Eye Blinking and Drowsiness Detection

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***Abstract* - A driver sleepiness detection system is presented, which involves the use of an algorithm to identify driver tiredness. The most relevant visual indications that represent the driver's condition for detecting drowsiness are eye behaviour. An eye aspect ratio and physical landmark data are used in the facial algorithm. The algorithm's landmark detectors are resistant to a wide range of head orientations, face expressions, and illumination conditions. In each video frame, the proposed real-time method will estimate eye aspect ratio, which measures eye open level. It interprets the pattern of eye blinks as EAR values. Potential sleepiness is recognised in this way. Drivers falling asleep due to weariness or long-haul driving, as well as irresponsibility, cause a huge number of road accidents. By delivering non-invasive and simple-to-use specialised gadgets, the suggested system under development can assist prevent this.**

***Index Terms* - dlib library, drowsiness, EAR (Eye Aspect Ratio), Warnings.**

1.INTRODUCTION

The feeling of being weary or drowsy is referred to as drowsiness. It usually happens when a person is fatigued or hasn't had enough sleep. If not treated properly, drowsiness can develop to a variety of other problems. It could affect your health by causing you to forget a things or fall asleep at inopportune moments. Driving while tired is also claimed to be riskier than driving while inebriated. Drowsiness has an impact not only on the individual who is drowsy, but also on those around them. When an employee is drowsy and sleeps at work, it has an impact on both the organisation and the individual. If a person becomes tired and falls asleep at work, it may result in an accident, disrupting the task's orderly progress. If security workers at work become tired, it may lead to a breach of security in numerous situations. Our goal is to create a warning mechanism for this issue. This way, the victim and others close to him or her can be notified before it is too late. To do so, we will need a system that monitors a person's face and eyes to see whether they are drowsy, then sounds an alarm and sends an SMS to the victim's contact information. The goal of this research is to use face and eye detection techniques to enable real-time monitoring. After all of the analysis, the video will be captured with a camera, and the drowsy victim and the person responsible for the victim will be cautioned individually.

2. LITERATURE REVIEW

A. PHYSOCLOGICAL CHARATERISTICS SENSING

The most precise method is based on physiological activity in humans. The sensing technique can be used in two ways: the first is to measure changes in physiological signals such brain waves, heart rate, and eye blinking; and the second is to measure physical changes like drooping posture, head leaning, and open/closed states of the eyes. Though this technology is quite accurate, it is not very realistic in nature because the electrodes would have to be attached directly to the driver's body, which can be irritating and distracting to the driver. Furthermore, long periods of driving cause perspiration to build up on the sensors, reducing their ability to monitor precisely.

B. VEHICLE RESPONSE SENSING

Steering wheel movement, accelerating and braking patterns, vehicle linear speed, lateral acceleration, and displacement can all be monitored continuously to keep an eye on the driver and the vehicle. The proposed technique is a non-intrusive method of detecting tiredness, however it is often confined to vehicle type and driving style.

C.MONITORING DRIVER RESPONSE

The method for detecting tiredness entails watching the driver's response. This necessitates the driver's input to the system on a regular basis to signal awareness. This strategy has a significant drawback in terms of exhausting and aggravating the vehicle's driver at regular intervals.

