# CNN AND SVM-BASED DROWSINESS MONITORING & ALERTNESS SYSTEM

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## Abstract

Drivers fatigued driving is a significant and latent danger in traffic accidents are a serious issue globally resulting in thousands of deaths annually, research has shown that drowsy driving reduces reaction time lowers consciousness and heightens the risk of accidents. Inorder to counter this serious problem a detection system based on machine learning is implemented to track drivers by continuous monitoring and warn them before they doze off while driving. This system takes advantage of opencv and deep learning algorithms to monitor facial expressions such as eye closure, blinking rate, yawning and head orientation other sensor-based data like lane distance behavior can be fused to achieve more precise predictions by using sophisticated algorithms. Such as 'Convolutional Neural Networks (CNNs)' and 'Support Vector Machines (SVMs)'. The system is capable of distinguishing alert from drowsy conditions with great precision the suggested solute.ion works by obtaining a live video feed of the face of the driver computing major landmarks which are in our face and measuring head pose levels in the event that the system picks up signs of tiredness it initiates alerts in the form of audio alarms steering wheel vibrations or visually alarms driver. This project is intended to enhance road safety through minimizing accidents resulting from drowsy driving the system is conceived to be efficient cost-saving and able to perform in continuos monitoring thus fitting into contemporary cars and fleet management systems.

**Keywords**

Driver Alertness Monitoring System, Machine Learning, Convolutional Neural Networks ,Support Vector Machines ,Real-Time Monitoring, Road Safety.

## 1] Introduction

Drowsy driving is one of the main causes of accidents on roads across the globe. the decreased alertness of a driver can cause delayed responses and poor decision-making, and therefore it is imperative to create systems that can detect and react to drowsiness in real-time. Current measures like lane detection or physical alert sensors are constrained by their precision and real-time ability. This paper suggests a system that employs sophisticated machine learning methods to overcome these limitations.

## 2] Literature Review

Existing works have employed multiple machine learning strategies for detecting drowsiness among drivers. Rule-based methods depend on thresholded features like closure of the eye, but are not adaptive in nature. Deep learning models, particularly CNNs, have achieved improved performance when extracting features from facial images. Environmental variations and occlusions remain problematic, nonetheless. Hybrid schemes that integrate CNNs and SVMs have presented potential for achieving higher accuracy.

**Title:** An Integrated System for Drivers' Drowsiness Detection Using Deep Learning Frameworks.

**Authors:** Biswarup Ganguly, Debangshu Dey, Sugata Munshi.

**Abstract:** This paper presents a real-time driver drowsiness detection system using deep learning. It integrates Faster R-CNN for eye region detection and CNN for eye state classification to determine drowsiness levels. An Atmega328p microcontroller is used to implement an alert system, ensuring timely warnings to prevent accidents caused by drowsy driving.

**Date Published: 26-27 February 2022**

**Title:** A Systematic Review on Driver Drowsiness Detection Using Eye Activity Measures.

**Authors:** AHMET KOLUS

**Abstract:** This study systematically reviews driver drowsiness detection (DDD) systems based on eye activity measures, which are effective in early drowsiness detection. By analyzing 41 empirical studies, it classifies eye activity indicators, measurement technologies, and decision-making algorithms used for drowsiness prediction. The findings provide insights for future research and development of more effective DDD systems.

**Date Published:** 8 July 2024

**Title:** Driver Drowsiness Detection and Monitoring System using Machine Learning

**Authors:** Rohith Chinthalachervu, Immaneni Teja, M. Ajay Kumar, N. Sai Harshith, T. Santosh Kumar

**Abstract:** This research presents a real-time driver drowsiness detection system using facial expression analysis and machine learning. The system captures facial movements via a webcam and calculates Eye Aspect Ratio, Mouth Opening Ratio, and Nose Length Ratio for drowsiness detection. A Support Vector Machine (SVM) model achieves 95.58% sensitivity and 100% specificity, ensuring high accuracy. The system is cost-effective, does not require expensive sensors, and is compatible with all vehicle types.

**Date Published:** 01 September 2022

**Title:** A Deep Learning Approach To Detect Driver Drowsiness

**Authors:** Madhav Tibrewal, Aayush Srivastava, Dr. R. Kayalvizhi

**Abstract:** This paper presents a driver drowsiness detection system that analyzes the driver's eye state to detect drowsiness and issue timely alerts, helping prevent accidents. With 40% of road accidents caused by drowsy driving (as per CRRI), this system aims to enhance road safety by identifying fatigue early and notifying drivers before any serious risks occur.

