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DROWSINESS DETECTING SYSTEM USING CONVOLUTIONAL NEURAL NETWORK

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Abstract: *Drowsy driving is a major problem in INDIA. The risk, danger, and often tragic results of drowsy driving are alarming. This usually happens when a driver has not slept enough, but it can also happen because of untreated sleep disorders, medications, drinking alcohol, or shift work.*

Drowsiness detection is a safety technology that can prevent accidents that are caused by drivers who fell asleep while driving. Drowsy driver detection is one of the potential applications of intelligent vehicle systems. Drowsiness detection primarily make pre-assumptions about the focusing on blink rate, eye closure. Here we employ machine learning to determine actual human behavior during drowsiness episodes.

In this project, we will be using OpenCV for gathering the images from webcam and feed them into a Deep Learning model which will classify whether the person's eyes are 'Open' or 'Closed'. A convolutional neural network is a special type of deep neural network which performs extremely well for image classification purposes.

Key words: Open CV, CNN.

1. INTRODUCTION

A countless number of people drive on the highway and country roads each and every day for hours. Truck drivers, Bus drivers, Taxi drivers their livelihood depends upon driving and common people also drive for long hours. Due to this they have a good chance to fall asleep while they are driving due to stress or lack of sleep.

According to the 2016 report of world health Organization, 1.24 million road traffic deaths occur every year. This makes it the number one cause of death among those aged 15-29 years. This number is predicted to increase to around 1.9 million by 2030 and to become the seventh leading cause of death if no action is to be taken [1]. These crashes result in more than 1,550 fatalities and 71,000 injuries. However, these numbers are underestimated, and up to 6,000 fatal crashes each year may be caused by drowsy drivers.

The main idea behind this project is to develop a nonintrusive system which can detect fatigue of any human and can issue a timely warning. Drivers who do not take regular breaks when driving long distances run a high risk of becoming drowsy a state which they often fail to recognize early enough.

Real Time Drowsiness behaviors which are related to fatigue are in the form of eye closing, head nodding or the brain activity.

1.1 Benefits of system:

- It ensures the safety of the driver.
- The system will provide an alert when driver is in state of drowsiness.
- Transportation business where almost daily accidents occur due to driver fatigue can be saved.
- Military applications where high intensity monitoring of soldier is needed.
- Operators at nuclear power plants where continuous monitoring is necessary.

- In classrooms where students feel drowsy and inattentive during the class.

2. LITERATURE SURVEY

Various methodologies that have been proposed by researchers for drowsiness detection and blink detection during the recent years.

Manu B.N [3] in 2016, has proposed a method that detect the face using Haar feature-based cascade classifiers. Initially, the algorithm needs a lot of positive images (images of faces) and negative images (images without faces) to train the classifier that will detect the object. So along with the Haar feature-based classifiers, cascaded Ada boost classifier is exploited to recognize the face region then the compensated image is segmented into numbers of rectangle areas, a tiny position and scale within the original image.

Due to the difference of facial feature, Haar-like feature is efficient for real-time face detection. These can be calculated according to the difference of sum of pixel values within rectangle area and during the process the Ada boost algorithm will allow all the face samples and it will discard the non-face samples of images.

Amna Rahman[4] in 2015, has proposed a method to detect the drowsiness by using Eye state detection with Eye blinking strategy. In this method first, the image is converted to gray scale and the corners are detected using Harris corner detection algorithm which will detect the corner at both side and at down curve of eye lid.

After tracing the points then it will make a straight line between the upper two points and locates the mid-point by calculation of the line, and it connects the mid-point with the lower point.

Now for each image it will perform the same procedure and it calculates the distance‘d’ from the mid-point to the lower point to determine the eye state. Finally, the decision for the eye state is made based on distanced’ calculated. If the distance is zero or is close to zero, the eye state is classified as “closed” otherwise the eye state is identified as “open”.

They have also invoked intervals or time to know that the person is feeling drowsy or not. This is done by the average blink duration of a person is 100-400milliseconds.

