

AI based Smart Proctoring System – Proctoror

Rajesh Sahoo¹, Dashmesh Singh², Vedantika Wagaj³, Pankaj Chaudhari⁴ and Santosh Warpe⁵
^{1-2,5}MIT Academy of Engineering, Computer Engineering, Pune, India
³⁻⁴MIT Academy of Engineering, Electronics and Telecommunication Engineering, Pune, India
Email: {rssahoo, dusingh, vvwagaj, chaudharipk, stwarpe }@mitaoe.ac.in

Abstract—Throughout this pandemic, most educational institutions are compelled to switch to a web-based education system. Colleges began offering online lessons and assessments for all subjects. We acknowledge the importance of preserving academic discipline, and thus the sainthood of testing inside examinations. Our concept, Proctoror, is an AI-based web operation that uses AI algorithms to detect suspicious gestures and conditioning while conducting online exams. With our advanced AI-based proctoring software, campaigners can take assessments from afar while maintaining the test's integrity with features such as biometric authentication using face recognition and detection, electronic devices detection via object detection, browser lockdown, eye and gaze tracking, head movements tracking and an overall feedback report generation.

Index Terms— Proctoring, Online Exam, Artificial Intelligence, facial recognition, object detection, face detection, eye, and gaze tracking.

I. INTRODUCTION

During this Pandemic situation, almost all educational institutions were forced to transition to a web education model. Colleges started taking tests and semester exams online. We admit that sustaining academic rigor and consequently the saintship of testing inside tests is essential. This unforeseen shift to online literacy has different goods on students of every position. We believe the perpetration of a proctoring system is what the situation calls for.

Our design, Proctoror is an AI grounded web application, which detects suspicious gestures and behavior, using AI algorithms like implementation of face detection and face recognition using the haar cascade algorithm, object detection for detecting mobile phones and other stuff through which candidates can participate in cheating, eye and gaze tracking plus head movements are captured using PCCR technique and also used CNN model in implementation of the same, copy-paste disable and browser lockdown. The whole app is made on React Js and the backend of our system was made using NodeJS and Flask. All the databases of students and teachers and the feedback report is stored using MongoDB as a database.

II. LITERATURE SURVEY

Sahil Motwani et al. [1] they brilliantly revealed the flaws in the system for online proctoring that existed prior to 2018. They concentrated on the concept of mass proctoring with less human work. Their prime focus was on applying AI Proctoring to handle fraudulent activities on laptops, computers, and even cellphones. They were primarily concerned with giving clear and accessible information about how and where infractions and efforts to

compromise the integrity of a test might be reported, including anonymous methods. In addition, the data obtained must be protected from hacking and theft.

R. Veal et al. [2] study provides a system that allows students to be authenticated by biometric identification as well as ongoing proctoring. To ensure that the student is not doing anything wrong, automatic facial recognition utilizing photos from the web camera, speech recognition using audio clips recorded by the microphone, and keystroke dynamics recorded by the keyboard are all used in the authentication process. The technology is linked to the institution's Learning Management System, which collects biometric samples from students at registration, such as photos and audio clips, and creates a biometric model.

Atoum et al. [3] study illustrates an online exam proctoring system that attempts to maintain academic integrity during the e-learning process. The method described in this paper is simple to operate, requiring only two cameras and a microphone to complete the test. User authentication, text detection, audio detection, active window detection, gaze estimation, and phone detection are among the features available. These traits are then utilized to detect cheating.

Michelle et al. [4] mentions a fully automated software that monitors each student's testing environment and sends reports to the instructor's dashboard in this post. Proctortrack, an anti-cheating software that detects suspicious behavior, recognizes the true names of test-takers, and bans the usage of illegal applications, is used to make the exam monitoring stringent. The computer lockout feature prohibits students from looking up answers on the internet, and ProctorLIVEAI identifies any changes in the test-behavior. taker's Identity verification, data recording with screen captures, automated data analysis of each student without human interaction, and browser lockdown are all included.

Asep Hadian S. G et al. [5] that takes a new strategy in which user verification is prioritized on a continuous basis. To train the CNNs to recognize the user in low light and general settings, a big collection of user photos is employed. They did it by employing filters to detect characteristics that must pass non-linear mapping for the CNN to learn the values.

Honorlock [6], an automated proctoring system that uses screen recording, camera recording, audio recording, and computer limitations to track student conduct and activities during online exams, is mentioned in the article. Multiple test options are available, including browser lockdown, requiring a 360-degree room scan, or permitting URLs to be used during the exam, mobile phone and other device identification, live pop-ins, and more.

