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A Real-Time Monitoring System for the Drivers Using PCA and SVM

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Abstract – *In real-time scenarios, tracking and monitoring a human behavior from a video is very active research. In human computer interaction, recognition and monitoring of end user's expressions, emotions and behavior from the real-time video streaming plays very important role. In such systems it is required to track the dynamic changes in human face movements quickly in order to deliver the required response system. The one real time application is drowsiness detection based on facial detection and expressions such as drowsy driver detection in order to prevent the accidents on road. Face and eyes behaviors based facial video analysis or drowsiness detection for the drivers is the scope of this paper. This paper presenting the methodology for face detection and eyes close estimation in term of drowsiness and alertness detection from a real-time video analysis. Cascade object detector is used for face detection then applying Principal components analysis (PCA) and support vector machine (SVM) in term of eyes close estimation. Whenever the drowsiness is recognized it will buzz an alarm at the system.*

Keywords: *Real-time video, Face/Eyes detection*, Drowsiness detection, *eyes close estimation*, PCA, SVM.

1. INTRODUCTION

Drowsiness and non-alertness of the drivers are the major causes of traffic accidents, especially for drivers of large vehicles (such as cars, buses and heavy trucks) due to long driving periods and lack of sleeping, so for these reasons there is a need to develop a system to do a function in term of decreasing the accidents. In this paper, we propose a vision-based drowsiness and non-alertness detection system for the drivers monitoring, which is easy and flexible for deployment in all kinds of vehicles. The system consists of modules of face detection, eyes detection, eye openness/close estimation, and drowsiness/alertness measure percentage of eye close and facial appearance. The main function of the drowsiness detection systems is to track and detect the feature points and the facial behaviours of the people then find the drowsiness from those behaviours so that the systems can be applied in many fields. There are many purposes behind streets mishaps some of them are a direct result of dozing or weariness. Consequently, car producers have started actualizing innovation based wellbeing frameworks. Some of these best in class frameworks incorporate impact cautioning and brake bolster, drowsiness discovery and astute night vision with person on foot location. Numerous frameworks are intended to work in current vehicles as checking frameworks for the consideration of drivers while driving. Numerous new advances are developing to meet the expanding wish for more secure vehicles and roadways. A few frameworks proposed to alert the driver when the level of driver responsiveness appears to change showing exhaustion.

Fig -1: Modern System for Drowsiness Detection.

The innovation which is utilized as a part of these frameworks works via naturally breaking down individual driving qualities including the assessment of controlling developments. In spite of this advance and improvement, it is uncertain whether these frameworks work rapidly and with high unwavering quality to ready drivers without diverting them from the street conditions. Frameworks may give a false discovery for once in a while, so with false recognition, the drivers might be irritated by frameworks that give repetitive notices.

In this paper an economical feasible monitoring and detection system for the drowsy drivers is designed which can be used to do the function, the key point is using a simple camera which is installed direct in front of the driver with a MATLAB system as a processing system, the system will able to monitor the driver's face and track the eyes to detect the state of drowsiness. simple wired/wireless webcam is used. The video is captured from webcam then processed by the system and action will be taken is alarm the driver. Cascade object detector from Viola-Jones algorithm is applied to detect a driver's face, eyes. Principal components analysis (PCA) and support vector machine (SVM) in term of eyes close estimation.

1.1 Related Work

Various vision-based structures have been produced for drowsy driver detection in view of driver confront checking. These systems use a camera mounted in front of the driver that concentrations clearly towards driver's face and focuses on recognizing as indicated by the driver in high-assurance face pictures. They can be organized on the camera used and approach for facial and eye incorporates figuring. IR cameras and normal shading cameras have been used. On the other hand, both elements focus based techniques and twofold game plan approaches have been inspected for eye state estimation.

