DRIVER FATIGUE DETECTION USING DEEP LEARNING

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Abstract - Over the years, drowsy driving has caused many traffic accidents. By using alarm output devices to remind drowsy drivers of roadside awareness, car accidents or accidents can be avoided. An intelligent system has been developed to detect drowsiness and warn the driver. The driver prevents accidents by activating the alarm, saving money, and reducing loss and pain; however, due to the high variability of environmental parameters, modern methods have some limitations. Insufficient light will affect the camera's ability to accurately measure the driver's face and eyes. As the detection is late or not detected, this affects the image processing and analysis, thus reducing the accuracy and efficiency of the method. Various methods have been researched and analyzed to find the best method with the highest accuracy to detect the driver's drowsiness.
The proposed system uses a real-time system that uses a computer camera to automatically track and process the driver's line of sight. The webcam receives the image for processing. Then, use the haar cascade file to find and recognize the face in each frame. If no face is detected, another picture will be taken. When a face is detected, the area of interest on the face will be highlighted. This region of interest contains the eyes, and the eyes are identified from the region of interest through the haar cascade file. The number of frames with closed eyes is controlled. When the number of frames exceeds a certain threshold, a warning/warning message will appear on the screen, indicating that the driver is drowsy.

Key Words**:** *Dataset, Python, Preprocessing, ML algorithms, haar cascade, frame, threshold*

1.INTRODUCTION

Machine learning is to predict the longer term from past data. Machine learning (ML) could be a sort of AI (AI) that gives computers the power to find out without being explicitly programmed. Machine learning focuses on the event of Computer Programs which will change when exposed to new data and therefore the basics of Machine Learning, implementation of an easy machine learning algorithm using python. The Process of coaching and prediction involves the use of specialized algorithms. It feeds the training data to an algorithm, and the algorithm uses this training data to give predictions on new test data. Machine learning can be roughly separated into three categories. There is supervised learning, unsupervised learning, and reinforcement learning. A Supervised learning program is both given the input file and therefore the corresponding labeling to find out data has got to be labeled by a person's being beforehand. Unsupervised learning has no labels. It provided the learning algorithm. This algorithm has got to find out the clustering of the input file. Finally, Reinforcement learning dynamically interacts with its environment and it receives positive or feedback to enhance its performance.Data scientists use many various sorts of machine learning algorithms to get patterns in python that cause actionable insights. At a high level, these different algorithms are often classified into two groups supported by the way they “learn” about data to form predictions: supervised and unsupervised learning. Classification is the process of predicting the category of given data points. Classes are sometimes called targets/ labels or categories. Classification predictive modeling is the task of approximating a mapping function from input variables(X) to discrete output variables(y). In machine learning and statistics, the classification
The most common cause of traffic accidents is the driver's drowsiness. Statistics show that drowsiness increases the risk of accidents, serious injuries, and even death, while economic losses are negligible. Physical relaxation, including mental arousal and fatigue reduction; in this state, he no longer performs any safe driving operations. Many drivers do not feel drowsy due to traffic jams. Drowsy driving is a real problem for society because it affects and endangers all road users: drivers and pedestrians as well as drowsy drivers. Driving has become a daily activity for most people, and safe driving is the top priority. This can monitor the driver's drowsiness in real-time, reduce traffic accidents, and save millions of lives worldwide. The use of this auxiliary system to measure the alarm level is essential to prevent traffic accidents. To develop this system, it is important to understand the degree of drowsiness. Four types of measurement methods are commonly used to test the level of sleepiness: Face detection uses a variety of methods, some of which encode information about typical facial features and

