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Driver Drowsiness Detection Using Neural Network and MachineLearning Algorithms

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Abstract: *The goal of this project is to build a drowsiness detection system that candetect when a person's eyes are closed for a few seconds. The system alerts the driver when drowsiness is detected, because driving when you are drowsy can become very dangerous. Most road accidents are caused by drowsy drivers. So, to prevent these accidents, we will build a system that will alert the driver when he feels drowsy. Our approach to this open problem is to use a series of 60-second images, recorded with the driver's face visible. To determine if a driver is showing symptoms of drowsiness, two alternative solutions have been developed with an emphasis on minimizing false positives. The accuracy achieved by the system is similar: around 60*

Key Word: *Drowsiness Detection; Computer Vision; Face Detection; Machine Learning.*

I.INTRODUCTION

Transportation is an important part of human life, especially road transportation. India currently ranks second in the world in terms of road connectivity, after the United States. Accidents are more common in India due to poor road connectivity and poor road quality. The number of "traffic accidents" nationwide has increased from 368,828 in 2020 to 422,659 in 2021. Driver drowsiness and fatigue are major causes of traffic accidents. Every year they add to the number of deaths and fatalities around the world. It is important to use new technologies to design and build systems capable of monitoring drivers and measuring their level of attention throughout the driving session. ADAS (Advanced Driver Assistance System) modules are used to reduce the number of accidents due to driver fatigue, thereby increasing road safety. The system manages the automatic detection of driver drowsiness based on visual information and artificial intelligence. We use an algorithm to detect and analyze the driver's face and eyes to measure the percentage of eye closure. Drowsiness or drowsiness can be described as a biological state in which the body transitions from wakefulness to wakefulness. Drivers may be distracted and unable to perform maneuvers such as avoiding a frontal collision or braking. There are clear signs that the driver is too sleepy to keep their eyes open. Developing techniques to detect or prevent drowsiness at the wheel is a major challenge in the field of accident prevention systems. The goal of this project is to develop an analog drowsiness detection system. The focus will be on designing a system that will accurately monitor whether the driver's eyes are open or closed. By monitoring the eyes, it is believed that symptoms of driver drowsinesscan be detected at an early enough stage to prevent accidents. A sequence of images of a face and the duration of an observed eye opening or closing. The closed eye detection method is PERCLOS. This detection method is based on the time the eyes are closed, which refers to a specific percentage of time. Facial image analysis is a hot research area, with applications such as facial recognition and human recognition and detection for security systems. This project focuses on eye localization, which consists in determining the position of the eye by applying existing methods in image processing algorithms. Once the position of the eyes is detected, the system determines whether the eyes are open or closed and detects fatigue and drowsiness.

II.MATERIAL AND METHODS

Software Requirements
Operating System - Windows XP, 7, 8, 10, 11
Arduino
Python 3.9
Language Python

Hardware Requirements
Connecting wiresbuzzer
arduino UNO
cabel for arduino UNOAny Processor
Processor Speed:-:1 GHz to 2 GHz
RAM:-:256 MB and above
Hard Disk:-: 2TB and above

For our project, we used a real sleepiness dataset created by a research team to detect several stages of sleepiness.