3. DATASET COLLECTION

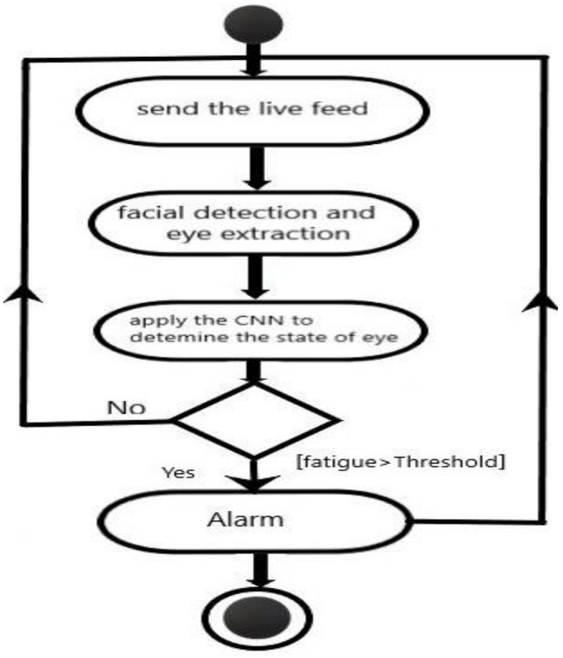
DD dataset is the largest to date realistic drowsiness dataset. The detection of eyes and their parts, gaze estimation, and eye-blinking frequency are important tasks in computer vision.MRL[5] Eye Dataset, the large-scale dataset of human eye images. This dataset contains infrared images in low and high resolution, all captured in various lightning conditions and by different devices.

The dataset is suitable for testing several features or trainable classifiers. In order to simplify the comparison of algorithms, the images are divided into several categories, which also make them suitable for training and testing classifiers [6].

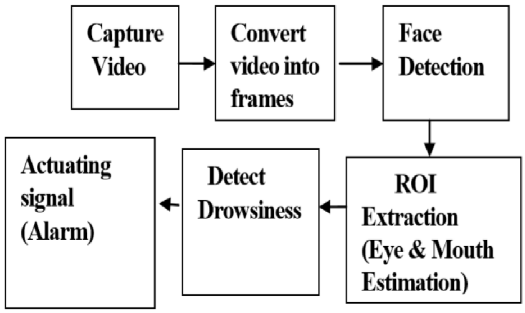
- subject ID: in the dataset, we collected the data 33 men and 4 women
- image ID: the dataset consists of 84,898 images

4. IMPLEMENTATION

A) Activity Diagram:



B) **Block Diagram:**



4.1 Algorithm:

A Convolutional Neural Network (CNN) [7] is comprised of one or more Convolutional layers (often with a sub sampling step) and then followed by one or more fully connected layers as in a standard multilayer neural network. The architecture of a CNN is designed to take advantage of the 2D structure of an input image (or other 2D input such as a speech signal).

This is achieved with local connections and tied weights followed by some form of pooling which results in translation invariant features. Another benefit of CNNs is that they are easier to train and have many fewer parameters than fully connected networks with the same number of hidden units.

In this article we will discuss the architecture of a CNN and the back propagation algorithm to compute the gradient with respect to the parameters of the model in order to use gradient based optimization.

4.1 Face Detection:

For the face Detection it uses Haar feature-based cascade classifiers is an effective object detection method proposed by Paul Viola and Michael Jones[8] in their paper. It is a machine learning based approach where a cascade function is trained from a lot of positive and negative images.

Initially, the algorithm needs a lot of positive images (images of faces) and negative images (images without faces) to train the classifier. Then we need to extract features from it. For this, Haar features shown in the below image are used. Each feature is a single value obtained by subtracting sum of pixels under the white rectangle from sum of pixels under the black rectangle.

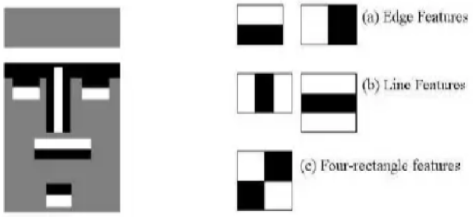


Figure. 3.1: Extracted haarcascaed features

4.2 Eye Aspected Ratio Calculation:

For every video frame, the eye landmarks are detected. The eye aspect ratio (EAR) between height and width of the eye is computed.

$$EAR = \frac{||p2 - p6|| + ||p3 - p5||}{2||p1 - p4||} \quad (1)$$

Where p1. . . p6 are the 2D landmark locations. The EAR is mostly constant when an eye is open and is getting close to zero while closing an eye. It is partially person and head pose insensitive. Aspect ratio of the open eye has a small variance among individuals; and it is fully invariant to a uniform scaling of the image and in-plane rotation of the face. Since eye blinking is performed by both eyes synchronously, the EAR of both eyes is averaged [9].

