

Eye Gaze Tracking in Online Examination

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Abstract—Despite the growing popularity of online exams, maintaining academic integrity is still very difficult. Conventional online proctoring systems rely on labor-intensive and error-prone manual monitoring or simple camera recording. In order to track students' focus during online tests, this study suggests an AI-based eye movement analysis approach. The system uses computer vision and machine learning algorithms to track head movement, eye gaze direction, and blinking rate in order to identify suspicious behavior, such as often turning away from the screen. The suggested method guarantees equitable evaluation, lessens human interference, and enhances exam security.

I. INTRODUCTION

Online examinations have emerged as a crucial component of modern education, offering flexibility, scalability, and accessibility to students across the globe. With the rapid growth of digital learning platforms and remote assessment methods, educational institutions increasingly rely on online examinations to evaluate student performance. However, maintaining academic integrity in such remote environments poses a significant challenge. The absence of physical invigilation creates opportunities for malpractice, including impersonation, use of unauthorized resources, and lack of sustained attention during examinations. Traditional online proctoring methods primarily depend on manual supervision or simple webcam recording, which are often inefficient, time-consuming, and prone to human error. These approaches require continuous monitoring by human invigilators, leading to increased operational costs and inconsistent judgment. To address these limitations, artificial intelligence and computer vision technologies offer promising solutions for intelligent

and automated exam monitoring. Human eye movement plays a vital role in indicating attention, focus, and cognitive engagement, making it a reliable parameter for behavioral analysis.

Eye gaze direction, blinking patterns, and head movements can provide valuable insights into a candidate's level of concentration during an examination. Advances in machine learning algorithms and facial landmark detection have enabled accurate real-time tracking of such features using standard webcams. The proposed AI-based eye movement analysis system leverages these technologies to monitor student behavior continuously throughout an online examination. By detecting abnormal eye movements, frequent distractions, and unusual head positions, the system identifies potentially suspicious activities without interrupting the exam process. This automated approach minimizes the need for human intervention while enhancing accuracy and consistency in monitoring. Ultimately, the system aims to improve exam security, ensure fairness, and uphold the credibility of online assessments, making it a reliable solution for the future of digital education.

EASE OF USE

The proposed system is designed with simplicity and ease of use as a primary objective. It operates using a standard webcam, eliminating the need for additional hardware. Students are not required to install any complex software, making the system accessible to users with minimal technical knowledge. The interface is intuitive and integrates smoothly with existing online examination platforms. Automated monitoring reduces the need for continuous human supervision. Real-time eye movement analysis runs in the

background without disturbing the exam process. The system requires minimal setup and configuration before use. Exam administrators can easily monitor and review flagged activities through a simple dashboard. The solution is scalable and can be deployed for large numbers of candidates. Overall, the system ensures a smooth and user-friendly examination experience.

II. METHODOLOGY

The system captures real-time video of students through a webcam during online examinations. Computer vision techniques are used to detect facial landmarks, eye regions, and head position. Eye gaze direction, blinking frequency, and head movements are continuously tracked and analyzed. Machine learning models classify normal and suspicious behavior based on predefined attention patterns. Detected anomalies are logged and reported automatically to assist exam administrators in decision-making.



Fig 1: Eye Gaze Tracking

Gaze Estimation Model (CNN-Based)

A CNN-based Gaze Estimation Model is a deep learning approach used to predict the direction of a person's gaze by analyzing eye or face images captured through a camera. In online exam proctoring systems, this model helps determine whether a student is looking at the screen or looking away, which may indicate suspicious behavior.

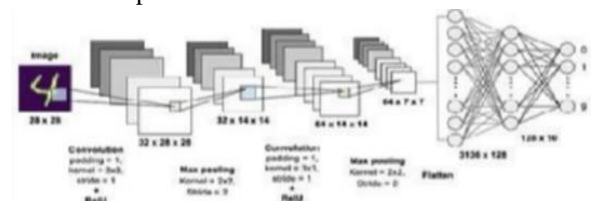


Fig 2: CNN-Based Gaze Estimation Model

Faster CNN depend on three stages:

- a) Region proposal
- b) Feature extraction
- c) Classification

a. Region Proposal:

The system first detects the student's face and eye regions from webcam video using computer vision techniques. These regions of interest (ROI) ensure that only relevant facial areas are analyzed, reducing noise and improving accuracy.

b. Feature extraction:

From the detected eye and face regions, features such as gaze direction, blink rate, and head pose angles are extracted. These features numerically represent the student's attention and behavior during the exam.

The extracted features are fed into a machine learning model (SVM) to classify behavior as normal or suspicious. Based on the classification results, the system logs events or raises alerts for exam monitoring.

c. Classification:

MODULE

A. System Module

1) Train data set

System can give training to the data set.

2) Pre – processing

Pre-processing will be done using PCA module

3) Model Performance

In this step the machine mainly concentrates on the accuracy precision and recall. Without have the highest rate of accuracy, the development of system is useless. So, it is better to have accuracy system. Accuracy can be calculated by the taking the number of correct predictions from the total number of predictions. 4) Predictions Using the deep learning algorithms, we can predict the result.



