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Drowsiness Detection using Eye Blink

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Abstract: Proposed Drowsiness Detection System is based on Blink Detection method which is based on calculating the distance between two arcs of eye using connected 'labeling method'. Proposed method is robust enough against different users, noise, and eye shape changes with highest accuracy. It uses a Haar based cascade classifier for eye tracking. The presented method is non intrusive and hence provides a comfortable user interaction. This paper presents a labeling method for eye tracking and blink detection in the video frames obtained from low resolution consumer grade web cameras.
Keywords: Blinking, eye arc , Haar cascad , labeling, PERCLOS, Face detection, Real-time system

I. INTRODUCTION

Different methods have been developed for eye tracking and blink detection. The eye tracking methods includes use of, feature based models, template matching, appearance based models, statistical models, clustering algorithms etc. The eye blink detection methods includes the use of intensity vertical projection, SIFT feature tracking, template matching, skin color copies, Gabor filter responses etc. But most of these methods need special hardware settings and their performance is not reliable when used in real world situations under uncontrolled lighting conditions and normal resolutions. Therefore, this paper presents a new method for eye tracking and blink detection using consumer grade cameras. The accessible method is very much user friendly and does not require any specialized hardware. It performs well in uncontrolled lighting conditions under standard resolutions of an USB web camera.

II. RELATED WORK

It proposes a non-intrusive approach for detecting drowsiness in user, using Computer Vision. The algorithm is coded on OpenCV platform in Window environment. The element considered to detect drowsiness is face and eye detection, blinking, eye close and gaze. Input is acquired in real time and live fed from a camera that supports night vision. The algorithm is Haar trained to detect the face and the eye from the considered frame. We proposed a drowsy detection algorithm also uses haar feature extraction by using opencv platform. The HAAR Classifier Cascade files inbuilt on OpenCV include different classifiers for the face detection and the eyes detection. The inbuilt OpenCV xml. The Visual Studio Express platform is used to show simulation output of the drowsiness system. In this particular work on non-recursive system have been introduced to detect shutting of eyes of the person who is sitting in front of Computer**.**

III.WORKING PRINCIPLE

The primary purpose of the Drowsy User Detector is to develop a system that can reduce the drowsiness. The system may be programmed to provide an instant warning signal when drowsiness is detected with high certainty, or, alternatively, to present a verbal secondary task via recorded voice as a second-stage probe of driver status in situations of possible drowsiness. The IR transmitter is used to transmit the infrared rays in our eye. The IR receiver is used to receive the reflected ultraviolet rays of eye. If the eye is closed means the output of IR receiver is high otherwise the IR receiver output is low. This to know the eye is closing or opening location. This output is give to logic circuit to indicate the alarm. Here one eye blink sensor is fixed in vehicle where if anybody looses conscious and agree through alarm. The proposed system is used to avoid drowsiness.[2]This paper involves avoiding laziness of employee or user to unconsciousness through Eye blink. Here one eye blink sensor is fixed in system where if user lose his consciousness, then it alerts the user through buzzer.

IV.FACE AND EYE DETECTION

Primarily Haar classifiers have been used for Face and Eye detection. A rectangular Haar like feature can be defined as the difference of the sum of pixels of areas inside the rectangle, which can be at any position and scale within the original image. Each Haar like feature consists of two or three connected black and white rectangles. The Haar wavelets are a natural set basis functions which encode differences in average strengths in different regions. The value of a Haar-like feature is the difference between the sums of the pixel gray level values within the black and white rectangular regions:

"f(x)=Sum black rectangle (pixel gray level) – Sumwhite rectangle (pixel gray level)"

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The advantage of using Haar like features over raw pixel values is that it can reduce/increase the in-class/out-of-class variability, which makes the classification easy.