In [2] presented a novel vision system for bus driver monitoring. The system is designed for easy deployment by using existing dome camera which is installed in front of the driver and without using any extra hardware. The main contribution of this system is a novel vision-based system for bus driver fatigue detection which is applicable to low-resolution face images captured from an oblique viewing angle to the driver's face. Experimental results of this system show that proposed method is able to distinguish the simulated drowsy and sleepy states from the normal state of driving on the low-resolution images of faces and eyes observed from an oblique viewing angle.

In [3] designed a driver fatigue detection system on a smartphone and proposed a novel eye detection method named progressive locating method (PLM). The aim of designing PLM is getting rid of the restriction of statistic method and trying to focus on the apparent and geometric relationship within the facial region. The system is divided into three parts: First, skin-colour model is employed to detect the field of the driver's face. Second, PLM enhances the accuracy of eye detection rate, Third, the driver's wakefulness state which is the opposite of the fatigue state is measured by counting over the different combinations of states.

In [4] presented a yawning detection system utilizing Embedded Smart Camera that perceives a yawning mouth with a high distinguishing proof rate. They simply do face and mouth revelations, with no following, and they have used Viola–Jones count also they go without using techniques that require a colossal get ready database of yawning in perspective of classifiers, in order to lessen the computational time. The structure is segregated into three areas; the First step is to distinguish the person's face. The second step is mouth disclosure. Viola–Jones detector is used for face and mouth recognizable proof which has starting at now been completed in the OpenCV programming library. The last walk of the technique is to choose yawning; the back projection framework is used to do this limit. This limit is done by finding the territory and histogram of the driver's mouth in the main casing.

In [14] presented the proposed eye state detection system which consists of four portions: face detection, eye detection, iris detection based on CHT and eye state analysis. The system will firstly detect the face. Secondly, after the face is detected, then it will detect the eye on the face region. After the eyes are successfully detected then the CHT will detect circular shape of the eye which represented as an iris. Then finally, the system will determine the status of the eye.

2. PROPOSED WORK AND METHODOLOGY

In this Section, first, an overview of the system framework is presented, and then, methodology is described. The details are focused on the face and eyes detection, eyes close estimation and alarming system.

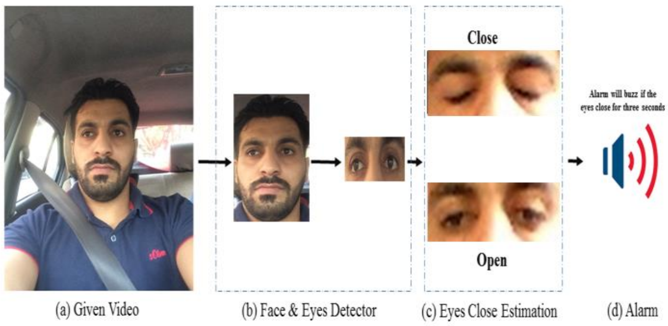

Fig -2: System Overview.

2.1 System Overview

The proposed framework stretches out by tending to the previously mentioned deficiencies and along these lines takes into consideration programmed and more solid recognition of drowsiness time from facial video caught by a wireless/wired webcam which is connected with MATLAB server.

The first step of the proposed motion-based drowsiness detection system is face detection from facial video, which has been accomplished by Viola and Jones object detection framework using Haar-like features obtained from integral images. Facial videos captured in real-life scenarios can be subject to the problems of pose variation, varying levels of brightness, and motion blur. When the intensity of these problems increases, the face quality decreases. A low quality face produces erroneous results in detecting facial features using either GFT or SDM. To solve this problem, pass the detected face to Principal component analysis (PCA) and support vector machine (SVM) those help to find the feature extraction, image frames, Euclidean Distance and facial expression of the input video. Thus, the low quality faces can be discarded by employing thresholds to check whether the face needs to be discarded.