3.PROPOSED SYSTEM

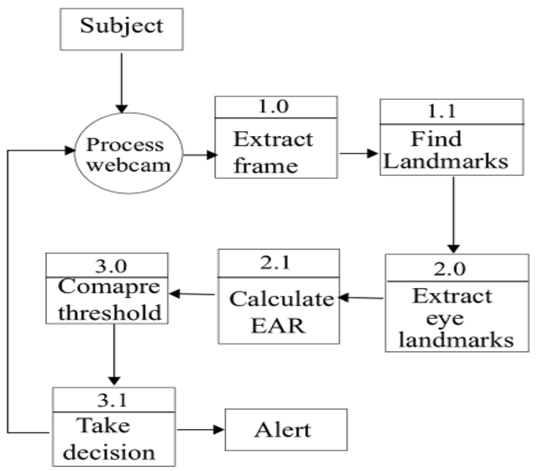

Fig-1-Proposed system overview

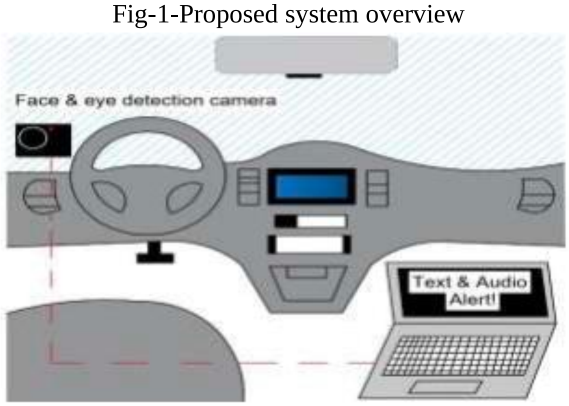

Fig-2-Proposed Hardware Setup

The suggested system is a driver sleepiness detecting device that may be installed in a car. Figure 1 depicts the suggested system overview, while Figure 2 depicts the proposed placement of essential components to put the system into practise.

Blinking is the process of a human eye rapidly closing and reopening. Every person blink in a slightly distinct pattern. Blink patterns differ primarily in closing and opening speeds, as well as the degree of squeezing an eye and duration. For the localisation of the eyes and their outlines, we propose using a facial landmark detection approach.

Fig-3-Facial Landmarks

Frame by frame, facial landmark detection (as shown in figure3) is conducted on the input video sequence. Dlib, a machine learning toolkit, and OpenCV with Python bindings are used. Human face characteristics such as the nose, eyes, jawline, eyebrows, and mouth can be located and represented via facial landmark detection.

Head posture estimation, face alignment and swapping, blink detection, and more applications use facial landmark detection. The challenge of detecting facial features in a human face is a subset of the shape prediction problem. When given an input image, a shape predictor locates regions of interest along the shape.

We use shape prediction models to recognise essential facial components on a face in facial landmark detection. Any conventional face landmark detection method has two major phases, namely,

1. Localisation of face in input data(image/video).
2. Detection of important facial structures on the face region of interest.

Using a pre-trained H.O.G. and Linear S.V.M. object detector primed specifically for face identification tasks is typically the initial step. Similarly, the (x,y) coordinates of the face in the input data (video/image) are used to create a face bounding box. The second phase entails the identification and labelling of face features such as the nose, mouth, jaw, left eye, right eye, and left eyebrow and right eyebrow.

A training image set of tagged face landmarks can be used to implement facial landmark detection. The collection is manually tagged by putting (x,y) coordinates of regions of interest on the map. Priors, or the probability of distance between two input pixels, will also be used.

Following this procedure, an ensemble of regression trees can be trained to detect face landmarks based on pixel intensities rather than feature extraction using pixel intensities. As a result, high-quality forecasts may be made in real time.

The dlib library's pretrained facial landmark identification model can locate 68 (x,y) coordinates, each representing a facial structure. Figure 4 depicts the index locations of each region of interest.

The points in figure 4 are from the iBUG 300-W dataset, which was used to train the dlib face landmark detector. For object detection, the dlib library includes a minor modified version of H.O.G. and a linear S.V.M. technique.

Input video from a camera gazing over the driver is converted into images depending on a number of frames and rescaled to 500 pixels wide. On the input frames, grey scaling is applied. Each image frame generates face bounding boxes. Because generated face coordinates are available, each region of the face may be located. To extract eyelashes, each part of the face can be accessible separately by NumPy array slicing.

We may extract localization information of the eye region by utilising zero indexing using Python, which has (according to figure 4):

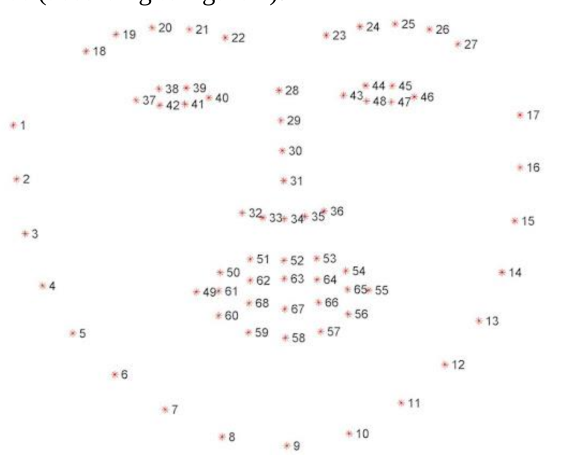

Fig-4-Facial Landmarks Index

1. Right eyebrow through 17 to 22
2. Left eyebrow through 22 to 27
3. Right eye through 36 to 42
4. Left eye through 42 to 48

For drowsiness detection, the next step is to identify and count eye blinks in the input video stream. Localization of eyes, thresholding to define white region of eyes, and determining if the aforementioned region departs for a given period of time, signalling a blink, are all common approaches to counting blinks.

