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# Driver Drowsiness Detection System Using Machine Learning

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**ABSTRACT:** Driver drowsiness has end up one of the primary motives of lethal street accidents that lead to serious bodily injuries, loss of lives. Continuously riding for lengthy hours except relaxation reasons fatigue and as a result deadly avenue accidents. Intense workload on the drivers tends to make them work overtime. These lengthy working hours make them fatigued which in flip makes them sense drowsy whilst driving. The essential victims of this overburden are the truck drivers and bus drivers who pressure non-stop throughout day and night. This imposes a important hazard to a human existence and as nicely as to the lifestyles of the passengers. The purpose of this is to boost a prototype drowsiness detection machine (DDD). The focal point will be positioned on designing a machine that will accurately display the open or closed country of the driver's eyes in real-time. By monitoring the eyes, it is believed that the symptoms of driver fatigue can be detected early ample to keep away from a vehicle accident.

**KEYWORDS:** Eye blink detection, Drowsiness Detection, Eye Aspect Ratio, accident prevention, driver information systems.

## I. INTRODUCTION

Driver drowsiness and fatigue are one of the most frequent motives for accidents. The range of fatalities due to such accidents is increasing global every year. These paper pursuits to reduce the variety of accidents due to driver drowsiness and fatigue. This will in turn extend transportation safety. Driver drowsiness detection is a science in automobiles that is beneficial in stopping accidents and saving the lives of drivers when they are getting drowsy. Drowsiness whilst riding tends to car crashes and accidents. Many people die in automobile collisions each 12 months due to fatigued riding those consequences from slumbering deprivation, intoxication, drug and alcohol abuse, publicity to warmth or alcohol. Automobile producers such as Tesla, Mercedes-Benz, and others have more than a few features for using help such as Warning of lane deviation, emergency braking systems, variable cruise control, and resource steering. These innovations have assisted drivers in fending off the incidence of collisions. Samsung has investigated the interest degree of a driver by reading facial traits and patterns.

Every 12 months many human beings lose their lives due to the fact of fundamental avenue accidents throughout the world and Drowsiness is the most important problem that threatens the street security and reasons extreme bodily and someday intellectual accidents to human lifestyles and to financial growth. The largest range of accidents in the world is due to drowsiness or fatigue. Drowsiness can be described as an growing awareness position alongside with a napping leaning to fall. This presence whilst using normally leads to extreme accidents as the driver is unable to action stopping such as turning off the road. Intense workload on the drivers tends to make them work overtime. These lengthy working hours make them fatigued which in turn makes them experience drowsy whilst driving. The principal victims of this overburden are the truck drivers and bus drivers who pressure nonstop at some stage in day and night. This imposes a principal chance to his/her existence and as nicely as to the lifestyles of the passengers.

Neglecting our responsibilities closer to safer journey has enabled heaps of lots of tragedies to get related with this wonderful invention each and every year. It may additionally appear like a trivial factor to most of us however following policies and policies on the avenue is of utmost importance. While on road, an car wields the most strength and in irresponsible hands, it can be unfavorable and sometimes, that carelessness can damage lives even of the human beings on the road. One variety of carelessness is no longer admitting when we are too worn-out to drive.

### A. Problem Statement

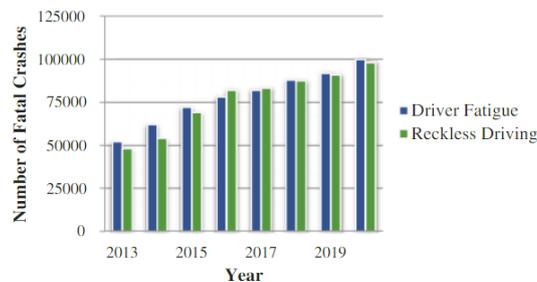
Drowsiness is one of the main issues that threatens the road safety and causes even injuries to human life and economical losses. The thought of mortality is increasingly haunted by approximately 20% fall road accidents worldwide. Teenagers, shift workers, commercial drivers and people with untreated sleep disorders or with short-term

or chronic sleep deprivation are at increased risk of drowsy driving and for having a fall-asleep crash. The aim is to implement a system that will prevent deadly accident sort owner drowsy driver just in time which would alert the driver before anything undesired happens.

### B. Objectives

The primary objective of the proposed system is to overcome one or more problems of the existing systems.

