AN IMPLEMENTATION OF MOUTH AND EYE DETECTION BASED DROWSY DRIVER WARNING SYSTEM USING VIOLA JONES ALGORITHM

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Abstract— Alertness of driver is very important to reduce the recent accident occurs in the road. Sometimes due to long journey the drivers get tired and suffer from the problems of sleepiness during journey. So it is important for the driver to make them alert when they suffer from this problem. In this work, a technique developed to monitor them during their whole journey. In this work this is done on the basis of detecting their eyes or their body posture. Some of the methods have already designed for the detection of the drowsiness of the driver. The algorithm is designed using MATLAB. This method includes sensor or camera which will capture the image and the captured image would continuously send to the system. In this system we using viola jones method for fast tracking of face and eyes. This system having the customized GUI with hardware working prototype, which shows the fatigue condition of driver.

Index Terms— Arduino, Computer vision library, Image Processing, Matlab, Eye tracking, Viola jones algorithm, Drowsy driver detection.

I. INTRODUCTION

In few decades ago, the mechanism of the vehicles was different and it was different in control due to manual mechanism. But after twentieth century there was revolutionary changes takes place and day by day the vehicles becomes more powerful from the driving point of view. Since, technology to control the vehicles becomes more reliable. Most of the accidents happened due to the problem of drowsiness of the driver, which leads to the sleepiness. Therefore, it is necessary to design a system which can detect the sleepiness, drowsiness and fatigue of the driver. So that these increases curve of the accidents can be reduced. The data of these accidents are collected from the Ministry of Road and Transports. A Display driver drowsiness Warning system [1] through which a system has established. So that the perfect monitoring of the driver can takes place. A visual based system [2] is established so that the monitor through visual is possible. Fatigue of the driver shows negative impact on the abilities of driving vehicle. From the statistics from the govt. it has been analyzed that from all the accidents 50-60% are due to the drowsiness of the drivers. From the statistics it is found that annually almost 1200 to 1300 deaths occurs due to drowsiness or distraction of the driver from the driving. Now days, it becomes very important for us to design the system to avoid this type of activities. This statistics can be reduced by the systems, which are introduced in this work which completely based upon MATLAB. Driving is not an easy task whether it is very complex task because the entire driver's should be alert and monitor the other vehicle driver activities. So that if any incident going to occurred due to laziness or due to any reasons of distraction of the driver from the driving. By taking the correct decision or actions on time that accident can be stopped. Since people give many clues when he/she is fatigue or drowsy. By detecting the signs of sleepiness [9], we can stop the future accident while indicating the driver that the driver is no more in the condition of driving. This drowsiness occurs either due to distraction, due alcohol [14] or due to tension etc. A new technologies are designed which can detect those activities or capture the sign of the drowsiness. The human being body gives number of symptom which indicates that the person is fatigue or feeling sleepy. By detecting only those sign this alert system work and intimate the driver for it. There are two ways to detect this drowsiness of the driver, by capturing video of all the activities performed by the driver's and continue capturing of the image and comparing it with the reference image whatever is stored as a database in it. The term drowsy or sleepy is same. Mostly the activities of the eye will categories between the person who feel sleepy or who is not. The stages of sleep can be categorized as non-rapid eye movement (NREM) and rapid eye movement (REM) basis. The NREM defined by these three stages. Transition of the state of awake to a sleep (Drowsy), Light sleep and Deep sleep.

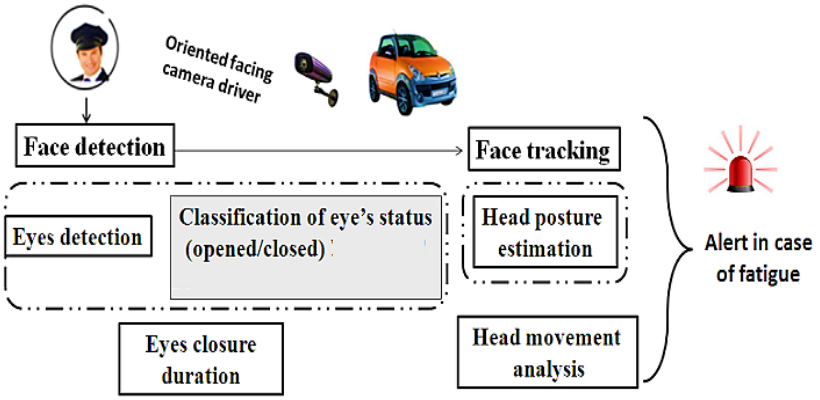

Figure 1: Framework of the Eye-Tracking based drowsy driver system

Objective:

The main objective of this work is to design a system which can completely avoid the road accidents, which occurs due to drowsiness or sleepiness or fatigue of the driver by continuously monitoring on the body posture, facial expression or the movement of the eyes.

