Driver's Drowsiness DetectionSystem

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***Abstract*--- Nowadays, the main reason of road accidents is the drowsiness of driver. In this paper, we are focusing on designing a smartphone based driver aided system that helps to detect driver drowsiness conditions while driving. This technology uses smartphone front camera to take driver's image .This approach provides real time monitoring. This system in turn detects drowsiness of driver. The system uses Viola Jones method which detects objects in the images i.e. detects face and eye localization is done by Haar like features. If eyes remain closed for the successive frames, system gives indication as "drowsy driver" and alerts the driver with alarm.**

***Keywords*--- Drowsiness ;Smartphone; Alarm; HaarCascade.**

I.INTRODUCTION

After continuous driving for long time, driver easily get tired and which result into driver fatigue and drowsiness conditions. Research states that majority of accidents are occurred due to driver fatigue. Different countries have different statistics for accidents that occurred due to driver fatigue. Developing technology for detecting driver fatigue to reduce accident is main challenge. There are various approaches available for detecting sleepiness conditions:

1) Based on vision based tracking
2) Using physiological signal to measure heartbeat rate to observe driver's behaviour.
3) Observing driver's brain activities
4) Vehicle base method.

But these approaches are expensive as they require electrodes and high processing back ends to run system and these does not provide accuracy while detecting drowsiness.This is smartphone based method which uses frontend camera. It captures driver's image through camera and processesit's real time. Driver fatigue state is estimated using eye blinking rate of driver. After detecting driver fatigue and distraction, system raises an alarm to alert the driver and passengers to prevent accidents. Different types of alarms are used to alert driver. This paper explains about proposed methodology for Driver Aided System to prevent accidents. This approach uses Open Source Computer Vision (OpenCV) library for face and eye tracking. OpenCV provides real time image processing and also satisfies low processing power, high speed and cost effectiveness requirement.

II.RELATED WORK

There are various researches on this topic .Most of the research is based on vision based method. It includes tracking driver's eyes by detecting eyes closure state to detect driver's sleepiness conditions. Eye tracking method is done by using various methods like template matching, eye blinking detection. Some of the approaches include observing driver's behaviour by using physiological approaches like observing brainactivities using sensor. It include use of electrodes to detect electric signal from driver's skin. This approach is used for monitoring driver's health and eye blinking detection.

Another approach includes use of bio signals and dynamic Bayesian network to detect driver fatigue through different sensors. Different approaches use different methods to detect driver drowsiness: histogram based method to extract eye contour, skin colour extraction and eyes extraction method using automotive learning and particle filtering algorithm. Another approach is based on the driving behaviour. It includes steering motion based monitoring that is when steering is still for some fractions of time then it help to detect drowsy condition. In this method driver is alerted using steeringvibration.But all of these approaches do not provide accuracy for detecting driver fatigue. Though Electrode ECG, EEG methods provide accuracy for driver health monitoring and eye blinking detection ,they are expensive and annoying as it require electrode to be in contact with driver's skin. This system provides solution by eye blink detection method. Using smartphone which makes the system cost effective and efficient.[1]

III.METHODOLOGY

In proposed Method, driver's live image is captured through the smartphone front camera. OpenCV provides a way through which live video can be acquired and processed. OpenCV is used to track facefrom images acquired. It helps to provide quick processing by consuming less power. Open Source computer vision provides accuracy in tracing face. Acquired image is present in RGB format which has too many color combinations to track face and face regions. So there is need to convert RGB into Grayscale format. Grayscale format gives only black and white combination which makes faceregions detection easy.

HaarCascade classifier is used to detect faces. It provides training dataset for face and regions tracking. Haar classifier provides rapid face regions detection in rectangular frames. After detection of face centroid of the face is calculated. Centroid of the face is necessary for accurate eye tracking. Eyes are present on the top portion of face i.e. eyes are present at the few pixels below from top of face. Haarclassifier training application is used to track eyes. Eyes are detected in the form of rectangular frame. In eyes tracking, eyeballs are detected using black coloredpixels which represents pupils. Haar classifier is used to detect both left and right eye.Close and open state of the eye is determined using template matching method. If these pupils are not detected for given fraction of time then alert will be raised. After detection of closed eyes it provides alarm to alert the driver.

