Eye Blinking and Yawning Detection for Drowsiness Driver

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***Abstract*: Driver drowsiness is one of the critical causes of roadways accidents nowadays. Thus fatigue and drowsiness detection play vital role in preventing the corresponding road accidents. Over the last decade, many image processing based approaches were developed to detect driver's fatigue and drowsiness status. These approaches mainly focus on the extraction of the driver's face and predict the eye blinking rate from the eye region and the yawning rate from the mouth region. However, these features are not necessarily the best to describe the driver's fatigue level, because from one side, some drivers may have imbalanced eye blinking rate due to medical issues, and from the other side, some drivers may have high yawning rate while they have fully driving attention. In this paper, an online face monitoring system was installed and a large list of eyes area features was extracted in spatial and frequency domain including two new features which are circularity and black ratio. Four support vectors machine classification models were developed based on combinations of the relevant features. The analysis of these models showed that the highest accuracy (91.3%) was achieved when the wavelet coefficients, texture features, circularity, and black ratio are employed. The results of the proposed approach indicated its promising inline implementation into car cabin to decide the driver's drowsiness status.**

***Index Terms*: Driver Face Detection, Driver Eye Detection, Driver Yawning Detection, Driver Drowsiness.**

I. INTRODUCTION

Driving is a challenging task where the driver has to be vigilant to take the current decision on time to other drivers' actions and different road conditions. A common activity in most people's life is driving; therefore, improving driving (making driving safe) is an important issue in everyday life. Even though the driver's safety is improving in road and vehicle design, the total number of serious crashes is still increasing. Reducing the number of vehicle crashes would benefit to save life of millions people around the world. Vigilance is the state of wakefulness and ability to effectively respond to external stimuli. and crucial for safe driving. Recently many countries have noted the importance of improving driving safety. Developing vision based warning systems for drivers is an increasing area of interest. Computer vision has gained a lot of importance in the area of face detection, face tracking, eye detection, Yawning detection [1] for various applications like security, fatigue detection, biometrics. As per RTI data, around half million accidents occur in a year, in India alone. Further, around 60% of these accidents are caused due to driver fatigue (drowsiness). As per the survey reports of Road Traffic Injuries (RTI) the road accident ranked fourth among the leading causes of death in the world. Nearly 1.3 million people [2] die every year on the world's roads and 20 to 50 million people suffer non-fatal injuries, with many sustaining a disability as a result of their injury. According to forecasting of statistics the number of road accident will increase to 5 million in 2020. A common activity in most people's life is driving; therefore, improving driving (making driving safe) is an important issue in everyday life. In this paper a simulation and analysis of fusion method has done to increase drowsiness detection efficiency, merging the eye closure and yawn detection results for a more intelligent decision. The proposed method is based on the facial features of the driver captured by a camera installed in front of the driver.

II. PROPOSED APPROACH

The driver fatigue detection procedure consists of different phases to properly analyze changes in the mouth of the driver. These phases are categorized as follow and each phase will be introduced in detail in the following sections:

1. Face Detection
2. Eye Detection
3. Mouth Detection
4. Face Tracking
5. Yawning Detection

The overall system diagram is shown in Figure 1. The details of each step will be further explained in the following subsections

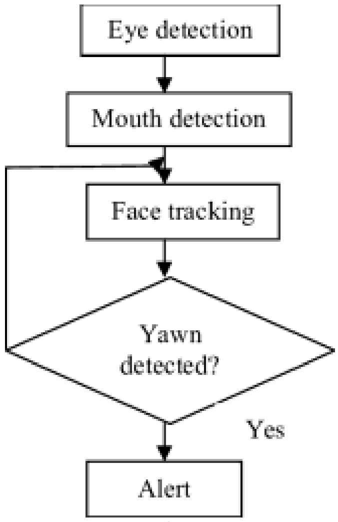


Fig 1: System diagram

III. FACTORS CAUSING DRIVING DROWSINESS

Driver Fatigue is often caused by four main factors: sleep, work, time of day, and physical. Often people try to do much in a day and they lose precious sleep due to this. Often by taking caffeine or other stimulants people continue to stay awake. The lack of sleep builds up over a number of days and the next thing that happens is the body finally collapses and The person falls asleep. Time of day factors can often affect the body. The human brain is trained to think there are times the body should be asleep. These are often associated with seeing the sunrise and sunset. Between the hours of 2 AM and 6 AM, the brain tells the body it should be asleep. Extending the time awake will eventually lead to the body crashing. The final factor is a person's physical condition. People sometimes are on medications that create drowsiness or have physical ailments that cause these issues. Being physically unfit, by being either under or overweight, will cause fatigue. Additionally, being emotionally stressed will cause the body to get fatigued quicker

IV. DEVELOPED SYSTEM

The different steps involved in the algorithm of the developed system are as follows:

1. Capturing video frames using the web camera
2. Face detection and extraction

Each of these steps is explained in the following sections in detail.

A. Capturing Image using the web camera

In the first step, the video of the subject under test is captured using the web camera. The video captured is stored as a collection of frames (images). Each of these frames are extracted and processed separately.

B. Detection and extraction of face image

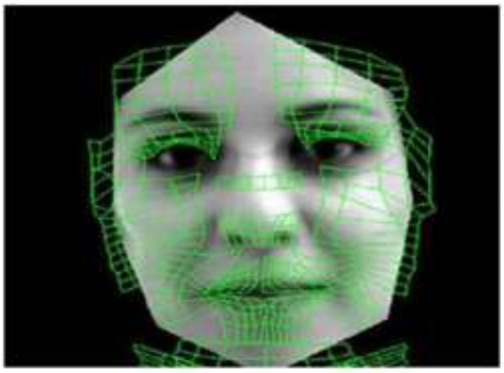
From the video frames captured by the web camera, the faces are extracted. For this, the face detection method of Haar based cascade classifiers proposed by Viola and Jones is used.

