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MONITORING AND PREDICTION OF DRIVER FATIGUE

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Abstract: The paper titled as "Monitoring and Prediction of Driver Fatigue" describes a driver-fatigue level which is based on various visual cues. For acquiring driver fatigue, video images of driver are taken into consideration. For characterization of individual's level of fatigue, different visual cues are extracted. These visual cues are combined in a particular manner for measuring fatigue level of an individual. These required visual cues are nothing but eyelid movement, gaze movement, head movement and facial expression. Probabilistic model is prepared for typical prediction of fatigue level. For detection of fatigue level of an individual, various visual cues are required. With the use of multiple visual cues and their systematic combination concurrently results in more accurate and robust characterization of fatigue level as compared to use of single visual cue. This system is corroborated and proposed under real-life fatigue conditions with human subjects of different ethnic backgrounds, genders and ages with/without glasses and under various illumination conditions. The system is recognized to be accurate, robust and reliable for fatigue level characterization. This paper is found very advantageous, helpful and convenient for fatigue level detection.

Key Words: Fatigue, Drowsiness, Hough, Level of alertness

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INTRODUCTION

Fatigue is a state of drowsiness. It is a kind of weariness which is caused by exertion or exhaustion. It can occur long before one falls asleep at the wheel during driving a vehicle. It shows lack of energy of an individual. Fatigue is the feeling of extreme tiredness that can make it difficult to perform ordinary tasks for an individual. Fatigue affects everyone differently in different way.. Fatigue may come along with pain. Working ability of any individual can get affected by state of drowsiness.

Fatigue level detection is mainly related with human eyelid movement. The level of alertness is characterized with the help of human eyelid movement. Level of alertness is very important factor while any person or an individual is driving a vehicle. Different visual cues which are related to the alertness level of an individual are extracted and are combined in a particular manner for measurement of the fatigue level of an individual. The required visual cues are named as eyelid movement, eye blink parameters, gaze movement, facial expression and facial expression. Fatigue monitoring starts with extracting visual parameters and is used to characterize person's level of vigilance.

A probabilistic model is developed for the purpose of prediction and monitoring of fatigue level. Various visual cues are required for detection alertness level of an individual or a driver.Use of multiple visual cues provides better results as compared to use of a single visual cue. Different methods have been developed for detecting the driver alertness level based on image processing technique, vehicle driving pattern and physiological parameter changes. Driver facial behaviour like eye blink, eye gaze, head movement and yawning are captured by camera based image processing technique [4].Fatigue monitoring and prediction is necessary for increasing the productivity in labours, employees and workers for the prevention of number of vehicular road accidents. Drowsiness can be detected with the indication of their fatigue level. The system is recognized to be reliable, accurate and robust for the fatigue level characterization.

II. LITERATURE REVIEW

QiangJi[1] and his team members proposed a system for real-time nonintrusive monitoring and prediction of driver fatigue. Their proposed work is divided into three parts.First part is focused on a discussion of the computer vision algorithms and the hardware components which are necessary for extracting the needed visual cues.After extracting these required visual cues, the issue of sensory data fusion and fatigue modelling and inference is to be discussed in second part.Experiments under real-life conditions are conducted for validating the driver-vigilance-

monitoring system as final i.e. third part. This paper is very helpful for monitoring and prediction of driver fatigue. Muhammad JafarAli[2] presented an algorithm which has been developed by using multiple fatigue parameters for real time detection of human fatigue. For generating a cumulative measure of fatigue, the PERCLOS, the variation of head position and the tilt, blink rate has been used with nonintrusive techniques of monitoring.Blink rate and the PERCLOS value are used for tracking purpose in combination with head pose and variation to predict levels of fatigue in an individual. Blink events are measured which are found as a binary signal. For getting correct prediction, the PERCLOS value is used. Prediction algorithm continuously receiving the frames which contains data provided by sensor.The results obtained for real time fatigue monitoring based on variation in head position was found to be substantially accurate under simulated situations.The decision algorithm is found to be quite accurate.Yong Du[3] proposed an efficient and effective vision based driver fatigue detection method. This method has provided results for fatigue level based on localization of face, localization of eyes and detection of fatigue. For the purpose of face detection, the interframe difference approach binding colour information is used. If it exists, the face area is segmented from an image which is based on a skin tone model. The process of crystallization is simulated for obtaining location of eyes within the face area, an eye area, an average height of pupil and width to height ratio are used for analysing the eye's status.By analysing the changes of eye's states, and confirmation of driver fatigue is done. Besty Thomas[4] proposed a wireless sensor embedded steering wheel for real time monitoring of driver fatigue detection. It is an intelligent steering wheel sensor network consisting of multiple numbers of embedded IR sensors encircled on the steering wheel.Drowsiness is detected by reflective IR sensors array which comprises of IR emitters and phototransistor detectors.This was an attempt to correlate the drowsiness and heart rate variability gave way to a cost-effective and non-obstructive method of drowsiness detection.The system issues a two level warning system when there is a significant variation in the pulse rate is observed. The wireless sensor system will gather signals from multiple sensors placed on the wheel, which provides real time monitoring and feedback, data analysis and reporting driver performance to remote centre. This system was an attempt to correlate the drowsiness and heart rate variability gave way to a cost-effective and non-obstructive method of drowsiness detection.Unique heart rate calculation algorithm which is adaptable for the entire individual was incorporated by this system. Each of the modules has various functionalities for detection of driver drowsiness and it is tested using Lab view software. Mingheng Zhang [5] proposed (RESEARCH ARTICLE) a hybrid model for early onset prediction of driver fatigue with observable cues based on SVM and GA. For evaluating the performance of the proposed method, an experiment with driving experiment data is carried out. The results showed that GA has good convergence and relative stable performance.

