Driver Drowsiness Detection

Report submitted in partial fulfillment of the requirement for the degree of

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Under the Supervision of

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HOD, CSE

By

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DECLARATION

This is to certify that Synopsis Report Entitled "**Driver Drowsiness Detection**" which is submitted in partial fulfillment of the requirement for the award of degree B.Tech. in Computer Science and Engineering to R.K.G.I.T, Ghaziabad, Dr. A.P.J. Abdul Kalam Technical University, Lucknow comprises only original work and studies carried out by students himself. The matter embodied in this synopsis has not been submitted for the award of any other degree.

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ABSTRACT

Road crashes and related forms of accidents are a common cause of injury and death among the human population. According to data from the World Health Organization, approximately 1.35 million people die each year as a result of road traffic crashes. In India, the number of accidents that has occurred due to driver fatigue has been alarmingly high due to continuous driving, throughout day and night. The effects of drowsiness are similar to alcohol, it will make driving inputs (steering, acceleration, braking) poorer, destroy reaction times and blur the thought processes. 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. Several deadly accidents can be prevented if the drowsy drivers are warned in time. A direct way of measuring driver fatigue is measuring the state of the driver i.e. drowsiness. So it is very important to detect the drowsiness of the driver to save life and property. The driver drowsiness detection system will monitor the driver’s eyes using a camera, and by developing an algorithm this project will detect symptoms of driver fatigue early enough to avoid the person from sleeping. So, this project will be helpful in detecting driver fatigue in advance and will give warning output in form of alarm. Though there are several methods for measuring the drowsiness but this approach will be completely non-intrusive which does not affect the driver in any way, hence will give the exact condition of the driver. The relevant features will be extracted from facial expressions such as yawning and eye closure for inferring the level of drowsiness. For implementing this system several OpenCV libraries will be used, this library is based on the real time facial images analysis for warning the driver of drowsiness or in attention to prevent traffic accidents. The facial images of driver will be taken by a web camera. An algorithm and an inference will be proposed to determine the level of fatigue by measuring the eyelid blinking duration and face detection to track the eyes and mouth, and warn the driver accordingly. The strong point of this proposed system will be that the location of the driver will be sent to his / her near and dear one so that in case of any accident with the driver, the person near and dear to him will come to know about the driver on time. Moreover, the warning will be deactivated manually rather than automatically. This will ensure the driver's activation as until he sets off the alarm, the alarm will not go off.

LIST OF ACRONYMS

- OpenCV – Open Source Computer Vision
- WEBCAM – World Wide Web Camera
- PERCLOS - The percentage of time that an eye is closed in a given period
- ECG - Electroardiogram,
- EMG - Electromyogram
- EOG - Electrooculogram
- EEG – Electroencephalogram
- CNN - Convolutional Neural Network
- ANN – Artificial Neural Network
- IR – Infrared
- KSS - Karolinska Sleepiness Scale
- SDLP – Standard Deviation of Lateral Position
- MLP - Multilayer Perceptron
- BPNN - Back Propagation Neural Networks
- RCNN - Retinal Connected Neural Network
- RINN - Rotation Invariant Neural Network
- FNN - Fast Neural Networks
- PNN - Polynomial Neural Network.

LIST OF FIGURES

CHAPTER – 1
INTRODUCTION

1.1. DRIVER DROWSINESS DETECTION SYSTEM

Drowsiness or fatigue is one of the main factors that threatens road safety and causes serious injuries, deaths and economic losses. The effects of drowsiness are similar to alcohol - it will impair your driving inputs (steering, acceleration, braking), destroy your reaction time and blur your thought processes. In recent years, the rate of fatal motor vehicle accidents resulting from distracted driving has been increasing. Therefore, there is an urgent need for an alert system to continuously monitor the driver that can alert the driver and reduce the chances of accidents on the roads due to drowsiness problem.