II. SYSTEM METHODOLOGY

We use viola-jones algorithm for detection of drowsy driver detection. it is based on machine learning approaches , Where we can train many positive and negative images using cascade function. This algorithm is use to detect the object from the real time capture images and video. We need extract feature images from it. Each of feature having a single value which is obtained by subtracting the sum of pixels under custom rectangle from the sum of pixels under black rectangle.

The function of this proposed system contains various stages such as skin color detection, face detection, mouth detection and eye detection etc. We will discuss all the blocks one by one to understand the complete process of detection of eye and mouth. So that the road accident due to drowsiness[10] can be avoided. For the proper detection of the status of eye and mouth or the facial expression a web cam is installed with are the controlled by computer vision.

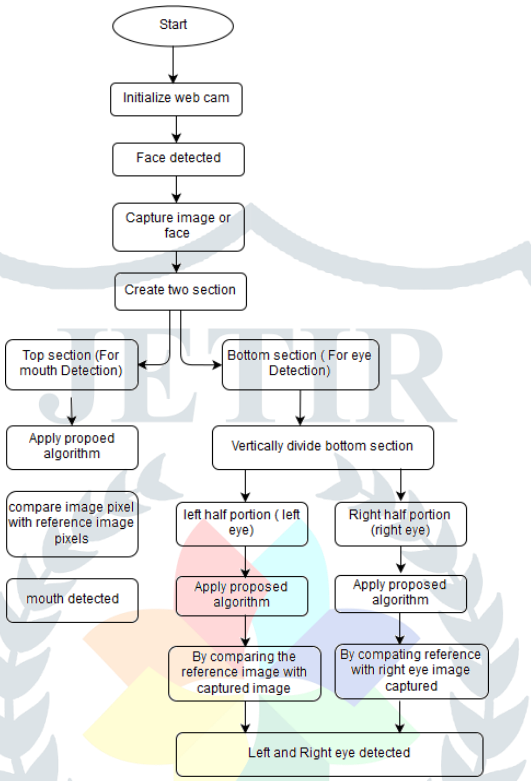

Figure 2: Flow diagram of mouth and eye detection

1. Acquisition of images

This is the process of the acquiring image from web cam or the camera whatever is installed for the proper monitoring of the face. After acquiring facial image, preprocessing is performed.

2. Face width detection

To detect the complete width of the face, lateral analysis of the image captured is done. Width are detected on the basis of change in pixel pattern and white pixels. Once this width is captured the image is separated into two half depending upon these values of the pixels.

3. Crop image

When the facial image is captured, the image is cropped between two sections based on the average height using cropping tool. The first section contains the eyes segments and the second section contains mouth section.

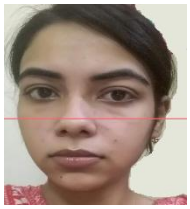

Figure 3: Cropped captured image into two section

4. Mouth detection:

This section is detected based on the coordinate system which are required for the better allocation of the all the pixels response for the detection of the mouth expressions. Now the poster of mouth will be either open or close. Depending upon either these two positions of the mouth, out algorithm will work.

Mouth open:

When mouth is opened. First of all, it is not necessary that if mouth is opened then the condition of sleepiness is present there. So continuous monitoringof the image produced by this section is done. [7] If the mouth found open for repetation of time it is case of the drowsiness. The open condition of mouth is detected means the black pixels in binary image will be large in comparison to the reference

frame. This difference cannot be more than 6 percent of the pixels which is black in the ideal frame. If the mouth opens for consecutive 2 seconds as per the frames selected, it means the person is yawning and in this case the response to warn the driver will be generated.

Figure 4: Mouth open detection

Position of Head detection

If the head is lowered then the normal level, or turned the number of pixels of the skin decrease as compared to the reference or ideal frame. If head is found to be in different directions for at least 2 seconds, it means the person is leads towards accident and the alert warning will be generated.

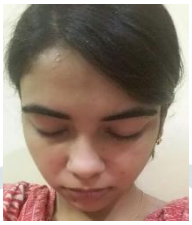

Figure 5: Head Lowering Position

5. *Preprocessing*

The preprocessing operations defines the operation performed before the further examination of the face takes place like detecting eye, mouth and head. It includes the processing of a image captured to increase the processing speed as per the capacity of the memory and removal of noise. This method uses the techniques called compression and expansion of the image to perform the drowsiness detection. White pixels represent the actual portion of the face whereas the black pixels represents noise present with the desired pixels. After digitization of the facial image, the procedure to remove noise is used which involves an expansion of image processing method, this is done with the help of the median filter. These preprocessing operations are enough to support the detection of the vertical positions of the eyes. The eye contraction is used when the eye come back to its actual position i.e. when the eye gets open.

