Maixdock Based Driver Drowsiness Detection System Using CNN

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Abstract. This article demonstrates how to use Maixdock to build a drowsy driving monitoring system. A behavioral deterioration in one's ability to drive is known as drowsy driving. To categorize sleepiness signs like breathing and squinting deep learning has been used in this study. Yolo design training was done using example pictures. To categorize sleepiness signs like blinking and breathing, this study employs the Convolutional Neural Network (CNN). The CNN design was trained using 1310 images in total. Then the yolo was trained with Adam's optimization method. Ten people participated in a live experiment to determine how well this version worked. In this study, a new deep learning-based method for real-time sleepiness monitoring is proposed. It can be easily applied on a low-cost integrated chip and has a good level of performance. A single computer can then receive the data that was gathered. Facial characteristics, such as gaping, and ocular metrics, such as eye-closing, are the areas of concern used here. In this study, additional variables like camera distance from the vehicle and illumination effects are examined. These variables have the potential to influence the rate of categorization accuracy. The key of the car will not turn on if the motorist is intoxicated until the situation is altered. If the vehicle is already in a drivable state, the system will warn the driver via an alarm, and a heartbeat monitor will also identify the data and warn the driver. The Proposed method gives a good accuracy of detection, approximately 90% higher than existing methods.

Keywords: Raspberry Pi · Convolutional Neural Network · Drowsiness detection · Yawning

1 Introduction

One of the main sources of fatalities in humans is traffic mishaps. The fact that there are more cars on the road globally makes this worse. Long drives frequently make drivers drowsy and mentally exhausted. 2.3 to 2.5 percent of all deadly crashes nationally were reportedly the result of drowsy driving [1]. According to National Sleep Foundation research, 32% of motorists experience driving while fatigued on a monthly average.

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A cognitive deterioration in driving abilities that is typically linked to long-distance driving [2] is what is known as "drowsy driving." Lack of sleep the night before traveling is typically the reason. It can occasionally also be brought on by other issues like unresolved sleep conditions, medicines, consuming alcohol [3], or shift employment. Because of this issue, checking a driver is fundamental to blood alcohol content and notifying them if necessary.

In recent years, several novel low-cost, non-invasive technological advances have been developed to identify sleepy driving. It very well may be isolated [4] into two classifications given whether signal processing is used for images or not. The distinction between the two groups is made based on the sort of incoming data, which can be either bodily signs or pictures from the camera.

Eye tracking and blinking are a couple of warning indications that a video can detect as a sign of driving [5] fatigue. To identify these characteristics for sleep monitoring, numerous methods have been created. Head part examination, support vector machines, and brain organizations are the most promising methods.

Deep Learning [6] offers modern and effective methods for identifying sleepiness trends in drivers. Convolutional Neural Networks (CNN) and Deep Neural Networks (DNN) are two popular Deep Learning models utilized for image-based driving sleepiness detection systems. For physiological kinds of input data, Recurrent Neural Network (RNN) is one of the Profound Learning plans habitually utilized for driving drowsiness [7] discovery systems.

In this paper, different types of deep learning techniques were studied and analyzed. To train a CNN classifier model, raw images of people yawning or being seated in a car were taken with a wide range of images varying from each other, including the lighting part, and capable of potentially giving false values when used. The drowsiness symptoms should be identifiable. Some of the images have people yawing and drowsy whereas others do not such that we can segregate accordingly.

Globally, road mishaps and deaths are frequently caused by drowsy driving. Despite numerous efforts to increase public awareness about the dangers of driving while fatigued, drowsiness remains a significant risk on the road. Traditional methods of detecting drowsiness, such as monitoring driving behavior or asking drivers to self-report their level of fatigue, have limitations and are not always reliable.

To address this issue, there is a need for an automated system that can detect drowsiness in real-time, using advanced technologies such as head pose estimation, facial expression analysis, and machine learning algorithms. The system should be able to identify indications of sluggishness, like hanging eyelids or changes in facial expressions, and alert the driver before an accident occurs.

This project's objective is to create a sleepiness detection system that can accurately and reliably detect driver drowsiness in real-time, and potentially save lives by preventing accidents caused by drowsiness.

2 Literature Survey

2.1 System for Monitoring and Warning Driver Fatigue Based on Eye Tracking

"Eye following based driver weakness checking and cautioning systems" are becoming increasingly popular in the automotive industry. The device monitors the driver's eye motions with an infrared sensor to detect indications of tiredness or sleepiness and sends a warning.

