Driver Drowsiness Detection System Using Artificial Intelligence

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Abstract: ***An increased vehicle on roads and the application of lack of traffic rules leads to many human error crashes and leads to deaths of people. In this paper, we recommend the driver monitor and assist a device that uses IoT sensors, such as alcohol sensor and the ultrasonic sensor to assess mental alertness as well machine learning algorithms to get little and regular sleep yams to get drowsiness. It also monitors the Eye Aspect Ratio (EAR) as well the driver's Mouth Aspect Ratio (MAR) arrives at the set number of frames to check sleep and yawning. As a result, the system is extremely sensitive to the detection of sleep. This also necessitated the implementation of a facial recognition function, as most drivers monitoring is done individually. The device constantly monitors the driver using the camera for indicators of sleepiness, and utilises a buzzer to warn a drowsy driver, according to our test results. The purpose of our work is to improve as well prevent drunken driving and drowsiness driving behavior in drivers. This IOT based application help to measure the real time drowsiness of driver using the sensors and give the best results which can help to predict the false drowsiness.***

Keywords: Eye Aspect Ratio, Mouth Aspect Ratio, Yawn Detection, Facial Landmarks, IOT Sensors, Machine Learning, Fatigue Check, Drowsiness Detection

1. Introduction

Human activities are increasingly reliant on transportation systems. We can all be victims of fatigue while driving, whether it's from a bad night's sleep, a change in physical condition, or long trips. Sleep deprives the driver of his or her alertness, resulting in potentially dangerous situations and raising the probability of an accident. Unfortunately, this leads to a rise in traffic deaths, with twenty people killed every hour and twenty-five children slain on Indian highways every day. Human errors including drunk driving, fatigue, and distractions have all been identified as key risk factors for road accidents. Among many others, in a recent WHO report. Two of the most common causes of car accidents are drowsy driving and fatigued driving. They raise the number of fatalities and injuries every year all around the world. The lives of people who are affected and those who are connected to them are put under mental, physical, and financial stress as a result of such events. In this environment, it's vital to use emerging technology to design and build systems that can track and measure drivers' attention levels throughout the driving process.

This model is provided in this paper in order to decrease the number of accidents caused by driver inattention and thereby improve road safety. This technology automatically detects driver drowsiness using optical information and artificial intelligence. Thanks to remarkable technological advancements, we can now successfully proposed the model which decreases human mistakes on the road using internet of things technology and machine learning methods.

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2. Research Objective

Following Research Objectives are described while studying the proposed model:

1) To detect the driver drowsiness and provide an alert system to driver.
2) To monitoring and Analyze the face tracking of driver and obstacle detection in real time.
3) To prevent the Accidents through alerting the driving force earlier than something risky happens.
4) To predict the false drowsiness level using EAR, MAR Technique, Facial Landmarks and hardware sensors which improve the accuracy.

3. Proposed Methodology

Monitoring and assistance of a real-time cost-effective driver a program that uses alertness and fatigue check with help of Internet of Things approach and Machine learning algorithm which widely used by people device to prevent human error on the streets as well to improve good driving behavior.

a) Flowchart

The flow chart for proposed method is as shown in figure:

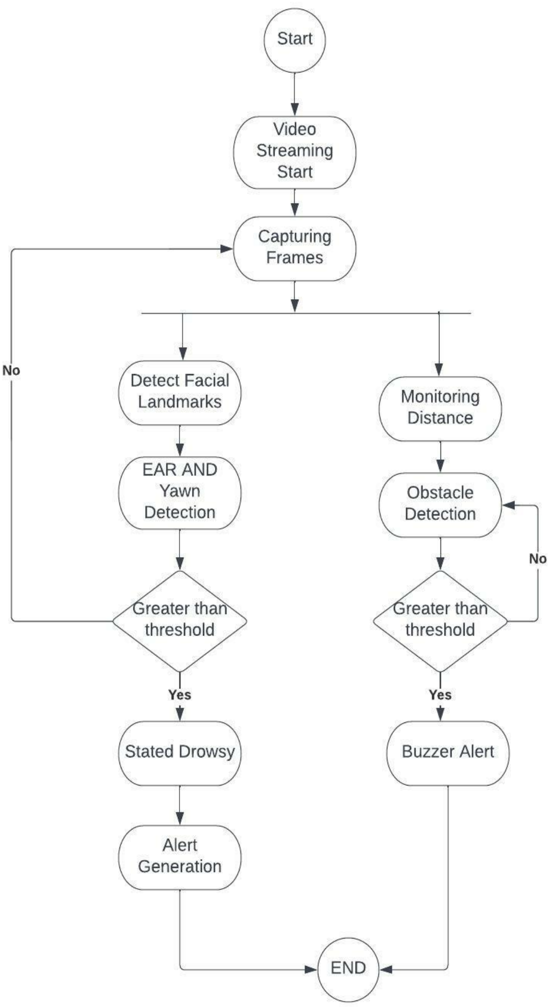


Figure 1: Flow chart for Driver Drowsiness Detection System

The above flowchart shows hybrid model of Internet of things (Hardware) and Artificial Intelligence (Software) approaches for feature extraction. Input to the model is video streaming of driver frames captures data set which passed through the flow shown in above work chart and output is classification of drowsy state of driver.

b) Components Used

Monitoring and assistance of a real-time cost-effective driver a program that uses alertness and fatigue check with help of IoT technology and ML algorithms are widely used an Indian people to prevent human error on the streets as well to improve good driving behavior.

The system uses an Ultrasonic sensor, Pi-Cam Detector and an alcohol gas sensor MQ-3, LCD Screen, Raspberry Pi-Camera, and Buzzer shown in figure 2,3,4,5 and 6 respectively, to detect a drowsiness of driver. This sensors connected to the microprocessor which take the input from this sensors and give the output in the form of alert generation using the buzzer sound system until the driver is in normal state.

1) At the heart of the this system is a Raspberry Pi 3B+ microprocessor, as indicated in Fig 2. Process all data through IoT sensors and cameras, then employs machine learning algorithms to assess driver behaviour with lower numbers.

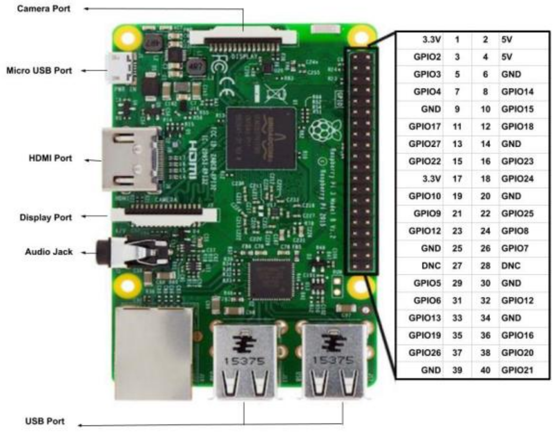


Figure 2: Raspberry Pi 3B+ microprocessor.

2) If the microprocessor detects little obstacle between the given threshold distance, the alarm states raised using a car sound system or buzzer. The ultrasonic sensor is fixed right front side of the car to measure the closeness of any obstacle in terms of car or tree or divider. We can also add any other ultrasonic sensors next to the mirror which will also detect the same but it in our case we are dealing with the only sensor.

Figure 3: Ultrasonic sensor

3) The MQ-3 alcohol gas detector used to measure the person seating on driving seat is drunken or in normal state if he is found to be drunk the signal send to microprocessor and the system generator the buzzer signal as an alert system.

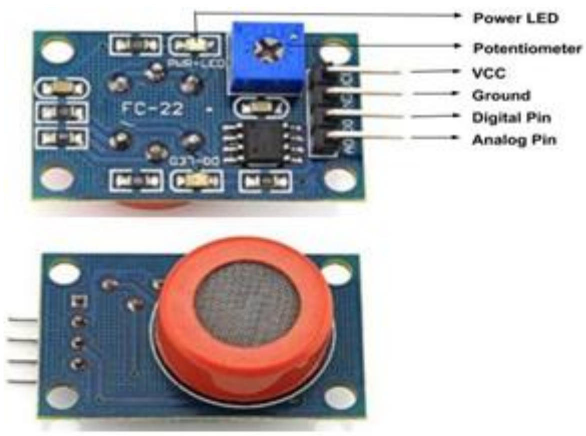


Figure 4: MQ-3 alcohol gas sensor

4) The system uses a 5-MP camera, shown in Figure 5. Since The chances of drowsiness are high at night, of course it is important to be able to see at night on camera.

So, infrared lights are used to capture video in any light. A video server from the camera is sent to the microprocessor seeing sleep symptoms such as sleep deprivation as well yams.

Video feed is analyzed by a single frame value every two seconds. If the microprocessor detects little sleep in 10 consecutive frames or 10 consecutive yawns, the alarm states raised using a car sound system or buzzer.