- 1) To capture and pre-process the driver image.
- 2) To find eye detection fastly using non-intrusive method.
- 3) To find eye state fastly.
- 4) To wake up the driver to avoid accidents.
- 5) To protect the people and vehicle.
- 6) To provide a system that concentrates on a non-intrusive vision-based system.
- 7) To provide a driver drowsy detection system that will work well in day and night irrespective of lighting condition.
- 8) To provide for increased efficiency by avoiding frame loss.
- 9) To provide a driver drowsy detection system that uses customized image processing algorithm to concentrate on the eyes detection.
- 10) To provide knowledge based method to authenticate the eyes movement using the image-processing algorithm to reduce the chance of misdetection or wrong alarm.



## II. RELATED STUDY

Real Time drowsiness detection using eye blink monitoring, Amna Rahman, MehreenSirsha, Aliya Khan A literature survey summarizing some of the recent techniques proposed in this area is provided. To deal with this problem we propose an eye blink monitoring algorithm that uses eye feature points to determine the open or closed state of the eye and activate an alarm if the driver is drowsy.

Safe driving by detecting lane discipline and driver drowsiness, YashikaKatyall, SuhasAlur, Shipra Dwivedi This paper will concentrate on avoiding the road accidents by concentrating mainly on drunk driving or drowsiness and lane discipline. The paper has two parts. Firstly lane detection using Hough Transform. Secondly, eye detection of driver for drowsiness detection. Thus, the main focus is on the fatigue of the driver and his maintenance of lane discipline. Driver drowsiness detection using behavioral measures and machine learning techniques:

A review of state-of-art techniques, MkhuseleNgxande, Jules-Raymond Tapamo, Michael Burke – 2017.

This paper presents a literature review of driver drowsiness detection based on behavioral measures using machine learning techniques. Faces contain information that can be used to interpret levels of drowsiness. There are many facial features that can be extracted from the face to infer the level of drowsiness. These include eye blinks, head movements and yawning.

Optimized driver safety through driver fatigue detection methods, Mr. Omar Wathiq, Dr. Bhavna D. Ambudkar In this paper, they have presented the detailed study on different approaches for driver safety using various driver drowsiness or distraction detection techniques.

After discussing the limitations of previous method, they designed the novel driver safety method with objective of improving the efficiency of driver distraction detection. The designed method is based on optimized face detector and feature extraction method with SVM classifier. The outcome of this paper is new efficient driver safety technique based on video image processing.

Machine learning and gradient statistics based real-time driver drowsiness detection, Cyun-Yi Lin, Paul Chang, Alan Wang, and Chih-Peng Fan

In this paper, the machine learning and gradient statistics based driver drowsiness detection is developed for the real-time application. The proposed system includes four parts, which are the face detection, the eye-glasses bridge detection, the eye detection, and the eye closure detection. Driver drowsiness monitoring system using visual behavior and machine learning, Ashish Kumar, Rusha Patra

Drowsy driving is one of the major causes of road accidents and death. Hence, detection of driver's fatigue and its indication is an active research area. Most of the conventional methods are either vehicle based, or behavioral based or physiological based. Few methods are intrusive and distract the driver, some require expensive sensors and data handling. Therefore, in this study, a lowcost, real-time driver's drowsiness detection system is developed with acceptable accuracy.

Real-time drowsiness detection algorithm for driver state monitoring systems, Jang WoonBaek, Byung-Gil Han, Kwang-Ju Kim, Yun-Su Chung, Soo-In Lee

In this paper, they have proposed a novel drowsiness detection algorithm using a camera near the dashboard. The proposed algorithm detects the driver's face in the image and estimates the landmarks in the face region.

A Survey on state-of-the-art drowsiness detection techniques, Muhammad Ramzan, Hikmatullah Khan, Shahid Mahmood Awan, Amina Ismail, Mahwish Ilyas, and Ahsan Mahmood – This paper tells drowsiness or fatigue is a major cause of road accidents and has significant implications for road safety. Several deadly accidents can be prevented if the drowsy drivers are warned in time. A variety of drowsiness detection methods exist that monitor the drivers drowsiness state while driving and alarm the drivers if they are not concentrating on driving. The relevant features can be extracted from facial expressions such as yawning, eye closure, and head movements for inferring the level of drowsiness.