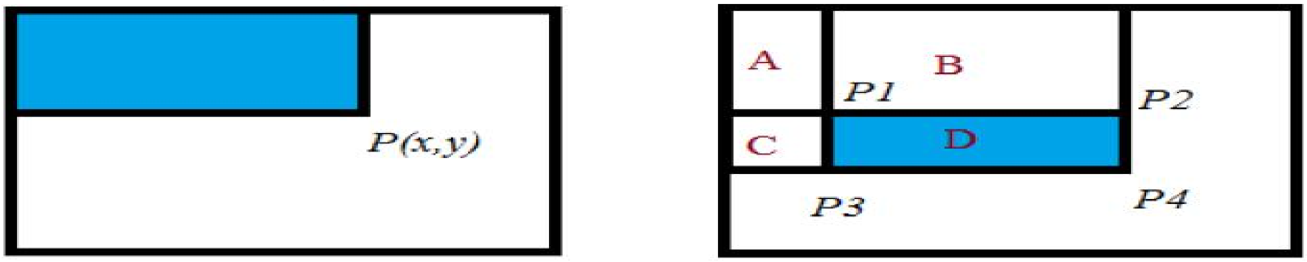

Figure 1. Integral image representation

From Figure 2, Integral image at location of x, y contains the sum of the pixel values above and left of x, y, inclusive:

$$P(x,y) = \sum_{x' < x, y' < y} i(x',y')$$

$$P_1 = A, P_2 = A + B, P_3 = A + C, P_4 = A + B + C + D$$

$$P_1 + P_4 - P_2 - P_3 = A + A + B + C + D - A - B - A - C = D$$

The calculation of Haar like features is made fast by the use of integral image symbol[5]. The number of Haar like features in an image is too large. In a sub image of size 24x24 the number of features contained is 180,000. The Haar like features are evaluated in a cascaded manner .Weak classifiers reject the region where the chance of finding face is less[8]. More time is spent on the promising regions in the image .The features used in each stage and their threshold is selected in training phase. Training is done with AdaBoost algorithm. In training phase the classifier is trained with a number of positive and negative samples to get a cascaded classifier[10]. It consists of cascaded stages of weak classifiers. The optimum set of cascaded features and corresponding thresholds are gained from the AdaBoost algorithm.

V. FACE TRACKING

Searching for face in every frame in every scale rises the computational complexity. The real-time performance of the algorithm can be better if we use the temporal information[2]. If the position and size of face is known accurately in a frame, then we can select a Region of Interest around that position where we can find the face in following frames. The computational complexity is less since the search region is reduced.

Figure 2. Tracking in Video

Figure 2. shows two cases in tracking, if the position of face is accurately known in one frame, the location of the face can be predicted in subsequent fames. This reduces the computational complexity. But in the second case the motion of face is fast so the location of face will be outside the selected ROI. By tracking face with a prediction method avoid this problem. In tracking, the ROI

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is selected around the predicted position of face in the subsequent frame thereby reducing the tracking failure[9]. There are several methods available for object tracking mean shift tracking, optical tracking and Kalman filter based tracking. The first two methods relies image intensity values in following frames. The performance of mean shift tracking and optical tracking is poor because of the changing light conditions. We have selected Kalman filter based estimate since the prediction method depends on the measurement of face location from Haar based face detector only.

VI. EYE DETECTION

Two separate classifiers for open eye and closed eye are used in this method. The classifier for open and close are trained with a databank and positive and negative images are given for training[3]. The ROI selection is done and the detection of eye is performed in the localized region. The flow chart of the Haar based eye detection is shown here. The number of open and closed eyes over one minute windows are calculated and PERCLOS values are found.

