A Non Intrusive Approach for Detection of Driver Drowsiness and Alcohol Influence using IOT

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Abstract: One of the major contributors to car accidents is either being drunk or tired, which has a significant impact on road safety. By having appropriate warnings in place for overworked drivers, more fatal accidents could be prevented. Various technologies for detecting drowsiness can be implemented to keep track of a driver's alertness and alert them if they show signs of inattentiveness while driving. The sensors in self-driving vehicles must be able recognize if the person who drives is drowsy, angry, or experiencing extreme changes in emotions, such as drowsiness The sensors must constantly track the driver's expressions and identify their facial characteristics to recognize changes in their facial expressions and figure out if they are driving safely.. Real-time alerts or notifications can be established at regular intervals in this document. Machine learning techniques are used to measure the amount of tiredness, and the convolutional neural network-based detection of drowsiness approach based on eye aspect ratio was constructed and tested with varied brightness circumstances, providing an accuracy of 83.25% in identifying facial expression alterations. Additionally, an Arduino board with an alcohol sensor which is used to detect alcohol consumption by the driver, which is checked and recorded before each trip and continuously stored in the organization's database. By monitoring these recorded details, vulnerable drivers can be identified and safety while driving can be ensured.

Keywords: Driver drowsiness detection, Alcohol level detection, Convolutional Neural Network (CNN) Algorithm, Driver behavior analysis Data collection and analysis, Predictive analytics

1. Introduction

The US Highway Traffic Safety Administration (NHTSA) reports that roughly 2.5% of fatalities are the result of tired driving. In 2015, there were almost 72,000 accidents involving drowsy driving. Driving when intoxicated results in vehicle accidents more commonly than driving while intoxicated. when drowsy driving causes the driver to microsleep, driving when intoxicated causes the motorist to react more slowly than a sober one. Luxury automobiles now come equipped with sensors and radars that make it possible to record such accidents and take preventive measures, but it would also be helpful if the car could detect driver fatigue and suggest a break. The majority of the algorithms used in current image processing models are big and require specialized technology, which makes them ineffective on mobile devices.

2. Literature Survey

Researchers and automakers have created a variety of ways to reduce the frequency of crashes brought on by driver weariness, from analysing driving habits to monitoring the driver's brain waves and vital signs while operating a vehicle. Predictive algorithms backed by data and machine learning underpin the majority of these solutions. These solutions can be broadly categorised into the three classes listed below.

McDonald etal[1] suggested developing a temporal and contextual algorithm to address the issue of sleep-related auto accidents. This algorithm examines the driver's steering angle, speed, and where the accelerator pedal is located to determine whether they are intoxicated. The data is analysed using a Bayesian Network, which has been demonstrated to produce less false positive results than other approaches like PERCLOS, which depend on patterns of eyelid movement. The findings of this study demonstrate the importance of taking into account the situation's context when forecasting tiredness and the importance of gathering data over a 10-second window before a potential event to assess the possibility of a fatigue-related lane departure.

The second method for anticipating sleep-related auto accidents uses the driver's vital indicators, brainwave patterns, and Electro-Encephalogram (EEG) measurements. Wei et al. compared full-scalp EEGs with non-hair bearing brain-computer interfaces, which are less invasive and more comfortable to wear, and discovered that there was no appreciable performance loss with the non-hair bearing devices. The result was the development of more comfortable headbands.Because EEGs cannot detect all levels of drowsiness, Kartschet al.[2] combined EEG and Inertia Measurements Unit (IMU) sensors to detect five stages of drowsiness with more than 95 accuracy. To identify drowsiness they integrated IMU and EEG data. Although the power requirements of EEG devices constitute a disadvantage, technology has enabled the creation of a parallel ultra-low power platform on a microcontroller, improving battery life to more than 46 hours and making the devices wearable and low maintenance. Tateno et al. devised a drowsiness detection technique that relies solely on heart rate monitoring to assess a person's breathing.The approach was discovered to be an accurate predictor of respiration and, consequently, tiredness. The approach was found to be a reliable predictor of breathing and, thus, drowComputerized vision can be utilized as an additional therapy. Deep Learning advancements have enabled computer vision researchers to improve detection and classification. This technology is employed in a variety of applications, like agriculture, health and wellness, and object identification. The implementation of this technology has had a considerable impact on the field of imaging data. Computer vision researchers are trying to exploit how a driver's facial expressions change when they get sleepy and find the ways for detecting drowsiness.

