

DRIVER DROWSINESS DETECTION USING MACHINE LEARNING

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Abstract: Drowsy driving is one of the major causes of road accidents and death. Drivers must keep a close eye on the road, so they can react to sudden events immediately. Driver fatigue often becomes a direct cause of many traffic accidents. Therefore, there is a need to develop the systems that will detect and notify the driver bad psychophysical condition, which could significantly reduce the number of fatigue related car accidents. However, the Development of such systems encounters many difficulties related to fast and proper recognition of a driver's fatigue symptoms.. Most of the conventional methods are either vehicle based, or behavioral based or physiological based. Few methods are intrusive and distract the driver, some require expensive sensors and data handling. Therefore, in this study, a low cost, real time driver's drowsiness detection system is developed with acceptable accuracy. One of the technical possibilities to implement driver drowsiness detection systems is to use the vision-based approach. Here we are detecting the driver drowsiness by estimating vision system of him/her. We will be using Open CV for gathering the images from webcam and feed them into a Deep Learning model which will classify whether the person's eyes are 'Open' or 'Closed'. 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.

Keywords: Open CV, image processing, Facial landmarks, Aspect ratio.

1.Introduction

1.1 About Project

Drowsy driving is one of the major causes of deaths occurring in road accidents. Driver drowsiness is an overcast nightmare to passengers in every country. Detection of driver's fatigue and its indication is an active area of research due to its immense practical applicability. The basic drowsiness detection system has three blocks/modules; acquisition system, processing system and warning system. If drowsiness is detected, a warning or alarm is send to the driver from the warning 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. This is a nonintrusive measurement as the sensors are not attached on the driver. In behavioural based method the visual behavior of the driver i.e., eye blinking, eye closing, yawn, head bending etc. are analyzed to detect drowsiness. This is also nonintrusive measurement as

simple camera is used to detect these features. In physiological based method the physiological signals like Electrocardiogram (ECG), Electrooculogram (EOG), Electroencephalogram (EEG), heartbeat, pulse rate etc. are monitored and from these metrics, drowsiness or fatigue level is detected. These factors motivate us to develop a low-cost, real time driver's drowsiness detection system with acceptable accuracy. Hence, we have proposed a webcam based system to detect driver's fatigue from the face image only using image processing and machine learning techniques to make the system low-cost as well as portable.

1.2 Objectives of Project

One of the most wanted systems to avoid accidents these days is the safety of the driver. Our main objective of the project is to ensure that the driver is safe. To enhance the safety of the driver, we are trying to detect the duration of eyes of the driver, being closed and when he is drowsy or when drowsiness is detected we are using an alarm or buzzer to alert him. By this we can reduce the accidents and traffic management can also be maintained. The objective of this project is to build a drowsiness detection system that will detect that a person's eyes are closed for a few seconds. This system will alert the driver when drowsiness is detected. One of the technical possibilities to implement driver drowsiness detection systems is to use the vision-based approach. Here we are detecting the driver drowsiness by estimating vision system of him/her. We will be using Open CV for gathering the images from webcam and feed them into a Deep Learning model which will classify whether the person's eyes are 'Open' or 'Closed'. The approach we will be using for this project is as follows. Take image as input from a camera. Detect the face in the image and create a Region of Interest (ROI). Detect the eyes from ROI and feed it to the classifier. Classifier will categorize whether eyes are open or closed. Calculate score to check whether the person is drowsy.

1.3 Scope of the Project

There are many products out there that provide the measure of fatigue level in the drivers which are implemented in many vehicles. The driver drowsiness detection system provides the similar functionality but with better results and additional benefits. Also, it alerts the user on reaching a certain saturation point of the drowsiness measure. The model can be improved incrementally by using other parameters like blink rate, yawning, state of the car, etc. If all these parameters are used it can improve the accuracy by a lot. We plan to further work on the project by adding a sensor to track the heart rate in order to prevent accidents caused due to sudden heart attacks to drivers.

2. Literature Survey

An intelligent video-based drowsy driver detection system, which is unaffected by various illuminations, is developed in this study. Even if a driver wears glasses, the proposed system detects the drowsy conditions effectively. By a near-infrared-ray (NIR) camera, the proposed system is divided into two cascaded computational procedures: the driver eyes detection and the drowsy driver detection. The average open/closed eyes detection

rates without/with glasses are 94% and 78%, respectively, and the accuracy of the drowsy status detection is up to 91%. By implementing on the FPGA-based embedded platform, the processing speed with the 640×480 format video is up to 16 frames per second (fps) after software optimizations.

