DRIVER DROWSINESS DETECTION USING DEEP LEARNING

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Abstract - *Drowsiness detection is an important research area in the field of computer vision and driver safety. It involves the use of image and video processing techniques to detect signs of drowsiness in drivers, such as drooping eyelids or changes in facial expression. This can help to prevent accidents caused by driver fatigue, which is a leading cause of road accidents worldwide. Drowsiness detection systems typically use machine learning algorithms and computer vision techniques to analyze the driver's face in real-time and identify signs of fatigue. This can involve detecting changes in facial expressions, such as drooping eyelids or yawning, as well as tracking the driver's eye movements to detect signs of drowsiness. Recent advances in deep learning and neural networks have led to significant improvements in the accuracy and reliability of drowsiness detection systems, making them an increasingly important tool for improving road safety. These systems are now widely used in the automotive industry, and are also being explored for use in other applications, such as aviation and industrial safety.*

Key Words: **Computer vision, drowsiness, Convolutional Neural Networks, Eye Aspect Ratio, OpenCV, Haarcascade classifier.**

1.INTRODUCTION

Every day, on average, 1200 traffic accidents are recorded in India, of which 400 result in immediate fatalities and the others have serious consequences. The main factors include both alcohol and sleep. Drivers may experience sleepiness as a result of lengthy periods of driving or being intoxicated, which is their main source of distraction. This distraction risks the life of driver, other passengers, and pedestrians in addition to those in the other cars and on the road. To avoid these circumstances, our team suggests a solution that uses CNN (Convolutional Neural Network), Python, and OpenCV to identify driver sleepiness. Here, we built a system that can recognise characteristics on a driver's face and warn them if they ever nod off while driving using Python, Open CV, and Keras (Tensor flow Library). The technology recognizes the eyeballs and asks whether they are closed or open.

The alarm will sound to alert the driver to stop because they are drowsy if their eyes are closed for more than three seconds or if they blink more than ten times in one minute. We created a CNN network that is trained using data that can distinguish between closed and open eyes. The CNN model is then applied to the live feed from the camera in order to process it and determine whether the eyes are open or closed.

2. LITERATURE REVIEW:

This study uses OpenCV to demonstrate a real-time system for identifying eye blinks in video sequences. It estimates the eye aspect ratio (EAR), which describes the condition of the eyes being open, using facial landmark detection. The study explores several techniques, such as motion estimates and decision-making based on eyelid coverage, for automatically recognising eye blinks. The suggested strategy beats threshold-based techniques and employs SVM for classification. The research emphasises how adaptable contemporary facial landmark detectors are to changes in head tilt, lighting, and facial emotions.[1]

The SVM (Support Vector Machine) method is the foundation of the real-time driver tiredness detection system proposed in this paper. The system collects information from video recordings such as the percentage of closed eyes (PERCLOS), the number of mouth openings, the number of blinks, and head detection. SVM is used to categorise data and separate drivers who are weary from those who are not. The system will be trained using a dataset for the study, and real-time video recordings will be used to assess the system's performance. According to reports, the accuracy of the system for detecting weariness can reach 97.93%.[2]

The creation of a driver drowsiness detection system based on electroencephalography, electrooculography, and image processing techniques is examined in this research. EOG tracks eye movements, whereas EEG measures brain activity. The usage of electrodes and sensors for signal acquisition is discussed in the study, along with improvements in material science and MEMS (Microelectromechanical Systems) technology. Through picture categorization, the open or closed eye state is also examined. Deep learning methods, including artificial neural networks, are used for classification. In order to classify images for sleepiness detection, the paper mentions the use of Deep Belief

Networks, Restricted Boltzmann Machines, and Deep Autoencoders.[3]

In this article, eye state is used to detect tiredness. This assesses if the eye is in an alert or drowsy condition, with an alarm sounding when the eye is in an alert state. Using the Viola-Jones detection technique, the face and eye region are identified. To extract features, stacked deep convolution neural networks were developed and employed throughout the learning phase. The CNN classifier uses a SoftMax layer to classify the driver as either asleep or awake.In this, the proposed system has an accuracy rate of 96.42%. When the model predicts that the output state will be consistently drowsy, this effectively identifies the driver's alertness level and sounds an alarm.[4]

