobile vehicle crash detection system; Tey Han Yee et al[2018][18]	System consists of Acceleromter,gps,linear acceleration	_	• When an accident is detected system will look for closest service provider	• Optimization should be done to user detection page • Customization for users and providers should be added such as preferred providers nearby

Literature Review

TITLE with authors and year of publication	METHOD/technology	Accuracy / o/p	ADVANTAGE	LIMITATION
Machine learning based surveillance system for detection of bike riders without helmet and triple rides; Apoorva Saumya et al.[2020][19]	Takes a video of traffic and processes the video with the help of YOLOV3 model	_	The vertical projection of images are used to count the number of riders,so that more than two can be detetcted	• Night vision is not efficient • Bigger quantities of positive and negative examples cannot be remebered
Automatic accident detection and reporting framework for two wheelers; Amit meena et al.[2014][20]	Microcontroller based low cost accident detection unit with gps positioning	_	• Quick response • GPS coordinates included	Not involving the geographical context of the user and employee that in assessing the accidental scenario

SRS

Functional Requirements:

- GPS module for SOS
- Helmet detection
- Crash detection
- Triple riders detection
- UI

SRS

Non Functional Requirements

- Tracking

Hardware and Software Requirements:

- RASPBERRY PI 4(8 GB RAM)
- GSM module
- GPS module
- Vibration sensor

TECHNOLOGY STACK

- Language for hardware:Python
- Hardware:Raspberry pi 4,NodeMCU
- Image Processing: YoloV3

PROPOSED SYSTEM

- The proposed system is a smart bike which consists of enhanced safety features
- The system is divided into mainly 3 modules:
  - (1)Helmet detection
  - (2)Crash detection
  - (3)Triples riding detection

1.Helmet detection

- This module ensures whether the rider and the co-passenger is wearing a helmet
- Image processing is the technology/methodology used
- If one/both the passengers are not wearing an helmet the engine ignition is automatically turned off

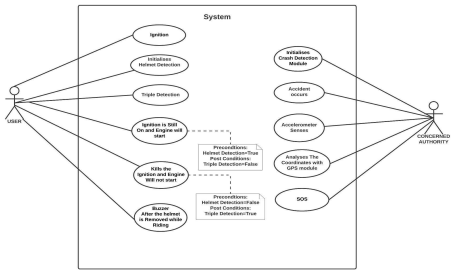
2.Crash detection

- This module notifies the concerned authority and preconfigured numbers whenever a crash is detected on the vehicle
- A gps module and an integrated gsm modem is combined onto the crash detection module
- The gps module helps to obtain the coordinates of the crashed vehicle during an accident
- The location of the accident and the SOS is broadcasted utilizing GSM modem

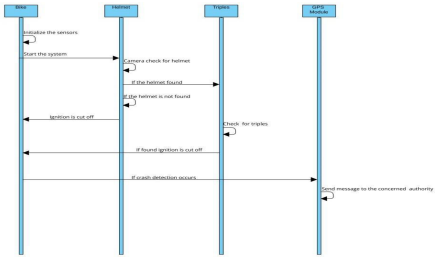
3.Triples riding detection

- This module checks whether more than 2 passengers are present on the motorvehicle
- Image processing technology/methodology
- If more than one passenger is detected the ignition is turned off

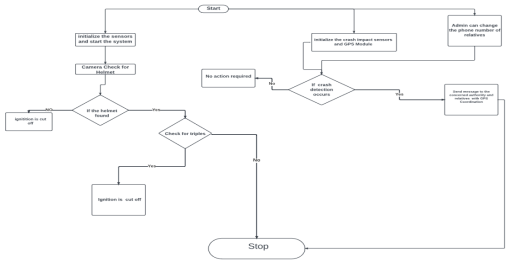
USE CASE DIAGRAM



SEQUENCE DIAGRAM



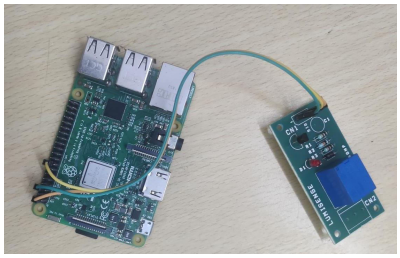
ACTIVITY DIAGRAM



SYSTEM IMPLENETATION

HELMET DETECTION MODULE

- This module is to detect whether the rider and the pillion rider is wearing the helmet or not.
- YOLO V3 is used here.
- Trained the YOLO with some dataset.
- So once the camera is on, it detects the face and compares with the dataset provided.
- After checking, if the image captured by the system and the datasets are equal then the ignition will turn on. If the image captured by the system and the datasets are not equal, then the ignition will not turn on until the rider and the pillion rider wears the helmet.

