e-ISSN 2963-2870
Vol 3 2022

DEVELOPMENT OF ONLINE PROCTORING AND QUESTION AND TEST INTEROPERABILITY

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Abstract

One of the information technology facilities used to support the teaching and learning process in a distance is the application of online exams. This system has been used for a long time by students and lecturers as a developer of test materials. In developing the system, innovation efforts are needed, one of which is Online Proctoring and Question and Test Interoperability. This study aims to implement Online Proctoring and Question and Test Interoperability so that it is expected to be able to evaluate exams and provide recommendations to stakeholders to improve the quality of exam services. This research is a research and development using mixed methodology. The research was conducted for two years. The first year research will be carried out in 2020, is to study relevant theories and research results, draft models and mechanisms or procedures for use, conduct FGDs to validate draft models and mechanisms, and revise draft models and product procedures for Online Proctoring and Question and Interoperability test developed. In this first year research, researchers also held FGDs to validate the products developed, namely Online Proctoring and Question and Test Interoperability. The result of this prototype was developed a flowchat form with access individuals and access groups.

Keywords: Online Proctoring and Question and Test Interoperability

1 INTRODUCTION

The implementation of quality education is mostly carried out on the island of Java and has not been evenly distributed throughout Indonesia. Especially the problem of administering the test. All Indonesian people want to get quality education, easily accessible and affordable. One solution to this problem is e-learning and online exams (Yuliyanto, Wahyuni, and Seputra, 2016).

Online exam system using facial recognition to authenticate students attending online exams. The system works continuously (with short time intervals), to check student identity during the entire exam period to ensure that the student who started the exam is the same person who continued to the end and prevent possible cheating by looking closely. The system will issue an early warning to students if suspicious behavior is known by the system (Fayyoumi & Zarrad, 2014). Automatic Facial Recognition (AFR) technology has made many improvements in a changing world. Attendance Real-Time Face Recognition is a real-world solution that comes with the day-to-day handling activities of student attendance systems. The presence of a facial recognition-based system is the process of recognizing student faces to take attendance using facial biometrics based on high-definition monitoring videos and other information technologies (Nandhini, Duraimurugan, & Chokkalingam, 2019).

The multimedia analysis system is a system that performs online automated proctoring exams. The multimedia analysis system tools or hardware used include one webcam, one wearcam, and a microphone. Aims at visual and acoustic environmental monitoring of the test site. The system includes six basic components that continuously estimate key behavioral cues: user verification, text detection, voice detection, active window detection, gaze estimation and phone detection. By combining the continuous estimation components, and applying a transient sliding window, we designed a higher level tool to classify whether a test taker is cheating at any point during the exam. Extensive trial results demonstrate the accuracy, robustness, and efficiency of our online test preparation system (Atoum, et.al., 2018).

The results of Alessio, et.al., (2017)'s research on the performance tests of 147 students enrolled in several parts of the online course, after being compared using a linear mixed effects model with almost half of the students not having proctoring and the rest needed to use online proctoring software . Students scored, on average, 17 points lower [95% CI: 14, 20] and spent significantly less time on the online test using processing software versus the non-programmed test. Significant class and time-of-use disparities occurred across different exams, both across and within sections of the same course where some students used the testing proctor software and others did not.

The Learning Management system (LMS) requires human resources who have competence in designing, manufacturing, reviewing and finalizing the LMS system (Indriani, Fathoni, and Riyana, 2019). The integration tester of IMS Questions and Interoperability Tests (QTI) and IMS Learning Design (LD) in the implementation of E-learning from a pedagogical and technological point of view conducted by Sitthisak, et.al., (2007) stated that presenting an assessment using IMS QTI provides flexibility and reuse within the IMS LD Learning Unit (UOL) for individual studies. However, for group studies, the use of QTI items encountered coding difficulties, because group members needed to wait for feedback from all students.