find structural features such as eyebrows, eyes, nose, mouth, and hairline. -And use the relationship between them to recognize faces. The proposed method uses segmentation to recognize faces in dirty backgrounds. The edge detector and Cannes heuristics are used as edge matches to remove edges from the group. Up to the boundary between the head and the fundus, and the face is recognized. It has also been found that human skin color and facial structure are good features for facial recognition. For this method, the most important feature is the skin color you can have. In this method, the maximum variety threshold is used. Another technique for face detection is to traverse the histogram in the HSV color space to isolate the skin area. The original skin sample is used to run an iterative algorithm. To determine the skin color, this method uses the control histogram as a control, so the assigned threshold is compared with the result of the histogram comparison to analyze the skin area. The pattern matching method stores multiple patterns for different faces to describe them as a whole, or stores facial features separately, and calculates the correlation between the input image and the stored pattern to determine how similar the pattern is to the face. The first stage involves the calculation of five haar-like features and the overall picture to quickly evaluate these features. The second stage involves the development of an Adaboost classifier by selecting a small number of features. Refers to the implementation of a series of due diligence to alleviate the limitations of Adaboost's own decision-making committee. It is recommended to use the implementation of the Viola-Jones method, and it is called a "haar classifier" because it uses a function like haar, which performs addition and subtraction operations on the rectangular area of the image to extract features before thresholding the result. Jones, OpenCV uses diagonal features and other types of haar-like features introduced by Viola-Jones to extract facial features.

2. BACK GROUND OF STUDY

In India, the number of traffic accidents involving light and heavy vehicles (such as buses, trucks, and trucks) is increasing every year. Drowsiness and fatigue are the main factors leading to traffic accidents. Driving in this situation may cause serious consequences. Because this affects the driver's judgment and concentration, if you show signs of lethargy or drowsiness before driving, try to get enough sleep, drink caffeine or take a break, which can help avoid falling asleep while driving. In many cases, even if drivers know that they are tired and continue to drive, they still refuse to take any of these measures. Therefore, identifying drowsiness is an important step to prevent traffic accidents. The eyes are a clear sign of tiredness and sleepiness.

3. LITERATURE SURVEY

In June 2010, Bing Yang et al. [10] described an "in-camera drowsiness manual for classifying driver conditions under real driving conditions". They assumed that the measurements of the driver's eyes could determine drowsiness in a simulator or experiment. These indicators are statistically estimated, and using a classification method based on a large data set of over 90 hours of actual journeys, the results show that when blink detection works normally, eye tracking drowsiness detection works well for some drivers. Despite some suggestions for improvement, there are still problems with poor lighting conditions and people wearing glasses. Therefore, camera drowsiness measurement makes a valuable contribution to the drowsiness baseline, but it is not reliable enough to be the only baseline.

In 2011, M. Flores et al. [13] describes the "infrared driver drowsiness detection system for smart vehicles" and recommends the introduction of advanced driver assistance system modules that automatically detect driver drowsiness to reduce these types of deaths. The Driver Distraction AI algorithm is used to process visual information to locate, track and analyze the driver's face and eyes to calculate indicators of drowsiness and distraction. Due to the near-infrared lighting system, the real-time system works at night, and finally an example of different driver images taken at night in a real vehicle is shown to test the proposed algorithm.

June 2012, A. Cheng et al. [7] describe "driver drowsiness detection based on computer vision technology". They proposed an inconspicuous method that uses eye-tracking and image processing to detect drowsiness. A robust eye detection algorithm has been proposed to solve the problems caused by changes in lighting and driver conditions. posture. The calculation takes into account the percentage of eyelid closure, the maximum duration of the closure, blink rate, average eye-opening rate, eye-opening speed, and eye closing speed. These measurements are combined with Fisher's linear discriminant function using a stepwise method to reduce correlation and derive an independent index. The results of six participants participating in the driving simulator experiment proved the feasibility of this video-based drowsiness detection method with an accuracy of 86.

2013 G. Kong et al. [3] describes "visual analysis of eye condition and head position to monitor driver alertness". They performed a visual analysis of eye conditions and head position (HP) to continuously monitor the alertness of the driver. The driving mode is based on closing eyes or nodding to determine the driver's level of drowsiness or distraction. -Notify the driver of the vehicle. A support vector machine (SVM) classifies a sequence of video clips as an alarm or non-alert driving events. The experimental results show that the proposed scheme provides a high classification accuracy and an acceptable low level of errors and false positives for people of different nationalities and genres under the actual traffic conditions on the road.

In June 2014, Eyosiyas et al. [5] describes "driver drowsiness

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detection and dynamic simulation based on HMM". They proposed a new method of dynamic modeling and analysis of driver's facial expressions based on the Hidden Markov Model (HMM) to detect drowsiness. The experimental results confirm the effectiveness of the proposed method.