IV.SYSTEM DESIGN

This System mainly consists of 5 modules namely,

1. Image Acquisition using camera
2. Dividing into frames
3. Face Detection
4. Eye Detection
5. Drowsiness Detection

The functionalities of each module is described below,

Image acquisition

Image acquisition is nothing but obtaining the live video a person. This is achieved, by making use of camera.

Dividing into frames

This module is used to take live video as its input and convert it into a series of frames/ images, which are to be processed.

Face detection

The face detection function takes one frame at a time from the video, and in each and every frame it tries to detect the face of the person. This is achieved by making use of a set of pre-defined Haarcascade samples.

Eyes detection

Once the face is detected, the eyes detection function tries to detect the person's eyes.This is achieved by making use of a set of pre-defined Haarcascade samples.

Drowsiness detection

After detecting the eyes, the drowsiness detection function detects if the person is drowsy or not, by considering the open state and closed state of eyes. This can be achieved using Template Matching Algorithm.

V. VIOLA-JONES ALGORITHM

Viola-Jones method developed by Paul Viola and Michael Jones. This method focuses on detecting objects in images. Object detection is done by Simple rectangular features, called Haar-like features, an integral Image for rapid feature detection ,AdaBoost machine-learning method and cascaded classifier to combine many features efficiently[2]. These methods are described as follows :

Haar-like features

Haar-like feature considers adjacent rectangular regions at a specific location in a detection window. It sums up the pixel intensities in each region and calculates the difference between these sums. Thisdifference is then used to categorize subsections of an image. The key advantage of a Haar-like feature over most other features is its calculation speed. Due to the use of integral images, a Haar-likefeature of any size can be calculated in constant time.

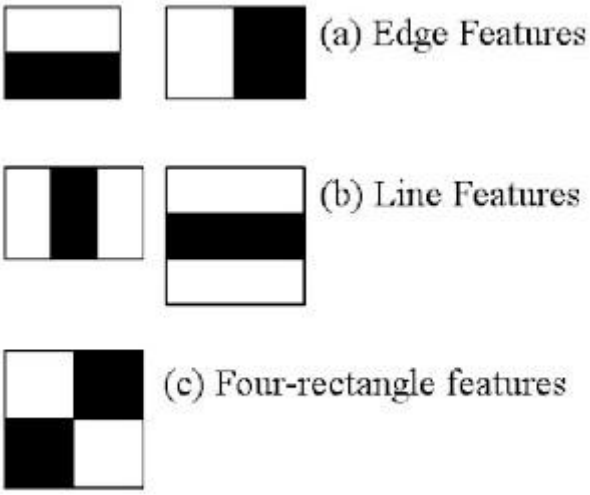


Fig.1Haar-like features

Integral image

The simple rectangular features of an image are calculated using an intermediate representation of an image, called the integral image**.** The integral images are an array which consists of sums of the pixels. intensity values located directly to the left of a pixel and directly above the pixel at location (x,y) inclusive. Here, A[x,y] is the original image and Ai[x,y] is the integral image.[3]

$$Ai[x, y] = \Sigma A[x', y'] \quad (1)$$

$$x' \leq x, y' \leq y$$

Ada boost

Adaboost, nothing but "Adaptive Boosting ", is a machine learning method given by Yoav Freund and Schapire in 2003. It can be used with many other types of learning algorithms to improve their performance. Adaboost takes a number of positive and negative images features and training sets, The machine creates a set of weak classifiers of Haar-like features. It selects a set of weak classifiers to combine and that assigns lesser weights to good features whereas larger weights to poor features. This weighted combination gives strong classifier.

Cascade classifier

The cascade classifier consists of number of stages, where each stage is a collection of weak learners. The weak learners are simple classifiers known as decision stumps. Boosting is used to train the classifiers. It provides the ability to train a highly accurate classifier by taking a weighted average of the decisions made by the weak learners.

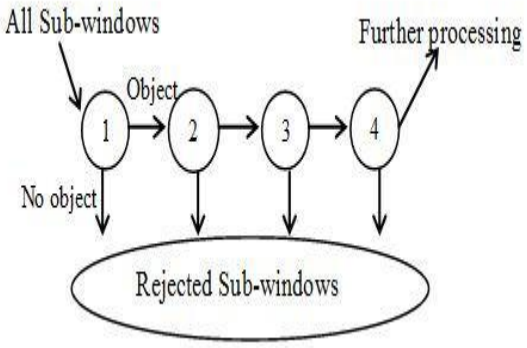


Fig.2

Each stage of the classifier shows the region defined by the current location of the sliding window as either positive or negative. Positive indicates an object was found and negative indicates no object.

