Project Report On

AI BASED ONLINE PROCTORING SYSTEM

By

Lavesh Salaskar

Ankit Shetty

Department of
Electronics & Telecommunication Engineering

Vidyavardhini's College of Engineering & Technology

University of Mumbai

2022-2023

AI BASED ONLINE PROCTORING SYSTEM

submitted in partial fulfillment for the requirements

of degree of ***Bachelor of Engineering*** *in*

Electronics & Telecommunication Engineering

by

Lavesh Salaskar(38)
Ankit Shetty(40)

Supervisor

Dr. Vikas Gupta

Department of
Electronics & Telecommunication Engineering
Vidyavardhini's College of Engineering & Technology
University of Mumbai

2022-23

Project Report Approval for Bachelor of Engineering

This project report entitled

AI BASED ONLINE PROCTORING SYSTEM

by

Lavesh Salaskar(38)
Ankit Shetty(40)

*for the award of degree of **Bachelor of Engineering** in*

Electronics & Telecommunication Engineering

by the University of Mumbai during the academic year 2022-2023.

Supervisor : Dr. Vikas Gupta ( )

Internal Examiner : _____ ( )

External Examiner : _____ ( )

Dr. Amrita Ruperee	Dr. Harish Vankudre
HOD, EXTC	Principal, VCET

Date: _____

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Lavesh Salaskar(38) ( )

Ankit Shetty(40) ( )

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Acknowledgement

It is our privilege to express our sincere gratitude to our project guide, Dr. Vikas Gupta, alumni, mentor and industry expert Mrs. Asha Parmar, and all the teaching as well as non-teaching staff for their input, able guidance, cooperation, and constructive criticism throughout the duration of our project. We would like to extend our gratitude to Principal Dr. H. V. Vankudre and HOD Dr. Amrita Ruperee for their moral support and encouragement. We would also like to thank Vidyavardhini's College of Engineering & Technology and the Department of Electronics& Telecommunication for providing us with an ideal learning environment and facilities to undertake this project.

Lavesh Salaskar(38)

Ankit Shetty(40)

Abstract

Due to the lockdown environment, the world has shifted its normal practices to online modes. Due to which the exams for various schools, colleges face the problem of using a large number of personnel to proctor the students manually failing to ensure continuous integrity and security aspects of the examination. These results encouraging examinees to use unethical methods to score more in exams and falsely grading the knowledge and ability of a student. Also, in general, in online examinations, a human cannot proctor at large scales, effectively.

The aim is to develop a proctoring system capable of monitoring at scale, and ensuring that examinees do not engage in cheating or any other unethical behavior.

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Chapter 1
Introduction

The current pandemic situation has forced colleges and schools to advance their ongoing curriculum. Technology played a pivotal role in leveraging the online mode of learning when the lockdown restrictions took place. As a result, many educational institutions transitioned to online test-taking as physical examinations were stalled, resulting in higher demand for online proctoring tools. Also, the exams for various schools, colleges face the problem of using a large number of personnel to proctor the students manually failing to ensure continuous integrity and security aspects of the examination and a human cannot proctor at large scales, effectively. This poses several issues like abnormal behavior by the student, failing to ensure continuous integrityand security aspects of the examination like unauthorized access to different system components (e.g. cheating and malpractices). Although it allows students to take their tests online in a remote location while managing the integrity of the examination, this may also result in falsely grading the knowledge and ability of a student. Proposed system automates the proctoring process at scale with the aid of computers, and reduces the load on human proctors

1.1 Aim and Objectives

The aim of the project is to develop a computer vision-enabled and AI-powered proctoring system that assists human proctors in various types of online examinations. This system uses multimedia streams such as video and audio from the user as input data, which is processed along with a few system variables. Relevant information is extracted, and the data is then fed into an algorithm that calculates the probability of the user engaging in malpractices.