In August 2014, García and others [9]. described an "inexpensive, touch-sensitive 3D controller surveillance system". A solution for driver monitoring and event detection based on 3D remote camera information is proposed. The system combines 2D and 3D methods to assess the head position and identify areas of interest. When analyzing the 3D point cloud and 2D projection registered by the sensor, the point corresponding to the head is determined and extracted for later analysis. The estimate of the pose with three degrees of freedom (Euler's angles) is estimated based on the iterative algorithm of the closest point. Finally, the relevant facial area is identified and used for further analysis such as event detection and behavior analysis. Inexpensive sensor system for 3D driver monitoring. This is an interesting tool for studying the human factor that can automatically search for certain factors and detect specific driver-related events such as drowsiness, inattentiveness, or the driver's head posture.

In 2015, Rahman, M. Sirshar and A. Khan et al.[1] A blink monitoring algorithm is proposed, which uses eye function points to detect the open or closed state of the eyes, and sends out an alarm when the driver is drowsy.

4. EXISTING SYSTEM

Drowsiness while driving is a very common problem that causes thousands of deaths every year. Now a solution is needed to prevent accidents and fatalities, and sophisticated systems have been developed to provide solutions to detect driver fatigue. In the existing system, EEG analysis is used to detect drowsiness. The Power Spectral Density (PSD) attribute is used for EEG-based sleepiness. Low-frequency EEG bands (delta, theta, and alpha), especially the alpha band, perform while sleeping compared to being awake. In contrast, the high-frequency bands (β and γ), particularly the β band, show a decrease in performance during drowsiness. Concerning the brain areas, the frontal, parietal and occipital lobes have a directional significance, in particular, the occipital lobe α and the frontal lobe β are two possible indicators. The identification of significant brain regions with certain frequency ranges helps to reduce the number of electrodes that form the basis for the development of the effective EEG-based system for detection and reminder of drowsiness.

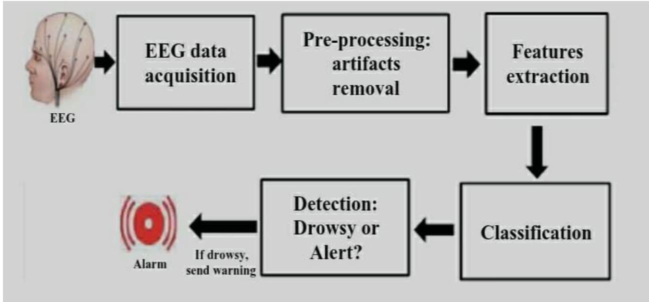

Fig 1: Architecture of the Existing System

Drawbacks:

1. The drowsiness features are extracted and the driver is alerted in case of drowsiness is detected.

2. The model does not require prior information on the individual who is testing it.

5. PROPOSED SYSTEM

Safe driving has become the top priority of daily life. The main reason for developing a real-time system that monitors the eyes of drivers is to reduce accidents, benefiting millions of people worldwide. A simpler but more effective way to do the same thing. A method for detecting and observing the driver's eyes more accurately is proposed. In the proposed system, a sleepy driver detection system was developed using Python and Dlib models. It is used to match the coordinates of the input video landmark with the face and sleepiness detected by tracking the aspect ratio of the eyes and mouth. Analyze the movement of the eyes to see if they are closed or open. The number of frames with eyes closed is the same. When this number of frames exceeds a certain threshold, the driver will receive a visual warning on the navigation screen to let them know that the driver is asleep. The proposed system is implemented by testing videos from publicly available standard data sets and real-time video captured by cameras.

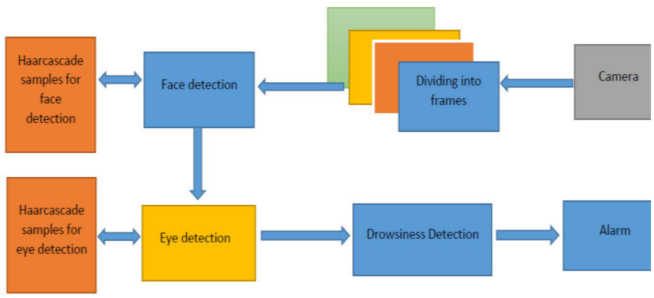

Fig 2: Architecture of the Proposed System

Fig 3: Hardware interface connection

Advantages: The persons' drowsiness level is determined using the time interval computed between two successive blinks of the driver. Face and eye detection in normal illuminating conditions are solved using the proposed system.

