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Online Exam Student Anti-Cheat Tool

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ABSTRACT— The rapid growth of online education has necessitated the development of effective tools and strategies to mitigate cheating in online student exams. This abstract presents an overview of an online student exam anti-cheat tool designed to address the challenges associated with maintaining academic integrity in remote assessment environments.

The proposed tool incorporates a combination of advanced technologies and innovative methodologies to detect and deter cheating behaviors during online exams. Key features include:

1. Behavioral Monitoring: The tool utilizes machine learning algorithms to analyze students' behavior during exams, such as eye movement tracking, keyboard typing patterns, and mouse activity. Deviations from expected behavior patterns can be flagged as potential cheating indicators.
2. Proctoring Solutions: The tool integrates real-time video proctoring to monitor students during exams. Proctors can observe students remotely, verifying their identities, and ensuring adherence to exam rules and regulations. Automated proctoring features, including facial recognition and identification, can be employed to enhance efficiency.
3. Plagiarism Detection: To combat plagiarism, the tool incorporates advanced plagiarism detection algorithms that compare students' exam responses against a vast database of online resources, academic publications, and previous student submissions. Any instances of content similarity are identified and flagged for review.
4. Secure Browser Environment: A secure browser interface is implemented to prevent students from accessing unauthorized materials or websites during exams. The tool restricts navigation to external resources, disables copy-paste functions, and blocks other applications to maintain a controlled exam environment.
5. Data Analytics and Anomaly Detection: The tool employs data analytics techniques to identify abnormal exam patterns and trends. Statistical analysis of student performance, response times, and other relevant data can uncover suspicious activities that may indicate cheating.
6. Authentication Mechanisms: To ensure the integrity of exam takers' identities, the tool employs multi-factor authentication methods, such as password verification, IP address tracking, and device recognition. These mechanisms help prevent impersonation and unauthorized access.

The proposed online student exam anti-cheat tool aims to provide educational institutions with a comprehensive solution for maintaining academic integrity in online assessment settings. By combining behavioral monitoring, proctoring solutions, plagiarism detection, secure browser environments, data analytics, and authentication mechanisms, the tool offers a robust defense against various cheating methods. Further research and development are required to refine the tool's effectiveness and address potential privacy concerns, but it holds significant promise in promoting fair and unbiased online examinations.

Keywords— Cheating detection; Face detection; Object detection; Face tracking;

I.INTRODUCTION

In today's world learning capability is judged with examinations. Thus, the need of exams today in universities, schools, colleges and even companies for recruitment purposes. The general paper-pen tests/exams are now slowly being replaced by the online internet-based testing system. The growth of Internet has largely evolved teaching and learning from a conventional classroom into an invaluable educational resource accessible remotely from disperse geographical locations, beyond physical boundaries. The online learning environments are likely to be accessible, available, updatable, re-source efficient, useable, economical [1] and have been widely adopted by several educational institutions in various disciplines. Researchers in [2] found that about 74% of students surveyed believed it was easier to cheat on an online class compared to the conventional class format. The same study found that 32.1% of responding students admitted to cheating in a conventional class format while 32.7% admitted to cheating in an online course structure [3].

The main advantage of online examination is that it can be conducted for remote candidates and evaluation of answers can be automated for MCQ questions and other essay type questions can be evaluated manually or through auto-mated system, depending on the questions and the requirements. Also, online examinations can be conducted at any time and does not incur higher cost as traditional exam scenario as there is no paperwork involved (e.g., printing exam papers, prepare paper admissions etc.,) , there are no invigilators, also no need of arrangement of exam centers. When comparing with traditional exam scenario the cost for an online examination will be almost zero. In the online learning, examination is integrated with the teaching

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and learning com-ponents. In an online examination scenario, there may be no face to-face interaction between students, tutors, and administrators, thus, security is vital to the credibility of online learning environments. The nature of online learning environments makes it more vulnerable to various security threats. Online examinations being an integral part of the learning environment can be high stake applications, which may fall to impersonation and malicious attacks for higher grades. One of the primary goals of student authentication is to ensure the genuine interaction of individual students with the online examination. The conventional user-id and password authentication cannot verify the identity of an online student [4].