The framework is shown in Figure 3. The system identifies the face from a given video input caught by wireless/wired camera which is connected to the MATLAB. The video will process and detecting the eyes and mouth for that recognized face. Detection of the drowsiness for that recognized face will calculate by identifying the state of eyes (close or open). Once the eyes are detected as the close for three seconds (as our assumption), the action will be taken the sound will alarm the driver.

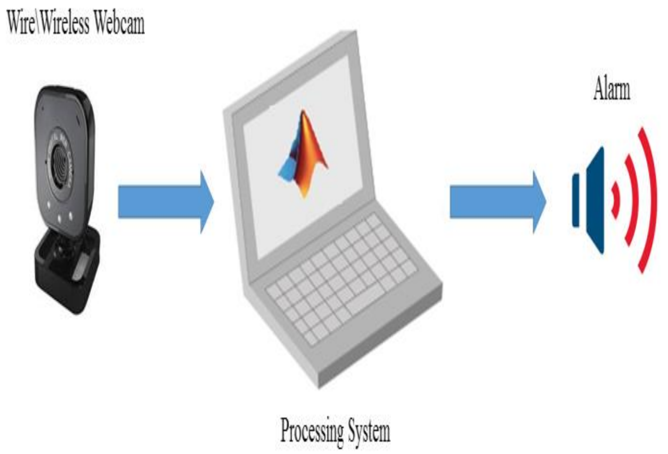

Fig -3: Proposed Framework.

2.2 Proposed Methodology

To design a system to monitor a status of the drivers, following steps are taken:

Face and Eyes Detector: The Viola–Jones object detection framework is the first object detection framework to provide competitive object detection rates in real-time proposed in 2001 by Paul Viola and Michael Jones. Although it can be trained to detect a variety of object classes, it was motivated primarily by the problem of face detection. Cascade Object Detector API of viola-jones algorithm from MATLAB is used to detect the face from the image. Once face is detected, within the face to detect the eyes we use another Cascade Object Detector for eyes. Then these extracted eyes are sent to PCA and SVM.

Steps of the Principal Component Algorithm (PCA):

1) Get database set of images and then find mean of the images

2) Find the difference between mean image and each of database images

3) Find covariance matrix of the matrix obtained from step 2 for this covariance matrix.

4) Find Eigen values and Eigen vectors, and then we will find the Eigen faces with larger Eigen values.

5) Find out weight vector using this Eigen faces.

6) For new/unknown image also the process will be echoed from step 1to3 and then find out weight vector for test image.

7) Now find Euclidian distance between weight vectors of unknown image and database images.

8) If this distance is less than threshold then test image is considered to be in database and hence authorized, otherwise unauthorized.

In the flowchart of the system (Fig 4) the fatigue or drowsiness will be detected based on the image frames mean of the trained video that is stored while stating the system. The proposed system will check continuously for the match of the expressions which is stored in the database and according to the image frames the drowsiness will be detected, instantly the alarm will buzz and alert will be generated.