The suggested drowsiness detection system is based on a distance ratio between facial landmarks of the eyes, which is an elegant and reliable solution of eye aspect ratio. E.A.R. is a simple, quick, and accurate method of detecting eye blinks. We focus on indices of two sets of face structures, namely the eyes, for blink identification.

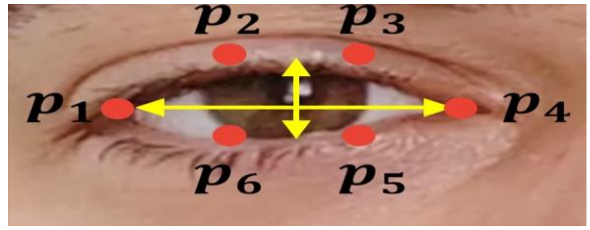

Fig-5-Eye Landmark Points

As shown in figure5, each eye is represented by six (x,y) coordinates, starting at the left corner of the eye and working clockwise around the eye region. The E.A.R. is the relationship between the plotted coordinates' width and height.

$$\text{EAR} = \frac{\|p_2 - p_6\| + \|p_3 - p_5\|}{2\|p_1 - p_4\|}$$

Fig-6-Eye Aspect Ratio Equation

The six points of the connection are p1, p2, p3, p4, p5, and p6, which are two-dimensional eye landmark locations. The E.A.R. equation computes vertical eye landmark distance in the numerator and horizontal eye landmark distance in the denominator. Two sets of vertical points and one set of horizontal points exist.

When the driver's eye is open, the E.A.R. value remains relatively constant, but drops to zero when a blink is detected. It is partially insensitive to person and head pose. The aspect ratio of the open eye has a tiny range of variation between individuals and is totally invariant to image scaling and in-plane rotation of the face. The EAR of both eyes is averaged because blinking is a synchronised operation. As a result, we eliminate the necessity for an image processing technique by relying on E.A.R. to identify eye blink.

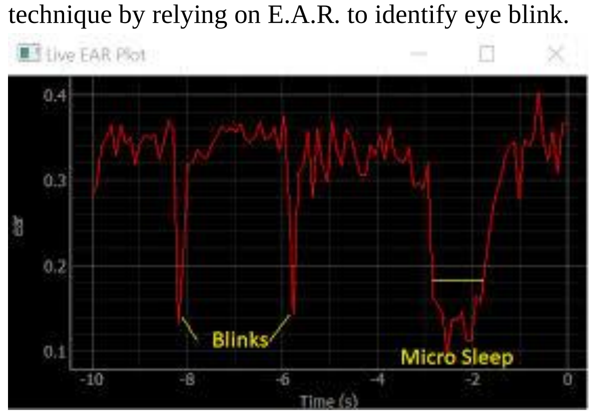

Fig-7-EAR Value Graph

The eye appears to be entirely open in figure7, top left image, therefore E.A.R. should be larger and steady across time. E.A.R. rapidly approaches 0 value in the event of a blink, as shown in the top right image. The bottom graph shows the E.A.R. values for a video clip over time. E.A.R. remains constant until plummeting to near-zero levels and then recovering, illustrating a single eye blink. A blink or eye closure can be detected using thresholding with an E.A.R. value of0.3, which can be useful in a variety of situations. To register tiredness, we additionally set the number of consecutive frames with an E.A.R. value less than 0.3. To detect driver tiredness, this should be set to 48.The thresholding settings can be changed to suit various implementation requirements.

A camera installed near or on the dashboard of a car and pointing at the driver can provide a live video feed. It could be a USB camera or a camera module for the Raspberry Pi.

To get a more exact blink detection, we can average the E.A.R. data collected from each eye. Low E.A.R. levels combined with the time it stays below the threshold value can be used to detect drowsiness in drivers. The system can sound an alert to wake up the driver if E.A.R. data suggest that the driver's eye has been closed or near-close for a significant amount of time. The E.A.R. is regularly monitored for instances in which the value drops low but does not rebound, indicating tiredness and the driver closing his or her eyes.

