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Prevention of Accidents Using Driver Alertness System

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ABSTRACT: Road accidents have become more common nowadays due to the increase in growth of the population. There is an occurrence of one death for every four minutes due to a road accident in India. One of the major reasons for road accidents is due to either driver drowsiness or distraction. To overcome such accidents some novel method has to be developed that is feasible to all vehicle drivers. Therefore, a new driver monitoring method was designed to solve these type of issues. The proposed scheme notices the major features such as eye index (EI), pupil activity (PA), head pose and if the drowsiness is suspected, the heart rate of the driver is monitored. In this mechanism, a micro controller is used that detects the eye blinks with the help of eye blink sensor. In addition to that the improper head pose and position is identified through the images. If any drowsiness is detected by the heart beat sensor, then that leads to the generation of alarm buzz and then the vehicle is halted by the auto-brake system. The results proves the identification of EI and PA appropriately and therefore the eye-detection errors and the consequent false alarms for drowsiness are decreased.

KEYWORDS: Eye index(EI), Pupil Activity(PA), Heart rate

I. INTRODUCTION

Driver inattention is one of the leading factor for highway crashes. The National Highway Traffic Safety Administration (NHTSA) estimates that approximately 25% of accidents reported by police, involve some form of driver inattention—the driver is distracted, asleep or fatigued, or otherwise lost in thought. It also conservatively estimates that 100 000 police reports on vehicle crashes were direct results of driver drowsiness resulting in 1550 deaths, 71000 injuries, and \$12.5 billion in monetary losses.

According to the NSF's (National Sanitation Foundation) 2002 poll Adults between 18-29 are much more likely to drive drowsy and cause accidents while compared to other age groups. Driver diversion happens when a protest or occasion draws a man's consideration far from the driving errand. Therefore, a new driver monitoring method was designed to solve these type of issues. If the driver is looking ahead, drowsiness detection is performed otherwise, distraction detection is performed. In proposed system driver drowsiness can be best studied from changes in physiological signals like heartbeat, head pose and eye blink. Three fundamental methodologies have been produced to distinguish driver absent mindedness, i.e., physiological, driving-conduct based, and visualinclude based methodologies. Physiological approaches involve analysis of vital signals such as brain activity, heart rate, and pulse rate. However, physiological approaches frequently require cathodes that are joined to the driver's body, which are meddlesome in nature and may make irritation to the driver. In view of the variations in the position, speed, controlling wheel edge, increasing speed, and breaking, the framework decides whether the driver is alert or not. The feature based approach breaks down visual highlights from the driver's facial pictures. Drowsy individuals frequently create one of a kind visual highlights on the face, for example, eye squinting, yawning, eye and head movements.

Heart rate is an extremely crucial wellbeing parameter that is straightforwardly identified with the soundness of the human cardiovascular framework. This portrays a system of estimating the heart rate through a fingertip utilizing a PIC microcontroller. While the heart is pulsating, it is really directing blood all through the body, and that makes the blood volume inside the finger supply route to change as well. This variance of blood can be identified through an optical



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detecting component set around the fingertip. The signal can be intensified further for the microcontroller to check the rate of variation, which is really the heart rate. Decline in heart rate shows that the driver is sleepy.

II. LITERATURE REVIEW

Driver drowsiness can be best studied from changes in physiological signals like heartbeat, head pose and eye blink. *Ping Wang and Lin Shen* developed a [1] Method of Detecting Driver Drowsiness State Based on Multi-features of Face.

This method detects driver's drowsiness by using only the features of the face while other positions of the driver are ignored. *Jaihie Kim* developed a [2] Vision-based method for detecting driver drowsiness and distraction in driver monitoring system. This method detects the driver drowsiness and distraction using the image detection. The author *Taner Danisman* takes one of the physiological factor for detecting drowsiness i.e [3] Drowsy Driver Detection System Using Eye Blink Patterns. This method detects the drowsiness using the changes in the eye movements. Later, the author, *Dr.Preeti Bajaj* introduced a [5] Driver Fatigue Detection using mouth and Yawning Analysis. This analysis uses the features of mouth for results. The every movements of the mouth is monitored and according the alert is made. While *Jiang Yu Zheng* developed a [4] Vehicle detection and tracking in car video based on motion model. This mechanism detects the features in one dimension by real time processing. *C.Hoffman* [5] vehicle detection fusing 2d visual features. This paper presents a method for detection and tracking of vehicles by finding various characteristic features in the images of a monochrome camera. The detection process uses shadow and symmetry features to generate vehicle hypotheses. These are fused and tracked over time using an Interacting Multiple Model method (IMM). The author, *Fayad* uses a single layer laser scanner, [6] Tracking of objects using a laser scanner in driving situation based on modeling target shape. This method tracks only the partial hidden objects in the vehicle while driving the vehicle.

