AI-ML Based Smart Online Examination Framework

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Abstract. Online examinations are the way of conducting examinations on the user's mobile devices or laptops rather than actual paper. In situations when physical exams cannot be conducted online exams have been the preferred choice. In physical examinations, the number of students doing malpractices reduces by a great amount as there are examiners physically present to monitor every student. The idea of Smart AI-ML-based Online Framework is to reduce the malpractices done by the students in the online mode as far as the current platforms in use are concerned. For this, there are some methods used that are based on machine learning algorithms. The main task during the exam time is the continuous live detection of every candidate and for this facial detection using a webcam is necessary. Before this, a proper pose setup and facial illumination need to be ensured. With the live detection happening the examiner can track the student from their end as well as get the alerts based on the student's illegal conduct. Overall, the system can perform the proctoring tasks in a fully automated fashion and thereby requiring very minimal effort from the examiner in monitoring the candidates. We have concluded that the Smart Online Examination platform is a much viable solution to the existing platforms for conducting the exams and doing the proctoring.

Keywords: E-learning · Online proctoring · Face detection · Artificial intelligence

1 Introduction

The traditional examination system process is long and time-consuming whereas the online examination system provides a quick and accurate solution within the specified time frame. Online exams require fewer resources and are more reliable and accurate as compared to offline tests. Students have quick access to online exams thereby reducing the necessity for faculty and staff for managing a large number of teaching materials and dealing with seating arrangements. The system provides a fast and accurate solution within the specified time frame and the scoring process is simpler and saves teachers time. The assessment is quick, reliable, and accurate. The online exam provides flexibility and security within it, as each student can receive random questions from an equivalent sample test. The online exam allows one to add videos, images, audio, PDF files, and more to the tests. Online exams allow for several features to stop malpractices, like locking the browser, disabling the print, arrow, and ESC keys [2].

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Proctored exams are a type of online exam to protect the integrity and prevent malpractices of students. When such an online examination system is combined with automated proctoring it adds more value to the entire system as the teacher can conduct exams in a much efficient manner by getting all the activity of candidates at one place [4, 7]

1.1 Facial Recognition and ML

Facial Recognition is a process that maps an individual's face and saves it as a face print. The software program makes use of algorithms to look at a captured face and compare it to the saved one to verify one's identity. Machine learning algorithms best recognize the numbers so it is pretty challenging. This numerical illustration of a face is named a function vector. As a result, using machine learning the function vector can detect the following aspects in a person's face:

1. Height of face (cm)
2. Width of the face (cm)
3. Average color of face (R, G, B)
4. Width of lips (cm)
5. Height of nose (cm)

By combining machine learning and making it applicable for online examinations has done betterment in this field. They yield a system that is fully automated in conducting examinations, monitoring each candidate without the examiner needing to do it individually, and grading the students along with getting automated attendance while also maintaining the records for future reference [6].

The distribution of this paper from hereafter is as follows: Sect. 2 contains the literature survey done and Sect. 3 presents the objectives of the project. Section 4 describes the existing system architecture, methods, and the solution to that is shown in the proposed system architecture in Sect. 5. Section 5.1 contains the results of the proposed system along with the strength and weaknesses it contains. Section 6 contains the conclusion.

2 Literature Survey

In [1] authors have discussed the facial feature detection algorithm which is needed to detect the face of the candidate from several image sets. It is based on the average variance calculation of the three components in the face image like eyes, nose, and mouth and the extraction of these features.

In [10] authors have discussed CNN (Convolutional Neural Networks) a deep learning algorithm that helps in face verification and detection. The system requires training samples by taking a large number of sample data of students' faces obtained from online lec tures and examinations.

In [5] authors have discussed a tab locking mechanism that ensures candidates do not navigate away from the exam screen because their exam window is locked while the exam is in progress. By having randomized system for question papers the students do not get the same questions and the questions are also shuffled.

YOLO is a machine learning algorithm that is used to perform object detection. It can be used to detect objects in still images, provided sample video, or from a real-time webcam which is used in this system as discussed in [9]

Deepface is a deep learning python-based framework that can detect faces from images. It is a neural network-based and has already been trained with sample images of other people.

To capture the candidate's eye position, eye tracking and pupil detection are necessary. Authors in [8] present face landmark detection which is a computer vision-based method to detect and track the user's eye movement by forming key points on it.

