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A Review method on 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. It is important for driving support systems to detect status of driver's consciousness. Particularly, detecting driver's drowsiness could prevent drivers from collisions caused by drowsy driving. This paper, does the detailed survey of the various methods to detect drivers fatigue, which can help to increase vigilance of the driver and make him alert from fatigue state.

Keywords

drowsiness detection, driver fatigue, face detection, fuzzy logic

1. INTRODUCTION

Driver drowsiness is an important factor in the motoring of vehicle accidents [1,2,3,4]It was demonstrated that driving performance deteriorates with increased drowsiness with resulting crashes constituting more than 20% of all vehicle accidents [9]Traditionally transportation system is no longer sufficient. Recently artificial intelligence techniques has emerged and became a popular topic among transportation researchers. In recent years, there has been growing interest in intelligent vehicles. A notable initiative on intelligent vehicles was reported by the U.S. Department of Transportation with the mission of prevention of highway crashes [9] The ongoing intelligent vehicle research will revolutionize the way vehicles and drivers interact in the future. The US National Highway Traffic Safety Administration estimates that in the US alone approximately 100,000 crashes each year are caused primarily by driver drowsiness or fatigue. Thus incorporating automatic driver fatigue detection mechanism into vehicles may help prevent many accidents. One can use a number of different techniques for analyzing driver exhaustion. One set of techniques places sensors on standard vehicle components, e.g., steering wheel, gas pedal, and analyzes the signals sent by these sensors to detect drowsiness [7, 9]. It is important for such techniques to be adapted to the driver. A second set of techniques focuses on measurement of Physiological signals such as heart rate, pulse rate, and Electroencephalography (EEG) [8]. It has been reported by researchers that as the alertness level decreases EEG power of the alpha and theta bands increase as shown in figure 1. Hence providing Indications of drowsiness. However this method has drawbacks in terms of practicality since it requires a person to wear an EEG cap while driving. A third set of solutions focuses on computer vision systems that can detect and recognize the facial motion and appearance changes occurring during drowsiness [4,11].The advantage of computer vision techniques is that they are non-invasive, and thus are more amenable to use by the general public. There are some significant previous studies about drowsiness detection using computer vision techniques. Most of the published research on computer vision approaches to detection of fatigue has been focused on the analysis of blinks and head movements[13,15].However, in the fatigue detection systems developed to date, drowsiness warning system using image processing has become most widely used because it provides a remote detection[13].

Due to the increase in the amount of automobile in recent years, problems created by accidents have become more complex as well. Traditional transportation system is no higher sufficient. In recent years, the intelligent vehicle system has emerged and became a popular topic among transportation researchers. However, the research of safety in vehicle is an important subset of intelligent vehicle system research. Meantime, active warning system is one of the designs on active safety system. The safety warning systems, mostly active warning systems for preventing traffic accidents have been attracting researchers.

Owing to the progress of digital signal processing technology, real time image processing is beginning to

be achieved breakthroughs in the field of many practical applications.

Typically, after high hours of driving or in absent of alert mental state, the eyelids of driver will become heavy due to fatigue. The attention of driver starts to lose focus, and that creates risks for accidents. These are typical reactions of fatigue, which is very dangerous. Usually many exhausted drivers are not aware that they are in falling asleep. In fact, many such drivers can fall asleep any time during their driving.. The rest of the paper is structured as; In Section 2 is Related Work. In Section 3 we describe about Drowsiness Detection System. In Section 4 we describe about different Methods to Detect Drowsiness Section 5 we give Conclusion to paper.

2. RELATED WORK

Various algorithms were proposed till date, they can be classified:

1. Biological indicators
2. Vehicle behavior
3. Face analysis

Some of them are intrusive methods and some are non-intrusive. The intrusive methods include ECG, EOG and Head motion. In some of this type of methods drivers had to wear a head gear while driving. While in other methods they used pulse detectors which were placed in the steering wheel and in the back of the seat. These too were not reliable most of the time .That is why this technique was not much adopted for common people. Methods to detect drowsiness on the basis of vehicle behaviours such as vehicle steering activity, vehicle speed and vehicle lateral position were also developed but they were too slow to alert the driver before he fell asleep [5,7]these methods alerts driver only after they fell asleep not before they were in the episode of the drowsy state The face analysis done till date are mostly non-intrusive and uses camera to detect the facial expressions.it further uses image processing tools to detect the facial expressions.some methods used the change in intensities in binary images to detect the drowsiness state while others used the facial expressions such as yawning to detect it. Biological indicators such as brain waves, heart rate and pulse rate. These techniques have the best detection accuracy but they require physical contact with the driver thus they are not practical.

