# Face Detection for Drivers' Drowsiness Using Computer Vision

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*Abstract*— **In the present study, a vehicle driver drowsiness warning or alertness system using image processing technique with fuzzy logic inference is developed and investigated using MATLAB, but the processing speed on hardware is main constrained of this technique. The principle of the proposed system in this paper using OpenCV (Open Source Computer Vision) 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 are taken by a camera which is installed on the dashboard in front of the driver. An algorithm and an inference are proposed to determine the level of fatigue by measuring the eyelid blinking duration and face detection to track the eyes, and warn the driver accordingly. If the eyes are found closed for 5 or 8 consecutive frames, the system draws the conclusion that the driver is falling asleep and issues a warning signal. The system is also able to detect when the eyes cannot be found. Present paper gives the overview of the different techniques for detecting drowsy driver and significance of the problem, face detection techniques, drowsiness detection system structure, system flowchart, introduction to OpenCV. The proposed system may be evaluated for the effect of drowsiness warning under various operation conditions. We are trying to obtain the experimental results, which will propose the expert system, to work out effectively for increasing safety in driving. The detail of image processing technique and the characteristic also been studied.**

*Keywords*— **Drowsiness Detection, Face Detection, OpenCV, Drowsiness Monitoring, Warning.**

## I. Introduction

Due to the increase in the amount of automobile in recent years, problems created by accidents have become more complex as well [12]. The official investigation reports of traffic accidents point out those dangerous driving behaviors, such as drunk and drowsy driving, have taken a high proportion among all the accidents, it is necessary to develop an appropriate driver drowsiness and alertness system that can directly improve the driving safety [13].

However, several complicated issues are involved with keeping an eye on drivers all the time to wipe out all possible hazards. Driver fatigue is a significant factor in a large number of vehicle accidents. Recent statistics estimate that annually 1,200 deaths and 76,000 injuries can be attributed to fatigue related crashes [12]. The development of technologies for detecting or preventing drowsiness at the wheel is a major challenge in the field of accident avoidance systems. Because of the hazard that drowsiness presents on the road, methods need to be developed for counteracting its affects. The aim of this paper is to develop an algorithm for drowsiness or alertness detection system. The focus will be placed on designing a system that will accurately monitor the open or closed state of the driver's eyes in real-time [5]. By monitoring the eyes, it is believed that the symptoms of driver fatigue can be detected early enough to avoid a car accident [3] [5] [6].

Detection of fatigue involves a sequence of images of a face, and the observation of eye movements and blink patterns. The analysis of face images is a popular research area with applications such as face recognition, virtual tools, and human identification security systems [3]. This paper work is focused on the localization of the eyes, which involves looking at the entire image of the face, and determining the position of the eyes, by a proposing well image processing algorithm. Once the position of the eyes is located, the system is designed to determine whether the eyes are opened or closed, and detect fatigue.

This paper proposes a computer vision based driver drowsiness system, use of OpenCV in image processing, interfacing of web camera to OpenCV, Haar classifiers like feature based face detection methods, eyelid identification, and developing alertness system using eyelid status to warn the driver accordingly by providing an alarm.

The remainder of this paper is organized as follows. Section II describes the different techniques for detecting drowsy driver and significance of the problem. In Section III describes proposed system structure, system flowchart and introduction to OpenCV. In Section IV describes the interfacing of web camera to OpenCV. Section V Haar classifiers like feature based face detection techniques. In Section VI describes the results and finally we make conclusion in Section VII.

## II. Drowsiness detection techniques

There are several types of drowsiness detection but possible techniques for detecting drowsiness in drivers can

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be generally divided into the Following categories: sensing of physiological characteristics, sensing of driver operation, sensing of vehicle response, monitoring the response of driver [11].

### A. *Monitoring Physiological Characteristics*

From all the methods, the techniques that are best, based on accuracy are the ones based on human physiological phenomena [12]. 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 status of the eyes [4].

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.

### B. *Remaining Methods*

Driver operation and vehicle behavior 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 [11].

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. The problem with this technique is that it will eventually become tiresome and annoying to the driver [7].

### C. *Significance of the Problem*

i) A drowsy/sleepy driver is unable to determine when He/she will have an uncontrolled sleep.
ii) Fall in sleep crashes are very serious in terms of injury Severity.
iii) An accident involving driver drowsiness has a high fatality rate because the perception, recognition and vehicle control abilities reduces sharply while falling asleep.
iv) Driver drowsiness detection technologies can reduce the risk of a catastrophic accident by warning the driver of his/her drowsiness.

## III. PRPOSED SYSTEM STRUCTURE AND SYSTEM FLOWCHART

Day by day there is great improvement on Microprocessor in recent years; a large, 2D image can be easily process by a these microprocessor. To process this image, the MATLAB can be used. The image analysis techniques using MATLAB have been greatly accepted and applied. But problem when it will work on real time video bit stream or frames of images from video, it takes very long processing time to process these images and hence system can fail with real time.

