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DETECTING DRIVER DROWSINESS USING FACIAL RECOGNITION

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***Abstract*— Driver's fatigue and its indication is an active research area. Most of the conventional methods are either Drowsy driving is one of the major causes of road accidents and death. Hence, detection of vehicle based, or behavioural based or physiological based. Few methods are intrusive and distract the driver, some require expensive sensors and data handling. Therefore, in this study, a low-cost, real-time driver's drowsiness detection system is developed with acceptable accuracy. In the developed system, a webcam records the video and driver's face is detected in each frame employing image processing techniques. Facial landmarks on the detected face are pointed and subsequently the eye aspect ratio, mouth opening ratio and nose length ratio are computed and depending on their values, drowsiness is detected based on developed adaptive thresholding. Machine learning algorithms have been implemented as well in an offline manner.**

Keywords—Face Detection, Eye Detection, Eye Tracking, Feature Extraction, Machine Learning, Real time Processing, OpenCV, Drowsiness Detection

1. INTRODUCTION

Drowsy driver detection system is one of the potential applications of intelligent vehicle system. Driver fatigue is one of the main reasons causing traffic accidents. According to the National Highway Traffic Safety Administration (NHTSA) estimates, 100000 police reported crashes are directly cause by driver fatigue each year, which results in an estimated 1550 deaths, 71000 injuries, and $12.5 billion losses. In 2002, the National Sleep Foundation (NSF) reported that 51% adult drivers had driven a vehicle while feeling drowsy and 17% had actually fallen sleep.

The system will use a small security camera that helps to detect and track the drivers face, eyes and mouth. For the purpose of processing, four key measures will be used to help detect drowsiness, viz eye blink rate, eye closure duration and yawn detection. Each of these algorithmic components will be integrated into the main system, and their collective outputs will be compared with standard levels studied by research and help decide the level of drowsiness in the driver. In

case drowsiness is detected, an appropriate warning is issued to alert the driver through an appropriate audio signal.

This algorithm consists of two main parameters. They are Eye Aspect Ratio and Mouth Aspect Ratio. The EAR and MAR values are initially calculated for the drivers and a threshold level for both the eye and yawn can be obtained. This obtained EAR and MAR threshold value is continuously compared with real time video. If the real time EAR and MAR values jumps the threshold level, drowsiness is detected and it would trigger the alarm and also the vibrator. The vibrator will be placed either at the back side of the seat or under the seat. With the increasing pace of life and work the human beings have started compromising with the thing they need most, to efficiently function in a given situation i.e., adequate rest and sleep to be active while doing a task. Driver's drowsiness is a very cautious thing and has already led to a lot of mishaps. Some researchers even provide a data that nearly 1200 deaths and 76000 major injuries are caused due to the fatigue driver was facing which eventually led to a crash. With the help of modern-day technology and real time scanning systems using cameras we can prevent major mishaps on the road by alerting car driver who is feeling drowsy through a drowsiness detection system. By concentrating on the eyes, it has resulted that the onset of driver fatigue can be detected to avoid a car accident. Detection of drowsiness depends on the eye movements and time elapsed between blinks to help generate a score on which a driver is assessed if he is drowsy or not. To prevent these accidents, we have developed a system using python, OpenCV which works on the live feed of the driver through a webcam which is then processed to generate a score based on the time between eyes closing and opening and when eyes are closed for a long time the score starts increasing and also when the mouth is opened. When it reaches a certain mark, the alarm starts beeping alerting the driver and waking him up.

2.LITERATURE REVIEW

The authors proposed a real-time driver drowsiness detection system using OpenCV. They used a webcam to capture images of the driver's face, and then extracted features such as eye closure, head pose, and blink rate from the images. They used machine learning algorithms to classify the driver's state as drowsy or awake. The system achieved an accuracy of 92.5% in detecting driver drowsiness, Vivek Mahale [1]. They used a camera to capture images of the driver's face and used OpenCV to detect facial landmarks such as the eyes, nose, and mouth. They extracted features such as eye closure and head pose and used a Support Vector Machine (SVM) to classify the driver's state as drowsy or awake. The system achieved an accuracy of 90.6% in detecting driver drowsiness, Pragati Srivastava, [2]. They used a webcam to capture images of the driver's face and trained a convolutional neural network (CNN) to classify the driver's state as drowsy or awake. They achieved an accuracy of 96.7% in detecting driver drowsiness. The system also included a warning mechanism that alerted the driver if they were drowsy, A. Sivasangari, [3]. They used a camera to capture images of the driver's face and used OpenCV to detect facial landmarks such as the eyes, nose, and mouth. They extracted features such as eye closure and head pose and used a k-Nearest Neighbors (k-NN) classifier to classify the driver's state as drowsy or awake. The system achieved an accuracy of 91.8% in

detecting driver drowsiness, Tushar Singh Manchanda
H,[4]. In this work, we focus our attention on detecting driver's fatigue from yawning, which is a good fatigue indicator. We propose a system aimed at identifying yawning by measuring physical changes occurring in driver's mouth using circular Hough transform (CHT). The aim of this study is to develop an algorithm for yawning detection to monitor driver fatigue level, Mandalapu Sarada Devi,[5]. Advanced Driver Assistance Systems (ADAS) are the first step towards autonomous vehicles. They include systems and technologies designed to make more accessible the driver's attitude to prevent accidents and prevent an accident. My thesis project fits into this context, Nawal Alioua[6].

3.METHODOLOGY

PRE-PROCESSING:

The video is obtained from a camera focused on the driver's face. The processing rate of the acquired video is 25 frames per second. These frames are then flipped and converted to grayscale.