To achieve the project aim, the following objectives have been identified: to develop a proctoring system that can efficiently identify cheating behavior, accurately identify malpractices, consume fewer resources, and be user-friendly. The developed system aims to be efficient in identifying cheating behavior, accurate in detecting malpractices, requiring fewer resources, and user-friendly to ensure the ease of use for both the proctor and the examinee. Achieving these objectives will provide an effective and reliable proctoring system that helps maintain the integrity of online examinations.

Chapter 2
Literature Survey

The Paper[1] proposed systematic review of existing literature on online exam solutions in e-learning. The review aims to answer nine relevant questions related to online proctoring, which include leading studies, online exam features, development approaches, techniques/algorithms, existing tools, datasets, and country participation in research. Through this systematic review, the paper provides an overview of the current state of research in online proctoring and highlights the techniques, tools, and global adoption of online exam solutions in e-learning. The findings of this review can serve as a valuable resource for researchers, educators, and practitioners interested in online exam solutions in e-learning.

The Paper[2] presentan efficient approach based on Convolutional Neural Networks (CNN) for performing three tasks related to facial analysis: face verification, recognition, and clustering. The first task involves verifying whether two faces belong to the same person or not, while the second task aims to recognize the identity of an individual in a given image. The third task involves clustering the faces based on their similarity to identify common individuals. The proposed CNN-based approach offers a robust and accurate solution for these tasks, which are crucial for various applications such as security systems, surveillance, and social media analysis. The experimental results demonstrate the effectiveness of the proposed approach in achieving high accuracy in all three tasks. Overall, this paper provides a valuable contribution to the field of facial analysis by proposing an efficient and effective CNN-based approach for face verification, recognition, and clustering.

The Paper[3] presentsa basic framework for a secure online examination system that aims to address various security concerns related to the design of the online examination webpage and network. The paper proposes a combination of different security measures, including the use of a firewall on the system server, and a proxy and MMC (Microsoft Management Console) on the client system. The proposed security measures aim to ensure the integrity, confidentiality, and availability of the examination system, by preventing unauthorized access and ensuring that the system is not vulnerable to external threats. The firewall helps to filter out unwanted traffic and

unauthorized access attempts, while the proxy and MMC on the client system provide an additional layer of security by restricting access to the online examination system to authorized users only. The proposed framework provides a robust and secure solution for online examinations and can be useful for educational institutions, organizations, and companies conducting online assessments. Overall, this paper highlights the importance of designing a secure online examination system and provides a basic framework that can be used as a foundation for more advanced and sophisticated systems.

The Paper[4] proposes a comprehensive discussion of various techniques and algorithms related to online proctoring, with a focus on the hardware requirements needed for their implementation. The paper explores different techniques that can be used for online proctoring, including user verification, text detection, speech detection, active window detection, gaze estimation, phone detection, and cheating behavior detection. User verification techniques involve verifying the identity of the user taking the exam, while text detection techniques focus on detecting any unauthorized text present during the exam. Speech detection techniques aim to detect any audio activity that could indicate cheating, while active window detection techniques ensure that the test-taker is not accessing any unauthorized applications or windows. Gaze estimation techniques can detect any abnormal eye movements that could indicate cheating, while phone detection techniques aim to prevent the use of mobile devices during the exam. Finally, cheating behavior detection techniques use advanced algorithms to detect any suspicious or abnormal behavior during the exam. Overall, this paper provides a valuable resource for educators and practitioners interested in online proctoring techniques and algorithms, and highlights the importance of hardware requirements in their successful implementation.

The Paper[5] designed and implemented a Study about Motivational Factors This study aims to identify the motivational factors that determine the implementation of an evaluation system. The study identifies a list of motivational factors that are critical to the successful implementation of such a system. These factors include quality management (QM), available information (AI), external conditioning (EC), trust (T), perceived compatibility (PC), perceived usefulness (PU), attitude (A), and intention (I). Quality management refers to the importance of ensuring high-quality standards throughout the implementation process, while available information highlights the need for relevant and accurate information to be available to stakeholders. External conditioning refers to the external factors that can influence the implementation of the evaluation system, while trust highlights the importance of building trust and confidence among

stakeholders. Perceived compatibility refers to the alignment between the evaluation system and the goals and values of the organization, while perceived usefulness highlights the importance of the system being seen as beneficial and useful by stakeholders. Attitude and intention refer to the mindset and willingness of stakeholders towards the implementation of the system. Overall, this study provides a valuable insight into the motivational factors that determine the successful implementation of an evaluation system and can be useful for organizations and institutions seeking to implement such a system

2.1 Analysis Table

In Analysis Table No. 2.1, a detailed analysis of the research papers has been conducted.