**Date Published:** 05 May-2021

**Title:** Driver Drowsiness Detection Using Machine Learning

**Authors:** Manoj Rode, Anirudh Bethi, Santosh Baddam, Bala Laxmi Prasanna Kondaveti, Tejaswini Gadipally, Naresh Katroth

**Abstract:** This project develops a real-time driver drowsiness detection system that continuously monitors the driver using a webcam and analyzes eye blinking patterns with OpenCV. If the driver's eyes remain closed for more than two frames, the system detects drowsiness and triggers an alarm alert, helping prevent fatigue-related accidents and enhance road safety.

**Date Published:** 22 November 2022

**Title:** Early Identification and Detection of Driver Drowsiness by Hybrid Machine Learning

**Authors:** Ayman Altameem, Ankit Kumar, Ramesh Chandra Poonia, Sandeep Kumar, Abdul Khade Rjilani Saudagar

**Abstract:** This paper presents a real-time driver monitoring system that detects drowsiness and emotional changes using machine learning. The system employs facial expression analysis with Support Vector Machines (SVM) to identify signs of fatigue, anger, or inattention. Upon detection, it alerts the driver and can slow down the vehicle for safety. Tested under variable lighting conditions, the model achieved 83.25% accuracy, improving existing detection methods.

**Date Published:**30 November 2021

**Title:** Driver Drowsiness Detection System – An Approach By Machine Learning Application

**Authors:** Jagbeer Singh , Ritika Kanojia , Rishika Singh , Rishita Bansal , Sakshi Bansal

**Abstract:** This research focuses on developing a driver drowsiness detection system using face and eye tracking to prevent road accidents. The system extracts eye images, compares them with a dataset, and triggers an alarm if the eyes remain closed beyond a threshold. If the driver responds, tracking continues; otherwise, the alert persists. The model achieves 80% accuracy, helping reduce fatigue-related accidents and improve road safety.

**Date Published:** 31 DEC 2022

**3] Methodology**

**Visual Tracking Object For Input**

The visual camera employed for a driver drowsiness warning system with night mode observation needs to be an infrared (IR) or near-infrared (NIR) high-resolution camera with a minimum resolution of 720p (1280x720 pixels) for sharp facial feature recognition. It must provide a minimum frame rate of 30 fps for real-time detection of eye closure, yawning and head movements ,the camera should be equipped with a wide dynamic range WDR and low-light sensitivity to perform well in both daylight and night environments for nighttime monitoring an IR-cut filter removal functionality or NOIR (No Infrared Filter) camera should be implemented enabling enhanced visibility in the dark. furthermore the camera should possess IR led illuminators 850nm or 940nm wavelength in order to deliver improved facial recognition in pure darkness without inducing driver discomfort. A global shutter sensor is used over a rolling shutter to minimize the motion blur in order to ensure proper tracking of rapid eye blinking and head nods the field of view (fov) must be set between 60 and 90 so the entire face of the driver is being captured even on slight movements for embedded systems it is advisable to use a USB or MIPI interface for simple integration with raspberry pi,jetson nano or other edge computing hardware.

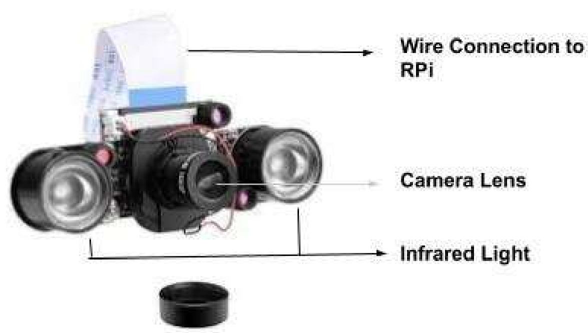



Fig1 camera module used in the system

**Datasets:** images and videos of drivers were obtained from public datasets such as yawdd that contain labeled samples of sleepy and wakeful states

**Preprocessing:** methods like grayscale conversion cropping and normalization were used to provide uniform input data quality.

**Feature Extraction:**

Important indicators are landmark points on face for drowsiness detection based on facial landmarks the most important points are around the eyes nose and mouth through which eye closure duration head pose and other facial features can be analyzed to decide whether a person is drowsy or not the human face consists of 68 key landmarks it is used to identifies the face and as well as used to monitor it by including various formulas.