Comparison of the different results between various methods suggested that SVM-GA provides lower prediction errors and time consumption than the other approaches. This information indicates that SVM-GA seems to be a powerful tool for driver fatigue state prediction during the early onset phase. Zhengpei [6] calculated the ratio of eye closing during a period of time. The ratio can reflect driver's vigilance level. Researchers have been working on the detection of driver's drowsiness using various techniques, such as physiological detection [7][8][9], driver behaviour monitoring [10], vehicle running status analysis [11] and vision-based detection [12] .

III. PROPOSED METHODOLOGY

The proposed architecture for monitoring and prediction of driver fatigue is shown in figure1 which is a flowchart showing basic procedure for fatigue detection. It can be named as driver's vigilance system. This considered system architecture provides an idea about fatigue detection with the extraction of various visual cues and these visual cues are as eyelid movement, gaze, head movement, facial expression.These visual cues are observed and measured for fatigue level detection. An alertness level is varied from person to person.Also some kind of contextual information is provided with different visual cues which consisting of sleep history, physical fitness, time of day and temperature. For the purpose of information fusion, the two types of information i.e. contextual information and information related to extraction of various visual cues are fused together and a decision is made, whether fatigue is detected or not. If result is observed as fatigue detected then warning system is activated and if fatigue is not detected then the whole procedure restarts again by taking operator's or driver's image. The overview of the proposed driver vigilance system is shown in figure2. Here camera is placed in such a position that it can capture the driver's face image. The camera must be positioned such that firstly the driver's face takes up the majority of the image and secondly the driver's face is approximately in the centre of the image. After images of driverhave been extracted, the face detection algorithm is applied to these images. Face is detected properly with this face detection algorithm. With completion of procedure for face detection, area of face is detected and next step is to apply eye detection algorithm. Locations of eyes are segmented properly with the help of eye detection algorithm. After an eye area is segmented, condition is checked for detection of fatigue or it can be said in other words as condition is checked for detection of drowsiness. With this proposed system architecture, driver's fatigue level is detected and his/her level of alertness is checked.

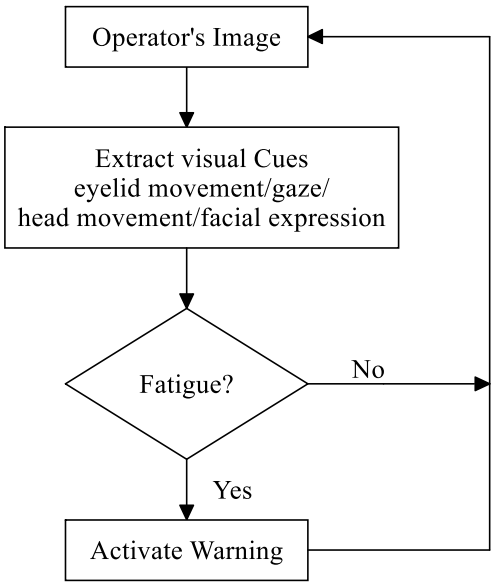

Figure 1:- Basic flowchart of the proposed system for Monitoring and Prediction of Driver Fatigue