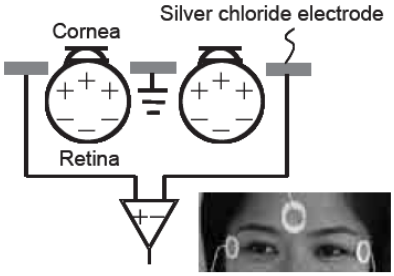

Fig 1:-The method of electro-oculography (EOG)

Vehicle behavior is another factor that can be used to detect drowsiness of driver. There is change in vehicles speed, drivers grip on steering, vehicles lateral position. The methods used to detect drowsiness based on facial expressions. The various facial expressions that can be used to detect the drowsiness state are as shown below

3. DROWSINESS DETECTION 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. 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 daytime and 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) and Mouth (yawning state). Depending on these Features, Drowsiness of a person is detected and generates an alert message as shown in fig 2.

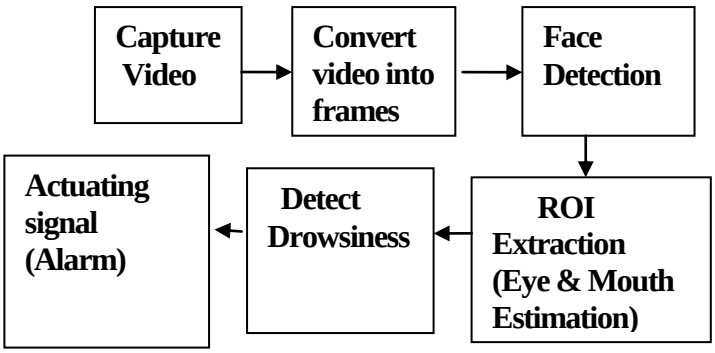

Fig 2: Block diagram of Drowsiness Detection System

4. Methods to detect Drowsiness

4.1 Template Matching based Eye Detection in Facial Image

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, template based 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 scheme is 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.

4.2 DETECTING METHOD FOR DRIVER DROWSINESS APPLICABLE TO INDIVIDUAL FEATURES

In this method i.e. the driver status monitor system, the method or the timing for offering information to a driver is changed according to the level of the consciousness or the attention of a driver, and the media or its method to offer information is changed according to assent or urgency level of the information. The purpose of this study is to realize a system that wins driver‘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.

4.3 SMART ALGORITHM FOR COMMERCIAL VEHICLE DRIVER DROWSINESS DETECTION

This method describes an experimental analysis of commercially licensed drivers who were subjected to drowsiness conditions in a truck-driving simulator and evaluates the performance of a neural network based algorithm, which monitors only the drivers’ steering input.

Correlations are found between the change in steering and the state of drowsiness. The results show steering signals differences can be used effectively for detection. This is a supervised training in which the known input-output patterns are presented to the network and the ANN learns (stores) the information The input patterns are the exemplars, i.e. 15-second summed of discredited steering angle, and the output is known state of the driver, i.e. the desired output vector, D(n).D(n) is represented by a classifying vector value of [1,0] for awake and [0,1] for sleep. Therefore, for training, for each input example X corresponds to a known output D(n). The presentation of input-output patterns is random, selected from the 600 exemplars. Training an ANN requires selecting the right and optimum architecture for the various training parameters. The ANN training is performed multiple times. An evaluation of the ANN model shows good performance under the crash prediction metric. The system issued at least one detection for 97% of all the observed crashes experienced by any of the subjects. Steering behavior is characterized by a period with no steering correction. Therefore, the ANN algorithm cannot detect these events since it was trained for.

4.4 Performance Evaluation of 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 drivers’ 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.