The solution of this long processing time is proposed in this paper. Figure 1 shows vision based driver alertness system structure. Figure 2 shows the flow chart of the entire process analyzing whether a warning should be signaled. The proposed design is implementing with the help of OpenCV.

Microsoft Visual Studio Express Edition 2008 is the plat form to be used for OpenCV library. First, the system obtains images from video bit stream of driver's face by an imaging system i.e. CCD camera or Digital camera, which is installed on the dashboard in front of the driver. Then the acquired face is cropped to locating only eye. By determining the eye area for each image, the first face is detected then the upper and lower eyelids are extracted. Using eyelid, the system detects eye-blinks i.e. eye opening and closing of the driver. Finally, using the eye-blink information, the system presumes how much drowsiness the driver is felling.

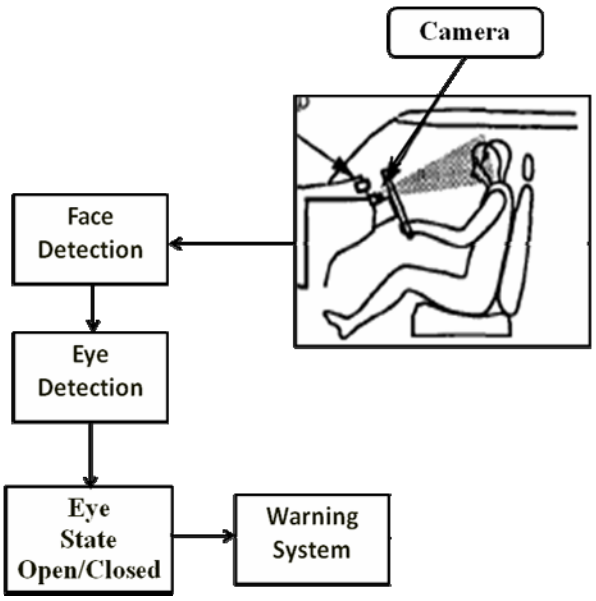


Fig. 1 Vision Based Driver Alertness System

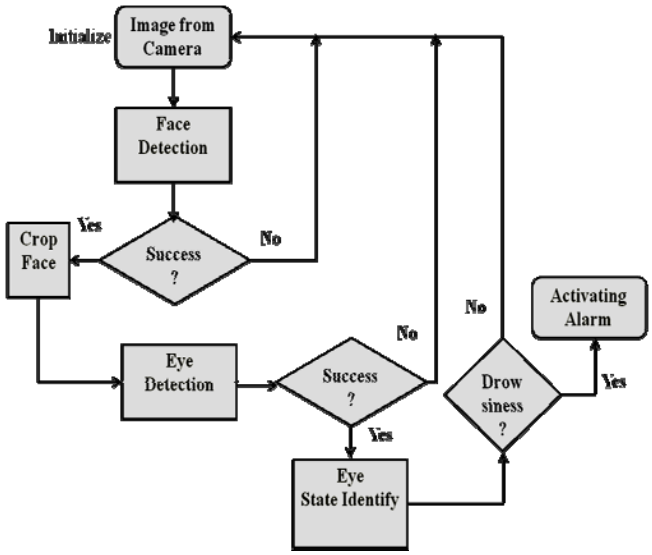


Fig. 2 Flowchart of the System

### A. *Introduction to OpenCV*

OpenCV stands for Open Source Computer Vision Library includes over 500 functions implementing computer vision, image processing and general-purpose numeric algorithms [2]. Portable and very efficient implemented in C/C++. Has BSD-like license that is, absolutely free for academic and commercial use [15].

OpenCV because of Computer Vision Market is large and continues to grow. There is no standard API (like OpenGL and DirectX in graphics, or Open SSL in cryptography), most of CV software is of 3 kinds:

i) Research code (slow, unstable, independent, incompatible data types for every library/toolbox)
ii) Very expensive commercial toolkits (Like Halcon, MATLAB + Simulink, etc)

Specialized solutions bundled with hardware (Video surveillance, Manufacturing control systems, Medical equipment). Standard library would simplify development of new applications and solutions much easier. Special optimization for Intel Architectures:

i) Creates new usage models by achieving real-time performance for quite "heavy" algorithms (like face detection)
ii) Makes Intel platforms attractive for CV developers.

## IV. Interfacing of Web Camera to OPVENCV

OpenCV library supports capturing image from a camera or a video file (AVI). To initializing capture from a camera the command is *cvCapture* capture = cvCaptureFromCAM (0)* is used; its meaning is capture image from video device # 0. Now capture frame from the video the command is *IplImage* img = 0.* OpenCV also supports the obtaining the images from several cameras simultaneously [2] [15].

