Human Drowsiness Detection System

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*Abstract*—In this project we are trying to develop a system which will detect fatigue in humans, and it will give warning. Due to drowsiness, office Humans are not able to meet the deadlines of the projects allotted to them. Due to the drowsiness in offices the cost of company increases due to the delay in their projects. In this project the system will continuously monitor the eye of the human using a camera. By applying a perfect algorithm, we can detect the symptoms of drowsiness in people, and we will give a warning to avoid the person falling asleep. This software uses Computer Vision techniques and Machine learning algorithms to analyze and detect drowsiness.

Keywords—Camera, Computer vision, Drowsiness

# Introduction

Drowsiness behaviors which are related to fatigue are in different forms like eyes closed, head nodded or different brain activity [1][2]. Due to the problem of drowsiness many companies face failure issues. So, we can either measure change in physiological signals, such as heart rate or blinking of eyes to monitor drowsiness.

All the former technique, which are more accurate are not realistic for example Electroencephalography (EEG) and Electrocardiography (ECG) may not be practical options as they necessitate specialized equipment and the application of highly sensitive electrodes directly onto the individual [3]. This method of detecting drowsiness will be very annoying and distracting for a person. The second method for measuring drowsiness is by measuring physical changes like eyes open/closed, yawning which can be detected and measured using camera [6][7]. By detecting the time of blinking of eyes one can say person is drowsy or not [8]. Therefore, through ongoing monitoring of an individual's eyes, it becomes possible to identify signs of drowsiness, allowing for timely alerts and potential interventions to counteract drowsiness [8].

# Literature Survey

In this study, the author attempts to address the issue that drivers who drive long distances without frequent breaks incur a high chance of experiencing fatigue, a condition that experts say they frequently fail to identify in time. Sleepy drivers in need of a break are responsible for approximately 25% of significant motorway accidents, according to studies. This means that sleepiness is a bigger cause of road accidents than drunk driving. Attention assist has an extended speed range, can alert drivers to their current level of fatigue and the amount of time since their last break, has adjustable sensitivity, and, if a warning is issued, uses the COMAND navigation system to show the location of nearby service areas. The system conducts real-time processing of a live video feed obtained from the driver's front-facing camera. Upon estimating the driver's fatigue level, the system triggers the alarm mechanism to issue an alert [2].

The researcher investigated about the machine learning and algorithms in this study it also includes supervised learning, unsupervised learning, and reinforcement learning. The objective of the study is to increase public understanding for machine learning and accelerate its involvement by developing theoretical frameworks, improving automated learning capabilities, including diverse digital technologies, and advocating for personalizes services. Artificial intelligence and science are developing at rapid rate, which has opened new development options. Including the vast theoretical knowledge, include statistics and algorithm complexity, into computer-based machine technology enhances the functional attributes of artificial intelligence [4].

This study delves into the exploration of detecting driver drowsiness for BCI applications using fNIRS, with an emphasis on leveraging deep learning techniques. Thirteen individuals without health complications participated to capture passive brain signals linked with drowsiness during a simulated driving scenario. Employing a continuous wave fNIRS setup, researchers measured brain activities, focusing particularly on the prefrontal and dorsolateral prefrontal cortices. The study utilized DNN to classify between alert and drowsy states. Convolutional neural networks (CNNs) were applied to color map images for both model training and testing. The objective was to identify optimal channels for detecting brain activity across time intervals of 0-1, 0-3, 0-5, and 0-1 seconds. The CNN achieved an accuracy of 99.3%, demonstrating its ability to discern between images representing drowsy and non-drowsy states. This suggested method shows potential in identifying drowsiness and determining the specific brain region for a passive BCI system [5].

This research introduces an effective three-phase sleepiness detection approach. The three stages involve eye tracking, yawning detection, and facial feature detection using the Viola-Jones method. After facial detection, the system achieves illumination invariance by selectively isolating the skin portion and consider only the chromatic components to eliminate background interference based on skin tone. The tracking of eyes and detection of yawning are accomplished through correlation coefficient template matching. To classify subsequent frames into tiredness and non-fatigue states, and to trigger an alarm for the former if it surpasses the threshold time, a binary linear support vector machine classifier concatenates feature vectors from each phase. Numerous real-time trials illustrate the effectiveness of the proposed strategy in identifying drowsiness and alerting the driver [6].

