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Real-Time Driver Drowsiness Detection System Based on Visual Information

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Abstract:
With the rise in population, the occurrence of road accidents has been increasing. A recent study showed that, around half million accidents occur in a year, in India itself. Out of which 60% of these accidents are caused due to Driver Drowsiness. Our aim is to provide a driver drowsiness system which will alert not only the driver but also the co-passengers with a loud alarm in the car. For that we will be using face tracking and video processing.

Keywords: Driver Drowsiness System, Fatigue Detection, Face Detection, Eyes Detection and Tracking, EAR.

I. INTRODUCTION

Drowsiness is the state of feeling tired or sleepy. We all can be victim of drowsiness while driving, simply after too short night sleep, tired physical condition or during long journeys. Drowsiness is the state of feeling tired or sleepy. Driver fatigue affects the driving ability in the following 3 areas, a) It impairs coordination, b) It causes longer reaction times, and, c) It impairs judgment [1]. The number of accidents as a result of drowsiness is increasing day by day. Recent statistics estimate that annually 76,000 injuries and 1200 deaths can be attributed to drowsiness related crashes. The advancement of technology in detecting the drowsiness of the driver is a noteworthy challenge as it can help reduce the probability of accidents taking place resulting in decrease in the death and injuries caused due to drowsy driving [3]. Considering the hazards, drowsiness presents on the road, it is necessary to develop and efficient system which can work under low light environment and with better and faster speed. Nowadays the driver safety in the car is one of the most wanted system to avoid accidents.

Our objective of the project is to ensure the safety system. In this manner, a system which can keep a check of driver's condition for drowsiness and alert the driver before it's too late. For this we need a system which will focus on the open or closed state of driver's eyes as by monitoring the state of the eyes detection of drowsiness is easy. Detection in real-time is the major challenge in the field of accident prevention system.

The purpose of this study is to provide a real-time monitoring system using video processing, face/eye detection techniques. This system deals with automatic driver drowsiness detection based on visual information. Our system will capture the video through camera and after processing, it will alert the driver based on the results. This system has overcome few of the limitations of the existing systems. Our System will not only alert the driver but also the co-passengers with a loud alarm. Parameters like efficiency, speed and light conditions will also be considered.

II. RELATED WORKS

Some efforts have been reported in the development of the system to detect the drowsiness based on various factors like recording of head movements, heart rate variability, grip quality and movement of the steering wheel against the path markings on the road [3]. A drowsy driver detection system has been developed to concentrate the eyes of driver and check the drowsiness. Drowsiness detection techniques, in accordance with the parameters used for detection is divided into two sections i.e. intrusive method and a non-intrusive method. The main difference of these two methods is that the intrusive method, an instrument connected to the driver and then the value of the instrument is recorded and checked. But intrusive approach has high accuracy, which is proportional to driver discomfort, so this method is rarely used. [2].

The system has the capacity to choose whether the driver's eyes are opened or closed. At the point when the eyes are close for a really long time, a warning sign is issued to driver [3]. Explore a driver drowsiness monitoring and early warning system, which uses machine learning techniques, based on vehicle telemetry data. The proposed system can ensure safe driving by real time monitoring of driving pattern [4]. A solution for driver monitoring and event detection based on 3-D information from a range camera is presented. The system combines 2-D and 3-D techniques to provide head pose estimation and regions-of interest identification.

Based on the captured cloud of 3-D points from the sensor and analyzing the 2-D projection, the points corresponding to the head are determined and extracted for further analysis [5]. Ingenuity method that combined both computer vision and physiological bio-signals for drowsiness detection. Initially, PCA model indicated the face region; follow by determination of eye region using GA based on face segment. Photo Plethysmography (PPG) is analyzed for its changes in signals waveform from awake to drowsy state [6].

III. SYSTEM METHODOLOGY

Our system uses an algorithm to locate, track, and analyze both the driver's face and eyes. Our developed system consists of 3 modules, which are Camera, Raspberry Pi and an alarm.