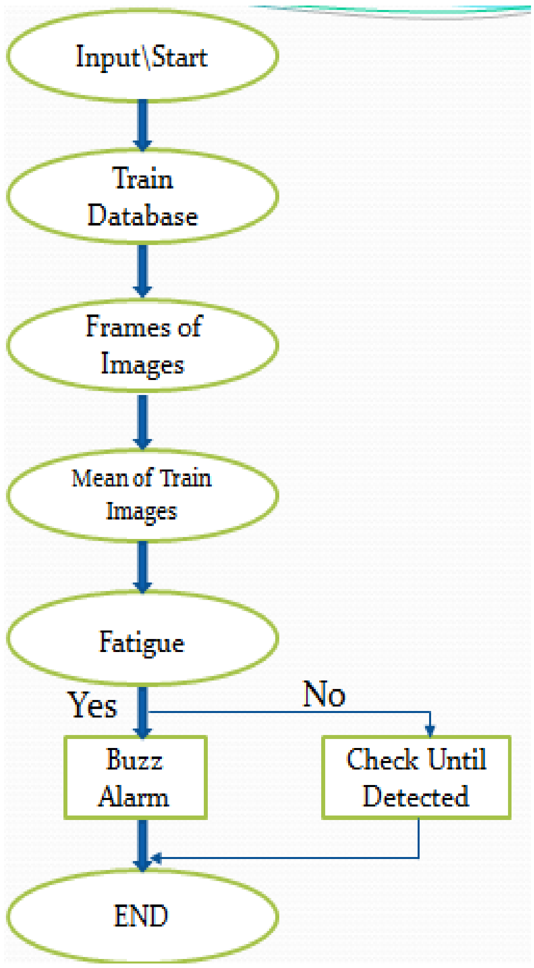

Fig -4: Flowchart of the system.

3. EXPERIMENTAL RESULT

The result of the proposed system based on the real-time image frames those caught by wired\wireless webcam. As soon as the driver is detected as a drowsy, the alarm sound will buzz at the system. The proposed framework includes PCA and SVM. Based on the detection of eyes and the input datasets, state of the drowsy driver and non-drowsy driver is determined. The result of the proposed system is shown high accuracy in practical experiment with the actual background and different people's faces, table 1. Shows the experiment results and accuracy achieved.

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Figure 8. shows the normal status of the driver while driving, so that whenever ever the eyes are open, the system consider that the driver is in normal state. In the other hand whenever the eyes are close for a while (three seconds in our case) the system will consider that the driver is sleepy or drowsy, Figure 9. shows the drowsy status.

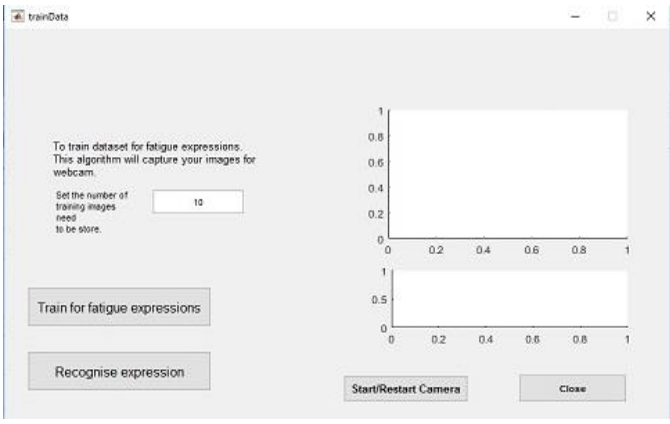

Fig -5: First Background.

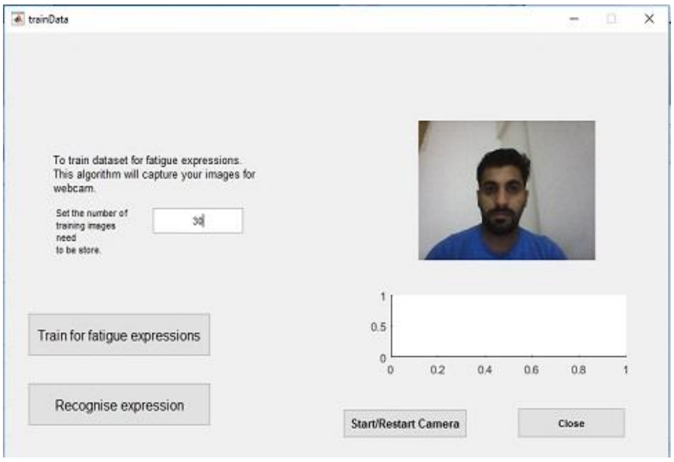

Fig -6: Start Webcam.

