SYNOPSIS Report on

DROWSINESS-DETECTION

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ABSTRACT

Number of peoples dying due to road accidents are increasing day by day. Drowsiness and sleepiness of drivers are amongst the significant causes of road accidents. Studies have suggested that around 17% of all road accidents are fatigue related. However, initial stages of fatigue and drowsiness can be detected before a critical situation arises which may cause an accident. A direct way of measuring driver fatigue is measuring the drowsiness.

Therefore, the proposed paper attempted to address the drowsiness issue. The system will monitor the user eyes using a camera and by developing an algorithm we can detect symptoms of user fatigue early enough to avoid the user from sleeping. In this project we use OpenCV which is basically used for face detection followed by 68 points of facial landmark identification.

So, this project is aimed towards developing a prototype of drowsiness detection system which detects the eye closure of user or driver and give warning to them upon detecting drowsiness. Driver face is captured, and eye retina detection are done, and blinking values are calculated then threshold values are set. And from these values we categorize the driver in 3 modes: active, drowsy, and sleepy.

Keywords—Driver drowsiness, face detection, OpenCV.

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INTRODUCTION

Drowsiness is one of the important causes of fatigue accidents which may produce several damage, injury, and deaths. This automatically becoming a major concern around globe and most of the countries are making great effort on how to detect drowsiness during driving. The drivers may be tired due to continuous driving for a long period.

Growth in roads infrastructures, advancements in vehicles and development of road safety laws are intended to reduce road accidents. However according to a report published by WHO, death count of 1.25 million people per annum on road accidents has not reduced [1]. Changes in our lifestyle resulted in increased number of traffic accidents due to driver's drowsiness or sleepiness [2]. National Highway Traffic Safety Administration (NHTSA) estimates that approximately 25% of police reported accidents involves driver fatigue [3].

The purpose of the research paper is to alert drivers so that they can be cautioned to pull over and stop driving to take some time in a drowsy state. This paper proposed a method by tracking eye position of drivers or users. Once the position of the eyes is located, the system is designed to determine whether the eyes are opened or closed and detect fatigue.

An accurate algorithm in real time eye tracking system has been challenging problem for computer vision. To prevent such dangerous and harmful situations, a real-time driver monitoring system is implemented using OpenCV, where the aspect ratios of eye is generated. With EAR i.e., Eye Aspect Ratio 0.25, the most common value for EAR in studies, the results show that the alarm is generated for the blinks. In this way an alarm can prevent such fatigue accidents and may save lives of the people.

LITERATURE REVIEW

As of now there has been an extensive amount of work done on drowsiness detection. But here we specify only a few important and relevant literature works.

In 2008, HONG Su et.al. "Squares Regression-Based Fusion Model for Predicting Drowsiness" was defined. It is suggested that partial least squares information fusion technique for modelling driver drowsiness with multiple eyelid movement features (PLSR) with that to deal with the matter of robust co-linear relations among protective fold movement options and, thus, predicting the tendency of the sleepiness.

In June,2010, Bin Yang et.al under simulated or observed conditions, “Drowsiness is referenced for the Driver State of eye and Head pose for Driver Alertness” is found. Physical measurements are based on the results of the most recent in-vehicle eye monitoring system. These metrics are assessed statistically and using a classification methodology based on a large database of 90 hours of real-world driving time.

In June 2012, A. Cheng et.al. „Driver Drowsiness Recognition Based on Computer Vision' was the title of the paper. Image processing and eye tracking is used to recognize non-intrusive sleepiness. Due to the changes in illumination and driver posture a strong eye detection algorithm is given to handle the problems caused by the change. Percentage of eyelid closure, maximum closure duration, blink frequency, average opening level of eyes, and closing of eyes are the six measures that are calculated. 86% of accuracy is shown in the video-based drowsiness recognition.

In June, 2014, Eyosiyas et.al. Proposed „Drowsiness Detection through HMM based Dynamic detection“. According to the proposed approach, facial expressions analysed and sleepiness is detected using Hidden Markov Model (HMM) based dynamic modelling. They used a virtual driving environment to enforce the algorithm. The proposed technique's effectiveness was confirmed by experimental findings.

RESEARCH OBJECTIVE

Every year many people lose their lives due to fatal road accidents around the world and drowsy driving is one of the primary causes of road accidents and death. Drowsiness the of driver is a state in which the person is neither fully alert nor completely in sleep mode it is in between state. For reducing the frequency of road accidents, effective steps should be taken to reduce driver drowsiness.

Here we have brought a noble automatic method to detect the drowsy driver from real-time video monitoring.

The large number of deaths occur due to drowsiness related road accidents and detection of driver drowsiness contributes to the decrease in the number of deaths occurring in traffic accident. In this context, it is extremely important to use technologies to implement the systems those are able to continuously monitor drivers and measure their level of alertness during driving.