**Diagram**:

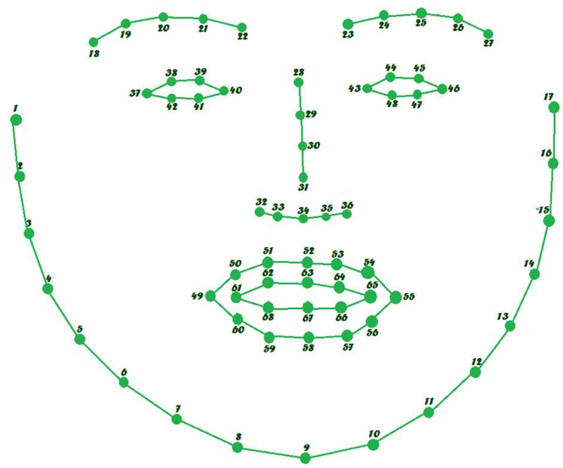


Fig 2 Shows the 68 Facial Landmarks

**Eye Aspect Ratio (EAR):** computation of distances between certain eye points to recognize abnormal eye closure.

**Formula**

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

**Model**

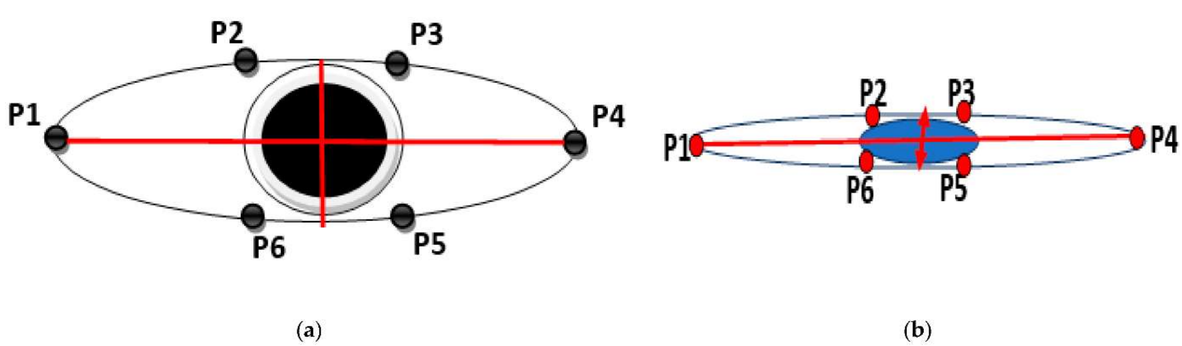



Fig3 shows EAR formula working process

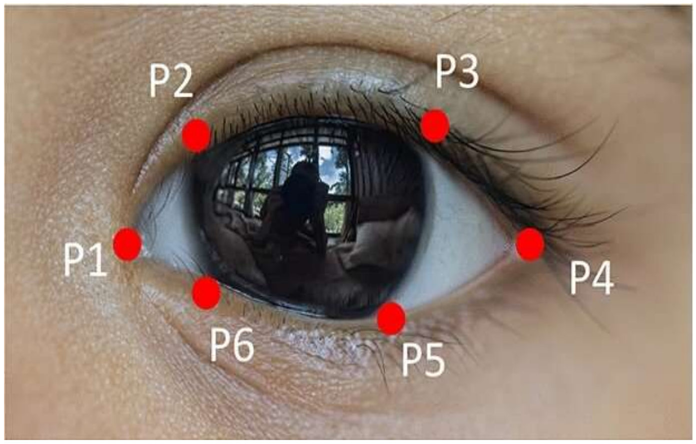
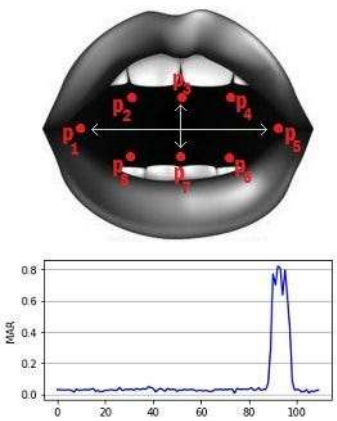



Fig4 Shows the Real Time monitoring of Eye by using EAR Formula

**Mouth Opening Ratio (MOR):** calculation of upper and lower lip distance to detect yawning.




$$\mathrm{MAR} = \frac{\|p_2 - p_8\| + \|p_3 - p_7\| + \|p_4 - p_6\|}{2\,\|p_1 - p_5\|}$$