Monitoring Driver Fatigue using Facial Analysis Technique

In this paper, we describe a non-intrusive vision-based system for the detection of driver fatigue. The system uses a color video camera that points directly towards the driver's face and monitors the driver's eyes in order to detect micro-sleeps (short periods of sleep). The system deals with skin-color information in order to search for the face in the input space. After segmenting the pixels with skin like color, we perform blob processing in order to determine the exact position of the face. We reduce the search space by analyzing the horizontal gradient map of the face, taking into account the knowledge that eye regions in the face present a great change in the horizontal intensity gradient. In order to find and track the location of the pupil, we use gray scale model matching. We also use the same pattern recognition technique to determine whether the eye is open or closed. If the eyes remain closed for an abnormal period of time (5-6 sec), the system draws the conclusion that the person is falling asleep and issues a warning signal.

2.1 Existing System

Traffic congestion is one of the major modern-day crises in every big city in the world. Previously different techniques had been proposed, such as infra-red light sensor, induction loop etc. to acquire traffic data which had their fair share of demerits. In recent years, image processing has shown promising outcomes in acquiring real time traffic information using CCTV footage installed along the traffic light. Different approaches have been proposed to glean traffic data. Some of them count total number of pixels, some of them calculate number of vehicles. These methods have shown promising results in collecting traffic data. However, calculating the number of vehicles may give false results if the intra vehicular spacing is very small (two vehicles close to each other may be counted as one) and it may not count rickshaw or auto-rickshaw as vehicles which are the quotidian means of traffic especially in South-Asian countries.

2.2 Proposed System

In this paper, a system in which density of traffic is measured by comparing captured image with real time traffic information against the image of the empty road as reference image is proposed. Each lane will have a minimum amount of green signal duration allocated. According to the percentage of matching allocated traffic light duration can be controlled.

3. PROPOSED ARCHITECTURE

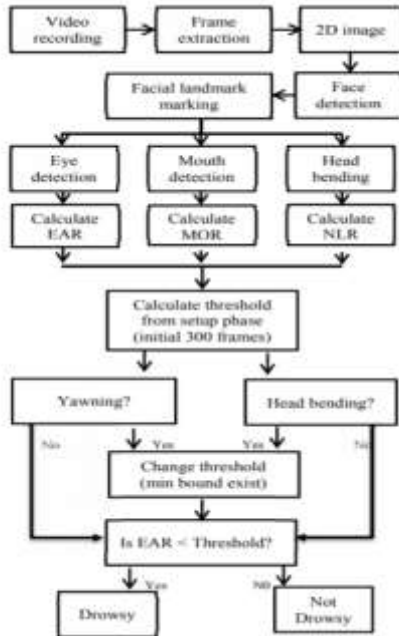


Fig:1 Architecture

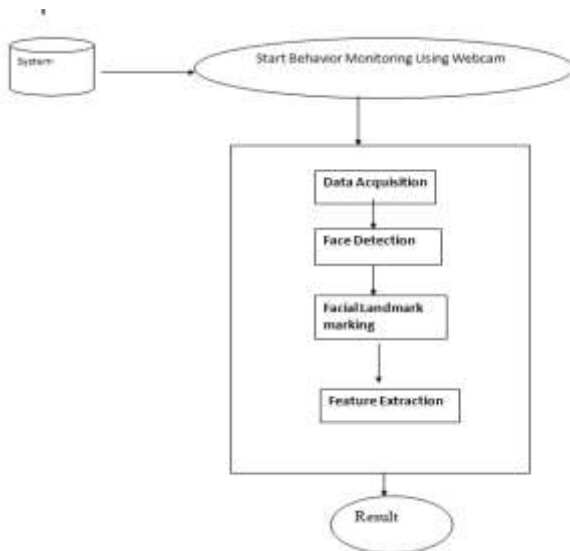


Fig:2 Flow Chart

4. Implementation

Modules:

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.

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 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 VM, 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.

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.

