IOT based Driver Drowsiness and Alcohol/Smoke Detection System Using Deep Learning Algorithm

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ABSTRACT —
Due to extended driving times and exhaustion, driver drowsiness is one of the main causes of traffic accidents, especially for drivers of large vehicles (like buses and heavy trucks). Driver drowsiness can also be found due to consumption of alcohol
Under operational circumstances. In this study, we offer an easy-to-deploy and flexible vision-based tiredness detection system for bus driver monitoring in big vehicles, including detection, face detection, eye detection, eye openness estimation, and alcohol. The following are the primary novel techniques: 1) A spectral regression-based method to estimate the continuous degree of eye openness; 2) A fusion algorithm that uses adaptive integration on the multi-model detections of both eyes to estimate the eye state. 3) An alcohol detection sensor that will detect the presence of alcohol molecules. When a camera with an oblique viewing angle to the driver's face is employed for driving status monitoring, the experimental results demonstrate the benefits of the system in terms of accuracy and robustness for difficult conditions

Keywords: Raspberry Pi, Camera, Machine learning, Video Analysis, MQ 3 sensor.

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INTRODUCTION

Driver's driving is a major problem. No one knows the exact movement when the body goes into state of asleep. This makes the driver less able to pay attention to the road. It affects the driver's ability to make good decision.

Behavioral Measures: A drowsy man or woman displays several characteristic facial actions, including fast and regular blinking, nodding or swinging their head, and common yawning. Computerized, non-intrusive, behavioral approaches are extensively used for determining the drowsiness stage of drivers with the aid of measuring their peculiar behaviors.[3] We propose a manifold learning algorithm that can learn a mapping from a low-resolution eye image (e.g., 32 ×24 pixels) to a 1-dimensional continuous level of eye-openness. There are two advantages of this approach. First, there is no need to detect eye feature points for symptom estimation which often fails on low-resolution face images. Second, it avoids classifying the ambiguous partially closed eyes into open or close states for binary state (0/1) classification. This improves the accuracy of identifying the "drowsy" state between "normal" and "sleepy" states. To obtain an accurate and robust estimate of eye openness, a novel fusion algorithm was proposed which adaptively integrates the results of eye openness estimations on the multi-model eye detections for both eyes. Based on the innovative techniques, the system achieves robust performance on challenging scenarios where the existing approaches often fail.

ARCHITECTURE

The methodology of this project is the first video is captured using a webcam and from the video first face is detected using the Harcascade algorithm and then the eyes are detected. Then we use our deep learning model which is built using transfer learning to know the status of the eye. If it is an open eye then it will say Active and if it is a closed eye then it will check for a few seconds and then it will say the driver is drowsy and will beep an alarm.

We will use Python, OpenCV, TensorFlow, and Keras to build a system that can detect the closed eyes of drivers and alert them if ever they fall asleep while driving. If the driver's eyes are closed, this system will immediately inform the driver. OpenCV that we are going to use now will monitor and collect the driver's images via a webcam that was attached and feed them into the deep learning model and then the model will classify the driver's eyes as 'open' or 'closed.'

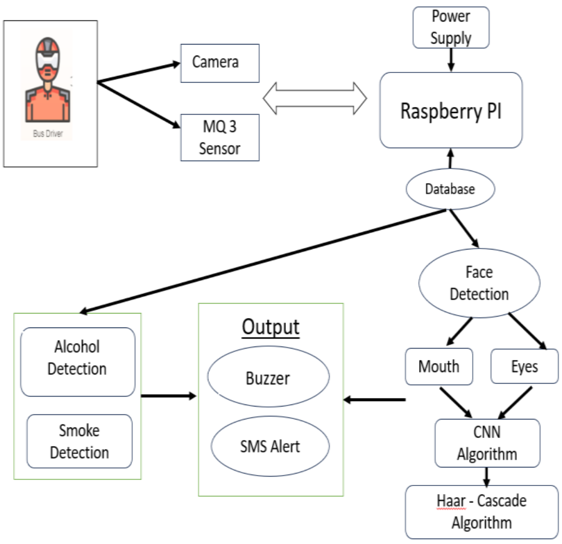

Figure 2.1: Architecture

ALGORITHM

A. Haar Algorithm

The Haar algorithm is a well-known image processing algorithm that is used for object detection and facial recognition. The Haar algorithm can be used in the context of drowsiness detection to identify characteristics on the face such as the eyes and mouth, which can subsequently be used to assess whether the individual is drowsy.

