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COLLEGE ADMISSION TEST WITH INTELLIGENT PROCTORING

Mabel Macabanti-Satonero
West Visayas State University-Lambunao Campus
mabel.satonero@wvsu.edu,ph

ABSTRACT *(Times News Roman, 12pt, Italic)*

The main objective of this study was to design and develop a College Admission Test With Intelligent Proctoring. Eye recognition and face motion algorithm were developed to monitor acts of cheating. Captured images captured were used for evaluation after the examination was conducted as a proof if cheating really was committed. This study is a web based proctoring that could detect acts of cheating, provide feedback for examinees who commit acts of cheating and provide a list of examinees who possibly cheat.

The study used an OpenCV Open Source Computer Vision algorithm to monitor examinee's eye and face motion while taking the examination. The images captured by the eye and face detection algorithm was evaluated and used as a proof if cheating was committed.

The system was evaluated using ISO/IEC 9126. A Questionnaire duly validated by experts was employed for user's to validate the system. Mean and Standard Deviation were used for statistical data analysis. Series of system testing were undertaken together with the users and experts.

The F- Measure was used to determined the harmonic mean of precision and recall in terms of the accuracy of the system. Based on the F-Measure, the study revealed that it has 84% accuracy and 92 % precision. Eventually, it showed that the result of the study was accurate and precise. The overall evaluation of the system by the users were very effective. Finally, the system was "very effective" based on the overall evaluation of IT Experts.

Keywords: *Admission, Intelligent Proctoring, Test*

Introduction

The reality tells us nowadays that students consider cheating as their normal way of life. Others are convincing themselves that it is better to cheat than to suffer the consequence of failing in their

academic subjects. The need to stop or at least lessen the growing percentage of academic cheating poses a challenge to teachers and schools.In the same manner, when this unrestrained practice continues it distorts the value of honesty which eventually putting both schools' program and image at stake.
The Center for Academic Integrity in Duke University reports that "on most campuses, over 75% of students admit to some cheating. In a 1999 survey of 2,100 students on 21 campuses across the United States of America, about one-third of the participating students admitted to serious test cheating." Given this, it behooves us as educators to learn as much as possible about cheating methods used by students.

Academic integrity is one of the major concerns in online teaching and learning in distance education context.Cheating for learners is easy because of technology Vivian M. Corll (2007).In an ordinary quiz or major exams as observed, students perceived cheating as a common act to get high grades just to pass the examination or subject.

Every year West Visayas State University conducts an entrance examination. Other campuses likewise, conduct entrance examination.WVSU invest time and moneyin conducting series of examinations facilitated by the office of the registrar.
Several studies conducted found out that inattentive proctoring facilitates student cheating DiPietro. (2010, April 19).One proctor is assigned for every fifty students. Based on interviews and data gathered, some took the exam together with their classmates or friends. With this scenario cheating is possible.

Students tend to disrupt the teacher or proctor's attention for them to do academic cheating. There are instances during examinations that students collaborate in performingacts of cheating for the sake of passing the exam and the subject as a whole.
Learning capability is judged by means of examinations. These are given in universities, schools, colleges and even companies for recruitment purposes.There are number of traditional assessment that also requires costs: the time of human proctors, care in control of the assessment materials before and after administration, and grading effort, all of which are simplified in online assessment Hutter, S. L. (2007). In fact, the number of computer-delivered tests is increasing in schools as a result of accountability legislation and the perceived advantages of computer-delivered tests. On the other hand, perceived advantages of computer-based testing include more flexible scheduling, the ability to tailor tests more specifically to students needs, and more rapid scoring and reporting Inc., S. (2014, September 19).

With the web-based examination, the scores or result and other reports are easily generated, thus, the university can cater to other needs of the students.Web applications are fast emerging as a popular area of information systems development. The availability of the internet as an inexpensive channel of communication and information exchange has resulted in its increased reachability. This has lead to a growing demand to develop web based applications in almost all the spheres of life Len Bass, P. C. (2012, October 12).

Universities are putting much budget, preparation and manpower in giving entrance examinations and to have examination resultswhich are reliable and question-free.
Examination system is used to sort talented students and depending on their performance, there are different opportunities for jobs and higher education. Examination system is critical since this decides the future of students MacKown, K. Y. (2014).

