DRIVER DROWSINESS MONITORING SYSTEM WITH ACCIDENT DETECTION WARNING

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Abstarct *Nowadays, there is a significant rise in the number of accidents caused by drivers who are too sleepy. The majority of driver's experience low energy levels as a result of their tiredness or fatigue from the amount of work they do. They therefore frequently experience drowsiness when driving. These fatigues greatly enhance the risk of accidents occurring. These models are integrated into the majority of high-end vehicles, though public transportation vehicles do nothave this technology. This project presents a holistic approach to address driver drowsiness, integrating computer vision, deep learning, and Internet of Things technologies. The system utilizes Python with OpenCV for image processing, Convolutional Neural Networksfor drowsiness detection and Haar Cascade Classifier for facial feature recognition. Moreover, an embedded system featuring NodeMCU, alarm systems, relay modules, a DC motor, vibration sensor and a motor speed control mechanism is employed, enhancing the system's functionality. Additionally, alcohol sensor is integrated to check whether the driver is drunk and gives a warning alarm.*

Keywords: Computer vision, Deep learning, IoT, Alarm systems, Motor speed, Vibration sensor

1. INTRODUCTION

A major risk to road safety is driver drowsiness, which raises the possibility of collisions and fatalities. Our project intends to create a complete Driver Drowsiness Detection System (DDDS) that makes use of cutting-edge technologies like computer vision, deep learning, and the Internet of Things (IoT) since we recognize how important it is to address this issue. By integrating Python-based tools like OpenCV for image processing, Convolutional Neural Networks (CNNs) for drowsiness detection, and Haar Cascade Classifier forfacial feature recognition, along with an embedded system comprising NodeMCU, alarm systems, relay modules, DC motor, vibration sensor and motor speed control, we aim to create a sophisticated solution that not only identifies drowsiness but also takes preventive measures.

The system begins by capturing real-time facial images of the driver using a camera strategically placed within the vehicle. OpenCV is employed for preprocessing and facial feature extraction, utilizing Haar Cascade Classifier to identify critical features such as eyes and head position. These features are then fed into a CNN model trained to recognize patterns associated with drowsiness, including eye closure and head nodding.

Upon detection of drowsiness, the system activates an alert mechanism using the integrated IoT components.NodeMCU, serving as the IoT device, communicates with the cloud or a centralized server to transmit alert signals. The alerting mechanism incorporates an alarm system to audibly notify the driver. Taking proactive measures to prevent accidents, the integrated IoT components include a relay module that controls a DC motor. In the event of detected drowsiness, the system slows down the vehicle's speed, ensuring a safer driving environment. The vibration sensor is also incorporated to alert the driver by vibrating the seat of the driver to makehim awake. Drunk and driving is also major cause for theaccident. So, additionally an alcohol sensor is integrated to check whether the driver is drunk and gives warning to the driver. To enhance user interaction and mitigate the potential for false alarms, we introduce an alarm reset button into the system. This feature enables the driver to acknowledge the alert and reset the system, providing a user-friendly experience while maintaining the system's vigilance during genuine drowsy states. The combination of computer vision, deep learning, and IoT technologies in this project forms a robust and intelligent solution to the critical issue of driver drowsiness, contributing to road safety and accident prevention.

2. RELATED WORKS

From reference [1] the proposed idea Advanced Driver Assistance Systems (ADAS) comprise of an active safety system that detects the driver's face to identify their level of tiredness. This research describes a camera-based technique that relies on fiducial components such as the driver's lips, eye movement, and hand movements, all of which are common human responses to yawning. A front-facing camera is put on the windscreen to continuously monitor the driver, and the images are processed using a Raspberry Pi. When the driver yawns or becomes drowsy, the suggested warning system sends an auditory warning. The results show that the proposed technique is successful in detecting indicators of driver tiredness and yawning.It can distinguish between when the driver's hand is placed over the mouth to denoteyawning and when it is touching other parts of the face todenote non-yawning.

