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# CNN BASED DRIVER DROWSINESS DETECTION: A REVIEW

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**Abstract**

The drowsiness of the driver and rash driving are the major causes of road accidents, which result in loss of valuable life, and deteriorate the safety in the road traffic. Reliable and precise driver drowsiness systems are required to prevent road accidents and to improve road traffic safety. Various driver drowsiness detection systems have been designed with different technologies which have an affinity towards the unique parameter of detecting the drowsiness of the driver. This paper proposes a novel model of multilevel distribution of detecting the driver drowsiness using the Convolution Neural Networks (CNN) followed by the emotion analysis. The emotion analysis, in this proposed model, analyzes the driver's frame of mind which identifies the motivating factors for different driving patterns. These driving patterns were analyzed based on the acceleration system,

speed of the vehicle, Revolutions per Minute (RPM), facial recognition of the driver. The facial pattern of the driver is treated with 2D Convolution Neural Network (CNN) to detect the behaviour and driver's emotion. The proposed model is implemented using OpenCV and the experimental results prove that the proposed model detects the driver's emotion and drowsiness more effectively than the existing technologies.

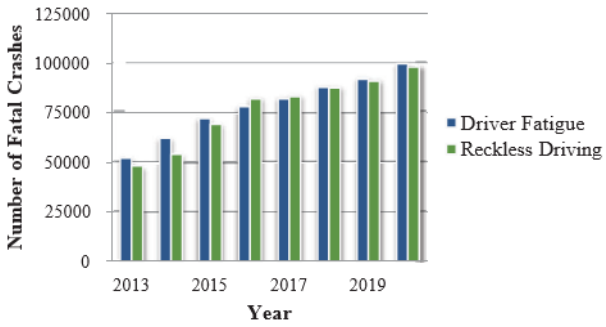
**Keywords** - Driver drowsiness; emotion analysis; convolution neural network; driver fatigue; driver mentality

## 1. Introduction

Driver Drowsiness and sleep deprivation is one of the major causes for a lot of road accidents. Driver in drowsy state is a danger to road safety and can cause serious injuries sometimes, resulting in death of the victim and also economical loss. Drowsiness means a state where person feels lethargic, has difficulty concentrating and tiredness in eyes of the drivers while he's driving vehicles. Most of the accidents happen in India due to the lack of concentration of the driver. Driving ability of the driver deteriorates with time owing to drowsiness. To avoid these situations, we developed a system which will detect the drowsiness nature of the driver and will also alert him immediately. Lot of people drive on the highways all day and all night. This includes bus drivers, truck drivers, taximen and people who are traveling long-distance, they suffer from lack of sleep. Because of sleep deprivation, it becomes very dangerous to drive when feeling fatigued. According to a database study conducted by the Australian Transport Bureau about fatality crashes, it is found that 16.6% of fatal crashes were caused by sleep deprivation and based on the report submitted by

Ministry of Transportation of Ontario, 25.5% of injury causing crashes and 17.8% of crashes with fatality related to sleep deprivation. In India, in 2015 only 148,00+ people died due to vehicle related accidents. Of these 1.4 lac, at least 21 percent were caused due to fatigue causing drivers to make erroneous errors. This is still a relatively smaller number, as among the multiple reasons that can lead to an accident, the involvement of fatigue as a cause is generally highly underestimated. Fatigue when combined with bad roads and bridges in developing countries like India is a recipe for disaster. Fatigue can't be measured unlike alcohol and drugs, which can be clearly measured and tests that are also available easily to do it. One of the best solutions to this problem of drowsiness and fatigue-related accidents is to raise awareness and promoting drivers to admit fatigue when needed. The first is not easy and much more expensive to achieve, and the other is not possible without the former as driving for long hours is very good pay based for drivers. When the job lucrativeness associated with a sector goes up, the wage associated with it also tends to shot up. It is also the case for driving transport trucks at night. Money also leads to drivers making unwise decisions like driving all night even with fatigue. This is because of the reason that the drivers themselves are not aware of the huge risk associated with driving when fatigued. Some countries have also imposed restrictions on the number of hours that a driver can drive at a one go, but it is still not enough to solve this problem as its implementation is very difficult and costly.