The technology works by analyzing the driver's eye movements, such as how often they blink and how long their eyes stay closed. If the system detects that the driver's eyes are closing for too long or too frequently, it will sound an alarm or display a warning message to alert the driver that they need to take a break.

Some advanced systems may also use other sensors, such as steering angle sensors to ascertain the driver's degree of depletion. The framework can then adjust the vehicle's speed, sound an alarm, or even apply the brakes if necessary.

Eye following-based driver weariness checking and cautioning systems are essential for improving road safety, particularly for long-distance drivers, commercial vehicle operators, and shift workers. The technology can help prevent accidents caused by driver fatigue [8] and lessen the number of fatalities on the streets.

Although the technology is still relatively new, it has the potential to become a standard safety feature in vehicles in the future.

2.2 Yawning Detection Reduction System for Driver Drowsiness

There have been numerous studies on yawning recognition and sleepiness forecast tools for drivers. One such paper is "Yawning Detection and Prediction System for Driver Drowsiness" by Hsu et al. published in the Journal of Sensors in 2015.

Ramani P. et al. (2022) developed a method for smart parking system using optical character recognition. Parking slots were identified automatically by OCR and placing a car without traffic and in time. The accuracy of prediction is lower [9].

Ramani P. et al. (2023) used segmentation algorithm to partition the images and classified the monuments using Multi layer Neural Network classifier and achieved good results for classification of heritage images [10].

Ramani P. et al. (2023) reviewed various non destructive methods for classification and segmentation algorithm for detection and classification of heritage structures. Measurement of different decay parameters is discussed and compared with different methods [11].

The paper proposes a yawning detection and prediction system based on an image processing technique using a webcam. The system can detect yawning and predict driver drowsiness before it becomes a critical issue. To identify and retrieve face features, the writers used the Viola-Jones method. To classify yawning and non-yawning facial movements, they used a Support Vector Machine (SVM).

The system also includes an algorithm to calculate the duration of time between yawns to predict the onset of drowsiness. The authors conducted experiments on a dataset of videos recorded by 26 subjects driving a car in a real-world setting. The findings demonstrate that the recommended technique is exceptionally exact at wheeze location and sleepiness detection in drivers.

The yawning detection [12] and prediction system proposed in this paper have the potential to enhance driver safety by providing an early warning system to prevent accidents caused by driver fatigue. The system could be integrated into vehicles as a standard safety feature or used in other industries where fatigue-related accidents are a concern, such as aviation and heavy machinery operations.

Overall, this paper demonstrates the potential of image processing and machine learning techniques in addressing the issue of driver drowsiness. in developing reliable and accurate systems for detecting and predicting drowsiness in drivers.

2.3 A Better System for Detecting Fatigue Based on the Personality Characteristics of the Driver

A study article titled "A superior weariness discovery framework in the view of social qualities of driver" recommends a strategy for recognizing driver fatigue that considers the person's unique behavioral patterns. The paper was published by Wang et al. in the Journal of Transportation Research Part C: Emerging Technologies in 2016.

The proposed system collects data on the driver's [13] behavioral characteristics, such as steering wheel movements, brake pedal pressure, and accelerator pedal usage, to determine if the driver is fatigued. The authors used a Support Vector Machine (SVM) algorithm to analyze the data and classify the driver's state as alert or fatigued.

In a trial using a driving simulator, 30 volunteers were given instructions to operate a vehicle for two hours on a fictitious motorway to assess the system. The findings demonstrated that, with an average accuracy rate of 92.8%, the suggested method has a high degree of precision in identifying driving tiredness.

The paper suggests that the proposed system has several advantages over other fatigue detection systems that rely on physiological measures, such as heart rate and EEG signals. The proposed system is non-intrusive, easy to implement, and can provide real-time feedback to the driver, allowing them to take corrective action before an accident occurs. The proposed method provides more accuracy than existing methods.

2.4 A Real-Time Driver Fatigue Detection Technique Based on SVM Algorithm

The authors of the study "Real Time Driver Fatigue Detection Based on SVM Algorithm" propose a Support Vector Machine (SVM) algorithm-based method for the real-time detection of driver fatigue. The paper was published by Chen et al. in the Journal of Sensors in 2018.

The suggested system utilizes characteristics like the length of time the eyes are closed, the regularity of breathing, and the driver's head posture to ascertain whether they are tired or not. The SVM method is then used to decide if the driver is alert or sluggish considering these characteristics. The device is built to function in real-time, providing the user with instantaneous input.