6. MODULE DESCRIPTION

- Object Detection (Module-01)
- Face Detection (Module-02)
- Eye Detection (Module-03)
- Drowsiness Detection (Module-04)

Object Detection:

Object recognition is defined as a method of recognizing and recognizing the existence of a certain type of object; it can also be seen as an image processing method to identify objects from an image. There are many ways to classify and find objects. It is color detection, but it is not an effective object detection method because there can be multiple objects of the same color with different sizes. Therefore, it is more effective to use functions such as hair. Attributes are attributes of digital images used for object recognition. These are rectangular dark and bright areas with the same characteristics as the face. The cascade classifier consists of several stages, and each stage consists of many weak features. Windowing the entire picture and forming a powerful classifier. The results of each level are marked as positive or negative, where positive means the object was found, and negative means the specified object was not found in the image.

Face Detection:

Face refers to a kind of object and detection of the face is considered as a particular case of object detection. In this type of object detection, the objects in the interesting image are located, and based on their sizes the class to which it may belong is found out. In general, the face detection algorithm is mostly concentrated on finding the front side of the face. But the proposed algorithm that is developed focuses on cases such as the face may be in the tilted position and also it finds the possibility of multiple faces. This represents the rotation axis concerning the present observer from the reference of the face or even if there is a vertical rotation plane. In the proposed algorithm, it is considered that the picture or video is a variable, which means that different conditions like hue contrast and the amount of light may change its variance. The position of the input may also vary the output. The calculations actualize the face-detection assignment as a two-way pattern-differentiation task. It means the contextual features present in the interesting image are repeatedly changed into features and this results in preparing the respective classifier on the reference faces which decides if the specified area is a face or any other objects. If a positive response is obtained for face detection then the process goes for the next stage continuation, otherwise, the algorithm captures images till any hint of the face is found. The output is obtained by the utilization of the cascade part of the open cv. The Cascade file of Open Cv contains 24 stages and has got 2913 weak classifiers. The window starts with a size of 24 x 24 pixels. The starting scale is set to 1.0 and the step size of each scale was set to 1.1 and the position step size Δ was set to 1.0. The total number of scales used is 32 resulting in a total of more than 1.8 million possible detection windows which is huge. The training phase of the cascade was done by OpenCV.

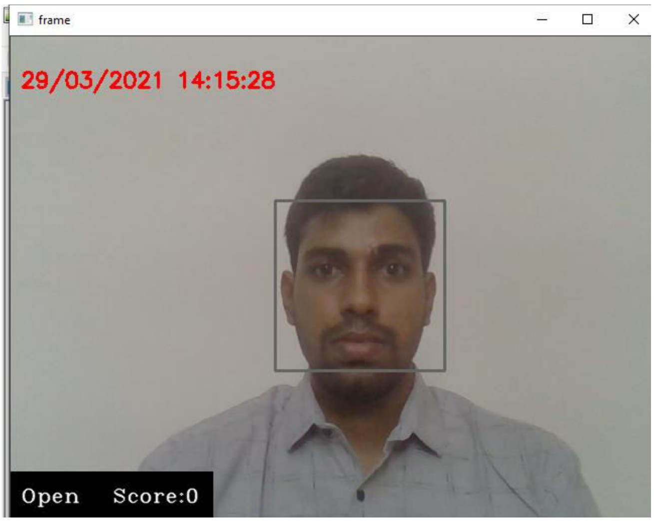

Fig 4: DETECTING FACE

Eye Detection:

Poor eye contrast usually causes many detection problems. After successful face recognition, the eyes must be recognized for further processing. In the proposed method, the eye is the solution parameter used to determine the condition of the conductor. In this case, it performs eye recognition in the designated area through feature recognition. The intrinsic method is used in the feature recognition process. When performing an eye test, the result is compared with a reference value or threshold value to determine the status. The eye recognition process is divided into two categories: eye contour recognition and eye position recognition. Usually, the premise of recognizing eyes is that they are darker than other parts of

