Real Time Driver Drowsiness Detection Using Open CV

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Abstract

Drowsy driving is a major problem. The risk, danger, and often tragic results of drowsy driving are alarming. Drowsy driving is the dangerous combination of driving and sleepiness or fatigue. This usually happens when a driver has not slept enough, but it can also happen due to untreated sleep disorders, medications, drinking alcohol, or shift work. No one knows the exact moment when sleep comes over their body. Falling asleep at the wheel is clearly dangerous, but being sleepy affects your ability to drive safely even if you don't fall asleep. An estimated 1 in 25 adult drivers (aged 18 years or older) report having fallen asleep while driving. Hence our model will provide an uninterrupted monitoring of the heart beat and eye of the driver in order alert the passengers and the driver himself.

Keywords—**heart rate monitoring, driver drowsiness detection, retina monitoring**

I. INTRODUCTION

Sleepiness during driving has been shown to result in a greatly increased risk of suffering an accident. Specifically, has shown that to drive while sleepy increases the accident risk four to six times, compared to alert driving. Furthermore, the risk of suffering an accident is higher during night driving or in situations with reduced prior sleep. In fact, at least 15- 20% of all vehicle accidents have been estimated to be sleepiness related.

Therefore, it is beneficial to develop a system to monitor the physical and mental state of the driver and give alerts at the critical moment when the driver is becoming fatigued, thereby preventing traffic accidents. In the last decade, diverse techniques have been used to develop monitoring systems for a variety of purposes. Those techniques used to detect a driver's sleepiness can be generally divided into three main categories . The first category includes methods based on biomedical signals, like cerebral, muscular and cardiovascular activity , and usually, these methods require electrodes attached to the driver's body, which will often cause annoyance to the driver.

Most of them are yet far from being effectively introduced in the market, according to recent reviews. The second category includes methods based on driver performance, which evaluate variations in the lateral position of the vehicle, in the velocity, in the steering wheel angle and in other signals recorded by CAN and the advantage of these approaches is that the signal is meaningful and the signal acquisition is quite easy. This is the reason because such systems have indeed entered the commercial market , and but, to the author's knowledge, in the open literature there are very few details available regarding the mechanisms or parameters of these systems. On the other hand, these systems are subject to several limitations such as vehicle type, driver experience, geometric characteristics, condition of the road, etc.

Then, these procedures require a considerable amount of time to analyse user behaviours and therefore, they do not work with the so called micro-sleeps—when a drowsy driver falls asleep for a few seconds on a very straight road section without changing the vehicle signals. The third category includes methods based on driver visual analysis using image processing techniques. Computer vision can be a natural and nonintrusive technique for monitoring driver's sleepiness from the images taken by some cameras placed in front of the user. These approaches are effective because of the occurrence of sleepiness is reflected through the driver's face appearance and head/eyes activity. Different kinds of cameras and analysis algorithms have been reported in the literature for this approach: methods based on visible spectrum camera and ; methods based on IR camera ; and methods based on stereo camera and . Some of them are commercial products as: Smart Eye, Seeing Machines DSS , Smart Eye Pro and Seeing Machines Face API.

However, these commercial products are still limited to some well controlled environments and they require of hard calibration processes. Then, there is still a long way in order to obtain a robust commercial product in this category. Regardless of the type of measurement, one of the chief problems of drowsiness detection studies is the difficulty of carrying out experimental tests to validate the techniques.

II. PROPOSED METHOD

The face alignment step, which crops the face areas of various sizes in the image to the same size, is an important factor that greatly affects the final recognition performance of the face recognition system. In this paper, the face image was rotated so that the two eyes are horizontal, based on their coordinates, and the image is rescaled to keep the distance between the eyes in all face images constant. To avoid the effects of hair style and background of an image on face recognition performance, the images were cropped to nearly equal sizes. The performance of local feature for face recognition has different characteristics depending on how the sub image is constructed. x NM and x SEG are the sub- images constructed by cutting partial areas of face images.

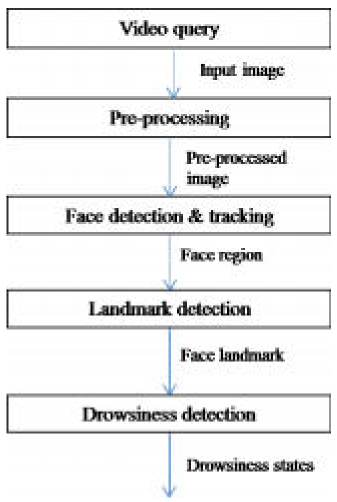

Fig 1: System architecture

The studies in the discipline of psychophysics, particularly delving into the process of how humans recognize faces of other people, as well as studies in the discipline of bioinformatics also examining human face recognition, commonly report that the relevant information concentrates on salient components such as the eyes, nose, and mouth. Based on results obtained from such studies, x ENM resulted as the sub image comprised of the eyes, nose, and mouth domains. Features could also be extracted by dividing the domain of the face regionally to relieve the effects of face recognition performance degradation by the distortion of face images attributable to factors such as illumination. x SEG is a sub- image resulting from the domain of the face divided into four sub-domains from which the local-features were extracted. Some pixels of a face image can also be selected to create sub-images. Considering the face recognition issue as a classification problem for image data, pixels with small variance in the same person's images in the feature space and large dispersion from other people's images are suitable for data classification. x FSDD and x VS are the sub- images constructed by selecting pixels useful for face recognition based on these discriminant analyses. x FSDD is the sub image constructed with pixels of a larger discriminant distance that represents the class discrimination power of individual pixels whereas x IVS is the sub-image constructed with pixels having more discriminative information based on the magnitude of the linear discriminant elements of the feature vectors.