In as much as West Visayas State University and its external campuses gave entrance examinations yearly, the use of College Admission Test With Intelligent Proctoring would be a platform to measure equally the learning capacity and skills of the takers. The examination is tailored with students' need since it can be updated and modified by authorized user if need arises. The result of the exam can be used to answer queries as to what the schools are producing good students in terms of English or Mathematics. Scores, list of examinees information are stored and could be generated for future use. Hence budget, time of the proctor, exam materials, care and control of the examination are simplified in the College Admission Test With Intelligent Proctoring.

Statement of Objectives

This research aimed to develop the College Admission Test With Intelligent Proctoring.

Specifically, this study aimed to:

1. develop a software for an online proctoring that can detect acts of cheating;
2. provide feedback for examinees who conduct acts of cheating;
3. provide list of possible examinees who cheat;
4. test the system using ISO 9126; and
5. test system for user acceptability and validity.

Conceptual Framework

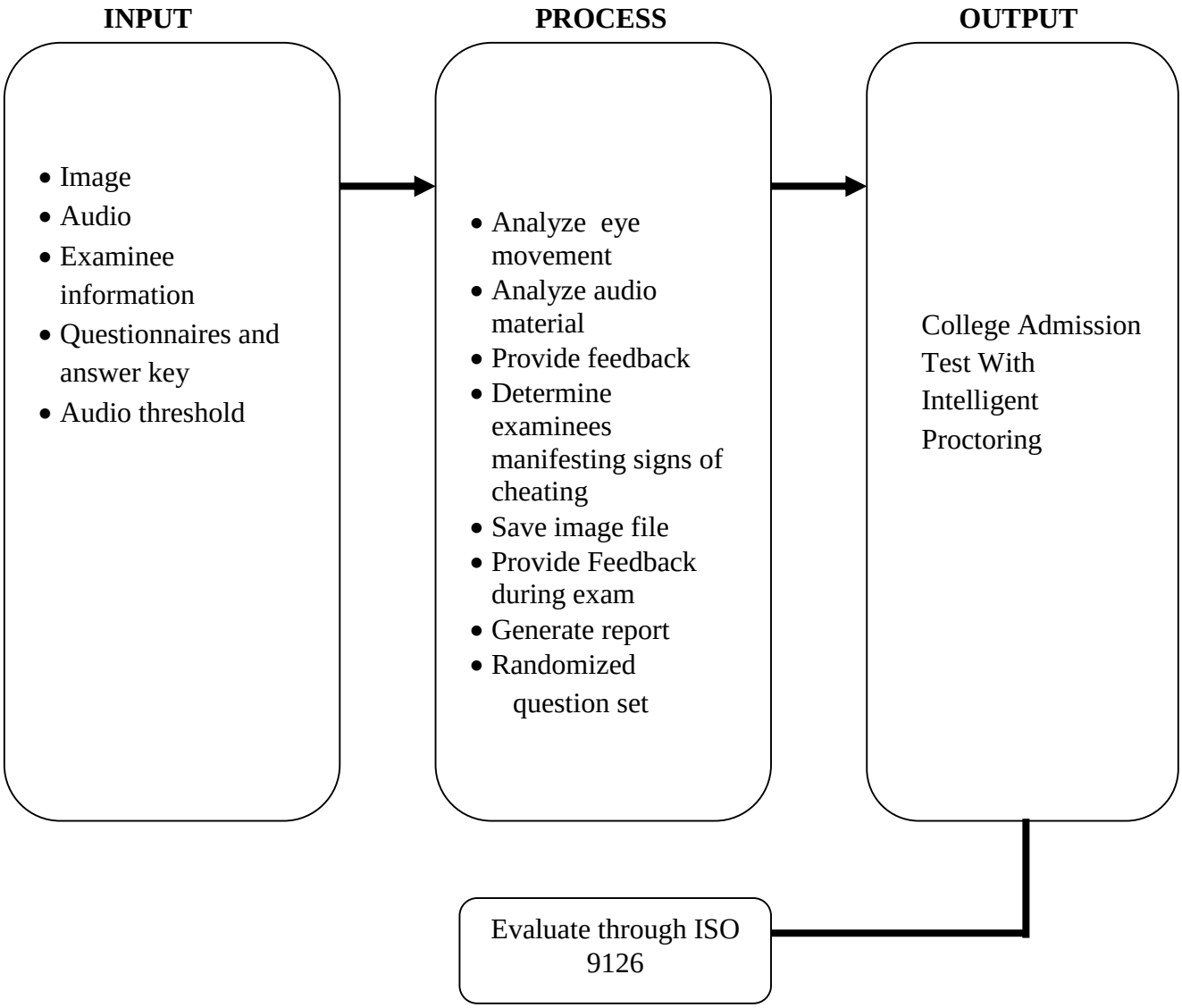

Figure 1. *Conceptual Framework of the Study*

The Conceptual Framework of the Study is shown in Figure 1.The inputs needed for the system are the image, audio, randomized question set, examinee information, questionnaires and answer key and audio threshold. The images are saved locally in the examinee's computer. In every series of eight shots one image will be sent to the server for evaluation if cheating was committed. Audio message will be heard by an examinee if the sound captured exceed the threshold being set.

Randomized question are generated by the system for each of the examinee. Examinee information is validated by the system before and after taking the examination. Questionnaires are encoded, modified and updated in the system by an authorized user. Answers are automatically checked by the system. Audio threshold are being set to the system.

The processes include the following: analyze eye movement, analyze audio material, provide feedback, determine examinees manifesting signs of cheating, save image file, provide feedback during exam and generate report.Eye movement is being analyze by the system, audio material, possible cheating

movement image are captured for evaluation if cheating was really committed.

The output of the system is the College Admission Test With Intelligent Proctoring that is evaluated through ISO 9126.

This study was limited into designing College Admission Test With Intelligent Proctoring.

College Admission Test With Intelligent Proctoring can be used for academic institutions like colleges, universities and training centers. The examination type that the system can accept only includes multiple choice format. Eye detection algorithm was used for the system, specifically applied to capture and detect any possible acts of cheating.