1.2. SIGNS OF DROWSINESS

There are several signs of drowsiness in the driver -

- Driver may be yawn frequently.
- Driver is unable to keep his eyes open.
- Driver catches him nodding off and has trouble keeping head up.
- The driver's thoughts wander and divert attention from the road.
- The driver can't remember driving the last few miles.

1.3. METHODS TO DETECT DROWSINESS

Numerous works have been carried out in the field of driver drowsiness monitoring and detection systems using a variety of methods.

There are several different methods used to detect, measure and predict the drowsiness of a driver -

- Subjective methods
- Physiological methods
- Vehicle-based methods
- Behavioral methods
- Hybrid methods

1.4. PRINCIPLE OF PROPOSED SYSTEM

The principle of the proposed system will be based on the analysis of real-time facial images using the OpenCV library, with a view to warn drivers of drowsiness or to prevent traffic accidents.

But this project will go with Behavioral methods which include -

- Yawning
- Amount of eye closure
- Eye blinking

The driver's facial images will be taken by a webcam. An algorithm and an inference will be proposed to determine the level of fatigue by measuring the eyelid blinking duration and face detection to track the eyes, mouth and warn the driver accordingly. If the eyes will be found closed or the mouth will be found open for 5 or 8 consecutive frames, then the system will conclude that the driver is asleep and will issue a warning signal.

Detection of fatigue will involve a sequence of images of a face, and the observation of eye movements and blink patterns. Yawning will be included to make the system more precise by determining the movement of the mouth. Once the position of the eyes and mouth will be located, the system will be designed to detect fatigue.

1.5. ADVANTAGES OF PROPOSED SYSTEM

- The location of the driver will be sent to his / her near and dear one so that in case of any accident with the driver, the person near and dear to him will come to know about the driver on time.
- The alarm warning will be deactivated manually rather than automatically. This will ensure the driver's activation as until he sets off the alarm, the alarm will not go off.

CHAPTER – 2

LITERATURE SURVEY

2.1 INTRODUCTION

Drowsy driving means operating a motor vehicle when a person is unable to retain alert due to lack of sleep. Drowsiness or fatigue is one of the main factors that threatens road safety and causes serious injuries, deaths and economic losses. Previous studies showed that the drowsiness level of a driver is related to their facial expression, driving behaviours, and physiological responses.

There are many signs of the driver's drowsiness –

- Eye blinking
- Frequent yawning
- Difficulty keeping your eyes on the road
- Head nodding
- Irregular speed
- Drifting in and out of your lane
- Daydreaming

Due to the hazards that fatigue create on the roads, researchers have developed various methods to detect driver drowsiness and each technique has its own benefits and limitations.

2.2 LITERATURE REVIEW

To increase accuracy and accelerate the detection of drowsiness, several approaches have been proposed. This section attempts to summarize previous methods and approaches to drowsiness detection.

2.2.1 EEG-based Drowsiness Detection for Safe Driving Using Chaotic Features and Statistical Tests, Zahra Mardi, Seyedeh Naghmeh Miri Ashtiani, Mohammad Mikaili[1]

The first class of techniques employs data derived from physiological sensors, such as Electrooculography (EOG), Electrocardiogram (ECG) and Electroencephalogram (EEG) data. EEG signals provide information about the brain's activity. The three primary signals to measure driver's drowsiness are theta, delta, and alpha signals. Theta and delta signals spike when a driver is drowsy, while alpha signals rise slightly. According to Mardi et al., this technique is the most accurate method with an accuracy rate of more than 90%. Nevertheless, the main disadvantage of this method is its intrusion. For this, several sensors must be attached to the driver's body, which can be inconvenient. On the other hand, non-intrusive methods are far less accurate for bio-signals.