A method of driver's eyes closure and yawning detection for drowsiness analysis video image processing by infrared camera, Wisaroot Tipprasert, Theekapun Charoenpong, Chamaporn Chianrabutra

A challenge of research in area of the driver drowsiness detection is to detect the drowsiness in low light condition. In this paper, we proposed a method to detect driver's eyes closure and yawning for drowsiness analysis by infrared camera. Integration of ensemble and evolutionary machine learning algorithms for monitoring driver behavior using physiological signals, Afsaneh Koohestani, Moloud Abdar, Abbas Khosravi – The level of consciousness and the concentration of drivers while driving play a vital role for reducing the number of accidents. In recent decade, in-vehicle infotainment (IVI) [or in-car entertainment (ICE)] is one of the main reasons that lead to degradation of driver's performance and losing awareness.

Driver drowsiness detection, K Satish, A Lalitesh, K Bhargavi, M Sishir Prem and Anjali T

All over the world drowsiness has been the significant cause of horrible accidents which is causing deaths and fatalities injuries. Day by day fatal injuries numbers are increasing globally. From the past many years, researchers have concluded drivers with a lack of sleep and more tiredness which causes drowsiness of the driver. This paper shows a new experimental model is designed for detecting drowsiness of driver is presented to reduce accidents caused by this problem which increases transport safety.

#### **A. EXISTING SYSTEM**

The a number strategies that have been employed until date in order to apprehend the drowsy kingdom of driver can be more often than not classes into three training such as physiological, behavioral and car parameter primarily based techniques. Among this technique, physiological as properly as car primarily based strategies are intrusive in nature whereas behavioral primarily based method is non-intrusive in nature.

Forsman et al., designed a framework which employed the a number automobile motion like modern-day function of automobile on lane, steering wheel motion and motion contain in brake as properly as acceleration pedal and so on, in investigation of drowsiness degree of driver's.

Simon et al., discover the reality that kingdom of drowsiness in driver recognized via the quite a number electric powered sign such as electromyography (EMG) for muscle tone, electroencephalogram (EEG) for talent activity, electrocardiography (ECG) for coronary heart rate, electrooculogram (EOG) for ocular activity. Here, the evaluation includes in identifying the degree of drowsiness based totally on the physiological traits is intrusive in nature.



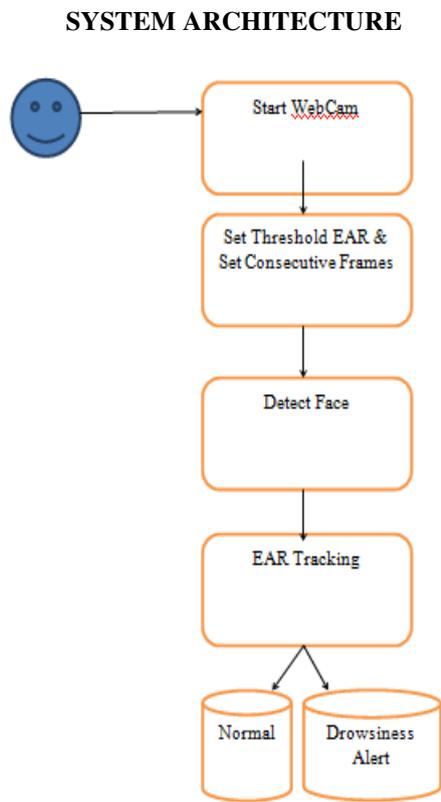
### B. PROPOSED SYSTEM

Our proposed system consists of three primary components: face and eye recognition using the Haar cascade classifier, facial feature extraction using OpenCV, and drowsiness classification using CNN implemented in Keras. The system is designed to operate in real time by capturing video information from a camera installed on the dashboard or inside the car. In this model, the OpenCV library is used to take input from a live video stream captured by the camera. First, the Haar cascade classifier is used to recognize the driver's face and eyes from the input video frames. A large dataset of open and closed eyes was used to train the CNN model. This is used to determine the driver's level of drowsiness the alert will sound based on the score.

