

# A Review on “Real-Time Nonintrusive Monitoring and Prediction of Driver Fatigue”

**Miss. Renuka R. Pande**

P.G. Department of  
Electronics &  
Telecommunication,  
Sipna C.O.E.T, Amravati, India  
panderenuka17@gmail.com

**Dr. A. S. Joshi**

Professor in P.G.,  
Department of Electronics &  
Telecommunication,  
Sipna C.O.E.T, Amravati, India  
atuljoshi1974@rediffmail.com

**Abstract**— The project titled as “Real-Time Nonintrusive Monitoring and Prediction of Driver Fatigue” describes a driver-fatigue level based on various visual cues. For acquiring driver fatigue, cameras are laced with infrared illuminators. For characterization of individual’s level of fatigue, different visual cues are extracted and are combined in a particular manner for measuring fatigue level of an individual. Eyelid movement, gaze movement, head movement and facial expression are required visual cues. For typical prediction of fatigue level, probabilistic model is prepared. Various visual cues are required for detection of fatigue level of an individual. Using 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 under real-life fatigue conditions with human subjects of different ethnic backgrounds, genders and ages with/without glasses and under various illumination conditions. For fatigue level characterization, the system recognized to be accurate, robust and reliable. This project is found very advantageous and convenient for fatigue level detection.

**Keywords**– Fatigue, Drowsiness, Real-time, Hough, Level of alertness

## I. INTRODUCTION

Fatigue is a kind of weariness caused by exertion or exhaustion. It can occur long before one falls asleep at the wheel. It affects your reaction time, your ability to concentrate and your general understanding of the road and traffic around you. It also affects the working ability of any individual.

Fatigue level detection is mainly related with human eyelid movements which typically characterize the level of alertness. Level of alertness is very important factor while any person is doing any work. Various visual cues which are related to the level of alertness of an individual are extracted and are combined in a particular manner for the measurement of the fatigue level of the person or an individual. Eyelid movement, gaze movement, head movement and facial expression are nothing but the required visual cues. Fatigue monitoring starts with extracting visual parameters which typically characterize a person's level of vigilance.

For the purpose of prediction of fatigue level, a probabilistic model is prepared. Different visual cues are necessary for detection of level of alertness of an individual or a person. Use of multiple visual causes provides better results than the use of a single visual cause. Different methods have

been developed to detect the driver alertness level based on image processing technique, vehicle driving pattern and physiological parameter changes. Camera based image processing technique captures the driver facial behavior like eye gaze, eye blink, head movement and yawning [1]. For increasing the productivity in labors, workers and employees and for the prevention of number of vehicular accidents, fatigue monitoring and prediction is necessary. With the indication of their fatigue level, drowsiness can be detected. The system is recognized to be accurate, robust and reliable for the fatigue level characterization.

## II. PREVIOUS WORK DONE

Besty Thomas[1] proposed a wireless sensor embedded steering wheel for real time monitoring of driver fatigue detection which is an intelligent steering wheel sensor network consisting of number of embedded IR sensors encircled on the steering wheel. For drowsiness detection, reflective IR sensors array is used 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 is incorporated with a unique heart rate calculation algorithm which is adaptable for the entire individual. 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 center. Each of the modules has various functionalities for detection of driver drowsiness and it is tested using Lab view software. Muhammad Jafar Ali[2] proposed an algorithm for the real time detection of human fatigue which has been developed by using multiple fatigue parameters. Blink rate, the PERCLOS, the variation of head position and the tilt has been used in generating a cumulative measure of fatigue with nonintrusive techniques of monitoring. For tracking purpose, blink rate and the PERCLOS value are used in combination with head pose and variation to predict levels of fatigue in an individual. Blink events are measured is a binary signal. The PERCLOS value is used for getting correct prediction. Prediction algorithm continuously receive the frames containing data given by sensor. The decision algorithm is found to be quite accurate. Yong Du[3] presented an effective and efficient vision based driver fatigue detection method which provides results for fatigue level based on localization of face, localization of

eyes and finally detection of fatigue. For face detection purpose, the inter-frame difference approach binding color information is used and if exists, the face area is segmented from the image based on a skin tone model. Then for obtaining the location of eyes within the face area, the process of crystallization is simulated. For analyzing the eye's states, an eye area, an average height of the pupil and width to height ratio are used. Finally, with the confirmation of driver fatigue is done by analyzing the changes of eye's states. Mingheng Zhang [4] proposed (RESEARCH ARTICLE) a hybrid model for early onset prediction of driver fatigue with observable cues based on SVM and GA. An experiment with driving experiment data is carried out for evaluating the performance of the proposed method and the results showed that GA has good convergence and relative stable performance. By comparing 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 [5] 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 [6][7][8], driver behavior monitoring [9], vehicle running status analysis [10] and vision-based detection [11] [12] [13] [14].