3 Objectives

1. To set up proctoring mechanism to stop malpractices in an exam by creating a system that validates each user well before the exam using facial recognition.
2. To allow the faculty to alert warnings or end the exam if students are found performing malpractices.
3. To provide a platform for the faculty to set the questions and also have support for multiple languages and detailed reporting.
4. To allow faculty to give additional times to students with disabilities
5. To send attendance and activity report details to faculty
6. To deploy our framework on the cloud to achieve load balancing and scalability.

4 Existing System Architecture

There are many tools and software available on the market for taking tests online. However, most of them are hosted inside the system and are not intended for free use. Monitoring is not enabled on other widely used open-source evaluation platforms. This allows students to engage in professional illicit activity, such as talking to others or minimizing the screen to find answers while taking the test. The existing system includes the following aspects:

1. The system includes a simple username and password combination to log into the exam portal (Fig. 1).

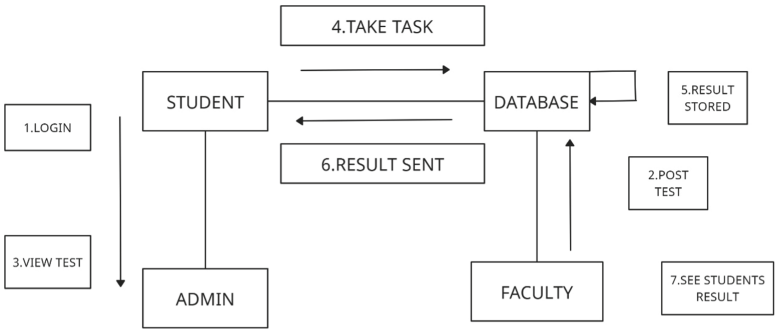

Fig. 1. Authentication of users

2. For taking the attendance, the faculty has to supervise the student by calling out their name.
3. There is no diversity in questions as there are a series of similar questions available in the questionnaire for all the students taking the exam.

This project aims to solve the limitations of the existing systems and further develop a new system.

5 Proposed System Architecture

The proposed system is explained by dividing it into two blocks of sequence diagrams, one for the student end and another one for the examiner end.

Student Block. Before the candidate begins to attempt the examination they must register and login into the exam portal with their credentials.

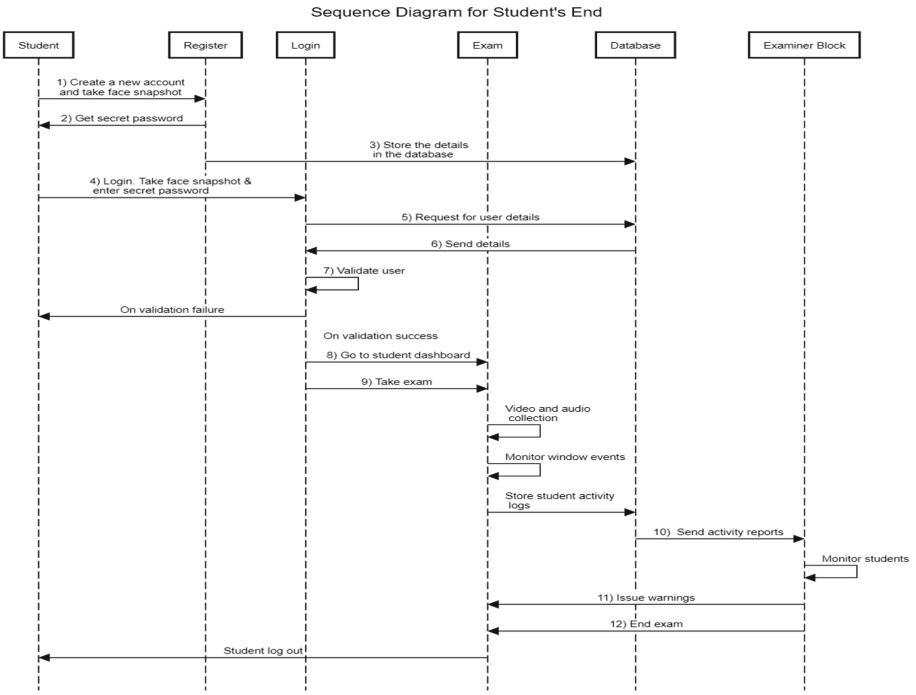

Fig. 2. Workflow for student's end

Username and Password
This combination is one of the most widespread authentication methods used due to its relatively low cost of deployment and convenience to the users. However, users can

impersonate another person and there would be no means to detect if an online student is the one he or she claims to be. For this purpose, two-factor authentication mechanism is used. During the registration process, the student's mobile number or email plays a very important role. Every time the student logins for an exam an OTP (one-time-password) will be sent to the registered mobile number or email. As a result, one student cannot take the exam on the other's behalf as one student can register only with one mobile number/email at a time.