Table 2.1 Analysis Table

Title	Technique(s) Used	Conclusion
A Systematic Review of Online Exams Solutions in E- Learning: Techniques, Tools, and Global Adoption. [1]	Literature survey.	Found various existing onlineproctoring tools and their features.
FaceNet: A unified embedding for face recognition and clustering. [2]	Convolutional Neural Network.	Face verification, recognition and identification of common people among these faces was done.
Toward constructing a secure online examination system. [3]	Network security.	Security problem was discussed and solutions were proposed. Network security was also explored.
Automated Online Exam Proctoring. [4]	Discussion on various techniques and algorithms for various features required for proctoring.	Multimedia was used as basis for analytics for proctoring system.
Implementation of e-proctoring in online teaching: A Study about Motivational Factors. [5]	Locates the motivational factors determining the implementation of the evaluation system.	Limited to study of motivational factors, which could be eliminated by future studies.

Chapter 3
Problem Definition

In online examinations, a human cannot proctor at large scales, effectively. This posses several issues like abnormal behavior by the student, failing to ensure continuousintegrity and security aspects of the examination like unauthorized access to different system components (e.g., cheating and malpractices). This results in falsely grading the knowledge and ability of a student.

Proposed system automates the proctoring process at scale with the aid of computers, and reduces the load on human proctors

Chapter 4
Proposed Approach

The chapter has a complete description of the working and Implementation of the Project. A process diagram along with the algorithm used are shown here.

