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Advanced Accident Detection and Prevention

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ABSTRACT –

The quick development of technology has improved our lives, but it has also made driving more dangerous. As a result, there are more car accidents. Death toll is frequently caused by unfortunate crisis offices. Our research offers an answer for accident detection and prevention that assures the safety of human life. Based on features, the application has been divided into two modules. This module, which focuses on several facets of Android-based automatic car accident detection and accident avoidance, is made to be integrated into a system.

I. INTRODUCTION

According to a 2015 report, India has more than 21 million registered motor cars overall. In India, 22,536,000 people possess cars, and 17.6 million two-wheelers were sold to consumers in that same year. Every day, there are 1214 traffic accidents in India. Two-wheeler accidents account for 25% of all fatalities from traffic accidents. According to a recent report, Tamil Nadu is the state where the most injuries from traffic accidents occur. Figure 1.1 shows the Indian Roads Accident Report for the year 2016. In India, a roadway accident leads to one death almost on cue. According to a poll conducted by the ministry of road transport and highways' transport research wing and published by the Indian government, more persons died in traffic accidents in 2016 than they did in 2015. The statistics show that 413 people died every day as a result of 1,317 traffic accidents. Additionally, the data indicates that at least 17 people died in traffic accidents every hour.

Our daily lives now heavily rely on the Internet of Things (IoT). More than 13 billion electronic and digital gadgets are now in use, or two devices per person. The "SMART HOME" is a good illustration of the Internet of Things; the most advanced gadgets have programmable and remote-controlled appliances. Future IoT growth will mostly come from all economic sectors, including business, industry, healthcare, and public safety. The convergence of Internet connectivity, robust data analytics capabilities, utility components, and all other common objects is changing the way we live and work. Therefore, the definition of the phrase "Internet of Things" is the extension of network connectivity and processing capabilities beyond computers to include common household things that can generate, trade, and consume data with little to no human involvement. Many lives could not be saved despite wearing helmets due to a lack of prompt medical attention. Our research intends to speed up contact with those closest to the injured person so that the victim can receive medical treatment more quickly. The goal of the project is to raise the percentage of motorbike riders who are safe on the road.

II. Motivation

Traffic accidents have caused millions of individuals worldwide to lose their lives or suffer physical disabilities over the course of many years. Since human error is virtually always a factor in traffic accidents, this has provided motivation to prevent accidents on the road. According to estimates, there will probably be a doubling of the number of fatalities caused by road accidents during the next ten years. With the advancement of technology and innovation in the twenty-first century, increased emphasis is placed on vehicle security. As the number of vehicles increases, it is our duty to reduce the number of traffic accidents that occur. Drunk and sleepy drivers are primarily to blame for accidents. The installation of this project will decrease the accident that was brought on by the aforementioned reason. Unfortunately, manual accident detection is frequently employed when an accident occurs. For any safety precautions, this technique depended on pedestrians passing by the accident scene to alert the proper emergency authorities. This method, however, was flawed since it required a witness to the accident, was unreliable owing to witness language barriers, and involved delays and errors. When an accident is detected, the system uses GPS to pinpoint its precise location and sends that information to the emergency unit via GSM module. This aids in many lives being saved by alerting the rescuer in time.

III. Literature review

According to one study (Manjesh, N., 2014), one helmet has sensors that detect vibrations when the rider is in an accident and use a GPS module to relay location data to a microcontroller board. A GSM module automatically sends an emergency message to predetermined contacts if the vibration exceeds a minimum stress limit. Another study (Sreenithy Chandran, 2016) suggests a cloud-based solution that uses GPS, the BMA222 accelerometer, a Wi-Fi enabled processor (TI CC3200), sensors, and cloud computing platforms to deliver alarm messages to emergency contacts.Through the use of an

