Driver Drowsiness Detection For Smart Vehicles Using Deep Learning

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Abstract- *A person while driving a vehicle - if does not have proper sleep or rest, is more inclined to fall asleep which may cause a traffic accident. This is why a system is required which will detect the drowsiness of the driver. Recently, in research and development, Deep learning methods have been used to predict a driver's conditions. Those conditions can be used as information that will improve road safety. A driver's condition can be estimated by basic characteristics age, gender and driving experience. Also, driver's driving behaviors, facial expressions, bio-signals can prove helpful in the estimation. Deep Learning has brought progression in video processing which enables images to be analyzed with accuracy. In this paper, we proposed a method for detecting drowsiness by using convolution neural network model over position of eyes and extracting detailed features of the mouth using OpenCV and Dlib to count the yawning.*

Keywords- Driver drowsiness detection, Dlib ,Face detection, OpenCV

I. INTRODUCTION

Driver drowsiness detection using OpenCV, dlib and python uses mainly the concept of a mathematical value called Eye Aspect Ratio (EAR), which is a simple and effective approach. The proposed method has several advantages over the traditional MATLAB based face detection methods: A) Speed: MATLAB is fabricated from java which in turn is fabricated from C. Therefore, the computer initializes by interpreting the code and converting it into java and then finally executes the script, when a code is scripted and run on MATLAB. But in OpenCV, C/C++ library functions are used, which directly provides the computer with the machine language code and hence helps in faster execution. With OpenCV, there is more utilization of time and resources in image processing and less in interpreting. B) Portability: Any device which runs on C can run OpenCV because OpenCV runs on C. It can toil well with Windows, mackintosh or Linux. C) Cost: MATLAB is very much expensive than OpenCV. MATLAB costs around USD2150 but OpenCV is free of cost. The base MATLAB has commercial, single user License and so it is expensive. But OpenCV is a BSD license, so it is free of cost. Paper is organized in the following manner.

II. LITERATURE SURVEY

In[1] Driver Drowsiness Detection System Using Python - Major road accidents are caused by drowsiness while driving.

Drowsiness caused by tiredness driving is becoming more common these days. If the driver's eyes are drowsy for more than 5 seconds, the eye blink sensor detects the blink rate. If the eyes are found to be closed, the car's speed is reduced. Along with sleepiness detection, the CNY70 sensor is used in our suggested system. If the driver's eyes show signs of weariness, the alarm system is activated. These sensors are linked to an Arduino UNO, and a buzzer sounds to inform the user if sleepiness is detected.

In[2] Driver Drowsiness Detection System Using Opencv And Keras - A computer’s vision-based thoughts concept has been used for creating this Drowsy Driver Detection System. The camera being the initial point of the system by 5 providing the live feed of the driver to the framework that concentrates it straight towards the face of driver and checks the driver's eyes with a particular objective to catch drowsiness of the driver. On analyzing the live video an alert is issued to the driver in circumstances where drowsiness is outcome of the analysis. The framework moves the control of the program forward using information picked up from the picture to find the facial tourist spots, which helps the system to identify where the eye’s location of an individual exist. If the eyes of driver are closed for a specific amount of time, the proposed framework draws a conclusion that the driver is feeling drowsy and an alarm for safety is sound. The system works after initially face is recognized and eyes are spotted, it also works well in dim lighting conditions too.

In[3] Driver Drowsiness Detection System with OpenCV and Keras - Drowsiness of the drivers is the principal cause of injuries in the world. Because of loss of sleep and tiredness, drowsiness can occur even as riding. The first-rate manner to keep away from accidents because of drivers' drowsiness is to come across drowsiness of the driving force and warn him before fall into sleep. To discover drowsiness many techniques like eye retina detection, facial function recognition has been used. Here on this paper, we suggest a way of detecting motive force drowsiness, the usage of eye retina detection and pulse charge detection of the driving force. On this record, we endorse an extra accurate drowsiness detection approach which is a hybrid technique of eye retina detection and pulse sample detection.