Online course examinations are useful to evaluate the student's knowledge using modern computer technology with no effects on the traditional university course exam that uses Pens, Papers, and invigilators. Online exam can improve the standards of student's examination whereas the traditional examination system using the pen and paper requires more effort by students and invigilators. Online examinations are considered an important source for university exam and developing network technology polices has given the possibility to conduct the exams online. Thus, the university students can benefit from these services. University course exams , using the multiple-choice questions and allowing the students to choose only one answer from alternative answers or the true/false questions, are traditionally using the paper and pens and they have always been a heavy load for both students and lecturers. Computer new technology has been generally useful to the fields of education. In attitude and tools, the new computer technology gives the lecturer the advantage of an effective assessment. The traditional way of identifying the students is checking the student card, driving license, resident card, or Passport. The online process and security of the online exam system helps with eliminating cheating [4].

Proctors are approved persons who are supposed to monitor an exam. The presence of a physical proctor is necessary in a traditional classroom setup. Requirement of having a proctor holds good even in an online classroom examination scenario. The creation of a system that can detect the malicious activities that might possibly happen in an automated manner will be helpful for the instructor [5].

So, automating the monitoring process without compromising the reliability and inexpensiveness is challenging which is addressed in this paper. The system proposed here uses a single webcam along with an internet connection. With this minimum requirement, our idea plans to develop a system which is:

1. Fully automated
2. Having no use of any expensive and user inconvenient external hardware

II.RELATEDWORK

There are several commercial online proctoring tools available for monitoring the online examinations like Kryterion Inc., Proctor U, Software Secure, and Loyalist Exam Services
[6] [7] [8]. Those software's help the instructor to conduct exams online. Usual requirements they ask for taking test from anywhere is the system with a webcam along with internet connection. But they ensure the integrity only with the certification of trained proctors they have. That indicates that they still rely on the human exam monitoring process [5].

Kryterion [6] is one of the widely used commercial online proctoring tools. The instructor coordinating the exam needs to connect with the Kryterion hardware for their students to attend and monitor the exam. Once the account creation has done successfully, Kryterion will share a link with the student.

That link enables user access for the student to attend the exam remotely. After that, student can login in the Kryterion website using the given username and password. Once student is successfully logged in, the correct examination slot is allocated and one of the online proctors will commence the verification process. Verification is a two-step process which involves verification of a valid ID card that student shows through the connected webcam and asking the students a few prepared securities questions. ProctorU [7] is another commercial online proctoring tool currently in use having the similar procedure as Kryterion. Software secure is the one using the recorded video for the proctor verification. They are not having real time proctoring facility. All other software's are using one of these two ways of proctoring only. Table II-1 compare between Kryterion, PSI Online and ProctorU Software's.

Table II-1 Commercial Proctoring Tool

Features	Kryterion	ProctorU	PSI
Physical Proctor	Yes	Yes	Yes
Webcam Usage	Yes	Yes	Yes
Internet Connection?	Yes	Yes	No
Capture Active Window?	No	No	No

Eye gaze tracking is a prominent method used for online proctoring. But this method usually requires specific hardware such as infrared high-resolution camera and infrared light sources. Also, mostly they require a rather long-winded calibration process. In address the eye gaze tracking problem using a low-cost equipment like a web camera in a desktop environment. They track the human face from the real time video sequence to detect the region around eyes. For finding out the iris center, they combine the intensity, energy and edge strength and use piece wise eye corner detector for detecting the eye corner.

The paper adopts a sinusoidal head model to simulate the 3D head shape, and propose adaptive weighted facial features embedded in the pose from the orthography and scaling with iterations algorithm, whereby the head pose can be estimated. Finally, they integrate this head movement information from the eye vector obtained to get the gaze tracking [9].

Research in [10] includes a description of cheating and its types, a description of online probation, a description of the electronic test via the internet, the engineering of the online

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administration system, the algorithm of the examination management system, the application of the electronic examination management system. This system aims to prevent cheating in exams via the internet. It uses Fingerprint Reader, eye movement by Eye Tribe Tracker, Voiceprint, but It is possible that one of the examinees may be able to Fake the fingerprint. Figure II-1 illustrates the E-Exam management System Architecture [10]. Their tests yielded the following: sensitivity is 100%, specificity is 95.56, precision is 95.74%, accuracy is 97.78%, and f-measure is 97.83% [10].

