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EMPLOYEE DROWSINESS DETECTION SYSTEM

Jaitee Bankar*[1], Sarvesh Pawar*[2], Raj Sodanwar*[3], Jay Shinde*[4]

*[1]Assistant Professor, Department Of Information Technology, R.M.D Sinhgad School Of Engineering, Pune, Maharashtra, India.

*[2,3,4]Student, Department Of Information Technology, R.M.D Sinhgad School Of Engineering, Pune, Maharashtra, India.

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ABSTRACT

The paper introduces a system designed to detect drowsiness in real-time. Developed to enhance workplace productivity through Artificial Intelligence, this system uses a basic webcam equipped with specific programming to monitor the user's eyes and mouth, determining signs of drowsiness. If drowsy behaviors, such as yawning or closed eyes, are identified, an alarm sounds to alert the employee. The system leverages Image Processing to pinpoint facial areas and uses Python and OpenCV to assess whether the user's eyes are closed or they are yawning.

The project's primary goal is to monitor employees working online to counteract productivity loss due to fatigue. Initially, the system identifies the facial outline, then locates the eyes and mouth using Dlib's Facial Landmark Detector. Once these areas are marked, it calculates the distance to check if the eyes are closed or if the mouth is open. If the eyes remain closed and the mouth open for a specific period, the system logs this. Should this pattern persist four times or more, the employee receives an alert through a buzzing sound.

Keywords: Drowsiness, Facial Landmark Detection, Python, Employee Productivity, Artificial Intelligence, Dlib Library, Face Detection.

I. INTRODUCTION

Employee drowsiness and work fatigue significantly impact productivity and lead to underperformance. According to Microsoft's recent Work Trend Index survey, which included data from about 6,000 workers across eight countries, 29% of Indian workers reported increased burnout—the second-highest rate in Asia. This project aims to boost employee productivity by detecting and monitoring drowsiness in real-time, preventing workers from falling asleep and alerting them promptly during work or meetings. The system focuses solely on image processing to extract eye and mouth regions from an individual's face to assess sleepiness. The project follows a structured process:

- Image Acquisition
- Face Detection
- Eye/Mouth Region Detection
- Eye/Mouth Counter Extraction
- State Analysis

Once the eyes and mouth are identified, the system assesses whether the employee shows signs of drowsiness. It addresses two major challenges: blinking and eye closure due to prolonged screen exposure. By applying an optimal threshold, the system only triggers an alert if signs of drowsiness persist over four instances, effectively reducing false alerts.

II. METHODOLOGY

To implement this project in a terminal, the system will guide users step-by-step through each library and component used. Key libraries include:

- OpenCV: Supports real-time computer vision and model execution for machine learning.
- Dlib: An open-source library for machine learning tasks such as classification, regression, and data transformation. This library was challenging to integrate but is crucial for detecting facial landmarks to monitor employees.

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- NumPy: Used for numerical tasks like Fourier Transforms, linear algebra, and matrix operations.
- Time and imutils: The latter assists in video streaming.

To isolate the face within the video frame, the system uses the Haar Cascade Classifier, where a "Detector" is trained with a frontal face file. This is complemented by a "Predictor" using the Shape Predictor 68 landmarks.dat file to pinpoint specific facial landmarks. Once landmarks are identified, the system extracts points for the eyes and mouth. Using these, it calculates the Eye Aspect Ratio (EAR) and Mouth Aspect Ratio (MAR) to detect signs of sleepiness or drowsiness in the individual.

The estimations for EAR and MAR are displayed as:

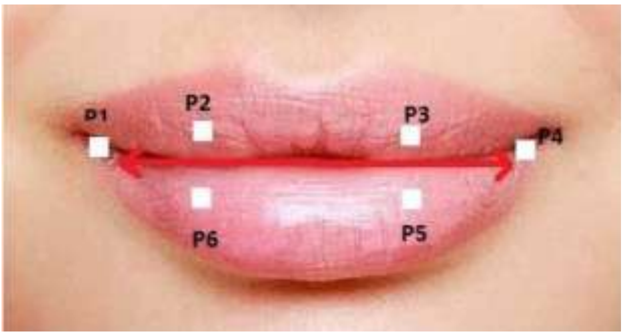

Figure 1: Shape Predictor Landmark for Closed Mouth.