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4.5 HYBRID DRIVER DROWSINESS DETECTION SYSTEM

Application of piezo-film movement sensors integrated into the car seat, seat belt and steering wheel was proposed for development of a non-invasive and hybrid systems for detecting driver drowsiness. A Car simulator study was designed to collect Physiological data for validation of this technology. Methodology for analysis of physiological data, independent assessment of driver drowsiness and development of drowsiness detection algorithm by means of sequential fitting and selection of regression models is presented. Statistical analysis shows that during the episodes of transitions to dangerous levels of drowsiness movement variations recorded by the seat sensors are decreasing. This finding indicates that the piezo-film movement sensors could be used as non-invasive devices for detecting the level of drowsiness on their own or in combination with other physiological signals.

Comp medics proposed use of non-invasive piezo-film movement sensors that can be incorporated into car seat, seat belt and steering wheel [3]. These sensors are potentially capable of recording patterns of Driver's movements, breathing and even heart rate that could be used for identifying the level of drowsiness. Another aspect of Comp medic's patented technology includes integration of different kinds of signal analysis including morphological processing of EEG and eye movement. During the transitions to significant drowsiness states there is statistically significant reduction in a measure of variation of the piezo-film movement sensors located in the back of the car seat. This finding can be considered as the first step in deriving the accurate and reliable algorithm for detection of driver drowsiness. The logic of the algorithm development can be viewed as a sequence of fitting the appropriate statistical models while determining suitable methods of processing different physiological indicator signals, combining those parameters in an optimum way and expanding the temporal scope of these models in the process. The first step would comprise investigation of significance of time course of changes in functions of individual physiological signals during the episodes of transitions to the dangerous drowsiness states. The signals and respective processing methods that are found to have statistically significant variations over the transition episodes could be selected as potential candidates for being the algorithm components.

The Second step of algorithm `development would comprise determination of the combinations of individual drowsiness measures that are most strongly associated with the odds (or log odds) of a state of dangerous drowsiness or a number of different drowsiness stages based on the observations from the episodes of transitions to drowsiness.

Finally a number of selected combinations of individual drowsiness measures could be validated[10,11] across the complete set of recorded observations including determination of sensitivity and specificity. The important aspects of development of the drowsiness detection system are its practicality, robustness and non-invasiveness. While the discussed approach to the algorithm development is capable of integrating and comparing different combinations of physiological measures those that are minimally invasive will be given priority. This consideration was the reason behind the focus on analysing properties of the seat movement sensors as presented in this technique.

4.6 Driver's Drowsiness Detection System for Ivvl Vehicle

In this paper, a non-intrusive driver's drowsiness system has been presented based on computer vision and image processing. This system uses visual information to analyze and monitor driver's eye state at near real-time and real-driving conditions. The proposed algorithm for eye detection and eye tracking is robust and accurate under varying light, external illuminations interference, vibrations, changing background and facial orientations. Furthermore, all drivers used in these experiments were exposed to a variety of difficult situations commonly encountered in a roadway. This guarantees and confirms that these experiments have proven robustness and efficiency in real traffic scenes. [12]

4.7 DETECTING METHOD FOR DRIVERS' DROWSINESS

A method to extract the driver's initial stage of drowsiness was developed by means of the blink measurement irrelevant to the surrounding brightness and individual characteristics with motion pictures processing [9]. The result was that an increase of the long eyelid closure time was the key factor in estimating the initial stage of driver's drowsiness while driving. And the state of drowsiness could be presumed by checking the frequencies of long eyelid closure time per unit period. The objective method to perceive the drivers'drowsiness was surveyed through the motion picture processing CCD camera system, focused on measuring the eyelid's opening that strongly shows the drowsiness well. A neural network computer system was used to capture adriver's face and eye area. We contrived to determine the eyelid's location using the Maximum and minimum points in the 1st derivatives of the individual eye area, and to determine the blink duration at zero Crossing points in the 2nd derivatives, which eliminate the characteristics of blinks among the individuals.

Experimental results showed this method could be applicable to presume the drowsiness of a driver by the fact that the frequencies of the long eyelid closure time per unit period matched well with the drowsy intensity proposed by subjects themselves and the side watcher.

5. 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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