ATmega328P microcontroller and Bluetooth (HC-05 Module) technology, this system can also send SOS messages with location information and allow users to listen to music while driving.A Peltier module (TEC-12706T125), which employs the thermoelectric effect to keep heat inside the helmet, is used in a helmet created for the rider's comfort and safety (Prudhvi Raj, 2016). Temperature is measured by a temperature sensor (LM35D), and in the event of an accident, the GPS module notifies emergency personnel of the exact location. Additionally, the thermoelectric module can aid in clotting bleeding and lowering danger. According to other studies (Sudarshanraju and Anshu Singh Gautam, 2015), GPS and GSM technology can be used to identify accidents and deliver alerts to emergency contacts.In one study (Nina Korlina Madzhi, 2013), a PIC16F84a microcontroller is utilised to control the system, which uses a Force Sensing Resistor (FSR) and BLDC Fan to detect head movement and motorcycle speed. The motorcycle can only be started if the rider is wearing and locking a helmet, and the motorcyclist will be cautioned if the posted speed restriction is higher than 100 km/h. According to several research (Jennifer William, Chitte, and Saravana Kumar, 2016), alcohol sensors (MQ-3) are used to detect the presence of alcohol in the rider's breath and prevent the vehicle from starting.A Smart Helmet concept is put forth in another study (Venkatesh, 2016) with a microcontroller (Intel Edison on Arduino Board), accelerometer (MPU6050), headset (Intex), and camera (Logitech) that can detect accidents and wirelessly transmit data to a phone. Additionally, the Smart Helmet pairs with a smartphone through Bluetooth to provide voice directions for the rider and notify them of emails and phone calls.

IV. OBJECTIVES

Major deaths result when accidents happen because people are not treated promptly. The primary causes could be that no one was present at the accident site to alert the ambulance or the family, or that the ambulance arrived late. The proposed work provides a solution to this issue by creating an accident detection system that uses reporting systems with the goal of saving at least half of the lives lost in accidents and prevention by regulating vehicle speed and also warning the driver. Future applications of this technology could include lock protection, other safety features, including preventing excessive speeding by informing the rider's family. Prompt detection and reporting will be crucial for saving countless lives. We employed image processing in this experiment, and it may be enhanced in the future by using cutting-edge technologies like neural networks to improve sleepiness predictions.

V. Proposed Systems

We build various sensors inside the Raspberry Pi board to spot probable mishaps and stop them. We initially used a web camera to track the person's eye movement in order to identify tiredness. The classifier that will identify the object is trained using other methods, such as the Haar feature. This method needs a lot of positive photos (photographs of faces) and negative images (photographs of objects without faces). The sum of the pixel values inside the rectangle can be divided to determine these. During the process, the Adaboost algorithm will accept all face samples and ignore pictures with no faces. We make use of sensors like the tilt sensor, which has a limited range of motion and measures tilt and slope. This sensor, which will detect the change in angle in the vehicle, is used to monitor tip over protection in industrial vehicles. Anytime the angle exceeds the threshold limit, an accident has happened. We activate the buzzer to warn the driver when we notice that the person is tired. This is carried out for a set number of seconds. In the case that an accident occurs, we submit the accident location's coordinates using the GPS module built into the Raspberry Pi board.Impact sensors are used at the vehicle's corners to detect and record shock or impact, indicating whether a real shock or impact has occurred. This is how we establish whether an accident has taken place. The DC motor, which controls the vehicle's speed, will gradually slow down and halt anytime a person is determined to be sleepy. When the vehicle's speed starts to drop, the LED lights mounted on its corners illuminate. To combine the many elements stated above, we use software on the raspberry pi board like OpenCV, which offers a library that binds in C++, C, Python, and Java. OpenCV is used for all types of image and video analysis, including facial recognition and detection.