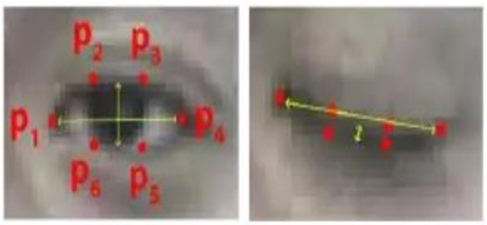


Figure. 3.2: Open and closed eyes with landmarks p(i) automatically detected

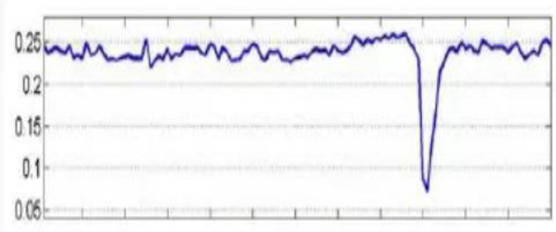


Fig.ure. 3.2: EAR for single blink

4.3 Process of system:

We will be using Open CV for gathering the images from webcam and feed them into a Deep Learning model which will classify whether the person's eyes are 'Open' or 'Closed'. The approach we will be using for this project is as follows:

- Take image as input from a camera.
- Detect the face in the image and create a Region of Interest (ROI).
- Detect the eyes from ROI and feed it to the classifier.
- Classifier will categorize whether eyes are open or closed.
- Calculate score to check whether the person is drowsy.

5. RESULTS

The proposed system results are from Sypder environment, it will open a new window in which it will allow the webcam to start and take the live feed to process it and give the required output.

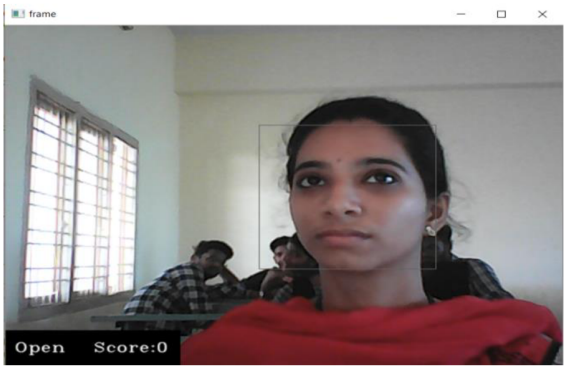


Figure.5.1 input and scoring when the state of eye is open.

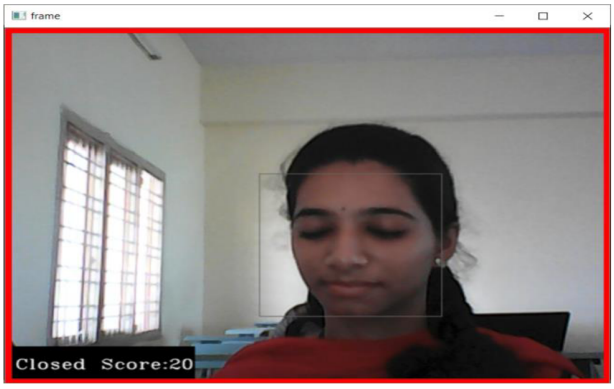


Figure.5.2: Input and scoring when the state of eye is closed.

As we can see infig.5.1, if the eyes are opened then it will state output as **open** and Score will be 0.And infig.5.2, if the eyes are closed then it will state output as **closed** and Score will be >0.

At this time, when proposed system finds the user is sleeping (i.e. eyes are closed for more than the given threshold) then it will send the signal to ring the alarm which will be loud enough to wake up the driver and save his life.

6. CONCLUSION

In this Python project, we have built a drowsy driver alert system that you can implement in numerous ways. We used Open CV to detect faces and eyes using a haar cascade classifier and then we used a CNN model to predict the status. This work will be extended on real time video stream to recognize drowsiness of driver and give him the alert.

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