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A Survey on Sleepy Eye Detection

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Abstract— **A large number of the vehicle accidents occurring are mainly due to the driver drowsiness and fatigue. The accidents occurring due to these reason are more fatal. Development of the driver drowsiness detection is a major challenge in the Accident avoidance field. The three possible ways of developing the drowsiness detection system are based on the body parameter analysis, vehicle parameter analysis, and face analysis. We concentrate on the face analysis based techniques.**

Index Terms— **face analysis, template matching, image processing**

I. INTRODUCTION

Most of the eye-detection literature is associated with face detection and face recognition. Direct eye detection methods search for eyes without prior information about face location, and can further be classified into passive and active methods. Most eye trackers require manual initialization of the eye location before they can accurately track eye features for real-time applications. A method for locating the eyes in static images was developed by Kanade in 1973 and has been improved by other people over the years. Most of these researchers have based their methods on Yuille's deformable templates to locate and track eye-features .This method looks for the valleys and peaks in the image intensity to search for the eyes. Once the location of the eyes is determined, its position information is used as a priori knowledge to track the eyes in succeeding frames. But it requires the eye template to be initialized manually at or below the eye otherwise it detects the eyebrow instead of the eye. Hallinan has tried to build an automated model for deformable templates the best candidates for the eye pair, but in order to make his method invariant to scaling, the template is initialized at different sizes at various places and the best candidates for the eyes are selected. Chowetal make use of the Hough transform in combination with the deformable templates to extract eye-feature points, but this approach is also time consuming as the Hough Transform for various scales had to be applied prior to detecting the iris, unless the approximate radius of the iris is known in advance. Deng and Lai presented the concept of regional force sand regional torque to accurately locate and resize the template on the iris even when the iris is in an extreme position, and for the correct orientation of the eye window before it can successfully locate and track the eyelids. All these methods track the eyes from frame to frame by read justifying the template of both the iris and the eye contour. Tianetal have shown that such an approach is prone to error if the eyes blink in the image sequence.

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II. LITERATURE SURVEY

“A new System for Driver Drowsiness and Distraction Detection” Mehrdad Sabet Reza A. Zoorofi **et. al. [1]** proposed a new system has been presented to monitor and detect driver drowsiness and distraction. This system uses advance technologies based on computer vision and artificial intelligence. For face tracking we employed feedback system using LBP, to prevent divergence and losing the target. Because of feedback system, detection and tracking modules can cooperate with each other. Eye state analysis performed by SVM with features which extracted using LBP operator. The proposed algorithm for face tracking and eye state analysis is shown to be robust and accurate for varying light, background changes and facial orientation. The system is also observed to provide agreeable results.

“Sleepy Eye’s Recognition for Drowsiness Detection” Shinfeng D. Lin **et. al.[2]** presents a sleepy eye's recognition for drowsiness detection without the training stage. In the beginning, an Adaboost classifier with Haar - like features is utilized to find out the face area. Then the eyes region is located by ASM. Finally, the binary pattern and edge detection are adopted to recognize the eye’s state. Experimental results prove that the proposed method could accurately detect the sleepy eyes. In addition, the comparative performance shows that the proposed recognition system without the training stage is useful for driver’s drowsiness detection.

“Design and Implementation of Driver’s Drowsiness Detection System on Digitalized Driver System-2013” Pranto Hidaya Rusmin **et. al. [3]** proposes a method which utilizes both the driver eye drowsiness detection as well as vehicle parameter analyses. This method of the driver drowsiness detection uses the fact that the eye region is in the 1/3rd top region of the face and hence the data overhead to detect the eye region in the face is reduced to a great extent. Then for drowsiness detection this uses basic template matching technique as earlier.

“Drowsy Driver Warning System using Image Processing” Singh himani parmer **et. al.[4]** proposes a drowsiness detection system based on the image processing technique. Here the symmetry of the face is utilized an half the face is only is used as input data hence reducing the data to be processed. After that the region in the face with the maximum darkness is identified and this region is the eye region. The previous mentioned process is only applied for the first frame and for the subsequent frames the eye tracker takes care of updating the information about the eye position. If only there is large deviation in the eye region the initialization phase is repeated. A two circle template matching technique is used for detection of state of the eye.

