

Driver Fatigue Detection System with Mobile Notification Alarm

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ABSTRACT:

This paper presents a sturdy and non-invasive method for detecting the real-time driver's drowsiness and enervation and monitoring the proposed significant schemes and system for preventing deadly road accidents. As the population grows it identifies to be directly proportional to the number of accidents which then becomes an important source to implement the implications for accident prevention safety. The proposed strategy is to enforce and monitor the facial landmark localization points to extract the eye outlines and the mouth corner regions from the detection of the camera fixed upright in front of driver supporting the SVM (support vector machine) face real detector machine. The approach towards the paper is to save the driver from being crushed by the analysis which aims to detect the Euclidean distance between the facial landmark points when eyelids of the driver comes closer and further the analysis of fatigue is also monitor with the help of yawning method of detection and we implement the exact proposed real-time implication as in case of eye-detection analysis technique. This system runs and falls under the natural lighting state and there is no hindrance with any driver's accessories like caps and hearing aids, etc. The comprehensive analysis for addition detection of prevention of accident can be monitored through the continuous popped up notifications that the drowsy driver's closed ones will receive when the driver is in the condition of fatigue with robust alarm system installed in the vehicle as well. This system can be analyzed by the driver's closed one as testing can be executed by tapping the received secured QR code that can be easily scanned with a mobile application showing the behaviour of human-machine interaction method. We are using the application of machine vision and Image processing for this purpose with the use of OpenCV, Scipy package, dlib, Python, and ML to implement and run our algorithm. Finally in the case of detection of drowsiness the fusion of state of the driver is regulated and a notification with warning message is popped up to the closed ones. The state of our tests and experiments will propagate to identify the high effective accurate results of the proposed agenda.

Keywords: Face detection, Face tracking, Yawning analysis system, Sleep fatigue, Drowsiness notifications.

1. INTRODUCTION:

There has been a tremendous level of increase in the amount of accidents due to reckless driving of the driver and a long way travel dwells the driver to be fatigue and can lead to the issue of drowsiness which causes the massive accidents also causing the death of the person on the spot. The condition of monitoring and observing the driver's state of surveillance and cautioning the driver in case of inadequate and lack of careful attention while driving has turned out to be one of the very important and special concerns to avert the drastic accidents. The major focus of putting efforts in order to avoid the accidents has become an important source in active safety field research.

According to the survey, it has shown that around 28-30% of accidents is a major contributing factor for the collision and the driver is in the condition of drowsy which results through statistics that 6-8 times greater times crash risks than the driver being in an alert state. Thus the driver fails to take correct measures of action in drowsy behaviour before the accident. The visual behaviour of the driver can easily be detected and analyzed through the modifications in their facial characteristics and features. There has been rigorous and intensive research that researchers have identified several strategies to prevent the hazards and developed proposed progress on its

limitations and benefits of every driver operations. Our proposed novel idea is to process visual gestures of the driver like eyelid motion analysis and yawning source detection through the frame shots detected by the installed camera in the vehicle, using a methodology to verify the segmented geometrical features of the eyelids and the movement of our mouth which turns the improper situation of the driving into a correct measured procedure.

Our technique has also been identifying the ability of the installed camera to monitor the results through sensors even if the driver is in the condition of perspiration. These non-intrusive strategies and techniques have made the physical changes more beneficial for real-scenario of driving conditions which is relevant in the periodical response detection of the drowsy state of the driver accurately.

This paper discusses the significantly developed methodology with the existing proposed system and is tested with different results in a variety of individual conditions with, unlike subjects. Through this drowsy driver's facial emotions and yawning expressions are integrated and synced with the detection based real-time procedures and techniques of their closed ones to avoid the minute chances of causing accidents. The performance of a few of the experimented results of the proposed system is also shown through the presented paper.