TayabKhan[3] and colleagues suggest measuring the curved form angle of the eyelids to determine whether the eyes are closed or open. This method was proved to be 95% accurate, however it requires adequate illumination to function properly because it performs badly in low-light conditions.

Shakeel et al. used the Mobile Net-SSD framework to train a bespoke dataset of 350 pictures. This approach achieved a Mean Average Precision of 0.84, demonstrating that it is both cost-effective and efficient. The algorithm's effectiveness is further enhanced by its ease of installation on an Android smartphone, as well as its real-time classification of camera streams.

Celona et al. [5] suggested a vision-based Multi-Task Driver Surveillance Framework that examines the posture of the head, mouth, and eyes at the same time to predict the degree of sleepiness. This analysis was carried out using the NTHU dataset.

In a separate study, Xie et al.[6] used transfer learning and sequentially learned information from yawning films to identify yawning in the YawDD and NTHU-DDD datasets. Better precision was attainable with this method, which was also resistant to changes in the location and angle of the face in reference to the camera.

Using machine learning methods, Mehta et al.[7] developed an app for Android that can detect facial features and compute the ratios of the eye aspect (EAR) and Eye Closing Ratio (ECR) to precisely determine a driver's weariness.

Conclusion from the Literature Review

In conclusion, researchers and automobile companies are exploring various solutions to reduce the number of sleep-triggered automobile crashes. These solutions range from analyzing driving behavior patterns to monitoring drivers' vitals and brain waves. Three general categories can be made for the most prevalent ones: detecting changes in driving behavior, using drivers' vitals and EEG readings, and using computer vision. Each of these categories has its own advantages and limitations, and some of the studies have shown promising results with high accuracy rates. For example, some studies have proposed algorithms that use the guidance angle, vehicle speed, and accelerator pedal position to determine drowsiness, while others have utilised heart rate monitoring to identify slumber and reduced breathing. Computer vision-based solutions have also been proposed, using techniques such as deep learning and facial landmark detection to analyze eyes, mouth, and head pose to predict drowsiness. Despite the advances made in these areas, further research is needed to improve the accuracy and reliability of these systems and make them more widely applicable.

3. Existing System

The current project design involves a sensor-based system for monitoring drivers to prevent accidents. The sensors collect data and send it to a microcontroller for analysis of the driver's status. However, this system is limited in its scope and has several drawbacks. One example is the use of an eye blink sensor connected to an Arduino microcontroller unit, which sends signals for analysis.

4. Proposed System

An idea for a system is to guarantee the accuracy of driving activities by detecting alcohol using cameras and sensors. The system leverages deep learning to recognize faces and keep track of their movements. The alcohol content is measured using a gas sensor and processed using Python to produce the results. To detect drowsiness, the system uses a blink sensor to monitor eye movements. Additionally, an IoT-based smoke detection system has been integrated to monitor air quality. If drowsiness is detected, the engine will automatically shut down and an email will be sent to the vehicle's owner. While this system has the potential to enhance road safety and reduce incidents caused by drunk driving, its accuracy and reliability may depend on various factors such as the quality of sensors, the algorithms used for data processing, and the overall design. It is essential to do thorough testing and assessment to make sure the system satisfies the requirements for actual use.