From reference [2] the proposed idea is to focuses on the design and implementation of a driver assistance system that monitors and alarms the driver usingintrusive acquisition methods known as Electrooculography (EOG) signals. The EOG signal acquisition circuit was implemented using an embedded system based on the Arduino board's ATmega2560 microprocessor. The created system used numerous measures to extract features from EOG data, making it extremely sensitive to detecting driver tiredness. Furthermore, the K Nearest Neighbours (KNN) classifier is employed to achieve high accuracies. This technology develops a low-cost device capable of promptly warning the motorist and ensuring their safety. The testing findings demonstrate the effectiveness and dependability of the proposed driver aid system.

From reference [3], In this proposed idea the heartbeatis used as a data source for this drowsiness detection system, which is then collected using a Photoplethysmography sensor. The algorithm then classifies and evaluates the driver's sleepiness degree based on his or her heartbeat. This system's processing unit is Arduino Nano and Odroid XU4, and the output is shown on an LCD. The created system has a success rate of up to 96.52%. This study demonstrated that a person's sleep quality has an impact on their heart rate.

From reference [4], the proposed idea is breathing signal acquired with an inductive plethysmography belt was processed in real time to determine if the driver was drowsy or awake. The suggested approach relies on an examination of respiratory rate variability (RRV) to detect the battle against falling asleep. Furthermore, a method for determining the quality of the respiratory signal is proposed. Both methods were integrated to eliminate false alarms caused by variations in recorded RRV associated with body movements rather than drowsiness.The validation tests were carried out in a driving simulator cabin, with external observers rating the drivers' state of attentiveness to evaluate the algorithm's performance. A leave-one-subject-out cross-validation yielded 96.6% specificity, 90.3% sensitivity, and an average Cohen's Kappa agreement score of 0.75 across all participants. A unique method for monitoring adriver's state of alertness by detecting the fight against falling asleep has been validated. The proposed method could be a useful car safety system for detecting tirednesswhile driving.

From reference [5], the purpose of this study is to identify drivers' alert states, namely the slightly drowsy state, using physiological indicators, behavioural measures, and driving performance. First, the association between a driver's arousal level, physiological signals such as electroencephalogram and electrocardiogram signals, behavioural measurements, and driving performance is explored using data collected from a driving simulator (DS) and driver monitoring system. To identify the alert and somewhat drowsy phases using machine learning methods, a total of 32 features are retrieved from the measured data over a 10-second period.This study uses four machine learning techniques to classify driver drowsiness: logistic regression, support vector machines, the k-nearest neighbour classifier, and random forest (RF). As a result, it has been demonstratedthat the RF technique can distinguish between alert and somewhat drowsy states with an accuracy of up to 81.4%. This study found that hybrid measurements can accurately detect driver tiredness over a 10-second timeframe.

3. OBJECTIVES

The objective of Driver drowsiness monitoring system with accident detection and warning is to improveroad safety by minimizing accidents caused by drowsy driving, which is a major contributing factor in road accidents worldwide. Improve road safety by reducing accidents caused by drowsy driving, minimizing injuries and deaths. Create algorithms and sensors that identify indicators of driver drowsiness in real time, allowing for early intervention before the driver gets too exhausted to respond properly. Implement techniques to detect probable accidents and deliver timely warnings to the driver, thereby mitigating or preventing crashes.

The goal of the project is to reduce the number of fatalities and injuries caused by drowsy driving, consequently saving lives and lowering societal and economic expenses associated with traffic accidents. Increase driver awareness of their fatigue levels and the significance of taking breaks or resting as needed to ensure safe driving conditions. Drive innovation in sensor technologies, data analysis algorithms, and human-machine interface design to develop an efficient and dependable sleepiness monitoring and accident detection system. Design the system to be user-friendly and non-intrusive, assuring high acceptance and adoptionrates among drivers. Collect data on driving habits and sleepiness patterns to help the system improve its accuracy and efficacy over time.