2. RELATED WORK:

The facial analytic features with respect to the driving monitoring system are classified into 3 major categories:

Firstly, the method based template where the facial generic features and properties are designed and with the matching templates they are useful in locating the models in the visual images. While these techniques are a valuable status for providing and generating facial property detection but usually afflicted by initialization of model and image diversity. The region which is matched with the image does not have the same flexible orientation as model, that's the reason for [1] behind using distorted templates to amplify the matching template approaches.

Secondly, the appearance based methods, these are the ones which require an intense amount of data, producing facial features in different conditions and in different aspects of subjects and domains for the training classifiers as SVM. In [2] a system for scanning eye on quick radial symmetry was introduced. With the grey distribution on the eye region segment, extracting the portion of the eye through real time trained detector, radial symmetry oriented operator make use of neighborhood eye information to locate precisely the center of the eye, as well as movement of the mouth by scanning through dashboard camera. Additionally through inter-related component analysis the region of the geometric features of the mouth is monitored and lip features and regions are detected and extracted.

Thirdly, the method based on features which locate few non-intrusive features of every facial properties and characteristics i.e. by the color distribution of iris and pupil, the different eyes can be distinguished. In this proposal, the knowledge of the structure of the facial features is approached. Barth and Timm [3] identified a localization of the center of the eyes in resolution images that can locate the center of the eye where image pixels and gradients connect with each other. At last Fan et al. [4] monitored and located the movement of the mouth to identify yawning and the driver can be easily alarmed. Through Gabon wavelets and grey projection the left and extreme right corners of the geometric features of the mouth are detected. Finally LDA approach is used to monitor the facial classified vectors to detect yawning.

Our methodology is more refined and robust with real time practical implementation. Through our algo it is feasible that an increased level of dependency on the detection based on the facial geometry is reduced but the efficiency of the detection is maintained and retained. The method that we applied based on Computer Vision, ML and Image Processing helps to detect the drowsiness of the driver.

2.1 FEATURES OF DROWSINESS:

The visual behavior of movement of eyelids is one of the reflections of the drowsiness level of an individual. The purpose of eye monitoring is to track the movement of eyelids and commute the parameters of relevant movements of these eyelids.

The awake state is classified by low frequency and the high frequency of average amplitude of the eyelids. When the driver feels drowsy the average amplitude of the movement of the eye decreases and there is an increase in the frequency successively. As the driver dwells into the drowsy state the amplitude of the eye coordinate movements will further decrease, with the long closure of closed eyes in case of fatigue.

3. PROPOSED METHOD:

1) The capturing of the image of the driver:

In the front seat of the driver, a video framed camera is installed where the processing through is done. In the software toolbox of CV, GUI is designed through the requirement of which the window command helps in extraction of video by MATLAB. The information on the image of the face will be represented in pixel format.

2) Tracking and Detection of facial features:

Computer vision is the major essence of the research field as it has an abundance of various applications like surveillance, detection and alert systems of drivers, biometrics and monitoring.

The face should be identified in any case of its orientation, conditions and lighting situations. However, the monitoring schemes should not be categorized on basis of detection through shape, size and texture but the problem can be challenging due to high equation of variability in texture and size as faces are non-rigid.

A finite observation window at all scales and positions in the window is set to run the basis of this method. The case of non-linear SVM is operated to look at the decision of whether the face is visible in the observation window. The SVM is conducted by making the input patch compared to the SV which can be treated as the anti-face and facial models. Adjacent to the window, the SV is scored and run by the nonlinear function. If the resulting sum beats the threshold the face will be detected.

3) Mapping of facial expressions with Dlib:

The python library Dlib helps in facilitating the algorithm that consists of pre-trained models with a landmark facial point detector. It determines and maps the face of the person in the mould of facial points with the help of estimating 68 cartesian local coordinates. The 68-point was then reliable in training the Dlib facial point detector and acts as a source of markings.