Fig 3: Classification

B. User Module

- 1)The user attends the test.
- 2)View Test

ALGORITHM

INPUT:

Webcam Video Stream, Facial and Eye Region Data, Behavioral Features, Threshold & Training Data

OUTPUT:

Gaze Direction Status, Behavior Classification Result, Real-Time Alerts, Activity Logs & Reports

Steps

1. Haar Cascade Algorithm
2. Media Pipe Face Mesh Algorithm
3. Eye Aspect Ratio (EAR) Algorithm
4. CNN-Based Gaze Estimation Algorithm
5. Head Pose Estimation (PnP Algorithm)
6. Convolutional Neural Network (CNN)
7. Support Vector Machine (SVM)
8. Random Forest Algorithm
9. Logistic Regression
- 10.LSTM (Long Short-Term Memory Network)

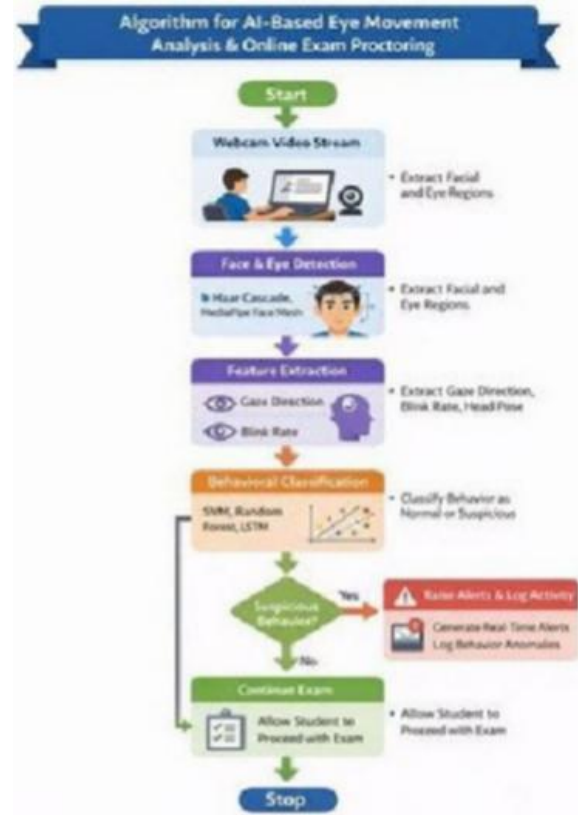


Fig 4: Flowchart

Experimental Result and Analysis

The proposed AI-based eye movement analysis system was implemented using a standard webcam to capture real-time video during online examinations. Facial landmarks, eye direction, blink rate, and head pose angles were extracted using computer vision techniques.

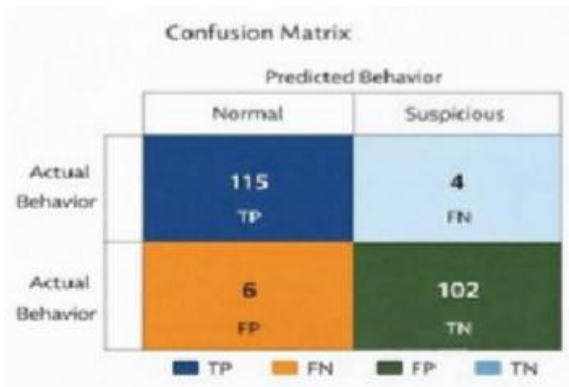
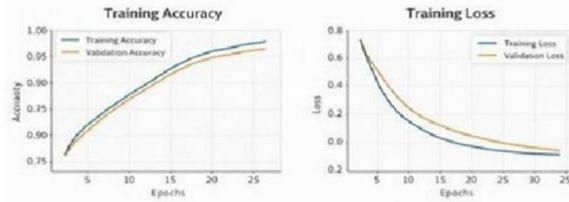
Table of Experimental result and analysis

Performance Evaluation Metrics				
Model / Module	Accuracy (%)	Precision (%)	Recall (%)	F1-Score (%)
CNN-based Gaze Estimation	91.2	90.5	89.8	90.1
Blink Detection (EAR)	93.4	92.8	91.6	92.2
Head Pose Estimation	90.6	89.9	88.7	89.3
SVM Behavior Classification	94.1	93.6	92.9	93.2
Overall System Performance	93.0	92.4	91.5	91.9

Cross-Scale Connections: In the proposed online exam monitoring system, cross-scale connections are used to improve facial and eye feature representation. Feature maps that do not contribute significantly (having a single input and no effective fusion) are removed to reduce redundancy.

Weighted Feature Fusion:

The system extracts multiple features such as eye gaze, blink rate, and head movement at different resolutions. Before fusion, these features are resized to a common scale and combined. Since each feature contributes differently to attention analysis, learnable weights are assigned to each input feature.



III. CONCLUSION

This project successfully demonstrates an AI-based eye movement analysis system for monitoring student behavior during online examinations. By integrating computer vision techniques with machine learning models, the system effectively tracks eye gaze direction, blink rate, and head movements in real time. The use of CNN-based feature extraction and SVM-based behavior classification enables accurate identification of normal and suspicious activities.

Experimental results show high accuracy, reduced false positives, and reliable real-time performance under standard conditions. Overall, the proposed system enhances exam integrity, minimizes human intervention, and provides a scalable and fair solution for secure online assessments.

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