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Automated Driver Drowsiness Detection For Non 2 Wheelers

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Abstract: **Many of the accidents occurs due to drowsiness of drivers. It is one of the critical causes of roadways accidents now a days. Latest statistics says that many of the accidents were caused because of drowsiness of drivers. Vehicle accidents because of drowsiness in drivers causing death to thousands of lives. More than 30% accidents occur due to drowsiness. For the prevention of this a system is required which detects the drowsiness and alerts the driver which saves the life. In this paper we present a scheme for driver drowsiness detection. In this driver is continuously monitored through webcam. This model uses image processing techniques which mainly focusses on face and eyes of the driver. The model extract the drivers face and predicts the blinking of eye from eye region. We use an algorithm to track and analyze drivers face and eyes to measure perclos. If the blinking rate is high then the system alerts the driver with a sound**

Keywords —Drowsiness, Distraction, Eye detection, Eye Tracking, Face Detection, Perclos

I. INTRODUCTION

Now a days there is huge increase in private transportation day by day in this modernize world. It will be tedious and bored for driving when it is for long time distance. One of the main causes behind the drivers unalertness is due to long time travelling without sleep and rest. Tired driver can get nap while driving. Every fraction of seconds nap can turn into dangerous and live threaten accident may lead to death also. To prevent this type of incidents it is required to monitor driver's alertness continuously and when it detects drowsiness the driver should be alerted. Through this we can reduce some percent of accidents and can save lives Drowsiness of the drivers is one of the key issues for majority of road accidents. Drowsiness threatens the road safety and causes severe injuries sometimes, resulting in fatality of the victim and economical losses Drowsiness implies feeling lethargic, lack of concentration, tired eyes of the drivers while driving vehicles. Most of the accidents happen in India due to the lack of concentration of the driver. Performance of the driver gradually deteriorates owing to drowsiness. To avoid this anomaly, we developed a system that is able to detect the drowsiness nature of the driver and alert him immediately. This system captures images as a video stream through a camera, detects the face and localizes the eyes. The eyes are then analyzed for drowsiness detection using perclos algorithm. Based on the result , the driver is alerted for drowsiness through an alarm system.

II. METHODOLOGIES

There are different methodologies to identify drowsiness state of the driver. They can be categorized into the following three main categories:

1. ***Behavioural Parameteres Based*****:** Measuring the driver's fatigue without using non-invasive instruments comes under this category. Analyzing the behaviour of the driver based on his/her eye closure ratio, blink frequency, yawning, position of the head and facial expressions. The current parameter used in this system is the eye-closure ratio of the driver.

2. ***Vehicular Parameteres Based*****:** Measuring the fatigue nature of the driver through vehicle driving patterns comes under this category. These parameters include lane changing patterns, steering wheel angle, steering wheel grip force, vehicle speed variability and many more.

3. ***Physchological Parameteres Based*****:** Measuring the drowsiness of the driver based on the physical conditions of the driver fall under this category. Such parameters may be respiration rate, heart-beat rate, body temperature and many more. Among other various approaches, these physiological parameters provide the most accurate results since they are based on the biological nature of the driver.

All the above approaches have their own advantages and disadvantages. Based on the desired result accuracy, any approach can be used. Physiological approach includes wearing of the equipment on the driver's body. This equipment includes electrodes to detect the pulse rate of the driver which might make the driver uncomfortable while driving. This also can't be assured that the driver always wears such equipment while driving which may result in

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inefficient results. Hence there is a hindrance using the physiological approach. Vehicular-based approach is always based on the efficiency of the driver and his condition. There are also constraints like the road condition and the type of vehicle which may change regularly. Hence it is best to follow the behavioural based approach through visual assessment of the driver from a camera. There shall be no equipment attached to the driver. Hence this technique is always the best approach and can be implemented in any vehicle without any modifications.

Every year a large number of deaths occur due to fatigue related road accidents. According to study around 20% accidents are occuring yearly with an average of 90 deaths per day due to drowsiness. Drivers who drive continuously will have a chance of getting tiredness. Hence detection of driver's drowsiness and its indication can significantly decrease number of accidents. To decrease these type of accidents some image processing techniques like viola jones, Adaboost, haar cascade, gobar features, facial land mark detection. The following are some methods for detection

M.A. Assari & M. Rahmati [1] proposed a system in which the drowsiness of the driver is detected by detecting the face through horizontal projection on the image and tracking the face components via template matching technique which comprised of eyebrows and eyes along with mouth. The proposed method has been implemented in simulation environment of MATLAB (Simulink). Addition of the IR lighting as sources of light helped in better detection of faces in this system.