If the label is negative, the classification of this region is complete, and the detector shifts the window to the next location. If the label is positive,the classifier passes the region to the next stage. The detector reports an object found at the current window location when the final stage classifies the region as positive. It is used to eliminate less likely regions quickly so that no more processing is needed. Hence, speeding up the overall algorithm.

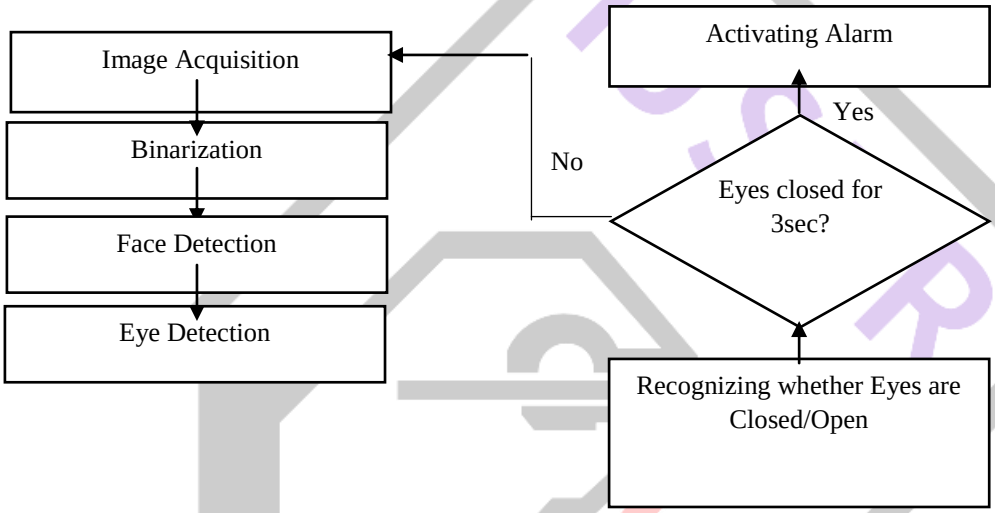
VI. TEMPLATE MATCHING ALGORITM

Template matching is a technique for finding areas of an image that match (are similar) to a template image (patch).This algorithm requires two primary components:Source image (I): The image in which we expect to find a match to the template image.Template image (T): The patch image which will be compared to the template image our goal is to detect the highest matching area.To identify the matching area, template image is compared against the source image by sliding it. i.e. moving the patch one pixel at a time (left to right, up to down). At each location, a metric is calculated so it represents how "good" or "bad" the match at that location is (or how similar the patch is to that particular area of the source image).

. VII. IMPLEMENTATION

We have used the Haar training applications in OpenCV to detect the face and eyes. This creates a classifier given a set of positive and negative samples. OpenCV is an open source computer vision library. It is designed for computationalefficiency and with a strong focus on real time applications. It helps to build vision applications quickly and easily. OpenCV satisfies the low processing power and high speed requirements of our application. Once the face is detected, the location of the eyes is estimated and eye detection is done using eyeHaar-cascade classifier.. The larger square indicates the face while smaller squares indicate the eyes. When eyes are closed, driver is alerted with alarm.

