Real Time Driver Drowsiness Detection system using Image processing

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Abstract: According to various studies and investigations it is noticed that one of the major cause behind the road accidents is driver's drowsiness. Thus, countermeasure device is currently essential in many fields for sleepiness related accident prevention. Real-time driver drowsiness system alerts users when they are falling asleep. The project is designed to combat narcolepsy and microsleep. Microsleep strikes quickly. Users probably don't even realize that they are in the process of falling asleep, and almost certainly don't notice that eye blinking for longer than usual. The implemented project is mainly based on three components 1) Face and Eye detection: Performs scale invariant detection using Haar Cascade Classifier perform through a webcam. 2) Eye feature extraction: Eye features are extracted using Hough Circle and 3) Extract single eye and perform drowsiness detection on it. Whereas the complete system is implemented on Raspberry Pi which uses a webcam to monitor user's eye blink rate and average blink duration to detect drowsiness. The project is designed for a car safety which helps prevent accidents caused by the driver getting drowsy.

Keywords — Drowsiness, Haar Cascade Classifier, Hough Circle, Image processing, Raspberry Pi .

I. INTRODUCTION

Drowsy driving is one of the major causes behind fatal road accidents. One of the recent study shows that one out of five road accidents are caused by drowsy driving which is roughly around 21% of road accidents, and this percentage is increasing every year as per global status report *on road safety 2015*, based on the data from 180 different countries. This certainly highlights the fact that across the world the total numbers of road traffic deaths are very high due to driver's drowsiness. Driver fatigue, drink-and-drive and carelessness are coming forward as major reasons behind such road accidents. Many lives and families are getting affected due to this across various countries. All this led to the development of Intelligent Driver Assistance Systems. Real time drowsy driving detection is one of the best possible major that can be implemented to assist drivers to make them aware of drowsy driving conditions. Such driver behavioral state detection system can help in catching the driver drowsy conditions early and can possibly avoid mishaps. Among these the major cause is due to driver errors and recklessness. Driver fatigue is cause behind such mishaps. Heavy traffic, increasing automotive population, adverse driving conditions, tight commute time requirements and the work loads are few major reasons behind such fatigue.With this paper, we are presenting technique to detect driver drowsiness using of Open CV, raspberry pi and image processing[1] .

In this paper, the different characteristics of drowsiness are described in Section II. Methodologies that are used for detection of Real Time Drivers drowsiness are introduced in Section III. This section motivates how face is detected and how eye detection is performed for automotive application and their detection is necessary for assessing driver

drowsiness. Section IV discusses the system architecture and introduces detection approach. Section V contains different experimentations. Results evaluating the approach are presented in Section VI. Finally, this study will be concluded in Section VII and Section VIII.

II. BACKGROUND

Several studies have shown various possible techniques that can detect the driver drowsiness. Such driver drowsiness detection can be measured using physiological measures, ocular measure and performance measure [2][3]. Among these physiological measure and ocular measure can give more accurate results. Physiological measure includes brain waves, heart rate, pulse rate measurements and these requires some sort of physical connection with the driver such as connecting electrode to the driver body. But this leads to discomfartable driving conditions. But ocular measure can be done without physical connection. Ocular measure to detect driver eye condition and possible vision based on eye closure is well suited for real world driving conditions, since it can detect the eyes open/ closed state non-intrusively using a camera [4].

In Real Time Driver Drowsiness System using Image Processing, capturing drivers eye state using computer vision based drowsiness detection systems have been done by analyzing the interval of eye closure and developing an algorithm to detect the driver's drowsiness in advance and to warn the driver by in vehicles alarm.

III. PROPOSED METHODOLOGY

A. *Face detection*

Open CV uses a face detection method developed in 2001 by Paul Viola and Michael Jones, commonly referred to as the Viola-Jones method which gives competitive object detection rates in real-time[7][8]. This method is mostly used in the face detection but can also be used for other object detections. There are four main components of Viola-Jones method for face detection framework 1.Simple rectangular features, called Haar features 2. An Integral Image for quick feature detection 3. Feature selection using AdaBoost and 4. Cascaded Classifier for rapid detection.

B. *Binarization*

Binarization is the first step to localize the eyes in the picture. Binarization is converting the image to a binary image. A binary image is an image in which each pixel is converted into a binary value which is '0' or '1'. The bright pixel will be represented with the value '1' whereas a dark pixel will be represented with '0'. Such binarization makes it easy to work on the image under detection. The grayscale image is converting to a binary image via thresholding. Thresholds are often determined based on surrounding lighting conditions, and the complexion of the driver.