4.1 Process Diagram

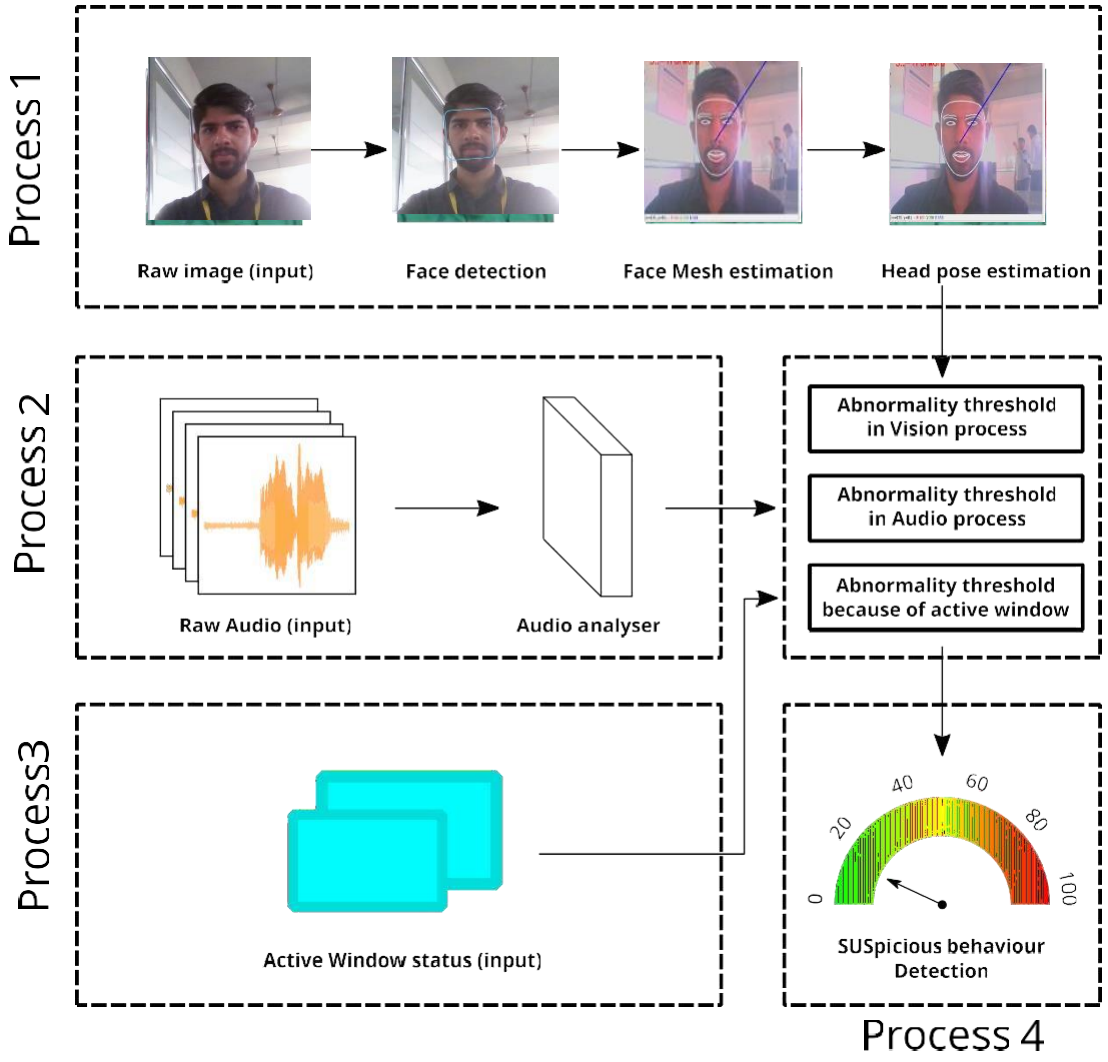

Figure 4.1 Process Diagram.

The process 1 does the head pose estimation of the module in which computer vision is used to get the angle of the head. Process 2 is used for speech detection; the audio is analyzed using a sound processing algorithm which detects speech based on the amplitude of the sound recorded.process 3 is used to make sure that the user is currently on the exam window. Data is then fed ina conditional algorithm which gives the suspicious behavior detection percentage based on set weightage.

4.2 Modules

1) **Hardware Components:**

   It is assumed that the user attending the exam will have access to a relatively modern system with a camera and microphone. One of the major challenges with the hardware is that the entire detection and validation process will be processed on the user's client device, which has limited processing resources. To address this, the system has been designed with lightweight algorithms that can run on low-spec devices. The computer will provide important system parameters, while the camera will provide the raw video stream and the microphone will provide the raw audio stream.

2) **Speech Detection**:

   In the context of exams, speech can serve as a means of communication for assistance. The assumption is made that the examinee is situated in a silent environment with no external disturbances. However, a significant challenge in speech detection is the occurrence of false positives, as there might be some background noise in the environment. To address this issue, a proprietary audio processing algorithm has been developed. This algorithm detects changes in the amplitude of background noise and measures the frequency of these changes relative to the idle noise value. By doing so, it can determine whether the examinee or an accomplice is speaking.

3) **Head-pose Detection:**

To detect abnormal behavior during exams, supervisors often monitor the direction of the examinee's gaze. In this project, the same concept is used to determine the direction/angle of the examinee's head. However, detecting the face and head orientation using computer vision algorithms can be challenging as it often requires significant amounts of training data and high-end graphic hardware. To overcome this challenge, third-party open-source algorithms from the MediaPipe library developed by Google are utilized. These algorithms can work effectively on low-end devices and provide accurate face landmarks. The Perspective-n-Points algorithm is then employed, utilizing an open computer vision library to process these landmarks and provide the 3D orientation of the user's head.

