A Review on Driver Drowsiness Detection System

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Abstract- **Nowadays, driving support systems, such as car navigation systems, are getting common, and they support drivers in several aspects. Driver drowsiness is one of the major causes of traffic accidents. It is a serious highway safety problem. If drivers could be warned before they became too drowsy to drive safely, some of these crashes could be prevented. In order to reliably detect the drowsiness, it depends on the presentation of timely warnings of drowsiness. To date, the effectiveness of drowsiness detection methods has been limited by their failure to consider individual differences. Based on the type of data used, drowsiness detection can be conveniently separated into the two categories of intrusive and non-intrusive methods. During the survey, non-intrusive methods detect drowsiness by measuring driving behavior and sometimes eye features, through which camera based detection system is the best method and so are useful for real world driving situations. This paper presents the review of existed drowsiness detection techniques that will be used in this system like Circular Hough Transform, FCM, Lab Color Space etc.**

***Keywords*:** Drowsy Driving; Drowsiness Recognition; Driver Monitoring; Circular Hough Transform; FCM; Lab Color Space; Varying Luminance Conditions.

1. INTRODUCTION

Drowsiness is simply defined as "a state of near sleep due to fatigue". It is technically distinct from fatigue, which has been defined as a "disinclination to continue performing the task at hand". The effects of sleepiness and fatigue are very much the same. Fatigue affects mental alertness, decreasing an individual's ability to operate a vehicle safely and increasing the risk of human error that could lead to fatalities and injuries. Sleepiness slows reaction time, decreases awareness, and impairs judgment. Fatigue and sleep deprivation impact all transportation operators (for example: airline pilots, truck drivers, and railroad engineers). In both conditions, driver can't focus on primary task of driving which may enhance the likelihood of crash occurrence. With the ever-growing traffic conditions, this problem will further deteriorate. For this reason, it is necessary to develop driver alertness system for accident prevention due to Driver Drowsiness as discussed below. Interaction between driver and vehicle such as monitoring and supporting each other is one of the important solutions for keeping ourselves safe in the vehicles. Although active safety systems in vehicles have contributed to the decrease in the number of deaths occurring in traffic accidents, the number of traffic accidents is still increasing.

The National Highway Traffic Safety Administration (NHTSA) estimates that approximately 100,000 crashes each year are caused primarily by driver drowsiness or fatigue in the United States [1]. In Japan, attention lapse, including that due to driving while drowsy, was the primary reason for traffic accidents in 2008. The Ministry of Economy, Trade and Industry in Japan reports that number of such accidents has increased 1.5 times in the 12year period from 1997 to 2008 [2]. Indian government also passed a law named 'Motor Bill' to improve safety on roads caused by driver drowsiness. The Bill is aimed at bringing down fatalities in road accidents by two lakh in the first five years in a scenario where India reports around 5lakh road accidents annually.

1.1 Methods

One solution to this serious problem is the development of an intelligent vehicle that can predict driver drowsiness and prevent drowsy driving. The percentage of eyelid closure over the pupil over time (PERCLOS) is

one of the major methods for the detection of the driver's drowsiness. Physiological measurements like electroencephalogram (EEG), electrocardiogram (ECG) [4], capturing eye closure, facial features [5] [6], or driving performance (such as steering characteristics, lane departure, etc.) are used for drowsiness detection. When drowsiness is detected while driving, audible sound, vibrations, or warning messages on a display are generally used to warn the driver to concentrate on driving or to take a rest. These methods help the drowsy driver to prevent drowsiness-related crashes in a moment, but it is hard to get rid of drowsiness by just being aware of it. As we found in the literature review, most of the methods need lot of equipment which is not possible in real life implementations. Also most of the methods which rely on camera input for detection of opening and closing eyelids are not to be tested like they can be implemented in real time as most of the scholars take image as camera is fixed in front of the driver's road view. As for clear view, it is not possible to put the camera on front mirror. Secondly most of papers have drawbacks when there is high luminance caused by sunlight as well as during dim light conditions like bad weathers. We decided to explore this topic further according to the climate of our country and decided to propose a noble method which can eradicate the above written shortcomings of the literature survey.

1.2 **Computer vision techniques** to detect the changes in driver's facial expressions [7]. Computer vision method to detect driver drowsiness based on detecting eyelid closing and opening using artificial neural networks as classification algorithm. There was no model previously built which is completely automated. Secondly there was no low cost solution existed for driver drowsiness detection. Thirdly there was no model working for varying luminance conditions (caused by sunlight as well as during dim light conditions like bad weathers). So there is an immense need of a low cost, completely automated driver drowsiness detection model working under varying luminance conditions.