The system for determining an individual's level of drowsiness in real time is proposed in this research. By employing artificial intelligence to boost Human productivity, this method seeks to improve society. This system will watch the user's mouth and eyes using a simple webcam that has been coded and positioned right in front of the user to determine whether the user is sleepy. The device will buzz an alarm to notify the Human if it detects signs of tiredness, such as yawning and closed eyes. To identify the target area of the face, it makes use of the idea of image processing. To ascertain whether the subject is yawning and whether their eyes are closed, Open CV is interfaced with Python programming. This project's primary goal is to monitor every Human working online to boost productivity lost to exhaustion and drowsiness at work. The face's outline is first recognized, and then the dlib Library's Facial Landmark Detector file is used to locate the mouth and eyes. To ascertain if the eyes and lips are open or closed, their distance from one another is measured. It is recorded if the mouth is found open for a specified period and the eyes are found closed for the same period. The Human receives an alarm buzz if the same thing happens more than four times [7].

The measurement of eye blinks and movements is accomplished through the use of the EAR, which calculates the ratio of the eye's width to the span between its vertical and horizontal points. EAR has found applications across several areas of scientific research, such as identifying deception and assessing cognitive load. The analysis derived from EAR calculations provides valuable perspectives on different aspects of psychology and human conduct [8].

OGDF serves as a method for designing and organizing graphs, enabling the visualization of complex networks and structures. This robust algorithm facilitates the creation of graph layouts that are both aesthetically pleasing and easily comprehensible [9].

Naive halfway fusion is a method that combines the outputs from multiple convolutional networks by averaging them at the midpoint of the network architecture, before merging them for a final prediction. This technique leverages the distinct features learned by each convolutional network, presenting a straightforward way to boost the performance of a group of these networks. Nevertheless, certain applications might demand more sophisticated fusion strategies for optimal results[10].

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| --- | --- | --- | --- | --- |
| **REFERENCES** | **METHOD USED** | **FEATURES-EXTRACTED** | **CLASSIFIER-USED** | **RESULT** |
| [3] | electroencephalography (EEG),  electromyography (EMG) are used | Different psychological features | Support Vector Machine and K-Nearest Neighbor | 89.7% |
| [11] | Used two methodologies convolutional neural network (CNN) and LSTM | Eye State, Rate of blink | Support Vector Machine | 97.2% |
| [12] | Support Vector Machine and Viola-Jones algorithm are used | Yawn, Movement of head and Eye closure | Support Vector Machine | 94.3% |
| [13] | Paper is reviewed and summarizes different machine learning techniques used | Eye closure rate, pose of head | Different Classifiers | Depend on different studies. |

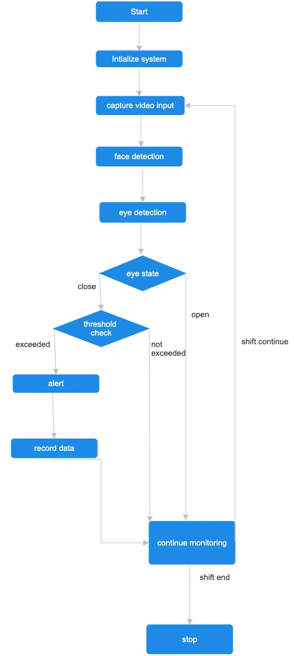
Table1: Analysis of different parameters used

# Proposed system

Our proposed system is entitled Human Drowsiness Detection system. It is designed specifically for the Humans working in organizations who feel drowsy in the working hours due to which sometimes there are delay in projects assigned to them.

The system will work on principle of counter, wherein a limit (say 15) is set above which if the Human is found sleepy (or his/her eyes are closed), then alarm will be played, and data will be stored before the alarm goes on. The counter will increase based on the time for which the Human’s eyes are shut. Also, it will track the productivity of the person by monitoring the keyboard activity done by the Human.

# Methodology



A screenshot of a computer

Description automatically generatedFor our project definition, we have used two different approaches for achieving the solution. The first one is Deep learning model in which we built a Convolutional Neural Networks (CNN) with keras. CNN is a specific kind of deep neural network that is widely recognized for its ability to classify images. A CNN is consists of three primary layers: The architecture includes an input layer, a hidden layer, and an output layer. A filter performs 2D matrix multiplication with both the layers and the filter itself, applying the convolution operation to the constituent layers of the hidden layer. This architecture encompasses various layers with diverse functionalities.

such as the Convolutional layer, fully connected layer, Input layer, and output (Final) layer. Each layer has an activation function and an optimizer except the final(output) layer.

