INTELLIGENT SYSTEM FOR DRIVER DROWSINESS DETECTION

E.Sateesh[1], Department of Computer Science and Engineering, Amrita Sai Institute Of Science and Technology,India.

V.Karthik Reddy[2] Department of Computer Science and Engineering, Amrita Sai Institute Of Science and Technology,India.

, **P.Naga Karthik**[3], Department of Computer Science and Engineering, Amrita Sai Institute Of Science and Technology,India.

P.Pavan Kalyan [4] , Department of Computer Science and Engineering, Amrita Sai Institute Of Science and Technology,India.

P.Bhoomika[5] , Department of Computer Science and Engineering, Amrita Sai Institute Of Science and Technology,India.

P.Anuradha[6] Department of Computer Science and Engineering, Amrita Sai Institute Of Science and Technology,India.

ABSTRACT

One of India's most important problems isthe high number of fatalities from road accidents. Road accidents can be caused by a number of different circumstances, including excessive speed, drunk driving, breaking traffic laws, and drowsy driving. One of the main factors contributing to these incidents is drowsy driving. Drivers of trucks, lorries, and buses are the most frequently affected by sleepy driving.One of the major contributing factors to traffic accidents is sleepiness. Road accidents, which cause fatalities, are one of India's most critical problems in the modern era. According to experts, drivers who continue travelling long distances at the same speed without taking regular breaks or rest periods are more prone to experience fatigue, which then causes accidents.On the other hand, a few factors that contribute to traffic accidents include drunk driving, exceeding the posted speed limit, and disobeying other laws and regulations. The demand for a technology that can identify sleepiness or exhaustion in people, especially drivers, is unquestionably great. To alert drivers to their current situation, inattentiveness must be cautioned at a very high level.

1. INTRODUCTION

Drowsiness is a complicated phenomenon in which the driver has fewer conscious levels. The detection of driver weariness or sleepiness can be done in a number of ways, both directly and indirectly.Long distance driving can be exhausting. Laziness and exhaustion are dominating peoples' daily lives today. Drowsiness can also be brought on by sleep deprivation (including irregular sleeping patterns), emotional and physical stress, and addiction to electronic devices.

In India and around the world, tiredness is the primary and most important factor contributing to traffic accidents. The enormous rise in traffic accidents caused by intoxication attracted the attention of researchers.Researchers have established that when tiredness increased, driving performance continued to decline. According to the leading studies, most accidents happen in the middle of the night.In light of this, improvements have been made to both intelligence systems and vehicles.. Other factors that are seen as being a crucial component of a smart car system include eye closure rate, yawning, and head bending, in addition to the vehicle's speed, steering wheel movement, and amount of time spent driving continuously.Other indicators, including physiological ones like heart rate and pulse rate, could be used. High vision cameras are employed in this system to find and capture real-time photos of the driver and produce warning signals as necessary. About this issue, numerous studies have indicated a wide range of models and technologies for the automation of sleepiness measurement. Several methods were built based on vision to detect items like faces. Eye closure levels were measured as a sleepiness indicator. Afterwards, a driver's sleepiness symptoms were identified utilising an infrared camera. Researchers developed an algorithm for eye detection and drowsiness detection using the idea of bright pupils. The basic notions were taken to be ocular localization and segmentation on a similar basis.This

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eventually led to the development of a non-Linear Support Vector Machine (SVM), which is utilised to improve the model's ability to detect sleepy eyes. These approaches all appeared to be difficult. The suggested essay includes a methodology for our system, experimental findings, future application, restrictions on the work proposed, and a conclusion.

