An Approach to track the Driver Gazeand Eyes off the Road to Avoid the Accidents

Kanchan Bobade, Ashish Manusmare, Neha Kottawar
[1](Electronics and Communication Eng. /Gondwana University, India)
[2](Electronics and Communication Eng. /Gondwana University, India)
[3](Electronics and Communication Eng. /Gondwana University, India)
Corresponding Author: Kanchan Bobade

ABSTRACT

Distraction driving is one of the causes of vehicle accident in countries. Passively monitoring driver activities constitutes the basis of automobile safety system that can potentially reduce the number of accidents by estimating driver focus of attention. This paper proposed an expensive vision based system to accurately detect eyes off the road (EOR). The system has three components. 1) robust facial feature feature tracking.2) head posed and gaze estimation; and From the video stream of camera installed on the steering wheel column, our system tracks a facial feature from the driver's face. Using the the track land mark and a 3-D model the system compute head pose and gaze direction. The head pose estimation algorithm is robust to no rigid face deformation due to the changes in expression. Finally, the system reliably detects EOR. The proposed system does not require any drive-dependent calibration or manual initialization and works in real time, during day and night. To validate the performance of the system in a real car environment, we conduct comprehensive experimental evaluations under a wide variety illumination condition, facial expression, and individuals. Our system achieved above 90% EOR accuracy for all tested scenarios. As a result there exists a short presentation of the image processing and the machine learning procedures that are used to accomplish such tasks. Thereafter, we further analyze the specific eye-tracking technologies and techniques that are used nowadays and the characteristics that affect the exact choice of eye-tracking equipment. For the appropriate choice we have to take into account the area of research-interest in which theequipmentwillbeused, continuously checking the readiness of the driver and alerting him for potential imminent collision incidents. Finally, we describe the existing way of connecting a device, in our case an eye-tracker,can be connected to an automobile's system.

Key words: digital image processing, driver monitoring system, eyes off the road detection, gaze estimation, driver drowsiness ,head pose estimation.

INTRODUCTION

The increasing number of traffic accidents due to a drivers' diminished attention level is a serious problem for the society. Drivers' abilities of vehicle control, natural reflex, recognition and perception decline due to drowsiness and tiredness, reducing the drivers' attention level. These pose serious danger to their own lives as well as lives of other people. According to the U.S. National Highway Traffic Safety Administration (NHTSA), drowsiness and falling asleep while driving are responsible for at least 100,000 automobile crashes annually. An annual average of roughly 40,000 nonfatal injuries and 1,550 fatalities result from these crashes.[4] These only present the casualties happening during midnight to early morning, and underestimate the true level of the involvement of drowsiness because they do not include crashes during daytime hours.

Vehicles with driver intelligence system that can detect drowsiness of the driver and send alarm may avert serious accidents. Several efforts to develop active safety systems have been reported in the literature for reducing the number of automobile accidents due to reduced vigilance. Among deferent techniques, measurement of physiological conditions like brain waves, heart rate, and pulse rate yields maximum detection accuracy[3] . However these techniques are intrusive as the sensing elements (electrodes) for measurement require physical contact with drivers causing annoyance. Less intrusive techniques like eyelid movement or gaze or head movement monitoring techniques with head-mounted devices as eye tracker or special contact lens also deliver good results.

These techniques, though less disturbing, are still not practically acceptable. A driver's state of attention can also be characterized by the behaviors of the vehicle he/she operates. Vehicle behaviors including speed, lateral position, turning angle, and moving course are good indicators of a driver's alertness level. While these techniques may be implemented non-intrusively, they are, nevertheless, subject to several limitations including the vehicle type, driver experiences, and driving conditions. Fatigue in people can be easily observed by certain visual behaviors and changes in their facial features like the eyes, head, and face. The image of a person with reduced alertness level exhibits some typical visual characteristics that include slow eyelid movement smaller degree of eye openness (or even closed), frequent nodding yawning, gaze (narrowness in the line of sight), sluggish in facial expression, and sagging posture. To make use of these visual cues, increasingly popular and non-invasive approach for monitoring fatigue is to assess a driver's alertness level through visual observation of his/her physical conditions using a camera and state-of-the-art technologies in computer vision. Techniques using computer vision are aimed at extracting visual characteristics that typically characterize a driver's awareness level from his/her video images. In a recent workshop sponsored by the Department of Transportation (DOT) on driver's alertness, it is concluded that computer vision represents the most promising non-invasive technology to monitor driver's alertness.