4) **Cheating Behavior Detection:**

The final output of the analysis is produced by the prediction algorithm, which utilizes data from the speech and video detection modules. The challenge here is to effectively integrate these data points and eliminate false positives. To address this, a lightweight in-house algorithm is used to process the extracted features and calculate the probability of cheating. The amplitude of sound is used to detect user speech, which is then stored as a flag indicating whether the user is speaking or not. Head pose detection is used to identify the direction of the user's gaze, with a threshold applied to the head angle. If the angle exceeds the threshold, two flags, x-axis and y-axis, are used to store the head pose. These flags, along with the sound flag and previous output, are then fed into a probabilistic conditional algorithm to predict the likelihood of suspicious behavior, expressed as a percentage of surety.

4.3 Analysis

The system has been designed with specific functional and non-functional requirements. The functional requirements include the use of sensors to monitor the user, processing the output of sensors, and giving feedback to the proctor based on sensor data.

On the other hand, the non-functional requirements comprise portability, reliability and security, performance and flexibility, capacity and scalability. The system needs to be portable, reliable, and secure. It should also be able to perform efficiently and flexibly. Furthermore, it should have the capacity to scale up as needed. These requirements have been considered during the design and implementation of the system to ensure that it meets the expectations and needs of the users.

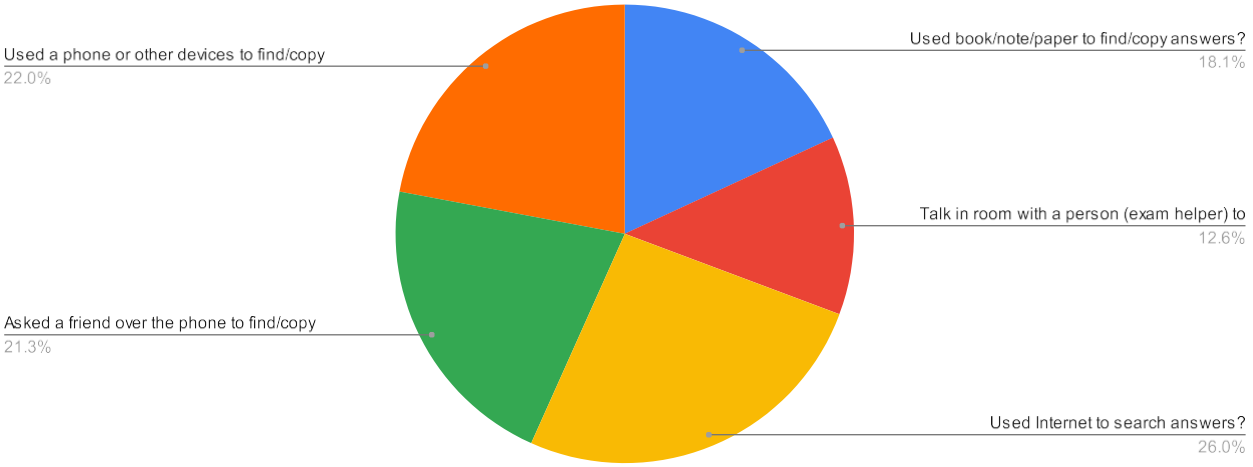

Figure 4.2 Analysis of cheating methods used (a survey).

4.4 Implementation Methodology

Three different methods are used in this proposed system which explain below:

For head pose estimation, we use OpenCV library for python for images capture and prepossessing. The MediaPipe library by Google is used for face recognition. It is an open-source ML library for various computer vision applications. We use the face recognition module to detect the face in the captured image. Then we use the PnP library to calculate the angle of the head and use that data to get the head angle data. We apply a threshold to the angle of the head pose on the X and Y axis such as if the user looks beyond the threshold, then it is detected as looking beyond the screen.