This paper joins both the visual component based and physiological ways to deal with detection of the driver drowsiness. The proposed mechanism utilizes the visual highlights, for example, eye index (EI), pupil activity (PA) and head posture and if the laziness is suspected, the heart rate of the driver is checked. The result of this is given to the Support Vector Machine (SVM) and if it crosses the threshold value, then the alarm rings and indicated the drowsiness of the driver. We identify the eyes and face using the Adaboost algorithm. A facial-feature-matching algorithm estimates three Euler angles of HP, i.e., nodding, shaking, and tilting, using a generic 3-D head model aligned with a 2-D face image. Then, we compute visual features such as eye index (EI), pupil activity (PA), and HP from a video segment of 4-s duration whereas EI and PA measures the eye closure and pupil movements. HP finds the movements only for certain gaze fixation areas. The proposed scheme considers all directional head and eye developments of the driver. A SVM classifier, which is prepared with the three visual highlights of EI, PA, and HP, is utilized to take in the driving patterns of the driver to group if the driver is either cautious or not. If the drowsiness is detected, then the heart rate of the driver is monitored using the heart rate sensor. If the heart rate gets decreased from the normal value indicating that the driver is drowsy, then the alarm rings alerting the driver about his drowsiness.

III. PROPOSED SYSTEM

In the proposed system, the onset of driver drowsiness is detected through continuous monitoring of the eye closure state using a videobased driver assistance system and also monitoring the heart rate by using heart rate monitoring system. This scheme notices the four major features such as eye index (EI), pupil activity (PA) and head pose and if the drowsiness is suspected, the heart rate of the driver is monitored. In this a low cost chargecoupled-device with micro controller that detect eye blinks with the help of eye blink sensor, with addition to that we are giving input image from the MATLAB which means drivers head pose and position is identified, in case any detection of improper pose is identified with the MATLAB image processing and drivers heartbeat to the condition prevailing, the alarm buzz is generated and vehicle is halted by the auto-brake system. The advantage of the proposed method is that the eye-detection errors and the consequent false alarms for drowsiness are decreased.

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BLOCK DIAGRAM:

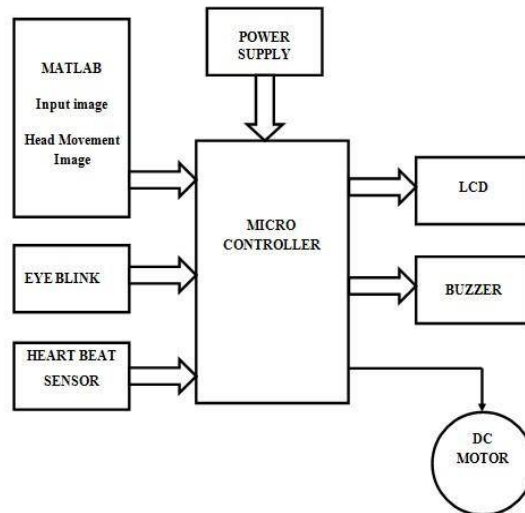


Fig 3(a) Block Diagram

The above system comprises of ARM11 (BCM2865), MATLAB, Buzzer and heart rate Sensor. The MATLAB is interfaced with the processor, to screen the driver while he is driving the vehicle. The yield of the cam sustains the controller; Heart rate sensor is likewise interfaced with the processor. Controller gets the signs from the matlab and sensor. If it finds the recognized estimations of heart rate is irregular than the typical esteems, it will begin to identify the eye developments. An eye development of the driver is given to the Haar course calculation and yield of the calculation is again handled with Bayesian system calculation. Aftereffect of the calculation delivers the choice about the drowsiness of the driver. In the event that sleepiness is acquired, it will make the alert to the driver who is driving the vehicle by utilizing buzzer.

VISUAL FEATURES

The driver alertness system is basically starts with the monitoring the driver's level of cautiousness. In order to avoid driver's inattention by sleepiness the eye blink sensor is used. Eye tracking is the process of measuring either the point of gaze (where one is looking) or the motion of an eye relative to the head, which is achieved by the means of a eye tracker. A eye tracker is a device for measuring eye positions and the eye movement, which also called as a visual system.