The ultimate goal is not only to detect extreme and overt sleepiness, but also to allow our system to detect milder signals of sleepiness. The dataset contains approximately 30 hours of video from 60 different participants. From the dataset, we wereable to extract facial landmarks from 44 videos of 22 participants. This allowed us to obtain a sufficient amount of data foralert and drowsy situations. Visual object detection is also an important problem in computer vision. The Sequence giving the initial state of the camera at the top of the frame. The algorithm can only detect objects with a moving average size between two images. Bolm et al proposed the minimum total square error (MOSSE) output filter using the new method of correlation filtering in computer vision technology. A stable correlation filter can be generated. Although MOSSE has highcomputational efficiency, its algorithm has low accuracy and can only provide gray information on one channel. Along with correlation filters, Li and Zhu use oriented gradient (HOG) histograms, color mapping functions, and scaling histograms to help track objects. Danelljan et al. HOG and discriminant correlation filters for detection. SAMF and DSST solve the problem of deformation or expansion when the tracked target rotates. Additionally, they also fixed the issue that the tracker cannot adaptively track the target and hence runs slowly. After successful execution of deep learning algorithms, some attempts involved deep learning and therefore correlation filters to detect moving objects. Therefore, these algorithmscannot detect real-time elements in a very real environment. The driving force behind the basic approach to defining facesis to obtain important data about the eyebrow, eye, lip and nose regions of the face. Advancing deep learning, the first test by Sun et al. Create DCNN from CNN to distinguish viewpoints. This calculation recognizes only 5 key points of the face above, although it is very fast. To achieve the accuracy of face key recognition methods, Zhou et al. Using FACE++ to streamline DCNN can additionally identify 68 facial key points, but this calculation combines the superior model and operation of this mysterious algorithm. Several CNN layers. Either way, the power of TCNN is based on outrageous information. Kowalski et al. An in-depth ranking system is introduced to identify key points of the face, which prioritize different calculations. Unfortunately, DAN requires large models and complex dependencies. To meet real-time performance requirements, We use dlib to identify the key points of the face. By referring to the existing driver drowsiness detection system, we help to build a more effective "fatigue detection system". We are learning from the results of various research papers and intend to improve existing systems, hence our proposed system. Below are various insights from different articles that are useful for our literature review.

Eye Proximity Analysis: Eye condition is an important characteristic widely used to determine driver drowsiness. Sleepiness includes the rate of eye closure (PERCLOS) and rate of eye retraction (EAR).The EAR is the ratio between theheight and the width of the eye. In contrast, PERCLOS closes as a percentage over a period of time. The main difference between the two is that EAR classifies eye relations as reduced, while PERCLOS classifies eyes as open or closed.

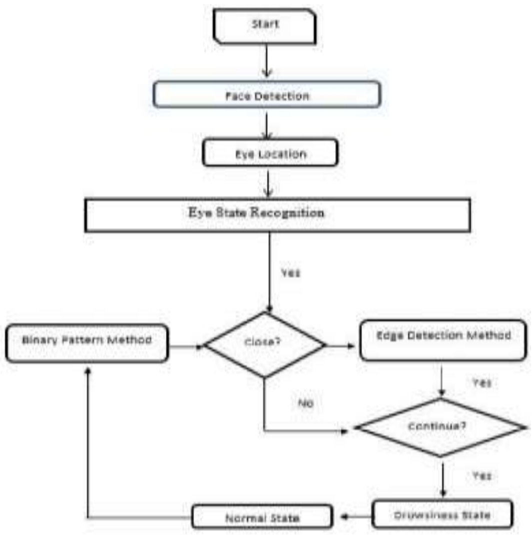

Figure 1: Process of Driver Drowsiness Detection

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Blink Rate: The Blink Rate measurement uses blink rate to measure drowsiness. The normal flashing frequency is about 10 times per minute, and the flashing frequency will be reduced when the driver is asleep.

Facial Analysis: This method uses a combination of facial features to detect driver drowsiness. This includes features such as forehead folds and extreme head positions. The following sequence of steps in the figure above represents a typical procedure for assessing sleepiness. The steps are as follows:

Video Capture: This is the step where the video image from the camera or smart phone is split into a series of frames. The video was shot in such a way that only part of the driver's face was captured.

Face Recognition: The second stage is usually aimed at detecting faces in image frames. Viola and Jones is the most commonly used algorithm for determining the driver's face in an image. However, with CNNs, the entire image is usually transmitted to a network with many filters and automatic detection.

Object Extraction: When applying face detection, various methods such as landmark location, histogram orientation (HOG), and local binary sample (LBP) are usually used to extract features.
Feature Analysis: The extracted features can then be further processed, for example PERCLOS or EAR for eye analysis or mouth-based methods for yawn detection.

Classifiers: The classification stage includes classifiers used to make decisions about driver drowsiness. If the classifier detects signs of drowsiness based on weighted parameters, an alert is triggered, prompting the driver to take a break. This approach has some limitations, as system performance is affected by lighting conditions, camera movement, and The frame rate used to capture the driver photo. Changes in lighting can often be corrected with an infrared camera

Proposed system and calculation of parameters

The proposed HOG-Linear SVM system is designed to successfully identify a drowsy driver and immediately wake him up by sounding an alarm. The system requires a camera to capture live video of the driver behind the wheel. This series of videos analyzes driver drowsiness.