Fig .1: Highly Automated vehicle system

Driver state assessment (DSA) The central theme of the present paper is to evaluate the role of the driver state monitoring in traffic safety.it demonstrated that driver state (including driver distraction and drowsiness) is a major contributing factor of highway crashes. We content that modifying driver behavior based on real potential to enhance traffic safety.we content that integrating driver state information with other safety technology such as collision warning system and lane departure warning systems will produce asignificantly greater benefit than the non-integrated components .

LITERATURE SURVEY

A review paper on portable driver monitoring the system for real time fatigue. This paper describe the method for detecting the problem of driver vigilance[1]Kunta shrikanya et al a face and eye detecting model for driving an automobile this paper proposed an expensive vision based system to exactly identify eyes off target [5].this paper were belonging to LPC2148 plays major role it was arm7 architecture.[8] Lee et al proposed and algorithm for yaw and pitch estimation based on normalized histogram of horizontal and edge projection combined with an ellipsoidal face model and a support vector machine classifier for gaze estimation. Hardware based approaches to driver head pose estimation and gaze estimation rely on near-infrared (IR) illuminator to generate the bright pupil effects[7] .the bright pupil effect allows low cost pupil detection, which simplifies localization of the driver's pupil using only computer vision technique.Jiand yang [10]describe a system for driver monitoring use eye ,gaze and head posed tracking based on the bright pupil effect. The pupils are tracking by using kalman filter.Matsumoto and Belinsky [11] present trackers based on template matching and stereo cameras. Excellent tracking performance is reported, but the method requires a fully calibrated stereo setup and a full facial model for each user.

The appearance of eye regions share commonalities across race, illumination and viewing angle. Rather than relying on a single instance of the eye region, the eye model can be constructed from a large set of training examples with varying pose and light conditions. Based on the statistics of the training set a classifier can be constructed for detection purposes over a larger set of subjects. Eye region localization by Eigen images uses a subset of the principal components of the training data to construct a low-dimensional object subspace to represent the image data. Recognition is performed by measuring distances to the object subspace. The limitations of the methods, which are purely based on detection of eyes in individual frames, are that they do not make use of prior information from previous frames which can be avoided by temporal filtering. Deformable template-based method relies on a generic template which is matched to the image. In particular deformable templates, an eye model is constructed in which the eye is located through energy minimization. The concern of distracted driving can be tied to the research carried by Bruyas et al (2008) which found attention sharing generated by phone use appears to increase the driver's mental workload thereby overloading the driver's cognitive capacities and impaired the driving performance.[12] The study carried out on cognitive distraction by Harbluk et al (2002), Strayer et al (2003) shows, during the cell phone conversation, drivers are observed to be looking at the sky much more often, not at the road, traffic, or road signs. It is commonly observed that, while the drivers are in-depth conversation, they simply ignore the other road users and even close their eyes as they are imbibed in their talk. This is counterproductive to driving safely. The outcome of the research carried out by Crundall et al (2005) show, driver behaviors such as impaired gap judgment, reduced sensitivity to road conditions, poor lane maintenance, and the increase in reaction time to driving-related events can all be as a result of distracted driving. The goal of driver identification task is to classify drivers from their driving behavior characteristics, and distraction detection identifies whether the driver is under distraction due to secondary tasks.

PROPOSED METHODOLOGY

SOFTWARE

MATLAB (**mat**rix **lab**oratory)a multi-paradigm numericalcomputing environment and fourth-generation programming language. A proprietary programming language developed by Math Works, MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages, including C, C++, C#, Java, Fortran and Python.

Although MATLAB is intended primarily for numerical computing, an optional toolbox uses the symbolic engine, allowing access to symbolic computing abilities. An additional package, Simulink, adds graphical multi-domain simulation and model-based design for dynamic and embedded systems.

- **Image acquisition**

Image acquisition is real time methods which capture vedio from this camera has low cost camera placed on dashboard because it helps to capture driver gaze angle to suitable to place on driver of a vehicle the person who is driving the car .Image acquisition is process with help of using sift algorithm. On down side,when the wheel is turning there will br some frame in which the driver face will be occluded by the steering wheel.