The framework was assessed in a driving test system to try different things with 10 members, where they were instructed to drive for two hours on a simulated highway. The outcomes showed that the proposed framework has high precision in detecting driver fatigue, [14] with an average accuracy rate of 93.3%.

The paper suggests that the proposed system has several advantages over other fatigue detection systems that rely on physiological measures, such as heart rate and EEG signals. The proposed system is non-intrusive and can provide real-time feedback to the driver, allowing them to take corrective action before an accident occurs.

2.5 Applying Composite Features in Viola-Jones Algorithm for Face Detection

A technique for face recognition is proposed in the study article "Face Detection Based on Viola-Jones Algorithm Applying Composite Features." This method combines the Viola-Jones algorithm with composite features.

The Viola-Jones algorithm is a well-known approach to face recognition; it employs a chain of algorithms and Haar-like characteristics to identify human expressions in pictures. In this paper, the authors propose using composite features that combine Haar-like features with other feature types, such as Local Binary Patterns (LBP) and Histograms of Oriented Gradients (HOG), to improve face detection accuracy.

The proposed strategy was assessed on several datasets, including the popular FDDB dataset, and accomplished a high precision pace of more than close to 100%. The proposed strategy is additionally contrasted with other cutting-edge facial acknowledgment techniques in the article, where its superior precision and speed are demonstrated.

The authors suggest that the proposed method has potential applications in various fields, including surveillance, human-computer interaction, and driver safety. In the context of driver safety, the proposed method could be used to identify driver [15] exhaustion and sluggishness by checking looks, for example, yawning and eye closure duration, in real-time.

3 Existing System

3.1 Introduction

The existing system monitors the vehicle's manual alcoholic checking is done by the manual process, traffic cameras are streaming the live video and find the accident location using a manual process.

3.2 Drawbacks

In the Existing system the cost of the Raspberry Pi (software) which they used is so effective. They have used only one detection. They used a low-power microprocessor, which is restricted in its ability to conduct multiple parallel operations and in its ability to connect high-power devices. AI camera is not used and the process is being done manually.

4 Proposed System

In the suggested system, a low-power AI microcontroller, an AI camera, and the Maixdock processor are used to identify the driver's sleepiness using CNN. In addition to it, GPS is used to track the location and alcohol sensor to detect the drunk and driving scenario. A heartbeat sensor (Max30102) is used to find the driver's health. Esp8266 relates to IoT to update the status of the sensors. If the vehicle is now in driving condition, then the framework cautions the driver to utilize a bell and pulse sensor also detect the readings and alert the driver, if the risk is present or not. These pulse sensors can be monitored by the owner through their CCTV. Hence it gives a combined output of whether a person is drowsy or not. The proposed system can be used for Android applications.

5 Methodology

5.1 Introduction

To stop car accidents driving with an obstacle in the flow of vehicles, turning on the power supply, and making sure the maixdock is successfully attached are the first steps of this project. This will be known once the maixdock properly interprets and examines the camera and the incoming pictures. 480p quality footage can be transmitted from the webcam. The driver's visage will be recognized, and the condition notice will appear. Finding the eyes, mouth, and heartbeat comes next. The level of the driver's tiredness will be classified by the drowsiness detection engine once these features have been identified (what about alcohol?) Our drowsiness recognition system requires two conditions to be satisfied before notifying the motorist. When the video detects that the motorist has his eyes closed for longer than two seconds is the first thing to watch out for. The alert will sound and "Drowsiness detected" will appear on the display." The schematic diagram of proposed method is shown in Fig. 1.

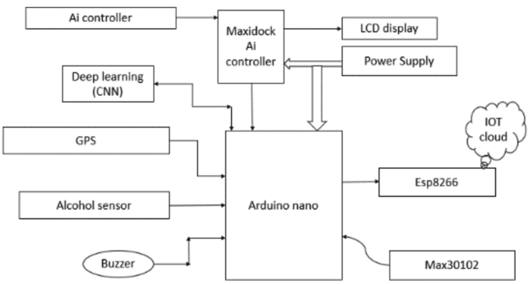


Fig. 1. Block Diagram for Proposed Method

When the camera notices the driver yawning, the second circumstance occurs. "Drowsiness detected" is displayed on the monitor, and an alarm is activated.