The movements of the pupil center is tracked in the real time. The face is taken as a object, where the detection is done using the face AdaBoost technique, which is known as the Viola-Jones algorithm and the adaptive template matching. The AdaBoost technique acquainted to object rotation, in this case the object is face. So, we implement adaptive template matching to overcome the restrictions of AdaBoost Algorithm.

The adaptive template matching follows the process, where already recorded face is taken as a Template T. In the event of the tracking course, the event is compared with the template T against each pixel on the image frame I. Normalized Sum-of-squares S matches the current template and the previously recorded frame. The region of the recorded profile is divided into four equal portions, top two part contains the eyes. To increase the accuracy the region is unsampled by two. The image is eroded and normalized using morphological operators, hence the illumination variations has been decreased. Adaptive thresholding is used to reduce illumination. Pupil is the one where the pixel of intensity is below the threshold level, initial threshold which is selected should be large enough to preserve the pupil area. Threshold is iterated until eye geometric constraints are satisfied. The conditions include : the eye width is twice the eye height and that a pupil width is not larger than twice the pupil height. When more than one pupil region exists, the largest region is



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selected as the candidate region for the pupil. The pupil center (xc, yc) can be found using the spatial moments for the pupil image

$$I(x,y) \text{ defined as, } \text{mpq} = \sum x^p \sum y^q I(x,y) \quad \text{xy} \text{pq}(1)$$

The pupil center is manipulated as the first order spatial moment m_{10} and m_{01} divided by the area m_{00} : $x_c = m_{10}/m_{00}$ and $y_c = m_{01}/m_{00}$. Under changing illumination conditions center of gravity has yield great results in estimation of the center of the pupil, if we opt blob contour mid as the center, the pupil center would be off center due to a non convex shape. The eyelashes can often cause a long shadow around the blob contour center which does not follow the desired ratio constraints. Thus, center of gravity is taken, as it has reduced error.

The pupil center is tracked using he/she BioID face database, which consists of the object's illumination conditions, backgrounds, and face sizes with 1521 gray scale images in a 384×286 pixel resolution of 23 different people. The relative deviation between the estimated and the ground truth pupil centers is the Error eye, i.e.,

$$\text{deye} = \max(|C_{\text{left}} - C'_{\text{left}}|, |C_{\text{right}} - C'_{\text{right}}|) / (C_{\text{left}} - C_{\text{right}})$$

HEAD POSE

In the estimation of the head pose angles, we have to compare the face image of the unknown HP angle in a 2-D scene with a 3-D Face model. And it is done by using the computer graphics model called as Blender. The use of a generic 3-D head model not only reduces the amount of computation but provides continuous HP estimates in all three rotation. The alignment and scaling of the 3-D head model is positioned according to the position and distance between the two eyes. The alignment of the head pose is done by the monitoring of the face rotation and the head pose for the first few seconds when the driver maintains the straight face to the camera. The rotation and translation of the head pose is determined by using the Posit Algorithm.

The 3-D pose of an object includes three rotation angles which includes nodding, shaking, and tilting and translation. In this case, the image coordinates of the object are the coordinates of the detected features on the face, and the 3-D model coordinates of these points are their corresponding points on the 3-D. We are applying the Lucas- Kanade optical flow method for tracking the changes in the head position. Optical flow finds an estimate of the feature points between two video frames extracted using the good features to track method. The selection of the number of features varies between 20 and 40 while tracking the feature points. We can give the certain description about the feature points whether they are robust or a sensitive based on the following determination. If the number of features is greater than 40, the feature points are not robust enough for tracking and if the features are less than 20, the tracking result of the feature points becomes sensitive.

After monitoring each movement of the head pose, it is updated to the live image and it is calculated in the form of a matrix multiplication of three rotations. The rotation matrix is done by,

$$R = R_z(\alpha)R_y(\theta)R_x(\gamma)$$

The computation of the three rotations are done by calculating α , θ and γ , the rotation matrix are determined. And by equating each element in R with its corresponding element, the determination of rotation matrix is done.

HEART RATE MONITORING

Heart rate measurement indicates the soundness of the human cardiovascular system. This project demonstrates a technique to measure the heart rate by sensing the variation of the blood volume inside a finger artery, which is caused by the pumping action of the heart. This project describes a microcontroller based heart rate measurement system that uses optical sensors to measure the alteration in blood volume at fingertip with each heart beat. The sensor unit consists of an infrared light-emitting diode (IR LED) and a photodiode, placed side by side as shown below. The IR diode transmits an infrared light into the fingertip (placed over the sensor unit), and the photodiode senses the portion of the light that is reflected back. The intensity of reflected light depends upon the blood volume inside the fingertip. So, each heart beat slightly alters the amount of reflected infrared light that can be detected by the photodiode. With a proper signal conditioning, this little change in the amplitude of the reflected light can be converted into a pulse. The pulses

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can be later counted by the microcontroller to determine the heart rate. The decrease in pulse rate indicates the drowsiness of the driver.

