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[ijirset@gmail.com](mailto:ijirset@gmail.com)

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# Drowsiness Detection Using Machine Learning

Ramitha Y.S<sup>1</sup>, Rani M.D<sup>2</sup>, Sana F Habib<sup>3</sup>, Shilpa S.U<sup>4</sup>, Ankitha Shetty<sup>5</sup>

UG Students, Department of Computer Science and Engineering, Alva's Institute of Engineering and Technology,  
Mangalore, Karnataka, India<sup>1,2,3,4</sup>

Assistant Professor, Department of Computer Science and Engineering, Alva's Institute of Engineering and  
Technology, Mangalore, Karnataka, India<sup>5</sup>

**ABSTRACT:** This paper provides a literature analysis of the diagnosis of driver drowsiness based on behavioural tests using algorithms for machine learning. Faces contain data that used to interpret degrees of sleepiness. In order to infer the degree of drowsiness, there are several facial characteristics that can be derived from the forehead. This involve blinks of the eye, gestures of the head and yawning. The development of a somnolence detection system that delivers consistent precise results, however, is a difficult task as it involves precise and robust algorithms are necessary. In the past, a wide variety of methods have been tested to diagnose driver drowsiness. The recent growth in deep learning demands that these algorithms be revisited to test their accuracy in somnolence detection.

**KEYWORDS:** Blinks of eye, Drowsiness, behavioural tests

## I. INTRODUCTION

The growing number of traffic accidents due to the decreased degree of caution of a driver has society is now a major concern. Any of these events was the results of the driver's medical condition. Most of these deaths, however, are due to driver fatigue and Drivers' .

One of the main causes of fatalities and injury in road crashes is drowsy driving. Drowsiness is an accidental human act caused by many causes, such as poor sleep, Exhaustion or ingestion of such drugs. It lacks its presence when a driver becomes drowsy. Mind and struggles to reflect on driving. Driving efficiency has been seen to be with increased drowsiness, the resulting injuries represent more than 20% of all accidents. As a result, the reaction rate of the driver is decreased and steering impairment is reduced. This causes many physical and financial damages

### Objective

In order to overcome the drawbacks of existing system, following objectives have been framed

- To capture the real time video of the driver recorded under ambient conditions using a webcam.
- To carryout image pre- processing and perform face detection using Viola Jones Haar cascade classifiers.
- To carryout Region Of Interest (ROI) detection and feature extraction using object detection frameworks.
- To calculate eye aspect ratio for each frame and classify them as drowsy or alert.
- To analyze the result for n consecutive frames and alert the driver using an alarm if drowsiness is detected.

### Problem Statement

Drowsy driving is one of the major causes of collisions. Therefore, the diagnosis and indication of driver exhaustion is an active area of study. The difficulty with sensing drowsiness is that whether the person is blinking or falling asleep, it is impossible to tell from a single frame. We suggest a behavioural solution that uses machines to solve this problem. Techniques of vision and machine learning that alert drowsy drivers after successful identification of sleepy drivers the signs of somnolence. Thus it embraces the notion that yawning identification can take place rather than a single picture over a continuous frame.

### Gap Identification

Most of the conventional methods are either vehicle based or psychological based. Few methods are intrusive and distract the driver, some require expensive sensors and data handling. The new technology includes a method based on a methodology based on actions. It makes use of techniques for image processing focused on the extraction without



human interference of visual features from the data. In a real-time video stream, we build a computer vision device that can detect driver drowsiness automatically and then play a warning if the driver seems to be drowsy.

## II. RELATED WORK

- Speech recognition techniques may be used to recognise a potential fatigued voice in the vehicle, but these techniques are complex.
- Using multiple sensors in the vehicle, driver biometrics can be identified and monitored and fatigue can be detected based on its location and critical signals, but these measures are rather invasive and can bother the driver.
- To recognise erratic actions of drivers about which the device knows first the behavioural features of the driver and contrasts his normal and existing response times to send a warning in the event of driver-dependent somnolence identification and the machine needs to be educated
- To monitor the facial features of the driver through one or more cameras to recognise a fatigue signal. In these devices, it is possible to track and evaluate yawning, eye closing and irregular head motions to diagnose drowsiness and alert the driver.