Camera Setup First, the camera is installed in front of the driver, so that we can successfully capture the driver's face for further processing. The camera must be set up so that it does not interfere with the driver, and it must be positioned correctly so that faces are clearly captured to provide accurate results. A Raspberry Pi can be used to integrate components into such a system, but since the Raspberry Pi has very little RAM, the overall load of the build process performing all system operations, rendering GUI and processing activities would be too large. If dlib is compiled on a Raspberry Pi, an error message will be displayed. However, this problem can be solved if we update the Raspberry Pi system to request maximum memory and update the page file size.

The camera can also be connected to a standard laptop computer. After the hardware configuration is complete, the sleep detection algorithm continues to determine which drivers are sleeping with the video stream from the camera.

Face Recognition Next detects the controller face displayed in the video stream. For face detection, we use the Histogram-Oriented Gradient (HOG) function, which uses the gradient address distribution as the function, which is more accurate and faster than other algorithms. Gradient histogram (HOG) image descriptors and linear support vector machines (SVM) can be used to train high-accuracy object classifiers or for specific research on people detectors. In this case, we will configure it for facial recognition. The HOG face descriptor follows the principle that the appearance and shape of local objects can often be well characterized by local gradient distributions or face orientations, even if the exact gradients or edge positions are not known. . In practice this can be achieved by dividing the image window into a small spatial region ("cell"), for each small spatial region a local 1D histogram of gradient directions or edge directions is accumulated over the pixels of the cell.

The combined inputs of plot form a view. For better light invariance, shadows, etc. It is also useful to normalize contrasts of local responses before using them. This can be successfully achieved by dividing the local ”energy” histogram into slightly larger regions of space. (”Block”) and use the result of this to normalize all the cells in the blocks of normalized descriptors will be named as histogram-oriented gradient (HOG) descriptors. By covering the detection window with a dense (actually overlapping) mesh of HOG descriptors and using their Feature vector included in the standard based on linear SVM window classifier gives us detection sequence person.

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Facial Feature Detection and Extraction Once the face is detected, it is a matter of identifying the key points of the faceand retrieving the desired key points of the face. There are many ways to find facial landmarks, but most methods use a set of regression trees to label and locate regions such as the right eyebrow, left eyebrow, right eye, and left eye. This detection algorithm is part of the dlib library. The method works by assigning specific (x,y) coordinates to an area around each facial structure and using this formed set of facial landmarks in the image.

This detector, available in the dlib library, estimates the location of 68 (x, y) coordinates specific to each facial structure. The 68 visual landmark coordinates are shown in the figure below. Given the facial coordinates of the 68 waypoints, we can locate and extract the eye regions using the face indices defined for the left and right eye regions. The right eye can beobtained using coordinates [36.42] and the left eye can be obtained using coordinates [42.48]. These indices are part of the68-point iBUG 300w dataset [21]–[23], where facial landmark detectors are available in the trained dlib library.

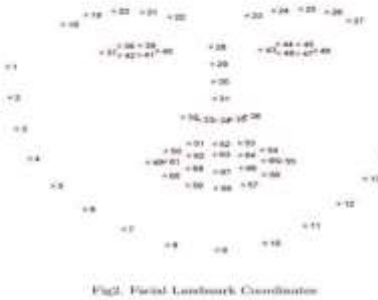

Figure 2: Facial Landmarks on Human Face

Eye Aspect Ratio Determination

To determine whether a driver's eyes are closed and to distinguish between standard blinks and closed eyes in drowsy conditions, the algorithm uses a facial cue detector. Calculates a single scalar called the eye aspect ratio, which indicates whether the eye is closed or not. For each video frame, find the eye area landmarks and use eye height and eye width to calculate Euclidean distance, Eye Aspect Ratio (E.A.R) Sleepiness Rating and Counter E measurements. Determine the A.R value to check if the driver is sleeping. When the driver's eyes are open, the E.A.R value remains constant, but whenthe eyes begin to close, the E.A.R value begins to drop to near zero ear. Regardless of head and body position. Therefore, using these results, we can classify the eye condition at E as open. A. R is zero or close to 0, otherwise the judgment condition is established. The last part is deciding whether to trigger an alert. The average duration of a human blink is100,400 milliseconds, so if the driver is sleeping, their blinks will be longer. In our system, the threshold is set at 5seconds, if it is exceeded, a signal is emitted and a warning appears

