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Remote Proctored Theory and Objective Online Examination

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ABSTRACT

The 21st century is the digital world, where everything is done through electronics and autonomous devices. In this era where no one wants to do any task which takes more effort and time, they do the same task by digital which makes effortless as well as time-saving. During COVID-19 pandemic many exams were discontinued. Remote Proctored Theory and Objective Online Examination is a case study for providing a solution for conducting online examination instead of manual examination. This will be a web application that allows examinees to conduct the exam for examinees by colleges/universities/organizations. This application will allow your theory as well as objective type's examinations for professional and non-professional courses.

Keywords – **Network Application for E-Examination, Online Examination, Remote Proctored Examination, Theory and Objective Examination, Virtual Exam Room.**

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I. INTRODUCTION

Remote Proctored Theory and Objective Online Examination is a general idea and proposed system for establishes a network for providing a service to the examinees as well as professors. Remote Proctored Theory and Objective Online Examination's purpose is to accomplish the requirement of the institute/organizations to conduct the exam online. Examinees can appear for the exam without actually going to any physical destination and saves the effort and time of the institutes/organizations and the examinees. We all know the current pandemic situation, where all universities/colleges/organizations' exams are either postponed or withdrawn due to the safety of humans. We have the latest technology, also we all aware of online examinations, but we are unable to organize such an exam. Necessity is the mother of inventions. And now we all want to utilize our technology for such type of examination, where any institute/organization can conduct remote proctored online exam the same as they conduct on their institute.

We suggest such type of examination system, where you can easily monitor all activity of examinee and conduct examination for remote areas. Proposed Features/Functionality are-

- All existing functionality of the online examination system
- Use **key logger and mouse activity** for tracking examinees' activities
- Allow **paragraph writing and image uploading features** for theory examination
- **Console lock** for preventing to open other windows/application during examinations
- **Camera, mic and location** access for verifying candidates.
- Use of **primary memory** and **cache memory** for offline/poor network connectivity area.
- **Encryption** and **Decryption** for data security.
- High-level **database management** for better utilization of database and data storage.

II. LITERATURE SURVEY

Automated Online Exam Proctoring, their Online exam proctoring (OEP), user verification, gaze estimation, phone detection, text detection, speech detection, covariance feature is used, there are two cameras is used the first camera is placed above or integrated with the monitor facing the test taker. The additional camera can be worn or attached to eyeglasses. In this system, a human proctor watching is necessary through a webcam from a remote location and another is the requirement of two cameras and other extra hardware which increase the cost of assembling [1].

Novel Solution Based on Face Recognition to Address Identity Theft and Cheating in Online Examination Systems, here camera identifies the facial features and transmits the signal to the server where scanned features are matched with stored identity. In the examination, the second video is taken by the camera. The images in the video are compared to verify the examinee if they were looking somewhere else other than his/her screen then a warning is displayed on the background. There is a possibility of cheating because the examinee will Change the tab and by using the browser or other documents saved in the computer they copy all data [2].

Online Examination System Using Voice Recognition System, In this system, the answer is in the form of voice and some predefine APIs are used will converts these answers into strings and that answers will check by the message Digester (MD5) algorithm and calculates the results depending on that probabilities. Here Examinee will search the answer according to the question on the phone or computer and answer it quickly. So cheating is possible there, and mostly some examinees are unable to tell the answer to the rapidly asked question [3].

Implementation of pHash algorithm for face recognition in the secured remote online examination system, here pHash, Perceptual hash functions, Face recognition techniques, Cryptographic hashing, identity infringement, Secure online examination, DCT, Perceptual hash algorithms are used. During the examination camera take the snapshot of examinee that verifies the examinee picture by comparing his image at exam time with his image at registration time, there are perceptual hash functions that are usually used to perform image verification. For all the processes the presence of examinee in necessary in the exam center [4].