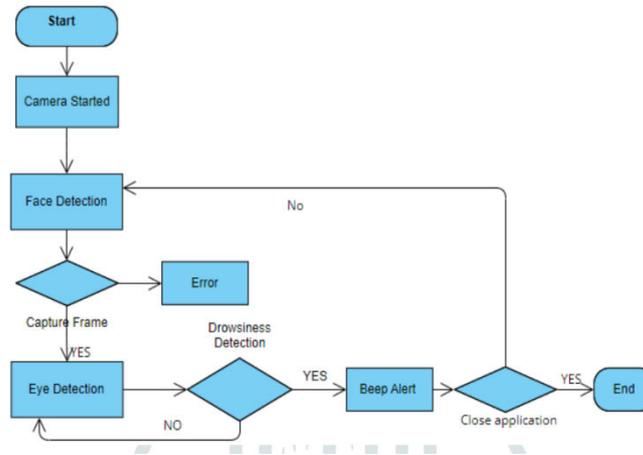
### III. PROPOSED SYSTEM ALGORITHM

- (1) Viola-jones face detection algorithm is used to detect the face the images and given as input to Viola-jones eye detection algorithm
  - (2) Once the face is detected, Viola-jones eye detection algorithm is used to extract the eye region from the facial images and given as input to CNN.
  - (3) CNN with four convolutional layers are used to extract the deep features and those features are passed to fully connected layer.
  - (4) Soft max layer in CNN classify the images in to sleepy or non-sleepy images.
- The proposed architecture of Drowsiness detection system using Deep CNN is given.  
The proposed model has three phases  
1. Preprocessing stage 2. Feature extraction 3. Deep CNN Classifier.

### A. FLOW DIAGRAM



**SYSTEM FLOW DIAGRAM**



**IV. DESCRIPTION OF MODULES**

**MODULES:**

- Input Acquisition
- Preprocessing
- Face Detection
- Eye Detection
- Eye Aspect Ratio (EAR)
- Blink Detection
- Alert

**MODULES DESCRIPTION:**

**Input Acquisition**

The enter video is taken as a stay video from the webcam, which are having the homes that are in the RGB. It is having each in the lightning and decrease format. The individual who desired to power is setting their eye on the net camera, which are been used to discover the higher resolution. The retina will be detected in such a way that is used to validate the man or woman thinking although via the detection. In the enter acquisition the enter video that are been extracted from the internet digital camera for the detection of the iris in such a way that there are considered that the man or woman eye is open in this case the detection system are been extracted for the drowsy driver detection the use of the iris is open or closed right here the iris is open and there are been detected on the net digicam and the processing is been carried out for the focuses on the eye of the person. It should includes the extensive open of the eye on the picture acquisition model.

**Preprocessing**

The preprocessing is frequent step that are been used to extract the correct video from the noisy format. Thus in our case the preprocessing is completed on the RGB image, that are having the 255 vary of pixels. There are having some of the minor distinction in the human left and proper eye. In the preprocessing module, our work there are detecting the open eye iris and circle the retina section of the eye for the in addition processing. There are highlighting some features, which are used to beautify the picture for the preprocessing step. The captured video are having the non uniform shape of the retina photograph that is illuminating to right the undesirable noise in the picture which is triggered with the aid of the in-accurate fixing of the of the eye in the ideal location. And they are some occlusion in photo due to the lighting, the shaking of the face and the foremost issue is the everyday blinking of the eyes. The frequent downside why the detection is no longer finished right is due to the deviation of the eye and the individual is carrying the spectacles. In these instances the detection are now not performed properly.

### Frames Extraction

From the video database, consecutive frames were extracted using a counter  $f(n) = f_1, f_2, f_3, \dots, f_n$ , according to the 25 fps and duration of each video. Considering the duration of the videos (30 s to 120 s), the fps was constant  $k = 25$ , and the frames of each video were obtained using Equation

$$f(n) = k \cdot Av$$

where the number of frames depends on the duration of each video in the dataset. An example is given with the time of 30 s and 120 s using Equation (1).

$$f(n_1) = 25 \cdot 30 = 750 \text{ frames}, f(n_2) = 25 \cdot 120 = 3000 \text{ frames}$$

### Face Detection

In our designed framework, we have viewed the facial function tracker library to discover the face from picture of driver. Since libraries based totally on Histogram of Oriented Gradient (HOG) characteristic descriptor for face detection. Here, in a easy word, gradient is a surprising alternate in pixel cost when we step from left to proper or pinnacle to backside i. e. from black to white or vice-versa. Moving from left to proper supply the horizontal gradient as nicely as motion from pinnacle to backside offers the vertical gradient.

### Eye Detection

The one of a kind characteristic associated to face offers the apparent signal of drowsy state. The eyes provide the signs of gradual as nicely as speedy blinking whereas mouth suggests the drowsiness situation thru the yawning. Along with these features, head motion additionally word the country of drowsiness as soon as it incline downward or nodding continually. Among these features, blinking of eyes is the outstanding one to determine the nation of drowsiness as per the a number of research mentioned above. Since, in our designed framework, we have imported the facial structure predictor programs to put off the in-built landmarks for the each the eyes from the handy landmarks.