Figure.1. System Module

1. Webcam - It is used for capturing the video in real time and monitors a stream for faces. In order to effectively capture the face, the webcam is placed onto the vehicle dashboard and is approximately 20cm away from the driver's face. At this distance, the webcam captures the most of the driver's face. The captured video is sent to the Raspberry Pi for further processing.
2. Raspberry Pi - The Raspberry Pi is a small single-board computer. Python is main programming language for Raspberry Pi. It performs a processing of the input video stream so to compute the level of fatigue of the driver. The analysis is based on calculating a number of frames of the Data stream where the driver eyes are closed. Video segments whose average eye state point exceeds the threshold value are detected as drowsy.
3. Alarm - When the drowsiness index exceeds a pre-specified Parameter or when the signal falls below the specified threshold it activates an alarm signal. Loud Alarm is buzzed to alert the driver indicating that he is drowsy and is dangerous to drive in this state and that he must take a break.

IV. PROPOSED SYSTEM

Drowsiness detection techniques are generally classified into three groups: methods based on the condition of the driver, the method based on the performance of the driver, and the combined of the previous method. The method based on the condition of the driver is divided into two categories, namely: a technique using physiological signals and image-based techniques [2]. To develop a system which deals with driver drowsiness and fatigue detection based on visual information. The system uses driver's face movements and eye locations to determine the state of driver's eyes and if drowsy. This system will be able to work under low-lighting conditions with the help of a webcam installed on the dashboard. Instead of showing a warning sign, our system will sound a loud alarm which can not only alert the driver but the rest of the co-passengers as well.

A. SYSTEM ARCHITECTURE

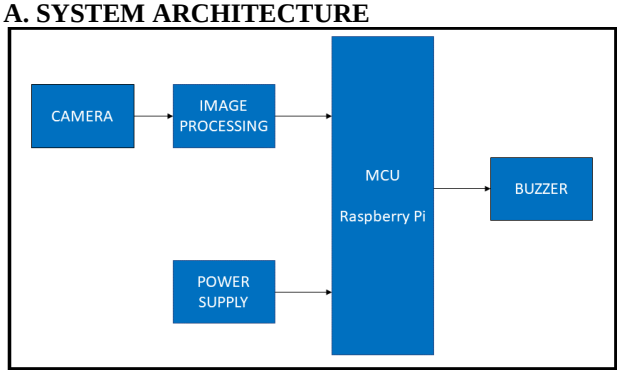

Figure.2. System Architecture

The system performs a processing of the input image stream so to compute the level of fatigue of the driver. The analysis is based on calculating a number of frames of the Data stream where the driver eyes are closed. The result of the Processing is sent to the alarm board, which activates an alarm signal when the drowsiness index exceeds a pre-specified Parameter [6]. Drowsiness detection system is designed to use a camera sensor on the front of the driver that is connected to an application. The sensor will detect the condition of the driver continuously, especially in the eye, when the eye is considered sleepy then the application will immediately sound an alarm to wake the driver [2]. Power is supplied to the system. Camera is used to monitor the status of the driver. We are using the raspberry pi processor this is the heart of the drowsiness detection system. Alarm is beeped when system sends the signal.

B. WORKING OF THE SYSTEM

The system begins with the initialization phase, which is video acquisition of both face and eyes. Then detection is used to extract both face and eyes regions and take them as frames to track them in the real time. For each tracking we test if that tracking is good or bad? If the Driver is drowsy or not? IF the Eye Aspect Ratio has fallen below the threshold? If the result has fallen below the threshold level then the system sends the signal to the alarm. The alarm buzzes and alerts the driver that he is sleepy and must take a break. If the tracking is good that is the Eye Aspect Ratio is normal then we return to the initialization step and continue to take the next frames from the video. The system will try to track the face again and again if no face is detected. The loud alarm has many positive effects as not only the driver but the passengers seated in the car may also get aware that the driver is sleepy and can take the required actions.