## III. HARDWARE AND SOFTWARE TOOLS REQUIREMENTS

1. Minimum: 4 GB of RAM
2. Minimum: 500 GB of Hard disk space
3. Processor: Intel® Core™ i5-4210U CPU.
4. Rasper pi Web camera
5. The IDE: Python IDLE or Pycharm
6. Operating System: Windows 7 or Higher Versions/Mac OSx
7. Programming languages and supporting Libraries: Python 3.7, Open CV 3.4.6

## IV. SYSTEM MODEL

The suggested scheme is based on an approach to actions. For facial recognition, we use image analysis methods to extract the visual characteristics of the driver's eye. Then, for a sequence of frames to diagnose drowsiness, the eye blinking and eye closure are examined. An troubling scheme is also used in the model of this framework.

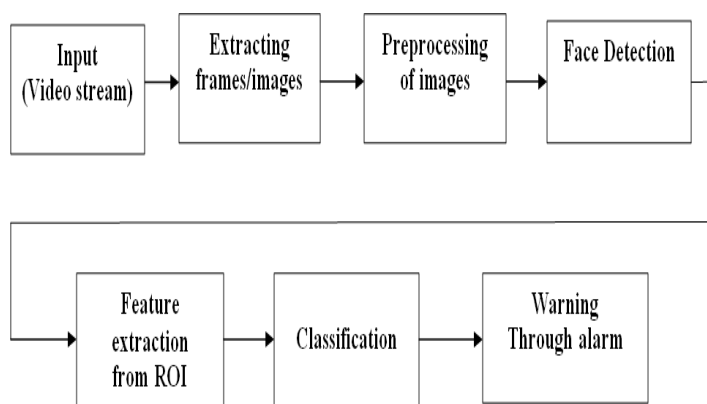


Fig 1. Driver Drowsiness Detection System Model

- Data acquisition and frame extraction:  
A camera will be positioned in front of the driver, approximately 30 cm away from the face, to monitor the drivers operation. The camera will be positioned in such a way that the following conditions are met: first, the face of the user



takes up much of the image, and second, the face of the user is roughly in the middle of the image. The drivers live video containing signs of alertness and drowsiness will be streamed and fed to the machine under ambient recording conditions. We can extract frames using Open CV from the obtained video. The video is fed in as an input in this step and transformed into a series of frames/images that are then processed. We can remove 16 frames from each second of a video.

• Pre-processing of images:

For operations of images at the lowest level of abstraction, pre-processing is a common term. Input and output are images of strength. To enhance the image data that suppresses unwanted distortion or enhances some image features essential for further processing, we perform pre-processing. We use different filters, such as Median filter, Wiener filter or Gaussian filter, for noise reduction. We can use contrast stretching for enhancement and illumination. We will first rotate and resize the obtained frames in this scheme after frame extraction. Then we can transform the image into a grayscale image using python packages so that it can be used for further processing.

• Face Detection and eye detection of driver (ROI):

The face detection feature takes one frame at a time and attempts to detect the face of the driver of the vehicle. We use an efficient algorithm for face detection: Viola-Jones Haar-Feature based Cascade Classifiers to detect the face of drivers from the video frames obtained. For a set of positive and negative images, the classifier is trained. We first detect the Region of Interest to prevent false positives (ROI). Here the face serves as a positive image sample and those images that do not have the face are the negative images. We apply eye detection on this ROI if the face is detected, otherwise it is discarded from any further detection mechanism. ROI is the eye here now. We get a localized, rectangular patch containing a pair of eyes. We monitor them continuously after detecting the face and eyes in the first photo.

• Feature Extraction from ROI:

We can use Convolutional Neural Networks (CNNs), which are state-of-the-art for image classification and feature extraction, to extract significant visual characteristics from the cropped photos. For the left eye and right eye, we now calculate the Euclidian distances and then calculate eye aspect ratios for each frame and compare them with the threshold value given.

• Classification:

Frames whose eye aspect ratio is lower than the threshold value(0.2-0.3) are labeled as drowsy and frames whose eye aspect ratio is higher than the threshold value are known as warning frames. The frames are numbered and the region of consecutive frames is continually analyzed for drowsy frames. If n (n = 48-50) consecutive frames are categorized as drowsy frames, the driver is declared to be drowsy.