In this paper, the NLDA (Null space LDA) feature vectors were employed for the construction of x IVS . Around 50% of the total number of pixels of a whole face image were selected to make x FSDD and x IVS . The respective two face images (fa, fb) of 200 subjects contained in the FERET database were used as training images to obtain the discriminant distance and NLDA feature vectors

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III. PROPOSED ALGORITHM

The proposed algorithm uses MCT AdaBoost classifier for the face detection and LBF regressor for the face landmark detection because they are very fast and accurate so as to be running on the embedded device. Fig. 2 shows the flow diagram of the drowsiness detection algorithm. First, the video query process retrieves an image frame from the camera. The input image is pre- processed by Gaussian filtering to remove noise. The proposed algorithm detects the face in the pre- processed image using MCT AdaBoost classifier. MCT feature is robust to the lighting conditions. We use two-stages cascade classifiers which is composed of weak classifiers. The first stage classifier consists of three- pixel position weak classifiers which have the upper high weights. Almost all of the non- objects are filtered out by the first stage classifier. It is determined by the sum of the weights of three weak classifiers whether or not the vehicle is true.

The second stage classifier consists of the remaining weak classifiers and determine whether or not the vehicle passed through the first stage classifier is true. And we use Correlation Filter in order to improve the reliability of the face detection. The correlation filter tracks the object by applying a correlation filter to the image transformed into the frequency domain. If a detection miss is occurred, the tracked region is regarded as a face region. In the detected face region, the proposed algorithm finds the face landmark which represents the main point of the face. We use 68 landmarks of 300-w dataset. There are many face alignment algorithms such as ensemble of regression tree regressing local binary features, and so on. In order to detect the landmarks, the proposed algorithm uses a method of regressing Local Binary Feature (LBF) which consists of local binary feature mapping and global linear regression using random forests. Eye states (closed, open) is determined by the value of eye aspect ratio (EAR) which is easily calculated by the landmarks in eye region. And drowsiness is determined by PERCLOS (PERcentage eye CLOSure) which means the percentage of the time the eyes are closed.

IV. RELATED WORK

Various algorithms and techniques have been proposed for drowsiness detection and prevention. Some of the methodologies and algorithms are discussed here. Viola & Jones Algorithm is robust which means it has a very high detection rate (true- positive rate) & very low false positive rate always. It is used in real time applications that processes at least 2 frames per second. It is a face detection algorithm and not a recognition algorithm. The algorithm has four stages namely Haar Feature Selection, Creating an Integral Image, Adaboost Training and Cascading Classifiers. The features sought by the detection framework universally involve the sums of image pixels within rectangular areas. As such, they bear some resemblance to Haar basis functions, which have been used previously in the realm of image-based object detection. However, since the features used by Viola and Jones all rely on more than one rectangular area, they are generally more complex. The figure on the right illustrates the four different types of features used in the framework. The value of any given feature is the sum of the pixels within clear rectangles subtracted from the sum of the pixels within shaded rectangles. Rectangular features of this sort are primitive when compared to alternatives such as steerable filters. Although they are sensitive to vertical and horizontal features, their feedback is considerably coarser. Haar Features All human faces share some similar properties. These regularities may be matched using Haar Features. A few properties common to human faces are the eye region is darker than the upper cheeks, the nose bridge region is brighter than the eyes. Composition of properties forming match able facial features such as Location and size: eyes, mouth, bridge of nose, Value: oriented gradients of pixel intensities. The four features matched by this algorithm are then sought in the image of a face.

Rectangle features: Value = Σ (pixels in black area) – Σ (pixels in white area)

Three types of them are two-, three and four rectangles. Viola & Jones used two rectangle features • For example: the difference in brightness between the white &black rectangles over a specific area. Each feature is related to a special location in the sub-window Summed area table. An image representation called the integral image evaluates rectangular features in constant time, which gives them a considerable speed advantage over more sophisticated alternative features. Because each feature's rectangular area is always adjacent to at least one other rectangle, it follows that any two-rectangle feature can be computed in six array references, any three-rectangle feature in eight, and any four-rectangle feature in nine.

V. CONCLUSION

The holistic features extracted from the whole image of a face and the local features extracted from its sub images have different characteristics in face recognition. In this paper, a method to construct composite features by selecting features equipped with rich information for face recognition from the holistic and local features was presented. For this purpose, the holistic and local features were extracted from the whole and sub- images of a face by using NLDA. Then,the amount of discriminative information contained in each extracted feature was measured by discriminant analysis and the composite features consisting of features rich in discriminative information were employed for face recognition. The face recognition performance was evaluated with images obtained from the FERET database, CMUPIE database, Yale B database, and AR database. The proposed method exhibited superior face recognition performance compared to using only the holistic or local features. The method also showed a comparatively higher face recognition performance than other methods, including hybrid methods. It is therefore expected that the method for the construction of composite features presented in this paper can be combined with other extraction methods to improve the discipline of pattern recognition performance as well as that of face recognition.

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