“Video-Based Detection and Analysis of Driver Distraction” Yiaxiao Yun **et. al. [5]** here in this paper the authors talk about both inner as well as outer side of the car to be traced. Video recording sensors are used and based on the frames received the status of the driver is drawn. The main distinguishing feature of this method is that the authors also focus on the outside of the car to track the vehicles on both side of the car by using sensors and based on the distance the driver is alerted about the situation. Face analysis and detection here works in a simple manner by reading the frames recorded by the camera and recognising the face. After face is recognised the other parts of the face are recognised based on the facial geometry, i.e. relative position of various organs on the face.

"Feature extraction" Xiaoguang Lu **et.al. [6]**
The process to determine the query face a one to many matching process is used which distinguish a query face image to all the stenciled images in a given face database. The identification process for the test images is carried out by detecting the image in the database which has the exorbitant resemblance with the test image. The identification process is a "closed" test, which explains that the sensor gets hold of an examination made of an individual that is known to be in the database. The features of the test subject is distinguished to the database's features and a sense of likeness for each feature is established. These similarity scores are then numerically ranked in a descending order. A "top match score" is a percentage of the number of times the greatest similarity score has been the right match for all the individuals. If any of the top r similarity scores is compatible to the test subject, it is taken into account as a correct match in terms of the cumulative match. The number of times one of the r similarity scores is the correct match for all individuals, is referred to as the "Cumulative Match Score". The "Cumulative Match Score" curve is the rank "n" to the percentage of the right recognition, where rank n is defined as the number of the highest similarity score.

"Kernel Principle Component Analysis in Face Recognition System: A Survey" Ritu Upadhayay **et.al. [7]**This step for Face Detection is to examine, if the human faces appear in a given image, and to locate it. The approximate results of this process are patches containing each face in the image input. With the purpose of [2] making further face recognition system more simple to carry it out, face configuration are executed to explain the scales and alignments of these patches.

The Feature Extraction step comes after the face detection step, the human-face patches are extracted from images. Using these patches instantly for face recognition have a few downsides to it, firstly each patch comprises over one thousand pixels but are too large to construct [2] a sturdy recognition system. Secondly, the face patches may be taken up from a different camera orientations and with a different face expressions as well as illuminations and may be afflicted from occlusion and clutter. To overcome with these drawbacks, the feature extractions are carried out to do in-formation packing, dimension reduction, salience extraction, and noise cleaning.

The face recognition is used for two key functions: [3][4]. Firstly, it is verification (one-to-one matching) when it is presented with an unknown individual's face image alongside with a claim of identity, determining whether the individual is who he or she declares to be. Secondly, it is the identification (one-to-many matching), where an image of of an unidentified individual is provided with and examining that person's identity by distinguishing that image with a database of the images of known individuals. There are a number of application areas in which face recognition can benefit from confirmation and recognition.

"Multi-view face detection based on kernel principal component analysis and kernel support vector technique." Muzhir Shaban Al-Ani **et. al. [8]** The algorithm can be obtained upon the capability of the KPCA. The KPCA feature removal efficaciously acts a nonlinear mapping from the input space to an implicit high dimensional feature space. The steps needed to carry out the principal components can be briefed up as follows;

• the matrix K can be computed, see Eq. (2). In this paper the polynomial kernel is used as a kernel function: ",$% "&".$%'(%).

Where a = 0.001; b =-1; n = 3 and xk RN are taken from the face images by rearranging the pixel value order as shown • In order to obtain the eigenfaces, the face image data are converted from matrices to vectors, where the vector version of each face is a column in a matrix. • The resulting eigenfaces are then point multiplied with the training set images to filter out outlier data and focus the training on the principal features of the face. The resulting images have their intensities scaled. • The first M = 50 most notable principal components are used as the basic vectors. It aims at training the KSVC to distinguish between the face and non-face patterns for face detection. • Projections of a test point onto the eigenvectors are computed.

"Automatic Facial Expression Analysis A Survey" C.P. Sumathi **et.al. [9]**
This system evaluates the measurement of actions and also divides the actions as per the manual of FACS[9]. The procedural steps involved in the analysis are 1.Face Acquisition 2.Facial Expression Extraction 3.Expression Recognition.