C. *Circular Hough Transform*

The Hough Transform is an algorithm presented by Paul Hough in 1962 for the detection of features of a particular shape like lines or circles in digitalized images. Hough transform is a standard image analysis tool for determining parametric curves such as lines and circles. The circular Hough transform used to determine the radius and center of the pupil and iris[5] [6]. Also to detect the presence of a circular shape in a given image, detect any shape or to locate the iris in the face Hough transform can be applied.

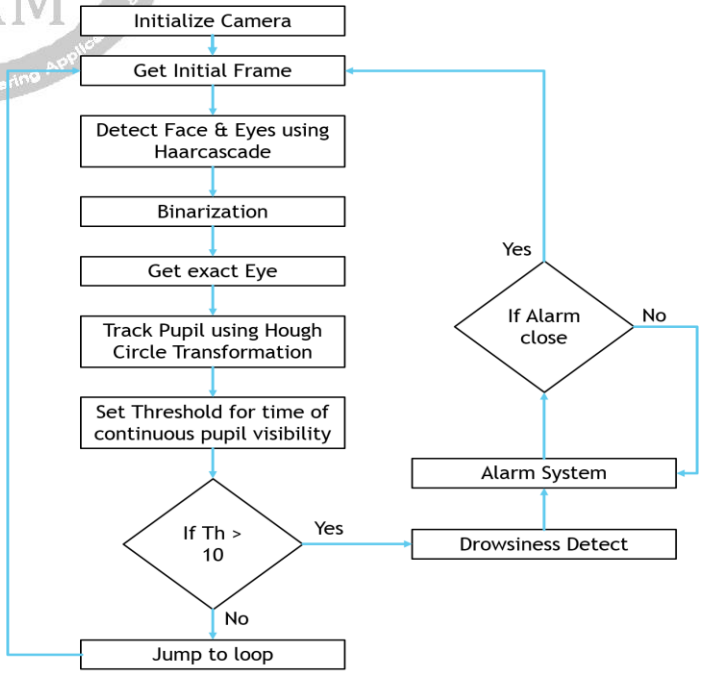

Fig 1: Methodology flowchart

Flowchart in Fig 1 explains the approach and logic used. The system starts with continuously capturing the images/frames. The proposed system will capture the continues images of driver's face and eye. The face and eye detection is based on the standard AdaBoost training methods along with Violas cascade approach using haar-like features [8]. Detecting the face and eye with such method is proven to be a faster and efficient way of eye detection. This method stays good even under improper/extreme light conditions, as long as the data captured and provided for training includes these conditions. The image of drivers face will be processed and the eye images will be derived out of it. Then the eye region along with the boundary of iris will be detected in the frame using Circular Hough Transform. Circular Hough Transform helps in extracting the circles with a center point (xc; yc) and a radius r. The CHT will detect bright spots based on the circles.

For initial open condition threshold value is set to zero, and loop is entered which will increment the threshold count if found eye closed. If conjugative frames found eyes were closed then threshold is increased and ones it reaches to a certain value (10) an alarm is activated. This is implemented to find out continues eye closure condition.

IV. SYSTEM ARCHITECTURE

The proposed system consists of three components:

1. Capturing: Camera mounted on the automotive dashboard captures the images of driver's face including eyes.

2. Processing and Detecting: Captured facial image is used to determine driver's eye i.e. open or closed. The driver's current eye state can be determined using HARR classifier cascades and Circle Hough Transform in OpenCV.

3. Signaling: In case of abnormal behavior that is drivers eyes found to be closed as a corrective action alarm signal will be raised. The Raspberry pi, a single board computer which is connected serially to the PC is responsible for the corrective necessary actions.