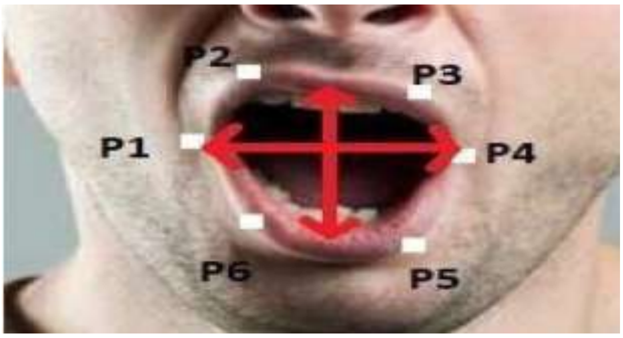

Figure 2: Shape Predictor Landmark for Open Mouth.

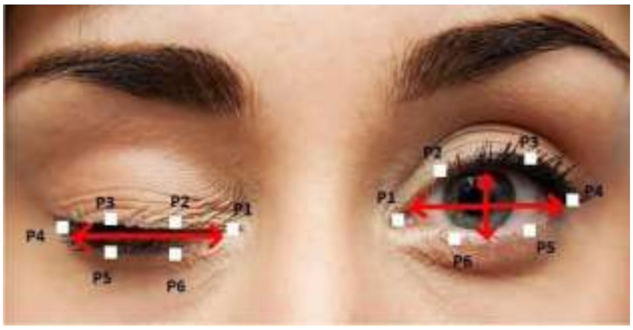

Figure 3: Shape Predictor Landmark for Open & Closed Eyes.

A. Formula for Eye & Mouth Aspect Ratio

$$EAR=MAR= \frac{|P2-P6|+ |P3-P5|}{2\ |P1-P4|}$$

B. Yawn Detection

A continuous video feed of the employee's face is monitored to detect gestures like yawning, which indicate signs of fatigue. A small camera, integrated within the laptop, records and analyzes the employee's behavior to identify signs of drowsiness, such as yawning.

C. Eye Closed Measurement

In addition to monitoring yawning, the system uses a camera to check whether the employee's eyes are open or closed. According to the Haar-cascade dataset, normal blinking lasts between 100-400 milliseconds. If the camera detects that an employee's eyes remain closed for longer than this threshold, it flags the individual as drowsy. If this occurs more than four times, an alert is triggered to ensure the employee remains attentive.

III. MODELING AND ANALYSIS

The Employee Alerting System using Real-Time Drowsiness Detection is developed with Python and OpenCV. This system utilizes a webcam to continuously monitor the employee's face, detecting facial landmarks. It tracks the face in real-time, and once drowsiness is detected—based on factors like eye closure and yawning—it triggers a warning after the fourth occurrence. Additionally, the system displays a count of the eyes closed and yawning events on the screen, allowing the user to view the drowsiness indicators. The system extracts the face region of an individual and identifies the positions of the eyes and mouth. It utilizes the Facial Landmark Detector file from the Dlib library in Python, which maps the face using coordinates to define the facial structure. This approach simplifies the process of identifying key facial features, such as the eyes and mouth, by referencing their specific coordinates. The Employee Alerting System uses Python and OpenCV to monitor employees' facial landmarks in real-time, detecting signs of drowsiness like eye closure and yawning. By leveraging the Dlib library's Facial Landmark Detector, the system accurately identifies the eyes and mouth to track drowsiness and issue alerts after multiple occurrences.