• Warning through alarm:

If, based on eye aspect ratios, the classifier detects the characteristics of drowsiness, an alarm will be triggered. The warning is issued to the drowsy driver via an audio message where a siren is played to awaken him.

V. DATA FLOW DIAGRAM

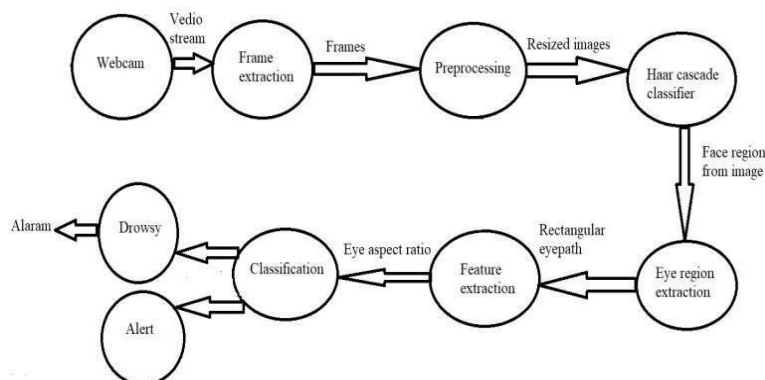


Figure 2. Data flow digram for drowsiness detection





The diagram above illustrates the application's Data Flow diagram. The Webcam records a stream of faces. The frames are collected from and pre processed from the video stream. The resized and gray scale images are fed to the Haar cascade classifier as an input. If a face is detected, then facial landmark identification is applied by the device and the eye regions are extracted. The machine measures the eye aspect ratio now that we have the eye regions, to decide whether the eyes are closed. Less than the threshold value of the eye aspect ratio means that the eyes have been closed. If the EAR value stays below the threshold for a reasonable period of time, the device may sound an alarm to wake the driver up.

### VI. FLOW CHART

We first need to position the camera in front of the driver in order to detect the face of the driver. Using the web camera connected to the device, we then continually monitor the driver. This live video is streamed and provided to the machine as input. From the video stream, the frames are then removed. In order to resize the images and turn them into gray scale images, we then pre-process them. Face detection is done using haar-cascaded classifiers and dlib libraries. If the frame is a positive frame, i.e; it has a face, the next step is to detect the region of the eye that is now the region of interest. If the frame does not contain a face, the device returns without further processing to retrieve images from the live feed. The next move is to decide whether the eyes are in an open or partly open or closed state once the eye area is detected. By extracting and analyzing the pixel values from the eye region, this is accomplished. The vector  $k$  is used to denote the number of frames in which the driver's eyes have an eye aspect ratio lower than the threshold. If the eye aspect ratio value is less than the threshold value, the  $k$  value is increased by one value, otherwise the  $k$  value is set to 0. To detect drowsiness, we use another variable  $n$  to determine the frame limits. If the  $k$  value, based on frame rates, exceeds the  $n$  value, the driver feels drowsy and so

