IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

IJARSCT

Impact Factor: 6.252

Volume 2, Issue 2, July 2022

Driver Drowsiness Detection System for Accident Prevention

H Nawaz Shariff[1], Likith M[2], Harshithaling S[3], Shreya S R[4], Dr Madhu B K[5]

Students, Department of Computer Science and Engineering [1,2,3,4]

Professor and Head, Department of Computer Science and Engineering[5]

Vidya Vikas Institute of Engineering and Technology, Mysuru, Karnataka, India

Abstract: *In our day to day life transportation systems plays an important role in human activities. Anyone can be the victim of road accidents at any time for various reasons but most of the accidents are caused due to drowsiness of the driver. The main reasons for drowsiness are due to lack of rest and sleep which causes tiredness on long journeys. Due to these factors, driver vigilance will reduce which causes serious situations and increases the chances of accidents. Because of this reason yearly, most of the accident is happening all over the world. In this technology advanced era, new technologies can play an important role in providing a solution to this problem.*

Keywords: Driver drowsiness, Eye detection, Yawn detection

I. INTRODUCTION

The main aim of the project is to build a system that will detect drowsiness from the driver face and alert him about it. Driver drowsiness detection is a car safety technology which prevents accidents when the driver is getting drowsy. Driver drowsiness and distraction, however, might have the same effects, i.e., decreased driving performance, longer reaction time, and an increased risk of crash involvement. Now days, road accidents are major problem and its percentage increases per year. The major problem behind the road accidents are drowsiness of car driver and if the driver is alcoholic. To overcome this problem, different technologies are developed. Driver drowsiness detection is a car safety technology which prevents accidents when the driver is getting drowsy. Various studies have suggested that around 20% of all road accidents are fatigue-related, up to 50% on certain roads. Driver fatigue is a significant factor in a large number of vehicle accidents. The development of technologies for detecting or preventing drowsiness at the wheel is a major challenge in the field of accident avoidance systems. Because of the hazard that drowsiness presents on the road, methods need to be developed for counteracting its affects. Driver inattention might be the result of a lack of alertness when driving due to driver drowsiness and distraction. Driver distraction occurs when an object or event draws a person's attention away from the driving task. As future enhancement Pedestrian detection is an essential and significant task in any intelligent video surveillance system, as it provides the fundamental information for semantic understanding of the video footages. It has an obvious extension to automotive applications due to the potential for improving safety systems.

II. EXISTING SYSTEM

An easy way to comply with the Journal paper formatting requirements is to use this document as a template and simply type your text into it. Even though existing wearable technologies will give data related to the driving force posture, the correct natural process of the person or his pulse, the selection of different parameters of vehicle sensors is that the most important and safe particularly in automobile industry wherever the vehicles enforced are additional dangerous than low-security cars. On another hand, 2 other options like driver comfort and redundancy should be considered in-vehicle systems.

2.1 Proposed System

In the developed system, a webcam records the video and driver's face is detected in each frame employing image processing techniques. Facial landmarks on the detected face are pointed and subsequently the eye aspect ratio, mouth opening ratio and nose length ratio are computed and depending on their values, drowsiness is detected based on developed adaptive thresholding. Machine learning algorithms have been implemented as well in an offline manner. A

sensitivity of 95.58% and specificity of 100% has been achieved in Support Vector Machine based classification.
Advantages:

- Provides better accuracy than the existing system.
- System design is user friendly, so user won't be having any troubles using our system.

2.2 Objectives

The objectives of the system is:

- To build a system that will be used in the detection of driver drowsiness.
- To build a framework that is easy to use and simple to utilize.

III. SYSTEM DESIGN

The detailed configuration begins after the framework configuration stage is finished and the framework configuration has been guaranteed through the survey. The objective of this stage is to foster the inward rationale of every one of the modules distinguished during the framework plan.

In the framework plan, the emphasis is on distinguishing the modules, while during detailed design the attention is on planning the rationale for the modules. At the end of the day in framework, plan consideration is on which segments are required, while in detailed design how the segments can be executed in the product is the issue.