5. Workflow

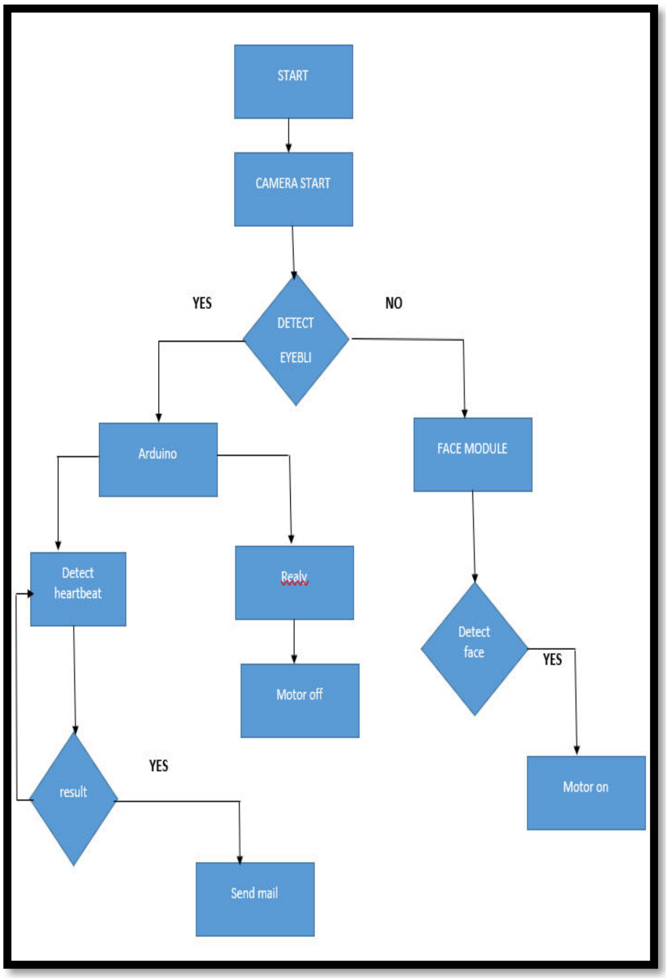
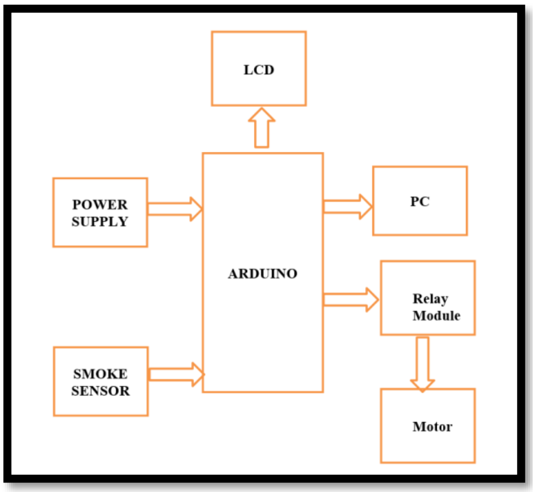


Fig: working of device

6. Architecture Diagram



The suggested system's architectural diagram shows a number of different parts working together to secure the driver's safety. At the heart of the system lies the Arduino microcontroller which acts as the central unit and controls the functions of all other components. The camera is used to capture the driver's facial features and monitor their activity. The blink sensor, connected to the Arduino, detects the driver's eye movements and sends the signal to the microcontroller. When the MCU gets data from the MQ2 gas detector, which detects the possibility of alcohol in the air, the alcohol concentration is calculated using Python. The findings of the monitoring procedure are shown on the LCD for simple viewing. The motor relay functions as a link within the electric motor and the microcontroller, ensuring that the engine only operates while the driver is awake.

7. Hardware and Software Requirements

The hardware requirements for this system include an Arduino board as the main microcontroller unit, a power supply unit to provide necessary power to the system components, an MQ2 gas sensor to detect alcohol levels, and a NodeMCU to aid in communication between the various parts. The system also includes a camera to capture facial features, a motor relay to control the engine, a smoke sensor to detect any potential fire, a motor, and an LCD screen to display system information. These components work together to effectively monitor the driver and ensure safety while driving.