Online Examination System, online examination system is to minimize the usage of paper and transform all form of data into digital form it is a web-based application where true or false question answering and option based question answering exam is conducted, all the examination process is run on window operating system [5].

Detection of Impersonation in Remote Online Examination, Facial Recognition using PCA (Principal Component Analysis) to build such system that overcomes this threat of intrusive and non-intrusive collusion and perform live identification and authentication of the candidate throughout the examination, QR code is used for login by the examinee, in QR code the special character has loaded that character provide the required question paper to the examinee. Here the main problem rise is that the error during the scanning of QR code. The error will be the mismatch of the data or other technical [6].

So in short, the current online examination system is good for conducting the online examination, but it has many limitations and issues like platform-dependent, tracking of examinees' activity, preventing and monitoring unfair means activity, affordable hardware, and security issues. So we are trying to solve the problem as we wish to provide a complete platform-independent environment, with secure and well managed remote proctored online examination, where both, institute and examinee will satisfy and comfort to appear in the exam.

III. PROPOSED ARCHITECTURE

Remote Proctored Theory and Objective Online Examination will provide fully secure and easy to manage examination environment. Here system architecture is defined that how the proposed system will verify the user and prevent unfair means activity.

- **Registration:** Examinees' will have to register themselves for examinations, once examination notification will be published by the organizations/universities/institutes.
- After registration, organizations/universities/institutes will verify the user, and accept their registration link, then provide their login credentials
- If registration did not succeed, organizations/universities/institutes will immediately notify the examinees'

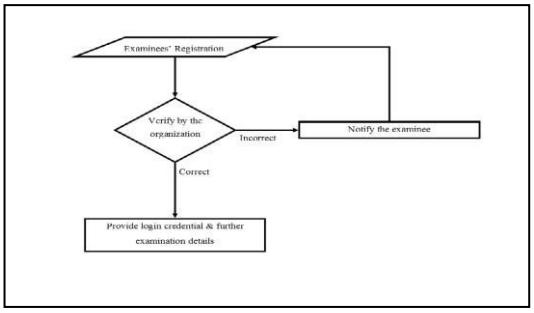

Fig. 1 – Registration process for examinee

- **Pre-Exam Verification:** The Examinee will be verified by the AI system. Here examinee will have to arrange some hardware like webcam and mic
- Before starting the exam, webcam and mic will be configured. So for the configuration of the webcam, there will be a frame that examinees the' picture, also this picture will be used for monitoring examinees' activity. Here examinee has to record a short video too, which will be used by the AI system for monitoring examinee's activity. The system will ask examinee for saw monitors corner so that AI&ML functions can be major monitor range for examinee eyes and head activity

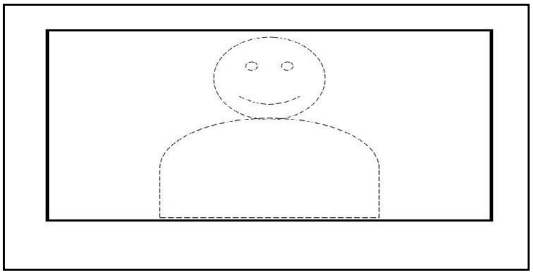

Fig. 2 – Webcam synchronization

- Then examinees' have to instructed for the exam such as precaution, what to do and what not etc. as he/she notified while registration
- **Tracking examinee's activity during examination:** Remote Proctored Theory and Objective Online Examination will have AI&ML functionality to prevent such type of unfair means activity, and warn examinees' if he/she can try to do such kind of external activities
- Remote Proctored Theory and Objective Online Examination system will measure the average maximum width of the examinee's monitor, so if the examinee's eye or head movement frequently goes outside the range, the system warns the

examinee. That means while adjusting webcam, the measurement also recorded by AI&ML, so it will fix the examinees' boundaries for head/eye movement for frequently movement, that will be monitored by AI&ML system