The figure below depicts the statistical analysis of the fatal crashes due to driver fatigue and reckless driving. It is clear from the statistics that the fatal count due to driver fatigue and reckless driving is almost equivalent to each other, whereas the present monitoring system concentrates only on the driver's drowsiness. Certain driver monitoring systems detect driver drowsiness, whereas some systems monitor the vehicle acceleration and the driver's eye movement




## 2. Related Work

Numerous researchers are actively involved in determining the solution for road accidents due to driver drowsiness. The plentiful research results have been classified into five categories of driving like normal driving, fatigue driving, reckless driving, drunken driving, and distracted driving. Some of the notable research results were illustrated from which the proposed system with enhanced performance has been designed.

de Naurois et al. (2018) designed a model for predicting the drowsiness of the driver using Artificial Neural Networks [9]. The system works on the heartbeat rate analyzing principle which is fed as the input to the Artificial Neural Network (ANN) to detect the drowsiness of the driver. The experimental analysis proves that the system has about 80% of accuracy in detecting the drowsiness of the driver. Jabbar et al. (2018) has designed a real-time driver drowsiness detection system using the android mobile application using Deep Neural Network (DNN) techniques [10]. The proposed method was designed based on the Deep Learning

method integrated with the Android mobile application. The system achieved an accuracy level of 80% based on the experimental analysis.

de Naurois et al. (2017) proposed a driver drowsiness detection model based on the Artificial Neural Networks (ANN) that detects the eye blink duration and its frequency as the major input to the Artificial Neural Network (ANN) [11]. The model identifies the drowsiness of the driver with an error of 0.22 and detects at a rapid rate with the mean square of 4.18 minutes. Moujahid et al. (2021) has proposed an efficient and compact face descriptor for detecting driver drowsiness with several approaches of face expression detection, multilevel face representation, and has compared with the dataset of NTH Drowsy Driver Detection (NTHDDD) [12]. The proposed framework is proven to be efficient at par with the performance using a convolution neural network.

Phanikrishna et al. (2021) designed an automatic classification model for detecting the drowsiness of the driver using wavelet packet transform [15]. The wavelet packet transform was extracted from the single-channel Electro-Encephalogram (EEG) signals from the driver. The proposed model yields 94.45% of accuracy in performing the real-time sleep analysis. Taherisadr et al. (2018) designed a model for identifying the attention of the driver using Mel-Frequency Cepstrum in the two-dimensional transform and Convolution Neural Network (CNN) [16]. The designed model extracts the two-dimensional Mel- Frequency Cepstrum representation of the ElectroCardiogram (ECG) sensed from the driver. The analytical results yield that the designed model is more efficient than the existing methodologies of drowsiness detection during driving. Lee et al. (2017) have designed a system that performs correlation analysis of ElectroCardiography (ECG) and Photoplethysmogram (PPT) data for detecting the drowsiness

of the driver [17]. This model is a noise replacement model and the experimental analysis proves that the Noise replacement model is better efficient than the PPT method of detecting the driver's drowsiness.

## 3. Methodology

Driver exhaustion and drowsiness are significant contributors to various automobile accidents. In the field of accident prevention systems, designing and maintaining technology that can effectively identify or avoid drowsiness at the wheel and warn the driver before a collision is a major challenge. We use OpenCV to take images from a webcam and these images given to a deep learning algorithm that can tell whether someone's eyes are closed or opened. In this case, we are looking for the persons face and eyes.

**Step1:** Image is taken as input from camera.

We'll use a camera to capture photographs as input. But, in order to gain access to the webcam, we created an endless loop that captures each frame. We employ the cv2 method given by OpenCV. VideoCapture(0) (cap) is used to access the camera and capture the object. With cap.read(), each frame is read, and then image is saved in a variable.

**Step 2**:Create a ROI by detecting a face in the picture.

To segment the face in the captured image, we first converted it to gray scale because, the OpenCV object detection algorithm only accepts grayscale images as input. To detect the objects, we don't need colour detail.

We use the Haar cascade classifier to detect the face. The classifier face= cv2.Cas is set with this section. for (x,y,w,h)infaces,we use cv2.rectangle(frame, (x,y), (x+w, y+h), (100,100,100), 1

**Step 3**: Use the ROI to find the eyes and feed them to the classifier.

The technique for detecting eyes is the same as for detecting ears. Cascade classifier is used in left and right eyes.