Tianyi Hong et al [2] presented a system which used face-detection method basing on the cascade of classifiers trained through Adaboost technique. Optimization in this system is performed by applying the integral image of the original image to develop a canny filter for cascade processing and improve the performance. Integrated performance primitives(IPP) have been used for better and faster computational results. This system is validated in GENE-8310 embedded platform.

B. Warwick et al [3] proposed a system that is based on physiological approach in which the driver wears a wireless biosensor called BioHarness, a wearable device capable of collecting the physiological data and then transmitting to a smartphone. This data is then analysed through Fast Fourier Transform(FFT) and Power Spectral Density(PSD) which provide the desired vectored inputs that can be fed into a Neural Network. This system is run on a drowsiness detection mobile app by the researchers.

K. Dwivedi et al [4] developed a system which identifies drowsiness of the driver using representational learning. A Haar-like face detector feeds the images to a 2-layer convolutional neural network for extracted features which are then used to train a softmax layer classifier for detecting whether a driver is drowsy or not drowsy. This system was able to yield a satisfactory result of 78% accuracy in detecting the drowsiness and alerting the driver.

J.J. Yan et al [5] proposed a system in which the images captured are converted into grayscale using the Sobel operator for edge detection. The position of the eyes are calculated using template matching. To determine the states of the eyes, the binarization and quick sort techniques are used which also confirm the distribution of the black pixels in the grayscale image. In this study, P80 is taken as the important criterion of the driver's physical state. There is a threshold value to compare with pixel value If the amount of black pixels is lower than this threshold value then it is considered as the driver in drowsy state.

III. PROPOSED WORK

Architecture: The following is the architecture for detecting drowsiness and the distraction

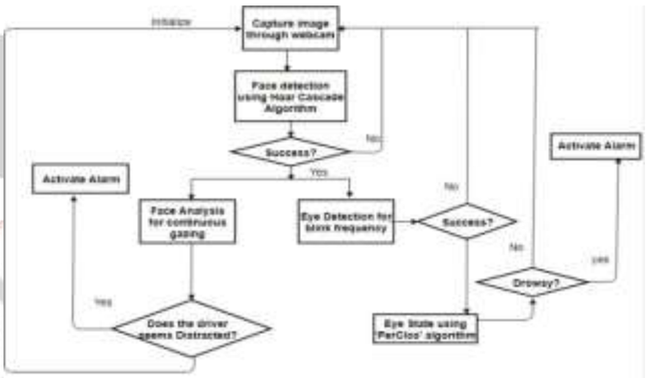

Fig 2.1 Architecture of the drowsiness detection system

The fig 2.1 the architecture for detecting the drowsiness of the driver. First of all the system captures images through the webcam and after capturing it detects the face through haar cascade algorithm. It uses haar features which can detect the face. If the system founds it as face the it will proceed for next phase i.e eye detection. The eye is also detected using haar cascade features and it is used for blink frequency. The state of eye will be detected using perclos algorithm. Through this algorithm we can find the percentage of time the eye lids remains closed. If it found eyes in closed state then it detects driver in drowsy state and alerts him by an alarm. In some cases distraction can be measured by continuous gazing. The driver's face is analyzed continuously to detect any distraction. If found then alarm is activated. The following are the algorithms used for detection

A. Haar Cascade:

Haar Cascade is based on the concept of features which are proposed by Paul Viola and Michael Jones in their paper "Rapid Object Detection using a Boosted Cascade of Simple Features" in 2001. It is a machine learning based approach where a cascade function is trained from a lot of positive and negative images. It can be used to detect objects from an image or a video.

 DOI : 10.35291/2454-9150.2020.0191

This algorithm comprises of four stages:
i. Haar Feature Selection
ii. Creating Integral Images
iii. Adaboost Training
iv. Cascading Classifiers

Though Haar Cascade is used for detecting almost all objects, it is popular for detecting faces in images. Adaboost which both selects the best features and trains the classifiers that use them. This algorithm constructs a “strong” classifier as a linear combination of weighted simple “weak” classifiers.