Hence, when the pupil activity, eye index and head pose demonstrates the drowsiness of the driver. The heart rate of the person can be noticed using the heart rate sensor. Thus, when it gets decreased the alarm rings which indicates the drowsiness of the driver.

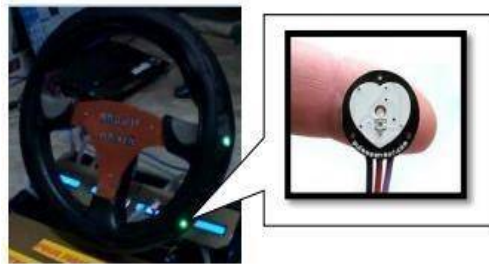


Fig 3(b) Heart Beat Sensor

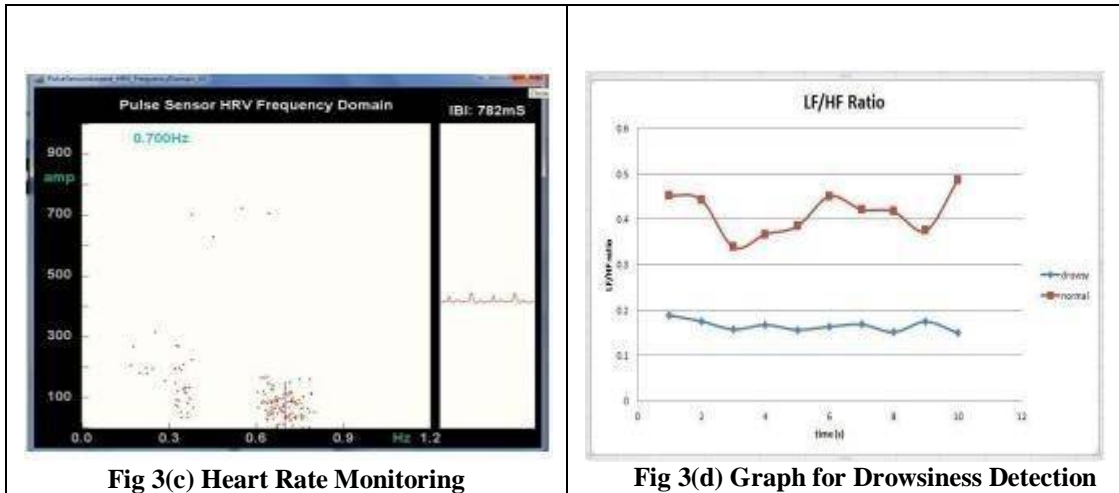


Fig 3(c) Heart Rate Monitoring

Fig 3(d) Graph for Drowsiness Detection

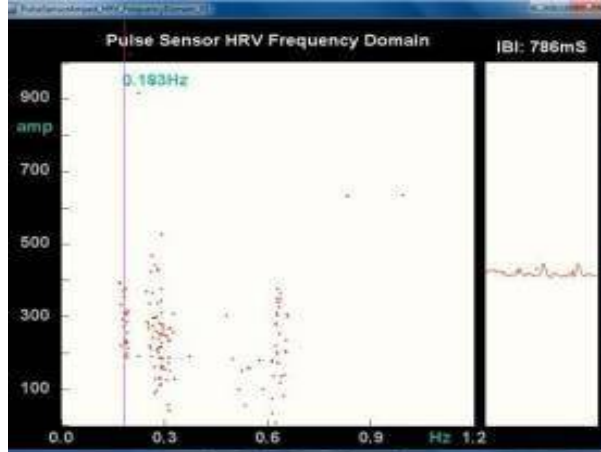


Fig 3(e) Normal Heart Condition



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IV. CONCLUSION

The purpose of the proposed model is to advance the system of Driving control version to prevent the accidents due to drowsiness of the drivers. Also it provides security for the driver by tracking his driving habits. The fusion of head position, eye blink and the heart rate sensors provides the high accuracy. These features enhances the next level of driving. Hence the highest clarification accuracy is achieved, which will detect driver inattention and minimize the number of false alarms to promote the acceptance of the system. In future we develop the precise estimation which distinguish the normal actions like laughter and normal facial muscle contraction. The integration of the sensors to monitor should be taken to the higher level of performance. Safe driving is a major concern of societies all over the world. This results in the effective accident prevention system due to overdose.

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