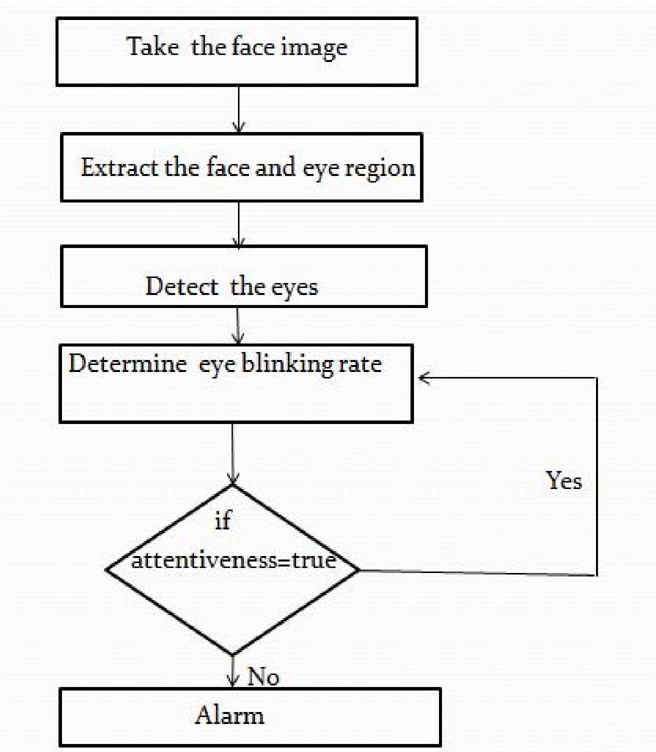

Figure 3. Flowchart of Drowsiness Detection with Haar classifier

Figure 3 shows the flow of our proposed system. First we are going to take the face image. From that face image we are going to extract and detect face and eye region. After detecting eyes, determination of eye blinking rate is occur. If close eyes are more than the threshold value then Alarm get activated otherwise our system continues it work again.

VII. EYE STATE CLASSIFICATION

The eyes are detected by the block LBP histogram based approach. The final stage is the classification of state of the detected eyes. Support Vector Machine is reported as strong for the classification of open and closed eye[5] . The weight components from the previous stage are used for the classification of eyes. SVM is a supervised learning method useful for data classification. The standard SVM is a binary classifier. A support vector machine constructs a hyper plane or set of hyper planes in a high or infinite-dimensional space, which can be used for classification or regression. Good classification accuracy can be obtained if the hyper plane is maximally distant from the nearest training data from both the classes. When data can not be classified by a linear classifier the original data can be altered into a higher dimension where the classes can be separated by a hyper plane[2]. The essence of SVM is to map the training data from the input space to a higher dimension feature space, where an optimal hyper plane can be found which can separate the data. In the SVM training process the dot product of input vectors have to be calculated in the feature space.

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VIII. DROWSINESS DETECTION AND ALARM

When compared with the blink rate of a person who is sleep deprived, the blink rate at the end of Matlab computing was reduced to 4-6 blinks per minute. When the microprocessor system compared this result with the threshold value stored in the source code, the output result was the sounding of the alarm, due to the condition mentioned below:

RESULT<THRESHOLD

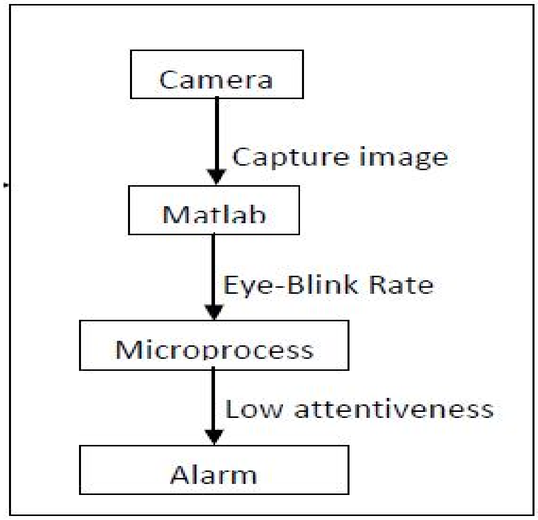


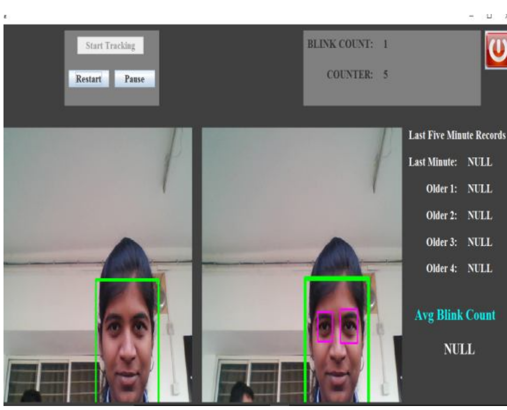
Figure 4:comparison

The output shown in the result block diagram is in the form of alarm or buzzer inside the vehicle. The accuracy of this system is dependent on the number of frames that can be extracted per minute and also on the degree of eyes open. For this purpose we used a dataset of eyes and calculated the pixel values surrounding the eyes i.e. the pupil, cornea, eye lashes, eyelid and the skin and find the mean of all these pixel values from the dataset. Now, we use test cases to find the accuracy of our system.Employing the above explained methodology, following
results were established.