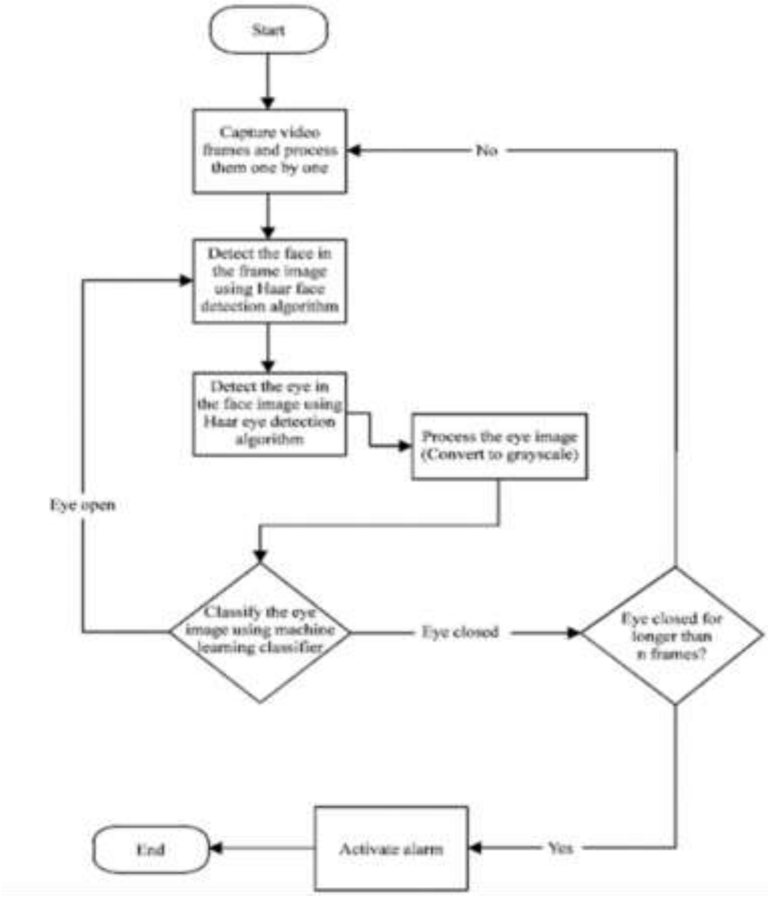

Fig 1. Block diagram

Component used:

Raspberry pi:

A processor, graphics chip, programme memory (RAM), as well as a number of interfaces and connectors for external devices, are all found on the Raspberry Pi board. The Raspberry Pi operates similarly to a regular PC and needs a power source, a console for ordering, and a presentation device.

Fig 2. Raspberry Pi

Operating System SD Card:

SD card with an installed copy of the Linux operating system is required because the Raspberry Pi lacks an internal mass storage device or built-in operating system.Any compatible SD card (4GB or more) that you have on hand can be used to make your own preloaded card. To prevent disputes over missing photographs, it is advised to use a fresh blank card.

Web and Bluetooth Association:

The Raspberry Pi 3 has a 10/100 Ethernet port and an onboard Bluetooth and Wi-Fi module. Either the Wi-Fi module or the Ethernet/LAN port are used to establish the internet connection.

Fig 3. Web and Bluetooth Connection

Energy Source:

The Raspberry Pi gadget as a whole is controlled via a tiny USB port. A USB connector can deliver 700 mA at +5 V dc.

DC motor:

DC motor driving circuits can be contained in compact modules, such as the board in this illustration. Motor drives are used to power motors and regulate their rotational direction and speed, as the name implies. Basic ebb and flow speakers known as engine driver ICs are in charge of informing an engine of its expected capacity.

Mouse and keyboard:

The Raspberry Pi3 has four USB ports, and the keyboard and mouse are connected to two of them.

The RPi has two main ports for its display: HDMI (High Definition) and Composite (Standard Definition). HD televisions and many LCD panels may be connected to the RPi using a standard "male" HDMI cable.

Impact sensor:

Since a collision is most likely to happen at the front of the car, an impact sensor is typically installed there. Both kinds of sensors, collectively known as inertia sensors, operate on the idea of sensing a drop in a moving vehicle's acceleration and producing an electrical impulse.

Fig 4. Impact sensor

GPS Module:

The Global Positioning System (GPS) is a satellite-based system that calculates and measures its position on Earth using satellites and ground stations. Navigation System with Time and Ranging (NAVSTAR) GPS is another name for GPS. For accuracy, a GPS receiver must receive information from at least four satellites.

Fig 5.GPS Module

VI. Methodology

Algorithm:

The Haar algorithm was used to build pretrained model shape predictor face landmarks, and deep learning is used to suggest a new frame that classifies the driver's eye condition as open or closed.