Fig 5 shows the mor formula with the pictorial presentation

**Head Pose Estimation:** key point detection for recognition of head tilting or head nodding.

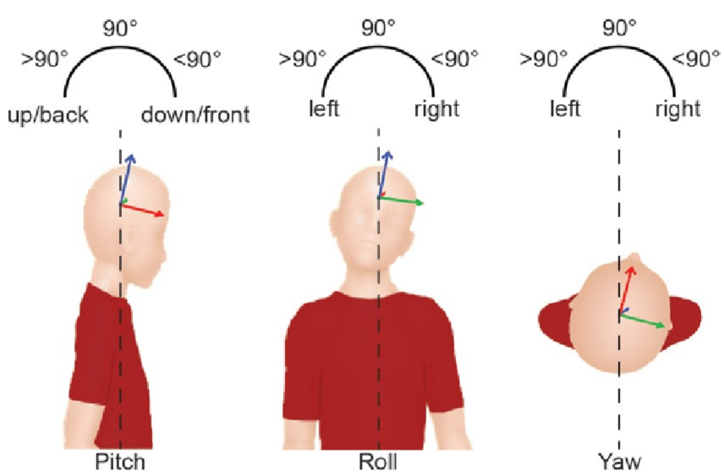


Fig 6 shows the head position monitoring with angular presentation

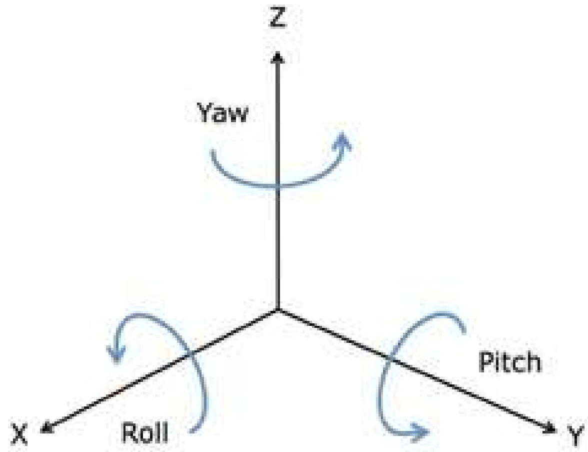



Fig7 shows the x,y,z co-ordinates for roll,pitch and yaw

**Formula**

**Formulas for Yaw, Pitch, Roll from Rotation Matrix $R$:**

$$\text{Yaw} = \arctan\left(\frac{r_{32}}{r_{33}}\right)$$

$$\text{Pitch} = \arctan\left(-\frac{r_{31}}{\sqrt{r_{32}^2 + r_{33}^2}}\right)$$

$$\text{Roll} = \arctan\left(\frac{r_{21}}{r_{11}}\right)$$

### 3.2 Algorithms And Models Utilized

**Convolutional Neural Networks (CNNs):**

CNNs were employed for feature extraction the structure had convolutional pooling and fully connected layers for recognizing visual patterns such as eye closure and yawning from images.

**Support Vector Machines (SVMs):**

SVMs labeled the features extracted as belonging to two classes alert and drowsy a radial basis function rbf kernel was employed for dealing with nonlinearity separability.

**Hybrid Model**

By integrating cnn-based feature extraction with svm classification the system attained improved detection accuracy and fewer false positives.

**3.3 workflow**

The workflow consists of the following steps

1. **Image/Video Input:** real-time video feed from a camera mounted on a dashboard
2. **Preprocessing Frames:** are preprocessed to normalize lighting conditions and remove noise
3. **Feature Extraction:** facial features eg eye landmarks mouth movements are extracted using cnn
4. **Classification:** svm model classifies the driver as drowsy or alert
5. **Alert Mechanism**: when drowsiness is recognized the system provides audible and visual warnings