A diagram of a process

Description automatically generated

The second approach to the solution of the Human Drowsiness detection problem is the transfer learning method. Transfer learning is an efficient method for training models on large datasets. Transfer Learning basically takes a pre-existing model and retrains the model on the dataset provided by the user. The main advantage this technique provides is that the total training time for the model is less. But as we are taking an already trained model on a general dataset the model lacks accuracy for the data. So, we can say that transfer learning is a tradeoff between model training time and model accuracy.

# Technology used

These are the technologies used for implementation of Human drowsiness detection system.

1. Python:

Python is recognized for its simplicity and readability. Serving as the main programming language in the code, Python facilitates efficient development and boasts a diverse ecosystem of libraries and tools, rendering it well-suited for a range of tasks, including machine learning and computer vision.

2. OpenCV (Open-Source Computer Vision Library):

OpenCV is a highly popular library in the field of computer vision. Being open-source, it offers a broad spectrum of utilities for processing images and videos, covering tasks like object detection and facial recognition, among others. This project employs OpenCV for real-time detection of faces and facial landmarks, crucial for monitoring faces and eyes in webcam feeds. The widespread adoption of OpenCV in computer vision owes to its swiftness, adaptability, and reliability.

3. Keras:

Keras, recognized for its user-friendly nature and high-level APIs, is an open-source deep learning framework. Functioning as an interface to various deep learning frameworks such as TensorFlow and Theano, Keras is employed in this code to load and execute a pre-trained CNN model designed for eye state classification. The use of Keras streamlines the tasks of constructing and training deep learning models, enhancing accessibility for developers.

4. NumPy (Numerical Python):

NumPy is a crucial library for performing numerical computations in Python. The software offers assistance for handling extensive arrays and matrices with multiple dimensions. Additionally, it includes a variety of mathematical functions. In this project, NumPy is used for array manipulation and image data preprocessing. It helps with data organization and preparation for feeding into the deep learning model.

5. Pygame:

Pygame is a collection of Python modules that are intended for video purposes and can be used on multiple platforms. game development, but it can be used for various multimedia tasks. In our project, pygame is used for sound playback, specifically for playing the "alarm.wav" sound when drowsiness is detected. It provides a simple way to add audio alerts to the system.

6. pynput:

pynput is a Python library for monitoring and controlling keyboard and mouse input. It is used in the project to monitor keyboard activity, including counting keystrokes. The collected data on keyboard activity can be employed for productivity monitoring.

7. os:

The os module is a part of the Python standard library and is used for collaboration with the operating system. Here it is used for file operations, such as saving images captured when drowsiness is detected, and for managing file paths.

8. time:

The time module is another Python standard library module used for time-related functions and operations. In this project, it is employed for adding delays, controlling the timing of alerts, and providing a smoother user experience by controlling the pace of execution.

9. gTTS (Google Text-to-Speech):

gTTS is a Python library that enables text-to-speech conversion. It allows the program to transform text into speech. In this project, gTTS is used to provide spoken feedback and alerts to the user when drowsiness or reduced productivity is detected.

10. dlib:

A C++ library, dlib encompasses an extensive array of machine learning tools and algorithms, incorporating functionalities like facial recognition and object detection. While it's not explicitly mentioned in the project, dlib is capable of face detection and facial landmark prediction, making it useful for similar computer vision tasks.

11. Haar Cascade Classifier:

Haar Cascade Classifiers are XML files that define Haar-like features for object detection. They are commonly used for detecting objects or patterns in images. In our project, Haar Cascade Classifiers are used for detecting the face, left eye, and right eye in the webcam feed. These classifiers are essential for the drowsiness detection component of the system.

The integration of various technologies and libraries, each possessing distinctive capabilities, results in the development drowsiness detection system. This system combines elements of computer vision, deep learning, real-time data monitoring, and alerting features. This powerful combination demonstrates the versatility and capabilities of Python and its libraries in building a real-time Human drowsiness detection and productivity monitoring system.

# Results

A person taking a selfie

Description automatically generated

**Image 1: Human is in alert state**

A person with his eyes closed

Description automatically generated

**Image 2: Human is in sleepy state**

|  |  |  |
| --- | --- | --- |
|  | **Accuracy of Training** | **Accuracy Of Validation** |
| **For CNN** | 98.01 % | 93.07% |
| **For Transfer Learning** | 78% | 74 % |

**Table 2.** Comparison Of Accuracy

# conclusion

In this project we can produce a system that will give notification if a person is feeling sleepy. Detection of drowsiness is done successfully. By making this project we have we are able to learn about TensorFlow and OpenCV. So, on my final count we added some extra fields by sending the daily drowsiness report to the HR department. It will also provide the productivity report of the Humans based on the results obtained.

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