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Driver fatigue detection and accident preventing system

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ABSTRACT

In today's availing conditions many traffic accidents have been occurring due to driver's fatigue or diminished vigilance level. Driver fatigue detection based on computer vision is one of the most hopeful applications of image recognition technology. There are several factors that reflect driver's fatigue. The eye is the most important feature of the human face. In this paper, we describe a system that locates and tracks the eyes of a driver and finds drivers fatigue and turns on the adaptive cruise control system. The purpose of such a system is to perform detection of driver fatigue by mounting a small camera inside the car, we can monitor the face of the driver and look for eye-movements which indicate that the driver is no longer in condition to drive and turns on the ACCS. Finally, experiment results show that the proposed fatigue monitoring system detects driver fatigue probability more exactly and robustly and sends the signal to ACCS.

Keywords: *Driver's fatigue, Pupil detection, Cruise control system.*

1. INTRODUCTION

Most of the traffic accidents all over the world have been occurring either due to fatigue or diminished driver's vigilance level [1] and these factors has become a serious problem for the society and pose serious threat to their lives if unresolved Fatigue of the driver is defined as a mental or physical exhaustion due to which he/she either feels drowsy or cannot respond appropriately to the situation. Many efforts have been taken for developing an active safety system for reducing the number of automobiles accidents due to diminished vigilance levels. For this reason, developing systems that actively monitors the driver's level of vigilance and alerting the driver of any insecure driving condition is essential for accident prevention.

In general, there are two different approaches used in these systems:

a) Intrusive techniques: which require physical contact with the drivers that measure physiological conditions, like brain waves, heart rate, and pulse rate.

b)non-intrusive techniques: are the techniques that monitor visual bio-behaviors, like head position, facial expression, eye openness, eyelid movement, gaze, also speed, moving course, turning angle, lateral position;

According to the information sources [7][8], these possible techniques for detecting fatigue in drivers can be broadly divided into three major categories as follow:

1) Drivers' physiological parameters- *based fatigue detection.* The best and accurate detection techniques are based on drivers' physiological parameters like brain waves, heart rate, pulse rate and respiration. But these techniques are intrusive and these sensing electrodes would have to be attached directly on to the driver's body, and hence be annoying and distracting to the driver.

2) Fatigue detection based on driving performance. Driver fatigue can also be characterized by the behaviors of the vehicle. Signs of driver fatigue can be found by monitoring the transportation hardware systems, such as the changes of the steering wheel, vehicle lateral position, driver's grip force on the steering wheel, acceleration, vehicle speed, acceleration, braking and turning angle, etc. While these methods may be implemented non-intrusively as opposed to Drivers' physiological parameters- based measurements. They are subject to the vehicle type, driver experience, and general driving conditions.

3) Fatigue detection from visual cues. Monitoring eyelid movement and gaze by using a video camera is an established technique[2] for driver fatigue detection. People in fatigue exhibit certain visual behaviors that are easily observable from changes in facial features. Visual behaviors that typically reflect a person's level of fatigue include slow eyelid movement, a smaller degree of eye openness, frequent nodding, yawning, sluggish in facial expression, and sagging posture. Using a video camera to monitor the driver is also non-intrusive and become more and more practical and popular with the rapid development of camera and computer vision technologies. These techniques, however, do tend to be sensitive to external factors such as luminance or appearance of the driver (e.g. whether the driver is wearing glasses or not).

4) Adaptive cruise control system(ACCS): ACCS[1][5] is automatic vehicle speed control system which works by detecting the vehicle in front. If the visualized vehicle is very near by the vehicle that has ACCS, it automatically slows down the speed of the vehicle, and if it is not controlled by the driver and can make a crash, ACCS automatically stops the vehicle.

Proposed System:

Multiple visual cues are used to characterize the level of alertness of the driver. The visual cue used here is eyelids state information. By monitoring the eyes, it is believed that the symptoms of driver fatigue can be detected early enough to avoid a car accident.