The purpose of the paper is to analyse human eye blinks using a recent facial landmark recognition and to apply E.A.R. (eye aspect ratio) for simple, quick, and effective blink detection. The system's ability to dependably and precisely estimate the degree of eye opening indicated that it was effective in detecting driver drowsiness. Because facial landmark detection only incurs a very little performance cost, this alert system can be employed in real-time. Because a fixed blink time is assumed despite the fact that everyone's blink duration varies, this paper has some drawbacks. EAR is calculated using two-dimensional data, which cannot take into account out-of-plane head orientation, and the model only uses the eyes to detect tiredness.[5]

3. PROPOSED SYSTEM:

3.1 Proposed system algorithm:

1. Haar Cascade classifier is used for object detection. It is used to extract eyes from the driver's face and given as input to CNN.

2. Deep features are extracted using CNN with four convolutional layers, and those features are then sent to fully connected layer.

3. CNN classifies the photographs as having closed or open eyes using the Soft Max layer.

The proposed system's architecture is given in **Fig- 3.1.1**.

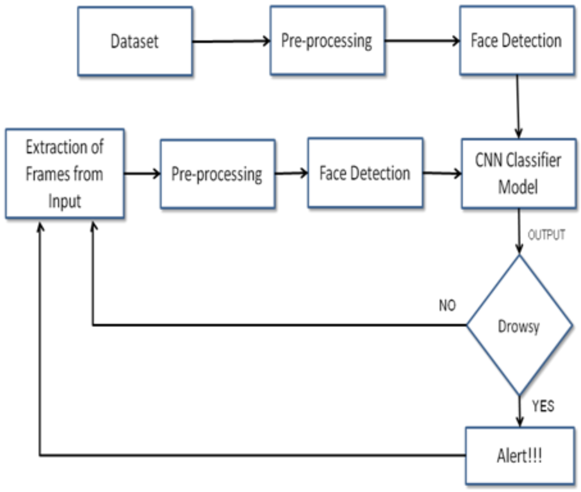


Fig- 3.1.1: System Architecture

3.2 Face detection and Eye Tracking:

Haar Cascade classifiers, which are based on the Viola-Jones algorithm, are used to achieve face detection. The patterns connected to faces, left eyes, and right eyes are already known to these classifiers. In order to identify faces in the video frames, the haarcascade_frontalface_default.xml is used. It pinpoints areas of the picture that most likely have faces. A bounding box is created around a face using OpenCV methods after it has been identified. Separate Haar Cascade classifiers are utilised to identify the left and right eyes within the detected face region. When eyes are found, the eye areas are cropped and resized to a uniform size. These resized images are prepared for further analysis.

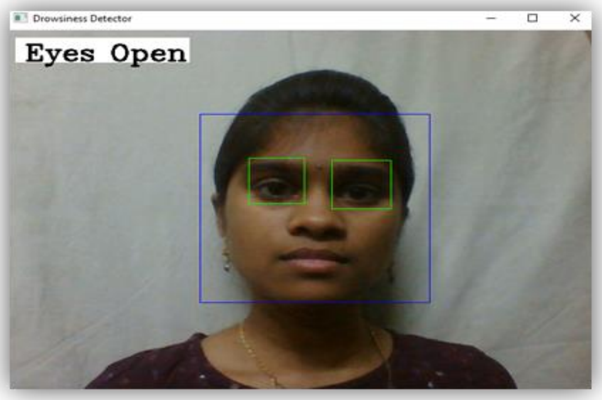


Fig-3.2.1: Images of face detection and eye tracking

3.3 Feature Extraction and Classification

A pre-trained deep learning model (a Convolutional Neural Network or CNN) is used to predict the state of the driver's eyes based on the cropped and resized eye images. The model has been trained to classify eye images as either "open" or "closed". If both eyes are predicted to be "closed" (the CNN model predicts "closed" status for both eyes), it indicates that the driver's eyes are closed, which may suggest drowsiness. A counter is maintained, and if the eyes remain closed for a certain number of consecutive frames (e.g., 10 frames), a drowsiness alert is triggered. This alert can be in the form of a visual message and an alarm sound.