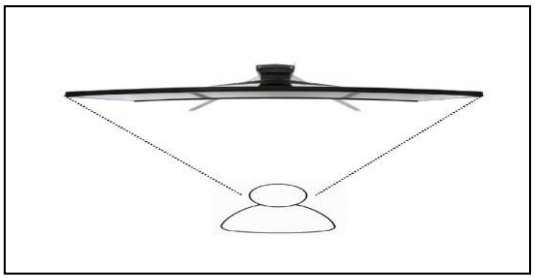

Fig. 3 – Monitor range with the webcam for capturing head/eye movement of the examinee

- Also, examinees' mic will be always on during examination, and match with the examinee's voice, if the system detects any other sound, then warn examinee for such kind of activity, so that examinee will not able to talk with anyone during the exam
- **Controlling examinees activity:** Remote Proctored Theory and Objective Online Examination system will lock whole console/monitor windows so that examinee will not be able to switch windows
- Also, the keyboard will disable during objective type question, For theory question, examinee have to click on given text box area for enable alpha-numeric key (Only alpha-numeric- "A-Z", "0-9", ",", ".", "/", "(),{},[]" and "?" keys, which keys will be used and enable during theory type question), no any other key like – Ctrl, Tab, Esc, Function Keys, etc. will be enable
- Also, the right button of the mouse will be disabled, and examination windows will be opened as maximized full-screen mode, so examinee will not able to switch or turn of the exam window during the examination
- The key logger also enable, to monitor examinees keystroke activity, this feature will allow the examinee to press only allowed keys, rest keystroke will be recorded in case if examinee did any type of external activity
- **Exam window:** Exam window of Remote Proctored Theory and Objective Online Examination will be the same as other online examinations like remaining time information, questions information, help guide button, virtual calculator, etc.
- For objective type question, examinee have to select correct/their choice of answer
- For the theory type question, the examinee has to click on given the textbox to enable keyboard typing options, and when the examinee did his/her answer, he/she have to click on the "Next/Submit" button, for save and continue his exam. After saving his/her theory answer, the keyboard will again disable
- There will be also an option for uploading images for theory type questions, which do after the examination. Examinee have to select/enter serial number or page number of self-drawn (without scale or another drawing tool) image during answer the theory type question, which will be uploaded by examinee after the examination
- The image can be uploaded by the scanner or simply click by webcam
- The following image is an abstract flow diagram that visualizes how Remote Proctored Theory and Objective Online Examination system will work

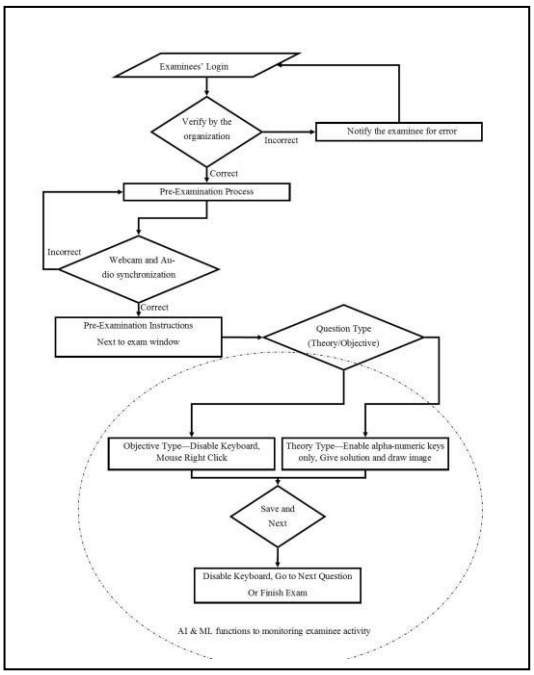

Fig. 4 – Proposed flow diagram

- **Database Management:** For better utilization of data storage, our system will generate a report and send all the data to the institute/organization after complete and declare the result of the exam, and then the system automatically flush old data, so we can use our database as the limited amount of size
- Before storing user data or submitting the answer data onto the server database, our system will be **encrypted** and **compress** the original data for security and manage data storage size
- **Internet Connectivity:** Remote Proctored Theory and Objective Online Examination will load all required functions and modules on examinees' local machine on primary and cache memory therefore examinee will not have to required internet connectivity all the time. In short, for registration, pre-examination process, load functions and module, and final submission of examinees' response, you will have to connect with the internet. Rest of the time, during solving/attempting the questions, you will not need internet connectivity