4) State of eye detection:

The facial expressions are monitored and the symptoms of the drowsy driver are identified in the previous step, the further step is to crop the locations of eyes which will reveal the condition of the eye. Blinking of the eyes is continuously monitored by detecting the eye status as closed or open. The frequency of the eye frame goes down when the driver is feeling drowsy. Also, the average condition of eye blinks is around 20 times per min, and when the eye blink frequency goes up with a continuous response, much greater than the 20 times per min then the driver is in a state of fatigue. When eyes are located successfully, the euclidean distance of the localization points between the eyelids is detected. SVM is a technique which involves both testing and training data with few data instances. The training set includes each instance which further consists of class labels and with the help of attributes in the testing set, the prediction of the target values is to be proposed.

The pupil is covered by the eye regions which are fiercely distributed and look different from various features of the face. A tremendous number of trained oriented images which classify as eyes and other non-eye features are utilized in training the SVM, which verifies and shows the correct measure of results which identifies marked regions of the real eye and eradicate as false ones.

3.1 ALGORITHM FOR THE DETECTION OF EYE STATUS:

The user which is detected as the driver has a camera mounted in front of him in the vehicle and hence the processing is done on both the eyes. Monitoring of eye blinking will be observed continuously. The window frames will help to locate the position of the eyes accurately and further the estimation of the location of the eye will take place through the euclidean distance of localization points, with an additional selection of ROI. After this there will be the detection of eyes and the following calculation will be performed for the judging criteria of drowsiness.

Now that we have the eye regions, we can compute the eye aspect ratio in which we create a function to compute the ratio of the distance between vertical eye landmarks and horizontal eye landmarks. If the eye aspect ratio indicates that the eyes have been closed for a sufficiently small amount of time, the driver will sound an alarm. The condition is on true and it follows the above method then the driver is drowsy and should be alerted.



Fig 1: Proposed System detecting the closed eyes of the person.

3.1.1 DETECTION FOR DROWSINESS PROCEDURE:

- The mounted camera will capture the image in the form of pixels
- The scanned video will develop frames and locate the positions and status of eyes
- The vertical and horizontal landmarks distance will help to provide the results of eye aspect ratio and localization points
- If the eye aspect ratio of the eyes detect and will monitor the duration of the period for which the eyes will be closed

If

Closed for longer interval of time, the driver is drowsy

Alarm will be raised to alert the driver

End if

3.2 DETECTION OF YAWNING STATUS:

Yawning is generalized by an open wide mouth. The distance between the upper and lower movement of the lip helps in contributing to determine the subject of the current status of the mouth. Through the value of simple and refined characteristics and features, the detection of yawning method categorizes the images based on the above features approach. To minimize the necessary cost, the region of the face was extracted with the support of the SVM method. This technique is based on the approach of localizing the facial edges of the mouth where the detection of the edge varies on various values of threshold in the condition of different intensities of light and the resolution interface of the camera and through this methodology the left and rightmost positions of the boundaries through the measure of vertical projection on the lower end half of the face and similarly measure the horizontal projection to extract the mouth localization marks and also to monitor and analyze the upper limit as well as the lower limit of the mouth.

If the distance of lip estimated from the above frame where the plotted landmarks are monitored is greater than the threshold of the lip distance, then the result is declared to be yawning and the subject of the current state of the user is displayed and accordingly, the alarm will be raised.

The approach is based on the canny edge technique which is computed to determine the edge of the lips and extract the localization points of the boundary of the mouth. Yawning is detected when the user opens its mouth the threshold value also rises when the comparison is made with the normal and general location of the position of the

mouth. The criteria for verification is computed with the located value of pixels at the time of yawning mouth as compared to the value of the mouth pixels, also the location of the relative user's open mouth in relation with edges of the lips.

The initial edge point is detected with the threshold having the upper value. The edge path is tracked with the support of the picture pixel and the edge is then determined if it meets the level of the drop threshold. There will be no markings of the pixel if the required value falls under the threshold having a lower value.

3.2 ALGORITHM FOR DETECTION OF STATUS OF YAWNING:

The proposed computation of Machine learning algorithm i.e. Adaboost which is detected to choose and blend the localization conducted features into the categorized linear classifier. To raise efficiency, every linear classifier is permitted to renounce an image. The trained classifiers are adapted to dismiss the image as to less amount of grouping of features on different scales and positions takes place.