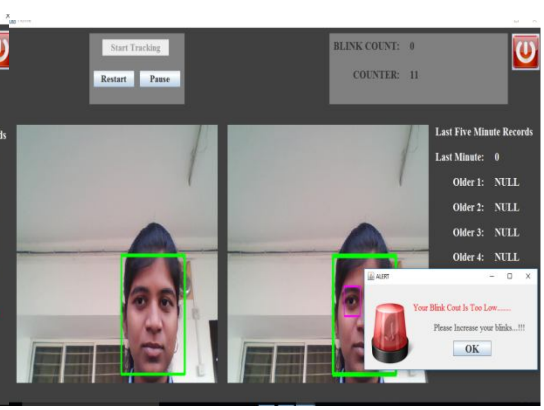
1) Average eye detection – 97%
2) Average eye-blink detection – 87%

IX.EXPERIMANTAL RESULT

Figures shows the results of eye detection from an image by using Haar based algorithm. Figures. (A) shows the blink count of image. (B) is the image shows that the message blink count is low concentrate please. (C) image shows that average blink count and if no one detect in camera then system automatically shut down which show in fig(E).



(A)



(B)

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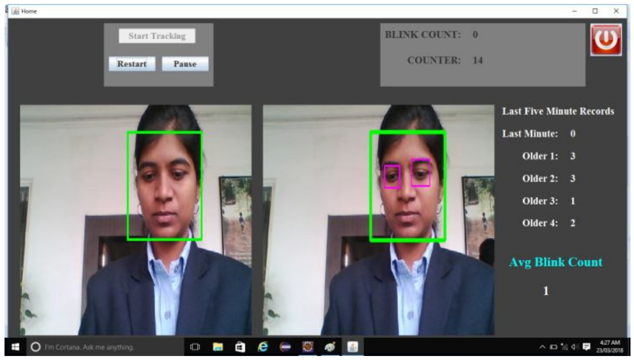
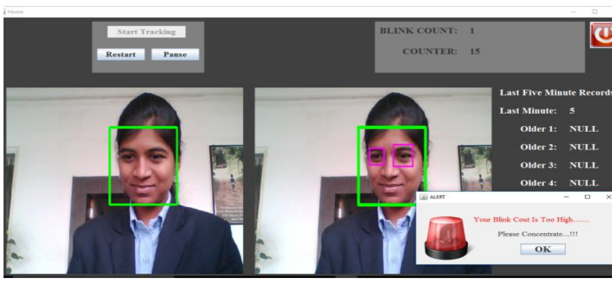
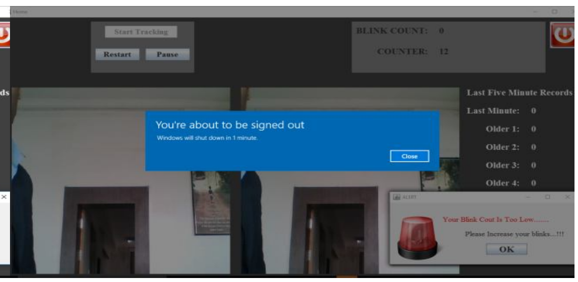


(C)





(D) (E)

X. CONCLUSION

The main components of the system consists of an eye blink sensor for user blink acquisition. Advanced technology offers some hope avoid these up to some extent. This study involves measure and controls through alcohol sensor and eye blink using IR sensor. The system is considered by maintaining simplicity, low cost and non-obstructive real time monitoring of drowsiness. The web camera captures the video and the frames are processed for detecting the eye status based on the edges. The derived status is monitored and the user is advised to blink often through pop up message box. The major problem faced in edge extraction from frames is that, it is difficult to extract when captured in poor lighting conditions. Future work is focused on light of these frames under uncontrolled lighting conditions.