Flowchart

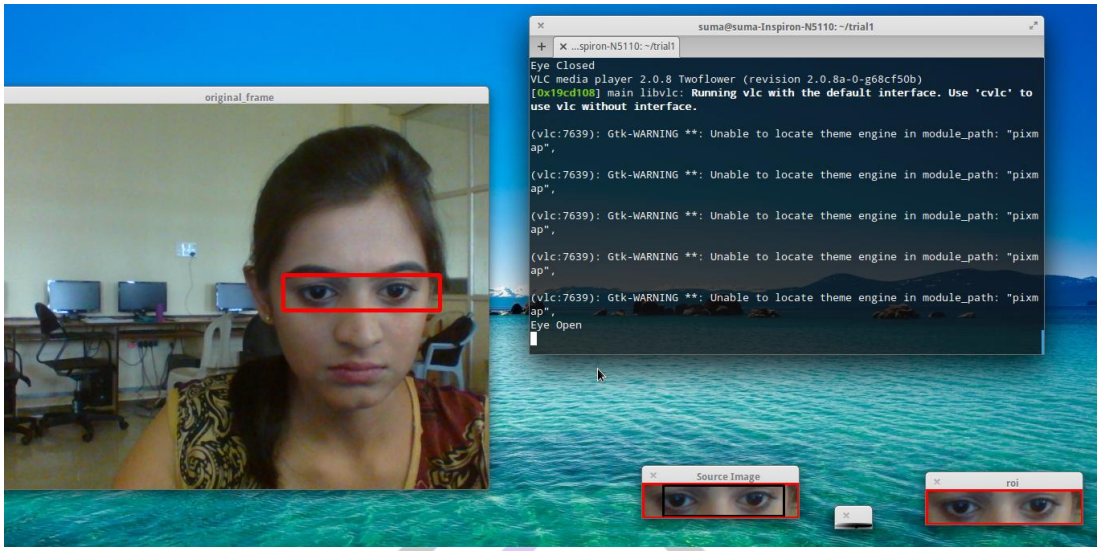


VIII. APPLICATIONS

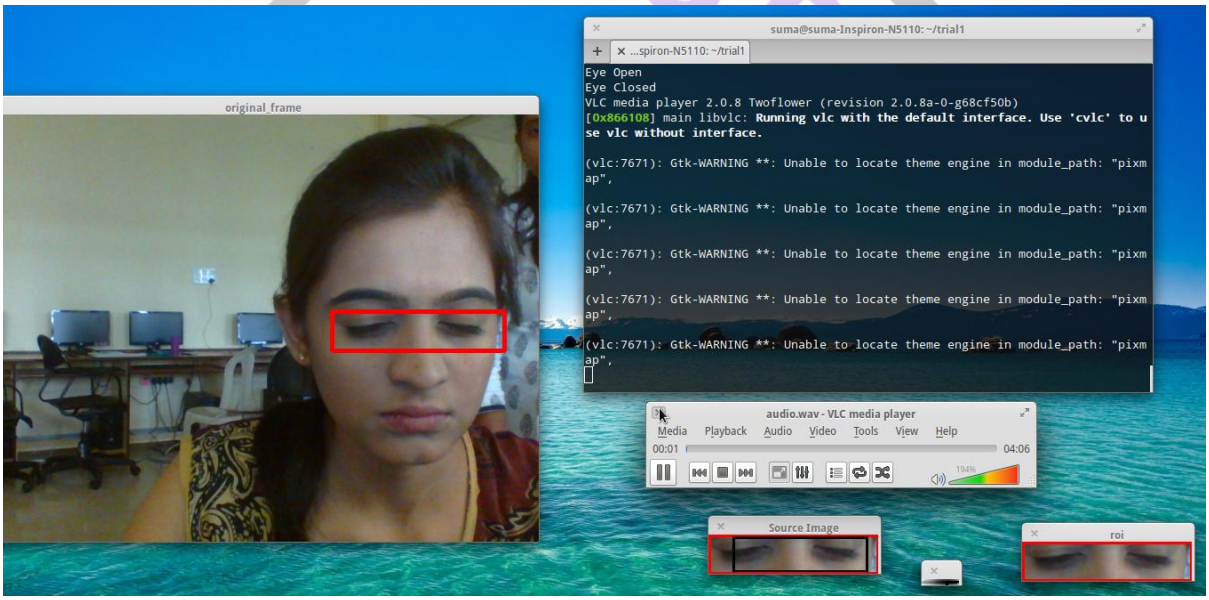
1. This system can be used in many applications like assisting driver in driving and reduce accidents occurred due to sleepiness.
2. This can be used by companies to keep their employees alert by fatigue detection of employees.
3. In colleges, to check whether the students are drowsy during lectures.
4. To check whether security guards are doing their job honestly.

Output Snapshots

1. When eyes are open



2. Drowsiness is detected and alarm is raised



X. CONCLUSION

This paper describes methodology for driver aided system. Proposed Real time Driver Aided System helps to reduce accident occurred due to driver fatigue. This technology takes all aspects forpreventing accidents by taking into consideration vision based fatigue detection. It provides efficiency and fast facial tracking using OpenCV library. As this method uses smartphone for processing, it makes the system cost effective.

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