FACE DETECTION:

The Haar-based classifier contains several features such as heights, weights, face features, the threshold of face colors. It is constructed by using a lot of positive and negative samples. Based on the positive sizes, some of the features will be extracted. Based on the Haar detection, edge detectors are applied. Output from the edge detector is stored in an array. The cascade consists both positive and negative samples. Eyes and mouth features are extracted and parallel processing is preceded by successful driver's face detection. The pixels of the upper area of face are only considered as eyes are present there. The eyes are positioned just a few pixels below the top edge of the face. Edge detection is applied to the region marked in the previous step. Out of the detected objects, the object with the highest surface area and the second highest are obtained.

These are the first and second positive samples given that they are twenty pixels apart and not the same. These are the eyes of our driver.

FACIAL MAPPING USING DLIB:

The algorithm is implemented using Dlib python library that contains a landmark's facial detector with pre trained models. It estimates and maps a person's face in the form of facial points with 68 cartesian co-ordinates as shown in Fig.2. The 68-point iBUG 300 dataset was used to train the dlib facial landmark predictor and is the source of these markings.

This project focuses on two libraries OpenCV and dlib and also on a mathematical concept called eye aspect ratio (EAR):

(a) OpenCV:

OpenCV means Open-Source Computer Vision Library. It is an open-source library used for computer vision and machine learning functions. OpenCV is written in C++ and has cross platform support. Its C++, Python, Java and MATLAB interfaces support Windows, Linux, Android, iOS and Mac OS. OpenCV was developed to provide a common tool for developing computer vision applications and to increase the use of machine perception in the commercial products. OpenCV aims towards real-time vision applications.

(b) Dlib:

Dlib is a general purpose open-source software library and has cross platform support. It is a tool of C++ which consists of machine learning algorithms and several tools for creating complex software which can be used to solve real world problems. Its development has began in 2002 and it has grown to include a wide variety of tools. It has features to support networking, threads, graphical user interfaces, data structures, linear algebra, machine learning, image processing, data mining, XML and text parsing, numerical optimization, Bayesian networks, and many more. Since it is open-sourced, it can be used in any app development free of cost.

(b) Eye Aspect Ratio (EAR):

Eye aspect ratio is the ratio of height to width of the eye. When a face is given as input, python's dlib library outputs 68 points on the face

Fig-3.1

EYE ASPECT RATIO = Sum of vertical distance / 2* horizontal distance of Eye EAR FORMULA.

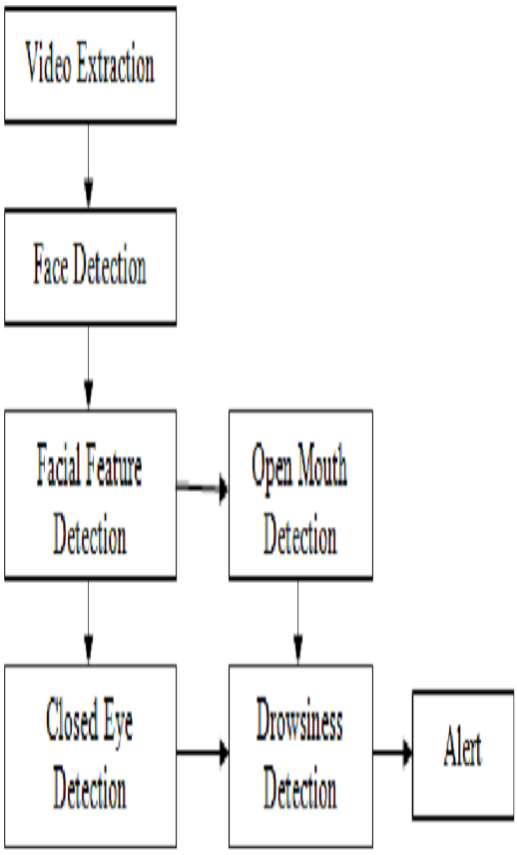
The more the EAR, the more widely eye is open. We would decide a minimum EAR value and used this to decide if the eye is closed or not.

EAR = ||P2-P6|| + ||P3-P5|| / 2*||P1-P4||

Yawn Detection:

Yawning is characterized by a widely opened mouth. Like the eye closure detection, the facial landmarks are used to detect an open mouth. The flowchart depicted in Fig. 3. describes the process of detecting the event of yawning from the instance a face is detected. Lip distance is the parameter used to determine if the subject's mouth is open. If the lip distance calculated from the frame is above lip distance threshold, the subject is determined to be yawning. An alarm is raised if the subject has yawned more than the set boundary value consecutively. Small openings that in reality are construed as a result of talking, eating is ignored.

Development Process



RESULTS

CASE 1: From the web camera live video is captured of the driver and image is converted into frames.

CASE 2: If eye aspect ratio (EAR) less than 0.3 then drowsiness is detected.

CASE 3: If mouth aspect ratio (MAR) more than 0.8 then yawning is detected. If not, again video is captured from the web camera.

CASE 4: If drowsiness is detected then driver gets alert with an alarm buzzer. Hence person will be saved from the road accidents.

Fig -3.2

4. CONCLUSION

The Drowsiness Detection Model is competent of detecting the sleepiness by keeping track of the eyes and mouth movements of the driver. The model deals with the eye's aspect ratio to detect the eye is open or close and mouth aspect ratio to detect the yawing. The alert is generated if the value of the detection counter exceeds the threshold value defines inside the driver code. The main focus for developing this project is to reduce the number of accidents which occur due to the sleepiness of the drivers.

5.ACKNOWLEDGEMENTS

Driver drowsiness detection using OpenCV as a valuable contribution to the field of computer vision and driver safety. The use of OpenCV, a powerful open-source computer vision library, has enabled the creation of an efficient and effective system for detecting drowsiness in drivers. The development of this system has required a great deal of expertise in computer vision, machine learning, and programming.

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