Evaluation of the Multiple Choice Question (MCQ) conducted by Aras, Rahayu, and Prabandari, (2014) concluded that the Multiple Choice Question (MCQ) could have an adverse impact on the learning process. In the MCQ questions which structurally contain flaws items, the contents of which only test memorization, not the application of a science, and questions that provide incomplete information. Regulations in the form of summative exams can motivate students to prepare themselves more seriously than formative exams.

The Open University has completed an online learning system and online exams. However, it has not been equipped with a reminder information system for collecting questions and using real-time facial recognition in finalizing exam questions in the question bank. Based on the description of the problem above, the writer is interested in raising a theme that will be discussed under the title "Development of Online Proctoring and Question and Test Interoperability".

Computer Based Examination

Administering a computer-based exam using the classical method is a process of administering an exam that involves providing a special exam center, namely using a machine configured with a static security policy, used specifically for exam purposes (Kaiiali, et.al., 2016). The problem of applying the classical method of carrying out exams uses large manufacturing costs, equipment maintenance, and an environment that must be carried out continuously (Panyahuti, et.al., 2019). These problems are the following: first, it is difficult to identify online test takers. The second is the difficulty of preventing cheating during the exam. Thirdly, the difficulty of keeping unauthorized use of textbooks and notes on exams. Fourth, the difficulty of preparing for online exams and arranging the implementation of the exam. Fifth, it is difficult to prevent student access, who may have access to the question bank.

Sixth, it is difficult to prevent students from using cellphones during exams, calculators, and Bluetooth devices. Seventh is the difficulty of limiting access to other individuals during exam time. The eighth is the difficulty of ensuring students who are good at using computers to upload and download. The ninth difficulty is identifying intentional computer crashes. The tenth is the difficulty of recording various methods of examination examination (Ghosh, et.al., 2011).

The researchers argue that online programs should address students' integrity in their use of supervisory software. One way to do this is to ensure that students being fairly evaluated are effective (Moten, Fitterer, Brazier, Leonard, & Brown, 2013). Research by Berkey and Halfond, (2015) found 84% of 141 students who responded to the survey. Students agree that their dishonesty in online exams is a significant issue. However, less than half of the students surveyed indicated that they had used proctoring software in online tests.

The study of King, Guyette, and Piotrowski, (2009) stated that 73% of the 121 undergraduate students surveyed found it easier to cheat on online exams compared to traditional face-to-face classes. When asked if they were more likely to cheat, a survey of 635 students found that almost one of them would consider cheating in any setting. College students also indicated that they were

more likely to cheat in class when exams were online. The survey results found no significant differences in students' descriptions of their cheating behavior in the internet and face-to-face classes (Watson & Sottile, 2010).

While many studies address the prevalence of cheating online vs. in-person classes, many of these studies rely on self-reports from college students (King, Guyette & Piotrowski, 2009; StuberMcEwen, Wisely, & Hoggatt, 2009; Etter, Cramer, & Finn, 2007; Watson & Sottile, 2010).

Research that focuses on actual student behavior has found conflicting results. For example, Ladyshewsky's research (2015) analyzed test scores of postgraduate students and found no difference between test scores in non-programmed online tests, when compared to in-person programmed tests. Likewise, Yates and Beaudrie's (2009) study found no difference in course scores between student communities who took monitored versus unmonitored exams.

Research Corrigan-Gibbs, et.al., (2015) found rampant cheating, seen between 26% and 34% of students cheating by searching for answers online. Innovative study by Alessio, et.al., (2017) regarding the effect of proctoring on online test scores using several techniques to identify student fraud. As for these techniques, they are: 1) the exact words of the question are entered in the Google search engine; 2) expert analysis of words, comparing responses from students to one another, as well as general website language focusing on idiosyncratic language; and 3) IP address tracking. The results showed clear differences in test scores in separate sections of the same course and under contrasting conditions. There are various strategies for addressing integrity during online testing, and the use of proctoring software is one of them (Berkey & Halfond, 2015).