An accurate algorithm in real time eye tracking system has been challenging problem for computer vision. To prevent such dangerous and harmful situations, a real-time driver monitoring system is implemented using OpenCV, where the aspect ratios of eye is generated. With EAR i.e., Eye Aspect Ratio 0.25, the most common value for EAR in studies, the results show that the alarm is generated for the blinks. In this way an alarm can prevent such fatigue accidents and may save lives of the people. The facial landmarks are continuously scanned and captured using camera. These collected landmark frames are given to EAR algorithm to read the eye aspect ratio and to MAR algorithm to read the Mouth Aspect ratio for drowsiness detection. The proposed method sets a threshold and predicts that the driver is drowsy when the EAR ratio goes below the threshold or when the eye is kept close for a long duration and when the MAR ratio goes beyond the fixed threshold. Then the system instantly alerts the driver with the help of a sound system. The driver gets alerted when he feels drowsy.

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TECHNIQUES & METHODOLOGY

Different techniques have been reported for the detection of driver's drowsiness . Here is a below table will summarize all the techniques:

Category	Measurement	Characteristics
Subjective	Through questioners by professional	A well-defined reference developed by expert
Psychological	EEG, ECG, EoG etc.	Measurement through sensors attached with driver
Vehicular	Steering wheel movement, Acceleration, Lateral distance, etc.	Measurement with sensors attached to the vehicle
Visual	Eye blinking per minute, Yawning, Head pose, Head motion, etc.	Computer vision-based measurement of the driver's behaviour

1. **Subjective Method: -** Subjective technique cannot be use in a real driving situation but is helpful in simulations for determining drowsiness.
2. **Psychological Method: -** Psychological signals like electrocardiogram (ECG), electroencephalogram (EEG), Electrooculography (EOG) can be utilized for drowsiness detection. A technique based on a psychological signal is more reliable. Vehicle movement-based detection is another technique. Here information is obtained from sensors attached with steering wheel, acceleration pedal and/or body of the vehicle. Signals collected from sensors are continuously monitor for the identification of noticeable variation in order to detect driver's drowsiness.

Taking advantage of this variation, psychological measures are taken with the help of dedicated sensors for the detection of drowsiness.

Eye movement detection through EoG signal to identify drowsiness was utilized by many researchers. In this technique, the eye orientation monitored through electric field generation by the potential difference between cornea and retina of the eye. Disposable electrodes at outer corner of each eye and one electrode at forehead are utilized to pick Rapid eye movements (REM) and Slow Eye Movements (SEM) signals. REM and SEM occur when the driver is awake and drowsy respectively.

The Heart Rate (HR) significant variation between different drowsiness stages, make it a vital sign. HR easy determination through ECG is well understood technique. Another important information

from ECG, Heart Rate Variability (HRV) which is the ratio of Low Frequency (LF) and High Frequency (HF) is of great interest. HRV decreases as the drowsiness rating increases on KSS.

Row physiological signals are prone to noises and artifacts due vehicle movement. Therefore, an effective filtering technique is a must requirement before processing a physiological signal. Statistical features are extracted, using various feature extraction techniques like Discrete Wavelet Transform (DWT) and Fast Fourier Transform (FFT), before further analysis. Finally, Artificial Neural Networks (ANN) ,Linear Discriminant Analysis (LDA), or other similar analysis were utilized for the drowsiness detection.

Physiological signals usage for drowsiness detection is accurate and reliable compared with other methods. However, physiological signals measurement is intrusive. Some researchers have investigated wireless technology for minimizing the intrusiveness. Some other researchers, eliminate the intrusiveness by putting sensors on the steering, on the cost of bearable errors due to improper electrode contact, considering the importance of user friendliness.

S. No	Sensors	Preprocessing	Feature extraction
1.	EEG, ECG, EoG	Optimal wavelet packet, Fuzzy wavelet packet	The fuzzy MI-based Wavelet-packet algorithm
2.	ECG	Band pass filter	Fast Fourier Transform (FFT)
3.	EEG	Independent component analysis, Decomposition	Fast Fourier Transform (FFT)
4.	EoG, EMG	Filtering & Thresholding	Neighborhood search

3. Vehicle Movement Based Techniques

In this technique, sensors are attached with some part of the vehicle like steering wheel and/or acceleration pedal. Signals collected from the sensors are analyzed for drowsiness detection. Steering wheel based drowsiness measurement is presented by Jung et al. Relatively larger variations in driving speed due to sleep deprivation was investigated.