4. FLOW DIAGRAM

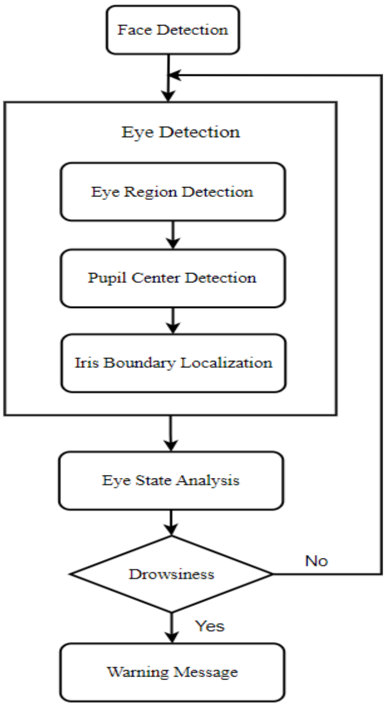

Figure 1: Flow Diagram

The flow diagram in the Figure 1 here offers an idea of alerting and displaying the drowsiness of the driver when detected. Here the camera module is the primary input device that captures the realtime eye movement of the driver and connects to the opencv which is a open source in-built library function in anaconda software. If drowsiness detected the data istransferred to embedded part via blynk. If drowsiness not detected the process starts from the beginning. Once the transferred data reaches the embedded part the alarm module starts alarming in buzzer simultaneously the vibration motor starts vibrating beneath the seat, the relay module slows down the speed of the vehicle and displaysthe detection of drowsiness.

5. ALGORITHM STUDY

5.1 Haar Cascade Classifier

The Haar method is a well-known image processing technique for object detection and facial recognition. The Haar algorithm can detect tiredness by identifying facial features like eyes and mouth and determining if the individual is drowsy. The Haar algorithm analyses the contrast between several parts of an image. The method employs pre-trained Haar features to identify visual patterns. These features are usually rectangular and can vary in size and direction. To detect tiredness, the systemcaptures a photo of the person's face using a camera.It would next apply the Haar algorithm to detect the image's eyes and mouth.

The system analyses the position and movement of features over time to detect drowsiness. If the algorithm identifies closed or drooping eyes or prolonged mouth opening, it may indicate sleepiness and the need for rest. Haar edge and line detectors can detect facial traits that indicate drowsiness in drivers. Combining numerous features allows for more accurate sleepiness detection. The Haar approach can be used to determine the borders of the driver's eyes. Measure the aspect ratio of the driver's eyes to determine if they are closed or partially closed, indicating tiredness.

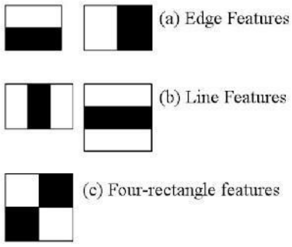

Fig - 2: Haar Cascade Classifier

5.2 Convolutional Neural Network

Drowsiness detection systems can employ Convolutional Neural Networks (CNNs) to automatically extract key information from photos or videos of a person's face or eyes. The CNN model derives important properties for distinguishing between these two statesfrom a large dataset of annotated images, each of which is labelled as drowsy or non-drowsy. These characteristics may include drooping eyelids, changes inthe anatomy of the eyes, and a degree of eye closure.Once trained, the CNN model can be used to label newpictures or video frames as drowsy or not. The CNNmodel processes an image or video frame using asuccession of convolutional layers that learn to recognizepatterns and attributes in the input image.Theconvolutional layer output is fed into fully connectedlayers, which classify it as drowsyor not.

In essence, CNNs automatically extract crucial data from pictures or video frames to detect drowsiness. Real-time technologies can detect drowsiness and alert drivers to potential accidents.