The contrast between various areas of a picture is examined by the Haar algorithm to determine how it operates. It makes use of a set of pre-established Haar characteristics that have been trained to identify particular visual patterns. These characteristics vary in size and position and are usually rectangular in shape. In order to identify drowsiness, the algorithm would first use a camera to capture an image of the subject's face. After that, it would recognize the lips and eyes in the picture using the Haar algorithm. To

ascertain whether the subject is sleepy, the program would next examine how these features moved and positioned over time.
For instance, the algorithm may recognize that a person is drowsy and needs to rest if it notices that their mouth is open for a prolonged amount of time or that their eyelids are closed or drooping.
In general, a variety of facial traits that might be utilized to assess whether a driver is sleepy can be detected by Haar edge and line detectors. It is feasible to develop a drowsiness detection system that is more accurate by combining various features.

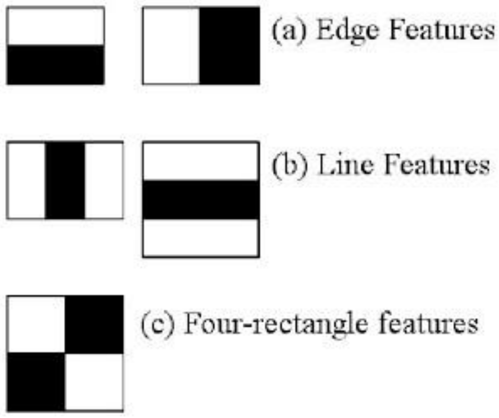

Figure 3.1: Haar Feature Detection

The driver's eye edges can be determined using the Haar approach. The aspect ratio of the observed eyes, a sign of tiredness, can be used to determine if the driver's eyes are closed or half closed.

B. CNN Algorithm

Convolutional Neural Networks (CNNs) can automatically extract pertinent information from pictures or videos of a person's face or eyes for use in drowsiness detection systems. The CNN model analyzes a large dataset of annotated photos, each of which is classed as either drowsy or not, and extracts features that are essential for differentiating between these two states. These features could include changes in the structure of the eyes, drooping eyelids, and the level of ocular closure.
The CNN model can be used to classify new pictures or video frames as sleepy or awake once it has been trained. Through a sequence of convolutional layers that learn to identify patterns and attributes in the input image, the CNN model analyzes an image or video frame. The output of the convolutional layer is then sent into fully connected layers, which figure out how to transfer these attributes to a final classification of either sleepy or awake. In conclusion, CNNs automatically extract important information from picture or video frames and utilize that information to determine the degree of drowsiness. This can help with the creation of real-time systems that alert operators or drivers when they start to feel sleepy and run the risk of getting into an accident.

IMPLEMENTATION

A. Software

Overview:
There are six main steps in the process. First, a head-shoulder detector is applied to detect the presence of a driver and locate roughly the position of the driver's head. Then, two models of face detectors are

used to detect a front-view face or an oblique-view face within the region of the head. Third, two eye detection methods are employed to locate the potential eye positions and scales in the image. In the fourth step, our proposed eye openness estimation method is applied to the located eyes by the two eye detectors. Next, a fusion operation is proposed to obtain an accurate and robust estimate of driver's eye openness based on adaptive integration on multi-model eye detections for both eyes. The score of driver's fatigue, i.e., PERCLOS, is computed on the recent records of eye openness over a specified period.

Detection of Drowsiness

Open eyes are indicated by an EAR value greater than 0.25. This test demonstrates that the driver has not succumbed to the visually depicted tiredness and that the face is not identified as drowsy. Similar to how a drowsy face is detected, the driver's drowsiness is identified when the graphically projected EAR value is less than 0.25. The eyelids' regular motions cause the EAR levels to fluctuate. When the driver exhibits signs of fatigue, an email notification is sent to the owner or relevant authority and the driver is alerted with a repeated voice message. In this case, a speech speaker is used in place of a buzzer to increase awareness; in the event that it malfunctions, the owner will issue any warnings after getting the message from its mail as represented.