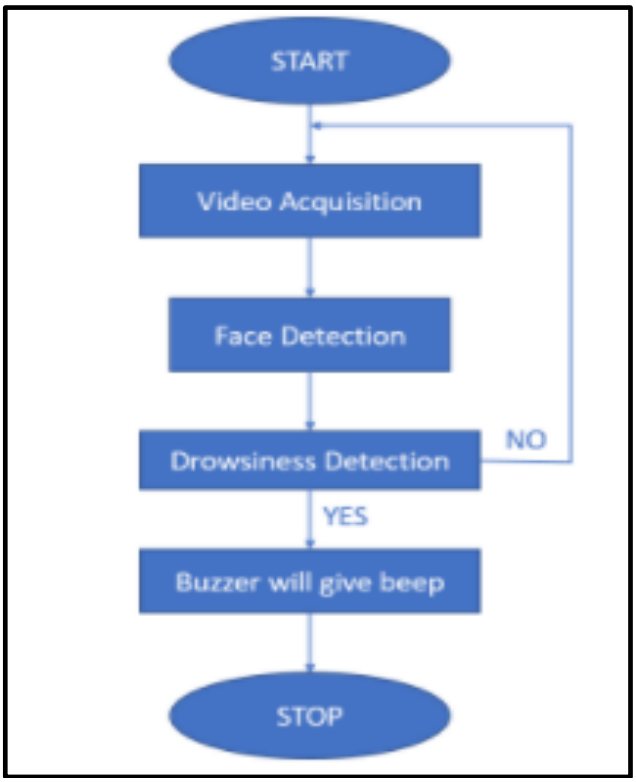

Figure 3: Working of System

1. Power on the system.
2. Camera will capture the video of the driver.

3. Raspberry Pi will work on the frames of the video.
4. If system detects the drowsiness of driver then buzzer will give beep.

C. EYE ASPECT RATIO (EAR)

It is an elegant solution that involves a very simple calculation based on the ratio of distances between facial landmarks of the eyes. Each eye is represented by 6 (x, y)-coordinates, starting at the left-corner of the eye and then working clockwise around the remainder of the region.

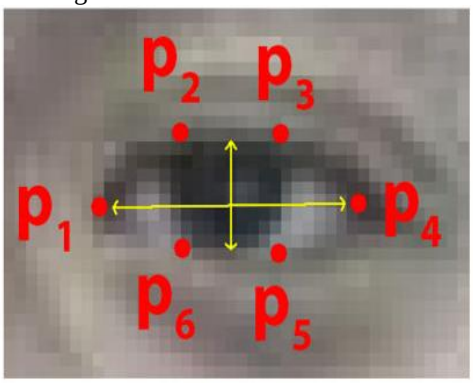

Figure 4: Coordinates of EAR

The following formula is used for calculation of EAR:

$$\text{EAR} = \frac{\|p_2 - p_6\| + \|p_3 - p_5\|}{2\|p_1 - p_4\|}$$

Figure 5: EAR Formula

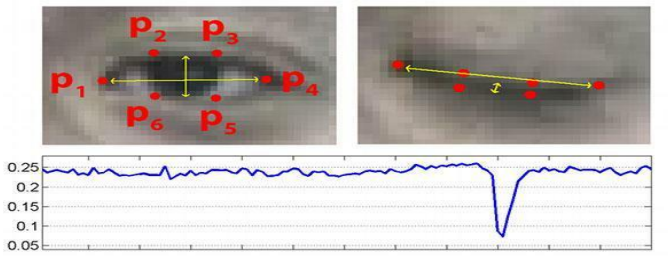

Figure 6: EAR Calculation Chart

D. ALGORITHMS

Various algorithms are used for tracking and identification of face and eyes as well as for detecting drowsiness. Two types of algorithm are used in the system:

1. Haar-Cascade
2. Eye Aspect Ratio(EAR) Algorithm

Haar-Cascade algorithm is used for face detection and eyes tracking which is followed by EAR to detect drowsiness. The programing is done with python using OpenCV. OpenCV already contains many pre-trained classifiers for face, eyes, smiles, etc.