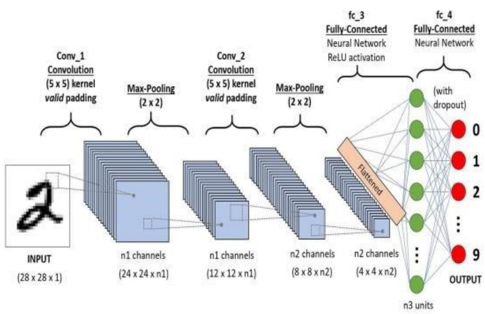

Fig - 3: CNN Algorithm

6. SOFTWARE STUDY

6.1 Anaconda (Python distribution)

Anaconda is a free and open-source distribution of the Python and R programming languages that aims to simplify package management and deployment for scientific computing (data science, machine learning applications, large-scale data processing, predictive analytics, etc.). Version control is handled by the package management system conda. The Anaconda distribution contains data-science packages for Linux, MacOS, and Windows. The anaconda distribution contains more than 1,500 items, in addition to the virtual environment manager and conda package. Furthermore, included is Anaconda Navigator, a graphical user interface (GUI) designed to replace the command line interface (CLI).

You can install individual open source packages from the Anaconda repository, Anaconda Cloud (anaconda.org), or your own private repository or mirror by using the conda install command. Anaconda Inc. builds and compiles all of the packages in the Anaconda repository and provides binaries for Linux 64-bit, MacOS 64-bit, and Windows 32/64-bit. Any package from PyPI can be installed using pip into a conda environment, and conda will maintain track of both pip- installed and its own installations. Custom packages can be made with the conda build command and then uploaded to other repositories such as PyPI, Anaconda Cloud, or others for distribution.

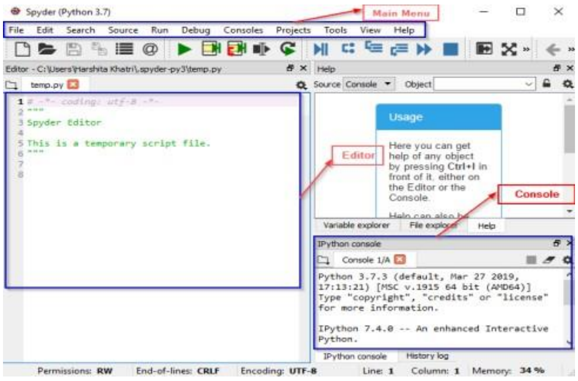

Fig - 4: Anaconda (Python distribution)

6.2 Open CV

A vast open-source library for image processing, machine learning, and computer vision is called OpenCV, short for Open Source Computer Vision Library. At the moment, it is significantly affecting real- time functioning, which is critical to contemporary systems. It may be applied to videos and images to identify objects, people, and even handwriting. When Python is combined with other libraries, like as NumPy, it may process the OpenCV array structure for analysis. To identify an image pattern and its various features, we employ vector space and perform mathematical operations on these features.

OpenCV allows you to perform various operations in the image:

Read the Image: OpenCV enables us to read an image straight from the camera or from a file so that it can be used for additional processing.

Image Improvement: We can improve an image by changing its sharpness, brightness, or contraction. This aids in visualizing the image quality.

Object detection: OpenCV can also be used to detect objects. It is possible to identify faces, patterns, bracelets, and watches. Recognizing faces, shapes, or even objects can be included in this.

Image Filtering: Applying different filters, likesharpening or blurring, allows us to alter images.

Draw the Image: With OpenCV, we can add text, lines,and any other kind of shape to your images.

Saving the Modified Images: After processing, we can save the altered images for further examination.