6. *Eyes Detection*

Eye tracking

The high speed processing, to eliminate the processing of each frame to detect the position of eye from the captured image, to obtain this a new function is used. This function is used in such a manner that the actual position of the eye can be tracked by recognizing the area which becomes impossible to track without using this function. [8] The eye tracking is a concept which defines the area of the facial image where eye search is made as per the central coordinated of the eye. This is necessary for this tracking system is to track the data from the captured image and compare it with the reference image. To track the actual position of the eye, by detecting the next frame so that actual information can be obtained. The degree of openness will decide the tracking of the eye whether it is correct or not. If the degree of openness of eye varies between the specified range. Similarly, if eye remains out of range which means it is not traced correctly. The region of eye will start from some initial points so to detect this points a coordinate system is required. Once the image is captured, at specific distance from the head and mouth the position of the eye are located. Let this distance is (0.5 * height of captured image) from the top and (0.25 * width of captured image) from the left. The size of window is (0.35 * height of image) in height and (0.58 * width of image) in width. Before detecting the eye, the conversion is done. The specified configuration represents a complete frame of the image which are capture and over which all the operations are need to be performed.

Eyes Closed:

Figure 6: closed eye position

The black pixels are detected when the eye is closed instead of getting white pixels. If the eye closed for 2 seconds the warning to the drivers produced and the alarm or buzzer will start so that the driver may know his position and stop the vehicles, to stop the accident which can be occurred if the driver will not stop the vehicle.

III. TESTING AND IMPLEMENTATION

Although the performed tests are repeatable and provide objective quantitative results, the subjective appraisal of the algorithms by a user operating wheel chair using eye controlled interaction system could be completely different. Therefore we created the Eye Tracker application using Matlab platform, which is a part of eye driven interface and allows testing eye pupil location algorithms on real time person images. The main objective of this system is to enable wheel chair movement operation based just on eye movement.

The movement of eyes changes the position of wheel chair. The application settings allow for the selection of one of the described eye pupil location methods. Therefore users are given possibility to test and assess usefulness of the chosen algorithm in their own conditions.

Experimental Setup:

To evaluate the performance of the face detector and eye detector of the eye gauge system under variations in lighting conditions, viewing angle and distance to the experimenter, the experimental set-up was as follows. The experimenter was situated in front of a 15-inch laptop. The screen of the laptop was put in the upright (vertical) position. The top of the screen contained a webcam, built into the laptop. The eyes of the experimenter were positioned at the same level as the webcam. The initial distance between the experimenter and the screen was 60 cm. The initial horizontal angle (α-hor) and vertical angle (α-vert) of the experimenter with respect to the screen normal were 0 degrees. Figure 7 displays a schematic illustration of (a) a top view and (b) a lateral view of the experimental setting.

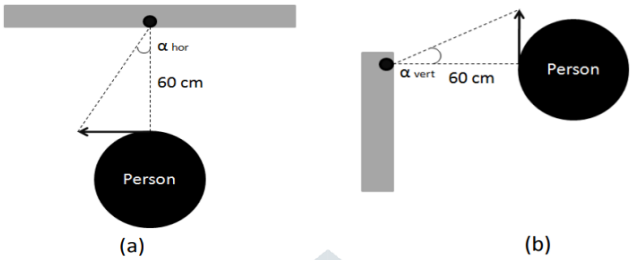

Figure 7: Schematic illustration of the experimental setting showing (a) a top view and (b) a lateral view. The black disk marked "person" represents the experimenter. The black dot in the grey rectangle represents the webcam in the laptop screen.

We design a customized GUI model which having the various function, can be detect and track the real time face and eye of the driving person. Our system is easy to handle and installation process.