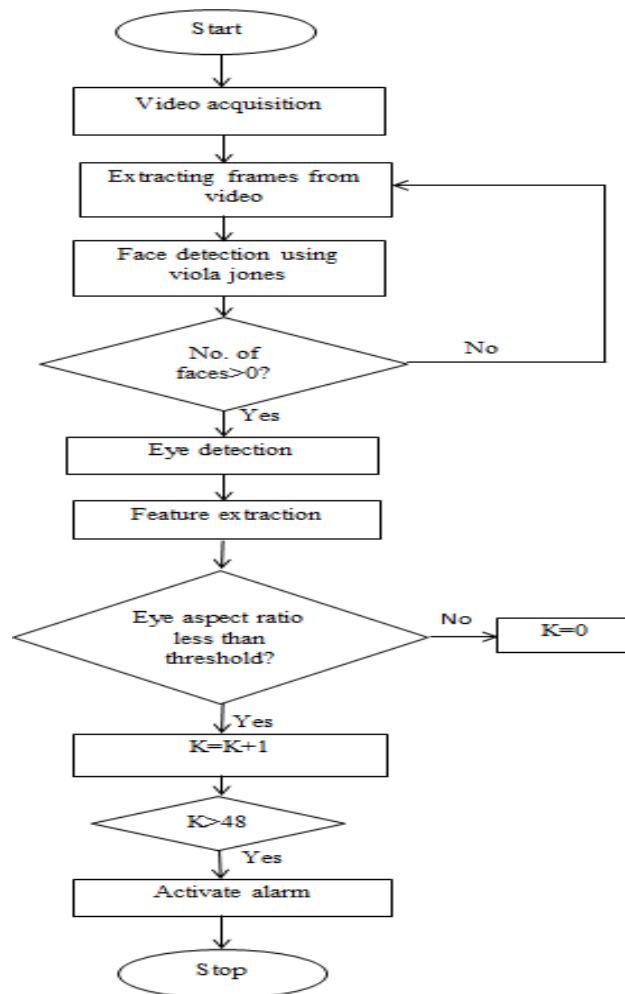
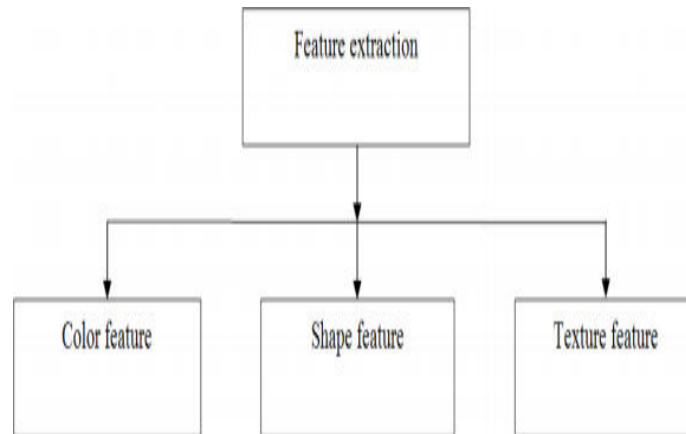


Fig 3. Flow chart

## VII. DATA FEATURE EXTRACTION TECHNIQUES

The most significant stage in image classification is feature extraction. It helps to extract the ideal function of an image as much as possible. To get the features that will be helpful in classifying and



**Fig 4. Feature extraction techniques**

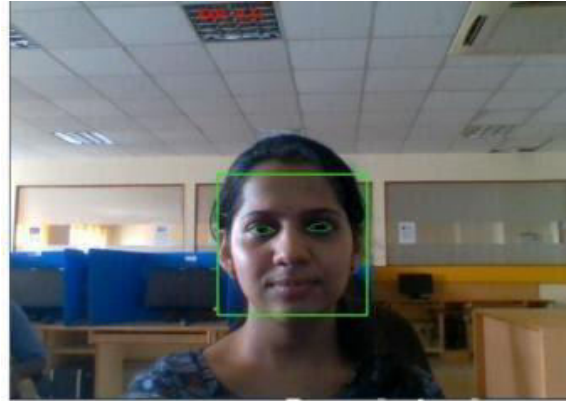
recognizing the images, feature extraction techniques are applied. We examined different feature extraction techniques in this paper. Such methods are known as low-level extraction and extraction of functions High-level extraction of features. Extractions of low-level features are focused on identifying the points, lines, edges, etc., while extraction methods of high-level features use the low-level feature to provide more relevant details for more image analysis processing. The Artificial Neural Network (ANN) uses mainly high-level feature extraction technique to extract the feature in multiple layers. The effectiveness of the method of extraction of features greatly enhances the further processing of an image. In image matching, pattern recognition and retrieval, these characteristics can be used. Image analysis provides methods for identification, segmentation, extraction and classification. The extraction technique of feature extraction is used to extract features by retaining as much details as possible from large image data sets. Efficiency and effectiveness of the collection and extraction of features are major challenges today.

**Color feature:** Various color spaces are used to differentiate at the beginning of image processing

those images. Various color spaces, such as RGB, LUV, HSV and HMM, exist. For the extraction of features in pictures, color histograms, color coherence vector, color moments-based and color correlogram are used. These methods are based on the extraction of the mean, skewness and standard deviation of the pixel image intensity. In detecting color distribution features in any given images meeting specific requirements, the color histogram was successful and quicker. But it struggled to balance a wide range of images and did not meet the following criteria: quality, precision. Color Moment is the easiest, compact and robust technique to extract the function from this system.