In[4] Driver Drowsiness Detection Using Opencv, Dlib and Python - In today's world, the number of road accidents that occur is increasing very rapidly. Some of these road accidents
are minor whereas some of them may seriously injure people or even take their lives. These road accidents may involve collision of vehicles with each other or crashing the vehicles on to the buildings or others. Road accidents may even result in the death of people. It is estimated that the total deaths due to road accidents in India is around 1,50,000 per year which is approximately 400 accidents per day. Almost 3 lives are lost in every 10 minutes due to road accidents. This shows that reducing the rate of the road accidents is necessary. The proposed method uses python along with two libraries OpenCV and dlib for facial 6 landmark detection. A mathematical value Eye Aspect Ratio (EAR) is then calculated for determining whether the eyes are closed or not.

In[5] Driver Drowsiness Detection System By using Python - All over the world Drowsiness has been the significant cause of horrible accidents which is causing deaths and fatalities injuries. Day by Day fatal injuries numbers are increasing globally. From the past many years, researchers have concluded drivers with a lack of sleep and more tiredness which causes drowsiness of the driver. This paper shows a new experimental model is designed for detecting drowsiness of driver is presented to reduce accidents caused by this problem which increases transport safety. In this work, two ways are used to detect the drowsiness of a person effectively. First Driver face is captured and eye retina detection and facial feature 7 extraction are done and blinking values are calculated then threshold values are set. The result from both methods is taken as input for taking the final decision and alerting the driver. Nowadays, road accidents have become one of the major issues. The major road accidents are caused due to drowsiness, drunken, and rash driving. This is the reason, every year the number of road accidents is increasing especially by cars. Due to drowsiness, drivers become less active while driving. This paper represents to build a system for Drowsiness Detection and Warning for automobile safety and accident prevention. We are using eye detection, drowsiness detection, and eye blinking pattern detection with the help of machine vision-based concepts. In order to detect fatigue or drowsiness, web-camera has been used which points directly towards the driver's face and detects the eye movement of the driver.

In[6] Drowsiness Detection and Warning System Using Python - Nowadays, road accidents have become one of the major issues. The major road accidents are caused due to drowsiness, drunken, and rash driving. This is the reason, every year the number of road accidents is increasing especially by cars. Due to drowsiness, drivers become less active while driving. This paper represents to build a system for Drowsiness Detection and Warning for automobile safety and accident prevention. We are using eye detection, drowsiness detection, and eye blinking pattern detection with the help of machine vision-based concepts. In order to detect fatigue or drowsiness, web-camera has been used which points directly towards the driver's face and detects the eye movement of the driver.

In[7] Driver Drowsiness Detection System - 8 Most of the accidents that have been reported in our country is due to lack
of concentration of the driver or feeling drowsy by the driver. Fatigue and microsleeping behind the wheel are frequently the cause of major accidents. However, early indicators of weariness can be noticed before a severe scenario emerges, therefore detecting and indicating driver fatigue is still a study issue. The majority of classic sleepiness detection methods are based on behavioral factors, while some are obtrusive and may distract drivers, and others need costly sensors. In this paper, we have designed a Driver Drowsiness Detection System using Python and Dlib models. This method can reduce the number of road accidents also the proposed system does not require any physical contact with the driver, so it is easy to implement. The system can detect facial landmarks, computes Eye Aspect Ratio (EAR) to detect driver's drowsiness based on adaptive thresholding. Deep learning algorithms have been employed to test the effectiveness of the proposed approach.

In[8] IoT-Based Smart Alert System for Drowsy Driver Detection - In current years, drowsy driver detection is the most necessary procedure to prevent any road accidents, probably worldwide. The aim of this study was to construct a smart alert technique for building intelligent vehicles that can automatically avoid drowsy driver impairment. But drowsiness is a natural phenomenon in the human body that

happens due to different factors. Hence, it is required to design a robust alert system to avoid the cause of the mishap. In this proposed paper, we address a drowsy driver alert system that has been developed using such a technique in which the Video Stream Processing (VSP) is analyzed by eye blink concept through an Eye Aspect Ratio (EAR) and Euclidean distance of the eye. Face landmark algorithm is also used as a proper way to eye detection. When the driver's fatigue is detected, the 9 IoT module issues a warning message along with impact of collision and location information, thereby alerting with the help of a voice speaking through the Raspberry Pi monitoring system.