Then, use left_eye=leye.detectMultiScale(gray) to detect the eyes. We extracted only the details of eyes from the captured image. This can be done by first removingthe eye's boundary box and then using this code to remove the eye image from the picture.

l_eye = frame[y : y+h, x : x+w]

This information is given to CNN, which decides whether the eyes are closed or not. The right eye also detected in the above manner.

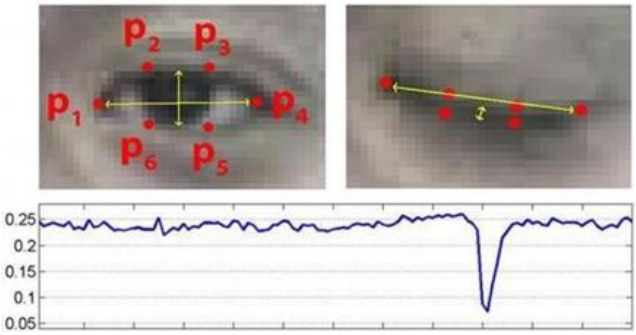



Fig. 2: Detection of Eyes using OpenCV

**Step 4** : The classifier will determine whether or not the eyes are open.

The eye status is predicted using a CNN classifier to feed the image into the model, since the model requires the proper measurements to begin with. We begin by converting the colour picture to grayscale.

r_eye=cv2.cvtColor(r_eye,cv2.COLOR_BGR2GRAY).

Then, since the model is trained on images with a resolution of 24*24 pixels, We resize the image to 24*24pixels.

cv2.resize (r_eye, (24,24)).

For better convergence, the date is normalized. r_eye = r_eye/255

The model is loaded using model=load_model(„models/cnnCat2.h5“) Now, each eye is predicted with the proposed model.

lpred=model.predict_classes(l_eye)

If lpred[0] = 1, it means that eyes are open, if lpred[0] = 0 then, it means that eyes are closed.

**Step 5:** Score Calculation.

The score is essentially a number that we'll use to figure out how long the individual has been closed-eyed. As a consequence, if both eyes are closed, we will begin to raise the score, but if both eyes are open, we will decrease the score. We're using the cv2.putText() function to draw the result on the screen, which displays the status of the driver or a person.

cv2.putTxt(frame,"Open",(10,height20), font,1,(255,255,255),1,cv2.LINE_AA )

A criterion is established, for example, if the score exceeds 15, it indicates that the person's eyes have been closed for an extended amount of time. Then the alarm turned on.

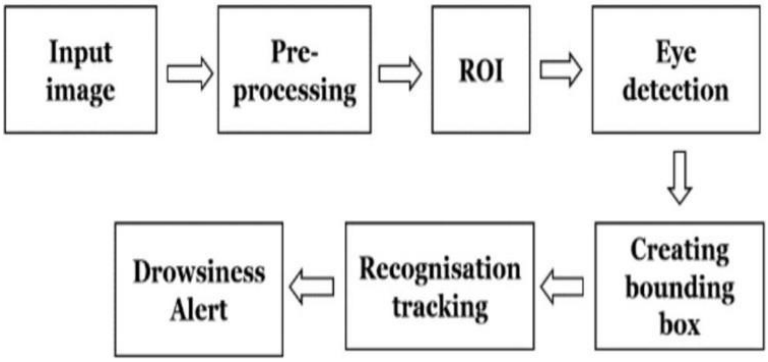



Fig. 3: Block Diagram for Drowsiness Detection Using CNN

## 4. Conclusion

The Drowsiness Detection System, which is based on the driver's eye closure, can discern between normal eye twitch and drowsiness, as well as detect drowsiness when driving. The suggested scheme will help deter injuries caused by drowsy driving. Using a Haar cascade classifier, OpenCV was used to detect faces and eyes, and then a CNN model to predict the status. An alert signal is provided when the eyes are closed for an extended amount of time. Continuous eye closures are used to assess the driver's alertness level. For the future work, this detection system can be made into hardware with advanced features.

**Future Scope:**

● The system can be made more accurate using various other parameters such as State of the Car, Detecting Foreign Substances on Face etc.

● An application can be developed where it can alert or prevent the user from sleeping.

● It can be used to develop an IOT device that can be installed in the car to detect driver's drowsiness.

● Similar models and techniques can be used for various other uses such as Netflix, Hotstar and other streaming service platforms can detect whether the person is sleeping and stop the video accordingly

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