Processing software involves two main elements. First, activate the camera on the computer, and record students who take the exam. This allows faculty to observe student behavior and identify activities that could indicate cheating such as talking to others or looking over information in books. Second, it limits students' ability to use their computers for other tasks by eliminating the ability to engage in activities such as copy-pasting, printing and searching the Internet, or recording everything students do on their computers, or both. Restricting a student's ability to use other tools or resources is known as "locking" the computer or browser. Exam recordings can be reviewed by the teaching professor or lecturer.

Research by Meinawati, Satoto, and Nurhayati, (2013) states that by using the E-service application for online exams, it is hoped that it will increase public interest in the Diponegoro University Computer Systems Department, and also make it easier for online test users and do

not need to use stationery for the process. Supported by Kusworo's research, (2010) shows that the creation of an online exam system is an online exam tool to optimize exam activities. The online exam system provides benefits, namely that there is no need to procure exam paper and saves time for exam corrections so that the efficiency and effectiveness that is the goal of making an online exam system can be achieved. The function of random questions in the online exam system can reduce fraud committed by examinees because the questions presented vary so that examinees will receive questions that vary from one to another.

The Online Examination System uses Face Recognition

Online exam system using facial recognition to authenticate students attending online exams. Computer systems will be able to find and recognize human faces quickly and precisely from images or videos captured by surveillance cameras. Many algorithms and techniques have been developed to improve facial recognition performance but the concept applied here is Deep Learning. This helps in converting video frames into images, so that students' faces can be easily recognized by their presence, so that their attendance into a database can be easily reflected automatically (Nandhini, Duraimurugan, & Chokkalingam, 2019).

Facial recognition system applications in real time can be found in surveillance, identification and security systems based on facial recognition. Observation of faces directly by humans has weaknesses, because the fatigue and boredom that may occur can cause a decrease in accuracy. For that the use of computers can be an alternative solution. In this study, facial recognition was carried out through the stages of face detection, feature extraction and face recognition, then matched with profile data stored in the database. Face detection uses the Adaboost method, facial recognition uses the Eigenface PCA method and a MySQL database to store profile information. The use of this method for facial recognition in real time conditions with differences in the distance between the sensor and the face, the position of the face, the intensity of light hitting the face, facial expressions and facial attributes in this study gave an 80% success rate in identifying faces (Suprianto, Hasanah, Santosa , 2013).

Online Proctoring

The Online Proctoring System is an online monitoring system that is carried out by recording the activities carried out by the examinees, both the computer screen used and the examinees' faces via a webcam. During the process of recording the examinee's activity, the system tests the availability of the internet on the examinee's computer. If the internet is available, the system will

broadcast live or stream. done by using a cloud service, which allows sending videos to a server which can then be opened on a computer that has access. If the internet is not available, the system will carry out the storage process.

The storage process goes through a compression and segmentation process so that the resulting recording storage does not take up a large amount of space and when the upload process experiences problems (connection loss) the upload process can be resumed without having to start over from the beginning. Storage is divided into 2 types, offline storage and online storage. In the offline storage process, recordings are stored in the computer's local drive storage, while in online storage, recordings are stored in cloud storage with an upload process. In the upload process, if a connection loss occurs, the system can continue the upload process manually or automatically.

The Online Proctoring System being developed is a system that is used to facilitate supervision when exams are being carried out, so that the examiner and the exam supervisor do not have to be in the same place. Seen in the table below:

Table. The difference between online and conventional exams

No	**Difference**	
	Online Exams	**Conventional Exam**
1.	Can be done anywhere	Done in a certain place
2.	Proctor and exam taker do not have to be in the same place	Proctor and exam taker have to be in the same place

The conventional exam process tends to cost more to provide a place and accommodation costs to go to the place where the exam is held. Meanwhile, in the online exam system, exams can be carried out anywhere as long as internet access is available. The second difference is that in conventional exams, the participant (exam taker) and the test supervisor (proctor) must be in the same place to carry out the supervision process. Meanwhile, in online exams, the proctor can supervise the exam directly with the live video stream feature.

e-ISSN 2963-2870
Vol 3 2022

Interoperability Questions and Tests

Question and Test Interoperability (QTI) is a standard format for representation of assessment content and results, supporting the exchange of this material between authoring and delivery systems, repositories and other learning management systems. This allows assessment materials to be written and submitted on multiple systems in turn. Hence, it is designed to facilitate interoperability between systems.