R. S. V. Raj et al. [7] requires the student to have a webcam-enabled computer and to show the whole room in which they are seated. Face detection is the initial module, after which the identified face is monitored to verify that the student is present during the examination. Active window capture occurs in tandem with continuous audio-video recording to determine whether the learner is attempting to open another folder or browser on the computer. Hand motions and other features can also be observed.

[8] says there are Several AI-based software programs to help students bridge the gap between online lectures and online exams. Examus is one such program that allows instructors to collect behavioral data from students during online lectures and then send it to proctoring services for enhanced online test supervision. Live OLP (Online proctor exam) was included in this paper, which allows the proctor to view and talk with the student, and completely automated OLP, which allows the webcam and microphone to begin recording on their own without the need for a live proctor.

H Sathish et al. [9] focuses on a voice biometric authentication architecture that can be used as a plugin for an examination program to make it more secure and safe when a candidate checks in. Voice Biometric Authentication (VBA) is used in the system, which is developed utilizing a three-tier architecture that includes a data layer, an application tier, and a Presentation tier. The data tier keeps the preset voice command, the application tier holds the business logic, and the presentation tier serves as the user-software interface.

N. Joshy et al. [10] Face recognition, OTP verification, and fingerprint authentication modules are used in this paper's multi-factor authentication system. The system employs a hierarchical structural technique in which the user begins by completing a suitable Registration procedure. Authentication, Password, Biometrics, Security, Data Protection, and Secure Login Verification are some of the features. Face recognition, an automated OTP generator, and a fingerprint authentication module are used in this system.

Another example of a proctoring system is the EU-funded project TeSLA.[11] Tesla aims at developing techniques for the verification of test-takers via biometrics. This involves facial recognition, voice recognition, keystroke analysis, and fingerprint analysis to ensure that no impersonation is taking place and that the answers are being given by the actual test-taker.

Shubangi Kale et al. [12] has provided a great reference and learning in this paper. We got to know and study about object detection via DML method in video tracking and different aspects of using it in various systems. We got a good insight about object detection and its application through this paper.

Rudragouda Patil et al. [13] in their paper explained about the various challenges faced while designing Automation in Assisting Evaluator for Grading of Answer Scripts and also very well explained all its approaches which was a great help in developing our quiz platform of the proctoror.

III. METHODOLOGY

First user will receive the credentials of the exam through email by the instructor, before starting the examination, the user will have to go through the system check whose instructions will be delivered on the mail as system requirements. If everything goes perfect, then the user will be diverted to the authentication and then the user can start his exam meanwhile multiple algorithms will be executing in the background to ensure that nothing goes wrong.

At the end of the exam, it will analyze the result and based on that the system will generate a report which will be sent to the proctor for further analysis.

Initial Design:

- 1) Within the initial phase, we are performing on research and implementing different algorithms using Artificial Intelligence. Our system's initial features include face and voice recognition for user biometric identification .
- 2) Face detection will count the amount of people sitting in the room using Haar Cascade. Similarly, voice recognition will match the voice of the candidate employing a combination of MFCC and LPC algorithm.
- 1) Face Detection: The target of the program given is to detect an object of interest(face) in real time and to keep tracking of the same object. OpenCV already contains many pre-trained classifiers for face, eyes, smiles, etc.. Here we've used face classifier.
- 2) Object Detection: The thing detection works on the Viola-Jones algorithm, which was proposed by Paul Viola and Michael Jones. The aforementioned algorithm is predicated on machine learning.
- 3) Gaze tracking: Eye gaze chase records the aim of gaze and eye movement in regard to the setting. The Pupil Center membrane Reflection (PCCR) technique is the most ordinarily accustomed to perform video-based eye gaze chase.
- 4) Face recognition: Face recognition may be a function of comparing unfamiliar faces with photos on a database of archives. The maps are often one-to-one or one-to-many, counting on whether we use face verification or face recognition.
- 5) Copy paste disable: The purpose of this setting is straightforward - it prevents applicants from copying responses offline.
- 6) Browser Lockdown: Browser lockdown is a custom browser that locks the test site within the learning management system.

