Driver Fatigue Monitoring & Warning System using Eye Tracking

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Abstract— The main purpose of this paper was to device a way to alert drowsy driver during driving. One of the cause of car accident comes from drowsiness of the driver. Therefore, this study attempt to calculate the level of drowsiness. The frequency of blinking of the eyes was used to determine whether or not a driver felt drowsy. We will propose an algorithm to locate, track and analyze eye to measure drowsiness associated with slow eye closure. Driver fatigue usually becomes a right away reason for several traffic accidents. Therefore, there is a need to develop the systems that will detect and notify a driver of her/him bad psychophysical condition, which could significantly reduce the number of fatigue-related car accidents. However, the event of such systems encounters several difficulties associated with quick and correct recognition of a driver's fatigue symptoms. One of the technical potentialities to implement driver temporary state detection systems is to use the vision-based approach.

Key words: Drowsiness Detection, Face Detecion & Tracking, Eye Detection and Tracking, Eye state, Eye Closure Detection

I. Introduction

Fatigue reduces a driver's attention, especially when driving long distances or at night, when reaction ability declines. The fatigue effect is a common, yet dangerous, driving experience that may even include a few seconds of shallow sleep. In response to this problem, several automobiles have begun installing onboard computers in their cars featuring a driver drowsiness detection system.

Currently, detecting driver drowsiness systems can be classified into two categories: contact types and contactless types. Contact types include measuring the pulse or body temperature, while detecting and analyzing the driver's facial expression is a standard contactless type. However, the products requiring physical contact are inconvenient for drivers and easily forgotten. On the other hand, most commercially available contactless driver drowsiness detection systems and related products use visible light to achieve face detection. During the day, they do not affect drivers; nevertheless, at night, since these systems need to gather the skin-color region, they are likely to increase the burden on driver's eyes since extra light was projected on the driver's face to properly obtain color images. Every person has a unique frequency and speed when blinking.

In order to build a personal fatigue model, the time proportion of this person's blink frequency and speed must be computed. This study develops a period of time sleepiness detection system supported grayscale image process and PERCLOS to work out if the motive force is worn out.

The projected system includes 3 parts:

1) it calculates the approximate position of the driver's face in grayscale images, and then uses a small template to analyze the eye positions;
2) it uses the data from the previous step and PERCLOS to establish a fatigue model; and
3) Finally, based on the driver's personal fatigue model, the system continuously monitors the driver's state. Once the driver exhibits fatigue, the system alerts the motive force to prevent driving and take a rest.

II. Literature review

Walid Hussein, M. Samir Abou L-Seoud, the British University in Egypt. [1]: The eye elements cannot be separately identified, and therefore, As a result and for simplicity, the deformable template method is applied to approximate the template which bound the eye area.

Jun-Juh Yan, Hang-Hong Kuo, Ying-Fan Lin, Teh-Lu Lio, Neo Victory Technology PVT. LTD, Taiwan, R.O.C [2]: They proved that a median filter can remove very large or very small data from center of eyes and face width sequences; therefore it can inhances the accuracy of result.

Walid Hussein, M. Samir Abou L-Seoud, The British University in Egypt. [1]: The white background of the iris covers more pixel in the instant of open eye than the instant of closed eye. Therefore, the black ratio is calculated by dividing the sum of eye block image over the sum of the face rectangle image.

Barış Guksa and Burcu Erkmen Faculty of Electrical & Electronics Engineering Yıldız Technical University Istanbul, Turkey [3] : In the learning process of haar-cascade classifier, the image in which the face exists is called positive image. The image in which the face doesn't exist is called negative image. In the classifying process, the face in the positive image is scanned by the frames, which are regulated in certain sizes, as stated below. Face area is tried to be detected by controlling dark and light values from the sum of pixel values in the dark area and from the sum of pixel values in the white area in it.

Jun-Juh Yan, Hang-Hong Kuo, Ying-Fan Lin, Teh-Lu Lio, Neo Victory Technology PVT. LTD, Taiwan, R.O.C [1] The iris region and eyelashes are darker than the skins and whites of the eye. And when the eyelids are closed the number of black pixels much less than when they are open.