This specification consists of a data model that defines the structure of the questions, the assessments and the outcomes of the questions and assessments along with an XML data binding which essentially defines the language for the questions exchanged and other assessment materials. XML bindings are widely used to exchange queries between various authoring tools and by publishers. Ratings and results are part of the specification of little use.

QTI is produced by the IMS Global Learning Consortium (IMS GLC), which is an industrial and academic consortium that develops specifications for interoperable learning technologies. QTI was inspired by the need for interoperability in question design, and to avoid people losing or having to retype questions as technology changes. Developing and validating good questions can be time consuming, and it is desirable to be able to create them in a technology neutral format and platform.

QTI version 1.0 is materially based on QuestionMark's proprietary Questions Markup Language (QML), but the language has evolved over the years and can now describe almost any reasonable question one might want to describe. (QML is still used by Questionmark and generated for interoperability by tools such as Adobe Captivate).

Version 2.0 was finalized in 2005 and only addresses the item level (i.e., individual questions) of the specification. A draft version of Version 2.1, which included test structure and results, was also released in 2005. But because Version 2.0 did not address test-level issues and was incompatible with Version 1, and because 2.1 was still under development, adoption of Version 2 was delayed. This was exacerbated in 2009 when IMS GLC withdrew a draft of Version 2.1 and informed the user community that the only version "fully supported" by IMS GLC was 1.2.1, which in effect also deprecated Version 2.0. Nonetheless, after a few more drafts, 2.1 was finalized and released in 2012.

The current version is 2.2, which was finalized in 2015, and then had two minor revisions, 2.2.1 and 2.2.2, the last being in November 2017. Version 2.2 updates and improves integration with W3C standards such as HTML5, SSML, PLS, CSS, ARIA, and MathML, and otherwise made relatively minor changes to the core Version 2.1 specification.

Version 2.x is a significant improvement over Version 1, which defines a new underlying interaction model. It is also notable for its much greater level of integration with other specifications (some of which were missing during production v1): the specification addresses relationships with IMS v1.2 Content Packaging, IEEE Learning Object Metadata, IMS Learning Design, IMS Simple Sequencing and other standards like XHTML. It also provides guidance for representing usage data and context-specific information to support content migration from previous versions of the specification.

Research Method Design

The approach model in this study was designed with a research and development approach. Gall, Gall and Borg (2003) describe that research and development originates from the industry-based development model, which is used as a product to design and develop a quality new product. In educational development sometimes called research based development appears as a strategy that aims to improve the quality of education. More specifically stated that in the field of education, research and development is a process used to develop and validate educational products and find new knowledge through "basic research", and aims to provide educational changes to increase potential positive impacts from research findings in solving educational problems and used to improve the performance of educational practices.

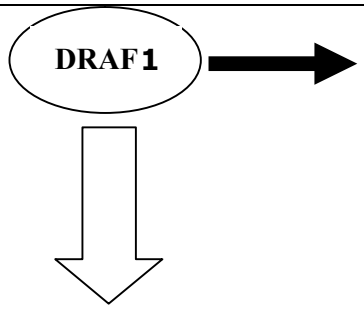
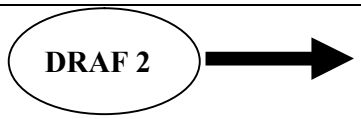
In general, the work procedure in research and development is in the following steps (Gall, Gall, and Borg, 2003:772), namely: (1) Research and information collecting planning. Review and gather information, including by reading literature, observing, interviewing and preparing reports on development needs. (2) Planning. Planning prototype components to be developed, including determining/defining the skills to be developed, formulating objectives, determining the sequence of learning activities, compiling scales of measurement and testing possibilities on a small scale. (3) Develop preliminary from product. Compile/develop the initial product/initial prototype. (4) Preliminary field testing. Conducting limited treatment/testing of the initial reconstruction model product (including conducting observations, interviews, and questionnaires). In this stage, classroom action research (CAR) will be carried out. (5) Main product revision. Revision of treatment results from the initial product model. (6) Main field testing. Implementation of field trials (observation, interview). Quantitative data at the beginning (pre) and end (post) of teaching were collected and evaluated. (7) Operational product revision. Perform product revisions, based on the results of field trials. (8) Operational field testing. Conduct field trials. (9) Final product revision. Perform final revision of the reconstruction model and determine the final product. (10) Dissemination and implementation. Dissemination and implementation/distribution to various parties.