IV. METHODOLOGY

Remote Proctored Theory and Objective Online Examination is a solution for today's issue, especially the online examination system, which allows universities and colleges to conduct secure and fully functional online examination. Where all examinees can appear in exam virtually from remote areas or from their native places.
Here are the proposed methodology and system architecture for developing and deploying Remote Proctored Theory and Objective Online Examination.

- **Developing Platform:** The developing platform for the application is based on deploying the application (which is discussed in the next section of the paper). That how and where to run the application with compatibility and availability of hardware and software to the end-user i.e. examinee and examiner.

Table 1: Development Technology

Platform	Technology	Description
1. Front End	JSP including HTML, CSS, JavaScript	JSP supports both scripting and element-based dynamic content and provides programmers to develop custom tag libraries to meet application-specific requirements.
2. Back End	Google Firebase	The real-time database supports to store and synchronize data. Firebase has become more active with google analytics. Firebase offers the facility of crash reporting to fix bugs immediately, quick and secure web hosting, firebase authentication, and firebase enables content storage with peace.

- **Deploying Platform:** Aim of the application is to connect all examinee and examiner. So both, examinee and examiner can easily connect, appear, and conduct the examination. Today's android/iOS platform is available everywhere, but it is not possible to keep track of examinees by examiner through mobile devices. And also typing long descriptive type answer using mobile devices are irritative for the examinee. So android/iOS is not a better option for the application. Now coming towards web application, on modern age every home has computer/laptop/tab devices which can easily run web applications. If any villagers or poor family will not able to afford such type of devices, solution for the problem is the digital world, where every locality has a primary school with computer, common service center or computer education center which own a computer/laptop. The examinee can request them and borrow their system for a small amount of time for appearing in their examination. So in finalize result **Web Application is suitable for deploying the Remote Proctored Theory and Objective Online Examination.**

V. CHALLENGES AND SOLUTIONS

Providing a secure well managed online examination platform is a big challenge for us. We have tried to find and solve such kind of problems and external activities which act as unfair means by the examinee. There are many challenges which will be faced while appearing or preparing for the online exams-

- **Problem:** There may be a chance that the examinees who are giving the exam can copy the answer by keeping the notes out of the range of cameras. Also, the examinee will be allowed to use the paper for their rough work, another problem is what happened when they write the answer behind the paper before the exam started
- **Solution:** The AI machine will be trained in such a way that if one tries to copy or cheat from nearby tools. Then it will easily identify the user movement and warn him for not doing such action anymore during the examination. For example, if one tries to keep books or notes in front or nearby and tries to copy from it then the system will check him/her movements in every 5-10 second that he/she is looking at the same place or not if they are cheating from some notes/books then they will consistently look at that in every few second and it will get noticed by the AI/ML system and they will warn then for such
- **Problem:** If there is low internet connectivity or connection lost in between the exam
- **Solution:** The system requires only internet connectivity during starting phase and ending phase (as mentioned in internet connectivity on section III, Proposed Architecture) that means during the pre-examination process there will be required internet connectivity for 15-20 minutes in which all his/her surrounding details will be capture by the system itself by using AI/ML system and if any unfair things will be found then it will warn for the same to the examinee or user who will appear for the exam. After this all his/her data will be saved in the local system and then they will have to connect for internet connection at the end phase where they will require to submit the paper
- **Problem:** There may be a chance that he/she can cheat on his/her system or what happened if the examinee saves all the answers in the clipboard
- **Solution:** No such unfair means can occur because there will be a console lock, in which no other window except the exam window can appear, and also all the keyboard keys will be disabled if not required. And if one tries to press windows, ctrl, alt or other combination of shortcut keys like ctrl+c, ctrl+v, etc. which does not have any importance

during the exam will warn the examinee or user for same and then the mouse will only work in the particular area of the screen when required only