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the face. Move along the top of the face to match the eye features that lead to the eye position. These areas are considered potential eye areas, and the non-skin areas of the face are restricted. Obviously, the eyes must be located in the face area, and the skin identifier cannot be used to distinguish the eyes from the skin. Therefore, in a few potential eye areas, there are simple eye groups. Using this method, first, create an eye model, and then recursively determine the position of the eye. However, this method largely depends on the starting position of the eyes, which should be closer to the actual position of the eyes. In terms of pattern matching, the proposed eye extraction algorithm is based on the use of rectangular gray-scale facial fitting functions and neural networks. The use of hair functions in AdaBoost results in higher computational efficiency and accuracy than other facial recognition methods. However, hair function has limitations in discerning ability. Although hair features vary by pattern, size, and location, they can only represent a regular rectangular shape, but in the proposed eye detection, the eyes and iris are round. Describe the pattern of the eyes. The probability classifier is used to distinguish between eyes and non-eyes to obtain higher accuracy and reliability.

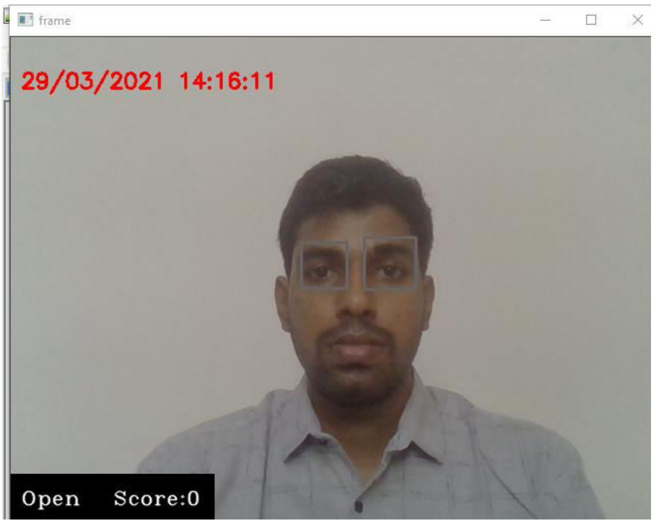

Fig 5: DETECTING EYE

Drowsiness Detection:

Eye Aspect Ratio (EAR):

EAR is the ratio of eye length to eye width. Eye length is calculated by averaging two different vertical eye lines.

Formula:

$$EAR = \frac{\|P_2 - P_6\| + \|P_3 - P_5\|}{2\|P_1 - P_4\|}$$

When a person is drowsy, their eyes may become smaller and blink more frequently. Based on this assumption, the proposed model predicts that when the aspect ratio of a person's eyes starts to decrease in consecutive images, the class will become drowsy, that is, his eyes will start to close tighter or blink faster. Figure 6(a) and Figure 6(b) show diagrams of the eye marks when the eyes are open and the eye marks when the eyes are closed. The graph of aspect ratio over time is shown in Figure 7. A decrease in the aspect ratio of the eye indicates blinking.