IV. SYSTEM DESIGN AND ARCHITECTURE

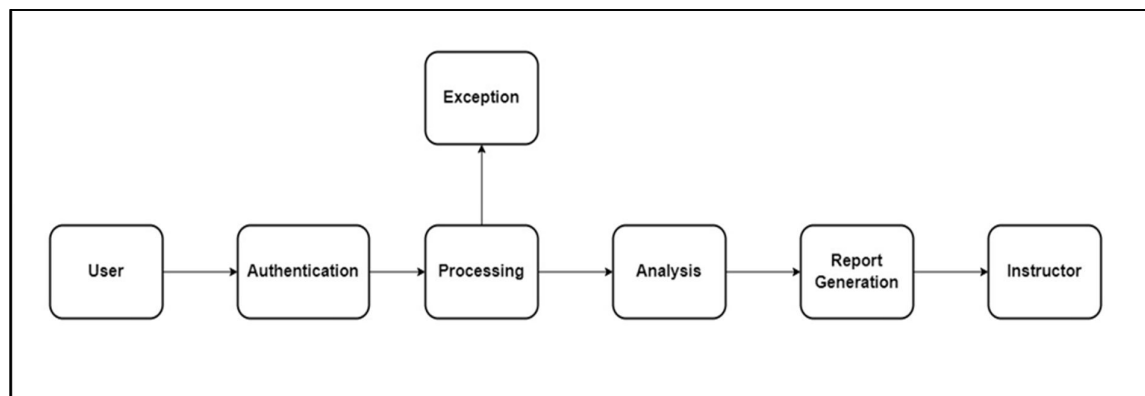


Fig 4.1 Block Diagram

First user will receive the credentials of the exam through email by the instructor. Then the user will be diverted to the authentication and then the user can start his exam meanwhile multiple algorithms will be executing in the

background to proctor the student. At the end of the exam, the system will analyze the result and based on that will generate a report which will be sent to the instructor for further analysis.

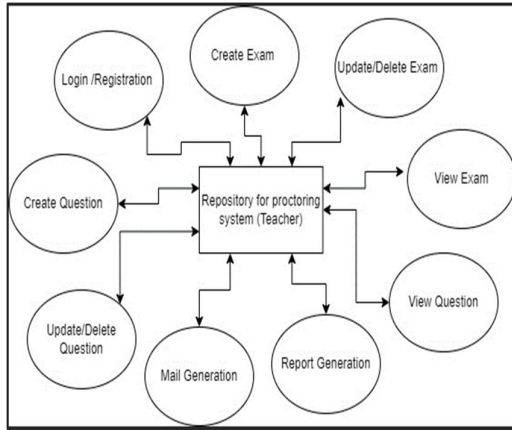


Fig 4.2 Architecture Diagram (Teacher)

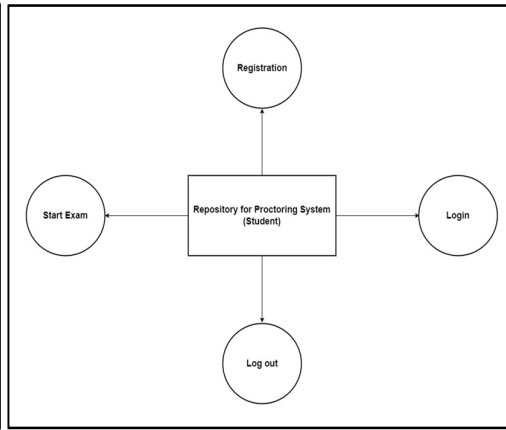


Fig 4.3 Architecture Diagram (Student)

Fig 4.2 shows the structure of instructor operations like creating, updating, deleting and viewing exams. Also the instructor can provide the students with credentials through mail generation and view the report generated by the system.

Fig 4.3 shows the structure of student operations like logging into the system through the credentials provided by the instructor and giving the exam under an AI based proctor. It also depicts how the repository is common for all those functions mentioned in the architecture diagram like a data centered architecture.

V. RESULTS AND DISCUSSION

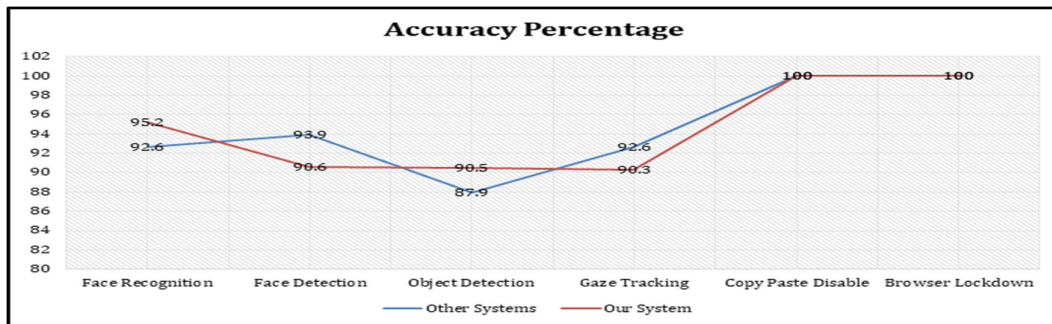


Fig 6.1 Accuracy Graph

TABLE I. ACCURACY TABLE

Functionality	Average of other systems	Our System
Face Recognition	90.7%	95%
Face Detection	93.9%	87%
Object Detection	84.6%	90.5%
Gaze Tracking	92.6%	87%
Copy Paste Disable	100%	100%
Browser Lockdown	100%	100%

Fig 6.1 and Table I shows a comparison of accuracy of various functionalities vs our system accuracy taken together. We have performed various tests and created a data set of results of those tests and took a comparative average for the accuracy of those functionalities in our system.