When the required locations and possible extractions of the mouth are obtained, this algorithm minimizes the categories of mouth into single oriented positive labeled detections. The drowsiness of the driver sitting in the vehicle is categorized by the high-frequency mode of yawning. If the opening of the mouth is monitored more than 3 sec, the driver is detected to be yawning and the corresponding threshold which increases the counter of the yawning. Further, the status of the threshold is checked, if it is reached to the extent of a limit, an alarm will be raised, otherwise, it will again go to the next frame for face detection.



Fig 2: Proposed System detecting the opened mouth of the person considering it to be Yawning.

3.2.1 DETECTION FOR YAWNING PROCEDURE:

- The location of the mouth region is detected and extracted
- The image pixel is changed into grayscale
- Canny edge method is computed to determine the edge of the lips
- The resultant labelled image is sync to match with the support of template matching

If

Objectives are matched with labeled template, then mouth is opened

{

If

Mouth is detected to be opened more than 3 secs, result analyzed as yawning

{

If

Yawning is detected, alarm is raised and the driver is in the condition of fatigue

Return drowsy

Else

The condition goes to the next frame for the face detection

}

Else

No Yawning

}

Else

Mouth Closed

4. EXPERIMENTATION RESULTS:

The fusion of both the eye and yawning detection analysis is a very sensitive notation for preventing the last-minute major accidents. The eye-detection is monitored with the support of attributes of eyes and through its algorithm, the eye aspect ratio is also configured and mouth facial localization points are calculated with detection of the yawn and with parameters of canny edge algorithm, both of them which runs parallelly and processing is done along with the results.

There is another robust feature added to prevent the mishaps is by popping up the notifications about the status of the current driver via captured through the camera. The video will be captured through the mounted camera in front of the driver seat. The visual behaviours of the driver will be caught through different image processing techniques. The frames will be designed from the installed video.

This will help in the detection of the contour area of the entire face where the different yawning and eye detection algorithm will be called and after collecting the values which are returned from the algorithm, the condition of the person will be monitored. If the status of the driver is drowsy an alarm will be raised to alert him. On the other hand, through this, a notification system is also synchronized which will boost the efficiency and performance of this technique. We have integrated the scan code with the notifications. The current notification will be popped up on the driver's cell phone which will also prompt emergency alert to him and in parallel, it will notify among others close family members who have the access of the same. This will lead to the continuous raising up of the notifications on the closed one's cell phone and thus through the appearance of scanning labelled QR code on their smartphones will propagate to identify and check the present status of the driver. This will help to improve the situation in case the driver has to dwell into the condition of fatigue and drowsiness by giving a spontaneous call at the response. The results which are obtained are detected to prevent the major hazards on the road in different conditions and different intensities.

The secured scan code which had been provided to the closed ones can easily track the facial emotions and expressions of the driver seating in the car and let's suppose when the driver's response is Yawning a continuous vibration notification will be sent to their closed ones cell phone stating a message "Yawning while driving" so that they can take the required measures like calling or texting him/her to prevent causing accidents.

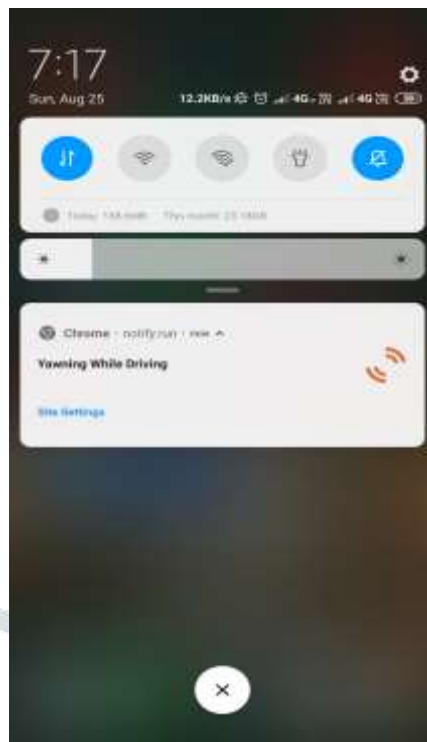


Fig 3: Proposed System notifying the concerned person about the state of driver to alert.