III. Proposed system

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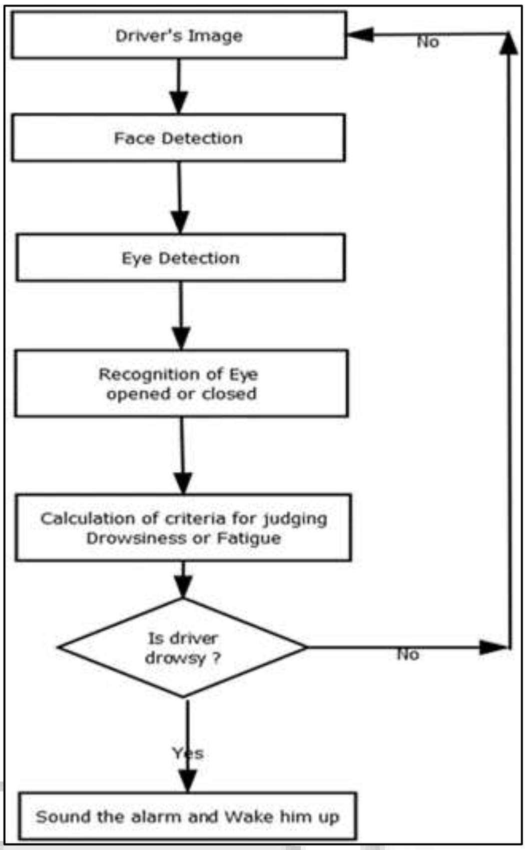

Fig. 1: Structure of Driver Fatige Detection

On the other hand, most commercially available contactless driver drowsiness detection systems and related products use visible light to achieve face detection. During the day, they do not affect drivers; nevertheless, at night, since these systems need to gather the skin-color region, they are likely to increase the burden on driver's eyes since extra light was projected on the driver's face to properly obtain color images. Every person has a unique frequency and speed when blinking. In order to build a personal fatigue model, the time proportion of this person's blink frequency and speed must be computed.

he next step is to calculate the personal information of blinking to determine when the time proportion of eyelids are closed more than 80 Percent. In order to ensure reliable results, the system requires several minutes of image capturing, the images of which are then separated into either the CLOSED or OPEN state.

$$TP=NC/(NC+NO)$$

where TP is the personal standard time,

- NC is the number of images in the CLOSED state,
- NO is the number of images in the OPEN state.

This system captures live images of the eyes. Our population is increasing exponentially in the country. The biggest problem regarding the increased traffic is the raise in number of road accidents. Road accidents are undoubtedly a global problem in our country.

A. *Eye Detection*

An explanation is given here of the eye detection procedure. After inputting a facial image, pre-processing is first performed by binarizing the image. The top and sides of the face are detected to narrow down the area of where the eyes exist. Using the sides of the face, the centre of the face is found, which will be used as a reference when comparing the left and right eyes. Moving down from the top of the face, horizontal averages (average intensity value for each y coordinate) of the face area are calculated. Large changes in the averages are used to define the eye area.

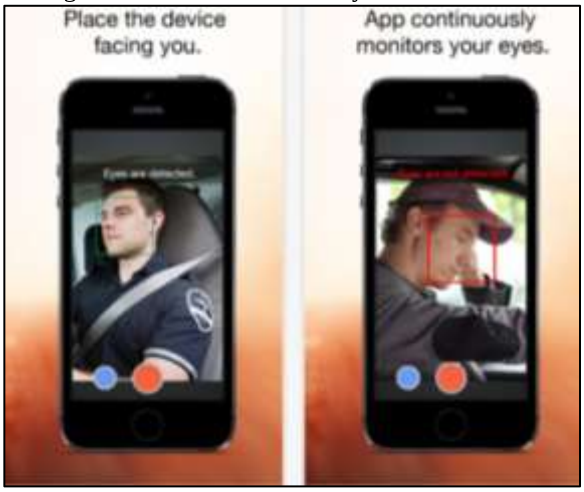

Fig. 2: Application Front View

Binarization The first step to localize the eyes is binarizing the picture. Binarization is converting the image to a binary image. Example of binarized image is shown in Fig 3.