## III. PROPOSED METHODOLOGY

The proposed system architecture gives the idea about fatigue detection with the extraction of various visual cues which includes eyelid movement, gaze, head movement, facial expression. The level of fatigue is detected by observing and measuring these visual cues. The level of alertness of an individual varies from person to person. Also the contextual information is provided with different visual cues which consisting of physical fitness, sleep history, time of day and temperature. These two types of information are very useful for the purpose of information fusion, after these two types of information get fused together, then there will come a decision making point that whether a fatigue is detected or not and with the help of these decision making point, two results are obtained. Two results are such as one is Fatigue detected and second one is fatigue is not detected. If the result is found to be true i.e. fatigue is detected then warning is activated and it alerts the driver by giving warning and if the result is found to be false then the

procedure is restarted by taking operator's image. The flowchart which is shown in figure1 is helpful in understanding the procedure for fatigue detection.

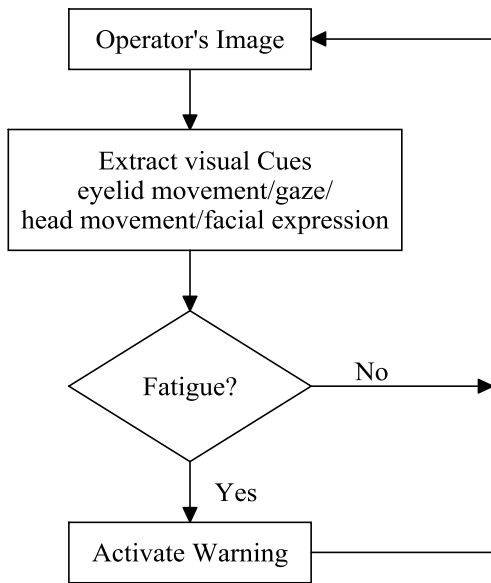


Figure 1:- Basic flowchart of the proposed system for monitoring and prediction of driver fatigue

Figure 2 provides the data flow diagram for the proposed work or can be said that proposed work. This data flow diagram includes different blocks named as input imaging, face detection, labeling of the face, next is finding parameters of labeled image, another one is finding maximum boundary box, making a mask, then another block is obtaining the filter image, slicing an eye area, next is 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 process. After face detection process, the face is labeled accordingly. The parameters of the labeled image and the maximum boundary box are found out. A proper mask is made using input image. The next task is to obtain the filter image. 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 restarted. For obtaining the results for fatigue detection, there is used of some algorithms which are named as skin detection algorithm, modified hough transform, YCbCr color model, an eye detection algorithm. 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 and with this fatigue detection is performed.