Face acquisition is the first step in which faces are detected from the input images or image sequences. The Face acquisition may detect faces in input images or detect face in the first frame and track the face in the remaining frames in case of image sequences. Based on the type of input the faces can be classified into 2D or 3D faces. After the face is located then thefacial features are extracted to identify the facial expression. Facial expression can be classified into two types namely Geometric or In Transient features and Appearance Features or Transient Features.

Geometric or Intransient Features: The features that are always present in the face but may be deformed due to any kind of facial expression.eg)Eyes, Eyebrows, Mouth, Tissue Textures, Nose. The facial components or facial feature points are extracted to form a feature vector that represents the face geometry

Appearance or transient Features: The features that appear temporarily in the face during any kind of Facial Expression. Eg) Different kinds of wrinkles, bulges, forefront, regions surrounding the mouth and eyes. With the help of the appearance-based methods, image filters, such as Gabor wavelets, are applied to either the whole-face or specific regions in a face image to extract a feature vector.

The last step is the Facial Expression Recognition in facial expression analysis where the extracted features are determined based on the action units. Not only the basic emotions like anger, happiness, sorrow are identified by the Recogniser but also identifies the expression caused due to pain, temporal dynamics , Intensity of Expression, Spontaneous Expression.

“Multi-View Algorithm for Face, Eyes and Eye State Detection-study paper” Latesh Kumari **et.al [10]**

This involves the Skin colour segmentation, wherein with the help of the skin colour segmentation we can separate the skin and non-skin regions of the image. This is however dependent of the colour models in which we are illustrating the human image. The selection of the colour model plays a significant role in skin segmentation to make it more effectual. The prospective colour spaces: CIEXYZ CIEXYZ YCbCr YUV YIQ .The computation of the separability of clusters of skin and non-skin pixels using scatter matrices. Another metric is to do a histogram comparison of the skin and non-skin pixels after colour space transformation. The YCbCr colour space was found to perform very well.

Skin detection is defined as a process of removal of skin pixels and non-skin pixels in an image or a video. The skin and non-skin regions are obtained by dividing the pixels of the given image with the help of a detector. According to computer vision, there are many ways to approach the methods developed for skin detection. A skin detector typically transforms a given pixel into an appropriate color space and then uses a skin classifier to label the pixel whether it is a skin or a non-skin pixel. In any given color space, skin color occupies a part of such a space, which might be a compactor large region in the space. Such region is usually called the skin color cluster. A skin classifier is a one-class or two-class classification problem. A given pixel is classified and labelled whether it is a skin or a non-skin given a model of the skin color cluster in a given color space. In the context of skin classification, true positives are skin pixels that the classifier correctly labels as skin. True negatives are non-skin pixels that the classifier correctly labels as non-skin. Any classifier makes errors: it can wrongly label a non-skin pixel as skin or a skin pixel as a no skin is a performance. The former type of errors is referred to as false positives (false detections) while the later is false negatives. A good classifier should have low false positive and false negative rates. As in any classification problem, there is a trade-off between false positives and false negatives. The more loose the class boundary, the less the false negatives and the more the false positives.

Eye detection: Eyes are detected based on the assumption that they are darker than other part of the face. Han at al. use morphological operations to locate eye-analogue segments, while Wu and Zhou find eye-analogue segments searching small patches in the input image that are roughly as large as an eye and are darker than their neighbourhood’s. For eye detection, there are four methods are used which include Viola-Jones eyes detector, the algorithm described by Valenti and Gevers , the approach proposed by Timm and Barth , and feature extractor by Ribarić, Lovrenčić, and Pavešič.

“Automatic Eye Detection and Its Validation” Peng Wang **et.al. [11]**

This paper talks about the Eye Detection Error on Face Recognition and the observation of how the recognition performance varies according to eye localization error and the eye positions of the base truth are synthetically concerned with random noises. The Face recognition is carried out using the perturbed eye positions. Given a normalized error, the random noise is uniformly distributed at a circle in 2D space. The data provided from FRGC 1.0 and PCA baseline algorithm are used in the experiment .The eye location errors notably influence the recognition accuracy. For example, about 1% (about 3 pixels for FRGC image or 0.5 pixel if the interocular distance is 50 pixels) eye location error reduces the face recognition accuracy by over 10%. When the error is about 5%, the face recognition accuracy reduces by 50%.