5. SCOPE:

The aspects for future work can be credited for wireless camera in place of input video from the wired camera and the image can be processed within the control system itself which can automatically prompt the buzzer for the alarm. The more performance-boosting and efficient algorithm can be implemented for the same night camera to execute in the extreme dark lighting conditions under different subjects.

6. CONCLUSION:

In this proposed paper, a non-intrusive algorithm is formed to determine the geometrical facial features and mean intensities of the eyelids for the detection of eye aspect ratio and edges of the lips for the detection of mouth regions is determined. The monitoring system detects the parameters for eye analysis drowsiness detection through the duration period of closure, the blinking frequency of the eyes and the duration for the movement of the eyelids. Along with this parallel processing is running to locate the lower lip position for yawning analysis fatigue detection. This method improves the efficiency and performance of the system with respect to detections in every different subject and condition but fails to detect in extreme dark lighting situations. The prevention of accidents is detected with the help of the proposed algorithm for monitoring the drowsiness.

REFERENCES

- [1] A. L. Yuille, P. W. Hallinan, and D. S. Cohen, "Feature extraction from faces using deformable templates," *International Journal of Computer Vision*, vol. 8, no. 2, pp. 99–111, 1992.
- [2] W. Zhang, H. Chen, P. Yao, B. Li, and Z. Zhuang, "Precise eye localization with AdaBoost and fast radial symmetry," in *Proceedings of the International Conference on Computational Intelligence and Security (ICCIAS '06)*, pp. 725–730, October 2006.
- [3] F. Timm and E. Barth, "Accurate eye centre localisation by means of gradients," in *Proceedings of the International Conference on Computer Vision Theory and Application (VISAPP '11)*, pp. 125–130, INSTICC, Algarve, Portugal, March 2011.

- [4] X. Fan, B.-C. Yin, and Y.-F. Sun, “Yawning detection for monitoring driver fatigue,” in Proceedings of the 6th International Conference on Machine Learning and Cybernetics (ICMLC '07), vol. 2, pp. 664–668, Hong Kong, China, August 2007.
- [5] “Driver Fatigue Detection using mouth and yawning” in IJCSNS International Journal of Computer Science and Network Security, VOL.8 No.6, June 2008.
- [6] Qiang Ji, Zhiwei Zhu, Peilin Lan “Real Time Non-intrusive monitoring and prediction of driver fatigue” “<https://www.ecse.rpi.edu/~cvrl/zhiwei/html/papers/VTFatigue.pdf>”
- [7] G. M. Bhandari, Archana Durge, Aparna Bidwai, Urmila Aware “Yawning analysis for driver drowsiness detection” in IJRET: International Journal of Research in Engineering and Technology eISSN: 2319-1163 | pISSN: 2321-7308
- [8] Wei Zhang, Bo Cheng**, Yingzi Lin “Driver Drowsiness Recognition Based on Computer Vision Technology” in ISSN11007-02141118/1811pp354-362 Volume 17, Number 3, June 2012.
- [9] Dr. Sheifali Gupta¹ & Er. Garima² “Road Accident Prevention System Using Driver’s Drowsiness Detection by Combining Eye Closure and Yawning” in International Journal of Research (IJR) Vol-1, Issue-6, July 2014 ISSN 2348-6848.
- [10] Aouatif Amine, and Mohammed Rziza “Driver fatigue detection based on yawning extraction” in Research Article | Open Access Volume 2014.
- [11] Professor Sumedh G. Dhengre “A Survey Paper On Drowsiness Detection & Alarm System for Drivers” in International Research journal of Engineering and Technology e-ISSN: 2395 -0056 Volume: 03 Issue: 12 | Dec - 2016.