Figure 2 illustrates the process followed by the system from the students' perspective. The student taking up the examination needs to set up a profile in advance. The profile will contain all the personal information along with the pictures of them taken by varying distances and light variations. For this, the system requires the use of a webcam of the device to take pictures of the user's face. On the day of the examination, the students have to enter their username as they are recognized during the registration process along with some other documents as proof [3]. Upon successful login, they are directed to the facial recognition page. New images of the user are taken and compared against the ones stored in the database to establish if they match within suitable bounds. Once the student is validated by this method, they are allowed to proceed with their examinations. This completes the two-factor authentication process as now the students are verified both by secret password and face recognition.

Examiner Block. Figure 3 below illustrates the process followed by the system from the examiner's perspective.

The examiner will be using this system for exam generation and monitoring the students while they are giving the exam. Another feature the proposed system provides is the ability to issue warnings to the students doing malpractices and eventually ending the exam for those who are repeatedly found doing the same. The exam generation process and the activity report details methods are demonstrated in the next subsections.

Question Paper Generation Process. The most crucial task that the examiner needs to carry out is the creation of the question paper. The system has been developed to increase diversity and avoid all the students getting the same questions and in the same order [5].

At the time of creation the examiner can specify the type of question from different options provided as per their choice.

The proposed system makes all examiners mandatory to display the questions in the form of images rather than plain text. This ensures that students do not copy-paste the text as it is in another tab to get the answers. The system also allows the examiner to create a CSV/doc file-based question paper and then simply import it in.

Alert Generation. Alert is an important feature implemented in this system. The webcam and microphone are used to capture the live images and audio from the student's end. The examiner is provided with a dashboard that enables them to see live data of all the students. Monitoring each individual is not possible in a real-time scenario and the alert based system generates such alerts. The alerts are displayed to the examiner containing the activity carried out.