1.3 FACE TRACKING

Face tracking system as shown in Fig.2, must be robust to head movement, rotation, pose variation and illumination changes. To achieve this goal we propose a method to use face detection using OPENCV (open source computer vision library).

Example of Face Tracking/Detection.

1.4 EYE DETECTION

Locating the position of eye is difficult task due to many factors such as lighting condition, expression, facial shadowing, etc. Using eye features, different measures can be calculated with percentage of eyelid closure, maximum closure duration, blink frequency, average opening level of the eyes, opening velocity of the eyes, and closing velocity of the eye and an effective driver drowsiness detectionmodel can be created which can work under varying unconstraint and luminance conditions.

After the position of face has been obtained, locating the eye can be done withbetter accuracy.

To detect eyes position we use open cv andshapepredictor.dat file previously built.

Example of face and eye detection.

2. LITERATURE SURVEY

In 2008, Hong Su et. al. [8] described **'A Partial Least Squares Regression-Based Fusion Model for Predicting the Trend in Drowsiness'**. They proposed a new technique of modeling driver drowsiness with multiple eyelid movement features based on an information fusion technique—partial least squares regression(PLSR), with which to cope with the problem of strong collinear relations among eyelid movement features and, thus, predicting the tendency of the drowsiness. The predictive precision and robustness of the model thus established are validated, which show that it providesa novel way of fusing multi-featurestogether for enhancing our capability of detecting and predicting the state of drowsiness.

In June, 2010, Bin Yang et. al. [9] described **'Camera based Drowsiness Reference for Driver State Classification under Real Driving Conditions'**. They proposed that measures of the driver's eyes are capable to detect drowsiness under simulator or experiment conditions. The performance of the latest eye tracking based in-vehicle fatigue prediction measures are evaluated. These measuresare assessed statistically and by a classification method based on a large dataset of 90 hours of real road drives. The results show that eye-tracking drowsiness

detection works well for some drivers as long as the blinks detection works properly. Even with some proposed improvements, however, there are still problems with bad light conditions and for persons wearing glasses. As a summary, the camera based sleepiness measures provide a valuable contribution for a drowsiness reference, but are not reliable enough to be the only reference.

In June, 2014, Eyosiyas et. al. described 'Driver Drowsiness Detection through **HMM based Dynamic** Modeling'. They proposed a new method of analyzing the facial expression of the driver through Hidden Markov Model (HMM) based dynamic modeling to detect drowsiness. They have implemented the algorithm using a simulated driving setup. Experimental results verified the effectiveness of the proposed method.

In August 2014, García et. al. described **'Driver Monitoring Based on Low-Cost 3-D Sensors'**. They proposed a solution for driver monitoring and event detection based on 3-D information from a rangecamera is presented. The system combines 2-D and 3-D techniques to provide head pose estimation and regions-of-interest identification. Based on the captured cloudof 3-D points from the sensor and analyzing the 2-D projection, the pointscorresponding to the head are determined and extracted for further analysis. Later, head pose estimation with three degrees of freedom (Euler angles) is estimated based on the iterative closest points algorithm. Finally, relevant regions of the face areidentified and used for further analysis, e.g., event detection and behavior analysis.The resulting application is a 3-D driver monitoring system based on low-cost sensors. It represents an interesting tool for human factor research studies, allowing automatic study of specific factors and the detection of special event related to thedriver, e.g., driver drowsiness, inattention, or head pose.

3. PROPOSED DRIVER DROWSINESS SYSTEM

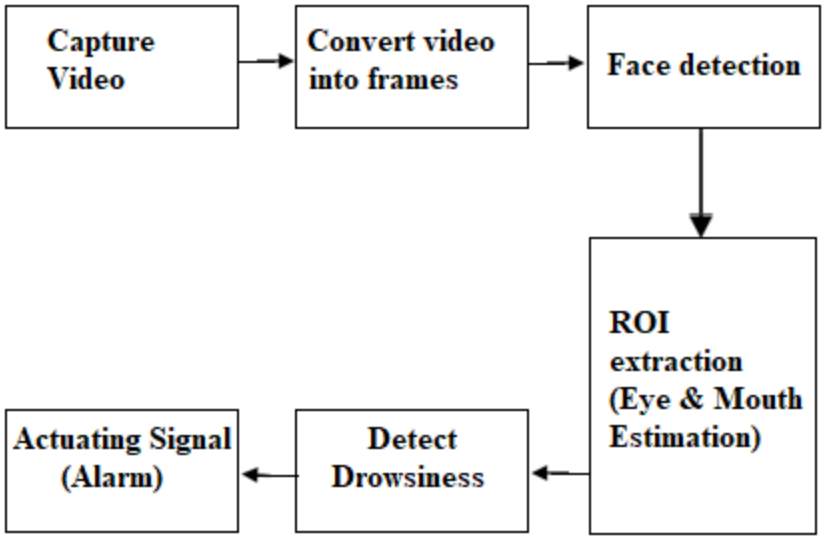
Drowsiness is a state of decreased awareness or alertness associated with a desire or tendency to fall asleep. Drowsiness is therefore the brains last step before falling asleep. This could for example be the outcome of hard physical work or other activities that uses the energy supply system of the body. It is a normal and natural companion of fatigue but it does appear alone. Experts say, drowsiness during the day, even during boring activities, indicates a sleeping disorder.