2. LITERATURE SURVEY

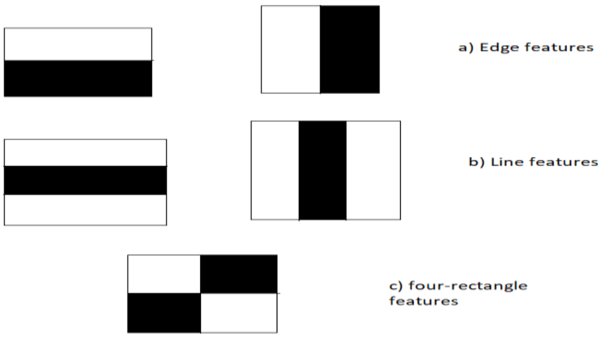
2.1 CNN Algorithms for Detecting Face and Eyes

An innovative method for solving key issues with face detection is presented in this paper and is based on analogic cellular neural network (CNN) techniques. The suggested CNN algorithms locate and assist in successfully normalise human faces. The amount of time needed is far less than with earlier techniques.

The algorithm starts with the detection of heads on colored pictures using deviations in color and structure of the human face and that of the background. By normalizing the distance and position of the reference points, all faces should be transformed into the same size and position. Eyes act as points of reference for normalisation. By looking for distinctive features of the eyeballs and eye sockets, another CNN technique locates the eyes on any grayscale image. Experiments on a common database demonstrate that the algorithm is dependable and operates quickly.

2.2 Face Detection using Haar Cascades

Paul Viola and Michael Jones in their 2001 publication "Rapid Object Detection using a Boosted Cascade of Basic Features" suggested an efficient object identification technique that uses Haar feature-based cascade classifiers. Using machine learning, a cascade function is trained using a large number of both positive and negative images. It is employed to find items in other pictures. Face detection will be used in this situation. To train the classifier, the algorithm first requires a large number of both positive (pictures of faces) and negative (images without faces). After that, we must draw features from it. .



2.3 Morphological and Color Image Processing for Eye Detection

Several applications, including eye-gaze tracking, iris detection, video conferencing, auto-stereoscopic displays, face identification, and face recognition, call for eye detection. The unique method for eye detection proposed in this paper makes use of colour and morphological image processing. When compared to other facial features, it has been found that eye regions in an image are distinguished by low lighting, high density edges, and strong contrast. The method suggested assumes the availability of a frontal face image (full frontal). First, a color-based training algorithm and six-sigma approach operating on RGB, HSV, and NTSC scales are used to identify the skin region. Further analysis involves morphological processing using boundary region detection and detection of light source reflection by an eye, commonly known as an eye dot.This results in a limited pool of eye candidates from which noise is then subtracted. This method is proven to be extremely effective and precise for locating eyeballs in frontal face photos.

Algorithm for Detecting Eyes on Greyscale Faces

A robust eye detection algorithm for grey intensity images is presented in this paper. The goal of our method is to combine the benefits of two existing techniques, feature-based and template- based, and to overcome their shortcomings. After detecting the location of the face region, a feature-based method will be used to detect two rough regions of both eyes on the face. Then, in these two rough regions, an accurate detection of iris centres will be continued using a template-based method. Experiment results on faces without spectacles show that the proposed method is not only robust but also quite efficient.

Real-Time Face Detection Using Edge OrientatioMatching

We describe our ongoing work on real-time face detection in greyscale images using edge orientation information in this paper. We will demonstrate how edge orientation can be used to model objects such as faces for detection. Based solely on edge orientation information, we will present a simple and efficient method for template matching and object modelling.We also show how to use a set of training images to generate an optimal face model in the edge orientation domain. We also demonstrate how to use a series of training photos to create an ideal face model in the edge orientation domain. Our method is computationally very quick compared to other methods that simulate the appearance of the face at different grey levels. A multi-resolution search with six resolution levels can process a 320x240 image on a Pentium II 500MHz in less than 0.08 seconds. We use a library of 17000 photos from more than 2900 distinct persons to show the detection method's effectiveness.There are significant differences in head size, lighting, and background. For that database, the achieved detection rate is greater than 93%.

3. METHODLOGY

Data Acquisition:

OpenCV offers a wealth of features for gathering and analysing live videos. By specifying the appropriate parameters, it is also possible to decide whether the video must be taken from an external camera or the built-in webcam. As was previously noted, OpenCV does not specify any minimum camera requirements; nonetheless, by default, OpenCV expects a specific resolution of the video that is being captured; if the resolutions do not match, an error is thrown. By manually setting the resolution of the video being recorded, it is possible to override the default value and avoid this problem.