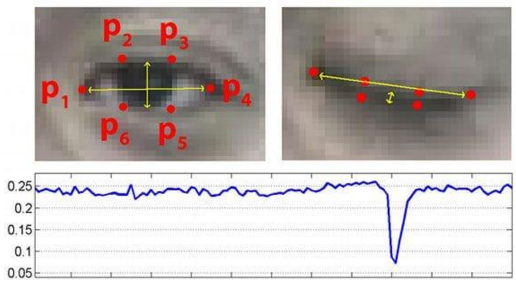

Figure 4.1: EAR

On the top-left, we have a fully open eye and the eye's facial landmarks plotted. Then on the top-right, we have an eye that is closed. The bottom then plots the eye-aspect ratio over time. As we can see, the eye aspect ratio is constant (indicating that the eye is open), then rapidly drops to close to zero, then increases again, indicating a blink has taken place.

In our drowsiness detector case, we'll be monitoring the eye aspect ratio to see if the value falls but does not increase again, thus implying that the driver/user has closed their eyes.

B. Hardware

Raspberry Pi

Raspberry Pi 3 model B is a Master card estimated singleboard PC (SBC) planned in the UK. This turns into the primary model to include remote availability. Wi-Fi 802.11n and Bluetooth 4.1.this can likewise boot from a USB. The Pi 3 model B+ and pi 3 model A+ are presented with 802.11ac and Bluetooth 4.2 in 2018 these interfaces, coming up next are available on Pi 3 Model B+:Gigabit Ethernet, simple sound/video 3.5mm jack,4x USB 2.0, HDMI, Camera sequential interface(CSI), Display sequential interface(DSI) and a 40-stick GPIO header pins- can associate with a camera.

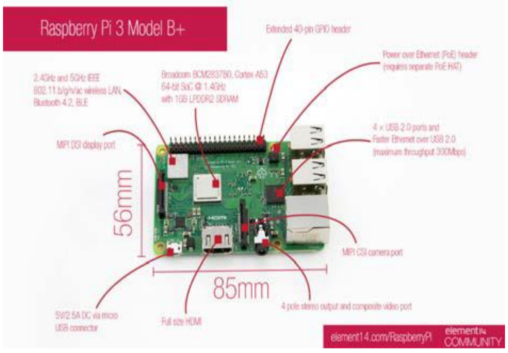

Figure 4.2: Raspberry pi 3 Model

Working of raspberry pi:

Raspberry Pi is a programmable device. It comes with all the critical features of the motherboard in an average computer but without peripherals or internal storage. To set up the Raspberry computer, you will need an SD card inserted into the provided space. The SD card should have the operating system installed and is required for the computer to boot. Raspberry computers are compatible with Linux OS. This reduces the amount of memory needed and creates an environment for diversity.

After setting up the OS, one can connect Raspberry Pi to output devices like computer monitors or a High-Definition Multimedia Interface (HDMI) television. Input units like mice or keyboards should also be connected. This minicomputer's exact use and applications depend on the buyer and can cover many functions.

Alcohol sensor module

This module is made using Alcohol Gas Sensor MQ3. It is a low cost semiconductor sensor which can detect the presence of alcohol gases at concentrations from 0.05 mg/L to 10 mg/L. The sensitive material used for this sensor is SnO_2, whose conductivity is lower in clean air. It's conductivity increases as the concentration of alcohol gases increases. It has high sensitivity to alcohol and has a good resistance to disturbances due to smoke, vapor and gasoline. This module provides both digital and analog outputs. MQ3 alcohol sensor module can be easily interfaced with Microcontrollers, Arduino Boards, Raspberry Pi etc.

This alcohol sensor is suitable for detecting alcohol concentration on your breath, just like your common breathalyzer. It has a high sensitivity and fast response time. Sensor provides an analog resistive output based on alcohol concentration. The drive circuit is very simple, all it needs is one resistor. A simple interface could be a 0-3.3V ADC.