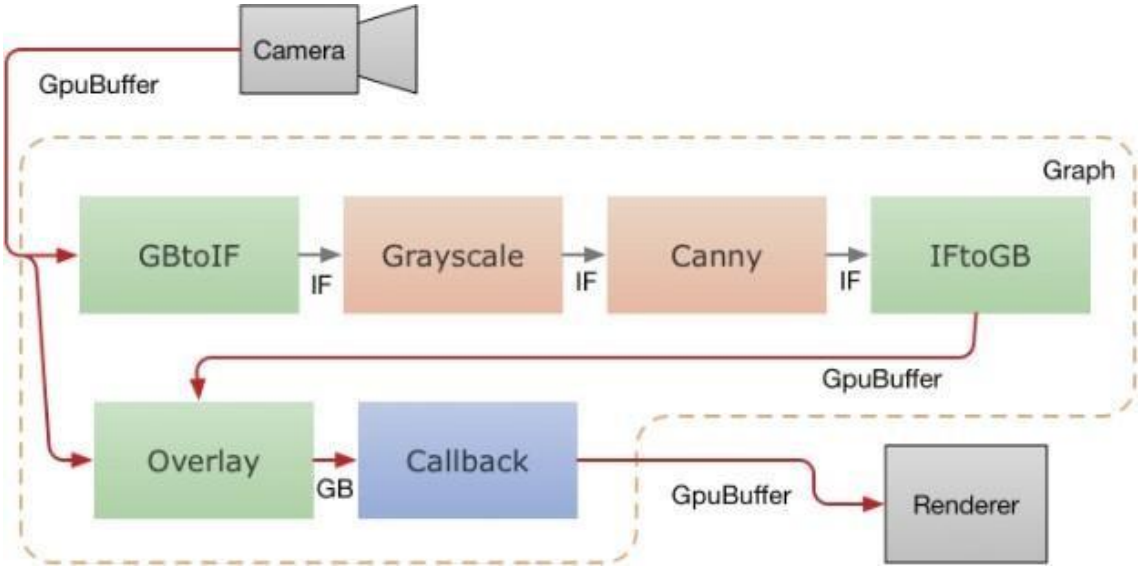

Figure 4.3 Face recognition algorithm processing.

If the user is looking right or left then the value of x-axis changes. If the user is looking left then it goes to the negative side of zero and if the user looks right then the value goes to the positive side of zero. And similarly, if the user looks up or down then the y-axis value changes. The values of x-axis and y-axis are then passed through an algorithm which checks whether it goes above the threshold then it changes the flag.

We detect audio in student's environment using sounddevice library in python. We use frames as input, and get its amplitude. Number of frames is monitored continuously and its amplitude is averaged out. If this average is greater than the threshold set by us over a period of time we consider it as suspicious behavior and feed appropriate weights to our algorithm for further processing.

For suspicious behavior detection we have used different flags pertaining to different inputs and these flags are then fed into a conditional algorithm which has set biases for different inputs. When a condition is satisfied, the resulting percentage output is added with a factor to the previous percentage to make the resulting percentage by time graph more continuous and not be in a step graph. When the suspicious percentage is above the set threshold then it is detected as cheating.

Previous Cheat	X axis	Y axis	Audio cheat	Final Cheat Percentage
0	0	0	0	0
0	0	0	1	0.2
0	0	1	0	0.2
0	0	1	1	0.4
0	1	0	0	0.1
0	1	0	1	0.4
0	1	1	0	0.15
0	1	1	1	0.25
1	0	0	0	0
1	0	0	1	0.55
1	0	1	0	0.55
1	0	1	1	0.85
1	1	0	0	0.6
1	1	0	1	0.85
1	1	1	0	0.5
1	1	1	1	0.85

Figure 4.4 Weightages for conditional algorithm.

Chapter 5
Result and Discussions

After the project was implemented, it underwent evaluation and testing on various parameters, and the results were listed and outputs were plotted accordingly.

The sounddevice library in Python was utilized for measuring the intensity of the sound in the audio, while the OpenCV library for Python was used for image capture and preprocessing.

For face recognition, the MediaPipe library by Google was employed as an open-source ML library for various computer vision applications.

The face recognition module was utilized to detect the face in the captured image, and the PnP library was used to calculate the angle of the head, which was then utilized to obtain the head angle data. A threshold was applied to the angle of the head pose on the X and Y axis, and if the user looked beyond the threshold, it was detected as looking beyond the screen.