The planned movement is frequently partitioned into two separate stages framework plan and definite plan. Framework configuration is likewise called a high-level plan. At the primary level spotlight is on choosing which modules are required for the framework, the details of these modules, and how the modules ought to be interconnected. This is called a framework plan or high-level plan. In the subsequent level, the interior plan of the modules or how the particulars of the module can be fulfilled is chosen. This plan level is regularly called the detailed design or rationale plan.

3.1 High Level Design

A data flow diagram is a graphical representation of the "flow" of data through an information system, modelling its *process* aspects. Often they are a preliminary step used to create an overview of the system which can later be elaborated. DFDs can also be used for the visualization of data processing (structured design).The DFD is also called as bubble chart. It is a simple graphical formalism that can be used to represent a system in terms of the input data to the system, various processing carried out on these data, and the output data is generated by the system.

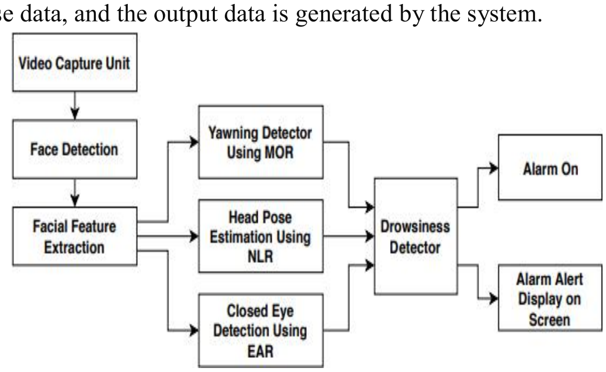

Fig: 3.1 High Level Design

A. Video Capture Unit

The video capture unit used to record the video in real time of the frame containing the river face through a camera placed on the car dashboard. The video is sampled with some frequency and the sampled frame is sent to the face detection unit.

B. Face Detection Unit and Features Extraction

This unit receives the sampled video frame from the video capture unit. The images from the video capture unit are the RGB image and for the very dim light condition, we perform low-light image enhancement and noise elimination. For improving the accuracy of our system, we eliminate the noise of the image before amplifying it through contrast enhancement. The above process is divided into two subtasks. At first, for denoising the image we apply the super pixel based adaptive noising and secondly, for amplifying the image luminance adaptive contrast enhancement is used. We need to denoise the image before contrast enhancement, so that the noise has been eliminated before its amplification through contrast enhancement. The above method increases the accuracy of our system significantly as it eliminates heavy noise, texture blurring and over-enhancement from the image which is then processed as accordingly. The image is changed to the grayscale image because for face detection we do not need the color data. For face detection in the frame, we use the rapid object detection which uses the boosted need only the eyes and mouth part of the face for the feature set. For this first, we scaled the rectangle boxed in face image to 100*100 pixels and then we use the 80x30 rectangular pixels window for eye and 40x40 rectangular pixels window for the mouth. The x- and y coordinates of the rectangular window is (10, 20) and (30, 60) for the eye and mouth respectively. The above cascade of the classifier by Viola-Jones that works with the Haar-like features. The face detection method returns the bscissa, ordinates, length, and breadth of the rectangle boxed in the facial image. As we part is then transferred to the fatigue detection unit for further processing.