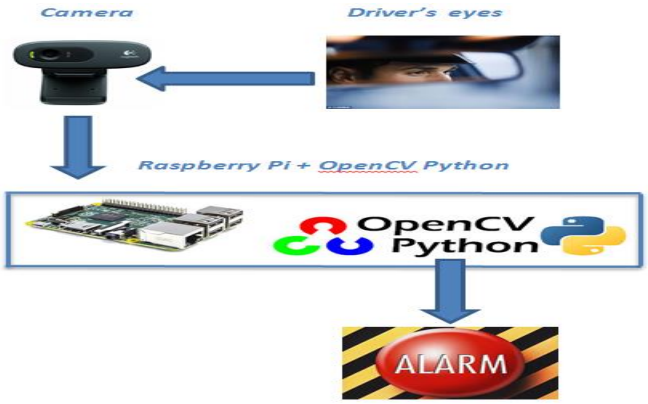

Fig 2: System Architecture

In the proposed system shown in Fig.2, the primary intent is to detect driver drowsy condition with real time by quickly processing the input data. The number of frames in which the eyes are found closed is monitored and counted. If the number of frames exceeds a threshold value, then a warning is generated showing that the drowsiness is detected. All these criteria have been well satisfied by choosing the system with the appropriate classifiers in OpenCV for eye closure detection. In this algorithm, first a driver's image is captured by the dashboard mounted camera for processing. In OpenCV, the drivers face detection from the captured image is carried out first, and then followed by the eye detection. Hough circle transform have been used to locate eye position on the face. With the eye detection technique we will only be able to detect the open state of eyes. The algorithm then counts the number of open eyes form each frame and determines the drowsiness. If the criteria are satisfied, then the driver is said to be drowsy. The buzzer connected to the system performs actions to correct the driver abnormal behavior. For this system, the eye and the face classifiers are required. The HARR Classifier Cascade files built-in there with the OpenCV contains different classifiers for the face and eye detection. The inbuilt OpenCV xml "*haarcascade_frontalface_alt2.xml*"and function "*Houghcircles()* " is applied on each captured frame to search and detect the face[9]. The face detection and open eye detection have been carried out on each frame of the driver's captured facial image. The variable Eyestotal is assigned to store the number of open eyes found in each frame. A variable will store the number of successive frames in which

the eyes found to be closed with the values like 0, 1, 2, 3… etc. Initially, this variable is set to 0. When both the eyes are open, then Drowsycount will be 0. Drowsycount will increase when Eyestotal < 2. For an eye blink, Drowsycount value be raised by 1. If the eyeblinks in more than 4 frames, i.e. variable count is greater than or equal to 4, then the condition for drowsiness is met and an alarm will be signaled at real time.

V. EXPERIMENTATION

The objective here is to read images and detect drowsy condition when eye is closed.

The very first step in this system is to detect the Face, Eye region and the Eye through OpenCV libraries, live video as a input to the system and get output as frame with face and region of interst, simulating the estimated result before actually implementing it to the hardware. The tests were conducted in various conditions including:

1. Different lighting conditions.
2. Drivers with spectacles.

Case 1: driver with normal eye

Fig 3 : Face detection result and Region of interest

Fig 4 : Cropped eye

Fig 5 : Images after Binarization and Thresholding

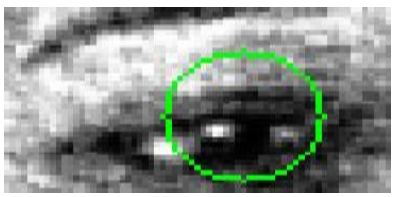

Fig 6 : Eye Detection result

Case 2: Driver is wearing spectacles

Fig 7 : Face detection result and Region of interest

Fig 8 : Images after Binarization and Thresholding

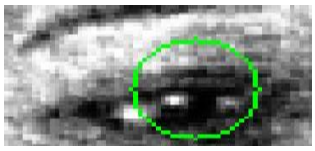

Fig 9 : Eye Detection result

As shown in screen snapshot, when the automobile driver is wearing spectacles, the face and eyes was successfully detected.

The following are some of the limitations of the proposed system.

1. The system fails, if the automobile driver is wearing any kind of sunglasses.
2. The system does not function if there is light falling directly on the camera.

VI. RESULTS

There are number of techniques used to improve the performance of the system as discussed earlier. Whereas the system is mainly focus on some parameter like speed and accuracy to improve the performance of the system. The previous studies shows that on 700 MHz it processes 15 frames/seconds but this system process on an average 20 frames/seconds working on 1.2 Ghz processor. Also the purpose of techniques used is to achieve the highest accuracy as explain in previous sections. Haar Cascade is used Adaboost, machine learning adaptive algorithm to improve the accuracy and performance of the system.

VII. CONCLUSION

The real time drowsiness detection system here to locate driver eyes and monitor them for fatigue is capable of detecting drowsiness in a rapid manner. The system is capable of differentiating a normal blink verses the drowsiness. Which can help preventing the driver from entering the state of sleepiness while driving? The system can be further improved and used in the automotives commercially. Based on the various images captured the knowledge is build which can help the system to decide the drowsy condition. Once the drowsy condition is identified the real time system issues an alarm. When such system is implemented in automotive this can reduce the risk of possible accidents due to drowsiness.

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