A Haar feature considers adjacent rectangular regions at a specific location in a detection window, sums up the intensities of the pixels in each region and calculates the difference between these sums. During the detection phase, a window of the target size is moved over the input image, and for each subsection of the image and Haar features are calculated. This difference is then compared to a learned threshold that separates non-objects from objects. Because each Haar feature is only a "weak classifier" i.e. its detection quality is slightly better than random guessing and a large number of Haar features are necessary to describe an object with sufficient accuracy and are therefore they are organized into cascade classifier to form a strong classifier. Selecting the most relevant features is performed through Adaboost technique which selects the best features and trains the classifiers that use them. This algorithm uses “Haar Cascade Frontal Face” classifier for detecting the faces since we need to detect only the frontal part of the face. The entire architecture is divided into 6modules.

1.Face Detection 2.Eye Detection 3.Face Tracking 4.Eye Tracking

5.Drowsiness Detection 6.Distraction detection

1. Face Detection: This module takes input from the camera and tries to detect a face in the video input. The detection of the face is achieved through the Haar classifiers mainly, the Frontal face cascade classifier. The face is detected in a rectangle format and converted to grayscale image and stored in the memory.

2. Eye Detection: in this module the face of the eyes are focused to detect drowsiness. The eyes are detected through video input through haar cascade eye classifier. The eyes are detected in frames.

3. Face Tracking: Due to the real-time nature of the project, we need to track the faces continuously for any form of distraction. Hence the faces are continuously detected during the entire time.

4. Eye Tracking: The input to this module is taken from the previous module. The eyes state is determined through Perclos algorithm.

5. Drowsiness detection: In the previous module the frequency is calculated and if it remains 0 for a longer period then the driver is alerted for the drowsiness through an alert from the system.

6. Distraction detection: In the face tracking module the face of the driver is continuously monitored for any frequent movements or the long gaze of the eyes without any blinks which can be treated as lack of concentration of the driver and is alerted by the system for distraction.

B.PerClos

Perclos is a drowsy detection measure used to calculate the percentage of eyelid closure over the pupil over time. It is used by various real-time drowsiness detection systems and is able to yield effective results. Developers use different set of hardware to capture the closure movement of the eyelids for developing the accuracy of the system. This project uses camera mounted on the dashboard of the vehicle and is set up in such a way that the driver is visible on the camera. This helps in better detection of the face and calculating the eyelid closure frequency using perclos measure.

A total of six points are marked for each eye and the Euclidean distance is calculated for each eye. The eye aspect ratio for each eye are then calculated for average eye-aspect ratio.

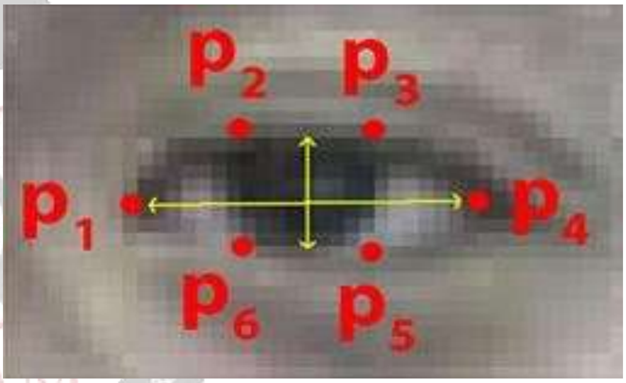

Fig 2.2 points localisation in perclos algorithm

ear = (A + B) / (2.0 * C)

where A is the distance between the first 2points (p2 and p6),B is the distance between the 2points(p3 and p5) and C is the distance between 2points (p1 and p4)

IV. EXPERIMENTAL RESULTS

1.Face Detection:

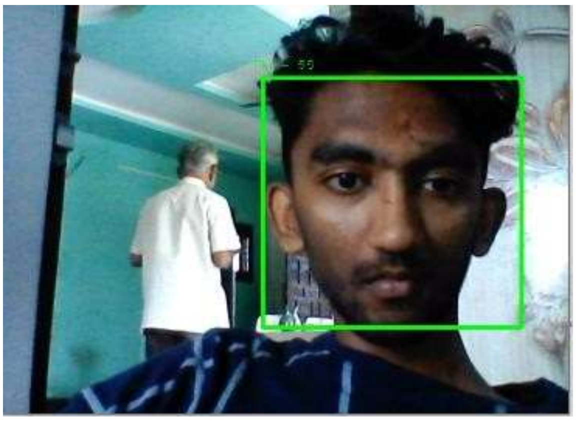

Fig 3.1 output for face detection

The fig 3.1 is output for face detection module. The input to

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this module is continuous stream of video and output will be face detection with in rectangular bounds. The face is detected by using haar cascade algorithm . It uses haar features through which the face is detected in a rectangular frames. The detection of the face is achieved through the Haar classifiers mainly, the Frontal face cascade classifier. The face is detected in a rectangle format and converted to grayscale image and stored in the memory which can be used for training the model.