The algorithm may be tweaked to detect one or more faces at once, as well as drowsiness detection for each one. Drowsiness detection appears to work well in a variety of circumstances, including driving in direct sunshine as well as dim or artificial lighting.

4.PROPOSED SYSTEM DETAILS

Fig-8-Normal Operation (Eyes are open)

Fig-9-Drowsiness Detected and Alerted(Eyes Closed)

5.CONCLUSIONS

The proposed approach will be effective in detecting driver tiredness by providing a precise enough estimation of eye opening. This is owing to the camera's resistance to low image resolution, incorrect head alignment, limited illumination, and a wide range of face emotions, among other factors. Due to the low performance cost of facial landmark detection, the proposed warning system can be employed in real time, and it can also be configured to use linear SVM. Even though everyone's blink length varies, a fixed blink duration is assumed. An adaptive technique can be used in place of the assumption approach. EAR is calculated using two-dimensional data, which does not account for head orientation that is out of plane. This can be rectified by estimating EAR using three-dimensional data from a three-dimensional landmark model (position and orientation). Failure to detect eyes in the input video sequence in the current system prompts the driver to modify or move to a more appropriate sitting posture.

To assist prevent road accidents, the suggested system can be enhanced by adding new safety features and functionalities to the current system. The system's future upgrades may include capabilities such as traffic light detection, speed restriction zone detection, speed tracking, and traffic infraction detection.

To aid in the prevention of road accidents, the suggested system can be enhanced by adding new safety features and functionalities to the existing system. Features like as traffic light detection, speed restriction zone detection, speed tracking, and traffic infraction detection could be added in future editions of the system.

REFERENCES

[1] W.W. Weirwille, "Overview of Research on Driver Drowsiness Definition and Driver Drowsiness Detection," 14th International Technical Conference on Enhanced Safety of Vehicles, pp 23-26, 1994.

[2] A. Kircher, M. Uddman, and J. Sandin, "Vehicle control and drowsiness," Swedish National Road and Transport Research Institute, Tech. Rep. VTI-922A, 2002.

[3] M. Eriksson and N.P. Papanikolopoulos, "Eye-tracking for Detection of Driver Fatigue", IEEE Intelligent Transport System Proceedings, pp 314-319, 1997.

[4] L. M. Bergasa, J. Nuevo, M. A. Sotelo, and M. Vazquez. Real-time system for monitoring driver vigilance. In IEEE Intelligent Vehicles Symposium, 2004. 1

[5] T. Danisman, I. Bilasco, C. Djeraba, and N. Ihaddadene. Drowsy driver detection system using eye blink patterns. In Machine and Web Intelligence (ICMWI), Oct 2010. 1, 6, 7

[6] M. Divjak and H. Bischof. Eye blink-based fatigue detection for prevention of computer vision syndrome. In IAPR Conference on Machine Vision Applications, 2009. 1

[7] T. Drutarovsky and A. Fogelton. Eye blink detection using variance of motion vectors. In Computer Vision - ECCV Workshops. 2014. 1, 2, 5, 6, 7.

[8] Medicton group. The system I4 Control. http:// www.i4tracking.cz/. 1

[9] S. Ren, X. Cao, Y. Wei, and J. Sun. Face alignment at 3000 fps via regressing local binary features. In Proc. CVPR, 2014. 2

[10] A. Sahayadhas, K. Sundaraj, and M. Murugappan. Detecting driver drowsiness based on sensors: A review. MDPI open access: sensors, 2012.1

[11] F. M. Sukno, S.-K. Pavani, C. Butakoff, and A. F. Frangi. Automatic assessment of eye blinking patterns through statistical shape models. In ICVS, 2009. 1, 2

[12] Z. Yan, L. Hu, H. Chen, and F. Lu. Computer vision syndrome: A widely spreading but largely unknown epidemic among computer users. Computers in Human Behaviour, (24):2026–2042, 2008. 1

[13] T. Soukupova and J. Cech. Real-Time Eye Blink Detection using Facial Landmarks. In 21st Computer Vision Winter Workshop Luka Cehovin, Rok Mandeljc, Vitomir ˇ Struc (eds.) ˇ Rimske Toplice, Slovenia, February 3–5, 2016