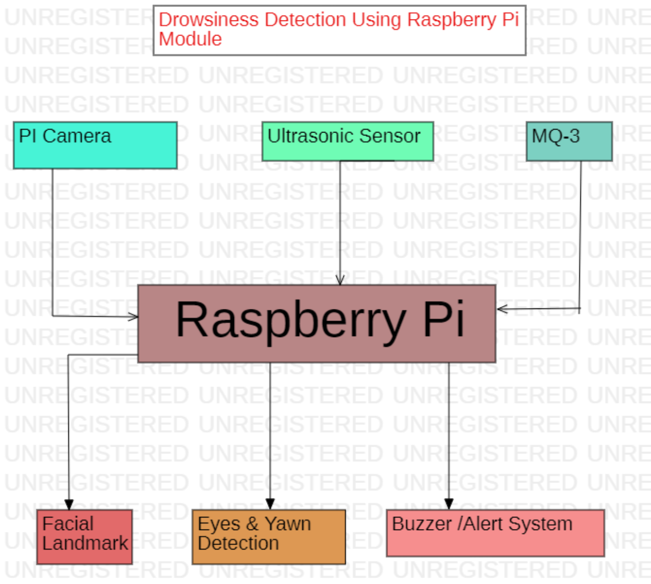
Figure 5: Raspberry Pi-Camera.

Our system uses raspberry pi 3B+ which support the Raspberry pi cam module which will continuous monitoring the video streaming of driver. This 5 MP camera detect the facial parameters of driver image and send the signals to the Microprocessor.

5) Buzzer is used as the alert system or sound generation system in this application. There are two different scenario when the buzzer plays into picture the first condition is whenever the driver found in drowsy state according to their Eyes Aspect Threshold Ratio and Yawn Detection Threshold value after the measure of 10 consecutive frames capture beyond the threshold the buzzer start alarming the signal to the driver.

Figure 6: Buzzer

In the second case the buzzer will start if there is signal generated from the ultrasonic sensor which will detect the distance between car and any obstacle is less than the threshold value set in the application.



c) Algorithms and Library Used:

Two submodels of system involve, sleepness and fatigue detection. In assessing common sense, MQ-3 and ultrasonic sensor which includes removable oral, feed data in RPi. RPi processes this data and produces the result LCD screen, notifies driver. In exhaustion check, the camera sends live video feed to RPi, where it uses ML algorithm for measuring alert or driver status during the trip.

d) Dlib facial features:

We used the pre-trained Linear SVM detector from the dlib package in our application. Dlib includes a pre-built model for detecting facial landmarks called shape predictor 68 facemarks.dat. The next step is to locate the landmarks on the face. The primary idea behind this method is to locate 68 specific places on the face, such as the corners of the mouth, closed eyes.

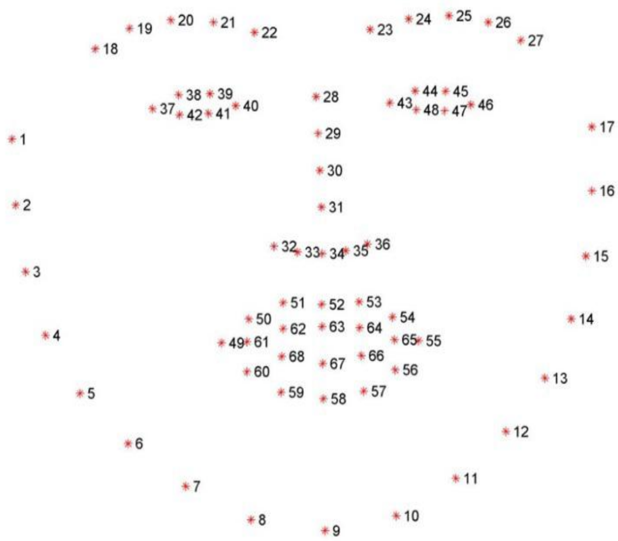


Figure 7: Facial 68 Landmarks.

B. Here we are using Support Vector Machine algorithm which is able to detected the face and non-face in every frame. SVM is a supervised learning algorithm,used to recognized data for the regression classification analysis.