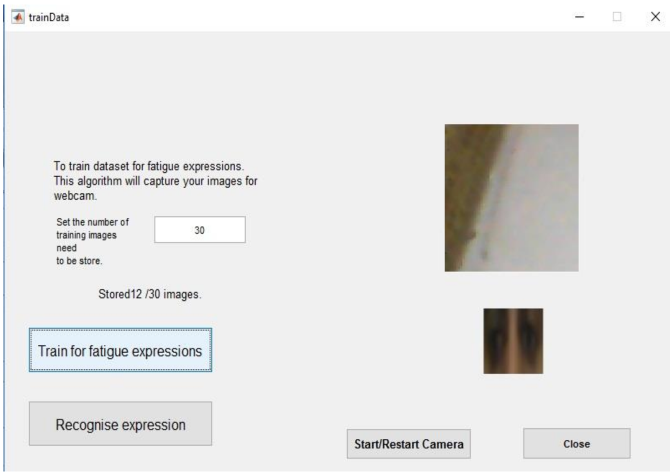

Fig -7: Train the Databases.

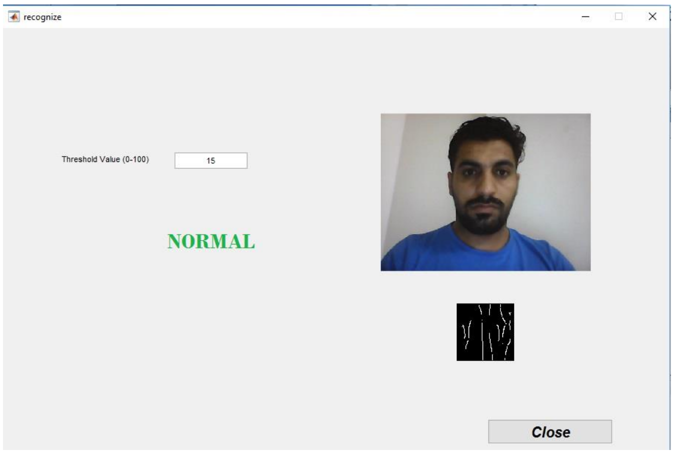

Fig -8: Normal Status Detected.

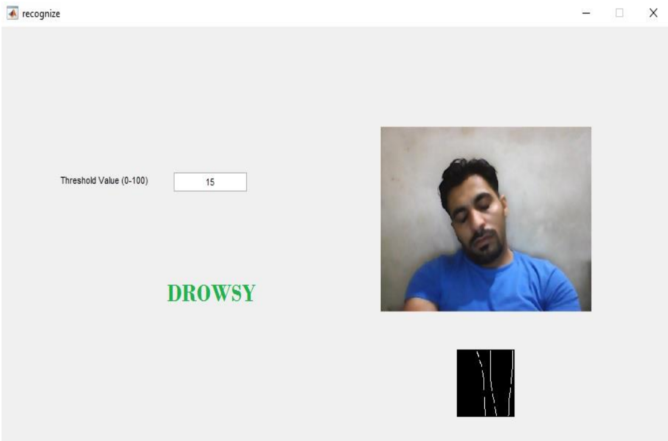

Fig -9: Drowsy Status Detected.

Table -1: Experiment results

Serial number	Threshold	Euclidean distance_ min	Execution Time A/Q no. of frames
1.	15	3.8948e+14	41
2.	35	3.8642e+14	43
3.	65	3.6847e+14	37

4. CONCLUSIONS

In this paper, we presented a system for a monitoring the drivers state and drowsiness detection. The proposed framework is using a real-time facial video. The proposed framework begins with recognition of face from a captured video using Viola-Jones algorithm then applied the same algorithm for eyes, then applying PCA and SVM in term of detection of the drowsiness. This framework is produced to monitor the status of the drivers in term of preventing them from the sleeping while driving. High accuracy achieved as compare to ground truth datasets. The most restrict can be faced this framework is the quality of the video due to different light conditions and motions blur while driving. In future work, the system will be extended to do the function as independent system with the help of intelligent hardware such as; Raspberry Pi or Arduino with more accuracy and without the need for computer intervention during implementation.

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BIOGRAPHIES

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