C. Fatigue Detection on Extracted Features

From the face detection unit, we get a sequence of eye and mouth image of the driver. Now from this extracted dataset, we can perform fatigue detection analysis on various facial features. These facial features include eyes (fast blinking or heavy eyes). The combined result of fatigue detection on these facial features is used to give the final result as to whether the driver is in fatigue or alert state. The images from face detection unit, in pixels, can contain a lot of features. If we perform as said in the previous unit we would get a feature vector of size 4000. This size can be further reduced with the use of Principle Component Analysis (PCA). PCA can be used to avoid the problem caused by high- dimensionality as it compresses the data while minimizing the amount of information lost. It searches for a pattern in the data and reduces as much possibly correlated high dimensional variables. The compressed data set can now be divided into training set and test set. To classify if the driver is fatigued or not fatigued, we use Support Vector Classifier. This can also be correlated from the fact that Support Vector Classifier is highly efficient in working with the high dimensional feature vector. It is also very flexible in dealing with linearly as well as nonlinearly separable data sets. SVM is a supervised learning method used for classification and regression. SVM is also referred to as Maximum Margin Classifier because it can maximize the geometric margin and minimize the emperical classification error simultaneoulsy. During classification SVM creates a maximal separating hyperplane. Now, two parallel hyperplanes are constructed on each side of hyperplane that separates the data. Here an assumption is made that larger the distance between the two parallel planes better is the generalization error of classifier. SVM was used to implement this problem because of, binary nature of classification problem and the efficiency of SVM in working with high dimensional data and its flexibility in working with both linearly and nonlinearly separable data sets. Unlike other classification algorithms, SVM can be used in both linear and non-linear ways with the use of a kernel. In cases when we have a limited set of points in 228 many dimensions SVM tends to be very efficient because it can find linear separation in the data. SVM is also eliminates the drawbacks of outliers as it uses only relevant points to find a linear separation, also called support vectors. Now, we can train the classifier on the training set and can check its accuracy using test set. The test set and training set are completely different i.e. no two instances in both data sets are same. We do this so that our SVC model is always tested on a data which it has not seen before. This strategy provides a better picture of the generalized functioning of SVC. After the SVC model is trained we can calculate the rediction accuracy of our model using cross validation. In cross-validation, we perform a number of iterations, wherein each iteration we give a different data subset to test set from the previously allotted set. Finally, the classifier would return 1 if the driver is found to be in fatigue state or return -1 if the driver is found to be in an alert state to the alert unit.

D. Alert Unit

The modeling of the alert unit is done on the format (r, t), $\{r>=0, t>=0\}$ where r is the resultant value and t is the time. The whole model depends on the output value of the fatigue Detection unit. The Support Vector Machine (SVM) classifies the image, whether they are fatigued or not fatigued. The representation of the classification output is either a +1 or -1 and this number is used by the alert unit in the following way. Specifically, the classification output is the input of a running sum that adds the consecutive output values and has a minimum value up to zero. This unit employs two threshold level, first one is to detect whether there is no or low fatigue level. The second threshold value is to mark the difference between low and high fatigue level. Whenever the resultant value goes above a specified threshold, it implies that fatigue is detected and the alert system goes active and takes action according to the detected fatigue level. For low fatigue level, the alarm rings for 10sec and after 10sec the system again checks the resultant value and performs the alert process accordingly. For high fatigue level, we can use more effective accident preventive measures like an automatic reduce the speed and ultimately stop the vehicle and, or water spray. This system can be used to track the fatigue level of a driver and detect the sleep onset with a safe margin.

3.2 Detailed Design

A block diagram of the driver drowsiness monitoring system has been depicted in Fig 4.2. At first, the video is recorded using a webcam. The camera will be positioned in front of the driver to capture the front face image. From the video, the frames are extracted to obtain 2-D images. Face is detected in the frames using histogram of oriented gradients (HOG) and linear support vector machine (SVM) for object detection. After detecting the face, facial landmarks like positions of eye, nose, and mouth are marked on the images. From the facial landmarks, eye aspect ratio, mouth opening ratio and position of the head are quantified and using these features and machine learning approach, a decision is obtained about the drowsiness of the driver. If drowsiness is detected, an alarm will be sent to the driver to alert him/her.