### Eye Aspect Ratio (EAR)

Eye component ratio (EAR) used to be estimated from the spot of the selected landmarks coordinate. The EAR shrinks quickly toward the zero at some point of the kingdom of drowsiness. EAR is the ratio of vertical to the horizontal size of eye. Contiguous landmarks of package deal are fundamental to localize the every eye i.e. both left or proper eye. These landmarks play a key position in the computation of eye issue ratio.

### Blink Detection

The price of EAR varies as per the unique nation i.e. open or closed. From the experiment, we have regarded a threshold for EAR in order to set up the big difference amongst the open as properly as shut country of eye. Here, time elapsed at some point of closing nation of eye is assumed as T. The one-of-a-kind kingdom of driver on the foundation of EAR price and elapsed. Since, it is assumed that time elapsed between two consecutive body is 100ms. Therefore, time elapsed for the duration of eye closing can additionally be reflect onconsideration on in phrases of quantity of frames. User can make these in the settings part.

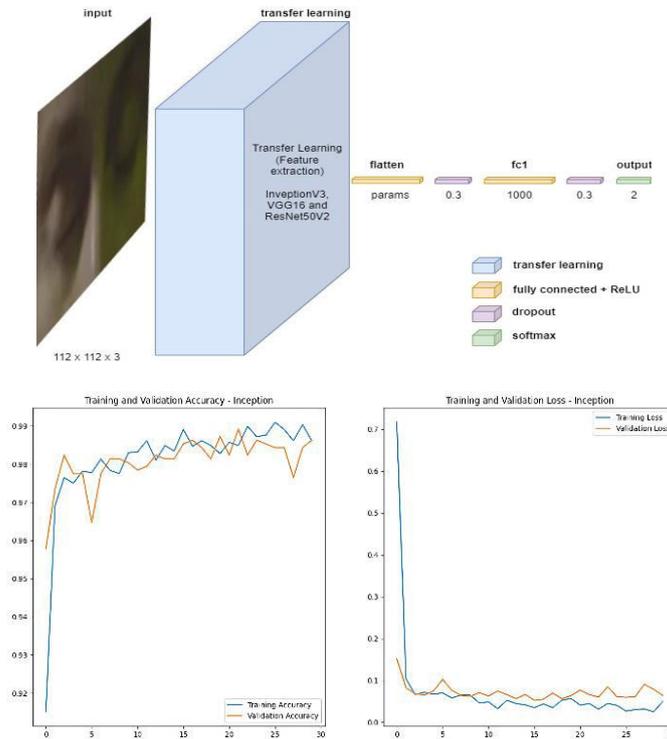
### Alert:

In the last module, we improve the Drowsiness alert in accordance to the Eye Analysis Ration (EAR), so the driver receives the Alert sound and so the driver can recognize that he/she is in sleepy stage and take indispensable motion accordingly, which prevents the accident.

### Model Architecture

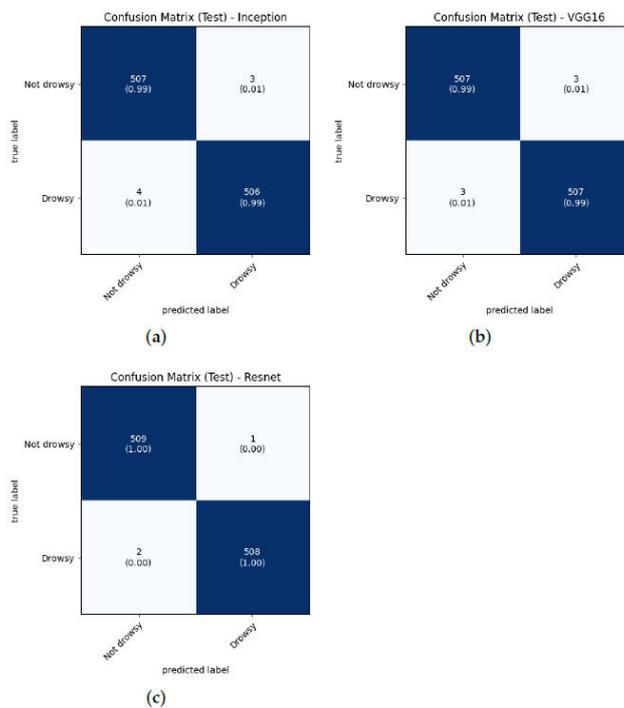
Three CNN architectures were trained based on: InceptionV3, VGG16 and ResNet50V2. By means of transfer learning, the feature extraction weights of each CNN were obtained. Next, the binary classification architecture (not drowsy and drowsy) was designed by flattening the transfer learning output, followed by a 30% dropout with a dense hidden layer of 1000 neurons with ReLU activation and a 30% dropout with a dense layer of 2 outputs with SoftMax activation. The classification process was the same for all 3 CNNs.