- **Problem:** Humans could not sit in the same position for two-three hours and also there will be problems in neck and eyes due to continuously looking in the same position to screen, then how your system will track such activity
- **Solution:** When there is a pain in the neck or if the user wants to change position than he/she can all the movements will be capture by the webcam or camera of the system and if there is a pain in eyes than one can close it for few seconds to minutes as their requirement and also one feature is also provided that if a user closes his/her eyes for more than three minutes than the system will beep or produce some sound so that if he/she sleep can wake up immediately. The most important thing is that the system will monitor continuously the same type of activities and warn the examinee. The system will not warn the examinee for random and natural human activities
- **Problem:** If any person will seat behind the camera and spell the word then the examinee will copy it easily
- **Solution:** In the system, the mic is also enabled which recognizes the examinee's voice during the pre-examination process, so if someone else spells anything continuously after random time slice, the system will warn to the examinee and leads to termination of the exam for the examinee
- **Problem:** How you verify the examinee after uploading an ID card in case another person will sit in place of examinee for appearing in the exam.
- **Solution:** Just before the exam, there is a pre-exam verification process which done all verification and environment setup for the examinee using our AI&ML system. Here AI will use the concept of the face recognition system. The face recognition system is a biometric technique that uses a combination of face detection and recognition for the purpose of identity recognition. In this biometric approach live image of intend or future user will be acquired, and face detection is performed acquired images for recognition and identity pass [7].

VI. RESULT AND DISCUSSION

Remote Proctored Theory and Objective Online Examination will, directly and indirectly, impact on universities, examinees, and examiners. A brief discussion about the impact is mentioned below.

- **Impact on Universities:** When exams are taken in offline mode then university needs to send question papers, answer sheet, etc. to each and every college which are affiliated to that university. This takes a lot of time and there is also a chance that such papers could leak if there are mistakes in their security systems. So such the thing will get avoided in case of a remote proctored examination system. As in this, there will be a centralized database in which all the required information whether it is a question paper or all other information, all will be feed in a centralized database and such will be used when required. For example:- Question paper will be store in a centralized database and will get active once the time begins for the exam and will get denied access when the exam time gets over. Thus, there are almost no chances of any kind of leak of question papers. When we talk about the offline based examination, if there is an error being found in the question paper then to correct such error the universities require to call or fax each and every college to correct that particular question which requires a lot of time to reach to each and every college. But in case of Remote Proctored Theory and Objective Online Examination System, if the university wants to correct the errors then that university needs to update question in the centralized database by using admin interface and when the university change that an automatic notification will be generated on the examinees' screen that a particular question number has been changed and the examinees could easily reach to that question and can correct his/her responses/answer.
- **Impact on Colleges:** In case of the examination held in colleges, the examination controller have to visit each and every class where the exam is actually happening and require to go time-to-time to check for the unfair means during examination but when we talk about the Remote Proctored Theory and Objective Online Examination System, the college's examination controller does not require to reach to each and every individual but rather can see each individual remotely and if the controller does not notice any of the unfair means being done by the student then Artificial Intelligence will take care of it. If some continuously unfair means is observed by the Artificial Intelligence then it will send a report to the university or college examination controller team to make student warn for the same. When the exam is conducted in the colleges then the colleges require to arrange for examination and because of this, the normal schedule plan gets disturbed because it is the responsibility of colleges to conduct exams successfully. So to make the examination successful, the college committee has to arrange the examiner for the examinees and make all sorts of arrangements for examinees. Thus requires a lot of time. But by using Remote Proctored Theory and Objective Online Examination system, no such arrangement will be required, all the work of the examiner will be done by the Artificial Intelligence itself. When there is an examiner or invigilator used in the examination hall ten also there will be chances of some unfair means but in Remote Proctored Theory and Objective Online Examination System, Artificial Intelligence will be

trained in such a way that there will be no or minimum chances of unfair means.