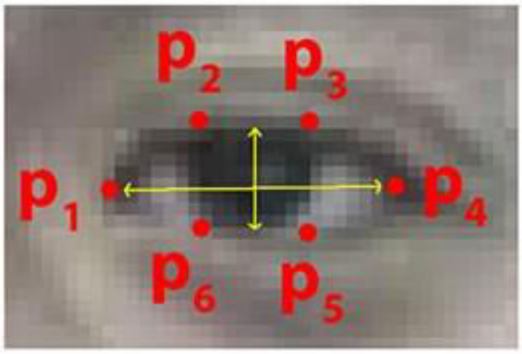

Fig 6(a): Eye landmarks when eye is open

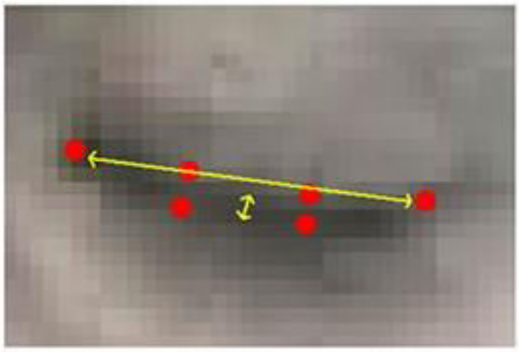

Fig 6(b): Eye landmarks when eye is closed

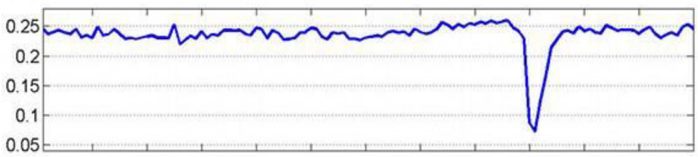

Fig 7: Eye Aspect Ratio over time

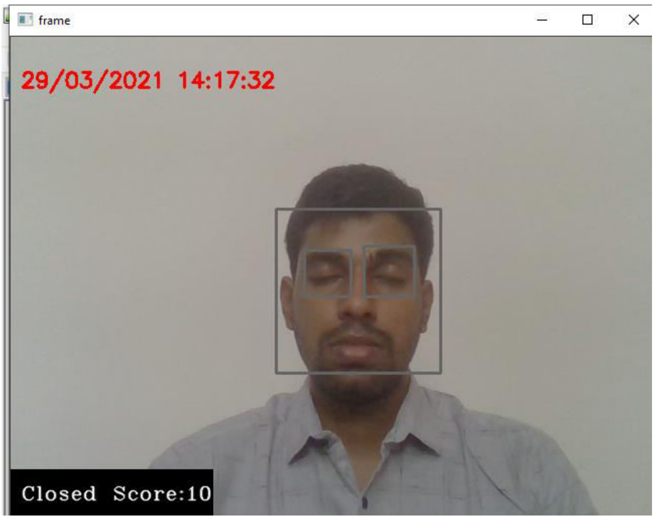

Fig 8: DETECTING DROWSINESS

7.RESULTS

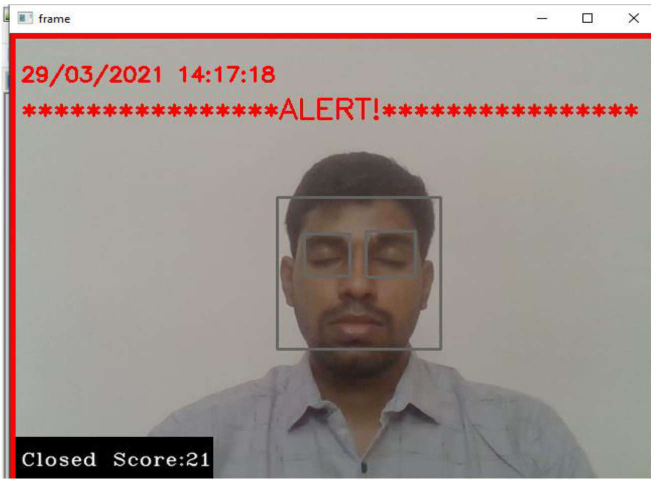

Fig 8: ALERT DRIVER FROM DROWSINESS

8. FUTURE SCOPE:

By using other parameters, such as blinking frequency, yawning frequency, machine status, etc., the proposed model can be gradually improved. In the future, adding sensors to track heart rate can improve the system to prevent accidents caused by sudden heart attacks. The same model and technology can be used in other areas, such as Netflix and other streaming services, it detects whether the user is sleeping and can pause the video accordingly. It can also be used in applications that prevent users from sleeping.

9. CONCLUSION

Drowsiness is the main cause of countless accidents every minute around the world. The proposed system is a prototype and will be implemented on a small scale in reality. It shows the implementation in different scenarios such as low light and darkness, and the system seems to give effective results under these conditions. With the help of Raspberry Pi software and a night vision camera, the video is recorded, processed, and divided into multiple frames in real-time, and each frame is analyzed with the previously saved image. If the system detects that the driver is drowsy, the score will automatically increase, and once the maximum threshold is reached, an alarm will sound and wake the driver. -Rescue people who have accidents due to this problem.

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