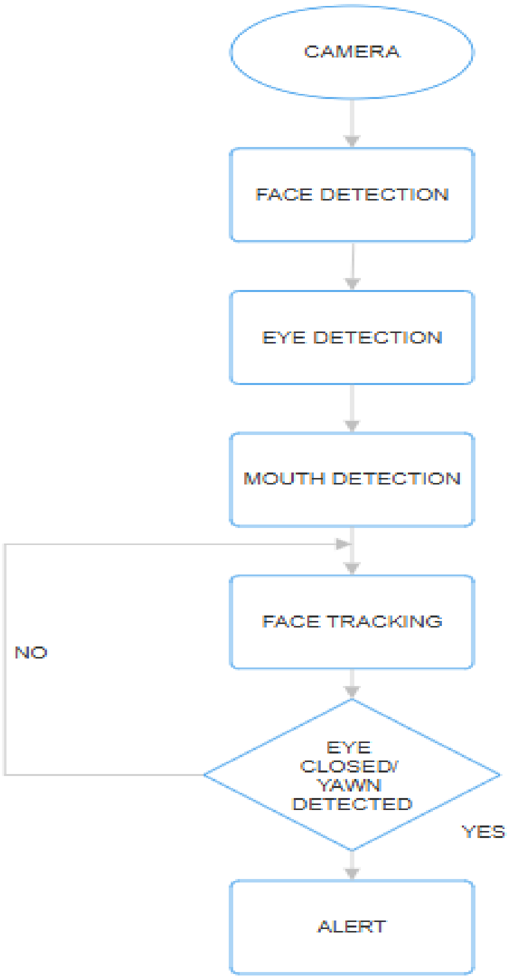

Figure 4: Flowchart of the proposed system.

Here's how the system visualizes the facial mapping coordinates:

In this system, the coordinates for the left eye range from points 36 to 41, and the coordinates for the right eye are from points 42 to 47. The coordinates for the mouth span from points 48 to 67.The system detects the eyes within these specified coordinates. The distance between the eyes is then calculated using the Eye Aspect Ratio (EAR) and Mouth Aspect Ratio (MAR) formulas. If the EAR for the eyes is below 0.18, and the MAR for the mouth reaches a threshold of 42 (as defined by the system), it indicates signs of sluggishness or drowsiness.

Figure 5: Facial Landmark Coordinate.

IV. RESULTS AND DISCUSSION

In this project, a drowsiness detection system was developed to monitor employees for signs of fatigue, enhancing workplace safety. The system typically used a combination of facial landmark detection, eye-blink detection, and head-pose estimation. The alert system successfully activated when drowsiness indicators were detected.

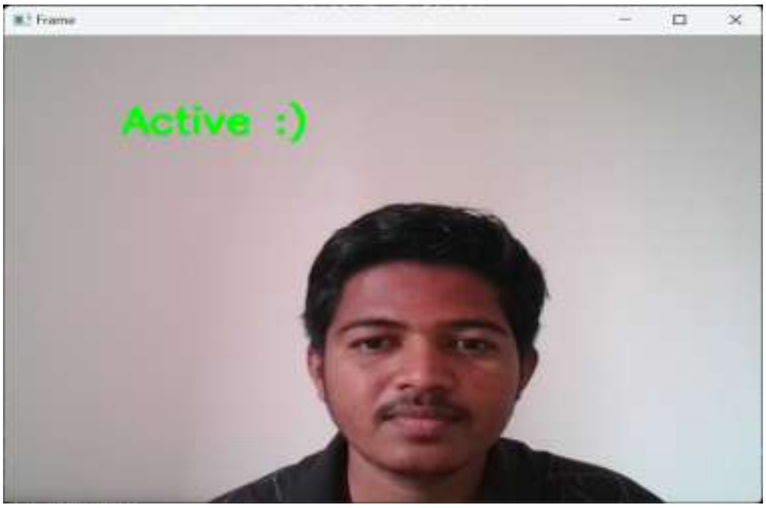

Figure 6: Activeness is Detected

Figure 7: Drowsiness is detected

Figure 8: Closed eyes are detected

V. CONCLUSION

The Employee Drowsiness Detection Project effectively showcased its potential to improve workplace safety by continuously monitoring real-time fatigue indicators. By analyzing eye and mouth aspect ratios to detect extended eye closures and yawns, the system reliably identified drowsiness signs and promptly alerted employees to refocus. While factors such as lighting and camera quality affected accuracy, the system demonstrated consistent performance under optimal conditions.

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