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Driver Distraction Detection Based on Eye Gaze

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Abstract

Nowadays vehicle accidents are most common if the driving is inadequate. Most of the accidents are caused due to mobile. NSTHA (National Highway Traffic Safety Administration) has stated that texting, browsing, and dialing is the reason for longest time of drivers taking their Eyes Off the Road (EOR) and increase the risk of crash by three times. Drivers easily get distracted by the activities happening around them such as texting, talking on mobile phone or talking to the neighboring person. In this project, a method is proposed to estimate the gaze of the driver and determine whether the driver is distracted or not. The system identifies the driver's Distraction or sleepiness and gives an alert to the driver as an assistance system. The camera placed in best position is chosen to be on the dashboard without distracting the driver. The system will detect the driver's face and eyes by using CNN that showed significant advantages regarding processing time and correct detection algorithms. The main aim of this project is to reduce the number of accidents caused by distracted driving.

Keywords--- *Driver's Distraction, Voila-Jones, Gaze Tracking, Head Position Estimation, Eye Detection.*

I.INTRODUCTION

The main target of eye gaze tracking based driver monitoring system is to reduce accidents caused by distracted driving. Distraction is mentioned as main cause in 78% of crashes and 65% of near-crashes in NHTSA (National Highway Traffic Safety Administration) study (2013). Distraction is a major factor in more than 20% of all accidents including fatalities and serious injuries.

Distracted drivers tend to decrease attention to important information needed for safe driving which makes them suffer from car accidents. NHTSA has classified driver distraction into four types as follows: auditory, visual, biomechanical and cognitive. Reasons for distraction can be driving after drinking alcohol, driving at night time, driving without taking rest, aging, fatigue because of continuous driving, long working hours and night shifts etc. Nowadays another concern for distracted driving is the use of mobile phones and other electronic devices while driving. NSTHA has stated that texting, browsing, and dialing is the reason for longest time of drivers taking their Eyes Off the Road (EOR) and increase the risk of crash by three times.

Proposed driver monitoring system based Eye gaze tracking and 3D head pose estimation can help in continuously monitoring and alerting driver in case of eyes off the road (EOR) or distraction and drowsiness. Implementing system which will give audio alerts and wheel vibration alerts depending on situation. To minimize the number of accidents caused by distraction is the motivation behind this project in order to improve traffic safety.

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II.LITERATURE SURVEY

This paper presents a prototype computer vision system for monitoring a driver's vigilance in real time. this process calculates six parameters as follows: Percent eye closure (PERCLOS), eye closure duration, blink frequency, nodding frequency, face position, and fixed gaze. using multiple visual parameters, the fusion of these parameters produce a more accurate inattention characterization than by using a single parameter. The system tested with different sequences recorded in driving conditions in a motorway and with different users. Some experimental results and conclusions about the performance of the system are presented. [1]

The system combines a head tracking system, and measures the gaze angle independently from the head pose. We show that the estimated measurement error angle do not vary when considering different head positions and directions of gaze and that the standard deviation stays within the desired accuracy. Finally, we discuss validity of the hypothesis we made on the eye model and the sources of inaccuracies. Possible tracks for further improvements include testing different infrared lights configurations, subpixel determination of both corneal reflections and pupil center, and subpixel stereo matching and integration of the Bruckner to detect when the eye fixates with the fovea directly into the camera with coaxial lighting.[2]

This paper proposes a robust eye detection system which uses face detection for finding the eyes region. The CHT(Circular Hough Transform) is used for locating the center of the iris. The parameters of the CHT are dynamically calculated based on the detected face information. A new method for eye gaze direction classification using SVM(Support Vector Machine) is introduced and combined with CHT to complete the task required. The CHT is used to locate the center of the eye irises. The proposed method uses color features of the detected eye region as inputs of Support Vector Machine classifier to determine the eye gaze direction.[3]

In this paper, we have proposed an efficient gaze area estimator based on a driver's head orientation. our method offers the following contributions.
1) To determine the driver's exact yaw, we proposed an elliptical face model alternative to cylindrical face model.
2) To find the driver's pitch reliably and efficiently, This paper presents a vision-based real-time gaze zone estimator based on a driver's head orientation composed of yaw and pitch.
3) this system proposed an efficient gaze estimation method based on the driver's head orientation using support vector machine.[4]

The face, an important part of the body, gives a lot of information. When driver is in a state of fatigue, facial expressions, e.g., the frequency of blinking and yawning, are different from those in the normal state.
We propose a novel system for evaluating the driver's level of fatigue based on face tracking and facial key point detection. We define the facial regions of detection based on facial key points. also, we introduce a new evaluation method for drowsiness based on the states of the eyes and mouth. [5]

