



# Non Intrusive Drowsy Driver Detection

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**Abstract :** 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 longer sufficient. In this paper we propose a new method for eye state analysis, in which we incorporate four step system for drowsiness detection: face detection, eye detection, eye state analysis and drowsy decision. Our novel eye detection first uses face detection to remove the background and then by using an eye detection method which uses brightness and roundness of the eye and iris it would detect whether the eyes are open or not.

**Key words :** face detection, eye detection, eye state analysis, drowsy decision.

## INTRODUCTION

Highlight a section that you want to designate with a certain style, then select the appropriate name on the style menu. The style will adjust your fonts and line spacing. Driver fatigue is a significant factor in a large no of vehicle accidents. It is an invisible killer for drivers. According to the National Highway Traffic Safety Administration (NHTSA), driving while drowsy is a contributing factor to 22 to 24 percent of car crashes. This record shows that car accidents caused by fatigue drivers is four- to six-times higher than near-crash/crash risk relative to alert drivers [1] as fatigue drivers fail to take correct actions prior to a collision. The National Sleep Foundation also reported that 60% of adult drivers have driven while felling drowsy in the past year, and 37% have ever actually fallen asleep at the wheel [2]. For this reason, a technique that can real-time detect the drivers' drowsiness is of utmost importance to prevent drowsiness-caused accidents. If drowsiness status can be accurately detected, incidents can be prevented by countermeasures, such as the arousing of driver and deactivation of cruise control. Ontario Ministry of Transportation's Driver's Handbook also mentions that "Drowsiness has been identified as a causal factor in a growing number of collisions resulting in injury and fatality. This is mainly due to the fact that driver fatigue impacts the alertness and response time of the driver thus increases the chances of getting involved in car accidents. Drowsy drivers may fall asleep at the wheel or tend to make serious – sometimes fatal – driving errors.

There are many technologies for drowsiness detection. They can be divided into three types: biological indicators, vehicle behavior, and face analysis [3]. 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 thus they are not practical. The second type vehicle behaviors such as speed, lateral position and turning angle are measured. 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. Although it can be less accurate than biological indicators, this type is non-intrusive and easily implemented. It can be employed independent of driver experience and vehicle type. Further, it is both more practical and accurate than vehicle behavior analysis. It is limited by lighting conditions and the driver's distance from the camera. In this paper, we present a new four step system for drowsiness detection which is fast enough and so accurate.

A driver who falls asleep at the wheel loses control of the vehicle, an action which often results in a crash with either another vehicle or stationary objects. In order to prevent these devastating accidents, the state of drowsiness of the driver should be monitored. The following measures have been used widely for monitoring drowsiness:

## LITERATURE REVIEW

**Vehicle-based measures**—A number of metrics, including deviations from lane position, movement of the steering wheel, pressure on the acceleration pedal, etc., are constantly monitored and any change in these that crosses a specified threshold indicates a significantly increased probability that the driver is drowsy [4],[5].

**Behavioral measures**—The behavior of the driver, including yawning, eye closure, eye blinking, head pose, etc., is monitored through a camera and the driver is alerted if any of these drowsiness symptoms are detected [6],[7],[8].

**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 [9],[10],[11],[12].

Other than these three, researchers have also used subjective measures where drivers are asked to rate their level of drowsiness either verbally or through a questionnaire. The intensity of drowsiness is determined based on the rating [13],[14].

## PROPOSED SYSTEM

In the first step, we detect face region by using a popular approach of utilizing support vector machines(SVMs) to crop the face region and remove the background. After detecting the face region, we detect eye region. It would be useful to detect the face before detecting the eye because in this way we would reach higher accuracy by omitting other objects which may be detected wrongly as the eye. Many works on eye detection have been used IR illuminators which can be dangerous for retina [3],[15],[16],[17] or required training data and used circle Hough transform [18]. As we are only interested in detecting the eye and not the exact position of it, it would be easier than eye tracking or gaze tracking.

After eye detection, we perform eye state analysis-determination of whether the eye is open or not. Orazio et al [18] used training data for closed eye detection. Our proposed method is based on the brightness of the eye and roundness of iris. This method can determine open or closed eye with a high accuracy without using any training data and IR source. Finally, we decide about drowsiness and give a warning message for drowsy state. In this paper we propose a system which does not require any special hardware and training data and also is fast enough and more accurate than pervious methods. Fig. 1 gives an overview of our proposed system.