2 METHODOLOGY

Development Procedure

This research is research and development using mixed methods. This research was conducted for two years. The first year of research that will be carried out in 2020, is to conduct a theoretical study and relevant research results, prepare a draft model and mechanism or procedure for use, conduct FGDs to validate the draft model and mechanism, and revise the draft model and product procedures Online Proctoring and Questions and Test Interoperability developed. Also in this first year of research, researchers held FGDs to validate the products being developed, namely Online Proctoring and Question and Test Interoperability. In the second year of research, empirical trials (limited and expanded) were carried out as well as dissemination of the products being developed. Figurally, the research procedure can be seen in Table 1 on the following page

Table 1. Research procedure

ACTIVITY	PRODUCT
	1st year Reviewing relevant research theories and results, then drafting the product being developed. Initial drafts and products are then validated through FGDs. Subsequently, this initial draft and product after revision was named Model 1.
	2st year Conducting empirical tests on products (limited and expanded tests and disseminating products through user tests, and revising them so that the product is final.

Subject, Place, and Time of Research

Respondents who were involved in the first year's FGD were 7 experts from the fields of evaluation, educational technology, and PJJ. The place of research is carried out at the UT head office and the time of implementation is in 2020.

Data Collection Techniques and Instruments

Data collection in this first year's research was carried out through the Focus Group Discussion (FGD) method. During the FGD, the experts were given a product draft, then they were asked to discuss it, guided by the researcher. The FGD participants were experts from related fields of expertise. After revision, the product draft was named Prototype-1. In the second year of research, Prototype-1 was tested empirically and disseminated through user tests.

e-ISSN 2963-2870
Vol 3 2022

3 FINDINGS AND DISCUSSION

The online proctoring system is an online monitoring system that is carried out by recording the activities carried out by the examinees, both the computer screen used and the examinees' faces via a webcam.

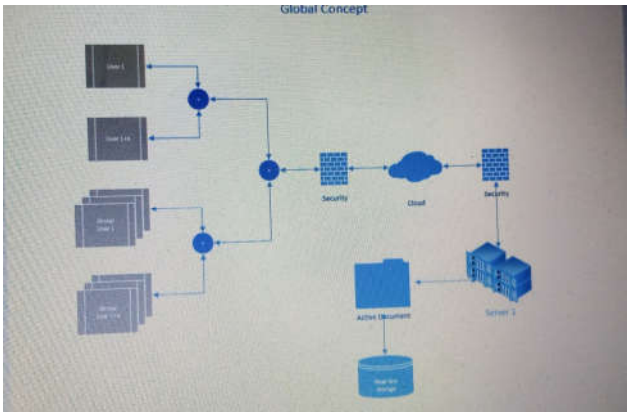
During the process of recording the examinee's activity, the system tests the availability of the internet on the examinee's computer. If the internet is available, the system will broadcast live or stream. done by using a cloud service, which allows sending videos to a server which can then be opened on a computer that has access. If the internet is not available, the system will carry out the storage process. The storage process goes through a compression and segmentation process so that the resulting recording storage does not take up a large amount of space and when the upload process experiences problems (connection loss) the upload process can be resumed without having to start over from the beginning.
Storage is divided into 2 types, offline storage and online storage. In the offline storage process, recordings are stored in the computer's local drive storage, while in online storage, recordings are stored in cloud storage with an upload process. In the upload process, if a connection loss occurs, the system can continue the upload process manually or automatically. The workflow of the Online Proctoring system can be seen in the figure below with the Online Proctoring System Workflow.