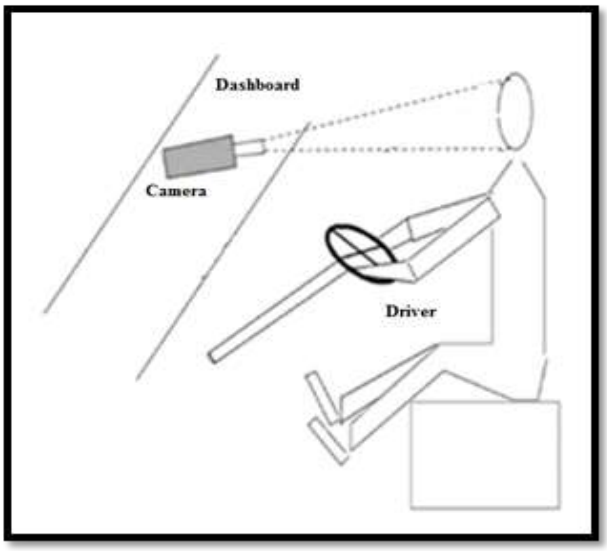

Figure 2:- Overview of proposed driver vigilance system

Figure3 provides detailed data flow diagram for the proposed work. This data flow diagram includes different blocks which are named as input imaging, face detection, labelling of the face, finding parameters of labelled image, finding maximum boundary box, making a mask, obtaining the filter image, slicing an eye area, block for eye detection algorithm, decision block for fatigue is detected or not, detected eye coordinate block, block for incrementing the

counter, another decision block for threshold value and the last block is for alert and reset counter. Face detection is carried out when the input image is taken into fatigue detection procedure. After face detection procedure, the face is labelled accordingly. The parameters of the labelled image and the maximum boundary box are found out. A proper mask is made using input image. To obtain the filter image is the next task. The eye area is isolated from the rest of the face in the image then eye detection algorithm is applied. The condition of eye detection i.e., 'eye detected?' is checked. If this condition is found false then for detection of eye coordinates, the input image is again verified for face detection.

If the eye is detected as per the condition, the counter is incremented. This incremented counter is compared with the threshold value as per the condition, 'is counter greater than threshold?' if the counter is noticed to be less than the threshold value, the image is again keyed in for the fatigue detection process. If the counter is found out to be true, an alert signal is sent and the counter is again changed to reset. After resetting the counter, the whole process is starts again. Some algorithms are used for obtaining results for proposed system architecture of fatigue detection. These algorithms are named as Skin Detection Algorithm, Modified Hough Transform, YCbCr colour model, an Eye Detection Algorithm. Face detection is done using YCbCr colour model. The modified Hough transform is nothing but the circular Hough transform for detecting the circle shaped or round shape object such as eyes. Eyes are detected with help of eye detection algorithm. Statistical analysis of eye blink is also an important part of the fatigue detection. These algorithms are helpful for making a comment on fatigue level of an individual. With the help of these algorithms, fatigue level of an individual can be detected as well as fatigue detection is performed.

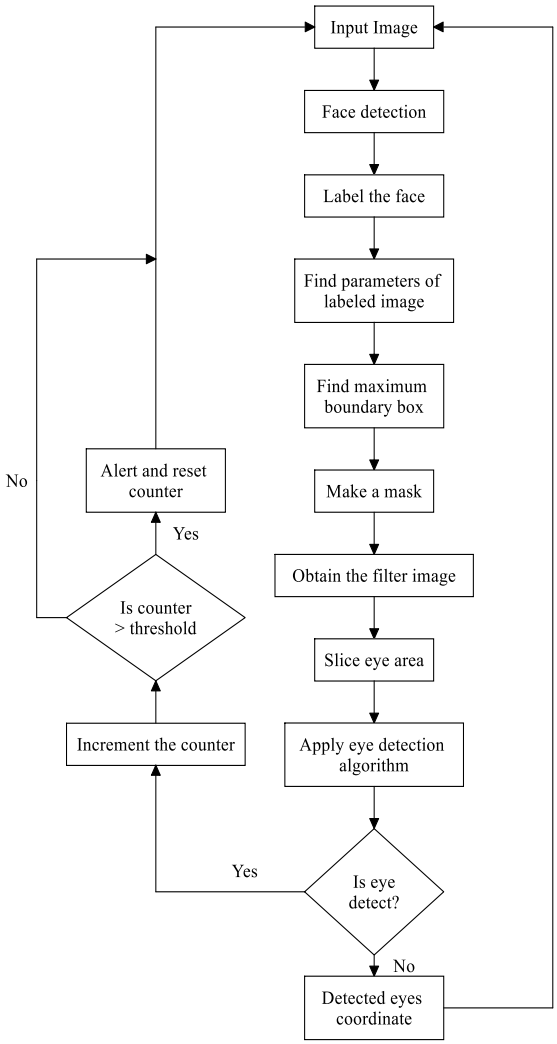

Figure 3:- Proposed detailed data flow diagram for Monitoring and Prediction of Driver Fatigue.

CONCLUSION

Different visual cues are necessary for detection of fatigue level of an individual who is driving a vehicle. Proposed system is found as reliable and accurate system for fatigue level detection. Use of multiple visual cues is better than the use of single visual cue. Probabilistic model is developed for detection of driver fatigue which uses multiple visual cues and their systematic combination provides a reliable results. Robust characterization of fatigue level is done with the help of multiple visual cues. For fatigue level characterization, the system recognized to be accurate, robust and reliable. This paper is found very advantageous and convenient for fatigue level detection.

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