III. EXISTING SYSTEM

The majority of existing systems consist of a camera mounted in front of the driver. It scans the driver's face and eyes to determine whether or not he is asleep. However, while facing in front of the driver, it obstructs the driver's frontal view. As a result, it may present further issues when driving.As a result, this System is not recommended. Furthermore, it displays varied findings depending on the location of the eye. When the eye is in the uplink position, the result is 80 percent accurate, while in the downlink position, the result is 55 percent accurate. In the existing system it will only detect if the person in drowsy. In the already available system it detects only once. It shows notification on display. Even if the person feels drowsy few more times the system will not change any different output.

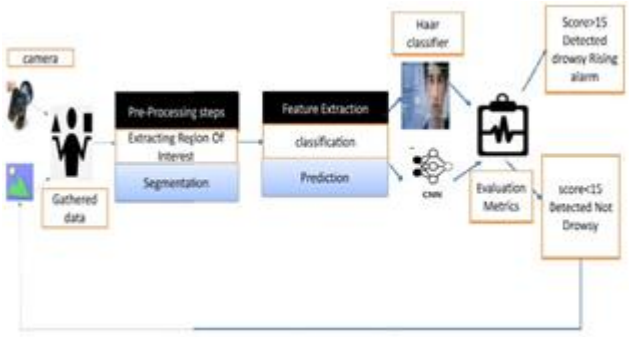
IV. PROPOSED SYSTEM

At first, the real-time video is recorded using a webcam. The camera will be positioned in front of the driver to capture the frontal face image. The frames are extracted from video to obtain 2-D images. Face is detected in the frames using Haar- Cascade face detection method. After detecting the face, facial landmarks like positions of eye, nose and mouth are marked on the images. From the facial landmarks, position of eyes and mouth are quantified. Using these extracted features and deep learning methods, a decision is obtained about the drowsiness of the driver. Convolution neural network is applied for classification of eyes, which detects drowsiness of driver by considering blinking of eyes. As an additional attribute to the system, feature extraction method is used for calculating mouth opening ratio, which also helps to decide if the driver is drowsy. If drowsiness is detected, an audio will be sent to alert the driver. If yawning detected it alerts with audio for 3 times and for the 4th time it sends a mail to respective mail ID with photo, and a quiz pop-up will open in that 4 random quiz questions are given.The driver needs to answer correctly, if he answers all 4 questions correct then resumes to detect drowsiness, if he answers wrong even to any one of the question then the pop up quiz is repeated until answer is given correctly.

V. SYSTEM ARCHITECTURE

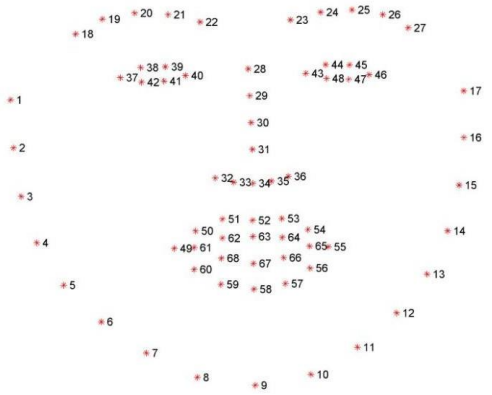
Driver drowsiness detection system acquires the input image from camera, and detects the drowsiness of the driver in three steps.

- Data source and Preprocessing
- Features extraction
- Face landmark detection



DATA SOURCE AND PREPROCESSING

For our training and test data, we used the Real-Life Drowsiness Dataset created by a research team from the University of Texas at Arlington specifically for detecting multi-stage drowsiness. The end goal is to detect not only extreme and visible cases of drowsiness but allow our system to detect softer signals of drowsiness as well. The dataset consists of around 30 hours of videos of 60 unique participants. From the dataset, we were able to extract facial landmarks from 44 videos of 22 participants. This allowed us to obtain a sufficient amount of data for both the alert and drowsy state.For each video, we used OpenCV to extract 1 frame per second starting at the 3-minute mark until the end of the video. Each video was approximately 10 minutes long, so we extracted around 240 frames per video, resulting in 10560 frames for the entire dataset.