## V. Face Detection Techniques

Face detection is the process of detecting faces in images or videos. Face detection in this project is carried out using the OpenCV library [14].

### A. *Method of Detecting Face Objects*

Haar-like classifiers are used for detection of the face in image or video. The classifier is better described as a cascade of boosted classifiers working with haar-like features.

i) Cascade – meaning the classifier consists of several simpler classifiers, called stages that are applied to a region of the image until the region is rejected by classifiers or passes all stages.
ii) Boosted – this means that the classifiers themselves at every stage are complex and are built from basic classifiers using different boosting techniques.
iii) Haar-like features – Haar is a wavelet transform that detects certain types of features. The OpenCV face detection algorithm uses these haar-like features shown in figure 3.

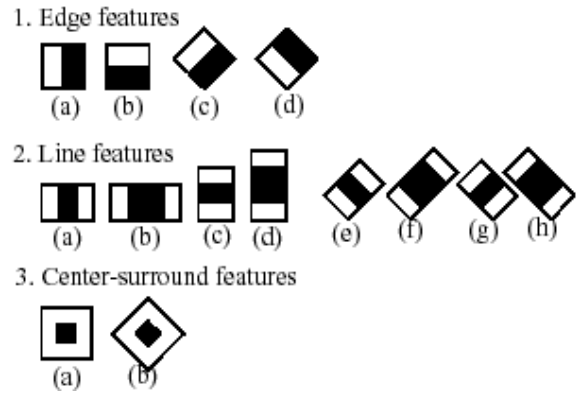


Fig. 3 Haar-like features used by OpenCV

OpenCV provides a number of object detection functions. First a dataset contained in the form of a XML file which is available within OpenCV called haarcascade_frontalface_alt2.xml is loaded in the memory. This file contains information about human faces. Once the

file is loaded, a function named cvHaarDetectObject is called. This function finds rectangular regions that are most likely faces in each image frame captured by a camera in real time, and the function returns those regions as a sequence of rectangles. Each time it considers overlapping regions in the image frame. It also applies some heuristics to reduce number of analyzed regions, such as Canny prunning. After it has proceeded and collected the candidate rectangles, it groups them and returns a sequence of average rectangles for each large enough group. The size of rectangles that represents faces is measured, and the largest rectangle is assumed to be the user's face. If the size of the face is greater than a threshold value, the system automatically logs in the user. Using this technique OpenCV can detect images that contain faces.

## VI. Result

This section describes the result of interfacing of Web Cam to OpenCV shown in figure 4 and face detection algorithm using haar-like classifiers features shown in figure 5:

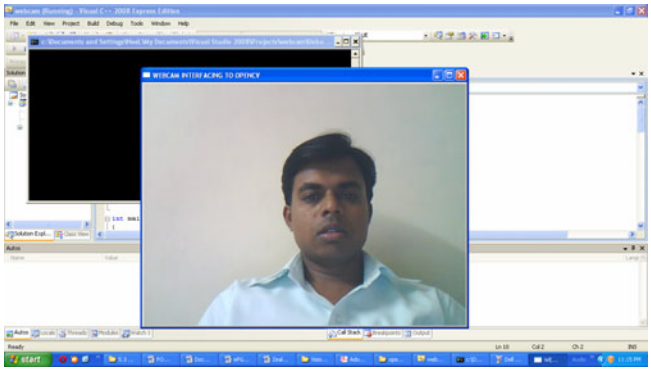

Fig. 4 Webcam interfacing to OpenCV

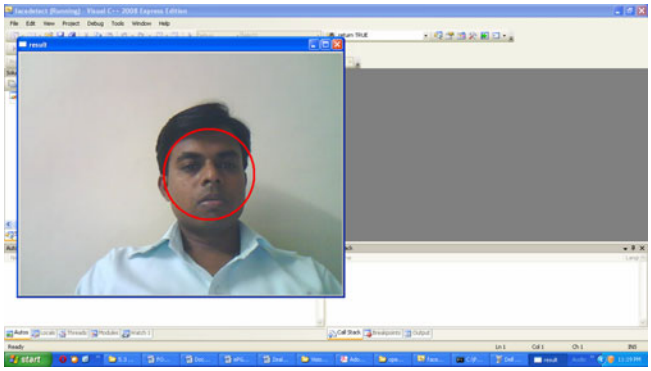

Fig. 5 Face detection using Haar-like features

## VII. Conclusion

In this paper, we proposed an image processing based system structure for face detection for drivers' drowsiness and for its alertness using computer vision. Image processing techniques with OpenCV can be achieves highly accurate and reliable detection of face. Using inbuilt function of library we tested the first initialization of web camera. The Haar-based classifiers features of OpenCv are used to detect the face from video bit stream. This algorithm was tested on Microsoft Visual Studio Express Edition 2008 platform.

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