- **Facial feature detection and tracking**

Facial features are used to detect the mental ability of the person who is driving and this helps to detect the concentration of the person while driving. Facial features are used to provide the most important information regarding the secondary task of the driver [9]. In fact, human behavioral studies have used facial expression to analyze the affective state, cognitive processes, and social interaction of an individual .Facial features like eye, head, face and vigilance helps to detect the fatigue in the person while driving. Facial features are useful in detecting driver's vigilance and distraction which helps to avoid collisions. The most popular techniques used for tracking a face is Parameterized Appearance Models (PAM) and these are Active

Appearance Models and Morphable Models. The shape recognition and object appearance can be computed with the help of Principal Component Analysis (PCA) technique on the set of data. SIFT descriptor are used for more complex representation.

Fig2. Facial Features Detection and Tracking

- **Eye-tracking vs.Gaze-tracking**

Eye-trackers necessarily measure the rotation of the eye with respect to the measuring system. If the measuring system is head mounted, as with EOG, then eye- in-head angles are measured. If the measuring Inmanyapplications,theheadpositionisfixedusingabitebar,aforeheadsupport or something similar, so that eye position and gaze are the same. In other cases, the headisfreetomove,andheadmovementsaremeasuredwithsystemssuchasmagnetic or video based headtrackers.

In [13] Yu and Eisenman, presented a new methodology to determine the point-of- gaze with a head-mounted eye-tracking system. It combined the well-known homography algorithm with distortion compensation, to determine the point-of-gaze frompointcorrespondencesinimagesobtainedbytheeye-tracker'sscenecamera.This methodology does not require either a separate head tracking system or accurate 3-D measurementsofobjectsinthe subject'sfieldofviewto determinethe visualscanning behavior (i.e. viewing time and viewing frequency of each object). The point-of-gaze estimation methodology can be used to assess visual scanning patterns accurately (to less than 0.90º). As such, it can provide insights into selective attention processes that can aid in the diagnosis and evaluation of subjects with mood disorders. The reduced complexity of the methodology allows it to be used in applications that require portability, flexibility, and a changing visual scene[14].

RESULTS

This segment assesses the accuracy of our system in different tasks. First, we compare our head pose estimation to other state-of-the-art approaches. Second, we report the performance of our EOR recognition scheme in videos recorded in the car environment. Finally, we evaluate the vigor of the head pose estimation algorithm to extreme facial deformation.
In this segment we will portray different stages engaged with the tiredness recognition framework.
A.**Image acquisition**

Utilizing a web camera introduced inside the auto we can obtain the pictures of the driver.though the camera creates a video cut, we have to apply our calculation on each edge of the video stream.in this paper we will just examine the handling component performed on a solitary casing .

B.Detect the face region

In this stage we detect the region comprising the face of the driver. A variety of technique are available , but we used a very artless one based on color space model. There are basis colour space RGB,HSV and YCbCr[11]. We can use any of them, but among them HSV AND YCbCr gives best result. in case of HSV Colourmodel,if we convert an images onto this color space model,a pixel whose H(hue) and (saturation) mechanisms satisfied the following condition would be treated as a skin color pixel.