Drowsy Driver Warning System Using Image Processing” Singh Himani Parmar **et.al. [12]**

The Localization of Face takes place based on the symmetry of the face, we use a symmetry-based approach. A sub sampled, gray-scale version of the image was found to be enough for the usage. A symmetry-value is then computed for every pixel-column in the reduced image. Consider the image to be denoted by I(x, y) then the symmetry value for a pixel-column is given by S(x) = ∑∑ [abs I ((x,y-w)-(x,y+w))]. S(x) is computed for X € [k,size-k] where k is the maximum distance from the pixel-column that symmetry is measured, and x size is the width of the image. The x corresponding to the lowest value of S(x) is the center of the face.

The Location of Eyes consists of a raster scan algorithm which is used for the most exact location of the eyes and extracts that vertical location of eyes.

The eye is tracked by looking for the darkest pixel in the predicted region. To help to be able to overcome tracking errors, we make sure that not even a single geometrical constraint is violated. Incase they are violated , we relocalize the eyes in the next frame. To find the best match for the eye template, we initially center it at the darkest pixel, and then a gradient descent is performed in order to find a local minimum.

Detection of Drowsiness talks about when the driver becomes more fatigued, the driver would have more eye-blinks to last longer. The number of consecutive frames that the eyes are closed will be kept in count in order to decide the condition of the driver. We need to determine if the eyes would be opened or closed; so a method is used that looks at the horizontal histogram across the pupil.

“**Driver Fatigue Detection based on Eye State Analysis”** Yong Du Peijun Ma Xiaohong Su Yingjun Zhang **et.al.[13]**

Localization of the Face consists of when the driver’s eyes’ position and light conditions that changes constantly while driving on road. It is not easy to search And locate the driver’s eye at a constant location. Moreover, the background is usually complex and unpredictable especially when the automobile is running on the road. The first step is to detect the face which helps to further reduce the range of eye detection and the process will improvise the accuracy and the speed of the eyes location and lower the interference of background. For purpose of reducing the blindness of face searching, we calculate interframe differences to decide whether there is an moving object. When a given object is detected and in the local area there contains skin color information in YCbCr color space, it is believed that there is a person before the camera. Although people of different races are different in skin color, a planar Gaussian distribution can be used to approximate the distribution of human skin color in YCbCr color space.

The localization of the eyes talks about the thermodynamic principle, for a closed system, the minimum of Helmholtz1 free energy f E is used to describe the equilibrium state in stead of maximum entropy. In such a system, the particles of set i has the same free energy of i f E. By Taking into consideration the vast variety to the nearby pixels and the likeness to the eye pixels sufficiently, the specific region of the eyes can be obtained

"**Driver Drowsiness Detection System and Techniques: A Review Research"** Vandna Saini **et.al. [14]**

Optical detection is the most common application of an optical sensor system which uses infrared or near-infrared LEDs to light the driver's pupils and are then observed by a camera system. The computer algorithms examine the blink rate and duration to determine drowsiness. The camera system may also monitor The facial features and head positions are also observed by the camera system for any signs of drowsiness, such as yawning and sudden head nods.

Most of the researchers have taken into account the following physiological signals to detect drowsiness, Electrocardiogram (ECG), electroencephalogram (EEG). The different stages of drowsiness, can be varied significantly due to the heart rate. Therefore, heart rate, which can be easily determined by the ECG signal, can also be used to detect drowsiness. Others have measured drowsiness using Heart Rate Variability (HRV), in which the low (LF) and high (HF) frequencies fall in the range of 0.04–0.15 Hz and 0.14–0.4.

