# Real time Driver's Eyes Status Detection using Viola-Jones Object Detection Framework

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***Abstract*- This paper presents improved algorithms for face and eyes detection and mouth in an image. Viola Jones technique and PERCLOS for eye and face detection techniques respectively are widely used. Viola Jones gives accurate face and eye detection but consumes more time whereas PERCLOS technique to understand the eye status consumes less time but lacks in accuracy. Our design is hybrid of both these techniques which increases accuracy while consuming less time. Viola Jones and other methods can accurately detect faces but in case of facial features detection their accuracy decreases. The focus in this research is mainly on increasing using Viola Jones and PERCLOS for face and eyes detection accuracy in detection eyes and their status (close or open) while consuming less time. Lastly we have discussed experimentation results.**

***Keywords- Viola-Jones Algorithm, Haar features, cascade, integral image, PERCLOS***

## I. INTRODUCTION

A number of factors can contribute to a driver becoming excessively fatigued. Lack of quality sleep is the primary cause of driver fatigue, especially when a driver fails to obtain sufficient sleep over a number of days or weeks, working long hours, driving long hours, not taking required rest breaks when driving, night driving. The sad fact is that most of these driving fatigue injuries and deaths could have been prevented if the driver had followed a few safety tips at the first signs of fatigue.

Road users have long been known to fall asleep whilst driving. Driving long hours can induce fatigue causing lack of concentration and occasionally road accidents. There has been done much work on driver fatigue detection system. The recent studies and work that have been done and the techniques and methods used till now. Driver fatigue detection system mainly measures various factors like face features, characteristics (edges and color), eyes status, mouth status (yawning)[3], physiological signals e.g. ECG and EEG[1], head positions and nod and Driving behaviors, such as accelerate, brake, shift and steer[2]. These approaches are presented and discussed in detail. Some typical driver monitoring systems are also introduced in this paper. Finally, a conclusion is presented.

The rest of this paper is organized as follows: Section 2 provides a detailed survey of different fatigue detection methods. In Section 3, details of some typical driver monitoring systems are provided and discussed. Finally, conclusions is presented in Section 4.

## II. EYES STATUS DETECTION TECHNIQUE

Eye Status Detection is catagoriesed into two major approaches that Viola- Jones odject Datection Technique and PERCLOS Technique

### *A. Viola-Jones technique*

Viola-Jones technique [4] is based on analyzing the input image and extracts information based on pixels and helps in detecting features. This window is scaled to detect faces of different sizes in the image. It is a scale invariant detector which runs through the image many times, each time with different size. Being scale invariant, the detector requires same number of calculations regardless of the size of the image. Viola Jones is based on a cascade of detectors. The first stage has detectors which remove only those parts of image which are non-faces. In the following stages the complexity of detectors are increased to analysis the features in more detail. A face is detected only if it is gone through the entire cascade. These detectors are the combination of integral image and Haar like features shown in figure 1.

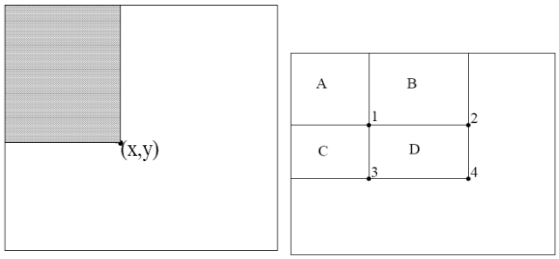



Figure 1. Viola Jones integral image construction.

The first step of this technique is to convert the input image into an integral image. Sum of all pixels above and to the left of a pixel is assigned to that pixel. By doing so, sum of all pixels any rectangle is calculated using only four values. Sum of the rectangle ABCD = D - (B + C) + A

The face detector in Viola Jones method analyzes a sub-window using features. These features consist of two or more rectangles. Each feature gives a single resultant value which is calculated by subtracting the sum of the white rectangle(s) from the sum of the black rectangle(s). Different types of features are shown in Figure 2.

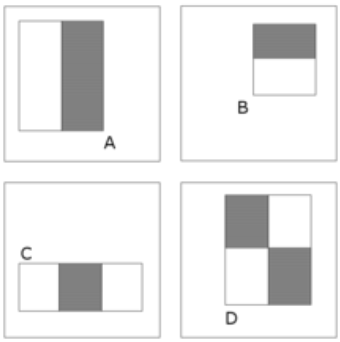



Figure 2. Viola Jones Haar like features.