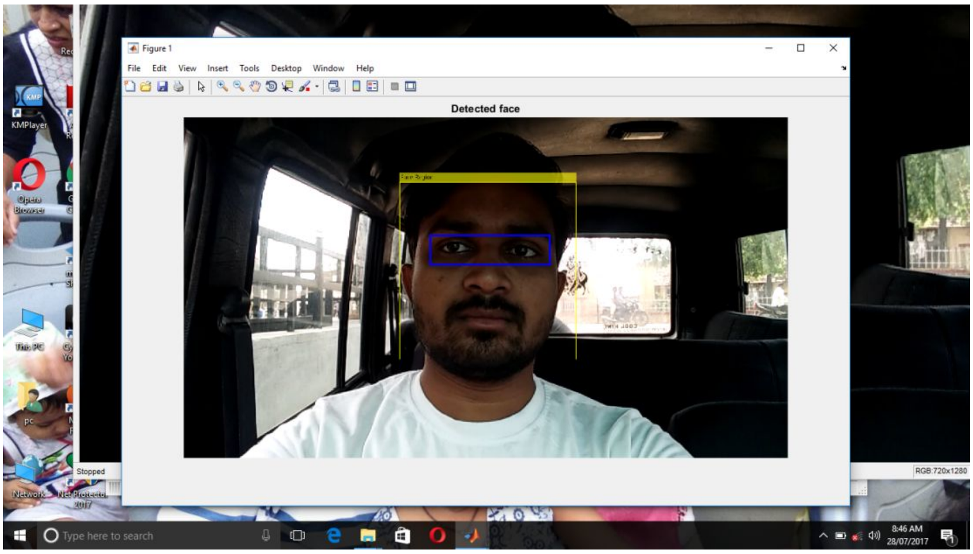


Fig 3 performance of our EOR detection system in videos recorded in the car

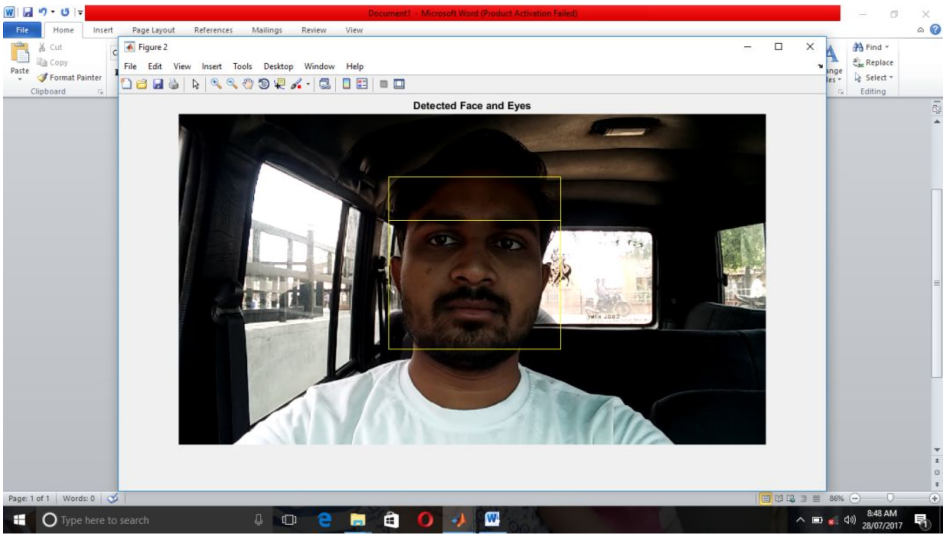


Fig 4 detected face and Eyes

Subsequently identifying the face region we should detect the eye region because in our approach, we use the eyes as our result parameter to determine the drowsiness of the driver [4] [5] [7] [8]. Recognition of eye region is also possible using various methods. In our approach, we use the concept of strength change, because eyes are the darkest part of the face.

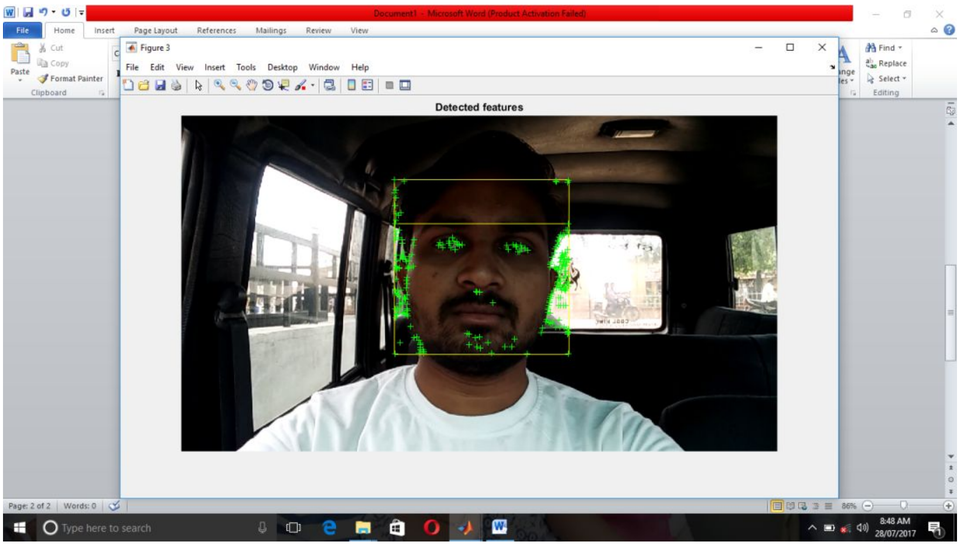
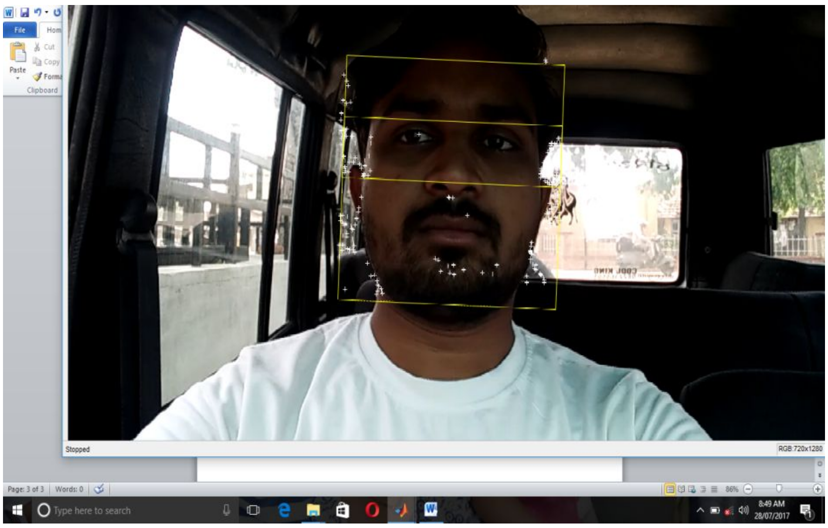


