International Journal of Research in Engineering, Science and Management
Volume-3, Issue-1, January-2020
www.ijresm.com | ISSN (Online): 2581-5792

Driver Visual Drowsiness and Attention Analysis System

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***Abstract*: The development of technologies for preventing drowsiness at the wheel is a major challenge in the field of accident avoidance systems. Driver fatigue resulting from sleep deprivation or sleep disorders is an important factor in the increasing number of accidents on today's roads. In proposed system method for detecting drowsiness will be implemented with the help of web camera facing towards drivers face for video capturing. Once the video is captured, monitoring the face region and eyes in order to detect drowsy/fatigue. The system is able to monitor eyes and determines whether the eyes are in an open position or closed state. In such a case when drowsy is detected, a warning signal is issued to alert the driver. The purpose of this project is to advance a system to detect fatigue symptoms in drivers and produce timely warnings that could prevent accidents. Proposed system presents an approach for real-time detection of driver visual drowsiness and attention analysis mechanism.**

***Keywords*: SVM, ACC, LDW.**

1. Introduction

Safe driving is a major concern of societies all over the world. Thousands of people are killed, or seriously injured due to drivers falling asleep at the wheels each year. Recent studies show those drivers' drowsiness accounts for up to 20% of serious or fatal accidents on motorways and monotonous roads, which impair the driver's judgment and their ability of controlling vehicles. Sleep deprivation and sleep disorders are becoming common problems among car drivers these days. A significant portion of the accidents occurring on highways is due to driver fatigue.

A system that can detect oncoming driver fatigue and issue timely warnings could help prevent many accidents, and consequently save money and reduce personal suffering. There are many indicators of oncoming fatigue, some of which can be detected using a video camera. Therefore, it is essential to develop a real-time safety system for drowsiness-related road accident prevention. Many methods have been developed and some of them are currently being used for detecting the driver's drowsiness, including the measurements of physiological features like EEG, heart rate and pulse rate, eyelid movement, gaze, head movement and behaviours of the vehicle, such as lane deviations and steering movements. Among those different technologies, ocular measures, such as eye-blinking and eyelid closure, are considered as promising ways for monitoring alertness. One of the symptoms that we try to detect is the micro-sleep. Micro sleeps are short periods in which the driver loses consciousness.

There are many technologies for drowsiness detection and can be divided into three main categories: biological indicators, vehicle behaviour, and face analysis. The first type measures 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. They are intrusive. Thus, they are not practical. The second type measures vehicle behaviours such as speed, lateral position and turning angle.

These techniques may be implemented non-intrusively, but they have several limitations such as the vehicle type, driver experience and driving conditions. Furthermore, it requires special equipment and can be expensive. The third type is face analysis. Since the human face is dynamic and has a high degree of variability, face detection is considered to be a difficult problem in computer vision research.

As one of the salient features of the human face, human eyes play an important role in face recognition and facial expression analysis. In fact, the eyes can be considered salient and relatively stable feature on the face in comparison with other facial features. Therefore, when we detect facial features, it is advantageous to detect eyes before the detection of other facial features. The position of other facial features can be estimated using the eye position.

2. Background

Typically, after long 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. In an image fatigue detection, correct and real time decision is important. Therefore, in this project eyelid closure is chosen to be the method for drowsiness detection when driving. The input to the system are images from a video camera mounted in front of the car, which then analyses each frame to detect the face region. The face is detected by searching for skin colour-like pixels in the image. Then a blob separation performed on the grayscale image helps obtain just the face region. In the eye-tracking phase, the face region obtained from the previous stage is searched for localizing the eyes using a pattern-matching method. Templates, obtained by subtracting two frames and performing a blob analysis on the difference grayscale image, are used for localizing the driver's eyes. The eyes are then analysed to detect if they are open or closed.

If the eyes remain closed continuously for more than a certain number of frames, the system decides that the eyes are closed and gives a fatigue alert. By monitoring the eyes, it is believed that the symptoms of driver fatigue can be detected early enough to avoid a car accident. Detection of fatigue involves a sequence of images of a face, and the observation of eye movements and blink patterns. The main focus is on the detection of micro-sleep symptoms. This is achieved by monitoring the eyes of the driver throughout the entire video sequence. The three phases involved in order to achieve this are the following:

1. Localization of the face,
2. Tracking of eyes in each frame, and
3. Detection of failure of tracking.

3. Literature survey

A. S. M. Asaduzzaman [1] developed a fuzzy-control massage seat to keep drowsy drivers awake. A non-intrusive prototype computer vision system has been proposed for monitoring driver's attentiveness in real-time. T. Kasukabe [3] developed a system with visual, cognitive, and decision making functions for elderly drivers to recognize various objects encounter during driving. Lee et al. [4] proposed a system with two fixed cameras to capture images of the driver and the road respectively, and then the images are mapped to global coordinates to monitor the driver sight line.

Zhao et al. [5] studied the reliability of steering behaviour to detect driver fatigue by multi wavelet packet energy spectrum using a support vector machine (SVM). Lee et. al. [6] developed a video sensor based eye-tracking and blink-detection system with Haar-like features and template matching for an automated drowsiness warning system. In addition, Yang demonstrated that drowsiness has a greater effect on rule-based driving tasks than on skill-based tasks using a Bayesian Network (BN) paradigm through simulator-based human-in-the-loop experiments.

Proposed a latent variable to represent the attributes of individual drivers for recognizing the emotional state of drivers using four sensors, specifically for respiration, skin conductance, temperature, and blood pressure. Among these methods, the techniques that are best, based on accuracy are the ones based on human physiological phenomena Weir wille, W.W. [7]. This technique is implemented in two ways: measuring changes in physiological signals, such as brain waves, heart rate, and eye blinking; and measuring physical changes such as sagging posture, leaning of the driver's head and the open/closed states of the eyes.