2. *Eye Detection:*

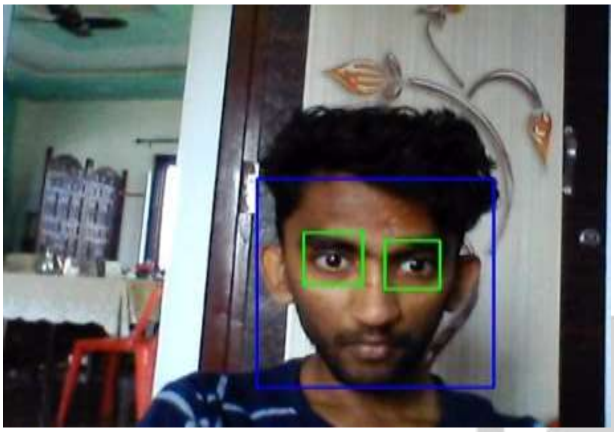

Fig 3.2 output for eye detection

The fig 3.2 is output for eye detection. The system detects eyes in the given particular frame in rectangular frames. The algorithm used for detecting the eyes is haar cascade. It uses haar features which are used for detecting the eyes in rectangular frames

3. *Drowsiness Detection:*

Fig 3.3 Drowsiness Detection

The fig 3.3 is the output for drowsiness detection. If the driver seems to be detected as drowsy then it will give an alert. The alert will be in the form of message as "YOU ARE SLEEPY. .PLEASE TAKE A BREAK" and also in form of sound. The aim is to make the driver wake with that sound. The drowsiness is detected by using perclos algorithm. The algo calculates the distance between two eyelids and if it found the distance less than a threshold value then it raises the alarm.

Time complexity: The time taking to detect a person whether he is sleepy or not is around 8 to 10 seconds.

4. *Distraction Detection:*

Fig 3.4 Distraction detection

The fig 3.4 is the output for distraction detection. When the driver is distracted it will alert him by raising an alarm. The system detects as distraction if the driver's eyes is not detected. If the driver seems to be observing somewhere else other than the road then it gives alert in form of message and the sound. This can be done by using face detection algorithm and if the face is not detected for some amount of time then it gives an alert to the driver.

COMPARISION TABLE:

ALGORITHM	ACCURACY	SPEED	REMARKS
HAAR CASCADE	78%	Detects very fast in light conditions	Requires training in low light conditions
CNN	76%	Detection time is fast	Takes more time for training
GOBAR FEATURES	67%	Taking more time for detection	It requires huge data set for training

Table 1: comparison of different detection algorithms

The above table is comparison of different face and eye detection algorithms. The comparison is based on different parameters. The parameters considered in the table are speed and accuracy. The algorithm which we used for detecting drowsiness is haar cascade. The accuracy of output with this algorithm is around 79%. If the light conditions are very good then it detects the face in very less time. If the system is trained then it will detect in low light conditions also. The system has to be trained to detect face in less lightening conditions. The other algo taken is cnn(convolutional neural networks). The detection time is very less and it gives very accurate results. It requires more amount of training for getting better results. For training it requires huge amount of data sets. Gobar features are another type used for detection and it has accuracy about 67%. It takes more time for detection. It also requires huge data set for training to get best results.

V. CONCLUSION

The current study developed an automated system for detecting drowsiness of the driver. The continuous video stream is read from the system and is used for detecting the

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drowsiness. It is detected by using haar cascade algorithm. The haar cascade algorithm uses haar features to detect face and eyes. Haar features are predefined are used for detecting different things. The haar features are applied on the image and blink frequency is calculated using perclos algorithm. If the value remains 0 for some amount of time then it detects as sleepy and alerts driver by activating an alarm. If the value remains constant for longer periods then the driver is said to be distracted then also an alarm is activated. The present system gives a result which has accuracy of 78%.

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