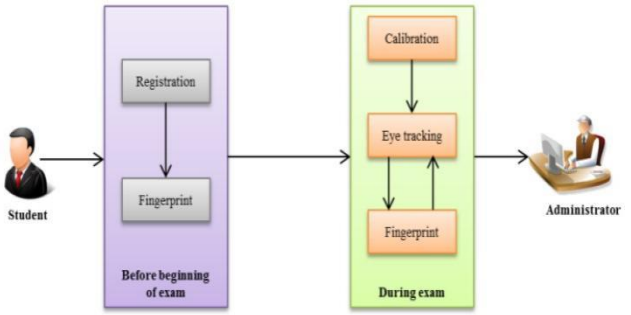

Figure II.1 E-Exam Architecture [10]

In [11], it was presented a multimedia analytics system to perform automatic and continuous online exam proctoring (OEP). This system aims to maintain the integrity of exams by providing real-time monitoring. The test taker uses two cameras, webcams and another camera installed above the glasses is used, and a microphone is used to hear what the student was talking to someone about whether he was or not. The system in [11] requires more cameras to watch the student but this is difficult to apply it in practice. Because cameras aren't available mostly.

Online exam proctoring (OEP) use user verification, gaze estimation, phone detection, text detection, speech detection, covariance feature. The exam takes place in two stages, the preparation stage, and the exam stage. In the preparation stage, the examinee enters the password and face, and it is ensured that all connected devices are working properly. To prevent the student from exiting the exam window and cheating while taking the exam, they used the (RLB) browser. Figure II-2 shows the OEP System Architecture.

RLB: it is a private browser in which the test taker is locked with an extension, the exam has no way to exit/return, cut/paste, or electronic system manipulation. But some tests require access to the internet [11].

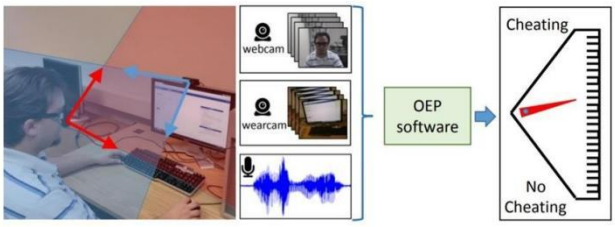

Figure II.2 OEP System

The system in [5] uses a webcam and microphone connected to the internet, and the implementers of this system seek to use the least capabilities and plan to develop fully automated, including video, audio, and active window details, having no use of any expensive and user inconvenient external hardware and having no need of physical proctor throughout the examination.

For lack of general data, they made 39 separate video clips with an average duration of two minutes for each video clip. The data set was recorded using a Sony Vaio Laptop webcam on frame 25 frames per second.

This system is limited to one student only, the system solves some of these problems and available, save. This system takes specific a number of photos. Admin made an account for the student and gave him privately the program before the exam password. then in the exam take photos for the student to match it with his photos on the system and start the exam then the admin can see the examinees during the exam time. The system gave a notification to Admin when a student cheat.

III.PROPOSEDSYSTEM

The proposed system targets university or school examination system. The e-exam management system can be divided into two main parts. The first part managing the perexam including examinee or student authentication, managing exam timing and schedule, … etc.. The second part is during the exam session, it is required to continuously guarantee that the examinee is the one who is claiming to be and is not cheating. This paper focuses on the 2nd part "Live Exam Monitoring System". Figure III.1 illustrates the proposed system architecture.

The e-exam management system includes several components:

1. Student Identification
2. Monitoring Schedular
3. Machine Learning

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A. Student Identification

This component is responsible for identifying the examinee. Since the system is mainly for university or school, which make the system closed under limited number of known examinees. The component identifies the examinee using an ID then feed this ID to the Monitoring Schedular and Machine Learning Components.

B. Monitoring Schedular

The schedular should communicate with examinee Web Browser through an exam Web Server with access to his/her web camera. The schedular use a Round Robin Algorithm to iterate through all examinees giving each examinee an equal time slice. In the beginning of each slice the schedular take a picture from the examinee web camera and send it along with the examinee ID to the machine learning component for further analysis.