Recognizing the face and the eye picture, the Haar calculation will be utilized, Haar calculation is a notable strong element based calculation that can distinguish the face picture effectively. The training set consisted of both open and closed eye images. When the training model is built, it will be ready to use to classify any new eye image that had been pre-processed. Its best algorithms for eye-based features and image processing techniques.

Techniques:

1.Face Detection:

The pretrained model shape predictor face landmarks were created using the Haar algorithm, and deep learning was then used to recommend a new frame that categorises the driver's eye condition as open or closed. The Haar calculation will be used to recognise the face and eye images. The Haar calculation is a well-known strong element-based calculation that can successfully distinguish the face image. Images with both open and closed eyes were included in the training set. Any fresh pre-processed eye image can be classified using the training model once it has been created. its most effective algorithms for analysing images and adding eye-based characteristics. Paul Viola and Michael Jones suggested an effective object detection method in their 2001 publication, "Rapid Object Detection using a Boosted Cascade of Simple Features," which uses Haar feature-based cascade classifiers for face detection. In this machine learning-based approach, a cascade function is developed using a large number of positive and negative images. Following that, it is employed to locate items in other images. We will concentrate on face detection in this area. The algorithm needs a lot of positive images—pictures of faces—and negative images—pictures lacking faces—to first train the classifier. The following step is to pull features out of it. These characteristics, which are the same as those in our convolutional kernel, are shown in the ninth image below. A single value is produced for each feature by dividing the total number of pixels in the white rectangle by the total number of pixels in the black rectangle. A cascaded Adaboost classifier with Haar-like characteristics is used to identify the facial region. The corrected image is initially segmented into a number of rectangular regions that might be any size or location within the original image. Because facial traits differ, the Haar-like feature works well for real-time face recognition. These can be calculated as the sum of the discrepancies between the pixel values inside the rectangle. The traits can be seen by the unique makeup of the black and white sections. A solid classifier called a cascaded Adaboost classifier, which combines a number of weak classifiers. Each weak classifier is trained via the Adaboost method. If a candidate sample passes through the cascaded Adaboost classifier, the face region can be located. Nearly all off samples can pass through, however non-face samples can be refused.

2.Eye recognition:

We have included face milestone expectations for eye placement in the framework. Facial landmarks allow for the localization and representation of prominent facial features like:

Eyebrows, Nose, Mouth , Facial features. Face arrangement, head present assessment, face trading, flicker recognition, and a lot more have all successfully used facial milestones. Regarding facial milestones, our goal is to distinguish notable facial designs on the face using shape expectation approaches. As a result, there are two phases involved in recognising face landmarks:

Identify key facial structures using the face ROI by defining the face in the image.Make the face of the image more regional: Haar feature-based cascade classifiers are employed in the initial stage of our approach, face detection, to localise the face picture.

Determine the face's most significant facial features.

ROI: There are many different types of facial landmark detectors, but each one aims to recognise and categorise the following facial regions:

- Mouth,
- Right eye brow,
- Left eye brow,
- Right eye,
- Left eye,
- Right eye,
- Nose

A labelled training collection of facial landmarks using images. On these photos, unique (x, y)-coordinated zones are manually labelled to surround each facial structure. Priors, and more particularly, the likelihood of the input-pixel distance between two pixels. The 68 (x, y)-coordinate points on the face that correspond to facial structures are estimated by the pre-trained facial landmark detector in the dlib package.