Drowsiness detection system that captures, processes, recognizes and provides results to the user, which user can take actions on the events Detection of fatigue involves a sequence of images of a face, and the observation of eye movements and blink patterns. Driver drowsiness detection systems can use cameras, eye tracking sensors and other hardware to monitor visual cues, where drowsiness can be detected through yawning frequency, eye-blinking frequency, eye-gaze movement, head movement and facial expressions.

By monitoring the eyes, it is believed that the symptoms of driver fatigue can be detected early enough to avoid a car accident. The requirements for an effective drowsiness detection system are as follows:

- A non-intrusive monitoring system that will not distract the driver.
- A real-time monitoring system, to insure accuracy in detecting drowsiness.
- A system that will work in both daytimeand nighttime conditions.

Detection of fatigue involves a sequence of images of a face, and the observation of eye movements and blink patterns. The analysis of face images is a popular research area with applications such as face recognition, virtual tools, and human identification security systems Region of Interest (ROI) is estimated depending on Eye state(open/closed). Depending on theseFeatures, Drowsiness of a person is detected and generates an alert message.



3.2 Other Methods to Detect driverdrowsiness:

3.2.1 TEMPLATE MATCHINGBASED EYE DETECTION

Eye detection is a pre-requisite stage for many applications such as human– computer interfaces, iris recognition, driver drowsiness detection, security, and biology systems. In this paper, templatebased eye detection is described. The template is correlated with different regions of the face image. The region of face which gives maximum correlation with template refers to eye region. The method is simple and easy to implement. The effectiveness of the method is demonstrated in both the cases like open eye as well as closed eye through various simulation results a novel and simple eye detection schemeis proposed in this paper. An eye template is used to detect eye region from face image. The template is matched with eye region using cross correlation technique.The method does not require any complex mathematical calculation and prior knowledge about the eye. It is a simple method and can easily be implemented by hardware.

3.2.2 DETECTING METHOD FOR DRIVER DROWSINESSAPPLICABLE TO INDIVIDUAL FEATURES

In this method i.e. the driver status monitorsystem, the method or the timing for offering information to a driver is changed according to the level of the consciousnessor the attention of a driver, and the media or its method to offer information is c h a n g e d according to assent or urgency level of the information. The purpose of this study is to realize a system that wins drive's confidence by the ways mentioned above. The driver Stan's monitor detects drowsiness from the change in the duration of eye closure during blinking and in attention from the change in the gaze direction. This method describes the detection of degradation of consciousness.

3.1.1 PERFORMANCE EVALUATIONOF STATISTICAL APPROACH FOR DROWSINESS DETECTION

An innovative image processing algorithm as Drowsy driver detection methods can form the basis of a system to potentially reduce accidents related to drowsy driving. an image processing algorithms along with non-intrusive approach. In this method Region of Interest (ROI) is going to be an eye, whose statistical property (average blob area) is considered. The fatigue is detected based on the Statistical value calculated for the ROI.

The innovation proposed ensures the safety and happiness of dozen and scores of driver's life. Comparison of both the driver's with and without spectacles was made, tabulation and graph was plotted with the statistical values for each frame, which shows that the statistical value for the frames were comparatively similar for the driver's with and without spectacles.

4. CONCLUSION AND DISCUSSION

This review paper describes the various methods for detecting driver's drowsiness by analyzing facial images taken by a camera. This system involves two steps firstly the eye detection then detecting the drowsiness of the eye. Detection of the eye is done by the image processing technique. In the second step we discuss various detection methods, the various movements of the body etc. lack of proper light after sunset can cause problems in reading the images. System detect the driver's eye wearing spectacles. In future implementation of the infrared light source could be a better solution for the lack of light after sunset.

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