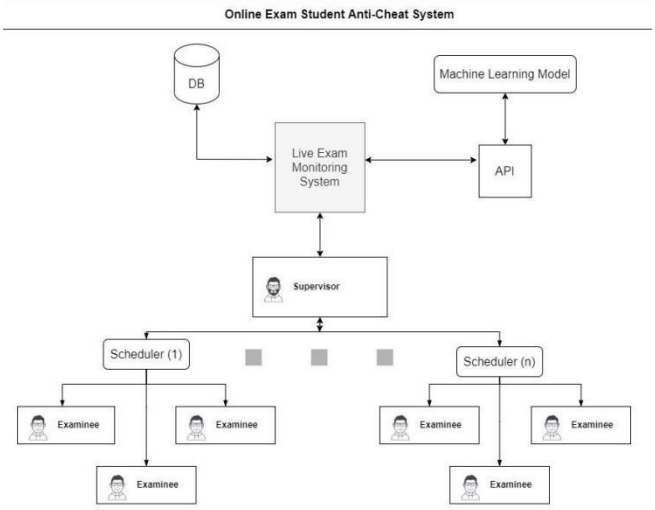

Figure III.1 System Architecture

C.Machine Learning

The Machine Learning component is responsible for confirm the examinee identity and cheating detection procedures. Since our system is closed under a known number of examinees, a suitable dataset can be built easily using several examinee pictures taken from different angles. These pictures can be used to train and validate a Support Vector Machine (SVM). This SVM is used as examinee Face recognition to confirm the examinee identity and match with the authenticated user Id.

The proposed system relay on the 1 vs others model to train the SVM on the huge number of examinees. This way the system will have several SVMs each one represents a specific examinee model identified with his/her Id. These SVMs can be stores based on examinees Ids using dictionary data structure for fast retrieval when needed. Figure III.3 shows sample of specific examinee pictures. While Figure III.4 shows sample of the training pictures used to train the SVMs.

The HOG is used as feature extraction technique or for face detection algorithm. HOGs are widely known for their use in pedestrian detection. A HOG relies on the property of objects within an image to possess the distribution of intensity gradients or edge directions. Gradients are calculated within an image per block. A block is considered as a pixel grid in which gradients are constituted from the magnitude and direction of change in the intensities of the pixel within the block.

Figure III.2 Specific Examinee Pictures

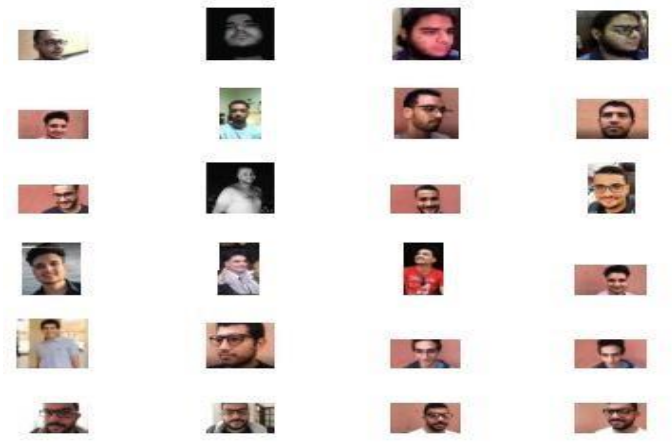

Figure III.3 Examinees Pictures

In addition to Principal Component Analysis (PCA) is used for face recognition. PCA is one of the widely used methods for dimensionality reduction. Its applications include face recognition, correlated cluster analysis, seismic analysis, web page watermarking.

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The machine learning component includes an object detection algorithm in order to detect the present of a second face or the present of object like mobile phones.

The machine learning component analysis the capture picture of the examinee and report its feedback to the system, if the examinee is not cheating no action will be taken. But if the examinee is cheating or suspicion to be cheating, the status will be reported to the proctor screen for manual verification, the schedular will keep track of the number of times each examinee caught cheating when the number become 3 or greater, the system will alert the proctor for manual monitoring and automatically record a 30 second video for the examinee as a proof for the cheating case. This video will be stored in the database for future manual analysis and verification.

If the system has many examinees and limited time of exam, the system can use multiple parallel schedulers, each one responsible for a number of examinees.

IV.EXPERIMENTALRESULTS

A.Model Performance

The model first check if there is a face exist in the captured image to reduce the processing time required. So, if there is no face detected the classification is no longer needed. Table IV-1 shows the model performance both cases: face exist & no face. If there is a face detected the processing time of execution increase as there is an additional phase which is the classification phase which takes approximately 0.74 seconds to execute, but if there is more than one face detected the execution time for each face will be 0.09 only and there is no need for the classification phase as it's considering a cheat.

Table IV-1 Model Performance

State Of Detection	Detection Time	Classification Time	Result
No Face	0.07254	0	0.073
One Face Detected	0.0977	0.747	0.844

After evaluating the changes in the accuracy of the above datasets we have decided to use 20 images in each class for training our model.