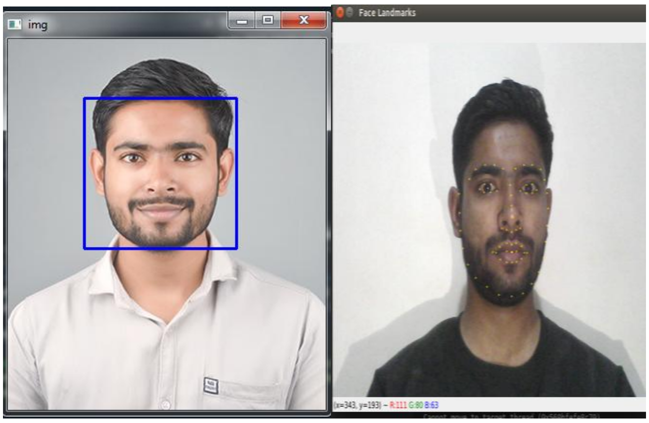


Figure 8: Detecting the Driver Frames and Applying facial Landmarks

a) Eye Aspect Ratio :

According to research the average blink of an eye takes around 400 ms, any longer than closed eye is considered artificial blindness. EAR, as the name defines, is the ratio of the length of the eyes to the width of the eyes.

$$\text{EAR} = \frac{\|p_2 - p_6\| + \|p_3 - p_5\|}{2\|p_1 - p_4\|}$$

where, p1, p2, p3…p6 are facial eye landmarks.

b) Mouth Aspect Ratio (MAR):

The Mouth The Mouth Aspect Ratio is also similarly calculate as we find the EAR for the measuring the sleepness of driver as we set the threshold value which will classify wheather the person feeling the sleep while driving the car. MAR basically used to calculate Yawn Detection.

c) Use Case Diagram :

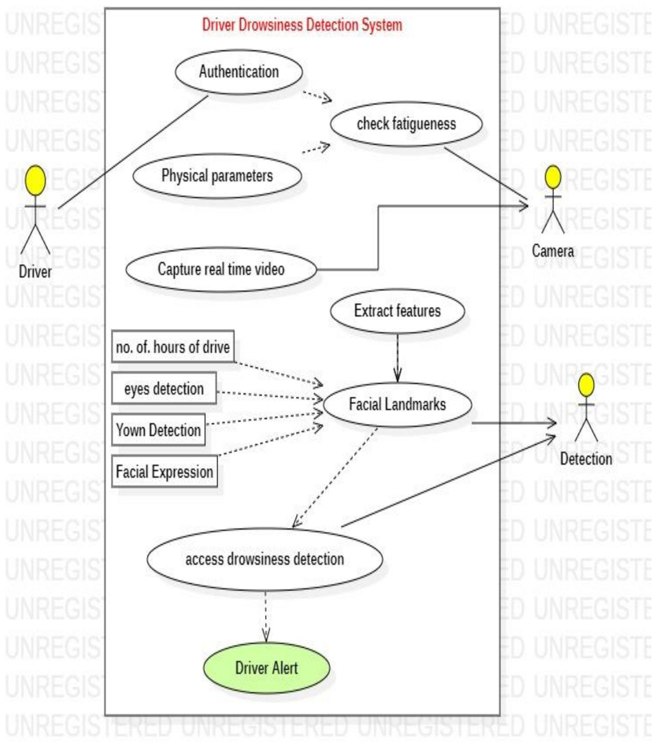


Figure 9: Use Case Diagram

d) Model Discription:

- The proposed Model having the threshold value is 0.27 for Eye Aspect Ratio and 15 for Mouth Aspect Ratio.
- The system is designed to captured 25 frames per second.
- The system found the values beyond the set thresholds for 10 consecutive frames, the system will trigger the alarm.
- A person feeling Drowsy if the Eye Aspect Ratio and the Mouth Aspect Ratio found falls below a certain threshold.
- The Accuracy will improve with the help of considering the real time data feed from the sensors to Raspberry Pi.
- The Ultra Sonic Sensor use which help to detect the closeness of Obstacle and generate an signal as Buzzer alert.
- The process will continuous detect till we give the quit key to the system.