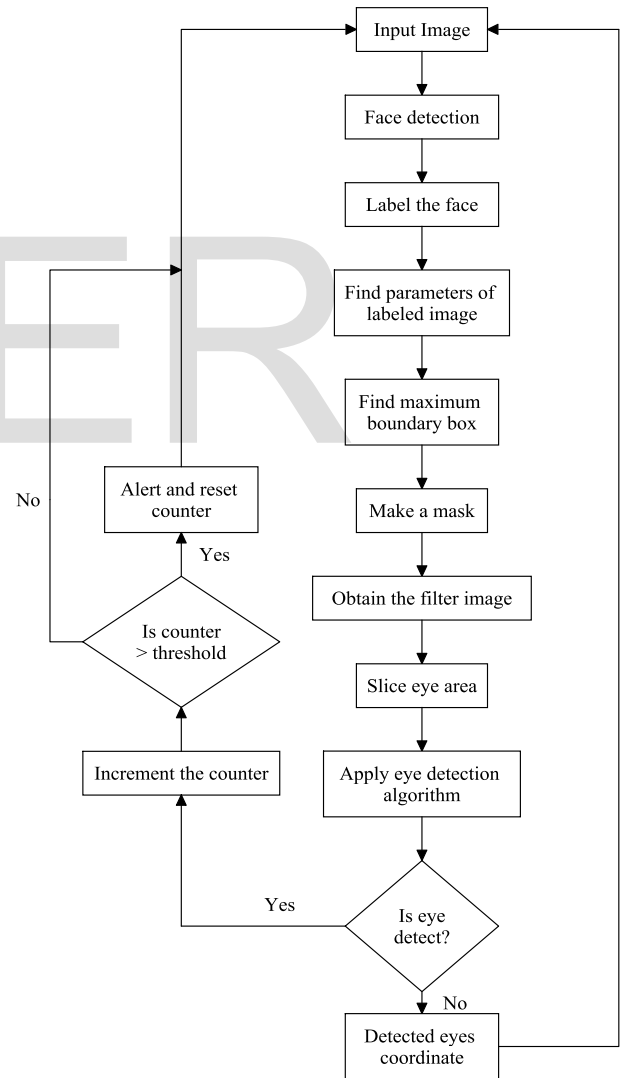


Figure 2:- Proposed detailed data flow diagram

## CONCLUSION

Various visual cues are required for detection of fatigue level of an individual. Use of multiple visual cues is better than the use of single visual cue because using 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. For fatigue level characterization, the system recognized to be accurate, robust and reliable. This project is found very advantageous and convenient for fatigue level.

## REFERENCES

- [1] Besty Thomas and Aushtosh Gupta, "Wireless Sensor Embedded Steering Wheel For Real Time Monitoring Of Driver Fatigue Detection", *Proc. of the intl. Conf. on Advances in computer Science and Electronics Engineering*, 2012, pp 223-226.
- [2] Muhammad Jafar Ali, SurvaSarkar, GNVA Pavan Kumar, and John-John Cabibihan, "A Non Intrusive Human Fatigue Monitoring System", *International Journal of Future Computer and Communication, Vol. 1, No. 3, October 2012*.
- [3] Yong Du, Peijun Ma, Xiaohong Su, Yingjun Zhang, "Driver Fatigue Detection based on Eye State Analysis", *Proceedings of the 11<sup>th</sup> Joint Conference on Information Sciences(2008)*.
- [4] Mingheng Zhang, Gang Longhui, Zhe Wang, XiaomingXu, Baozhen Yao, and Liping Zhou, "Hybrid Model for Early Onset Prediction of Driver Fatigue with Observable Cues", *Hindawi Publishing Corporation, Mathematical Problems in Engineering*, Volume 2014, article ID 385716, 9 pages.
- [5] Zheng Pei, Song Zhenghe, and Zhou Yiming, "Perclos-based recognition algorithms of motor driver fatigue", *Journal of China Agriculture University*, pp. 104-109, 2004.
- [6] Lal, S. K. L., Craig, et al, "Development of an Algorithm for an EEG-based Driver Fatigue Countermeasure," *Journal of Safety Research* , vol.34, pp.321-328, 2003.
- [7] Akira Kuramori, NorotakaKoguchi, "Evaluation of Effects of Drivability on Driver Workload by Using Electromyogram," *JSAE Review*, vol. 25, pp. 91-98, 2004.
- [8] Byung-Chan Chang, Jung-Eun Lim, Hae-Jin Kim, et al,"A Study of Classification of the Level of Sleepiness for the Drowsy Driving Prevention," *Proc. SICE Annual Conference*, pp.3048-3089, 2007.
- [9] Yoshihiro Takei, and Yashimi Furukawa, "Estimate of driver's fatigue through steering motion," *Proc. IEEE International Conference on Systems, Man and Cybernetics*, vol.2, pp.1765-1770, 2005.
- [10] Erezdagan, Ofer Mano, Gideon P. Stein, et al, "Forward Collision Warning with a Single Camera," *Proc. Intelligent Vehicles Symposium*, pp. 37-42, 2004
- [11] Nikolaos P, "Vision-based Detection of Driver Fatigue",*Proc.IEEE International Conference on Intelligent Transportation*, 2000.
- [12] Wen-Bing Horng, Chih-yuan Chen, Yi Chang, et al, "Driver Fatigue Detection Based on Eye Tracking and Dynamic Template Matching," *Proc. Of the 2004 IEEE International Conference on Networking, Sensing & Control*, pp. 7-12, 2004.
- [13] Zutao Zhang, Jiashu Zhang, "A New Real-Time Eye Tracking for Driver Fatigue Detection," *Proc.2006 6th International Conference on ITS Telecommunications*, pp.8-11, 2006.
- [14] AbdelfattahFawky, Sherif Khalil, andMahaElsabrouty, "Eye Detection to Assist Drowsy Drivers," *IEEE*. Pp. 131-134, 2007.
- [15] QiangJi, Zhiwei Zhu, and PeilinLan, "Real-Time Nonintrusive Monitoring and Prediction OF driver Fatigue," *IEEE Transaction on vehicular technology*, vol. 53, no. 4, pp. 657-662, 2004.

IJSER