In this paper, We proposed driver gaze direction estimation technique from smartphone video using computer vision methods. Categorizing the gaze space into eight common driving gaze directions enables fast extraction of relevant gaze. Fast feature descriptors and a linear support vector machine classifier are chosen to contain computational cost. Data collection procedure significantly improves generalization performance of the classifier across different driver/vehicle/camera settings without compromising driver safety or convenience.[6]

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the proposed paper presents a survey of the head pose estimation methods and systems that have been published over the past 14 years. This work is done by common themes, paired with the discussion of the advantages and disadvantages inherent in each approach. this paper presents a similar treatment for head pose estimation. The proposed algorithm is implemented in which the gaze of the person is estimated and the driver's attentiveness is detected by determining whether the driver is distracted or not. The algorithm has been implemented considering the frontal face images.[7]

In this paper, we presented an active appearance model and a fitting algorithm to track a driver's face, as a component for a driver alertness monitoring system. based on computer vision using active illumination. We test the tracker under different conditions where our previous tracking system fails or exhibits poor performance due to changing light conditions, occlusions, daylight or drivers wearing glasses. The algorithm is very efficient and able to run in real-time. Some experimental results and conclusions are presented.[8]

III. METHODOLOGY

A. Introduction

The gaze direction estimation of driver is implemented using different modules. Initially, face detection is done, and then accurate eye detection by using template matching method, further gaze estimation is done. The gaze of the driver is estimated as a measure of driver's distraction.

B. Face Detection using Viola-Jones algorithm

The input video or the images acquired from the camera are given to the haar cascade classifier after converting it to grayscale to detect the face. Viola-Jones algorithm needs positive images (images of face) and negative images (nonface images) to train the classifier. Haar features are used for this. To calculate these features, an integral image is used. Cascade classifiers are used to combine the features. If the input image passes through all the classifiers it strongly detects the face.
An USB camera is used to continuously track the facial landmark and movement of eyes and lips of the driver. This project mainly targets the landmarks of lips and eyes of the driver. For detection of sleepiness, landmarks of eyes are tracked continuously. Images are captured using the camera at fix frame rate of 20fps(frames per second). These images are sent to image processing module which performs face landmark detection to detect distraction and drowsiness of driver. If the driver is found to be distracted, then a voice (audio) alert is provided and a message is displayed on the screen. Following use cases are covered in this project

1.If eyes of driver are closed for a period of time then it is considered that driver is feeling sleepy and corresponding audio alarm is used to make the driver aware.
2.If the mouth of driver is open for the period of time then it is considered that driver is yawning and corresponding suggestion are provided to the driver to overcome drowsiness.
3. If driver don't keep eyes on the road then it is observed using facial landmarks and the corresponding alarm is used to make the driver

C. Video Capture

Video capturing is the process of converting an analog video signal produced by a video camera, DVD player, or television tuner to digital video and sending it to local storage or to external circuitry. The resulting digital data are mentioned to as a digital video stream, or more often, simply video stream. Depending on the application, a video stream maybe recorded as computer files, or sent to a video display, or both.

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D.Frame Processing

Frame processing based data is a common format in real-time systems. Data acquisition hardware often operates by accumulating a large number of samples at a high rate, and then propagating those samples to the real-time system as a block of data. This type of propagation maximizes the efficiency of the system by distributing the fixed process across over many samples; the faster data acquisition is suspended by slower interrupt processes after each frame is obtained, rather than after each individual sample is acquired.

E. Gaze Extraction

Eye gaze tracking and estimation Driver eye gaze is continuously changing during driving depending on surrounding conditions. Thus detecting eyes is not sufficient. Eyes need to be tracked in real time.so, Continuously Adaptive Mean Shift (CAMSHIFT) algorithm is used for real time eye tracking. Pupils of the eyes are tracked.

F. Classification

Classification is a process related to categorization, the process in which ideas and objects are recognized, differentiated and understood.

BLOCK DIAGRAM :

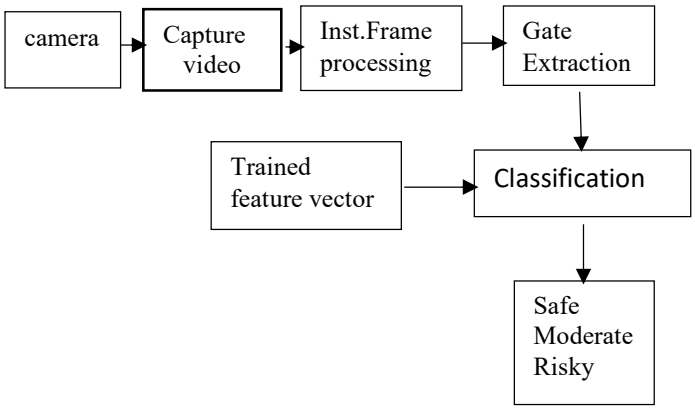

Fig 1: System Architecture

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FLOWCHART:

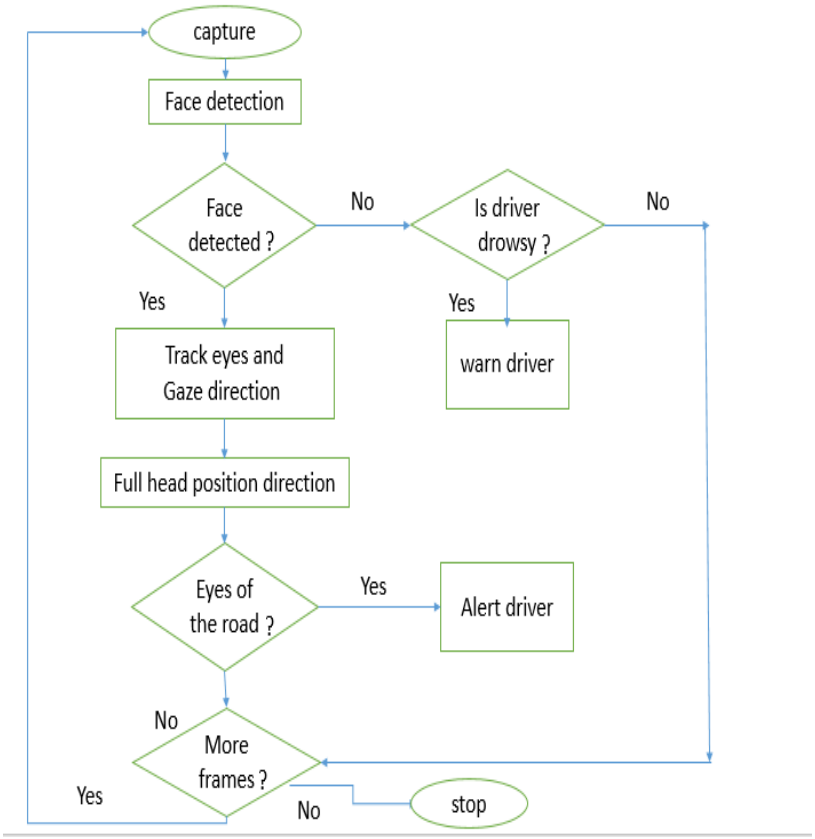

Fig 2: Flow Chart

IV.RESULTS AND DISCUSSIONS

The proposed system was implemented on Intel CPU. The algorithm was tested on input images of different datasets. The pixel intensity, shades near the eye region change depending upon the lightning conditions and time when the image is captured. For robust eye gaze estimation, the images were tested under different illumination conditions and a graph is plotted which displays the accuracy of correctly detecting the gaze under the different illumination conditions. It is tested on the input videos with frame rate 14 fps. The gaze is classified as left, right and the center. The gaze direction is displayed after every second in the videos. At the end of second, the result depends on the output of the previous frames. The number of occurrence of a particular direction was counted for every frame and the number was incremented for the next frames subsequently. The direction in which the person was gazing for more number of times that was taken as the direction after every one second.
True positive = No. of frames correctly detected /Total number of frames.
False positive = No. of frames incorrected detected /Total number of frames.

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V.CONCLUSION

The main goal of the system is to detect eye gaze direction and head pose direction. Another goal of this system is to detect drowsiness condition of driver and alert driver in both conditions. Viola Jones algorithm is implemented in OpenCV for rapid face detection with eyes extraction. Real time eye gaze tracking is proposed using CAMSHIFT algorithm. Pupil tracking is achieved Head pose estimation is proposed with AAM and POSIT algorithm. Different gaze zones are defined and eyes off the road can be detected by combining eye gaze and head position together. Fatigue detection is achieved by detecting closed eyes. If driver's eyes are off the road or if he is drowsy then alert will be generated. System is robust as two methods are combined to find gaze. If one method is failed to detect properly, then other method will work. System is also robust under night or low light conditions due to use of IR illuminators and build on raspberry pi to be compact and low cost.

VI. FUTURE SCOPE

The gaze estimation algorithm should be able to handle the head movements. The face detection algorithm needs to handle the head movements and needs to detect the face for all possible face orientations. The current gaze estimation is done only for frontal face images. The system can be extended to include non-frontal face images. The different roll, pitch angle of face images can be taken under consideration. The calculated gaze can be categorized into different viewing angles. The estimated gaze can be used to warn the driver. The system could warn the driver to pay attention whenever the drivers gaze gets fixated on position other than the road.

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