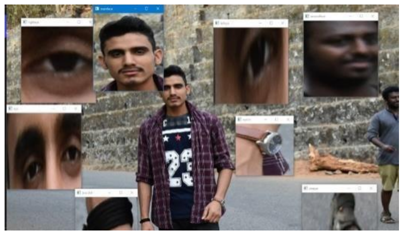

Fig - 5: OpenCV

7. HARDWARE STUDY

7.1 NodeMCU-ESP8266

Fig - 6: NodeMCU - ESP8266

ESP8266 is a cost-efficient and highly integrated Wi-Fi microcontroller for IoT application. With the help of NodeMCU, ESP8266 can be programmed to control various hardware components and sensors. It is capable of functioning consistently in industrial environment due to its wide operating temperature range. It can be programmed using the Arduino IDE making it a popular choice for IoT projects. The microcontroller unit can be used to collect the data form the sensors and transmit the data over Wi-Fi module. The module can also be programmed to send alerts when the collected data exceeds the threshold values. The ESP8266 has low power consumption and compact size making it ideal for IoT application and its built in Wi-Fi capabilities allow for easy data transmission without need for additional hardware. Additionally, the availability of open source libraries and the ease of programming with the Arduino IDE make it an accessible option for developers.

7.2 Buzzer

Fig - 7: Buzzer

A buzzer is a sounding equipment that producessound waves from audio signals. DC voltage is usually used to control it. As a sound device, it is typically usedin alert systems, PCs, printers, and other electronic devices. The buzzer can emit varied sounds, such as music, alarm, signalling, caution, and electric chime, depending on its design and intended usage. Oscillator solenoid coil, magnet, vibration diaphragm, enclosure, and other components make up an electromagnetic buzzer. The oscillator's sound signals current travels to the solenoid coil at the moment the power supply isturned on, creating a magnetic field. The solenoid coil and the magnet cause the vibration diaphragm to vibrate and produce sound on time. The electromagnetic buzzer operates between 2 to 4 hertz (Hz). A sound flagging device that can be mechanical, electro-mechanical, orpiezoelectric is a buzzer or beeper. Buzzers are used as alarm clocks, timers, trains, and confirmation of keystrokes or mouse clicks made by the user.

7.3 Vibration Motor

Fig - 8: Vibration Motor

This is a tiny round coin size motor. Use it to provide vibrational alerts. The bottom of the motor has a double-sided tape that can be used to secure it to any flat surface. It vibrates the surface it is attached to whenpowered. With an input voltage as low as 2.5V, thisvibration motor operates, and at higher voltages, it vibrates wildly. Its body contains wire leads that are useful for soldering the motor to a PCB.

7.4 DC Motor

Fig - 9: DC Motor

It is a geared dual shaft DC motor with a plastic building that runs between 3 and 9 volts. Its torque of 0.8kg/cm and RPM of 100 make it suitable for most applications. It is recommended to use this motor with more than 5V to have optimum torque in working condition. Dual shaft geared motors are useful in roboticsapplications. Shaft on both sides allows the user to use a Wheel and an Encoder simultaneously. In addition, the user has adequate headroom to adjust the motor'sorientation, allowing it to be used in any orientation depending on the needs of the application.

7.5 Relay Module

Fig - 10: Relay Module

An electrically powered switch is called a relay. The electromagnetic induction principle drives its operation. A magnetic field is created around the electromagnet when a current is delivered to it. Relays are used when a single, low-power, free signal is needed to regulate a circuit or when multiple circuits need to be limited by the same signal. To supply DC current to the node, a switch is used. Iron core and copper coil work as an electromagnet in the relay. The coil begins to attract the contact at the moment when DC current is applied to it. We refer to this as relay energizing. The supply returns to its initial place when it is removed. Researchers refer to this as de-energizing the relay. Relays are typically used to switch the smaller current values in a control circuit and control power in control panels, manufacturing, and building automation.

7.6 Alcohol Sensor

Fig - 11: Alcohol Sensor

By measuring the amount of alcohol gas in the surroundings, the MQ3 Alcohol Gas Sensor generates an analog signal. The sensor has a concentration measurement range of 0.04 mg/L to 4 mg/L. The concentration sensing range for breathalyzers is suitable. At 5 V, the sensor consumes less than 150 mA and operates in the -10 to 50°C temperature range. An output based on alcohol concentration is produced when a person alcoholic breaths close to the alcohol sensor, which measures the amount of ethanol in his breath. The LCD display will indicate whether alcohol has been detected.