Steering Wheel Movement (SWM) measurement using steering angle sensor is widely used for determining the level of driver drowsiness. Many researchers establish that normal drivers make more steering wheel reversals than sleep deprived drivers. Lane change effect is cancelled out by considering only small movement (0.5° to 5°) of the steering wheel. Hence, small SWMs make driver drowsiness detection possible. SWMs are greatly dependent on road geometry and it limit its usefulness.

Standard Deviation of Lane Position (SDLP) has gained the interest of researchers due to its simplicity and usefulness for drowsiness detection. SDLP is measured through software in the simulation environment and lane position is tracked through external camera in the field experiment. Through experimental verification, Ingre et al. established a direct relationship between SDLP and KSS. However, above experiment reveals poor correlation due to significant difference between selected subjects. Furthermore, SDLP is dependable on external factors like climate, lighting and road marking.

4. **Visual Techniques :-**
    - Computer Vision and Drowsiness Detection

Drowsiness never comes instantly but appear with visually noticeable symptoms. These symptoms generally appear even well before drowsiness in every driver. These includes Eye closing for longer time, High eye blinking rate, Heavy eyelids, Rubbing eyes, Yawing, Head nodding, Inability to focus and Hard to concentrate.

These challenges need to be overcome to create more effective face recognition systems. The Following are the challenges which affect the ability of Facial Recognition System to go that extra mile.

- **Illumination**

The illumination plays an essential role during image recognition. If there is a slight change in lighting conditions, it will make major impact on its results. It is the lighting to vary, and then the result may be different for the same object cause of low or high illumination.

- **Background**

The background of the object also plays a significant role in Face detection. The result might not the same outdoor as compared to what is produces indoors because the factor - affecting its performance-change as soon as the locations change.

- Template Matching Technique

In this technique, a template image presence in a larger image is checked through comparison. The template is an already stored image, especially selected for the comparison purpose. Both close and open eye templates are provided to the system. The system use pictures from the video to check the states of the eyes, calculate eyes closure time and compare with a predefined time for sleepiness and eye-blinking.

- Eye Blinking Technique

This technique detects the level of drowsiness and sleepiness by calculating the eye blinking rate and eye closure duration. The reason is that when a driver felt drowsy, his/her eye blinking rate and gaze between eyelids are different from normal situations. Ahmad and Borole monitor the position of irises and eye states in the technique. They placed a camera at a suitable place in the vehicle and acquire video. Then by applying computer vision techniques to sequentially localize face, eyes and eyelids positions to measure ratio of closure.

- PERCLOS Technique

PERCLOS(Percentage of Eye Closure) means percentage of time eye closed in a given period. To sense the level of drowsiness PERCLOS is a well-known parameter. Yan et al. [7] consider that a human blinks once every 5 s on average that is 12 times blinks per minute. They tried gray-scale conversion and template matching for extracting data.

- Yawning Technique

One of an important sign of fatigue is yawn. It is assume with a large vertical mouth opening compared. As compared to speaking, mouth is widely open in yawning process. Bhandari et al. detected yawn by face and then mouth tracking. After yawn detection, the system alarms the driver.

Advantages and limitations of different techniques:

Category	Advantages	Limitations
Subjective	Simple, no sensors and no equipment	Not possible in real time
Psychological	Reliable, accurate, early detection	Intrusive, expensive
Vehicular	Non-intrusive, Ease of use, small sensors and moderate processing	Unreliable, late detection
Visual	Non-intrusive, Ease of use, proven hardware	Lighting conditions, background, tough threshold setting

PROJECT OUTCOME

Every year thousands of people died in road accidents. Mostly, the accident occurs due to the drowsiness of the driver. Such causes can be avoided by exploiting the advanced technology. The progress in the field of image processing and computer vision made it possible to detect the drowsiness of the driver by monitoring drowsiness visual symptoms.

During the monitoring, the system can decide if the eyes are opened or closed. When the eyes have been closed, the alarm beeps to alert the driver and the speed of the vehicle is reduced. By doing this many accidents will decrease and provides safe life to the driver and safety of vehicle. A threshold algorithm can reliably detect eye blinks and proved the feasibility to detect drowsiness. It is possible by closely monitoring the drowsiness symptoms like eye blinking intervals, yawning, eye closing duration, head position etc.

The paper is a comprehensive review on various methods to detect drowsiness with the focus on computer vision based detection. It is intended that computer vision based detection of the hybrid symptoms eliminate the drawbacks of discussed techniques. The proposed system is more reliable and dependable for driver drowsiness detection. It is non-intrusive in its nature. A reasonable number of road accidents are preventable with the use of computer vision based drowsiness detection.

The results suggested that the position of mounting the camera should be mounted relatively low, and a low-power and diffused light source is also recommended.

PROPOSED TIME DURATION

The proposed time for the project is 5-6 weeks.

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