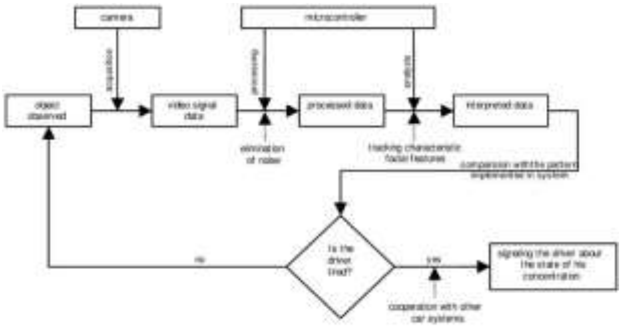

Figure 3: Driver Drowsiness Detection Block Diagram

III.RESULT

There are many behavioral and machine learning techniques that can be used to detect driver drowsiness. This article provides an overview of the use of machine learning methods to detect driver drowsiness and discusses a series of features and metrics for classification. The main purpose of these systems is to detect subtle changes in the driver's facial expressions, which contain information about drowsiness. Although different methods are available to measure sleepiness (behavioral, physiological, and vehicle-based), this review focuses on the behavioral method because it is noninvasive, applicable to a wide range of lighting conditions, and does not necessarily change media.

Figure4: Facial Recognition End Result

Figure 5: Hardware Component of Project

Table no 1: Unit Testing

TEST CASE:	1
NAME OF TEST	Face Detection
ITEM TESTED	Face
Remarks	**Test Successful**

Table no2: Unit Testing

TEST CASE:	2
NAME OF TEST	Eye Detection
ITEM TESTED	Drivers Eyes
Remarks	**Test Successful**

Table no 3: Functional Testing Face and Eyes

TEST CASE:	3
NAME OF TEST	Face along Eyes Detection
ITEM TESTED	Face and Eyes
Remarks	**Test Successful**

Table no 4: Integration Testing System Alert

TEST CASE:	4
NAME OF TEST	System Alert
ITEM TESTED	Buzzer with eyes andface
Remarks	**Test Successful**

IV.DISCUSSION

Future work could focus on exploiting external factors such as vehicle condition, sleep time, weather conditions, mechanical data, etc. For the measurement of sleepiness. Driver drowsiness is a significant threat to road safety, especially for commercial vehicle drivers. Round-the-clock operations, high annual mileage, exposure to harsh environmental conditions, and demanding work schedules all contribute to this serious safety issue. Monitoring drivers' drowsiness and alertness and providing feedback on their condition so they can take appropriate action is an essential step in the series of preventative measures needed to address this issue. Currently, there is no zoom or camera orientation adjustment during operation.As well as hereditary less closed eyes being unable to detect if the driver is drowsy. Future work could include automatically zooming in on eyes after they are located, as well as addressing a person's genetics.

V.CONCLUSION

We learn very common but complex software for this social problem. There are many behavioral and machine learning techniques that can be used to detect driver drowsiness. This article provides an overview of the use of machine learning methods to detect driver drowsiness and discusses a series of features and metrics for classification. The main purpose of these systems is to detect subtle changes in the driver's facial expressions, which contain information about drowsiness. Although different methods are available to measure sleepiness (behavioral, physiological, and vehicle-based), this review focuses on the behavioral method because it is noninvasive, applicable to a wide range of lighting conditions, and does not necessarily change . media.This article discusses machine learning methods such as SVMs, CNNs, and HMMs. Unfortunately, it is difficult to compare these methods, as there are currently only a limited number of standardized data sets available to do so. To answer this question, a meta- analysis was performed. This analysis highlights the effectiveness of CNNs compared to other methods, but also suggests that large data sets and tests are needed to detect sleepiness. Further work will focus on creating a dataset that includes a range of different breeds to allow more reliable comparisons of sleepiness.

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