4. Results

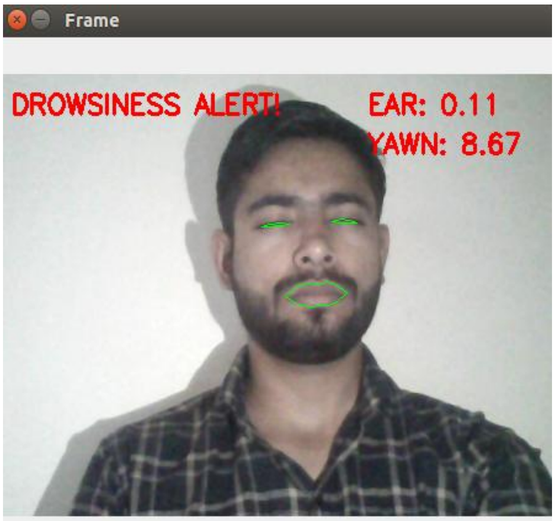
The Proposed System will able to working and testing under different test cases :

1) Normal Driving State:

The Normal state of driver is when he can not find in continuous yawning or feeling sleepy so that his eyes also not getting blink for some seconds then we can say that the driver is in normal working state and can able to drive safe. The below pictorial result can accurately classify the normal state of driver.

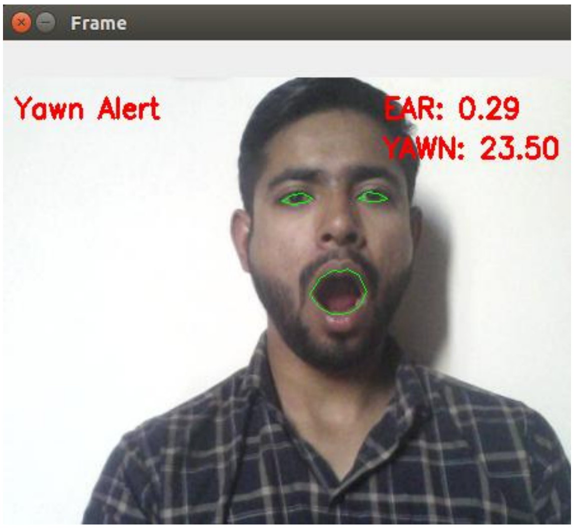
2) Drowsy State in Eyes:

After long hours of driving or due to unstable physical condition the driver will be in state of fatigueness and it will results in sleepness in eyes. So we are extracting the eyes feature from facial landmarks which will calculate the eye aspect ratio and by using the set threshold we can classify the driver state if he is find sleepy in consecutive 10 frames then the buzzer will trigger so that the driver can help to prevent from accidents. We set the threshold value for the EAR is 0.27 the following pictorial result can show if the value is beyond the threshold the message is displayed along with a buzzer alarm.



3) Drowsy State in Yawning:

Due to long working hours or improper sleep the people usually continuous getting yawn which is clear indication of need some rest or sleep so we also extract another feature from facial landmark i.e Mouth Aspect Ratio and set the threshold value as 15 set threshold we can classify the driver state if he is find sleepy in consecutive 10 frames then the buzzer will trigger so that the driver can help to prevent from accidents. following pictorial result can show if the value is beyond the threshold the message is displayed along with a buzzer alarm.



A. Analysis and Results

Our proposed solution has a real-time accuracy of 90%. Most of the time, it recognises the proper method for falling asleep and setting the alarm. When the driver's face is obscured by the camera, our suggested framework is unable to detect tiredness. The camera is pre-installed, and when the vehicle turns left, right, or bends, the suggested system recognises it as non-surface and continues to function normally. Calculate. The accuracy formula calculates how tired you are. As a result, the accuracy of 40 samples in our suggested method is 90%.

$$Accuracy = \frac{TP+TN}{TP+FP+TN+FN}$$

=40	Positive	Negative
True	TP -32	TN -4
False	FP -4	FN -0

Figure 10: Table for remembering the accuracy of the proposed method. We took 40 samples and 36 times well classify 5 times it misclassify.

B. Analysis

We check the performance of system using the different driver faces and test cases consider by using the driver is wearing the specs so we apply the module to check if the person seating on driving seat wear the specs can accurately able to classify if he is found in asleep. The below are the results which shows the system can be detected the drowsiness.

Figure: Above are results of Drowsiness Detection On Normal state of driver with Spectacles & Without Spectacles.

5. Challenges

1) A lot of other elements should be considered as well, such as the weather, such as if it is raining or terrible weather.
2) A variety of factors, including vehicle-based, physiological-based, and behavior-based methods, might influence drowsiness levels.
3) A few technical criteria, such as correctly recording face and eye features from unwanted movements, improper task conditions, technology limits, and individual variances, should also be seriously examined.

6. Future Scope

1) This proposed model will be used for different many uses like Netflix and many other streaming services which will be detected when the user is fallen asleep and based on that stop the video accordingly.
2) To track heart attack during driving additional sensors can be used.
3) It can also be used in Educational Institutes and Organizations to detect the drowsy behaviour.

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