Fig .5 Detected facial features



This process is done for the left and right side of the face separately, and then the identify the facial features found eye areas of the left and right side are compared to check whether the eyes are found correctly. Calculating the left side means taking the averages from the left edge to the center of the face, and similarly for the right side of the face. The reason for doing the two sides separately is because when the driver's head is tilted the horizontal averages are not accurate. For example if the head is tilted to the right, the horizontal average of the eyebrow area will be of the left eyebrow, and possibly the right hand side of theforehead.

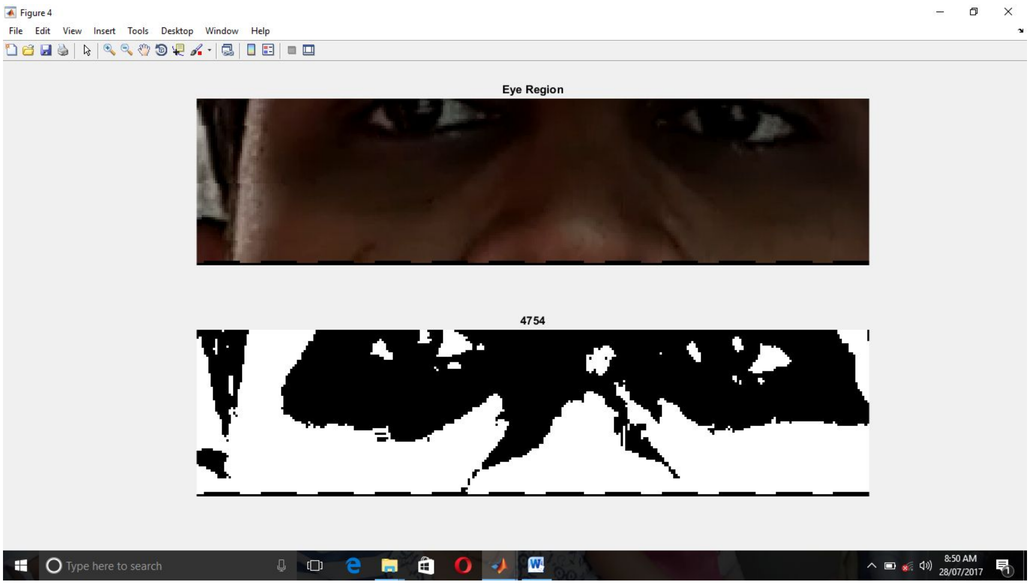


Fig 6 Eye region detection gray scale into binary scale

.Extracted The Eye Region

In this stage, we need to extract the eye region from the whole face because we have to examine the eye to determine whether a person feel drowsy or not.