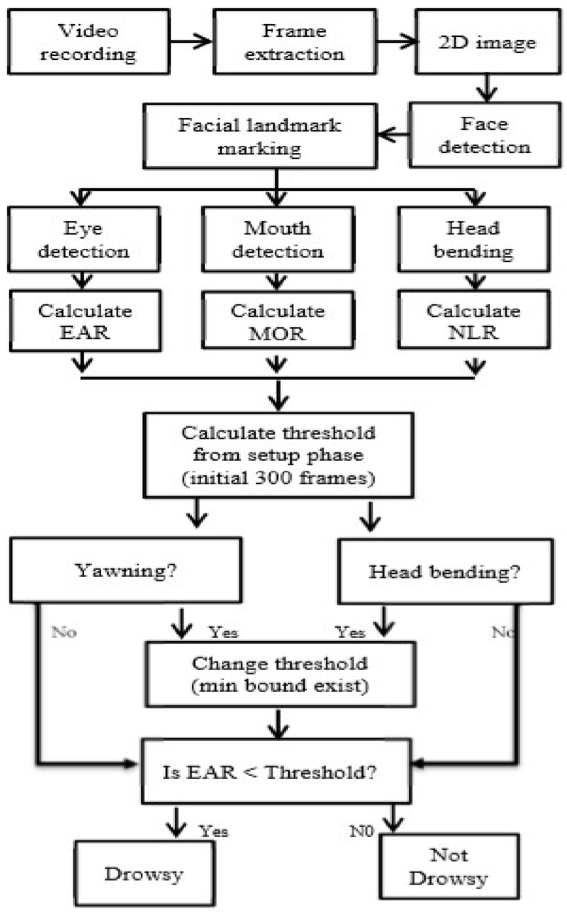

Fig: 3.2 Block diagram of drowsiness system

A. Facial Landmark Marking

After detecting the face, the next task is to find the locations of different facial features like the corners of the eyes and mouth, the tip of the nose and so on. Prior to that, the face images should be normalized in order to reduce the effect of distance from the camera, non-uniform illumination and varying image resolution. Therefore, the face image is resized to a width of 500 pixels and converted to grayscale image. After image normalization, ensemble of regression trees is

DOI: 10.48175/IJARSCT-5838

used to estimate the landmark positions on face from a sparse subset of pixel intensities. In this method, the sum of square error loss is optimized using gradient boosting learning. Different priors are used to find different structures. Using this method, the boundary points of eyes, mouth and the central line of the nose are marked and the number of points for eye, mouth and nose are given in Table I. The facial landmarks are shown in Fig 4.3. The red points are the detected landmarks for further processing.

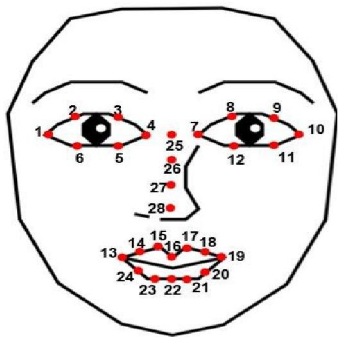

Fig: 3.3 Facial Land Marking

Table:

Parts	Landmark Points
Mouth	[13-24]
Right eye	[1-6]
Left eye	[7-12]
Nose	[25-28]

B. Algorithm

It consist of Video Capture Unit, Face Detection Unit, Head pose estimation system, Facial feature Extraction, closed eye detection, yawning detection, drowsiness detection, Alert Unit.

The general flow of drowsiness detection algorithm is given below.

- First, we'll setup a camera that monitors a stream for faces.
- If a face is found, we apply facial landmark detection and extract the eye regions:
- If the eye aspect ratio indicates that the eyes have been closed for a sufficiently long enough amount of time, then sound an alarm to wake up the driver.
- If the mouth aspect ratio indicates that the yawning for a sufficiently long enough amount of time, then sound an alarm to wake up the driver.
- Estimation of head pose also detect the drowsiness of driver.

C. Eye Aspect Ratio (EAR)

From the eye corner points, the eye aspect ratio is calculated as the ratio of height and width of the eye as given by

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

where pi represents point marked as i in facial landmark and is the distance between points marked as i and j. Therefore, when the eyes are fully open, EAR is high value and as the eyes are closed, EAR value goes towards zero. Thus, monotonically decreasing EAR values indicate gradually closing eyes and it's almost zero for completely closed eyes (eye blink). Consequently, EAR values indicate the drowsiness of the driver as eye blinks occur due to drowsiness.