1) Haar features:

The face detection method uses Haar features for face detection. Haar features are extracted by using a set of rectangular black and white windows. The black color has a weight of -1 and the white region has weight 0. The windows are first applied to the image and corresponding values are multiplied with the pixel intensities. Then these values are added together, and the Haar feature corresponding to the window used is obtained. But all the Haar features extracted are not required for successful detection of faces. Hence a boosting algorithm is used to find the most important features that can be used for face detection.

2) Cascade classifiers:
Once the Haar features are obtained then individual classifiers are built based on the values of each Haar feature. These individual classifiers are then arranged into a cascade classifier. A cascaded classifier is combination of several classifiers arranged in the different stages cascaded on after one another. The number of classifiers in each stage and their threshold values are determined by the boosting algorithm during the training of the classifiers with labeled face images. The cascade classifier used here has 22 stages and a total of 2135 features.

3) Face detection:
The general structure of the cascade classifier is given in Fig 2. A certain number of features are checked at each stage of the cascade classifier. When a region of the image is taken it is first checked using the first stage of the cascade classifier. If the image region fails to pass the first stage it will be rejected as it does not contain a face else it will be passed to the next stage. If the face region satisfies all the stages then the region is classified to have a face in it. The advantage of using a cascade classifier is that it can reduce computational load as each stage need only a certain set of the features to be extracted rather than the entire set of 2135 features extracted together.



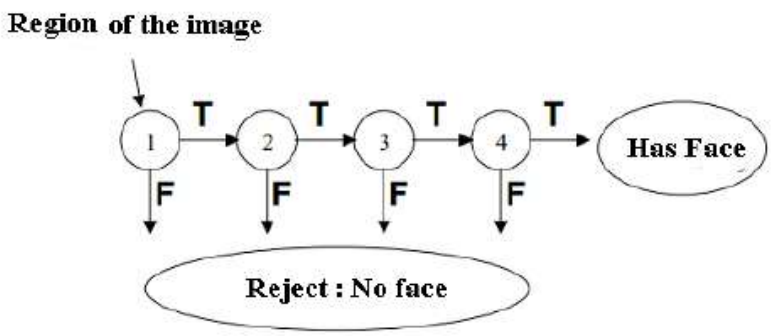
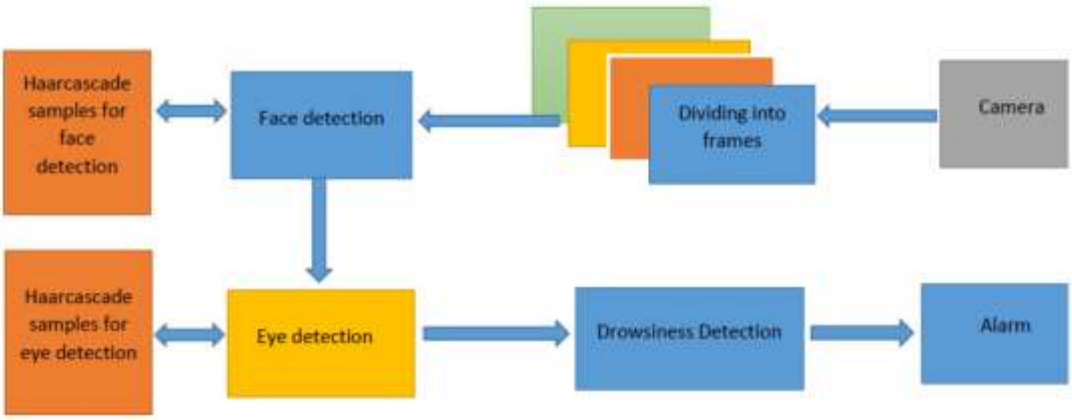


Fig 2: Geometric ratios of human face

V. SYSTEM ARCHITECTURE



VI. CONCLUSION

The Simulated system used to detect eye blink and yawning for driver's drowsiness using Viola Jones and Active Contour Method respectively. The performance of the system was measured in different light conditions for different subjects i.e without eyeglasses, with eyeglasses, without moustache and with moustache. This system easily detects the face and eye and mouth of a driver. A non intrusive visual based system is developed to locate eyes and mouth and determines the driver's drowsiness level through horizontal average intensities of the eyes and mouth region at face.

During monitoring the system is able to detect when the eyes are closed and mouth open simultaneously for too long and again and again in less period of time thus giving a buzzer sound to alert the driver. Also the system alerts the driver if he closes his eyes for long time which is giving information that the driver might have slept. The blinking of eye has been detected at a very high rate because independent haar classifiers are used for the eyes and Active contour method for yawning. Most recent 100 frames are analyzed and the average positive and negative alert were determined. The experiment was conducted for 20 days. The whole day was divided into 6 section (morning, afternoon, critical time 1, evening, night and critical time2). The female participants were given the same setups, webcams and programs for night and late night experiments. The eyes blinks were detected more accurate for the driver without eye glasses. The positive alert without eye glasses was best recorded in critical time 1 (92%) for 18-25 age driver and the negative or no alert was more for the with eye glasses in critical time 2(32%) for 50-60 age driver. In Mouth detection The positive alert without moustache was best recorded in critical time 1 (88%) for 50-60 age driver and the negative or no alert was more for the with moustache in critical time 2(29%) for 18-25 age driver.

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