2.2.2 Steering Wheel Behavior Based Estimation of Fatigue, JarekKrajewski, David Sommer, UdoTrutschel, Dave Edwards, Martin Golz[2]

The approach already used is based on driving patterns, and is highly dependent on vehicle characteristics, road conditions, and driving skills. To calculate driving pattern, deviation from a lateral or lane position or steering wheel movement should be calculated. While driving, it is necessary to make micro adjustments to the steering wheel to keep the car in one lane. Krajewski et al. detected drowsiness with 86% accuracy on the basis of correlations between micro adjustments and drowsiness. In addition, it is possible to use lane position deviations to identify driving patterns. In this case, the position of the car corresponding to a given lane is monitored, and deviations are analyzed. Nevertheless, techniques based on driving patterns are highly dependent on vehicle characteristics, road conditions, and driving skills.

2.2.3 Driver Drowsiness Detection Model Using Convolutional Neural Networks Techniques for Android Application, RatebJabbar∗†, Mohammed Shinoy∗ , Mohamed Kharbeche∗ , Khalifa Al-Khalifa§ , MoezKrichen‡ , KamelBarkaoui†[3]

Another technique for detecting a driver's drowsiness is through neural networks. RatebJabbar focuses on the detection of such micro sleep and drowsiness using neural network based methodologies. The author proposed a system in which accuracy was enhanced by using facial landmarks that are detected by the camera and passed to CNN to classify drowsiness. The main achievement of this system is its ability to provide lightweight alternatives to heavy classification models with more than 88% for the category without glasses, more than 85% for the category night without glasses. On average, more than 83% of accuracy was achieved in all categories. Nevertheless, the main limitation of this system is its complexity and intensive computation.

2.2.4 Real Time Eye Detection and Tracking Method for Driver Assistance System, SayaniGhosh, T. Nandy, Nilotpal Manna[4]

The last category consists of behavioral or computer vision measures that are reliable compared to vehicle-based because they focus on the individual rather than the vehicle. In addition, behavioral measures are non-invasive and more practical than physiological measures. Here, information is obtained using cameras to detect slight changes in the facial expressions of the driver. As behavioral measures are non-invasive in nature, they are becoming a popular method of detecting drowsiness. In this paper, author describes real time eye detection and tracking method that works under variable and realistic lighting conditions. It is based on a hardware system for the real-time acquisition of a driver's images using IR illuminator and the software implementation for monitoring eye that can avoid the accidents.

CHAPTER – 3

INFERENCES FROM LITERATURE

3.1 INFERENCES DRAWN OUT OF LITERATURE SURVEY

Various methods are available to determine the drowsiness status of the driver. But because of the various definitions and the reasons behind them, there is no universally accepted definition for drowsiness, all works discuss different ways in which drowsiness can be manipulated in a simulated environment. Various measures are used to detect drowsiness. These include subjective, vehicle-based, physiological and behavioral measures. The accuracy rate of using physiological measures to detect the drowsiness is high. But these measures are highly intrusive. The intrusive nature can be resolved by using contactless electrode placement.

The following measures are used to detect drowsiness –

3.1.1 Vehicle Based Measures

These measurements are determined in a simulated environment by placing sensors on various vehicle components, such as the steering wheel and the acceleration pedal. The signals sent by the sensor are then analyzed to determine the level of drowsiness.

Parameters –

Steering wheel movement

It is measured using steering angle sensor mounted on the steering column. When the driver is drowsy, the number of micro corrections on the steering wheel reduces compared to normal driving. Drowsy drivers make fewer steering wheel reversals than normal drivers.

Standard lane deviation

In field experiments the position of lane is tracked using an external camera. Ingre et al. conducted an experiment to derive numerical statistics based on SDLP and found that, as KSS ratings increased, SDLP (meters) also increased.

Advantages - Non intrusive

Disadvantages– Unreliable

3.1.2 Physiological Measures

The correlation between physiological signals electrocardiogram (ECG), Electromyogram (EMG), Electrooculogram(EoG) and electroencephalogram (EEG)) and driver drowsiness has been studied by many researchers. Nevertheless, the main disadvantage of this method is its intrusiveness. It requires many sensors to be attached to the driver's body, which could be uncomfortable. On the other hand, non-intrusive methods for bio-signals are much less precise.