The proposed architecture



**CNN Test and Evaluation Metrics**  
**CNN Test**

After training the CNNs, it was necessary to test them with the Test data. Where the processing of the images of the set (without data augmentation) was also performed. A batch size of 1 was used to analyze each image, testing 10 times with each trained network. An example of the confusion matrices for each CNN Test is shown in Figure 7.



**Evaluation Metrics**

By training the Train and Validation dataset, and testing the trained CNN models on the Test dataset, the confusion matrices were obtained. Based on from these confusion matrices the evaluation metrics used are: Precision (Equation (2)), Recall (Equation (3)),F1-score (Equation (4)) and Accuracy (Equation (5)), that define the system behavior

$$Precision = \frac{TP}{TP + FP}$$

$$Recall = \frac{TP}{TP + FN}$$

$$F1 - score = \frac{2 * precision * recall}{precision + recall}$$

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

**V. RESULTS AND DISCUSSIONS**

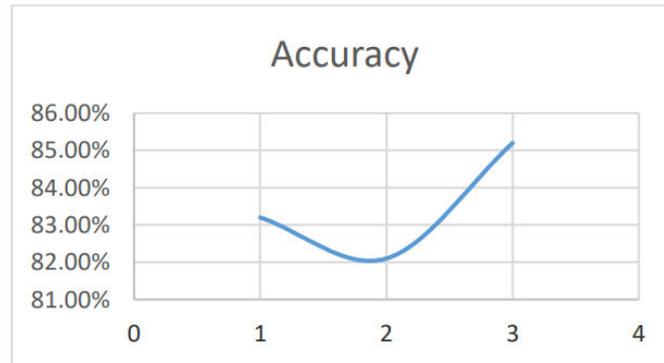
The method is applied to several eyes images and the results are obtained. The result of these tests is positive if the algorithm detects closed eyes as closed and open eye as open. In order to evaluate the performance of our method we applied it to some closed and open images. The result that the method/system gives by applying it on closed blood cells is shown in Figure 3. The figure shows that the system indicates that the eye is closed.



Driver drowsiness detection in a real environment:

- (a) Driver is in a normal state.
- (b) Driver is in a wakeful state. (c) Driver is with closed eyes, with a time of approximately 230 ms.
- (d-f) Driver goes to the drowsy state seen, with time longer than 300 ms, activating the visual alarm.
- (g-i) Driver with normal eye blink.

We have tested the model in real-time using a laptop camera.



## VI. CONCLUSION

In this paper, a low-cost, real time driver drowsiness monitoring system has been proposed based on visual behavior and machine learning. Here, visual behavior features like eye aspect ratio, mouth opening ratio and nose length ratio are computed from the streaming video, captured by a webcam. An adaptive thresholding technique has been developed to detect driver drowsiness in real time. The developed system works accurately with the generated synthetic data. Subsequently, the feature values are stored and machine learning algorithms have been used for classification. Bayesian classifier, Hear cascade classifier and Viola Jones Algorithm have been explored here.

## VII. FUTURE WORK

The Driver Drowsiness Detection System may be improved in a number of ways, including:

### Real-time tracking

At the moment, the system is only able to examine camera feed photos. A more sophisticated system may employ real-time tracking to determine whether the driver is looking around or getting distracted with other tasks.

### Integration with other sensors

To offer a more accurate forecast of the driver's state of sleepiness, the system might be combined with additional sensors such heartbeat monitors, steering sensors, and other inputs.

### Enhanced precision

The present approach applies a straightforward classifier to distinguish between open and closed eyes. A better system may employ advanced techniques to increase the accuracy of results. Personalization: By taking into account variables like age, gender, and medical issues, the system might be customized to each driver.

### Integration with vehicles

If a driver gets too sleepy, the system might be set up to inform them and automatically slow down or stop the car.

### Mobile application

A mobile application that interfaces with the system and gives drivers advice on when to take a break and information on their level of tiredness might be created.

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