Classification :-

After computing all the three features, the next task is to detect drowsiness in the extracted frames. In the beginning, adaptive thresholding is considered for classification. Later, machine learning algorithms

are used to classify the data. For computing the threshold values for each feature, it is assumed that initially the driver is in complete awake state. This is called setup phase. In the setup phase, the EAR values for first three hundred (for 10s at 30 fps) frames are recorded. Out of these three hundred initial frames containing face, average of 150 maximum values is considered as the hard threshold for EAR. The higher values are considered so that no eye closing instances will be present. If the test value is less than this threshold, then eye closing (i.e., drowsiness) is detected. As the size of eye can vary from person to person, this initial setup for each person will reduce this effect. Similarly, for calculating threshold of MOR, since the mouth may not be open to its maximum in initial frames (setup phase) so the threshold is taken experimentally from the observations. If the test value is greater than this threshold then yawn (i.e., drowsiness) is detected. Head bending feature is used to find the angle made by head with respect to vertical axis in terms of ratio of projected nose lengths. Normally, NLR has values from 0.9 to 1.1 for normal upright position of head and it increases or decreases when head bends down or up in the state of drowsiness. The average nose length is computed as the average of the nose lengths in the setup phase assuming that no head bending is there. After computing the threshold values, the system is used for testing. The system detects the drowsiness if in a test frame drowsiness is detected for at least one feature. To make this thresholding more realistic, the decision for each frame depends on the last 75 frames. If at least 70 frames (out of those 75) satisfy drowsiness conditions for at least one feature, then the system gives drowsiness detection indication and the alarm.

4.1 Algorithm

STEP1: We will be using Open CV for gathering the images from webcam and feed them into a Deep Learning model which will classify whether the person's eyes are 'Open' or 'Closed'. The approach we will be using for this project is as follows.

STEP2: Take image as input from a camera.

STEP3: Detect the face in the image and create a Region of Interest (ROI). Detect the eyes from ROI and feed it to the classifier. Classifier will categorize whether eyes are open or closed.

STEP4: Calculate score to check whether the person is drowsy.

4.2 Code Implementation

OpenCV is a computer vision and machine learning software library that includes many common image analysis algorithms that will help us build custom intelligent computer vision applications. In this application frequent image feed results in video tracking of our particular finger. Video tracking is the process of locating a moving object (or multiple objects) over time using a camera.

The ability to perceive the shape and motion of hands can be a vital component in improving the user experience across a variety of technological domains and platforms .One such technology is using Media Pipe .Media Pipe is a framework mainly used for building audio, video, or any time series data. With the help of the Media Pipe framework, we can build very impressive pipelines for different media processing functions.

Python 3.7. Python is broadly utilized universally and is a high-level programming language. It was primarily introduced for prominence on code, and its language structure enables software engineers to express ideas in fewer lines of code. Python is a programming language that gives you a chance to work rapidly and coordinate frameworks more effectively.

PyCharm is a dedicated Python Integrated Development Environment (IDE) providing a wide range of essential tools for Python developers, tightly integrated to create a convenient environment for productive Python, web, and data science development.

5. Result

#Main Screen



Fig:3 Home Page



Fig:4 Eyes open



Fig:5 Eyes Closed



Fig:6 Yawning count when eyes are open



Fig:7 Yawning count when eyes are closed



Fig:8 Loading dataset for Lane Detection



Fig:9 Lane detection

5. Conclusion

In this paper, a low cost, real time driver drowsiness monitoring system has been proposed based on visual behavior and machine learning. Here, visual behavior features like eye aspect ratio, mouth opening ratio and nose length ratio are computed from the streaming video, captured by a webcam. An adaptive thresholding technique has been developed to detect driver drowsiness in real time. The developed system works accurately with the generated synthetic data. Subsequently, the feature values are stored and machine learning algorithms have been used for classification. Bayesian classifier, FLDA and SVM have been explored here. It has been observed that FLDA and SVM outperform Bayesian classifier. The sensitivity of FLDA and SVM is 0.896 and 0.956 respectively whereas the specificity is 1 for both. As FLDA and SVM give better accuracy, work will be carried out to implement them in the developed system to do the classification (i.e., drowsiness detection) online. Also, the system will be implemented in hardware to make it portable for car system and pilot study on drivers will be carried out to validate the developed system.

6.Future Scope

A system in which density of traffic is measured by comparing captured image with real time traffic information against the image of the empty road as reference image is proposed. Each lane will have a minimum amount of green signal duration allocated. According to the percentage of matching allocated traffic light duration can be controlled.

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