Face Recognition includes accuracy of verifying registered user image with the image provided during sign in and to authenticate them to dashboard. Face Detection includes the accuracy of analyzing how many students are sitting in front of a camera at a particular instant and generating a log based on that number and condition.

Object detection includes accuracy of detecting various objects including mobile phones for checking a possibility of cheating or ill practices during the exam.

Gaze tracking includes accuracy of how well the algorithm can judge the eyes of students and track the position of where they are looking, what is their head position and various other functions. Copy Paste disable and browser lockdown tests the accuracy of how well both of these things can be prevented during the whole test.

VI. CONCLUSION

We have developed a system that incorporates biometric authentication- Face Detection and Recognition in order to verify the identity of users. In addition, our system prevents any cheating that might take place during the online examinations, and it also keeps a record of everything that the students do while they are giving the exam to make the software more efficient.

ACKNOWLEDGMENT

The authors want to express their gratitude towards their respected project guide **Prof Santosh Warpe** for his constant encouragement and valuable guidance during the completion of this project work. We also want to express our gratitude towards MIT Academy of Engineering for their continuous encouragement and support without which this project could not be completed.

REFERENCES

- [1] Motwani, Sahil and Nagpal, Chirag and Motwani, Manav and Nagdev, Nikhil and Yeole, Anjali, AI-Based Proctoring System for Online Tests (May 7, 2021). Proceedings of the 4th International Conference on Advances in Science & Technology (ICAST2021), Available at SSRN: <https://ssrn.com/abstract=3866446> or <http://dx.doi.org/10.2139/ssrn.3866446>
- [2] M. Labayen, R. Veá, J. Flórez, N. Aginako and B. Sierra, "Online Student Authentication and Proctoring System Based on Multimodal Biometrics Technology," in IEEE Access, vol. 9, pp. 72398-72411, 2021, doi: 10.1109/ACCESS.2021.3079375.
- [3] Atoum, Yousef & Chen, Liping & Liu, Alex & Hsu, Stephen & Liu, Xiaoming. (2017). Automated Online Exam Proctoring. IEEE Transactions on Multimedia. PP. 1-1. 10.1109/TMM.2017.2656064.
- [4] Michelle, A guide to successful online exam monitoring with Proctortrack, January 29, 2021,2:49pm <https://www.proctortrack.com/blog/article/a-guide-to-successful-online-exam-monitoring-with-proctortrack/>
- [5] A Design of Continuous User Verification for Online Exam Proctoring on M-Learning", Hadian S. G. Asep; Yoanes Bandung, 2019 International Conference on Electrical Engineering and Informatics (ICEEI), 9-10 July 2019
- [6] UNIVERSITY of WISCONSIN-MADISON,ACADEMIC TECHNOLOGY Division of Information Technology,Honorlock. <https://at.doit.wisc.edu/learn-uw/honorlock/>
- [7] R. S. V. Raj, S. A. Narayanan and K. Bijlani, "Heuristic-Based Automatic Online Proctoring System," 2015 IEEE 15th International Conference on Advanced Learning Technologies, 2015, pp. 458-459, doi: 10.1109/ICALT.2015.127.
- [8] Cybersecurity of Online Proctoring Systems. In Journal of International Technology and Information Management (Vol. 29)
- [9] AI based Voice Biometric Authentication For Remote Proctoring A. H Sathish, A.H Khan MK, Nagendra S, I.A. Nasir
- [10] N. Joshy, Kumar, M. G., Mukhilan, P., Prasad, V. M., Ramasamy, T., and Dr. Harini N., "Multi-factor authentication scheme for online examination", International Journal of Pure and Applied Mathematics, vol. 119, pp. 1705-1712, 2018.
- [11] Communications in Computer and Information Science, 829, 96–108. https://doi.org/10.1007/978-3-319-97807-9_8.
- [12] Kale, Shubhangi & Shriram, Raghunathan. (2021). Suspicious Activity Detection Using Transfer Learning Based ResNet Tracking from Surveillance Videos. 10.1007/978-3-030-73689-7_21.
- [13] Patil, Rudragouda & Ali, Syed. (2018). Approaches For Automation In Assisting Evaluator For Grading Of Answer Scripts: A Survey. 1-6. 10.1109/CCAA.2018.8777664.