Advantages- Reliable, Accurate

Disadvantages – Intrusive

3.1.3 Subjective Measures

Subjective measures are those which evaluate the level of drowsiness based on the driver's personal estimation. Method used here is questionnaire, commonly used drowsiness scale is the Karolinska Sleepiness Scale (KSS), a nine-point scale that has verbal anchors for each step.

Advantages - Subjective

Disadvantages - Not possible in real time

3.1.4 Behavioral Measures

The behaviour of the driver, including yawning, eye closure, eye blinking, head pose, etc., is monitored through a camera and the driver gets alert if any of these drowsiness symptoms are detected.

Parameters-

Yawning

Compared to speaking, mouth opens widely and is larger in yawning. Yawing can be detected using mouth and face tracking.

Eye blinking

In this system the position of irises and eye states are monitored through time to estimate eye blinking frequency and eye close duration. In sleepy state eye blinking and gaze between eyelids are different from normal situations. Using these eyes closure and blinking ratio one can detect drowsiness of driver.

PERCLOS(the percentage of time that an eye is closed in a given period)

PERCLOS is an established parameter to detect the level of drowsiness. The PERCLOS score is measured to decide whether the driver is at drowsy state or not.

Techniques -

1. Artificial Neural Network Based technique

Many of the studies are based on architecture of ANN such as - Multilayer Perceptron (MLP), Back Propagation Neural Networks (BPNN), Retinal Connected Neural Network (RCNN), Rotation Invariant Neural Network (RINN), Fast Neural Networks (FNN), Convolutional Neural Network,and Polynomial Neural Network (PNN). Other studies are based on ANN on combination with other techniques and methods such as Principal Component Analysis with ANN (PCA & ANN), Evolutionary Optimization of Neural Networks, Gabor Wavelet Faces with ANN, and finally Skin Color and BPNN.

Most of the studies of face detection systems have adopted ANN in combination with other approaches and algorithms to obtain better results for detection and improve the performance of face detection system. But this may increase the system complexity, required memory and time for face detection.

Advantages - Reliable, Accurate

Disadvantages - Computation intensive

2. Template Matching Technique

In this, one can use the states of eyes (images at different intervals) i.e. if driver closes eye/s for some particular time then system will give an alert.

Advantages- Nonintrusive, Ease of use

Disadvantages - Lighting condition Background

CHAPTER – 4

PROBLEM STATEMENT AND SOLUTION APPROACH

4.1 PROBLEM STATEMENT

Designing a prototype drowsiness detection system that will focus on continuously and accurately monitoring the position of the driver's eyes and mouth in real time and check if they are open or closed for more than the given period of time.

4.2 PROPOSED WORK

The objectives of the project for the proposed work are -

- Introduce novel approach to prevent driver drowsiness.
- Take video as input from webcam and convert it to frame.
- Accurately measure all the features to detect drowsiness like –

  Facial Landmark Detection.

  Eye and Mouth Detection.

  Eye Aspect Ratio

  Yawn Detection
- Share location to near and dear person.

The strong point of this proposed system is that –

- The location of the driver will be sent to his / her near and dear one so that in case of any accident with the driver, the person near and dear to him will come to know about the driver on time.
- The alarm warning will be deactivated manually rather than automatically. This will ensure the driver's activation as until he sets off the alarm, the alarm will not go off.

4.3 METHODOLOGY

The main challenge of detecting drowsiness will be to determine fatigue by facial expression and to measure it. To do this, the project will detect drowsiness in real time by determining the driver's eyes and mouth. Driver face monitoring system will check the physical state of the driver based on the processing of the driver face image. Driver’s fatigue status will be detected from eyelids closure, eye blinking, distance between eyelids and yawning in this proposed system. And if the driver gets tired, the system will generate an alarm until the driver becomes alert and regains consciousness. Driver fatigue will be detected from the eye area and signs of fatigue will be detected not only from the eye area but also from the mouth, including yawning.

The stages of the proposed system will be described in Fig.4.1 through a flowchart.