Haar-Cascade algorithm:
Step 1: Load the required XML classifiers
Step 2: Load our input video in grayscale mode
Step 3: Find the faces in the image. If faces are found, it returns the positions of detected faces as Rect (x,y,w,h)
Step 4: Get the locations and create a ROI (Region of interest) for the face and apply eye detection on this ROI
Step 5: End

EAR algorithm:
Step 1: Use the Detected Eye region from the above algorithm
Step 2: Compute the Eye Aspect Ratio to determine if the eyes are closed
Step 3: If EAR satisfies the drowsy condition then move to step 5
Step 4: If EAR is normal then go to Step 1
Step 5: Sound Alarm

V. CONCLUSION

Drowsy driving is a serious threat to drivers and traffic participants. The present's system lacks one or the other important feature that provides non-reliable results. Our proposed system will overcome these drawbacks and provide accurate and reliable results. The general flow of our drowsiness detection algorithm is fairly straightforward. A camera is setup to monitor stream of faces. After which, we apply facial landmark detection and extract the eye regions. We can compute the eye aspect ratio to determine if the eyes are closed. Video segments whose average eye state point exceeds the threshold value are detected as drowsy and the driver is alerted. The system can also be used efficiently in locomotives and aero planes. It has a wide scope in the future and can be improved to meet excellence. In the future, this thesis will be a part of a safety system being used in vehicles and help us save many lives. In near future, the project can be improved to detect passenger faces and only focus on the driver's face. The vehicle manufacturers can make this system inbuilt by using the dashboard screen and speakers. The system can be effectively used in locomotives and flights for detecting driver drowsiness. System can be improved to detect and track eyes even if the driver is wearing shades.

VI. ACKNOWLEDGMENT

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VII. REFERENCE

[1]. Authored by Ashish Naire, Vaijanath Patane, Umesh Patil, Prof. S.Y.Sawant, "Raspberry Pi Based Drowsiness Detection

System," International Journal & Magazine of Engineering, Technology, Management and Research.

[2]. Authored by Pranoto Hidaya Rusmin, Andrew B. Osmond, Arief Syaichu-Rohman, "Design and Implementation of Driver Drowsiness Detection System on Digitalized Driver System," 2013 IEEE 3rd International Conference on System Engineering and Technology, 19 - 20 Aug. 2013, Shah Alam, Malaysia.

[3]. Authored by JAVED AHMED, JIAN-PING LI, SAEED AHMED KRAN, RIAZ AHMED SHAIKR, "Eye Behavior based Drowsiness Detection System" School of Computer Science & Engineering, VESTC, Chengdu 611731, China

[4]. Authored by Gustavo A. Peláez C., Fernando García, Arturo de la Escalera, and José María Armingol, "Driver Monitoring Based on Low-Cost 3-D Sensors" IEEE TRANSACTIONS ON INTELLIGENT TRANSPORTATION SYSTEMS, VOL. 15, NO. 4, AUGUST 2014

[5]. Authored by Kashyap Vasudevan, Anjana P Das, Sandhya B, Subith P, "Driver Drowsiness Monitoring by Learning Vehicle Telemetry Data" Tata Elxsi Ltd., Technopark, Trivandrum, India.

[6]. Authored by B.-G. Lee, S.-J. Jung, W. -Y. Chung, "Real-time physiological and vision monitoring of vehicle driver for non-intrusive drowsiness detection" IET Commun., 2011, Vol. 5, Iss. 17, pp. 2461–2469.

[7]. Drowsiness Detection with OpenCV (https://www.pyimagesearch.com/2017/05/08/drowsiness-detection-opencv/)

[8]. Driver Drowsiness Detection by Stark Foundation