"**Performance Analyses and Comparison of Eye Detection Techniques"** Vijayalaxmi **et.al. [15]**

Using the Neural Network method the driving support systems, are becoming regular and aid the driver in many ways. A non-intrusive method of detecting Fatigue and drowsiness based on eye-blink count and eye directed instruction control helps the driver to avoid collisions caused due to driver's drowsiness. Eye detection and tracking methods under different circumstances such as illumination, background, face alignment and facial expression makes the concepts difficult. The algorithm proposed describes that firstly the network is trained to reject the non-eye region based on images with features of eyes and the images with features of non-eye using Gabor filter and Support Vector Machines to reduce the dimension and classify efficiently. The face is firtly divided using L*a*b transform colour space and then is later detected using HSV and Neural Network approach. The first step in the proposed algorithm is training SVM . A large data of eye and non-eye patterns are collected to train SVM. The images containing eyes of various sizes, alignments, positions, whether it is opened or closed, the non-eye-pair images are cut appropriately for the training of SVM. The right way of choosing a non-eye-pair image is highly crucial to train SVM because performance of SVM is dependent on the kind of non-eye-pair images that are being used. Initially the training SVM, the non-eye-pair images are similar to eye pair such as eyebrows, nostrils and other eye-pair like patches as eye pair. The performance of the method is determined with the sensitivity rate of 88.6%, specificity of 95.2% and accuracy of 89.2%.

"**A Computer Vision-Based System for Real-Time Detection of Sleep Onset in Fatigued Drivers"** Alexandra Branzan Albu **et.al. [16]**

In a given frame, template matching is not performed with a n exhaustive search. The first location of the match wherein the likeness of the ratio τ exceeds the tolerance τR is retained which helps in the speed of computation.

The closed-eye states are not as frequent as the open-eye states are, so template matching for open-eye is carried out initially. If no match is found for open eyes, a matching process against closed-eyes is carried out later on. If both matching processes do not identify matches then decision of no match is declared thereby.

"Fighting Accident Using Eye Detection for Smartphones Monitoring Physiological Characteristics" Mohamed A. Mohamed **et.al.[17]**

Inorder to obtain the best possible accurate method we can use the ones based on human physiological phenomena. It can becarried out in two ways; firstly to measurethe changes in physiological signals, suchas brain waves or heart rate or to measure physical changes such as eye blinking or sagging posture, leaning of the driver's head and the open or closed states of the eyes.To measure the changes in physiological signals is not realistic, since the sensing of electrodes would have to be attached directly onto the driver's body, and would inturn be a distraction for the driver.

If thedriver would have to drive for a long time it would result in perspiration on the sensors; lowering their ability to monitor accurately. The IR sensors & camera module that is to be used for measuring the changes in physiological signals brain waves. The second technique which has been discussed and executed in this paper is well suited for real world driving conditions since it can be non-intrusive by using optical smartphone cameras to detect change.

"Sleepy Eye's Recognition for Drowsiness Detection" Lin .S.D **et.al. [18]**

The heavy traffic often is a major cause that leads to a huge number of accidents taking place. The most common accidents taking place these days is due to the driver's drowsiness. To avoid this situation, this paper proposes a sleepy eye's recognition system for drowsiness detection. Initially, a cascaded Adaboost classifier with the Haar-like features is made use of to find out the face region. Secondly, the eye region is located by Active Shape Models(ASM) search algorithm. The binary pattern is then used and edge detection are adopted toobtain the feature of the eyes and determinethe eye's state. Experimental results demonstrate the comparative performance, even without the training stage, with other methods.

"A Survey on Driver's Drowsiness Detection Techniques" Jay D. Fuletra **et.al. [19]**

The main cause for fatal accidents to take place is the Drowsiness and sleeping while driving. The different drowsiness detection techniques are divided and then distinguished using their features. The computer vision based image processing techniques is one of them. It uses different kinds of images of the driver to detect drowsiness states using his/her eyes states and facial expressions. This technique is on the focus of this survey paper.

"Driver Fatigue Detection based on Eye State Analysis" Yong Du Peijun Ma **et.al. [20]**

This paper presents an effective aspect based on the driver fatigue detection method. Firstly, the inter-frame difference can be used to detect the face that binds the colour information. If it exists so then the face area is divided from the basis of a mixture of a skin tone model. Then the process of crystallization to obtain the location of eyes within face area can be carried out, ahead of this, the different features of the eye can be used to examine the eye's status. Finally, the driver fatigue is validated by examining the changes of eye's states. The proposed method. results show validity of the experiments carried out.

III. CONCLUSION

The different papers for sleepy eye detection and drowsiness detection papers are discussed here. The main focus here is on the face analysis based drowsiness detection system. To conclude even after so much study we feel that sleepy eye detection is an open area for research.

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