**4] System Architecture And Flow Diagram:**

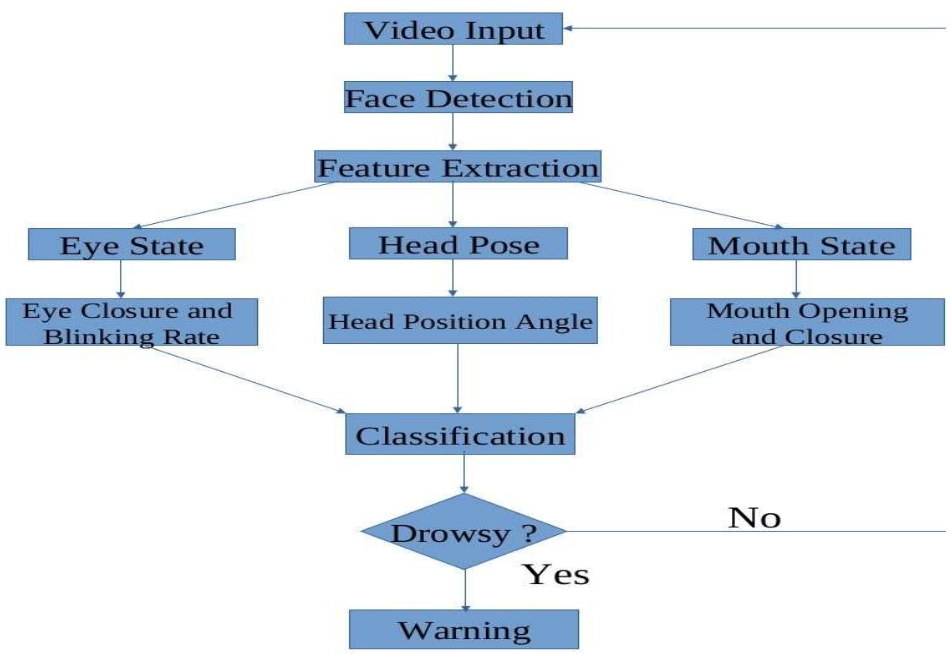



fig8 shows the architecture flow of the system working process

flow diagram description

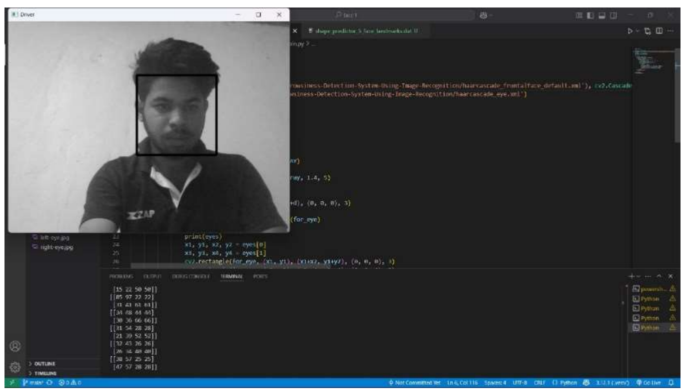
The flow diagram describes the system workflow from data acquisition to generating an alert the following are the breakdown of each component

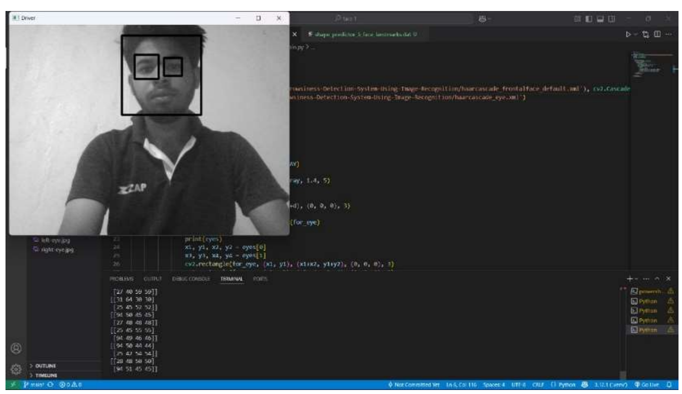
1. **Camera Module:** grabs real-time images or video of the driver

2. **Preprocessing Unit:** preprocesses the data to improve quality eg resizing noise removal
3. **Feature Extraction Module:** extracts the appropriate features such as eye and mouth landmarks using a cnn model
4. **Classification Module:** uses an svm to classify the state of the driver alertdrowsy
5. **Decision Module:** sends an alert if the result of classification shows drowsiness
   **[Camera] → [Preprocessing] → [Feature Extraction (CNN)] → [Classification (SVM)] → [Alert System]**

**5] Results And Discussion**

The system was evaluated using accuracy precision recall and f1-score metrics it achieved the following results





Accuracy-96 %
Precision-93%
Recall-96%
F1-Score-94%

The hybrid cnn-svm model performed better than isolated models demonstrating remarkable robustness under different lighting conditions however occlusion issues (e.g., sunglasses) are still areas of future work.

## 6] Conclusion

this work proposed a driver drowsiness detection system based on machine learning with cnn and svm models the system accurately detects drowsiness in real time and sends an alert to the driver minimizing the occurrence of road accidents future research will consider integrating physiological signs such as heart rate and enhancing performance in harsh environmental conditions

## 7] Referance

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