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Drowsiness Detection System for Car Assisted Driver Using Image Processing

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Abstract: **Driver in-alertness is an important cause for most accident related to the vehicles crashes. Driver fatigue resulting from sleep deprivation or sleep disorders is an important factor in the increasing number of the accidents on today's roads. Drowsy driver warning system can form the basis of the system to possibly reduce the accidents related to driver's drowsiness. The purpose of such a system is to perform detection of driver fatigue. By placing the camera inside the car, we can monitor the face of the driver and look for the eye-movements which indicate that the driver is no longer in condition to driver is no longer in condition to drive. In such a case, a warning signal should be issued. This paper describes how to find and track the eyes. We also describe a method that can determine if the eyes are open or closed. The main criterion of this system is that it must be highly non-intrusive and it should start when the ignition is turned on without having at the driver initiate the system. Nor should the driver be responsible for providing any feedback to the system. The system must also operate regardless of the texture and the color of the face. It must also be able to handle diverse condition such as changes in light, shadows, reflections etc. In given paper a drowsy driver warning system using image processing as well as accelerometer is proposed.**

Keywords: **Drowsiness Warning System, Accident, Eye detection, Face detection.**

I. INTRODUCTION

DRIVERS' drowsiness has been implicated as a causal factor in many accidents because of the marked decline in drivers' perception of risk and recognition of danger, and diminished vehicle-handling abilities. In 2002, the National Highway Traffic Safety Administration (NHTSA) reported that about 0.7% of drivers had been involved in a crash that they attribute to drowsy driving, amounting to an estimated 800 000 to 1.88 million drivers in the past five years. The National Sleep Foundation (NSF) also reported that 51% of adult drivers had driven a vehicle while feeling drowsy and 17% had actually fallen asleep. Therefore, real-time drowsiness monitoring is important to avoid traffic accidents. Previous studies have proposed a number of methods to detect drowsiness. They can be categorized into two main approaches. The first approach focuses on physical changes during fatigue, such as the inclination of the driver's head, sagging posture, and decline in gripping force on the steering wheel. The second approach focuses on measuring physiological changes of drivers, such as eye activity measures, heart beat rate, skin electric potential, and electroencephalographic (EEG) activities.

II. METHODS FOR DETECTION

Techniques can be divided into following categories

1. Sensing of physiological characteristics

2. Sensing of driver operation

3. Sensing of vehicle response

4. Monitoring the response of driver

The technique of sensing of vehicle operation is well suited for real world driving conditions since it can be non-intrusive by using optical sensors of video cameras to detect changes. Above mentioned first technique is not realistic since the sensing electrodes would have to be attached directly to the driver which will distract the driver. Even long time driving in summer may lead to perspiration on sensors, diminishing their ability to monitor accurately. Driver operation and vehicle behavior can be implemented by monitoring the steering wheel movement, accelerator or brake patterns, vehicles speed, lateral acceleration and lateral displacement which is also non-intrusive ways. The last one is by monitoring the response of driver which included periodically requesting the driver to send a response to the system. Among the techniques mentioned above, the best one is sensing of physiological characteristics phenomena. This technique will be implemented in two ways.

1. Measuring Changes in physiological signals, such as brain waves, heart rates and eye blinking.

2. Measuring physical changes such as sagging posture, learning of the drivers head and open or closed state of the drivers.