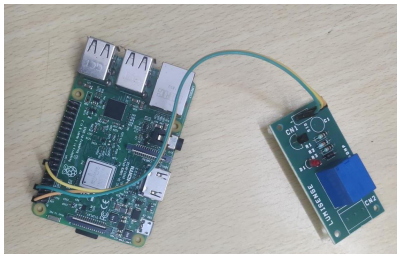


Helmet detection module

SYSTEM IMPLENETATION

TRIPLE DETECTION MODULE

- Check whether there are more than 2 riders.
- YOLO V3 is used here.
- Trained the YOLO with some databases.
- So once the camera is on, it detects the number of faces and checks the number of heads captured by the system.
- After checking, if the number of heads is more than 2 then the ignition will turn off automatically.
- Else the ignition will work as it is.

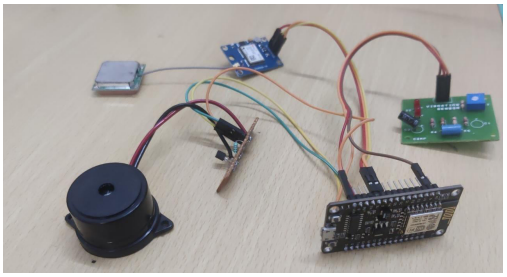


Triple detection module

SYSTEM IMPLENETATION

CRASH DETECTION MODULE

- It detects any sort crash and helps to inform the concerned authorities and about it
- The accident will be detected only if the bike's inclination is less than the specified angle degree.
- After that through GSM module it sends the message to the concerned people.
- The message consists of the exact location of the accident and so it will be easy for the people to track it.

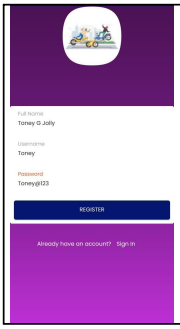


Crash detection module

SYSTEM IMPLENETATION

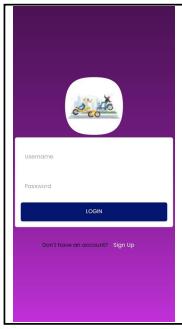
CRASH DETECTION APP

- This app is used to add numbers of the concerned people.
- Has an option for Sign-up and Login
- Can add more than one number.
- Once the accident is detected the, the alert message will be send to all the numbers in the app.
- The users can also edit the number whenever he want.



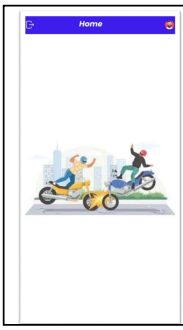
RESULTS

Sign up page



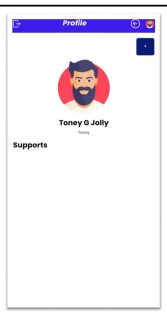
RESULTS

Login Page



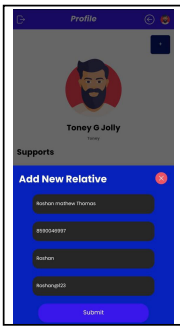
RESULTS

Home page



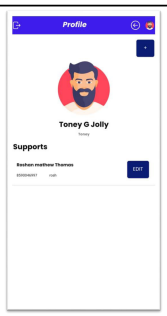
RESULTS

Primary User Page



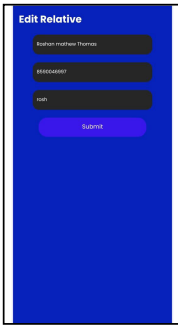
RESULTS

Add emergency contact page



RESULTS

After adding the emergency contact



RESULTS

Edit emergency page

CONCLUSION

- Smart Bike is a customized motor vehicle which focuses on the safety of the passengers.
- It is a step in the advancement of the safety features of a bike.
- Helmet detection module reduces the impact of an accident.
- Detection of triples helps to reduce triple riding on bikes and thus avoid accident caused due to triple riding.
- Crash detection module helps to inform the concerned authority when an accident occurs ,fast up the rescue and save the life of the passengers

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THANK YOU!

ANNEXURE - B

An enhancement of motor vehicle safety features using smart sensors

*Customize Motor vehicle which focus on the safety of the passengers

1st Krishna Prabha S
Computer Science Engineering Department
St Joseph's College of Engineering and Technology, Palai
Kottayam, India
krishnaprabhas900@gmail.com

2nd Roshan Mathew Thomas
Computer Science Engineering Department
St Joseph's College of Engineering and Technology, Palai
Kottayam, India
roshanmathewthomas2023@cs.sjcetpalai.ac.in

3rd Toney G Jolly
Computer Science Engineering Department
St Joseph's College of Engineering and Technology, Palai
Kottayam, India
toneygjolly6@gmail.com

4th Tony Raju Kuzhinjalil
Computer Science Engineering Department
St Joseph's College of Engineering and Technology, Palai
Kottayam, India
kuzhinjaliltony15@gmail.com