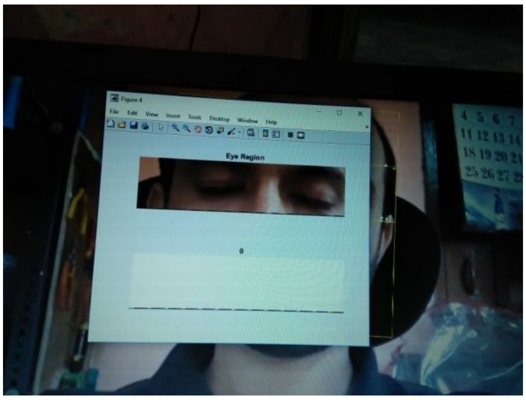


Fig 7 Recognition of eyes whether open or closed

D.Determining The State Of TheEyes

The state of the eyes (whether it is open or closed) is determined by distance between the first two intensity changes found in the above step. When the eyes are closed, the distance between the y – coordinates of the intensity changes is larger if compared to when the eyes are open. This is shown in Figure 6.The limitation to this is if the driver moves their face closer to or further from the camera. If this occurs, the distances will vary, since the number of pixels the face takes up varies, as seen below. Because of this limitation, the system developed assumes that the driver's face stays almost the same distance from the camera at all times.

E. DrowsinessDetection

When there are 5 consecutive frames find the eye closed, then the alarm is activated, and a driver is alerted to wake up. Consecutive number of closed frames is needed to avoid including instances of eye closure due to blinking. Criteria for judging the alertness level on the basis of eye closure count is based on the results found in a previous study [1].

CONCLUSION
,

This paper describes a real-time EOR system using the video from a monocular camera installed on steering wheel column. The system achieved an accuracy above 90 % for all of the scenarios evaluated, including night time operation. In addition, the false alarm rate in the on-the-road area is below 5. %. Our experiments showed that our head pose estimation algorithm is robust to extreme facial deformations. While our system provided encouraging results, we expect that improving the facial feature detection in challenging situations (e.g., profile faces, faces with glasses with thick frames) will boost the performance of our system. Currently, we are also working on improving the pupil detection using Hough transform-based techniques to further improve the gaze estimation.

ACKNOWLEDGEMENTS

This research was supported by publisher of this paper. We thank our colleagues from Ballarpur institute of technology who provided expertise that greatly assisted the research. Also, for sharing their pearls of wisdom with us during the course of this paper.

REFERENCES

[1] L. M. Bergasa, J. Nuevo, M. A. Sotelo, R. Barea, and M. E. Lopez, “Real-time system for monitoring driver vigilance,” IEEE Trans. Intell. Transp. Syst., vol. 7, no. 1, pp. 63–77, Mar. 2006.

[2] V. Blanz and T. Vetter, “A morph able model for the synthesis of 3D faces,” in Proc. 26th Annu. Conf. Comput. Graph. Interact. Tech., 1999, pp. 187–194.

[3] C. Cao, Y. Weng, S. Zhou, Y. Tong, and K. Zhou, “Face warehouse: A 3D facial expression database for visual computing,” IEEE Trans. Vis. Comput. Graphics, vol. 20, no. 3, pp. 413–425, Mar. 2014.

[4] M. L. Cascia, S. Sclaroff, and V. Athitsos, “Fast, reliable head tracking under varying illumination: An approach based on registration of texture mapped 3D models,” IEEE Trans. Pattern Anal. Mach. Intell., vol. 22, no. 6, pp. 322–336, Apr. 2000.

[5] T. Cootes, G. Edwards, and C. Taylor, “Active appearance models,” IEEE Trans. Pattern Anal. Mach. Intell., vol. 23, no. 6, pp. 681–685, Jun. 2001.

[6] A. Nabo, “Driver attention—Dealing with drowsiness and distraction,” Smart Eye, Gothenburg, Sweden, Tech. Rep., 2009.

[7] J. P. Batista, “A real-time driver visual attention monitoring system,” in *Pattern Recognition and Image Analysis*, vol. 3522, Berlin, Germany: Springer-Verlag, 2005, pp. 200–208.

[8] L. M. Bergasa, J. Nuevo, M. A. Sotelo, R. Barea, and M. E. Lopez, “Realtime system for monitoring driver vigilance,” *IEEE Trans. Intell. Transp. Syst.*, vol. 7, no. 1, pp. 63–77, Mar. 2006.

[9] V. Blanz and T. Vetter, “A morphable model for the synthesis of 3D faces,” in *Proc. 26th Annu. Conf. Comput. Graph. Interact. Tech.*, 1999, pp. 187–194.

[10] Cao, Y. Weng, S. Zhou, Y. Tong, and K. Zhou, “Facewarehouse: A 3D facial expression database for visual computing,” *IEEE Trans. Vis. Comput. Graphics*, vol. 20, no. 3, pp. 413–425, Mar. 2014.