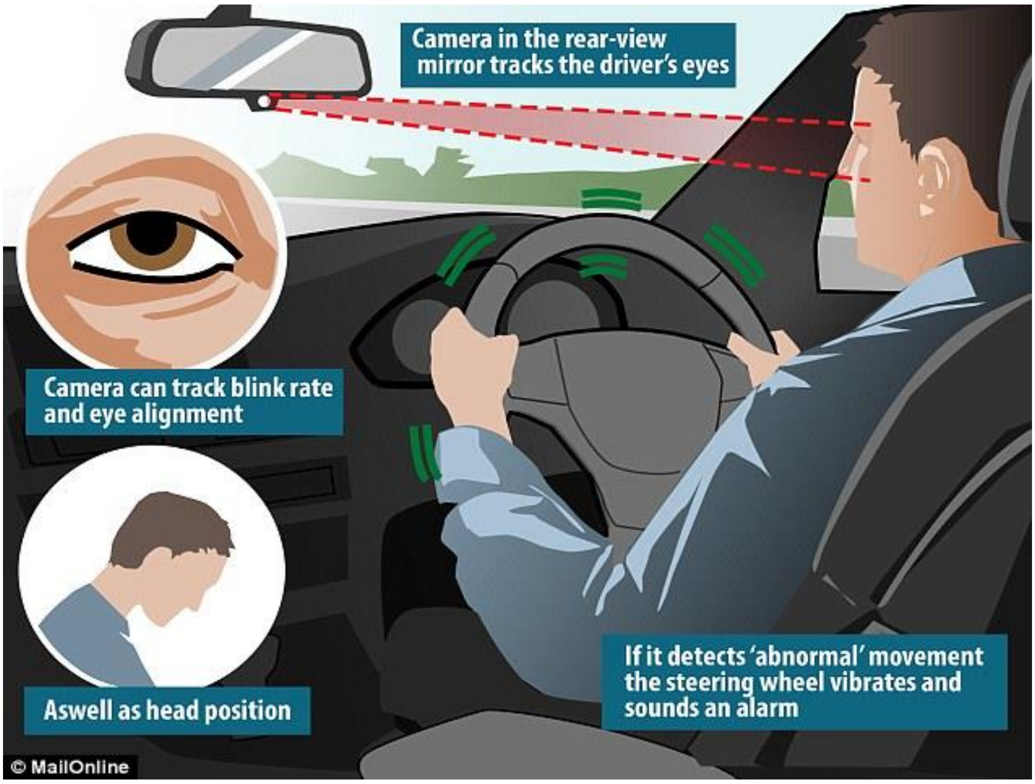


Fig. 1: Driver Drowsiness Detection System

To analyze driver's drowsiness several systems have been built. They usually require simplifying the problem to work partially or under special environments, for example D. Taneral presents an automatic drowsy driver monitoring and accident prevention system that is based on monitoring the changes in the eye blink duration. He proposed the method that detects visual changes in eye locations using the proposed horizontal symmetry feature of the eyes. This new method detects eye blinks via a standard webcam in real-time at 110fps for a 320×240 resolution. Flores Javier macro et al has presented a new Advanced Driver Assistance System (ADAS) for automatic driver's drowsiness detection based on visual information and Artificial Intelligent. This system works on several stages to be fully automatic. In addition, the aim of the algorithm is to locate and to track the face and the eyes to compute a drowsiness index. Garcia .i e has presented a non-intrusive approach for drowsiness detection, based on computer vision. It is installed in a car and it is able to work under real operation conditions. An IR camera is placed in front of the driver, in the dashboard, in order to detect his face and obtain drowsiness clues from their eyes closure. It works in a robust and automatic way, without prior calibration. The presented system is composed of 3 stages. The first one is pre-processing, which includes face and eye detection and normalization. The second stage performs pupil position detection and characterization, combining it with an adaptive lighting filtering to make the system capable of dealing with outdoor illumination conditions. The final stage computes PERCLOS from eyes closure information. In order to evaluate this system, an outdoor database was generated, consisting of several experiments carried out during more than 25 driving hours. Sharma nidhi et al. [5] presented a novel approach to alert a driver who tends to doze off while driving to avoid road crashes. In her system using a small camera that points directly towards the driver's face, an image is obtained. From that image, skin region i.e. face is segmented out using YCbCr colour space. Finally localization of eyes is done with fuzzy logic application to determine the level of fatigueness and then warn the driver accordingly.

III. ALGORITHM AND FLOWCHART

The function of the system can be broadly divided into eye detection function, comprising the first half of the preprocess-ing routine, and a drowsiness detection function, comprising the second half. After inputting a facial image, preprocessing is performed to binarize the image and remove noise, which makes it possible for the image to be accepted by the image processor. The maximum width of the face is then detected so that the right and left edges of the face can be identified. After that the vertical position of each eye is detected independently within an area defined by the center line of the face width and lines running through the outermost points of the face. On that basis, the area in which each eye is present is determined. Once the areas of eye presence have been defined, they can be updated by tracking the movement of the eyes. The degree of eye openness is output simultaneously with the establishment or updating of the areas of eye presence. That value is used in judging whether the eyes are open or closed and also in judging whether the eyes have been detected correctly or not. If the system judges that the eyes have not been detected correctly, the routine returns to the detection of the entire face. The following explains the eye detection procedure in the order of the processing operations.

a) Preprocessing:

The preprocessing operations include the binarization of a facial image to increase the processing speed and conserve memory capacity and noise removal. The image processor developed for this drowsiness warning system performs the expansion and contraction operation on the white pixels and processing for noise removal is performed on the small black pixels of the facial images. After the binarization, the noise removal procedure involves an expansion processing method combined with the use of a median filter. These preprocessing operations are sufficient to support detection of the vertical positions of the eyes. However, following identification of the eye positions, the size of the eyes must be converted back to the original image format at the time the degree of eye openness is output. To facilitate that, data contraction is performed in the latter stage of preprocessing.

b) Face width detection:

The maximum width of the drivers face must be detected in order to determine the lateral positions of the areas in which the eyes are present. Face width is detected by judging the continuity of white pixels and the pattern of change in pixel number. On that basis, the outer edges of the face are recognized and determined.

c) Detection of vertical eye positions:

Each vertical eye position is detected independently within an area demarcated by the center line of the face, which is found from the face width, and straight lines running through the right and left outer edges of the face. In a binary image, the eye becomes collection of black pixels, along with the eyebrows, nostrils, mouth and other facial features. These collections of black pixels are recognized on the basis of a labeling operation, and the position of each eye is extracted by judging the area of each label along with its aspect ratio and relative coordinate positions in the facial image. Through this process of detecting each vertical eye position, the central coordinates of each eye are recognized. The coordinates serve as references for defining the areas of eye presence.

d) Eye tracking:

A function for tracking the positions of the eye is an impor-tant capability for achieving high-speed processing because it eliminates the need to process every frame in order to detect each eye position from the entire facial image. This function consists of a subordinate for updating the areas of eye presence and recognizing when tracking becomes impossible. The basic concept of eye tracking is to update the area of eye presence, in which an eye search is made in the following frame, according to the central coordinates of the eye in the previous frame. The updating process involves defining an arc of eye presence on the basis of the coordinates (xk, yk) at the point of intersection of center lines running through the Ferets diameter of the detected eye. The area thus becomes the area of eye presence in which the system searches for the eye in the image data of the next frame. This process of using information on eye position to define the eye position for obtaining the next facial image data makes it possible to track the position of the eye. As it is clear from this description, the size of the area of eye position changes. If the eyes are tracked correctly, their degree of openness will always vary within certain specified range for each individual driver. Consequently, if the value found by the system falls outside the range, it judges that the eyes are not being tracked correctly. The process of detecting the position of each eye from the entire facial image is then executed once more.

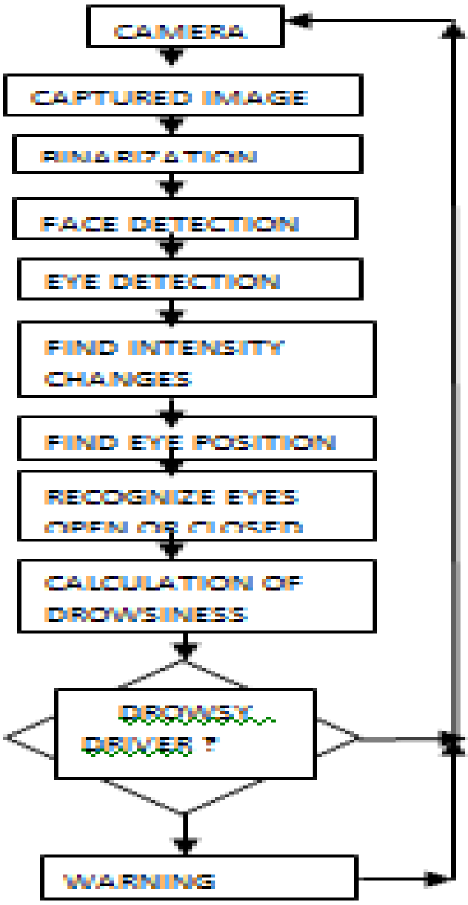
e) Judgment whether the eye are open/closed:

We constructed a template consisting of two circles, one inside the other. A good match would result in many dark pixels in the area inside the inner circle, and many bright pixels in the area between the two circles. This match occurs when the inner circle is centered on the iris and the outside circle covers the sclera. The match M (a1, a2) is computed as M (a1, a2) = I (p, q)- I (p, q) (p, q)a1 (p, q) a2 A low value for M (a1, a2) corresponds to a good match. The template is matched across the predicted eye-region, and the best match is reported. We track the eye by looking for the darkest pixel in the predicted region and thus the driver can be warned if found in drowsy state.

IV. SYSTEM DEVELOPMENT

Fig. 2: Detection of eye

The final system consists of a camera pointing at the driver. The camera is to be mounted on the dashboard inside the vehicle. For the system we are developing, the camera is stationary and will not adjust its position or zoom during operation. For experimentation, we are using a webcam. The grabbed frames are represented in RGB-space with 8-bit pixels (256 colors). We will not be using any specialized hardware for image processing.



System Algorithm:

The first step is the image acquisition which is done by using video camera which takes the video of the driver and convert into image frames. The second step is the face detection, in this we use viola Jones algorithm to detect face Viola-Jones algorithm is based on exploring the input image by means of sub window capable of detecting features. This window is scaled to detect faces of different sizes in the image. Viola Jones developed 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 the third step is eyes detection. Similarly, Eyes are detected by using this algorithm. To detect eyes we first detect nose and then detect pair of eyes. However, the RGB model includes brightness in addition to the colours. When it comes to human's eyes, different brightness for the same colour means different colour. When analysing a human eye, RGB model is very sensitive in image brightness. The next step is to extract the features of eyes i.e. to convert RGB image into YCBCR image: The Cb and Cr components give a good indication on whether a pixel is part of the skin or not. This can clearly be seen in Figure.8, which are the Cb and Cr values of all the pixels that are part of the eye. There is a strong correlation between the Cb and Cr values of skin pixels, to reveal the comparison between eyes and non-eyes in the YCbCr space.

The next step is to calculate the mean and standard deviation of eyes i.e. for open, drowsy and close image.

V. RESULT OF SYSTEM

The original Image and captured image and histogram of projected edges shown below;

Fig 3. The original image, the edges and the histogram of projected edges

VI. CONCLUSION

We developed a system that localized and track the eyes and head movements of the driver in order to detect drowsiness. The system uses a combination of template based matching in order to localize the eyes. During tracking, system will be able to decide if the eyes are open or closed and whether the driver is looking in front. When the will be closed for too long, a warning signal will be given in the form of buzzer or alarm kit message.

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