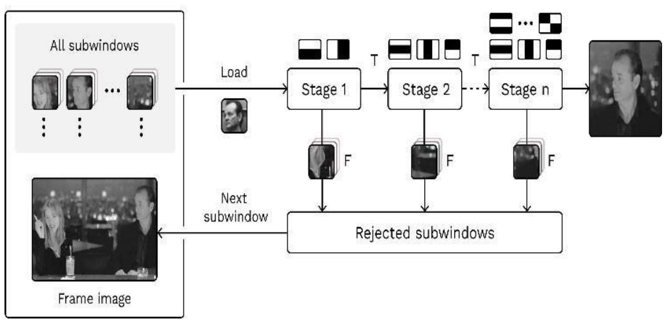
Frame Acquisition:

After the video has been obtained, it must be divided into a number of frames or images.This was initially carried out in two steps. In our example, since the video is not stored, the first step is to capture a frame from the camera. Once this is done, the following step is to extract the acquired frame. The picture or frame is initially decompressed while being recovered. Nevertheless, because the seized frame had to be temporarily stored, the two-step process required a long time to process. To solve this issue, we developed a single-step procedure in which a single function captures a frameand decompresses it before returning it**.**

Face detection:

The next stage is to find each frame's face after the frames have been correctly removed. By using the Haar cascade file for face detection, this is accomplished. The Haar cascade file was created by employing a mix of positive and negative samples, and it contains information on the face's height, width, and colour thresholds. We initially load the cascade file in order to detect faces. After that, send the captured frame to an edge detection function, which will find all potential objects in the frame, regardless of size. Since the face of the car driver takes up a lot of the image, we can specify the edge detector to detect only objects of a specific size, which is determined based on the Haar cascade file, where each Haar cascade file will be created for a particular size. This will reduce the amount of

Cascade structure for Haar classifiers



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processing because the face of the car driver takes up a lot of the image.The edge detector's output is currently stored in an array. In order to identify the face in the frame, the edge detector's output is now compared with the cascade file. It is necessary to indicate the number of failures on which an object identified should be categorised as a negative sample because the cascade consists of both positive and negative samples. We set this value in our system to 3, which helped us achieve both accuracy and faster processing. This module produces a frame that has a face in it.OpenCV's Haar Cascade Classifier: To train the classifier, the algorithm requires a large number of positive images (images of faces) and negative images (images without faces). After that, we must draw features from it.They resemble our convolutional kernel exactly. Each feature is a single value that is obtained by deducting the sum of the pixels under the white and black rectangles.

CASCADED CLASSIFIER:

The cascade classifier has several phases, each of which is made up of weak learners. Simple classifiers known as decision stumps are the weak learners. Classifiers are trained via boosting. By weighing the decisions produced by the weak learners, it enables the training of a highly accurate classifier. The region that the sliding window's current location defines is displayed as either positive or negative at each stage of the classifier. Positive means an object was discovered, whereas negative means there was none. If the label is negative, this region has been fully classified, and the detector moves the window to the following spot. The classifier advances the region to thefollowing stage if the label is positive.

Eye detection:

The next step after identifying the face is to identify the eyes. This can be done by applying the same method that was used to identify the face. However, we mark the region of interest before attempting to find eyes in order to limit the amount of processing. The following factors are considered while determining the area of interest:The eyes are only visible in the upper portion of the face that has been detected, and they are situated a few pixels below the top edge of the face.After marking the region of interest, the edge detection technique is only used on that area, considerably lowering thamount of processing.