7.7 Reset Button

Fig - 12: Reset Button

A small cheap single pole single through switch (SPST) that can be soldered on a PCB is the mini pushbutton. This push button, which is typically used asa reset button, closes a circuit when depressed. It has a 50mA rating. Its legs can be bent to fit on a breadboard, but by default, they are not breadboard friendly.

7.8 LCD DISPLAY

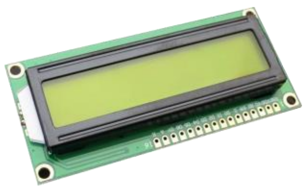

Fig - 13: LCD Display

Liquid Crystal Display is what LCD stands for. This kind of display technology is frequently seen inelectronic gadgets like digital watches, computer monitors, and televisions. A layer of liquid crystals is positioned between two sheets of polarizing material to form an LCD display. The liquid crystals alter shape in response to an electrical current, which either permits or prohibits light from passing through the display. Compared to other display technologies like CRT screens, LCD displays have a number of advantages. Comparing them to CRT screens, they are lighter, thinner, and use less power. They also provide better color accuracy and a higher resolution. The primary advantages of utilizing this module are its low cost, ease of programming, animations, and unrestricted display of unique characters and special effects.

8. PROPOSED WORK

As of update in January 2022, There is no any information on specific current or proposed methods for detecting driver drowsiness in that timeframe. However, proposed methods frequently involve the combination of advanced computer vision techniques and machine learning algorithms. For example, researchers could look into using deep learning models like Convolutional Neural Networks (CNNs) to detect drowsiness more accurately and contextually. These models could be trained on large datasets to detect subtle patterns in facial expressions and movements associated with drowsiness. Furthermore, the use of real-time processing and IoT technologies could improve the system's responsiveness by providing timely alerts and potentially integrating with other safety measures, such as adjusting vehiclespeed or activating alarms. Continuous technological advancements may introduce novel approaches, and it is recommended to look into the most recent research literature for the most up-to-date and cutting-edgemethods in driver drowsiness detection.

9. IMPLEMENTATION

We will use a camera to collect images as input. To access the webcam, we set up an infinite loop to capture each frame. Each frame is read and saved to a frame variable.

Create a Region of Interest based on the detection of a face in an image. To identify a face in an image, it must first be converted to grayscale, as the object identification method only takes this format. Colour information is not required to detect the items. To detect faces, we will use the Haar cascade classifier. The detecting process is then carried out. It generates detections with x, y, and height coordinates, representing the width of the object's border box. We can now create boundary boxes for each face.

Using the ROI, detect the eyeballs and pass them on to the classifier. The mechanism for detecting eyes is the same as that used to detect faces. We configure the cascade classifier for both the left and right eyes. We need to extract only the eye info from the complete image. To extract the eye image from the frame, first extract the eye's border box and then apply the code. The left eye alone stores the eye's visual data. Our CNN classifier will use this information to predict if the eyes are open or closed. The right eye will also be excised.

The Classifier determines if the eyes are open or closed. The CNN classifier is being used to predict ocularstatus. To input our image into the model, we must first perform specific actions, as the model requires the right dimensions to begin. To begin, we must convert the colour image to greyscale. The image is then resized. We standardise the data to promote convergence. We prepared our model. We now utilise our model to forecast each eye. If the prediction variable has a value of 1, the eyes are open; otherwise, they are closed.

The predicted values are fed into microcontroller where if the predictio value is 0 the drowsiness is detected and the alarm and sensors starts to work whereas if the prediction value is 1 then it again captures the real time image of the driver.