Viola and Jones used a simple classifier built from computationally efficient features using AdaBoost [26],[27] for feature selection. AdaBoost is a machine learning boosting algorithm that constructs a strong classifier through a weighted combination of weak classifiers. AdaBoost is a technique which helps in combining multiple "weak classifiers" into a single "strong classifier". A weak classifier which gives poor results, but better than random guessing. A simple example might be classifying a person as male or female based on their height. You could say anyone over 5' 9" is a male and anyone under that is a female. Viola-Jones face detection algorithm scans the detector several times through the same image – each time with a new size. The detector detects the non face area in an image and discards that area which results in detection of face area. To discard non face area Viola Jones take advantage of cascading. When a sub window is applied to cascading stages, each stage concludes whether the sub window is a face object or not. Sub windows which contain some percentage of having faces are passed to next stage and those which are not faces are discarded. Final stage is considered to have a high percentage of face objects.

*B. PERCLOS Technique*

In this step the status of the eye is detected using PERCLOS principle. PERCLOS used to judge whether drive is driving fatigue. PERCLOS is the abbreviation for Percentage of Eyelid Closure over the Pupil over Time, which is ratio of eyes close time per time. The ratio in PERCLOS method can represent fatigue, and is the most potential, the best method to detect driving fatigue [5]. The evaluation is done for three cases, i.e., eyes are open, eyes 80% close and eyes are completely close which are used as the evaluation criteria. Figure1 shows PERCLOS measuring theory. That is t1~t4 is measured. And calculated as show in formula 1

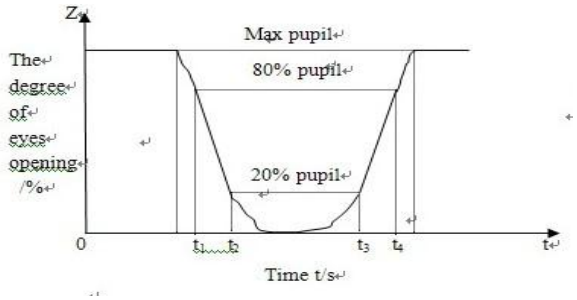



Figure 3. PERCLOS measuring theory

Where, f Percentage of eye close time, that is PERCLOS, t1 spend time from open the maximum to close 80% of pupil opening, t2 spend time from open the maximum to close 20% of pupil opening, t3 spend time from open the maximum to open 20% of pupil opening, t4 spend time from open the maximum to open 80% of pupil opening. This measurement method is as follows. First face image of driver is extracted by camera, then eye image is obtained by image processing, and then open or close of eye is determine after image analysis and recognition, finally more than 20% of pupil open is defined as eye open, otherwise as eye close. Opening size of pupil is measured through calculation of eye area that is defined as pixels number of eye region (horizontal edge pixels×vertical edge pixels). If PERCLOS is more than 40%, that is closure time of eye is more than 3s, then it shows that driver is fatigue[6].

*C. Proposed System*:

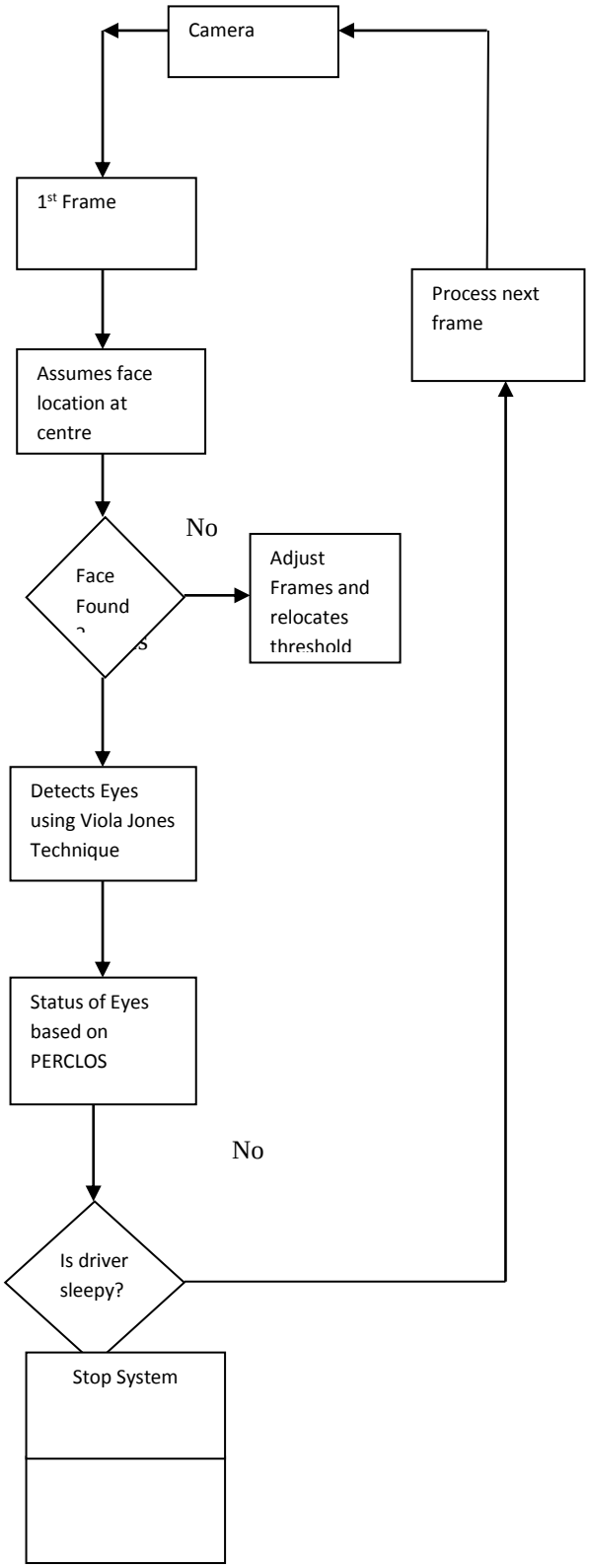



Figure 4 Flow chart for the Proposed System

## III. EXPERIMENTS AND RESULTS:

In this paper, the camera is set up on LCD monitor. User being in front of the monitor imitates the situation of driver sitting in front of dashboard when driving. The camera faces to driver to catch images, such as figure 5.

Figure 5. System Development of Simulation

Figure 6(a) and 6(b) is results of driver fatigue recognition. We use rectangular blue box to frame the face and white and yellow box to frame left and right eyes. In this paper, we can recognize driver's physiological state by combining with eye's feature and fuzzy logic and warn driver when they are fatigued.


Figure 6. Eye Status when driver is conscious


Figure 7. Eye Status when driver is conscious

According to 6 of figure 23, when the driver's physiological condition is normal in the screen, the system will determine that the driver is conscious; moreover, it will show message in the graphic user interface. Otherwise, when the driver is slightly fatigued, the system will change message into 'Eye is not found' to remind driver, as shown in 7. Furthermore, the system will trigger alarm to warn the driver to pay much attention or take a rest when the driver is tired seriously or drowsy.

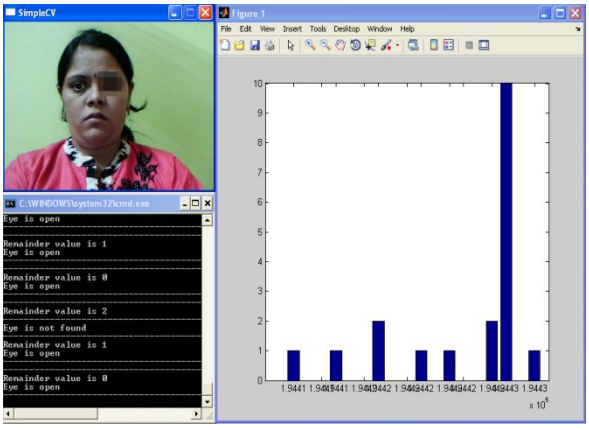



Figure 8. Eye Status when driver is conscious

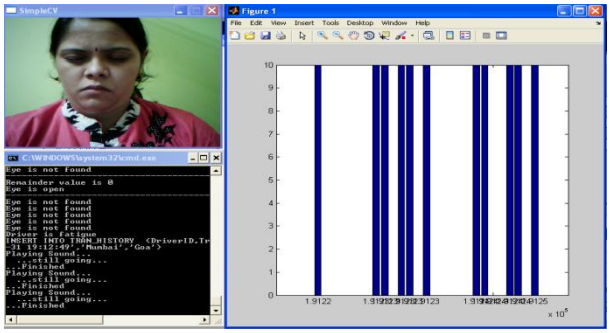
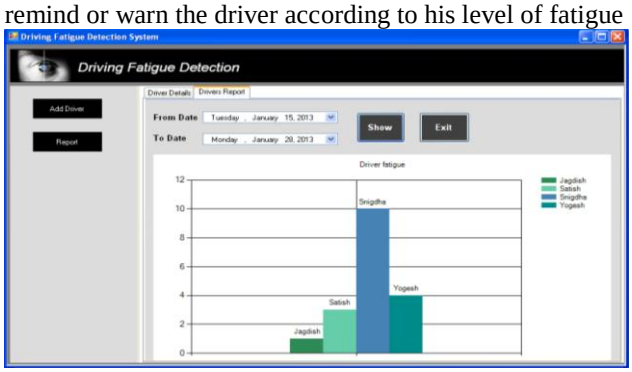



Figure 9. Eye Status when driver is conscious

Figure 8 and figure 9 are different samples of driver fatigue recognition. Figure 10 show complete analysis of multiple drivers and their alertness while driving at particular period of time. The system can work well on different drivers and analyze drivers' physiological condition precisely. It will remind or warn the driver according to his level of fatigue




## IV. CONCLUSION

This paper presents a system of drowsiness detection for driving car. Its main functions are face detection, feature extraction, warning of fatigue, and photograph for recording.

The system can find the positions of face and features in different light conditions and backgrounds and further issue warning. In the future, we still have to add up much environmental factors to improve the system and make it nearer to commercialization.

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