The following describes the flowchart of the results of the development of the online proctoring system workflow prototype design.
This slide depicts the global system as a whole where users are divided into two groups

1. Individual access
2. Access groups

Each access has network security which will later be determined by standardization (security). Before the user makes a connection with the server, his identity is first checked through a second layer security system (security). after everything is complete and safe, users can make transactions with Active Documents through the server.

e-ISSN 2963-2870
Vol 3 2022

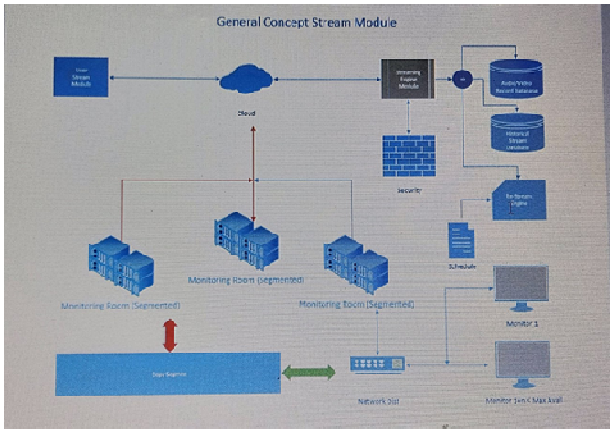


This is a somewhat more detailed description of the description above. Individual or group users. can make transactions to active documents with the encryption method which will later be standardized. each encryption will be different and stored in an access sand box stored on the main frame or server.

To establish a relationship with the server, the user must go through several stages of checking which will later be determined by standard. Connecting with the server can be done using WEB Based, Mobile Based while the devices used can use computers, gadgets, tablets, laptops etc. whose information is recorded or stored in the access sandbox box. so each user will be able to make a transaction if:

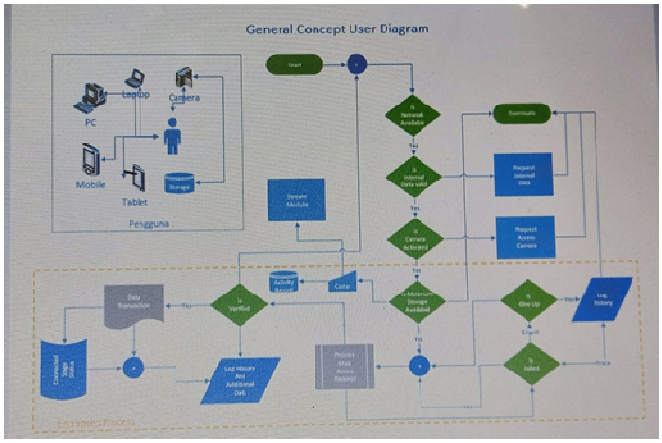
1. With a device whose information has been recorded in the sand box
2. Internal Data Verification
3. The two items will be matched through parallel Task checking. If true, then you can request documents on local verification.

On the second slide is the process that occurs with the standard function flow.



e-ISSN 2963-2870
Vol 3 2022

On the third slide is a process where each activity is completed with video recording which is sent to the streaming engine and restreamed to the parts that really need to monitor the activities being carried out. What needs to be considered in this section is the use of bandwidth or bandwidth considering that the band for audio video is quite wide.