These systems may fail to predict the driver's true state if the eyes are not detected due to varying lighting conditions or vibrations experienced in the real driving scenario. It happens because of their reliance on merely ocular parameters. Hence, it cannot be denied that an approach depending on different visual facial features will work more effectively than the one depending on just one feature. For this reason, our proposed system incorporates the eye state analysis to determine the fatigue level of the driver in real time. The computational overhead is reduced by decreasing the search area for the pupils.

In order to detect fatigue probability, the facial expression parameters must be extracted first. As fatigue level can be properly characterized by eye movements, a vision sensor is needed to recognize and track the eyes, a normal video-camera as a vision sensor can be use on the premise with the environment is bright enough. Here, eye closing count in successive frames can be detected using a web camera. In real time implementation if 30 fps considered then it is observed that successive frames have the same information, so instead of considering all frames of video files, select frames such that which gives more information but less computational requirements. In this proposed system instead of analyzing complete frame of video file, eye portion is separated after detecting face area , the facial features in these regions are considered in detail and corresponding eyes closing count t can be obtained using correlation method for this type of Digital Image Processing filtering and segmentation process has to be carried out.

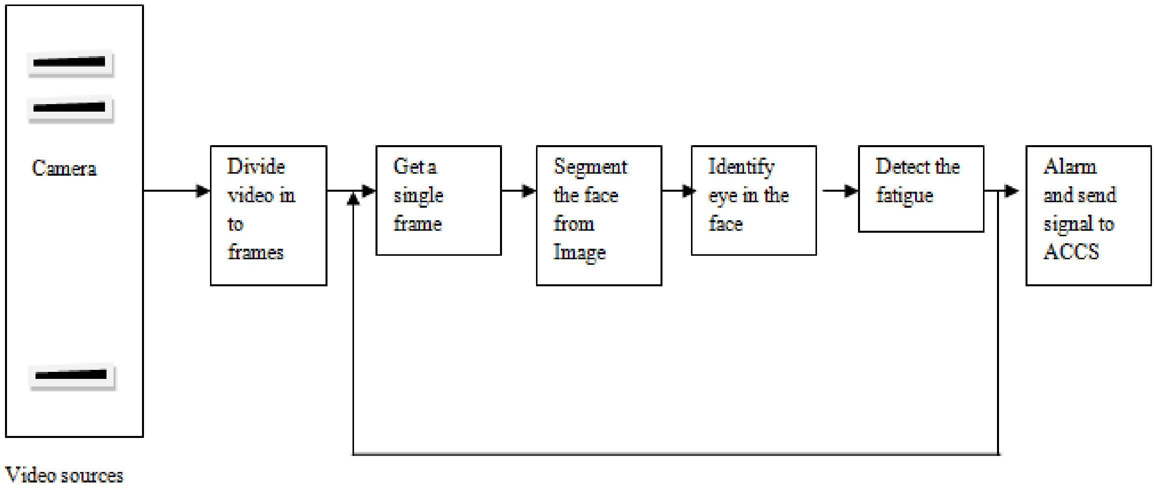

Figure 1: Block diagram for fatigue detection System

2. PROPOSED APPROACH

We present an algorithm that detects driver fatigue by analyzing changes in the eye state. The method proposed can be divided into the following phases:

- Image Acquisition
- Face Detection
- Pupil Detection
- Eye state Analysis
- Driver State Analysis

- Adaptive Cruise Control Activation

A. Image Acquisition

The purpose of this phase is to acquire video images of driver's face in real time so that directly observable visual cues could be gathered for fatigue determination [8]. The acquired images should be relatively invariant to light conditions and should facilitate pupil detection. They should provide enough information related to these visual bio-behaviors that typically characterize the driver's level of fatigue.

B. Face Detection

In order to collect the eye information and yawning information of the driver, the eyes are to be localized [8] first. But, since, it is a cumbersome task to look for these parts in the whole frame with changing light and background conditions; hence the area of search is reduced by looking first for the face in the video frame. Here first frames are obtained after analyzing the video files from which we gather the further details of eye closing count and yawn count using certain techniques of digital image processing.