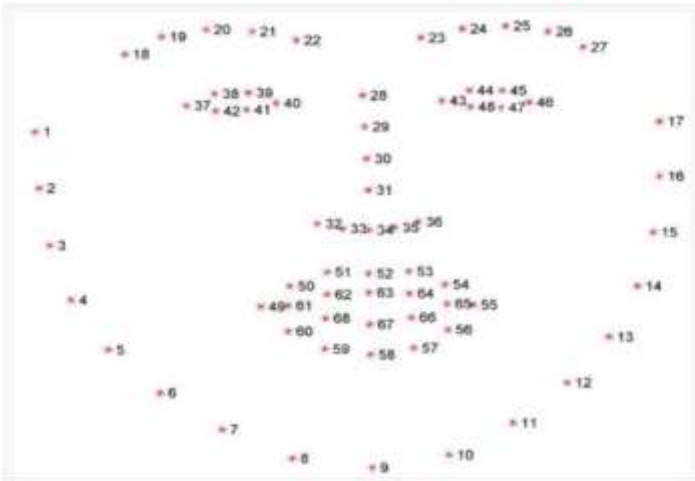

Fig 6 . Eye Detection

3.Recognition of Eye's State:

Sparse tracking, frame-to-frame intensity differencing, adaptive thresholding, and optical flow can all be used to calculate the eye area. Finally, a choice is taken about the presence or absence of eyelids. One can determine the state of the eye opening from a single image using a variety of techniques, including correlation matching with open and closed eye templates, heuristic horizontal or vertical image intensity projection over the eye region, parametric model fitting to locate the eyelids, or active shape models. The earlier methods frequently place too many restrictions on them, including the relative face-camera posture (head position), image resolution, lighting, and motion dynamics, among other factors. Heuristic approaches that use raw image intensity are probably quite sensitive, despite their real-time performance. As a result, we suggest a simple but efficient technique for detecting eye blinks with a recent facial landmark detector. A single scalar quantity that indicates a level of the eye opening is derived from the landmarks. Finally, an SVM classifier that has been trained on instances of blinking and non-blinking patterns determines where the eye blinks and predicts the per-frame sequence of the eye opening.

4.Eye Aspect Ratio Calculation:

Every frame of the video has an identification of an eye landmark. The height to width ratio of the eye is known as the eye aspect ratio (EAR).

$$EAR = \frac{\|p2 - p6\| + \|p3 - p5\|}{2\|p1 - p4\|} \quad (1)$$

where the landmarks shown in Figure, in two dimensions are p1,...,p6. When an eye is open, the EAR is nearly constant, but when an eye is closed, it approaches zero. The aspect ratio of the open eye is largely insensitive to head pose and person, and it is totally invariant to uniform scaling of the image and in-plane rotation of the face. The EAR of the two eyes is determined to be the middle value because eye flickering is conducted concurrently by the two eyes.

5.Eye State Determination:

The final phase determines the eye state depending on the EAR that was computed in the step before. If the distance is 0 or nearly zero, the eye condition is classified as "closed"; otherwise, it is classified as "open."

6.Drowsiness Detection:

The algorithm then uses a pre-set sleepiness condition to determine the person's status. A human blinks for 100–400 milliseconds, or 0.1–0.4 of a second, on average. As a result, if someone is tired, their eye closure must last longer than this. We chose a five-second time restriction. If the eyelids are closed for longer than five seconds, drowsiness is recognised and an alert pop is produced.

Technology Description of Technology Used:

OpenCV : An open source PC vision and AI programming library is called OpenCV (Open Source PC Vision Library). OpenCV was created to make it easier to incorporate artificial intelligence into commercial goods and to offer a standard framework for computer vision applications.

TensorFlow :TensorFlow is a machine learning platform that is completely open source. The focus of this course is on creating and refining machine learning models using a specific TensorFlow API, despite the fact that TensorFlow is a full management system for machine learning systems.

Machine Learning: Computers can automatically learn from data without being explicitly taught thanks to a programming technique called machine learning. In other words, these programmes change their behaviour by learning from data. One of the best machine learning languages is without a doubt

Python. To master linear algebra and the kernel techniques of machine learning, check out the machine learning-specific Python packages scipy, pandas, and numpy. The language is perfect for working with machine learning algorithms because of its comparatively straightforward syntax.

Kivy: Kivy is an open-source Python library for developing mobile apps with a natural user interface (NUI) and multitouch functionality. Android, Windows, Linux, and OS X are all compatible with it. Kivy is free and open source software that is distributed in accordance with the terms of the MIT permit. Kivy is the main framework created by the Kivy company, along with Python for Android, Kivy iOS, and a variety of other libraries made to be used on all platforms.