D. Mouth Opening Ratio (MOR)

Mouth opening ratio is a parameter to detect yawning during drowsiness. Similar to EAR, it is calculated as

$$MOR = \frac{(p_{15} - p_{23}) + (p_{16} - p_{22}) + (p_{17} - p_{21})}{3(p_{19} - p_{13})}$$

As defined, it increases rapidly when mouth opens due to yawning and remains at that high value for a while due to yawn (indicating that the mouth is open) and again decreases rapidly towards zero. As yawn is one of the characteristics of drowsiness, MOR gives a measure regarding driver drowsiness.

E. Head Bending

Due to drowsiness, usually driver's head tilts (forward or backward) with respect to vertical axis. So, from the head bending angle, driver drowsiness can be detected. As the projected length of nose on the camera focal plane is proportional to this bending, it can be used as a measure of head bending. In normal condition, our nose makes an acute angle with respect to focal plane of the camera. This angle increases as the head moves vertically up and decreases on moving down. Therefore, the ratio of nose length to an average nose length while awake is a measure of head bending and if the value is greater or less than a particular range, it indicates head bending as well as drowsiness. From the facial landmarks, the nose length is calculated and it is defined as

$$NLR = \frac{nose\ length(p_{28} - p_{25})}{average\ nose\ length}$$

The average nose length is computed during the setup phase of the experiment as described in the next sub-section

IV. CONCLUSION AND FUTURE SCOPE

This system works only on the required part of face image i.e. eyes and mouth, rejects the rest. This step decreases the unnecessary features in the feature set. Eye and mouth detection is less accurate than the face detection, that's why we use the face detection to get the eye and mouth image part of the driver. Estimating the head position of the driver will detect the drowsiness of driver. It makes the system optimized in the context of time and accuracy. The division of system alert unit into three units is an efficient way to alert the driver. It works in such a way that the driver is not subjected to sudden attack, which may lead to an accident. As future enhancement Pedestrian detection is an essential and significant task in any intelligent video surveillance system, as it provides the fundamental information for semantic understanding of the video footages. It has an obvious extension to automotive applications due to the potential for improving safety systems.

REFERENCES

[1]. W. L. Ou, M. H. Shih, C. W. Chang, X. H. Yu, C. P. Fan, "Intelligent Video-Based Drowsy Driver Detection System under Various Illuminations and Embedded Software Implementation", 2015 international Conf. on Consumer Electronics - Taiwan, 2015.

[2]. W. B. Horng, C. Y. Chen, Y. Chang, C. H. Fan, "Driver Fatigue Detection based on Eye Tracking and Dynamic Template Matching", IEEE International Conference on Networking,, Sensing and Control, Taipei, Taiwan, March 21-23, 2004.

[3]. S. Singh, N. P. papanikolopoulos, "Monitoring Driver Fatigue using Facial Analysis Techniques", IEEE Conference on Intelligent Transportation System, pp 314-318.

[4]. B. Alshaqaqi, A. S. Baquhaizel, M. E. A. Ouis, M. Bouumehed, A. Ouamri, M. Keche, "Driver Drowsiness Detection System", IEEE International Workshop on Systems, Signal Processing and their Applications, 2013.

[5]. M. Karchani, A. Mazloumi, G. N. Saraji, A. Nahvi, K. S. Haghighi, B. M. Abadi, A. R. Foroshani, A. Niknezhad, "The Steps of Proposed Drowsiness Detection System Design based on Image Processing in Simulator Driving", International Research Journal of Applied and Basic Sciences, vol. 9(6), pp 878-887, 2015.

[6]. R. Ahmad, and J. N. Borole, "Drowsy Driver Identification Using Eye Blink Detection," IJISET - International Journal of Computer Science and Information Technologies, vol. 6, no. 1, pp. 270-274, Jan. 2015.

[7]. A. Abas, J. Mellor, and X. Chen, "Non-intrusive drowsiness detection by employing Support Vector Machine," 2014 20th International Conference on Automation and Computing (ICAC), Bedfordshire, UK, 2014, pp. 188193.

[8]. A. Sengupta, A. Dasgupta, A. Chaudhuri, A. George, A. Routray, R. Guha; "A Multimodal System for Assessing Alertness Levels Due to Cognitive Loading", IEEE Trans. on Neural Systems and Rehabilitation Engg., vol. 25 (7), pp 1037-1046, 2017.