ProcSmart: An Online Proctoring Tool

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1 Introduction

The ongoing public health crisis has prompted colleges and organisations to go online for tests and remote proctoring. E-learning is learning for the future. The global e-learning market is expected to cross USD $325 billion by 2025. The e-learning industry's rapid growth has generated needs for diverse supporting technologies. The virtual proctoring space is one area that is expanding rapidly.

Proctoring Online Exams: Remote proctoring allows students to take exams online being at a remote location, without compromising the integrity. Students are required to verify their identification and agree to be monitored via video and audio. This digital media is then used to flag any suspicious actions by the test taker. For taking an online exam there is need for some minimal resources:

- An Internet Connection.
- PC/Laptop/Smartphone/tablet
- Webcam and microphone
- A browser

One can categorize online proctoring in 3 types.

1. **Live Proctoring (Online) :** In live online proctoring, a professional proctors tracks the activity of a student via live video and audio. This type of proctoring does eliminate the location constraints. However, it still needs a Proctor(human), and there is a need for Proctor and test taker to be present at the same time. Also, a proctor can only manage to access 10-15 students in one session which makes it very expensive.

2. **Recording :** In this proctoring, a proctor doesn't track the live feeds. The whole exam session is recorded and later a proctor analyses the recorded session to find any irregular activities. Typically, the recording is speed forwarded at 4x or even at 10x and if something suspicious is found then through analysis is done. This way it handles the disadvantage of the previous method where a student and proctor has to present at the same time. But still this type of proctoring requires humans so it's not very scalable and not cost effective.

3. **Autonomous Proctoring :** The most advanced form of proctoring is to develop a smart system which can perform autonomous proctoring. Similar to previous types, students audio-video and screen sharing feeds are recorded. But apart from that, a smart proctoring software, using video and audio analytics tries to find suspicious activities. This technique overcomes the drawback of the previous two methods. It doesn't require any human review and therefore is extensible and cost effective as well.

2 App Overview and Scope

The primary features of this project can be broadly categorized as follows:

2.1 Vision Based Features

2.1.1 *Facial Recognition*

These features will use the computer's camera and a camera API to keep track of users (i.e candidate taking the examination). It will keep track of the eyeball, lips and other facial features of the candidate. It will ensure the candidate is not replaced by any other individual during the course of the examination. The application will also ensure the face is not being spoofed using an image.

2.1.2 *Object Tracking*

Another visionary feature is to detect objectionable items such as mobile phones, textbooks, tablets, etc.

2.1.3 *Identity Verification*

This feature will ensure the candidate taking the exam has the same identity as the person registered for the exam. Identity verification should be done before the candidate is allowed to attempt the exam. This can be done by making sure the person on an ID card (College or government) is the same as the person in the camera. The name, student ID and date of birth can also be verified using a database of registered students and the information retrieved from the ID card presented before the examination.

2.1.4 *Scanning Submissions*

If the type of examination is written (pen and paper) and submissions need to be scanned or photographed. One of the "good to have" features is to have an inbuilt option within the application to scan images directly from a scanner or capture images from the webcam and at the same time ensure that the text is legible in the picture captured.

2.2 Computer Activity Tracking

This feature tracks the activities being performed on the computer during the course of the examination. In closed book exams, If activities such as switching tabs in browsers, using multiple browsers, using documents are performed, the application immediately notifies the examiner regarding the candidate's behaviour. One "good to have" feature is to make sure the exam is taken in fullscreen mode and to not allow the candidate to move out of the exam screen.

2.3 Audio Based Features

The application will use the computer's microphone to track the candidate's audio activities. The recorded audio will be converted to text using speech-to-text techniques and these texts will be used to further analyze user activity.

2.4 Adaptability to Lower Internet Bandwidth

This project is planned to be made in two compatibility modes. The first one that streams candidates live and the second that uses random interval image based proctoring. This feature is added in case the candidate is having internet bandwidth issues. When an examinee has good internet bandwidth the application uses, the live streaming option that monitors the candidate in a continuous manner. When the candidate has internet issues or lower bandwidth the application automatically switches to random interval image based proctoring, in which case an image of the candidate is taken at random interval (1-10 seconds) and the image is used to ensure good behaviour of the candidate. Another "good to have" feature is to use Machine Learning and train a dataset using a user's behaviour and use it to predict the future behaviour of the candidate. If a good behaviour is noticed over a period of time, lower bandwidth can be used for this candidate. This will save internet usage as well as computational complexities.

3 Why is this a "Killer App" ?

Proctoring human beings is one of the most difficult challenges in today's scenarios. Be it online or offline exams, invigilators and proctors have always been cheated by examinees. We, as humans, make rules to follow and we are smart enough to find loopholes in them to defy the complete proctoring system. Sometimes due to lack of good proctoring, instructors end up not taking an exam. Due to the current pandemic and classes being online, we faced this situation last semester where some of our midterms were cancelled and some took place online with live proctoring. Both the students and instructors suffered because of this situation. This was the situation for millions of students all over the world. Also, after the online exams, a few minutes of time were provided for the students to scan their handwritten answers and upload it. Sometimes scanning the answer sheets or taking a picture wasn't clear enough and uploading it took some extra time than the allowed time frame. It will also be unfair if we don't see it from an instructor's point of view. The proctoring system currently in place is biased. Although students are monitored, an instructor isn't still sure what's happening in the uncaptured areas by the webcam. Also, students can browse the internet, use a cellphone or take help from a friend who is already present there. All these problems motivated us to work for a smart and better online proctoring system.

If you have already started thinking that such a system won't have any future after the world comes out this pandemic. Studies have shown that more and more people have adapted to this change and have become comfortable with online learning which is all set to be the new normal.

4 Target Audience

Online proctoring system cannot only be placed in educational institutes but also in organizations which conduct online exams or interviews. Organizations like ETS which conducts SAT/GRE, can take leverage of the proctoring system and completely go online, without spending money on setting up computer labs and hiring proctors. Companies can use such a proctoring system while taking online assessments or during an interview with candidates.

5 Problem being Solved

Let us have a look at the issues being faced after the transition to online exams.

- In the current scenario, most of the countries in lockdown, it is almost impossible to take offline classes and proctor.
- It is also difficult to appoint a third party which provides an exam center for students. The cost could be overwhelmingly high.
- Proctors that are qualified are hard to find, and even if they are available, there is no qualitative scale to measure whether a job is done properly or not. Proctoring by humans is also subjected to personal opinion.
- Resources like Test centers, Proctors are limited. Such limitations may cause the exams to spread in multiple phases.
- Holding online exams without online proctoring leaves online exams vulnerable to cheating. Students may abuse the online exam system and often cases of impersonation and use of reference material, like textbooks, notes and digital devices, like smartphones, smart watches etc. are reported.

6 Technical Feasibility

From a technical stand point most of the features mentioned above should be feasible. We will use various machine learning and computer vision techniques to develop a system to monitor students behaviour and actions in real time. We will use python because of its rich support for Machine Learning algorithms as well as the ability for it to be used as back-end server.