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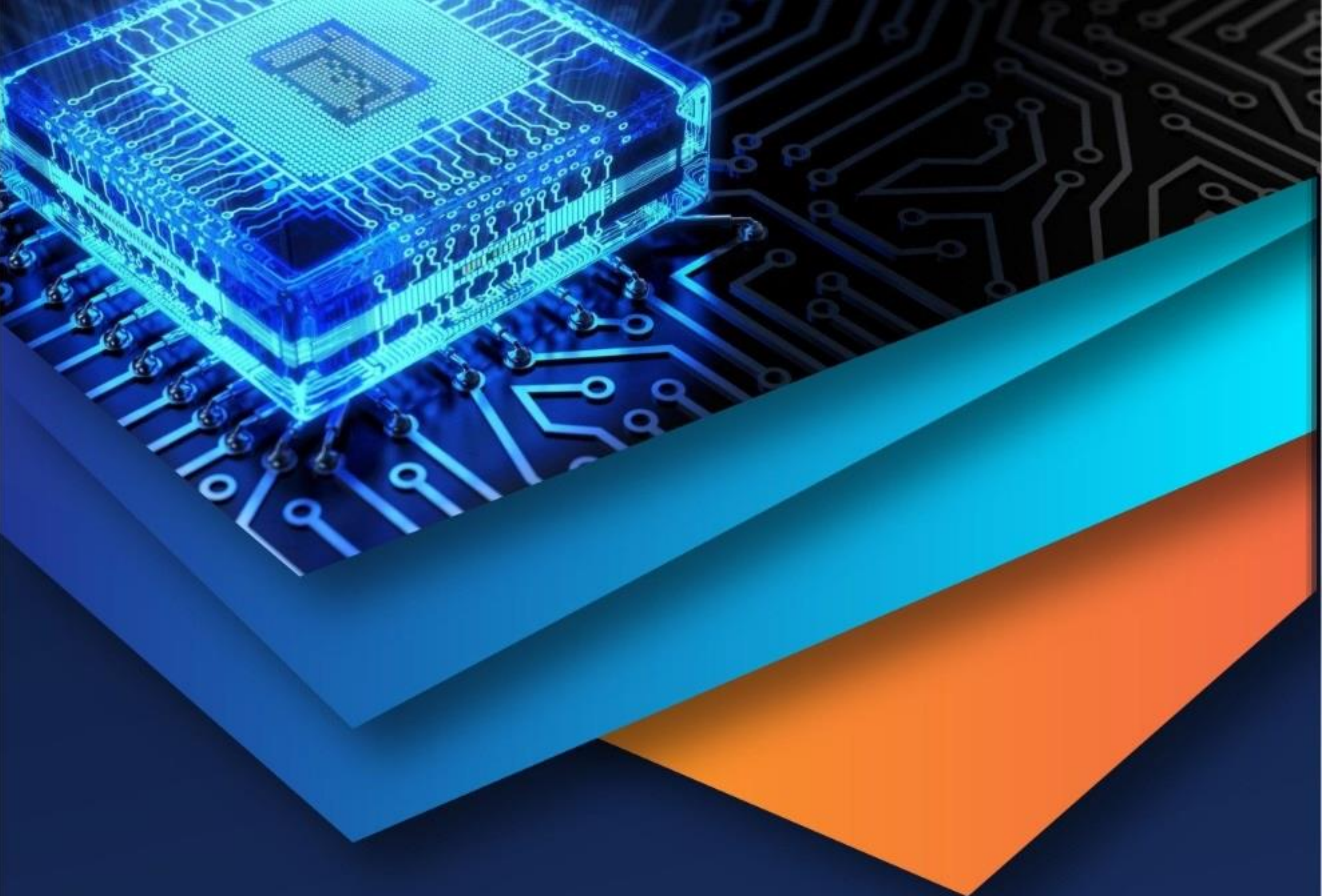

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