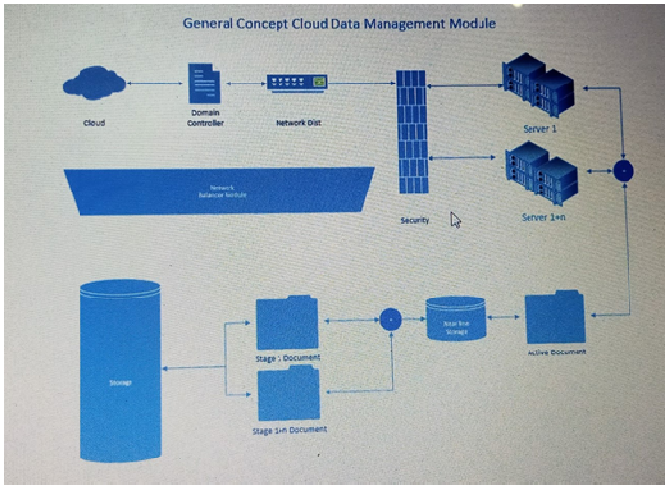


One thing that is important here is the plan or schedule to be able to restream. The system can serve audio video restream if there is a schedule. otherwise monitor access will be denied.

The fourth slide is the process in the data center section. where all access will be protected by security (the outline info is in the previous slide for user access).
This is from this slide the document is divided into several parts.

a. Active Document is a document that can be accessed directly from the device.
b. Near line storage is a document that will be archived but has not been done until the specified time limit. To be able to access this document, several stages of user checking are required, the standard of which will be determined later.
c. Document storage is a document that has been stored and cannot be accessed directly or to the items above. This document is offline. To be able to access this document, you must make a request to the offline section whose process can be determined later.

e-ISSN 2963-2870
Vol 3 2022



3.1 Initial Prototype Trial Process

The main contribution to the development of this prototype is to provide a comprehensive framework for online exam supervisors. Meanwhile to achieve good performance in evaluation, this framework can be improved in various ways. For basic components, you can apply more advanced algorithms to each component, such as representation-based deep learning features, typing-based continuous authentication, upper body alignment-based pose estimation, and model personalization. The initial prototyping trial process can expand the basic component set, to include additional components such as pen detection. For cheat classification, one can explore spatial-temporal dynamic features, similar to video-based activity recognition.

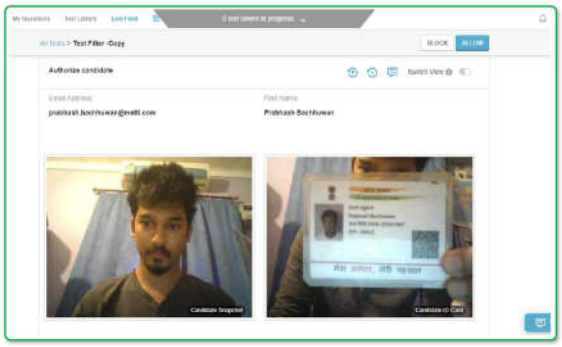
In addition, system efficiency can also be improved to maintain high accuracy in recognizing cheating events as a process in taking exams. Apps can choose more appropriate features and classifiers, and choose a smaller number of frames and use all frames. This process recognizes that there is always a possibility that some hidden cheating might be taking place outside of the view of the two cameras. To overcome this, the system plans to generate random commands, such as asking the test taker to look around or under the table to check the surroundings of the exam. To detect whether a test taker has a sensor, the system may occasionally display a simple icon on the computer screen to validate the wearcam can "see" it, or play a quick sound clip to validate that the microphone can "hear" it. Such randomness as command and intervention would likely make our system better against intentional fraudulent behavior. Note that the definition of fraudulent behavior depends on the context of the exam, such as an oral exam, open book exam, etc. The following is an initial review related to the application development prototype trial.

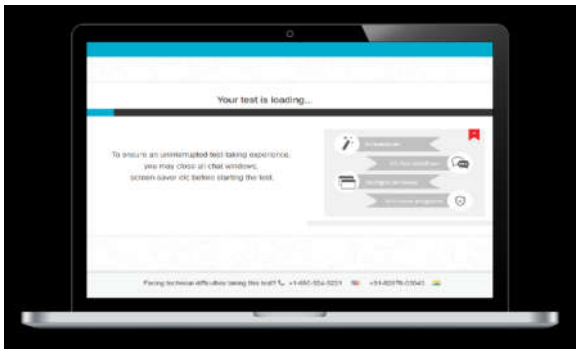
a. Test results prototype function 1: Recording the screen