10. BLOCK DIAGRAM

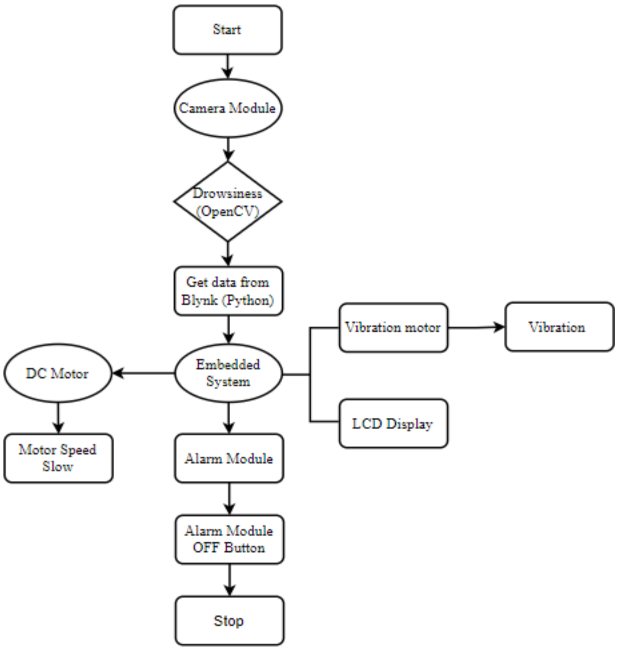

Fig - 14: Block Diagram

11. RESULTS

Here the output the project outcomes when the drowsiness of the driver is found detected, the alarmstarts notifying untill the driver becomes consious and resets the alarm, also the vibration motor gives vibration under the seat to make the driver awake, inorder to prevent accident the relay module reduces the speed of the vehicle and alcohol sensor senses whether the driver is drunk and the engine gets turned off before the vehicle starts.

12. CONCLUSION

In conclusion, the development of the Driver Drowsiness Detection System (DDDS) described in this project is a significant move toward combining deep learning, computer vision, and Internet of Things (IoT) technologies to improve road safety. Convolutional Neural Networks (CNNs) for drowsiness detection,OpenCV for image processing, and the Haar Cascade Classifier for facial feature recognition provide a strong basis for accurate and instantaneous driver behavior monitoring. A comprehensive solution to the hitting problem of driver drowsiness is ensured by the integration of IoT components, such as a DC motor for proactive safety measures, alarm systems, vibration motor, relay modules, alcohol sensor and NodeMCU for connectivity. An user-friendly alarm reset button and an audible alarm system increase the effectiveness of the system while providing a satisfying user experience. The proactive safety measures that are being suggested, such as regulating the speed of the car when drowsiness is detected, show a dedication to preventing accidents and promoting the general well-being of drivers. The vibration motor creates an vibration beneath the seat for awhile to alert the driver when drowsiness is detected. Aditionally, alcohol sensor also integrated to sense whether the driver is drunk or not. The implementation plan provides an organized method for systemdeployment and includes data collection, model development, IoT integration, testing, and continuous monitoring. With the rapid advancement of technology, this DDDS provides an adaptable and versatile solution that can be built in a range of vehicles and enhance road safety in various kinds of driving scenarios. Through the integration of the latest technologies, this project lays the groundwork for upcoming advancements in the field of driver assistance systems, with the ultimate goal of achieving safer and more secure transportation for every user of the road.

13. FUTURE WORK

In future, this project can be extended by incorporating a mechanism for providing feedback to the driver such as performance metrics, tips for staying alert, or displaying suggestions for taking breaks during long drives in lcd displays in the vehicle. This project can be extended for helping cab owners and travels owners by developing an app which shows the adequant times the driver felt drowsiness, whether he is drunk and driving and the maximum speed he reached while driving the vehicle. This can also be extended for monitoring the driver when he is wearing cooling glass. Also accidents occur due of wearing bluetooth earphones while ridingthe vehicle so also the idea can be developed for monitoring whether the driver wears any kind ofbluetooth in their ears to prevent accidents.

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