Now, using a Haar cascade XML file for eyes detection, we utilise the same method as for face detection to find the eyes. However, the results were not particularly effective; there were more than two items identified as positive samples, indicating the presence of multiple eyes.Here, we take into account Eye Aspect Ratio (EAR). This EAR ratio is derived using the formula that divides the eye's height by its width.

$$\mathbf{EAR = ||P2-P6||+||P3-P5|\,|\,/2||P1\text{-}P4||}$$

Where P1 stands for the facial landmark point I and (Pi -Pj) is the separation between points I and j. By analysing the ratios of the eyes closing and opening, we may show whether or not the driver is drowsy using the formula above.

Yawn Detection:

Eight coordinates are marked on the mouth using the dlib landmarks predictor function, working clockwise from the mouth's left corner. Consideration is given to the relationship between the horizontal and vertical co-ordinates. The ratio of the horizontal distance between the lip corners to the vertical distance between the lower and upper lips is computed to define MAR.

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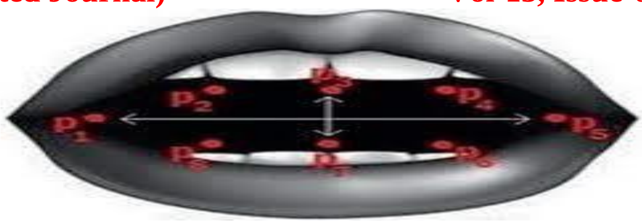
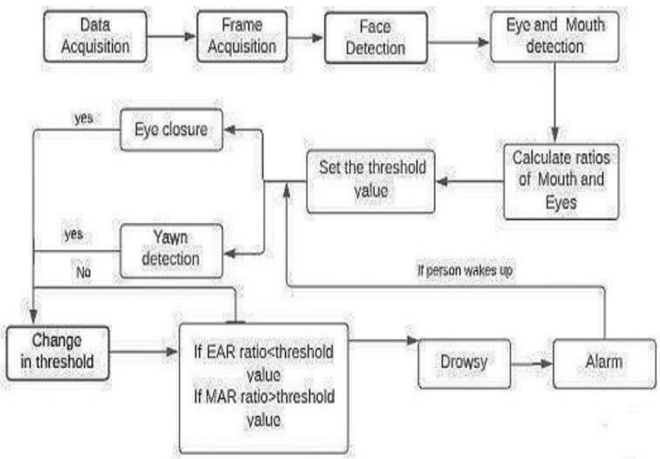


$$MAR=||P1-P5||+||P2-P4||2||P6-P3||$$

While yawning, the distance between lower and upper lips increases. As soon as MAR value exceeds a certain threshold, the yawn count is incremented

Alarm Activation:

The system will consider the driver to be tired and will sound an alarm when the Eye Closure and



Yawn Counts surpass specific specified threshold values for a predetermined number of frames. This would assist the driver in returning to his prior state of being active.

4. CONCLUSION:

A low-cost, real-time driver drowsiness detection system based on visual behaviour and machine learning has been suggested in the proposed work. The entire project is built on visual behavioral variables such as eye and mouth aspect ratios, which are calculated from streaming video and recorded using a webcam. To identify driver drowsiness in real time, an adaptive threshold method has been devised. With the generated synthetic data, the built system performs precisely. The feature values are then stored after using machine learning methods for categorization. In the future, wearable technology, including smart watches and other gadgets, may be used to identify metrics, such as pulse rate, heart rate, blood pressure, and others, to detect sleepiness more effectively and correctly.The system at this stage is a ―Proof of Concept‖ for a much substantial endeavor.This will mark the beginning of a distinguished technological growth that will lead to ace development. The designed system places a strong emphasis on real-time monitoring while prioritising flexibility, adaptability,and improvements. Future improvements are always intended to be things that take more preparation, funding, and personnel to be put into place. The following are a few suggestions for potential future improvements:Standalone product:

It can be used to monitor the driver of a car by being installed within the vehicle as a standalone product

.Smart phone application:

It might be implemented as a smart phone application that users may download on their smartphones. And after positioning it such that the camera is trained on the driver, the driver of the car can activate the application

Face with Mask Detection:

This feature can be used to detect faces wearing masks. If the driver is donning a mask, the device will also detect the mouth and awaken him or her.

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