The Convolutional Neural Network (CNN) method must be implemented in Python for this project, and the Arduino Integrated Development Environment (IDE) must be used to programme the Arduino board. Python is a powerful programming language with a wide selection of libraries and tools that can be used to create sophisticated algorithms. It is particularly well suited for machine learning applications. Code for the Arduino board is written, uploaded, and debugged using the user-friendly software platform known as the Arduino IDE. It provides a simple interface for programming the microcontroller and accessing the various hardware components, including the MQ2 gas sensor and the Node MCU. Both the Python and Arduino IDEs are essential tools for developing this project and ensuring that it runs smoothly.

8. Modules;

i) Data Acquisition

Data acquisition involves the process of collecting and converting physical measurements into digital numerical values that a computer is capable of processing. The data needed for this analysis is commonly sourced from research papers. Kaggle is a well-known platform for obtaining such information. Kaggle provides a user-friendly, customizable Jupyter Notebook environment, as well as a community where users can access and upload datasets, participate in data analysis challenges and interact with other researchers in data science and deep learning developers.

ii) Data Preprocessing

In the world of data mining, data preparation is the process of putting unprocessed information into a structure that is both usable and effective..This is an important step because applying data mining algorithms to noisy data may not yield accurate results. To enhance the overall quality of the data, it is crucial to process the data and eliminate duplicates, missing values, outliers, and inconsistent data points. Poor data quality can lead to false predictions and skew the overall view of the data. It is essential to ensure that decisions are based on accurate data and Data Preprocessing is key to achieving this goal, avoiding a "Garbage In, Garbage Out" scenario.

iii) Model Training

Model Education Professionals aim to determine the optimal weights and biases for an algorithm used in machine learning in order to minimize the loss function throughout the prediction range during the critical phase of data analysis study known as model training.

iv) Computer vision for visual classification

It is possible to recognise objects in still or moving images utilizing computer vision (CV), AI technique. Image identification, which is how things are identified, their position, or their behaviour on visual material, is involved. This enables picture and video classification, in addition to the use of screening and search tools.

Computer vision systems can accomplish the following categorization tasks:

Image classification with localisation entails recognising and designating an item in an image. This may be used to categorise scanned documents depending on their structure, such as differentiating papers with five blanks to fill out from those with three.

Object detection is the process of recognising and labelling various items in a picture and presenting their locations. This might be used in travel-related applications to categorise user-generated visual material such as images of menus for restaurants, interiors, and so on.

Object (semantic) segmentation - Object (semantic) segmentation is the process of locating the precise pixels in an image that correspond to each object. Identifying anomalies on X-ray scans, for instance, and categorizing them according to whether a doctor should be consulted...

Instance segmentation is the process of distinguishing between multiple versions of the identical class. For instance, naming a dog breed, recognizing people, or recognizing the kind of tree.

v) **Testing and evaluating the model**

Evaluation and testing of the model The method of separating the dataset into three sets—training, validation, and testing—allows for a full assessment of the machine learning model's performance.The validation set aids in the adjustment of the parameters of the model to reduce overfitting, whilst the set of tests is used to assess the model's correctness. The model is educated using the training set. Model evaluation, which involves the use of multiple metrics, is critical for understanding the model's strengths and shortcomings and ensuring its efficacy through the development process.

vi) **Deploying the model**

The next phase after the training, examination, and evaluation of the version is to put it into service as a device. Our design involves installing the device using the image that was taken during the pressure test, which will eventually permit us to assess the level of drowsiness and alcohol.