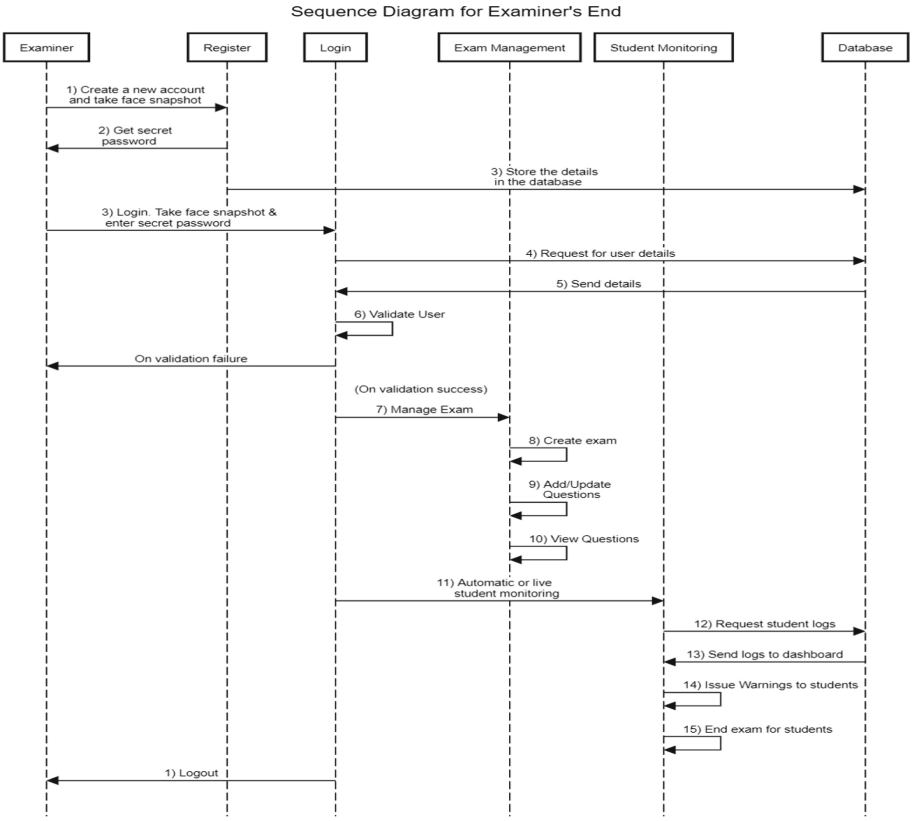

Fig. 3. Examiner's end process

Based on the above report, the examiner can send warnings to the student. After issuing multiple warnings if the student is still found doing malpractices then the examiner can decide to end the exam for that particular student.

The next section discusses some of the methods used to detect the face, video, and audio of the candidates

Object Tracking and Face Recognition. Dlib is a C++ based library consisting of machine learning algorithms and trained data sets that are capable of performing face recognition. In the centroid tracking algorithm, to detect any object a unique ID has to be assigned to it and then track in subsequent frames. This requires every object to be associated with a unique ID which will take up memory and is not a feasible solution. For this reason, we are adopting the correlation tracking method which is as follows:

i) detect the object once or in specific time intervals
ii) Apply the algorithm to track the object in subsequent frames.

The machine learning algorithm makes use of predefined data sets to track the object. For the dlib tracker to track the same object we need to define the boundary around

our target specified in four coordinates (top, right, bottom, left) which are passed to a predefined function 'rectangle' as shown below.

rect = dlib.rectangle(startX, startY, endX, endY)

The sample input is passed to the dlib object tracker which tracks it in further frames. The updating process of the tracker is performed at the back end. The process will be looped throughout the examination process to track the students.

The candidate will be allowed to give the examination only when they are verified by using face recognition and validation. The OpenCV library of python is capable of processing the images and videos to identify the faces and objects that appear in the samples. The face recognition module method used generates a 128-d real-valued number feature vector per face. This is like assigning unique codes to each face.

Figure 4 shows how the sample picture has been associated with the 128-d values. Once this has been accomplished, the encoded value and corresponding name from the database are assigned to it. In the actual process of examination, the images of candidates are detected, and then a box is applied around the face of the person (as marked by a white rectangle in the image above) based on the four coordinates and then convert this into the 128-d number value.

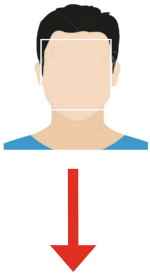

Fig. 4. Generating 128-d real number per face

We attempt to match each face in the input image to our encoding in the database. The result of this process will be as follows:

The distance is within an acceptable value indicating the faces match or else the faces do not match. The object tracking algorithm also performs the process of object detection in the candidate's live environment simultaneously. The object detection happens in the video frames in combination with the YOLO real-time object detection algorithm [9].

Tab Locking. The last thing the system prevents the students from doing is accessing other windows to fetch the answers. Authors in [5] use a method by having the examination window locked until the exam is over and generating warnings to the student in case the student navigates to other windows by some other methods.

5.1 Results

The strengths of the proposed system include the two-factor authentication which is the combination of secret password and the face validation at the time of login for both the examiners and the students, log generation that gives a detailed report of all the activities done by the students during their examination on the examiner's dashboard, and efficient exam generation process for the exam creation and its management (Fig. 5).

(a) Face snapshot during registration (b) Login by a different user

Fig. 5. Face registration and validation process

The weaknesses of the proposed system are that the system can detect all the window and user movement-related events but it is difficult to analyze the front view from the candidate's perspective. Also, the examiners can't set up a subjective and practical-based examination.

6 Conclusion

In our system, face detection is achieved by first capturing the face snapshot of the user and then verifying it with the stored images in the database. The system is also capable of performing student tracking throughout the examination. As the input facial image is captured in real-time during examinations there is a variance in image quality and the illumination of the face. On this aspect, the YOLO algorithm has provided very accurate results by detecting the objects in the candidate's live environment. The designed system is also able to automate the attendance process by generating the data of the students who have appeared for the exam. Our examination framework currently handles only objective-based questions. Hence the future scope of this work is to make the entire system a part of the e-learning framework and also provide support for practical as well as subjective-based examinations.

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