C. Pupil Detection

The goal of pupil detection [1] task is to constantly monitor the eye state of the driver for determining his/her vigilance and fatigue level. Since eye's pupil shape is round in the whole face detect the ones that are round in the whole face. The only exception is the lady driver wearing a bindi. Calculate the radii of both and compare. Generally, the radius of bindi is less than the eye pupil. In this way, we can escalate the condition. It is generally observed as eyes get closed the shape starts becoming elliptical. Now the radii start changing hence we can conclude that the person is going to fatigue state. This further helps us in reducing the computing cost of the fatigue detection system and makes it a good candidate for real-time use.

D. Eye State Analysis

The decision of drivers fatigue depends on the eye state of the driver. Thus, the radii of eyes and width to height ratios are passed as features to certain classifiers for classification and use enhanced image processing techniques for classification like SVM machines [6].

E. Driver State Analysis

The state of the driver is determined based on the above observable results. If the observation finds that the person is yawning along with the closed or half-open eyes, it immediately concludes that the person is feeling fatigue and rings the alarm assuming the severity of the situation. If the system still detects the fatigue, automatic cruise control system [7] will be invoked to decrease the speed of the vehicle and stop in a further emergency.

F. Adaptive Cruise Control System

This system works by 2 modes, one by cruise mode, in which speed is controlled by setting some speed limit. Another by following mode, in which the speed of the vehicle is controlled to maintain a set distance [2][5] from the preceding vehicle. The block diagram of adaptive cruise control is given below. It works either by using LIDAR system or by RADAR [5] system.

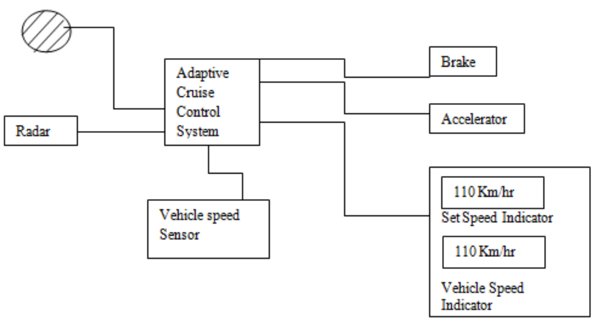

Figure 2: Block Diagram of Adaptive Cruise Control System

3. ALGORITHM

Step 1: Capture the Video from Webcam.
Step 2: Divide the video into frames.
Step 3: get a single Frame.
Step 4: Segment the face from the image.
Step 5: identify the Eye in the face.
Step 6: Analyze the Eyeball circle.
Step 7: If fatigue is detected, transmit the signal to ACCS, else go to next frame and start from step 4.

4. FLOWCHART

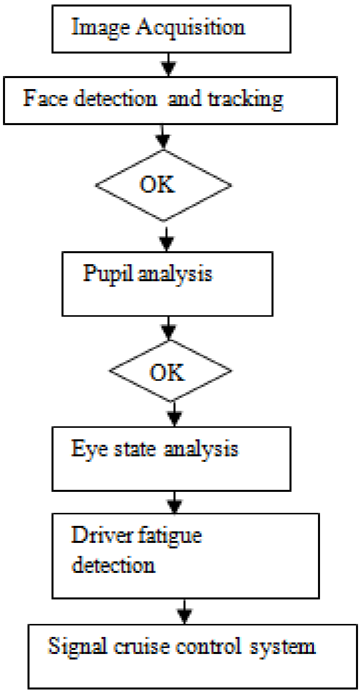

Figure 3: Flow chart for proposed System

System working Principle

In order to build this system, the first video should be processed and continuous frames should be generated. From extracted images, the face should be detected by using Haar-like feature based method [1] because of its high accuracy and faster execution. By using iris center localization, if the driver's fatigue is detected. Once the detection is done, the alarm will be sounded. The next continuous frames are checked for fatigue, if the fatigue is detected, then the control is transmitted to cruise control system which is received by the receiver.

5. CONCLUSION

This proposed system for monitoring driver fatigue can be implemented which detects the fatigued state of the driver through continuously monitoring the eyes of the driver and closely watches for driver safety. We generally can make use of Mat lab environment. But the proposed system does not work if the driver is wearing dark glasses. Hence certain techniques have to be incorporated into the system to make it work effectively.

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BIOGRAPHY

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