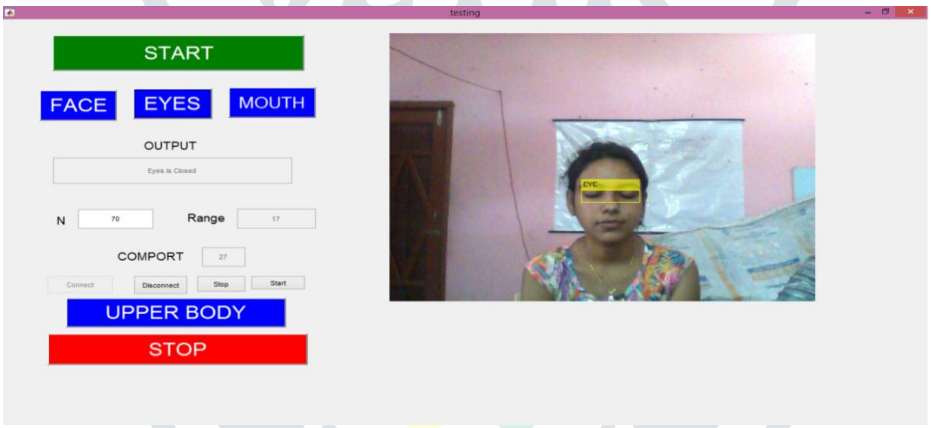

Figure 8: Eye closed condition for Drowsy Status

In eye close condition shows the drowsy statement of the system. In this time driver goes to sleep. When drowsy is recognized then the Matlab sends signal to Arduino for deactivate the car. In our system we implement the Arduino based structure. Where we show prototype model of car, which moves but when we detect the drowsy status, can will be alarm on then after car is stopped.

IV. RESULTS

Prototype of drowsiness detection system was designed using Arduino Uno hard ware and coded in Matlab Platform. It was tested with different subjects and different condition like straight and tilted head and photo copy of the output was shown below.

The result is obtained by taking several position of head like straight, tilted (Right), tilted (Left) etc. We can observe that when the eyes are open squares appears around eye indicating open state of eye. When eyes are closed circle disappears indicating closed state of eye. In both the cases face detection occurs which is shown by a yellow colored square. In the side window the output parallels with one and zero according to the fact that eye is opened or closed respectively.

We having the number of image acquisition and detection result in different back ground. We calculate the results in many person images. We always change the background brightness intensity and the background color for the reasonable output.

Image acquisition Background	**Face Detection**	**Eye Detection**	**Mouth Detection**	**Upper Body Detection**
Normal Light and Plain Background	94%	95%	92%	98%
Normal Light and Dark Background	95%	94%	91%	97%
High Brightness and Multicolor background	95%	95%	93%	99%
High Brightness and Plain Background	97%	96%	96%	100%

Table-1: Accuracy of the image acquisition using webcam in different backgrounds.

V. LIMITATIONS

Dependence on ambient light: The model developed for this purpose strongly depends on the ambient light condition. As our algorithm considers the eye sight as a dark region when it is closed and brighter region when it is open so if the ambient condition affects such that there may be possibility of brighter and darker condition depending on light source then it causes error in the result. Also this model depends on certain minimum level of light condition otherwise it becomes very difficult to detect. To avoid this error we can use either LED light for better detection or we can use an infrared camera.

Distance of camera from driver face: For best result we have assumed and designed the code according to the fact that the distance between camera and face should be nearly 100 cm. Hence the designed set up output may vary from vehicle to vehicle as different vehicle have different types of seat lengths.

Use of spectacles: In case the user uses spectacle then it is difficult to detect the state of the eye. As it hugely depends on light hence reflection of spectacles may give the output for a closed eye as opened eye. Hence for this purpose the closeness of eye to the camera is required to avoid light.

Multiple face problem: If multiple face arise in the window then the camera may detect more number of faces undesired output may appear. Because of different condition of different faces. So we need to make sure that only the driver face come within the range of the camera. Also the speed of detection reduces because of operation on multiple faces.

VI. DISCUSSIONS

We compared three algorithms for eye pupil location. Currently, all of them can be effectively used for gaze tracking and contactless computer operation. Although the other still lacks ergonomics, the technological progress will probably overcome that issue quickly. With better webcam images quality in terms of noise, sharpness and resolution, as well as growing computing power, operating wheel chair using eye gauge.

VII. FUTURE WORK

There is vast scope for this system of drowsiness detection. As there are several signs by which we can say the person is feeling drowsy. To detect the drowsiness several alternatives are available like eye detection, Iris detection, pupil detection, and Eye detection. Out of these options proposed system uses eyes behavior for drowsiness detection. For making the system more strong and efficient one can check the two different behavior together so chances of false identification may reduce. This system can be introduced in an organization like security system, Toll collection counters, importantly at check post.

In future works, a driver's distraction identification system will be developed. With its complex and ever-changing nature, including the effect of the light and the condition of shooting environment, it makes the skin segmentation of human faces in color images severely affect face detection, and also makes it an important research topic.

VIII. ACKNOWLEDGMENT

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