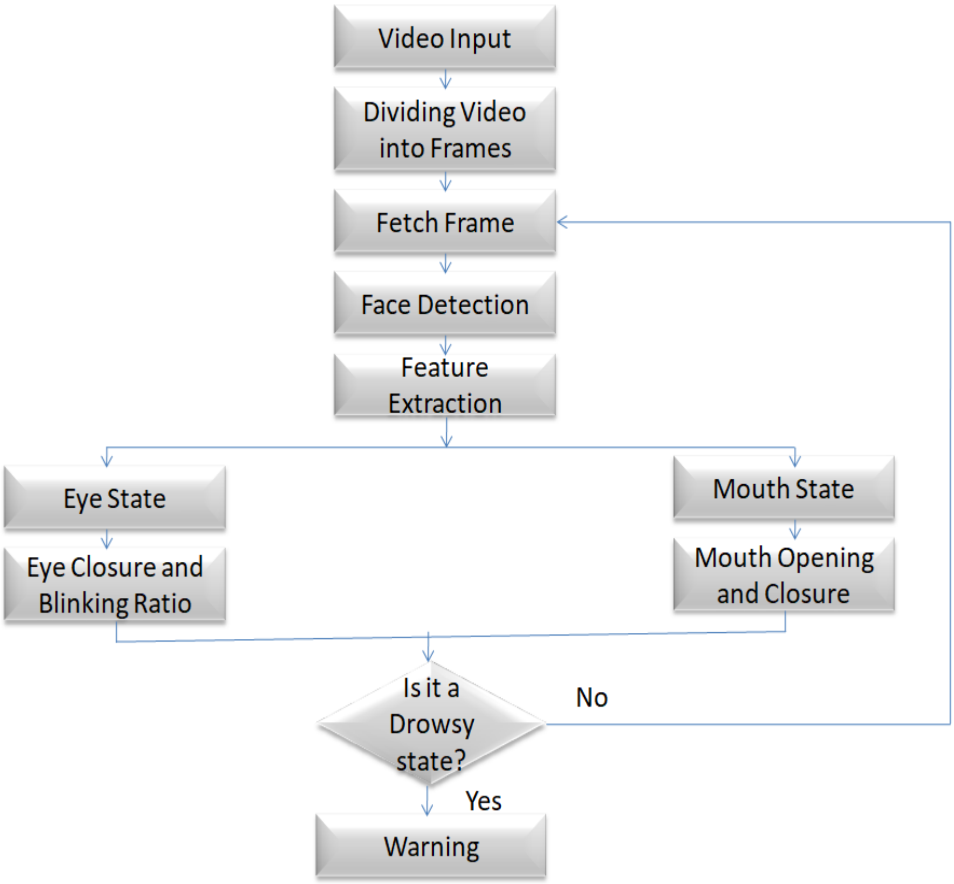

Fig.4.1 (Flowchart of Proposed System)

As a first step, the real time video will be taken as an input and then the video will be divided into several frames and the frame will be used for further processing. In second step, the system will locate the face area and facial landmarks from the frame. And then features will be extracted from facial components and landmarks. After the localization of the driver's facial features, the next challenge will be to find out the state of eyes and mouth. The blinking ratio will then be determined. Detection of eye state is not a sufficient factor to determine fatigue and drowsiness, yawning detection is also an essential feature for this. In the yawning position, the mouth becomes wider and the geometric features of the mouth change. When the mouth will begin to open, the value of threshold pixel will increase compared to the normal state of the mouth, which is nothing but yawning. If one or both of the two conditions will occur (eyes closed and yawning), the system will define it as a state of drowsiness and a warning alarm will be turned on and it will remain on until the driver would have come in a normal state. If the system will not find the driver in drowsy state then it will continue to receive frames and perform further processing. Also the location of the driver will be sent to his / her near and dear one so that in case of any accident with the driver, the person near and dear to him will come to know about the driver on time.

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PROPOSED PROJECT ACTIVITY CHART