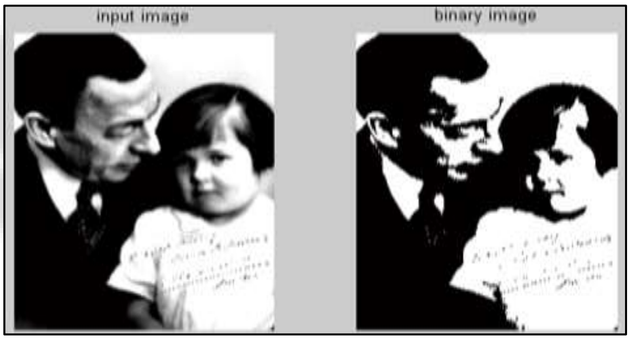

Fig. 3: Conversion from Grayscale to Binary Image

B. *Drowsiness Detection*

The state of the eyes (whether it is open or closed) is determined by distance between the first two intensity changes.

When the eyes are closed, the distance between the y – coordinates of the intensity changes is larger if compared to when the eyes are open.

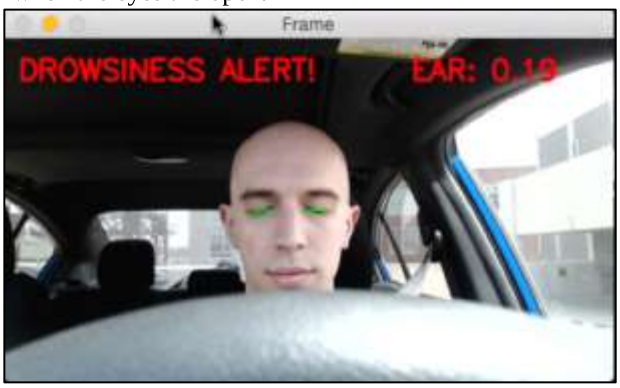

Fig. 4: Drowsiness Detected

IV. ALGORITHM

1) Camera input to our project.
2) The Facial Recognition file also as an input to recognition engine.
3) Recognised face region + eye recg .xml as input to recg eng.
4) Apply TP = NC(NC + NO) where TP is Personal Standerd time. While NC is No of images in closed state. And NO is the No of images in opened state. Used Hough Circle transform to recognised eye region.
5) If eyeball not detected for 5s then generate alarm.
6) Repeat from step 1.

This system can discover a driver fatigue by process of eye region.

If eyes are blinking ordinarily no warning is issued however once the eyes ar closed for more than 3 second this system issues warning to the driver in form of alarm.

V. ADVANTAGES

1) This model is straightforward and straightforward to know and use.
2) It is easy to manage due to the rigidity of the model each phase has special deliverables and a review process.
3) In this model phases ar processed and completed one at a time.Phases do not overlap.
4) Waterfall model works well for smaller comes wherever necessities ar terribly
5) Well un-derstood.

VI. CONCLUSION

The fatigue detection system in drivers has thus been simulated in Open CV and further implemented on the TI OMAP board. The real time system has been successfully created to detect the face and hence the eyes and mouth of the driver to check whether he is blinking or yawning to acquire information about his level of alertness.

The camera fixed near the headboard of the driver continuously captures images of the driver and these images are one by one processed. If the eyes are detected to be closed in more than 5 consecutive frames, the necessary buzzer sets off. However, the only alarm that has been implemented is a buzzer to alert the driver and we have not interfered with the actual working and performance of the vehicle.

The system has been tried and tested in different lighting conditions and with different people with varied facial characteristics. It has been experimentally found that absolute accuracy is achieved when the lighting conditions are bright and favourable.

The biggest drawback experienced till now is the presence of beard or sunglasses or spectacles on the driver's face. This interferes with the detection of eyes and mouth and may lead to false triggering. This system is real time and checks the state of the driver all through the journey. In order to have efficient usage of the available memory, once the earlier images that have been captured are processed, they are discarded to make way for next images. This reduces the memory requirements and makes the system faster.

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