DROWSY DRIVER DETECTION USING CNN

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ABSTRACT

Drowsy driving is a significant contributor to both traffic accidents and fatalities. Therefore, the identification of driver weariness and its signaling is a current focus of study. The majority of traditional approaches may be categorized as either vehicle-based, behavioral-based, or physiological-based. Only a limited number of ways are non-intrusive and do not divert the driver's attention. Additionally, many systems need costly sensors and data processing. Hence, our work has successfully built an affordable, real-time system for detecting driver sleepiness with a satisfactory level of accuracy. The camera captures video in the created system, and the driver's face is identified in each frame using image processing algorithms. The facial landmarks on the observed face are identified and used to calculate the eye aspect ratio, mouth opening ratio, and nose length ratio. Depending on the values of these ratios, sleepiness is recognized using a created adaptive thresholding method. Machine learning algorithms have also been applied offline. The classification based on Support Vector Machine has attained a sensitivity of 95.58% and a specificity of 100%.

Keywords—drowsiness detection, visual behavior, eye aspect ratio, mouth opening ratio, nose length ratio

I. INTRODUCTION

Drowsy driving is a significant contributor to fatalities resulting from traffic accidents. Truck drivers that engage in prolonged driving, particularly during nighttime, as well as long-distance bus drivers or those operating overnight buses, are more prone to experiencing this issue. Driver sleepiness is a significant and widespread problem for passengers in all countries. Annually, a significant number of injuries and fatalities result from traffic accidents caused by weariness. Therefore, the identification of driver weariness and its signaling is a highly researched field owing to its significant practical relevance. The fundamental sleepiness detection system consists of three blocks or modules: the acquisition system, the processing system, and the warning system. In this scenario, the acquisition system captures a video of the driver's frontal face, which is then passed to the processing block. In the processing block, the video is analyzed in real-time to identify signs of sleepiness. When the warning system detects sleepiness, it sends a warning or alert to the driver. Typically, the approaches for identifying sleepy drivers may be categorized into three types: vehicle-based, behavioral-based, and physiological-based. In the vehicle-based approach, many variables such as steering wheel movement, accelerator or brake use, vehicle speed, lateral acceleration, and deviations from lane position are continually monitored.

Identifying any anomalous alteration in these measurements is seen as an indication of driver tiredness. This measurement is nonintrusive since the sensors are not physically linked to the driver. The behavioural based technique [1-7] involves analyzing the visual behavior of the driver, such as eye blinking, eye closure, yawning, and head bending, in order to identify tiredness. This method of measuring is considered nonintrusive since it relies on a basic camera to identify these characteristics. In the physiological-based approach [8,9], several physiological signals such as Electrocardiogram (ECG), Electooculogram (EOG), Electroencephalogram (EEG), heartbeat, and pulse rate are monitored. These metrics are used to assess levels of sleepiness or exhaustion. This is an example of invasive measuring, since it involves attaching sensors to the driver, which might cause distractions. The choice of sensors in the system will directly impact both the cost and size of the system. Nevertheless, the incorporation of additional parameters or characteristics will enhance the precision of the system to a certain degree.These facts inspire us to create an affordable, real-time system for detecting driver sleepiness with a satisfactory level of accuracy. Therefore, we have suggested a system that utilizes a webcam to identify driver weariness just from facial images. This is achieved via the use of image processing and machine learning methods, resulting in a cost-effective and portable system.

II. SYSTEM ANALYSIS

EXISTING SYSTEM:

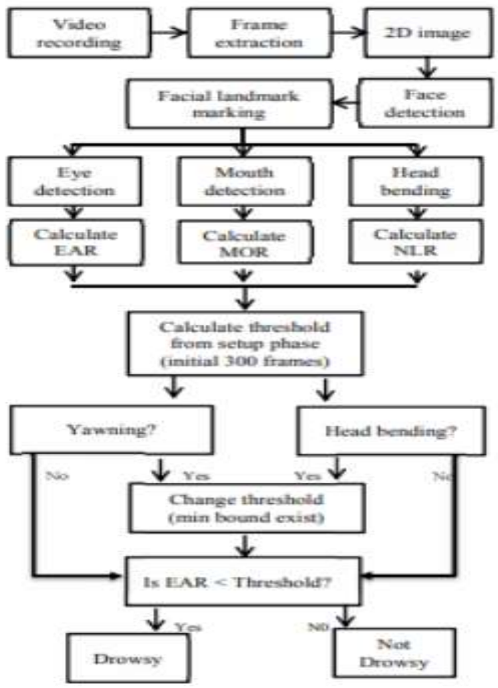
Drowsy driving is one of the major causes of deaths occurring in road accidents. The truck drivers who drive for continuous long hours (especially at night), bus drivers of long distance route or overnight buses are more susceptible to this problem. Driver drowsiness is an overcast nightmare to passengers in every country. Every year, a large number of injuries and deaths occur due to fatigue related road

accidents. Hence, detection of driver's fatigue and its indication is an active area of research due to its immense practical applicability.

PROPOSED SYSTEM:

Generally, the methods to detect drowsy drivers are classified in three types; vehicle based, behavioural based and physiological based. In vehicle based method, a number of metrics like steering wheel movement, accelerator or brake pattern, vehicle speed, lateral acceleration, deviations from lane position etc. are monitored continuously. Detection of any abnormal change in these values is considered as driver drowsiness. This is a nonintrusive measurement as the sensors are not attached on the driver. In behavioural based method [1- 7], the visual behavior of the driver i.e., eye blinking, eye closing, yawn, head bending etc. are analyzed to detect drowsiness.

SYSTEM ARCHITECTURE



III. IMPLEMENTATION

MODULES:

A. Data Acquisition The video is recorded using webcam (Sony CMU-BR300) and the frames are extracted and processed in a laptop. After extracting the frames, image processing techniques are applied on these 2D images. Presently, synthetic driver data has been generated. The volunteers are asked to look at the webcam with intermittent eye blinking, eye closing, yawning and head bending. The video is captured for 30 minutes duration**.**

B. Face Detection After extracting the frames, first the human faces are detected. Numerous online face detection algorithms are there. In this study, histogram of oriented gradients (HOG) and linear SVM method [10] is used. In this method, positive samples of fixed window size are taken from the images and HOG descriptors are computed on them. Subsequently, negative samples (samples that do not contain the required object to be detected i.e., human face here) of same size are taken and HOG descriptors are calculated. Usually the number of negative samples is very greater than number of positive samples. After obtaining the features for both the classes, a linear SVM is trained for the classification task. To improve the accuracy of SVM, hard negative mining is used. In this method, after training, the classifier is tested on the labeled data and the false positive sample feature values are used again for training purpose. For the test image, the fixed size window is translated over the image and the classifier computes the output for each window location. Finally, the maximum value output is considered as the detected face and a bounding box is drawn around the face. This non-maximum suppression step removes the redundant and overlapping bounding boxes.

C. 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 [11] is 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 2. The red points are the detected landmarks for further processing.

IV. CONCLUSION

This research presents a cost-effective and real-time method for detecting driver sleepiness. The system utilizes visual behavior and machine learning techniques. In this context, we calculate visual behavior characteristics such as eye aspect ratio, mouth opening ratio, and nose length ratio from the real-time video obtained from a camera. A real-time driver sleepiness detection method has been devised using an adaptive thresholding mechanism. The implemented system demonstrates precise functionality while operating with the artificially created data. Afterwards, the feature values are saved and machine learning methods are used for classification. The Bayesian classifier, Fisher's linear discriminant analysis (FLDA), and support vector machine (SVM) have been investigated in this study. Empirical evidence suggests that FLDA and SVM have superior performance compared to the Bayesian classifier. The FLDA has a sensitivity of 0.896 while the SVM has a sensitivity of 0.956. Both models have a specificity of 1. Due to their higher accuracy, FLDA and SVM will be used in the proposed system for online sleepiness detection categorization. Additionally, the system will be integrated into hardware to enhance its portability for automobile systems. Subsequently, a pilot research will be conducted on drivers to authenticate the functionality of the produced system.

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