Online Proctoring – State of the art and plausible improvements

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Introduction

“Anytime, Anywhere!” theme of the online courses and academic institutions are for the betterment of the education domain. It reduces labor cost, physical infrastructure, and essentially provides education for greater volume and more diverse group of students. There are more than 10 million students who are trying to benefit from such facilities. However, there is a gap. The outcome of the courses is not trusted by the prospective employers and universities are not willing to give credit for such courses. This is due to the fact that it has been proven that scores in online exams were significantly higher than predicted ones [1] and moreover, online students had significantly lower degrees of explanatory power [2].

Further, it has been proven that proctoring students, online and offline, reduces the rate of cheating [3]. There are also empirical surveys which suggest that online exams are more prone to cheating as compared to in person exams.

Types of Cheating

Types of cheating are directly dependent upon the type of exam, namely Computer Assisted, Computer Aided and Computer Based. Cheating can be differentiated into two broader categories.

1. Seeking Online Help – This can be tried by a student while an exam is conducted in proper isolation. The famous tricks of using spyware, instant messenger, connecting to different servers or using VPN [6] in order to seek answers to the questions. This can be well taken care of using Packet Sniffers. In a semi-controlled environment, it becomes easier to address the issue.
2. Seeking Offline Help – This is a prominent area of detecting cheating. Subject might use notes, books, or other devices [7] in order to solve the hurdles faced.

It can be noted that in both of the aforementioned categories, student is desperately seeking for help. There is an elegant solution on top of this observation, which is mentioned in the Solutions.

Solutions

A survey conducted in 2010 [4] lists the tools and techniques to tackle the situation. It points out that majority of solutions involve recording an exam attempt or streaming a live video to a proctor who will review it remotely. This naïve approach not only takes more efforts, but is also costlier.

Another approach to view a problem is to predict if the student will cheat or not [5]. This involves personal as well as situational factors. Profiling students have other parameters which create a complex scenario. Moreover, a threshold probability in deciding if the student will cheat or not cannot be determined with high level of accuracy.

In a different approach using Computer Vision, a student is strictly observed based on only positional feature, looking into or away from the computer screen [8]. It imposes very strict restrictions. The author has come up with rudimentary methods to bypass the stringent behavior of the system, such as using counters to make sure a student is allowed to look away "k" number of times. The used feature is a very good one, but entire system should not be dependent on only that.

Another elegant approach takes facial expressions into account. This software, ProctorTrack, the world's first automated remote proctoring solution, detects unusual student behaviors. There seem to have restriction on the student to sit straight, always looking into computers. Students have reported that if they stretch or pick up a dropped pencil, these incidents are being marked. But more or less, ProctorTrack is leading the innovation in this domain.

From an algorithmic point of view, a recent research proposes interesting facts. Based on the findings in Neuroscience, a human cognitive system is in disequilibrium state when individuals are confronted with problems, obstacles to goals and obvious gap in knowledge [9]. In such state confusion is telling indicator of reality than other emoticons. Test takers hit impasses and are in cognitive disequilibrium when they do not know the answer to some question. And at this very point, to break out of disequilibrium, they may decide to cheat [7]. In his thesis, the author lists important features – student's time to answer the question, the student's visual focus of attention and affective state of a student, derived from emoticon – confusion.

Of course, there are more references available than mentioned here, but above are the prominent ones and other unmentioned solutions have a large amount of overlap with these.

New Proposals:

The aforementioned solutions rely on visual evidence captured using web cameras. Any system would be more accurate if it considers more than one type of feature. For e.g. using only facial expressions would not be as efficient as using facial expressions and body language. The research in two streams, namely body language and emoticons, is viewed more or less in isolation. The fusion of two would be much more accurate and reliable measure of reality. A recent study indicates that both, facial expressions and body language represent the emotion more accurately [10]. There is going to be a challenge of partial body occlusion, because the student is going to be in a sitting position, but the possible extension cannot be denied in this case as well.

In general, there is a need to look at a problem from different perspectives and effectively fusing the multiple simple systems would result in an increase in accuracy.

It can be noted that all of these approaches are feature driven. The human being is trying hard to find a feature set which represents the pattern, and on top of it cheating is labeled. An innovative solution would be to execute the data driven solution and let an algorithm decide which features are more important. This would be based on the Deep Learning approach. A bottleneck is going to be the *accurate dataset*, more on this in the next session. Given the diversity of a problem, training a net will not be an easy task. But once trained, it would be as accurate as a human being, if not more.

Privacy Issue

With any of the presently available systems, no one is 100% confident. So they must mark the aberrant behaviors, and send it over the network in order to make sure if it was cheating or not. In some cases, the entire exam session is sent over to the network. Though a privacy policy can always be there to ensure users that their privacy is not compromised, it seems to violate frame of references of users. This issue becomes far more important because the definition of privacy changes with respect to the context. As per the detailed study [11], the users of software ProctorTrack experienced anxiety over perceived invasion of privacy and anxiety over constantly being monitored. The commonsense worldview of a paper points out other issues, like the way software was introduced, unexplained cost, etc. These issues exist more from a management perspective and less technical. The gist is – users might get conscious, might not like to have their personal data sent over the network.

From a technical aspect, it depends on what data is sent over to servers so that algorithms can run. One quick-fix solution could be – perform a feature extraction locally, and send only feature vector with timestamp. Later, if any anomaly is detected, those frames can be extracted using timestamp information. This solution is directly dependent on underlying system architecture, algorithms used, run time complexity of feature extraction and other dependable components.

Another outline could be:

1. Perform a person identification [12] (using HOG descriptors or otherwise). This essentially segments the background.
2. Create a generic model, which would contain postural information, emoticons and any other features used for identification of abnormal behavior. Now user of the system cannot be identified.
3. Compose a new video using codec, and send this new video to servers, which does not contain any personal information.

Above system would heavily depend on what is current architecture of the system, if reformation is required and if yes, is one willing to reform the entire system. Due to less number of 3D cameras available to the general public, one won't be able to create 3D models o user's environment. So point 2 pses a significant development challenge, but it is not impossible to create. It would need deeper discussion to bring clarity on 'What one wants to achieve' then How follows seamlessly.

Privacy is also a matter of taking students under confidence. If they also understand and agree that proctoring is actually for their betterment. As ProctorTrack was first of its kind, from a historical point of view, it is quite usual to experience opposition at the beginning. Statistically, over 70% of the community is against cheating. So if they agree that such systems actually help in installing integrity, a sense of fairness, they would not mind being monitored.

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