Qiang Ji [8] developed a traffic-simulation model in which a vehicle is equipped with an adaptive cruise-control (ACC) and lane departure warning (LDW) system to monitor driver behaviour in a real traffic environment. The first technique, while most accurate, is not realistic, since sensing electrodes would have to be attached directly onto the driver's body, and hence be annoying and distracting to the driver. In addition, long time driving would result in perspiration on the sensors, diminishing their ability to monitor accurately. The second technique is well suited for real world driving conditions since it can be non-intrusive by using optical sensors of video cameras to detect changes.

G. N. Keshava [9] Driver operation and vehicle behaviour can be implemented by monitoring the steering wheel Movement, accelerator or brake patterns, vehicle speed, lateral acceleration, and lateral Displacement. These too are non-intrusive ways of detecting drowsiness, but are limited to Vehicle type and driver conditions. The final technique for detecting drowsiness is by monitoring the response of the driver. This involves periodically requesting the driver to send a response to the system to indicate alertness.

R. L. Lai [2] the problem with this technique is that it will eventually become tiresome and annoying to the driver. Able to arouse driver's attention with appropriate lights and sounds. Do not interfere or cause potential distraction of driver. Respond effectively to the control signal in terms of flashing format variation. The eyelid distance should be completely extracted from simple images. The detection should work both at daytime and night. Able to effectively detect the sleepiness of the driver.

4. Proposed system

Main aim and the objective of the system is to real time monitor the driver face through camera and monitor his eye, head motion abnormality and conclude the drowsiness if found with the help of analysis and standard comparison.

To make sure that it is the face region that is detected, and not the background that might have skin-like color, the system checks if the area detected as skin has a minimum area (number of pixels). During tracking, the eye templates are matched with the face region to locate eyes. The match scores for the eyes detected are checked continuously.

If the match scores for both the open and closed eyes fall below a certain threshold, the system decides that there is an error in tracking and goes back to face detection again. The eyes can be detected with fair accuracy unless there is large head-bouncing movement. Further, to ensure correctness in the detection of the eyes, the information about the horizontal alignment and the minimum distance between the two eyes is used.

Steps Involved:

- The first step is the image acquisition which is done by using video camera which takes the video of the driver and convert into image frames.
- The second step is the face detection.
- The third step is selection of eyes detection area.
- Now the Eye detected area is to be converted into grey image to find the edges of the eye region.
- By seeing the edges of the eye or width of the eyes, the processor will decide the drowsiness & it will send alert notification to the system.

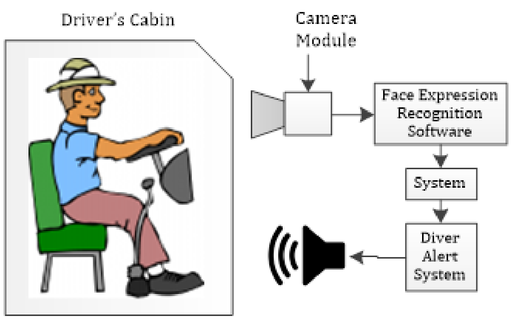

Fig. 1. Block diagram

- Detection of driver drowsiness by analyzing the eye movement with respect to time and alerting user in multiple mode.
- Creating an interaction between computer system and embedded system to demonstrate the system.
- Modes,
- First level: generate a beep sound to alert user
- Second level: slow down the proposed car model speed
- Third level: Send an alert SMS to predefined person.

A. Proposed Approach

Camera can see everything, but we need only face area to process upon and to get exact desired output. Face detection can be called as normalization process in face identify or face expression detection. By identifying the skin color pixel cluster we can get the face area. Skin color has no fixed RGB value but it has fixed shade or tone. Identifying the face area and crop it for further processing. It will speed up the processing speed as now we need to process very small area. It will also increase accuracy as we have exact data to compare with pattern.

Locating the position of the eye is a difficult task as different features define the same eye depending, for example, on the area of the image where it appears and on the color of the iris, but the main problem that occurs when driving is the changes in the ambient lighting.

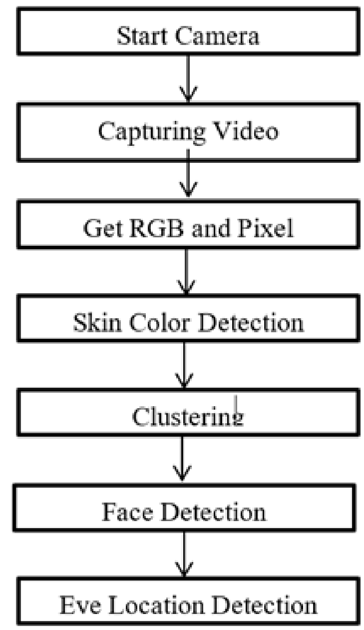

Fig. 2. Flow diagram for face detection and eye location system

5. Conclusion

It is seen that the method of detecting alertness on the basis of image recognition accurately traced the changes that occurred in the alertness level with elapsed time. Using the method of counting the number of eye closures, alertness levels were determined for facial image records obtained for several subjects. The foregoing results thus confirmed that the drowsiness detection system based on image recognition can provide detection performance close to that of techniques using physiological signals, even though it is a noncontact method. This indicates that the system is capable of early detecting the initial stage of drowsiness and accidents can be avoided. One factor that can be considered is the discrepancies between the timing for changes in alertness levels and the time when alertness judgments are made.

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