b. Based on the results of function 1 performance testing, it can be concluded that Preset1 has the video output with the lowest size. Based on the results of function performance testing 1, it can be concluded that the smaller the rtbufsize, the smaller the output video size. For probesize, the smaller the probesize, the smaller the output video size will be. The fast preset setting will have a smaller output video size than the slow preset setting. Setting function 1 which functions to record the screen on the Online Procotoring system will be continued using Preset
c. Functional Testing Results 2: Recording Examinees via Webcam
d. The results of function 2 performance testing are shown in table 3. Function 2 performance test results. Based on function 2 performance test results, it can be concluded that the size of the video produced from function 2 is 2.54 MB per minute. Based on the results of function performance testing 2, it can be concluded that in the process of recording test participants via webcam, no problems or errors were found.
e. Function Test Results 3: Segmentation
f. Based on the results of function 3 performance testing, it can be concluded that the average time required for function 3 to segment files is 2.1 MB per second. Based on the results of function performance testing 3, it can be concluded that the average file size that can be compressed is 0.02 MB per MB of the original file size.
g. Function Testing Results 4: Uploading
h. The test uses 3 different file sizes on 3 predefined connections. The results of the upload process are in the form of the time needed to carry out the uploading process up to 100% which can be seen in table 5. Test results for the uploading process
i. Function Test Results 5: Streaming
j. After testing three presets on three connections, it can be concluded that the quality of the streamed video is not affected by the type of connection used but is affected by the preset used. The metadata of each streaming test shows that connection differences also do not significantly affect the number of frames, fps, Lsize, and bit rate.
k. Multimedia analysis system for online exam supervisors, aims to maintain academic integrity in e-learning. The system is affordable and convenient to use from a text taker's perspective, as it only requires having two inexpensive cameras and a microphone. By recording video and audio, it extracts low-level features from six basic components: user verification, text detection, speech detection, active window detection, eye gaze

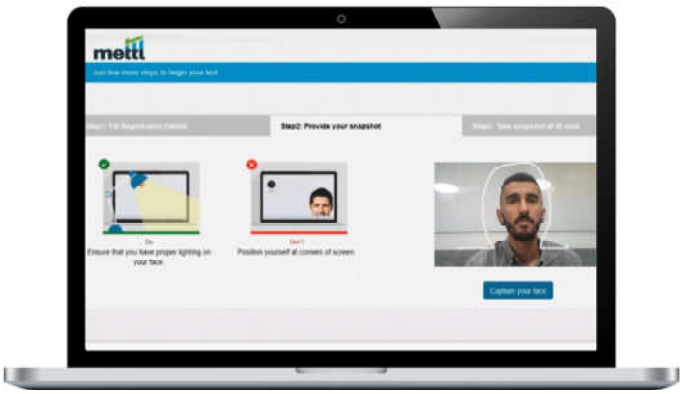
estimation, and detection phone. These features are then processed temporally in the window to obtain high-level features, and then used for fraud detection.

l. With a collected database of 24 test takers representing real behavior in online exams, and demonstrating system capability, with nearly 87% detection rate





2. Verify Authenticity with 3 Point Authentication System



a. Enter registration details (Columns can be customized)
b. Clicking on the photo
c. Verify his ID proof

4 CONCLUSION

The online proctoring system is an online monitoring system that is carried out by recording the activities carried out by the examinees, both the computer screen used and the examinees' faces via a webcam.

Storage is divided into 2 types, offline storage and online storage. In the offline storage process, recordings are stored in the computer's local drive storage, while in online storage, recordings are stored in cloud storage with an upload process. In the upload process, if a connection loss occurs, the system can continue the upload process manually or automatically. The workflow of the Online Proctoring system can be observed with the Workflow of the Online Proctoring System.

ADVICE

In this early stage research, a prototype was produced in the development of an online proctoring system workflow. In the first year the research design is carried out to produce a reference related to this development. For this reason, in the following year, it will be developed more technically and will be tested on the system and examinees.

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e-ISSN 2963-2870
Vol 3 2022