Use of an end-to-end neural network that predicts bounding frames and class odds simultaneously is suggested by the You Only Look Once (YOLO) theory. It is distinct

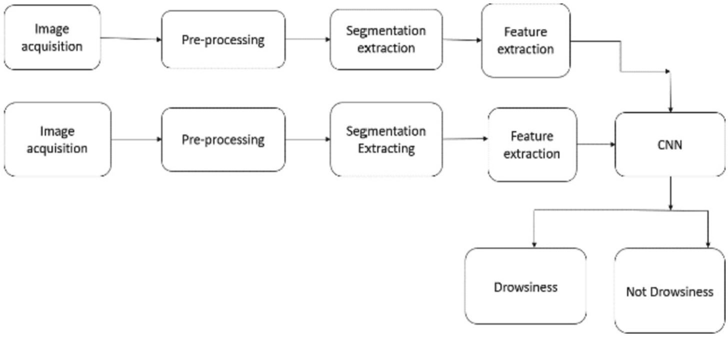


Fig. 2. Block Diagram for Drowsiness Detection

from the strategy used by earlier object recognition algorithms, which used classifications as detectors. With a completely different strategy to object identification, YOLO outperformed other real-time object detection algorithms and produced cutting-edge findings. While algorithms like Faster RCNN perform recognition on individual regions after using the Region Proposal Network to identify potential regions of interest, YOLO performs all of its predictions in a single iteration with the aid of a single layer that is fully connected. For the same image, methods that make use of Region Proposal Networks go through multiple iterations, whereas YOLO only needs to go through one. While Just go for it just requires one cycle, strategies that utilize district proposition networks require various rounds for a similar picture. Since the original introduction of YOLO in 2015, several new iterations of the same model have been suggested, each of which builds upon and enhances its precursor. The block diagrams of drowsiness detection and Yolo architecture are given [16] in Figs. 2 and 3.

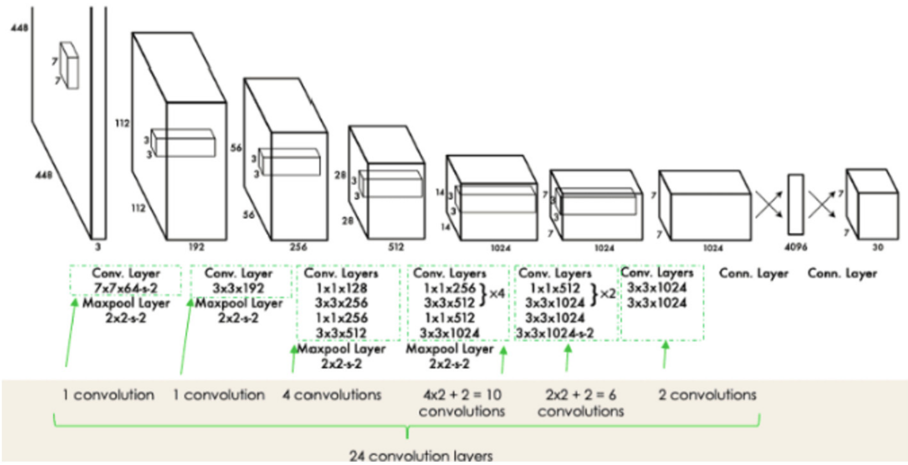


Fig. 3. Yolo architecture

5.2 Convolutional Neural Network (CNN)

It has three layers: a convolutional layer, a completely linked layer, and a pooling layer. It is a type of neural network that uses a grid-like design to handle input. The convolution layer is the fundamental part of CNN that is mainly in charge of calculation. Pooling reduces the number of computations required as well as the physical area of the depiction. However, the Prior Layer and Recent Layer are both connected to the Fully Connected Layer. Figure 4 shows the general architecture of CNN [17].

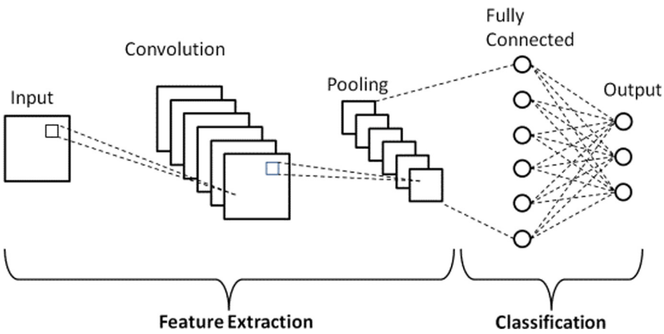


Fig. 4. CNN architecture

6 Result

The improved code for the driver drowsiness detection system uses head pose estimation, facial expression analysis, machine learning, and CNN to detect drowsiness based on eye aspect ratio, blinking of eyes, yawning, heart rate, location of the driver, and detecting of alcohol.