- **Impact on Examinee:** One of the most important features of the Remote Proctored Examination System that one would not require to go to the colleges/centers and give their exam there but requires an internet connection at their comfort place to give exams. So he/she will save time and can easily give the exam by being in their comfortable location. During examination time student are under high pressure and under that situation one requires to go to the colleges/centers for their examination, but the student by using Remote Proctored Theory and Objective Online Examination System can open it ten minutes before the actual exam starts and can arrange for all required things before exam starts. During the examination time, there is a problem that occurs when the invigilator actually checks for the valid student by disturbing each individual while writing an exam. So that is also taking care in Remote Proctored Theory and Objective Online Examination System by actually asking for all details before the exam starts and when the exams are actually going on than no any kind of disturbance will be occurred as all other types of notification will be blocked when the exam time is going on.
- **Impact on Paper Checking and Result Declaration:** The exam when conducted offline requires the use of the professor to check the answer sheet of the student and the result, in this case, becomes late because it requires human power to check the exam answer sheet. But when the Remote Proctored Online Examination System is used, it will require the professor to check the answer sheet by the professor for few years and the basis of this the Artificial Intelligence will make itself ready to check the answer sheet of the exam and will be capable of producing result faster than the time required in case of other modes of examination. Thus it will produce results in an effective way and within less time as compared to the offline mode.

Remote Proctored Theory and Objective Online Examination allows one to give the exam by being on their own comfortable location. But the exam will be under the surveillance that means the system will itself monitor your movements during the exam and on the basis of it, the result will be produced accordingly. The Remote Proctored Theory and Objective Online Examination will actually monitor each and every movement, the examiner actually make and if the proctored system finds that something is going wrong, it will produce a warning message of what unfair things the system finds in the examiner and one time allow the examiner not to do it again.

The exam is basically used to occur to check the knowledge of an individual and it is important to take care of everything an examiner needs in exam time and all this will be taken care by the Remote Proctored Theory and Objective Online Examination system which will provide a better environment to each and every individual actually giving the exam. The use of Remote Proctored Theory and Objective Online Examination will surely make the examination system fully digital where one does not require any kind of invigilator, all the work of invigilator will be done by the Artificial Intelligence itself.

This proctored system is a way to provide the examinee a better way to give exam and will also help as it reduces the manpower that means it will skip the use of human as an invigilator and will also reduce the efforts used in transferring the question and answer sheet from one place to another. It will also save the time for an examinee as well as the exam organizer who needs not require to keep an eye on the examinee giving exam all of the stuff will be taken by the machine itself.

VII. CONCLUSION

Online examination is one of the most important things which need to figure out, but this could not be possible by being in the home. One should require to go to the College/University/Centers etc. place to give their exam. But the Remote Proctored Theory and Objective Online Examination will allow one to give their exam whether it is objective type or it is theory type, all exam can be performed on this system easily. The most important thing which is being observed during exam time is that there should not be any kind of unfair means which can occur during examination. But in this remote proctored theory and objective online examination due to the use of modern technology will keep track of the one who is giving the examination. It's all information that will be tracked and will be shared with the college, university, or the one who is actually organizing the exam. This Remote proctored theory and objective online examination use the concepts of AI/ML in which there are minimal chances of unfair means as if such unfair things happen, it will identify and will warn the examiner accordingly. In simple words, it is the time to think for the exam to be digital as the world is growing at a very rapid pace and to compete with such, it is required to make examiner give their exam from their own location easily. Thus, this Remote Proctored Theory and Objective Online Examination system will help those examinees who actually live far away from their college/university or to the examination area where actually the exam needs to take place.

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