3.3.1 Convolutional Neural Network:

The proposed system uses Convolutional Neural Network for detecting driver's drowsiness. At First, A Sequential model is created. This type of model allows you to build a neural network by adding layers sequentially. First convolutional layer is added to the model. It consists of 256 filters, each with a 3x3 kernel size. The activation function used is Rectified Linear Unit (ReLU). The input dimensions of the image are 145x145 pixels with 3 color channels (RGB). After each convolutional layer, a max-pooling layer is added. The max-pooling layer reduces the spatial dimensions of the feature maps, in this case, by a factor of 2 in both dimensions. This helps reduce computational complexity and retain the most important features. The pattern of adding convolutional layers followed by max-pooling layers is repeated. In this case, there are three more pairs of convolutional and max-pooling layers with decreasing filter sizes: 128, 64, and 32.

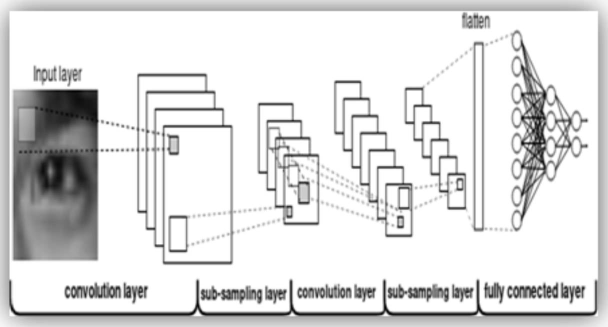


Fig- 3.3.1.1: CNN layers

After the convolutional and max-pooling layers, a flatten layer is added. This layer reshapes the output of the previous layers into a one-dimensional vector. This is necessary to connect the convolutional layers to fully connected (dense) layers. a dropout rate of 0.5 is specified, which means that during training, half of the neurons in the dropout layer will be randomly "dropped out," i.e., set to zero, at each training step. Two fully connected (dense) layers are added. The first dense layer has 64 neurons with ReLU activation, and the final dense layer has 4 neurons with softmax activation. The softmax activation is used for multi-class classification, and it outputs probability distributions over the classes.

4. EXPERIMENTAL RESULTS:

4.1 Experimental dataset:

The experimental dataset used in our project is kaggle dataset consisting 726 pictures of closed eyes and 726 pictures of open eyes. This dataset also consists of eye images with spectacles.

4.2 Performance Analysis:

1. We did 50 epochs, to get good accuracy from the model i.e. 98% for training accuracy and 96% for validation accuracy.

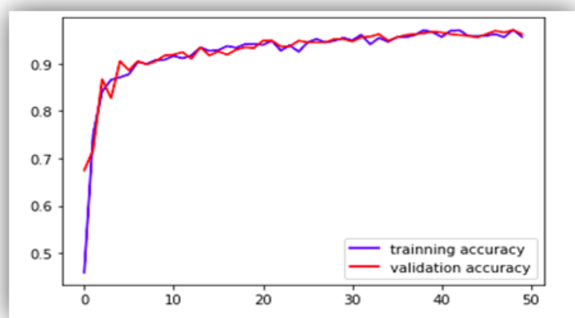
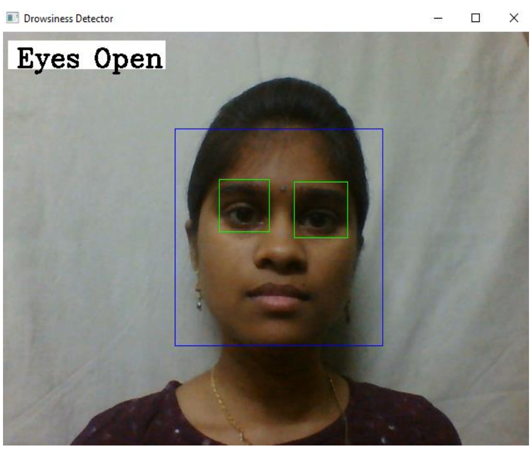