Overall, the improved code for the driver drowsiness detection system is more accurate and robust as it combines multiple techniques, machine learning, and CNN to detect drowsiness in drivers. According to the performance and grid in Fig. 5, this displays the training loss and precision for the project's circumstances under evaluation. As well as using the sample data set for CNN shown in Table 1 and dataset for testing has taken from Kaggle [18].

Table 1. Sample Data set for CNN.

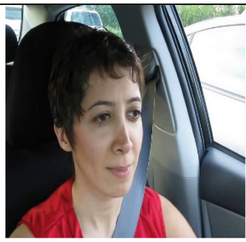
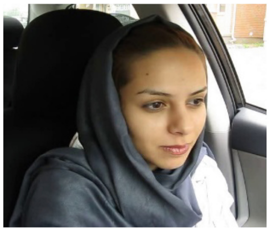
 **Eye closed**	 **Eye open**
 **Yawning**	 **Not yawning**
 **Empty seat**	 **Seat with driver**

Figure 6 is the hardware component that has been tested giving an output of alcohol detection which is shown in Fig. 7.

Table 2 compares the accuracy of the proposed method at different epochs. The proposed method gives 89 percent accuracy.

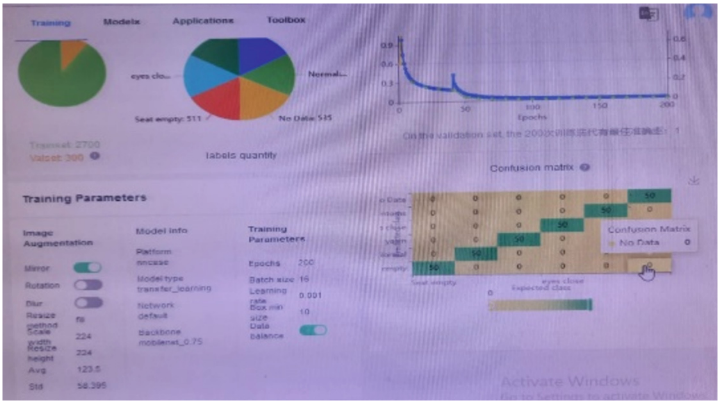


Fig. 5. Performance and confusion matrix for the proposed method

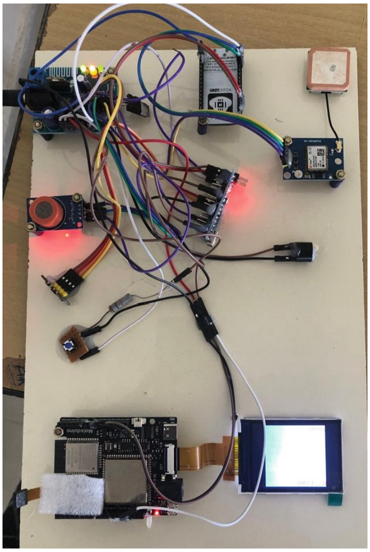


Fig. 6. Hardware component

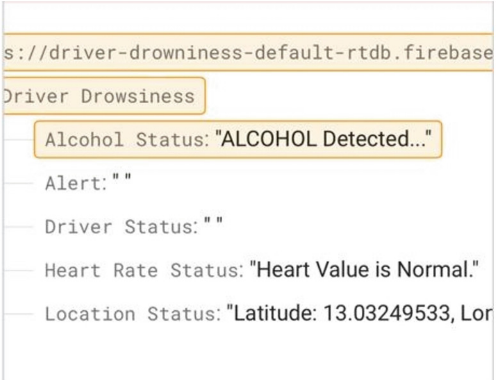


Fig. 7. Detection of alcohol

Table 2. Performance metric of proposed method

Epoch	Value Accuracy	Value Loss
18/200	0.8945	0.3602
19/200	0.8955	0.3528
20/200	0.8993	0.3347

7 Conclusion

The system is trained to identify the drowsiness symptoms of yawning and blinking using a convolutional neural network (CNN). This study used 1310 photos, including shots of eyes open, closed, yawning, or not gaping, vacant seats, and seats with drivers were used to teach CNN. Ten individuals tried the system prototype, which was developed in real-time. CNN's training results showed that our algorithm consistently anticipated a driver's sleepiness rate more than 80% of the time. The proposed system can be implemented on dashboards in future generations of automobiles.

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