Table IV-2 Accuracy of Recognition

No. of training images	Frontal	Not Frontal
10	80% ~90%	72% ~80%
15	90% ~94%	81% ~90%
20	96% ~97%	91% ~95%
25	96% ~97%	91% ~95%

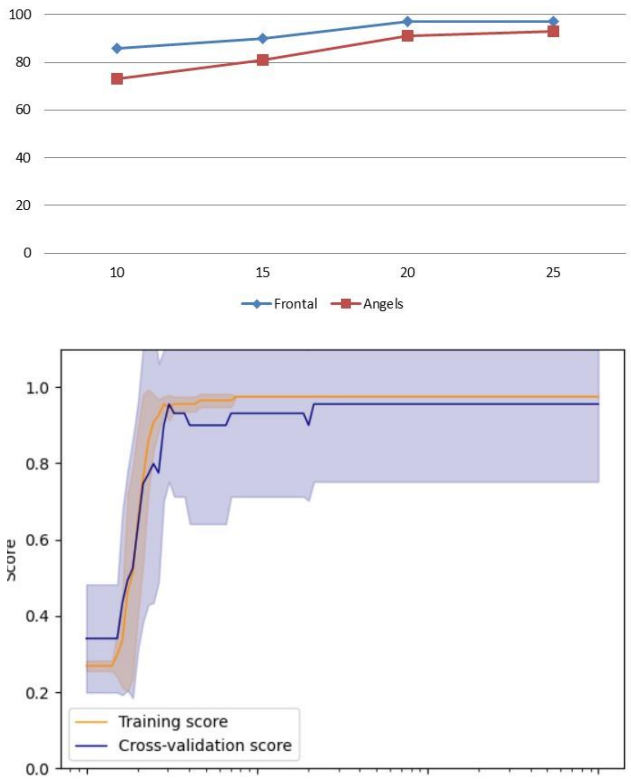

Figure IV.1 SVM Validation

B.System Performance

When the system schedular iterate over the examinees taking the exam, it expected to take some time processing and analysis each examinee data, also this time can be increase when the number of examinee increase. Table IV.3 and Figure IV.2 show how the total delay changes with the number of students used to train the system.

Table IV-3 Iteration delay

Number of Students	Total Delay (Seconds)
1	0.8
2	1.6
4	3.2
8	6.4
12	10

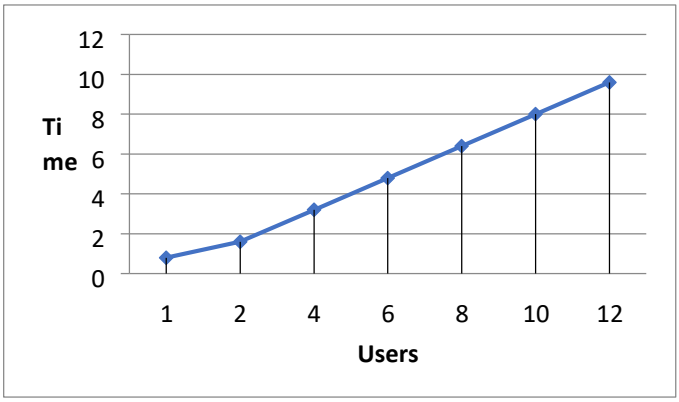

Figure IV.2 Total System Delay

V. CONCLUSION

This paper addresses the cheating in online exam. Specifically, it introduced the concepts of cheating and how it can be controlled in online exam. It provides a technique for detecting and preventing student from cheating through continuous authentication and online proctor. This system was developed in Php and MySQL for Web Server. While python has been used to build the machine, learning models. As a result, the system classified the examinee status as cheating or non-cheating based on two parameters: the total an examinee time on out screen and the number of times, the examinee is out of screen. To evaluate this proposed work, a series of experimental tests were conducted. The tests yielded an accuracy of approximately 95%. There are some limitations for the system that we presented in this paper, such as the handling of the cases of students with special needs.

VI.FUTUREWORK

There are several promising directions to extend the work presented in this research. The system can capture the active examinee browser tab/window to detect if the examinee changes the exam window. Also, Priority Scheduling can be used for monitoring schedular instead of Round Robin to give suspicion examinee more priority than normal examinee, so the system can iterate over the suspicion examinees over often.

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