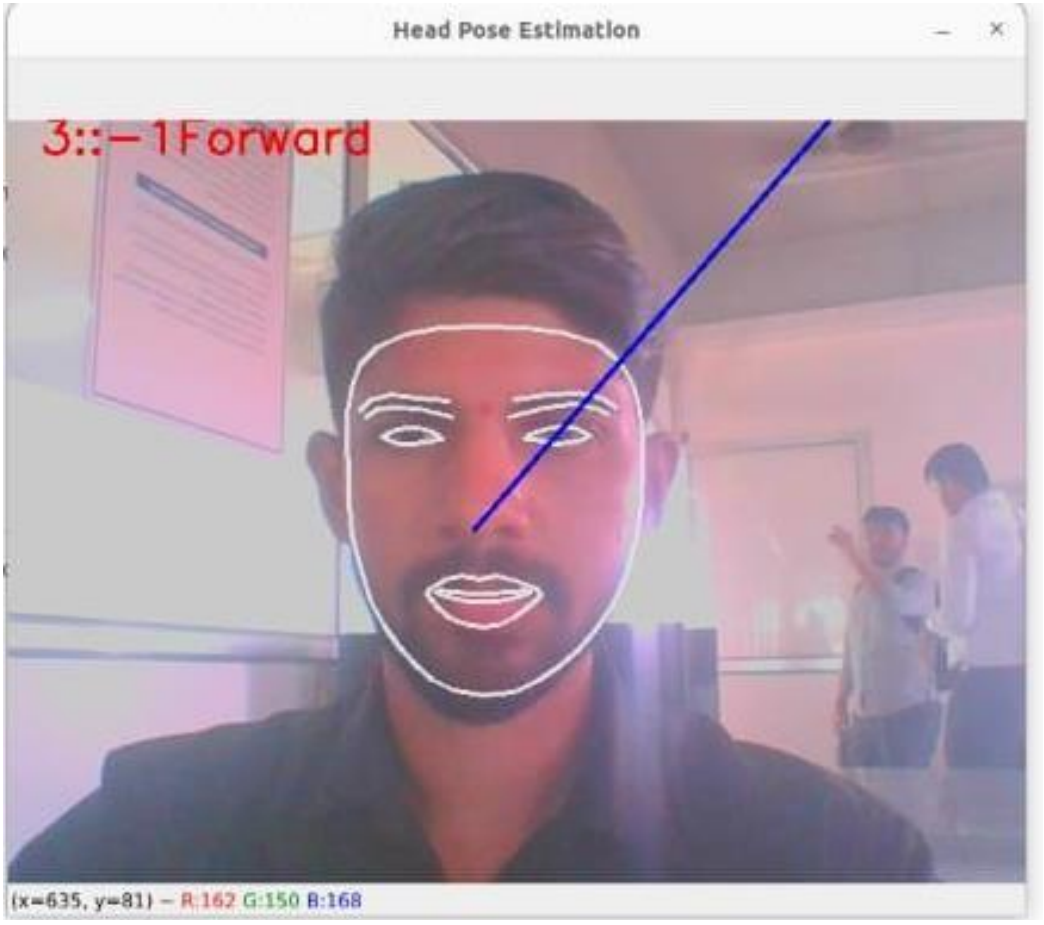

Figure 5.1 Result of head pose estimation.

Different flags were utilized for detecting suspicious behavior, based on various inputs. These flags were then fed into a conditional algorithm, which had specific biases for each input. If a certain condition was met, the resulting percentage output was added to the previous percentage, to create a continuous graph of percentage over time. When the threshold for suspicious behavior was crossed, cheating was detected. The output was represented in the form of a continuous graph with time on the X-axis and percentage on the Y-axis, which updated dynamically as time progressed.