VII. System Architecture

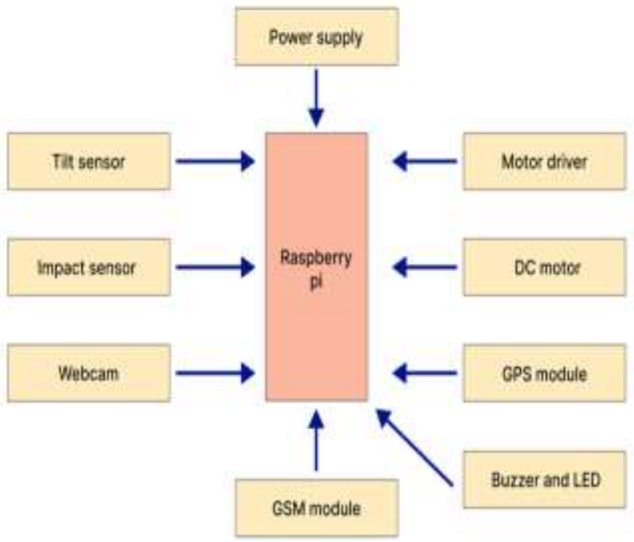

Fig 7. Architectural design

• Steps Involved :

1. The first step is to find the face in the picture.

2. Image processing: Identify the major facial components

3. Eye State Determination, Drowsiness Detection, and Eye Aspect Ratio Calculation

4. (Stops the vehicle)

5. Using a tilt and impact sensor to check the condition of the vehicle

6. Spotting a shift in a vehicle abnormality

7. Output (sends text messages containing the GPS coordinates).

VIII. OUTCOMES

Major deaths result when accidents happen because people are not treated promptly. The primary causes can be that no one was present at the accident site to alert the ambulance or the family, or that the ambulance did not arrive in time. The proposed work provides a solution to this issue by creating an accident detection system that uses reporting systems with the goal of saving at least half of the lives lost in accidents and prevention by regulating vehicle speed and also warning the driver.

Future applications of this technology could include lock protection, other safety features, including preventing excessive speeding by informing the rider's family. Prompt detection and reporting will be crucial for saving countless lives.

IX. Conclusion

The majority of accidents in recent years have included motorbikes. Numerous lives are lost as a result of this worrying increase in motorbike accidents. The primary cause of many deaths is inadequate treatment received at the appropriate time. The main factors may be the ambulance's tardy arrival or the absence of a witness who could provide the ambulance with information or a family member who could provide it. By introducing an accident detection and reporting system that aims to save at least half of the lives lost in bike accidents, the proposed study provides a solution to this issue. This method might be used in the future to protect locks and for other safety concerns. By relaying the information to the rider's family, it may also be used to regulate the speed of the car and stop the driver from driving too fast. The duty of saving countless lives will fall on early detection and reporting.

X. Future Scope

The future scope of accident detection and prevention is promising as technology continues to evolve and improve. Some potential areas of development include:

Artificial intelligence: As machine learning and deep learning algorithms continue to advance, they can be used to improve the accuracy and speed of accident detection and prevention systems. These algorithms can learn from data and identify patterns that humans may not be able to detect, leading to more effective accident prevention.

Vehicle-to-vehicle communication: With the increasing use of connected vehicles, there is an opportunity for vehicles to communicate with each other to prevent accidents. For example, vehicles could alert each other when they are approaching an intersection, or when there is a hazard on the road. Autonomous vehicles: As self-driving cars become more common, the need for accident prevention technology may shift from the driver to the vehicle itself. Autonomous vehicles can use sensors and advanced algorithms to detect and avoid potential accidents.

Integration with emergency services: Accident detection and prevention systems can be integrated with emergency services to improve response times and potentially save lives. For example, if an accident is detected, emergency services can be automatically notified with the location of the accident and any relevant information.

Overall, the future of accident detection and prevention is likely to be driven by advances in technology, particularly in the areas of artificial intelligence, vehicle-to-vehicle communication, autonomous vehicles, and integration with emergency services.

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