5th Jibin Philip
Computer Science Engineering Department
St Joseph's College of Engineering and Technology, Palai
Kottayam, India
jibinphilip@sjcetpalai.ac.in

***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. The GSM module provides the location of the motor vehicle in case of an 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. SYSTEM ARCHITECTURE

A. SYSTEM MODELLING

The architecture of our proposed system is illustrated in figure 1. The system first checks whether the rider and the pillion rider are wearing helmet or not. If any one of then are not wearing the helmet, then the ignition will turn off automatically. If the rider and the pillion rider are wearing the helmet then it checks for the number of passengers. If there are more than 2 riders then the ignition will turn off automatically. While driving if the rider or pillion rider removes their helmet, then a beep sound will be generated by the buzzer which alerts the riders and make them wear helmet throughout their journey. When a crash is detected by the accelerometer, then

through GPS-GSM module, it sends the location coordinates to the concerned authorities and also to the emergency contacts of the rider.

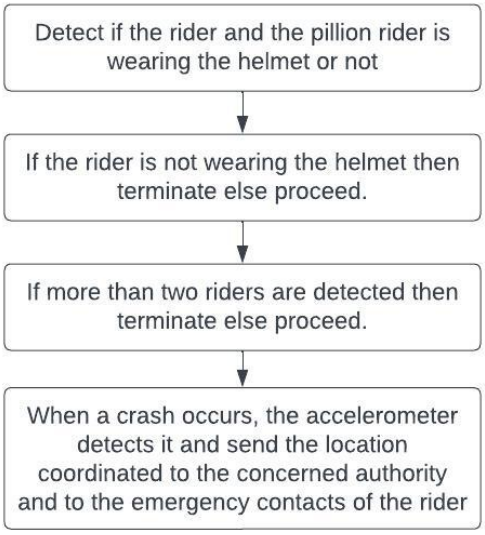

Fig. 1. System Architecture

IV. PROPOSED WORK

The system is divided into three modules :
(A) Helmet detection module
(B) Crash detection module
(C) GSM module
(D) Tripple Detection Module

A. *Helmet detection module*

The helmet detection module checks whether the rider and the pillion ride is wearing the helmet or not. If any one of rider or the pillion rider are not wearing the helmet then the engine will automatically turn off. While travelling, if any of the rider or the pillion rider are removing the helmet then a beep sound will be generated from the buzzer and this may force the riders not to remove their helmet while travelling. The figure 2 represent the helmet detection module.

B. *Crash detection module*

If the rider met with an accident in some isolated area, its very difficult to find a place and get help. There are situations where the victims maybe unconscious. So its really a threat to the riders.

Fig. 2. Helmet Detection Module

Smart Bike provides a Crash Detection Module. Smart Bike contains special sensors called accelerometer sensor that detects accidents. There are signals from the accelerometer and through these signals, it recognize whether the collision is severe or not. Then the vibration sensor will send a signal to the microcontroller which in turn will activate GPS-GSM Module. The figure 3 represent the crash detection module.

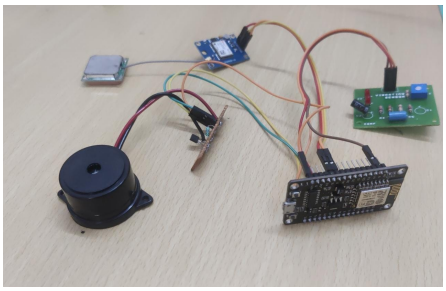

Fig. 3. Crash Detection Module

C. *GSM Module*

If the rider met with an accident in some isolated area, its very difficult to find a place and get help. There are situations where the victims maybe unconscious. So its really a threat to the riders.

When the accelerometer detects accident then GPS-GSM Module will get activated. This module mainly consists of a microcontroller, GPS modem and 9V DC power supply. Here the GPS module gets the location information from satellites in the form of latitude and longitude. The microcontroller processes this information and sends it to the GSM modem. Then the GSM Modem sends the information to the concerned authorities and also to the emergency contacts of the victim.

D. Tripple Detection Module

Nowadays three people in a motor vehicle is so common especially teenagers. Due to which bike accidents are common among teenagers. There are authorities to check this and still it continues to happen. Since the Technologies are moving forward and more reliable techniques can be used for this.
Smart Bike has a Tripple Detection Module. When the motor vehicle gets start, it checks whether there are more than two people in a it. If there are more that two people in it, then the engine will turn off automatically. A camera sensor is used for this purpose. the figure 4 represent the triple detection module

Fig. 4. Tripple Detection Module

V. 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. Hence our bike contains mainly 3 modules that is:
1) Helmet detection module
2) Crash detection module
3) Triple detection module
The main goal of our smart bike is to ensure the safety of both the rider and the pillion rider.

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