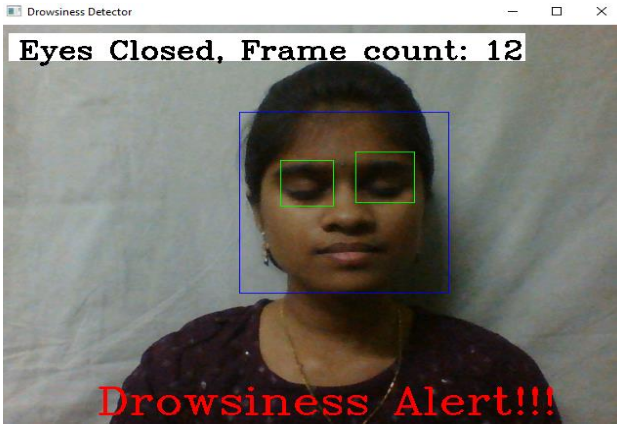
Chart-1: Accuracy Graph

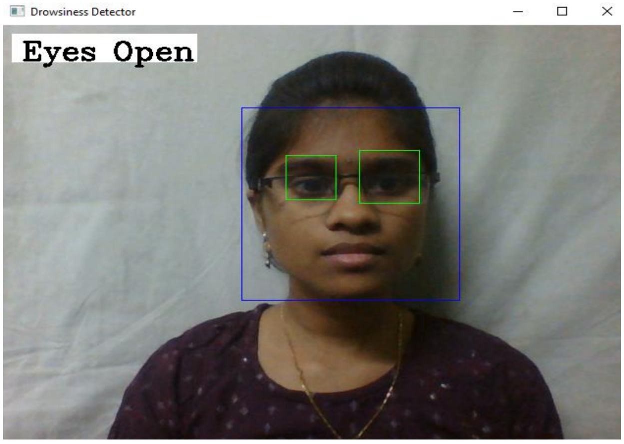
2. System will capture the video directly from webcam and pedicts the output as labels-Eyes Open and Eyes Closed.

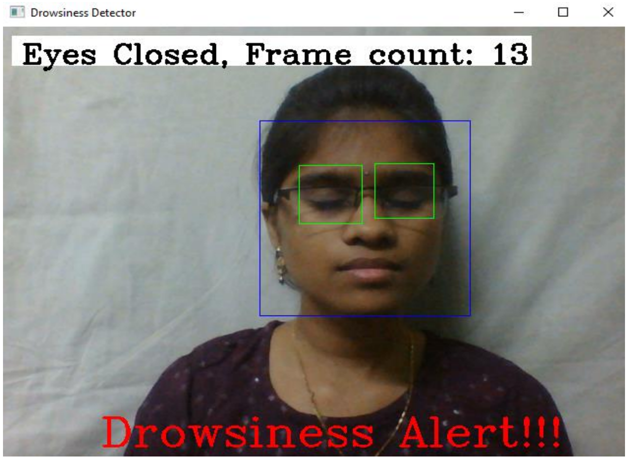
3. It displays frame count if the eyes are closed and if it reaches maximum threshold value , gives alert.

OUTPUT:









4.2 System Testing:

The following table represents test cases observed while doing the project to detect the driver's drowsiness.

Test cases	Eyes detected	Eyes closure	Result
Case 1	No	No	No result
Case 2	No	Yes	No result
Case 3	Yes	No	Eyes open
Case 4	Yes	Yes	Eyes closed,Voice alert

Table-1: System Testing

The system's approach states that the driver is feeling fatigued if their eyes are closed for an extended period of time (greater than the specified number of frames). From this point on, one of these exceptional cases occurs, and the related outcome occurs.When the face is correctly oriented and there are no wearing obstructions, the accuracy as determined during the performance analysis step is almost found to be 100%. When there is an obstruction, accuracy slightly decreases. The right results depend greatly on the ambient lighting conditions.

5. CONCLUSIONS:

Face and eyes were recognized on the footage of a person driving in order to determine whether they were drowsy or not. We employed a haar cascade classifier with OpenCV to find faces and eyes. Eyes were categorized as open or closed using a convolutional neural network. Based on how frequently eyelids were closed, drowsiness was assessed. The driver was warned by an alarm that was programmed to sound following the detection. Due to variables such as darkness, light reflection, obstructions caused by drivers' hands, and the wearing of sunglasses, it will be more difficult to discern drivers' situations and facial expressions. In addition to being a drowsiness detection approach that is frequently employed with other facial extraction methods, convolutional neural provides greater performance.

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