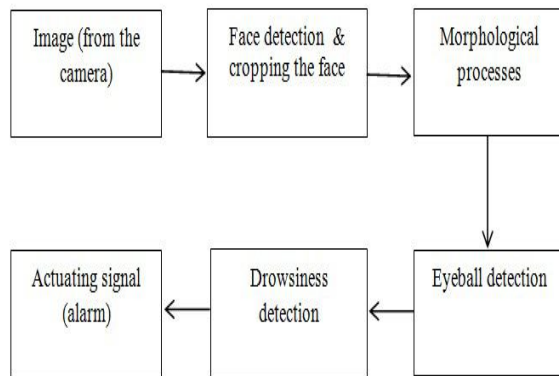


Fig 1: Diagram of the Proposed Drowsy Driver Detection

In our method we would first detect the face and crop the facial image which will isolate the face region from the background image and makes the eye detection more accurate because in this case instead of processing the whole image we would just focus on the facial image. We use a simple webcam which takes gray scale frames and by using a face detection library [19] we can accurately determine the position of the face and crop it. We can define a threshold for face detection which can be varied from -10 to 10 depend on the environment to reach better results. Another advantage of using face detection before eye detection is that you can use this system in higher distances which is not accessible in many previous works.

In this project we first used the system without enhancing face detection which resulted in about 95% accuracy [20]

which was not satisfactory but after enhancing face detection to our system the accuracy reached 97% when the eyes are open and 98% when the eyes are closed.

In the face detection processes we have used a new reduced set method for support vector machines (SVMs) which creates sparse kernel expansions that can be evaluated via separable filters. The detail of this method was described in [19].

## EYE DETECTION

After isolating the face from the background image, it is time to process the facial image to find the eyes in the cropped image. As we are using the grey scale images it is easy to separate the whole eye from the face by using its brightness and then after removing other parts of the face from the image we can use the roundness of the iris to determine the position of the eye. As we know the iris is the roundest object in the face so by defining two limits for the roundness we will check the roundness of the remained objects with these limitations and finally find the position of the eyes. Fig.2 shows a sample of detected eye. As we can see in this fig there are other detected objects that can be omitted by defining limitations for the roundness of detected objects and then by doing some morphological process the exact location of the eyes is determined. Fig.2 shows the detected eye by red circles. As can be seen in Fig.3 when the eyes are closed no round object is detected according to our definition and so no eye is detected.

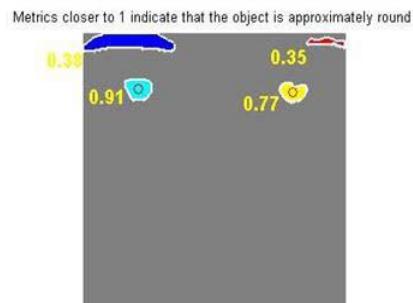


Fig 2: The eyes are detected and are separated by red circles at their center

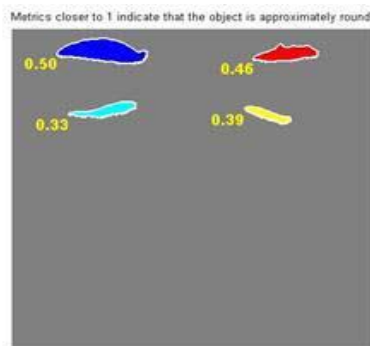


Fig 3: No eye is detected when the eyes are closed.

## EYE STATE DETERMINATION

Eye state determination is done by analyzing the existence of at least one eye in the processed image. When the pupil is covered by the upper eyelid, the person cannot see anything and in this case we would not be able to detect the eyes and so we would consider it as closed eyes. Detecting at least one eye is enough for us to make sure that the driver is not sleep. Typical blink duration is 0.3 s (approximate 9-10 closed eye image) for a non-drowsy person. We repeat this process for every one among ten frames to avoid blink which may causes a wrong response for the system.

## EXPERIMENTAL RESULT

We used a simple webcam with a resolution of 640×480 and we changed the light condition and the distance from the camera. With this proposed algorithm, we can achieve 97% accuracy for the open eye and 98% accuracy for the closed eye compared to other methods.

## CONCLUSION

In this paper we proposed a new algorithm for drowsy detection which uses face detection to reduce errors and then by a simple and confident method we detect the region of the eyes and their states. The advantage of this system is that by using face detection before eye detection the accuracy of the system would improve and also this method does not need any IR illuminators, training data or special camera.

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