**Texture feature:** Extraction of texture-based features can be categorized as spatial and spectral texture on the basis of their different benefits to be

## VIII. RESULT



**Fig 4: Face and eye detection**

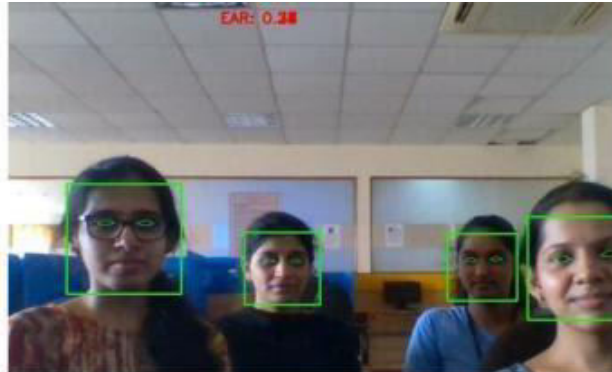
This snapshot shows the identification of face and eye by a rectangular patch done by haar cascade classifier. It also shows the EAR value of the eye for the current frame.

**Shape feature:** Form feature extraction techniques can be defined as Contour-based and region-based approaches in two categories. Only from the boundary and area-based approach extracts feature from the entire region can the contour-based technique measure the shape feature. Two modes of approach are involved in these approaches. First is an ongoing strategy that does not break form into subparts. To derive the function vector, it uses the integral boundary. Second, the Discrete (Global) Approach divides the boundary of the form into subparts and calculates the vector of the multi-dimensional function. Calculating area, circularity, eccentricity, major axis orientation, and bending energy are included in the Shape descriptor. Popular boundary decomposition methods are based on polygonal approximation, decomposition of curvatures and curve fitting used in image processing. The spatial texture is  $F$  simple to use and information can be extracted from any shape. These features are very susceptible to distortions and noise. The spectral texture is good and requires less calculations. Square region with sufficient size is needed for effective feature spectral texture. To extract the texture function for image classification, the Gabor filter is commonly used. By gaining the center frequency and orientation parameter, the Gabor filter or wavelets characterize an image. By capturing the energy at a specific frequency and direction, a function vector is generated.



**Fig 5.Driver wearing glasses**

This snapshot shows the driver wearing glasses. We can see that the system identifies both face and eye region and gives alert when the eyes are closed for more than 3 seconds.



**Fig 6. Multiple faces in front of camera**

This snapshot shows that multiple faces are detected along with the eye regions. But the system gives the ear for only one face

#### IX. CONCLUSION AND FUTURE SCOPE

Driver distraction is identified as a significant contributor to fatal accidents leading to deaths and injuries. There are several techniques used for detection of drowsiness. But there are few models in existence which provides alert to the driver in an affirmative case. Among the drowsy detection approaches, the techniques employing Computer Vision and Machine Learning have become prominent due to its predictive validity of detecting drowsiness. Thus, using these techniques we have designed a novel system to detect the drowsiness of the driver and issue an alert if drowsiness is detected. The system so developed is efficiently able to detect drowsiness based on eye related parameters. The activity of the driver is continuously monitored using a webcam. Then on obtained frames face and feature extraction is performed using Haar cascade classifiers and facial landmarks. Using eye aspect ratio concept, these features are interpreted across consecutive frames and are classified as drowsy or alert. If the driver is drowsing then the system give off an apt warning message to alert the driver. Thus, this system can avoid asleep at wheels and can reduce fatalities. Our model can be improvised by the following methods: Learning to detect faces and eyes in varied lighting conditions, such as at night with infrared lights. To this we need to make use of night vision cameras. In addition to this, the model should also be able to recognize drowsy eyes with sunglasses. The model can be further enhanced to detect the face in 3 dimensions so that face can be detected even if driver is moving his head around. Incorporating the code into an Android application or Raspberry Pi to make the system work in real time and alert the driver while he is driving. This will however require exhaustive testing on a larger dataset.

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