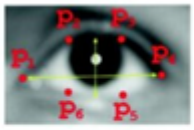
There were 68 total landmarks per frame but we decided to keep the landmarks for the eyes and mouth only (Points 37– 68). These were the important data points we used to extract the features for our model.

FEATURE EXTRACTION

Based on the facial landmarks that we extracted from the frames of the videos, we ventured into developing suitable features for our classification model. While we hypothesized and tested several features, the four core features that we concluded on for our final models were eye aspect ratio, mouth aspect ratio, pupil circularity, and finally, mouth aspect ratio over eye aspect ratio.

EYE ASPECT RATIO (EAR)

EAR, as the name suggests, is the ratio of the length of the eyes to the width of the eyes. The length of the eyes is calculated by averaging over two distinct vertical lines across the eyes as illustrated in the figure below.

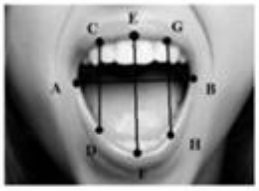


$$EAR = \frac{\|p_2 - p_6\| + \|p_3 - p_5\|}{2\|p_1 - p_4\|}$$

Eye Aspect Ratio (EAR)

MOUTH ASPECT RATIO (MAR)

Computationally similar to the EAR, the MAR, as you would expect, measures the ratio of the length of the mouth to the width of the mouth. Our hypothesis was that as an individual becomes drowsy, they are likely to yawn and lose control over their mouth, making their MAR to be higher than usual in this state.



$$MAR = \frac{|EF|}{|AB|}$$

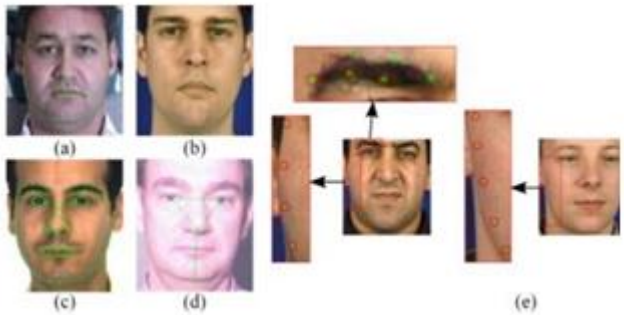
Mouth Aspect Ratio (MAR)

FACE LANDMARK DETECTION

Face landmark detection is a computer vision task where we want to detect and track keypoints from a human face. This task applies to many problems.For example, we can use the keypoints for detecting a human's head pose position and rotation. With that, we can track whether a driver is paying attention or not. Also, we can use the keypoints for applying an augmented reality easier. And there are so many solutions that we can generate based on this task.

FACE LANDMARK DETECTION WITH DLIB

Dlib is a library for applying machine learning and computer vision solutions.This library is based on the C++ language, but we can use a language like Python for using the library.One of the solutions that we can apply by using this library is face landmark detection.



VI. ALGORITHM

OpenCV:

OpenCV (*Open source computer vision*) is a library of programming functions mainly aimed at real-time computer vision. Originally developed by Intel, it was later supported by Willow Garage then Itseez (which was later acquired by Intel). The library is cross-platform and free for use under the open-source BSD license.

OpenCV supports the deep learning frameworks TensorFlow, Torch and CaffeOpenCV's application areas include:

- 2D and 3D feature toolkits
- Egomotion estimation
- Facial recognition system
- Gesture recognition
- Human–computer interaction (HCI)
- Mobile robotics
- Motion understanding
- Object identification
- Segmentation and recognition
- Stereopsis stereo vision: depth perception from 2 cameras
- Structure from motion (SFM)
- Motion tracking
- Augmented reality

VII. CONCLUSION

In order to detect a driver's drowsiness, facial features, eyes and mouth were identified on the video of an individual driving. Convolutional neural network was implemented to classify eyes as open or closed. Drowsiness was determined on the basis of frequency of closed eyes. Using OpenCV and Dlib in Python, frequency of yawning was examined. An alarm was set to ring after the detection to alert the driver. There will be limitations concerning the detection of drivers' conditions and facial expressions due to factors like darkness, light reflection, obstructions by drivers' hands and wearing of sunglasses. Convolutional neural gives better performance and facial extraction method accompanies it, as an additional drowsiness detection technique which is often used with other facial extraction methods.

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