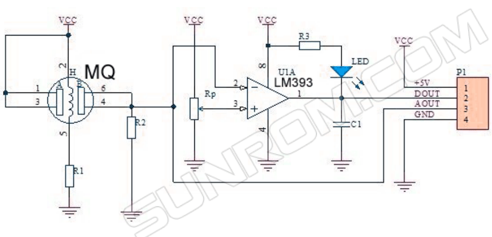

Figure 4.3 : MQ3 Board Schematic

Result & Discussion

The accuracy of the system in detecting driver drowsiness would be a primary measure. This would involve evaluating how well the deep learning algorithm can recognize signs of drowsiness based on factors such as eye movement, facial expressions, and head position. Similarly, the accuracy of detecting alcohol consumption or smoking by the driver would be another important metric. This could involve analyzing breath samples for alcohol content or detecting smoke particles in the air within the vehicle. The system's effectiveness in real-time monitoring would be crucial. This involves how quickly the system can detect signs of drowsiness, alcohol consumption, or smoking and alert the driver or authorities to take appropriate action. Evaluating the system's tendency to produce false positives (incorrectly identifying drowsiness, alcohol consumption, or smoking when none is present) and false negatives (failing to detect drowsiness, alcohol consumption, or smoking when it is present) is crucial for improving its reliability. Ultimately, the most critical outcome would be the system's impact on road safety. Evaluating whether the implementation of such a system leads to a reduction in accidents caused by drowsy driving, driving under the influence, or smoking-related distractions would be a key measure of success.

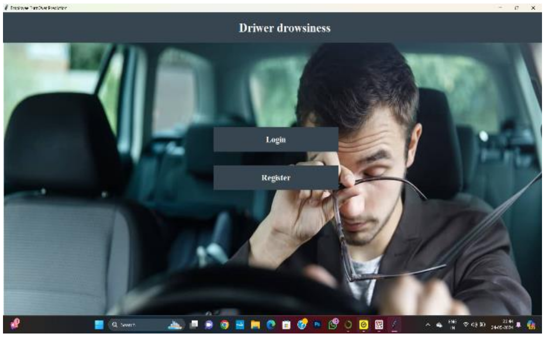

Figure 5.1: Registration & Login Page

Figure 5.2: Registration Page

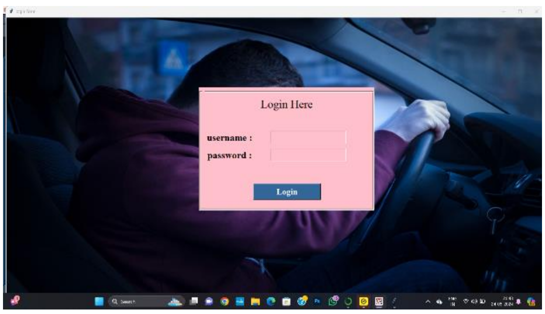

Figure 5.3: Login Page

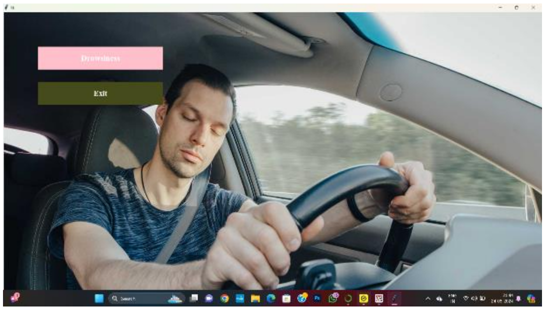

Figure 5.4: Home Page

Conclusion

In conclusion, the development of an IoT-based Drowsiness and Alcohol/Smoke Detection System using a Deep Learning algorithm holds great potential for enhancing road safety and preventing accidents caused by impaired driving. The integration of advanced technologies such as IoT devices, sensors, and deep learning models allows for real-time monitoring and timely intervention. This system addresses critical issues associated with driver drowsiness, alcohol consumption, and smoke presence, contributing to a safer driving environment.

The IoT-based Driver Drowsiness and Alcohol/Smoke Detection System represents a significant advancement in leveraging technology for road safety. By combining IoT, sensors, and deep learning, the system contributes to the overarching goal of reducing accidents and promoting responsible driving behavior. As technology continues to evolve, there is potential for further enhancements and widespread adoption, ultimately making roadways safer for all users.

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