9. Functional Requirements

i) Drowsiness Detection:

- The device should be equipped with a camera to capture the driver's face.
- Convolutional Neural Network (CNN) algorithm should be used by the apparatus to identify sleepiness symptoms including eye closure and yawning. The device should alert the driver when drowsiness is detected with a visual and/or auditory alarm.
- The device should store and log the drowsiness detection data for analysis and reporting.

ii) Alcohol Detection:

- The device should be equipped with a smoke sensor to detect alcohol levels in the breath.
- The device should provide anprecise alcohol level measuring in the breath.
- The device should alert the driver when a dangerous alcohol level is detected with a visual and/or auditory alarm.
- The device should store and log the alcohol level data for analysis and reporting.

iii) Data Collection and Analysis:

- The device should collect and store data from both the drowsiness detection and alcohol detection systems.

- The device should allow for the data to be analyzed and reported for trends and patterns.
- The device should provide an interface for users to access and review the data.

iv) User Interface:

- The gadget should have an intuitive user interface for simple setup and use. The device should provide options for adjusting alarm settings, data collection intervals, and other system parameters.
- The device should provide a clear and concise display of system status and alerts.

v) Power Management:

- The gadget should be capable of running continuously for at least 8 hours on one charge.
- When not in use, the gadget should feature a power-saving function to save battery life.
- The gadget should include a charging mechanism for easy recharging.

vi) Security:

- The device should have secure authentication and access controls to prevent unauthorized access to data and system settings.
- The device should be designed to be tamper-proof and secure against physical tampering.
- The device should encrypt all data transmitted and stored on the device.

vii) Reliability:

- The device should have a high level of reliability, with a minimum of 99.9% uptime.
- The device should be designed to withstand harsh operating environments and conditions.
- The device should be equipped with redundant systems and backup power sources to ensure continuous operation in the event of a failure.

viii) Working Environment:

- This equipment should work in the temperature ranging from 0°C to 50°C.
- During regular vehicle operation, the gadget must be able to tolerate vibration and stress.

ix) Constraints:

- The device should be compatible with Python and Arduino IDE.
- The device should have a low power consumption to ensure continuous operation.
- The device should have a compact design to fit in the vehicle.

x) Assumptions and Dependencies:

- The gadget assumes the driver's facial expressions is exposed to the camera for detection of drowsiness.
- The device depends on the availability of a power source and a backup power source.
- The device depends on a stable internet connection for data logging and analysis.

10. Future Enhancements

The current system designed to detect drowsiness and alcohol level in drivers is just the beginning. There is a lot of scope for further development and improvement. One such area is the deployment of sensors to constantly monitor the heart rate of the driver. This will provide additional information on the well-being of the driver and help to ensure their safety while on the road.

If anomalous data is detected, the system might send an emergency notice to the organization. This enables for immediate action to be done to guarantee the driver's and others' safety on the road. Additionally, the system can also send GPS tracking information of the vehicle, which will allow for real-time monitoring and response in case of an emergency.

This integration of heart rate monitoring and GPS tracking will significantly enhance the current system and provide a more comprehensive solution for ensuring driver safety. The future scope of this system holds immense potential and has the ability to make a significant impact in reducing road accidents and ensuring the safety of drivers and others on the road.

11. Conclusion

In this study, we develop a Convolutional Neural Network (CNN)-based enhanced drowsiness detection method. The goal is to develop a compact system that can nevertheless provide great performance when employed in embedded systems. The technology can identify sleepy driving behaviour by recognising face characteristics in photographs acquired by cell phones and input them into a CNN-trained deep learning model. With an overall level of precision of 83.33% across every category and a maximum size for the model of 75 KB, the model proved effective in being tiny yet somewhat accurate. This method is simple to integrate into contemporary car dashboards in order to enable enhanced driver assistance programmes or mobile devices that intervene when the driver is sleepy. It does, however, have significant limitations, such as difficulty recognising face characteristics owing to visual impairment from sunglasses or low lighting conditions. Further enhancements can be done to increase performance and face feature identification in low-light circumstances.

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