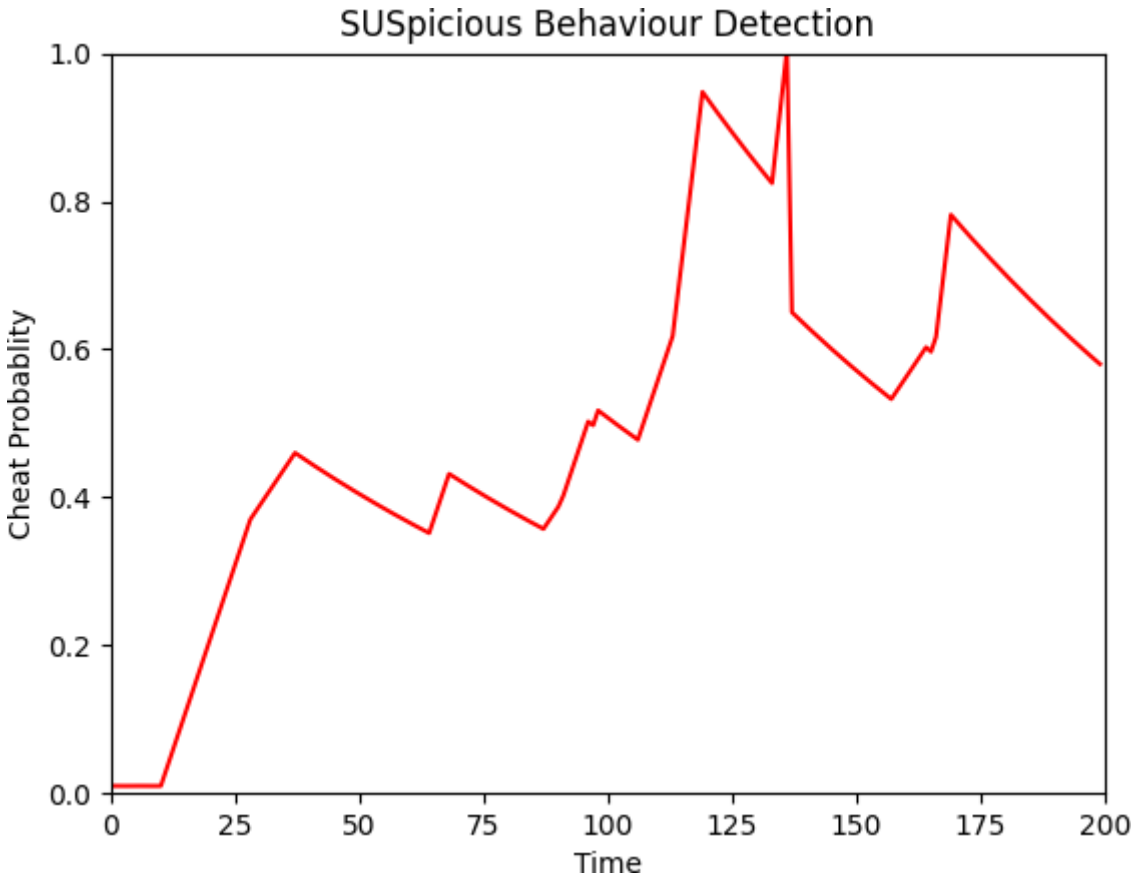

Figure 5.2 Result of suspicious behavior detection.

Chapter 6

Conclusion & Future Work

This system has become a popular topic of discussion as a result of the pandemic and the growing need for online testing. Its goal is to detect whether a user is exhibiting suspicious behavior using video and audio output. The development of the system involved the use of various machine learning algorithms for head pose detection, resulting in a successful implementation of head pose estimation using computer vision, as well as speech detection using a microphone. The system developed is capable of detecting suspicious behavior and is lightweight, consuming minimal resources. Furthermore, the proctoring system developed in this project is efficient, accurate, and user-friendly, making it suitable for various types of online examinations. Its ability to consume fewer resources also makes it cost-effective and easily scalable. With the increasing demand for online examinations, this system has the potential to significantly reduce the instances of cheating and ensure the integrity of the examination process.

As technology advances and datasets grow, it is expected that AI will be able to autonomously judge the severity of a situation and take appropriate action, such as pausing or ending an assessment.

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