The system handles operations for generating of statistical reports like determining school where most number of examinees are good in English or Math. Also, the system can generate report on number of registered examiners and examinations results. However, exam takers should meet the requirements first in order to take the online examination; otherwise they take it manually in the school examination room.

The system has a feature to detect either the test taker is wearing or not wearing eyeglasses. Venue of the examination should be with moderate lighting effects. Otherwise captured images would be blurred for evaluation.

The possible cheating images captured by the system would be used for evaluation by the expert manually if cheating was really committed.

The administrator of the system could set the audio threshold. It has a feature where examiners can wear eyeglasses. Examinees could have a choice wearing eyeglasses or not wearing eyeglasses from the type of examinee option. The system was tested only using 20 students. The researcher does not undergone testing using more than 20 test examiners.

The study was conducted at West Visayas State University-Lambunao Campus. Questionnaire for randomly selected users was constructed, checked and evaluated by the experts. ISO 9126 which is a standard for quality product software was used to test the conformance of the system to software standards set by ISO.

Literature Review

Admission Test

Admission tests are commonly done to evaluate students on their readiness to enter college. Common admission test is in the form of aptitude test. These tests are created and administered to measure the potential of the student to perform the necessary skills and knowledge as required by the course.

The number of computerized online tests is increasing in schools, as a result of accountability, legislation and the perceived advantages of computerized online tests. Perceived advantages of computerized online testing include more flexible scheduling, the ability to tailor tests to students needs, and more rapid scoring and reporting Vivian M. Corll (2007).

In this study, updating and archiving of test questionnaire on five given subject or category were given emphasis. Through an authorized user, test questions can be modified or updated. Data could be generated from queries on school with good graduate having a good result in mathematical and English skills. After taking the exam, scores and reports can be generated. To prevent cheating, randomized test items and time bound features were included.

Intelligent Proctoring

The field of eye detection has been very active in the recent years and a lot of different approaches have been proposed. Z. Zhou and X. Geng, use the idea of Generalized Projection Functions (GPF) to locate the eye centers in an approximate area, found using the algorithm of Wu and Zhou. In order to detect the eyes on an image, the length and angle maps of candidate regions are projected on the spaces spanned by the eigenvectors found during training and the similarity of projection weights with those of model eyes is used to declare an eye presence Zhi-Hua Zhou and Xin Geng, (2004)

.

This study was implemented based on the concept of OpenCV and with the algorithms: Eigenfaces, Fisherfaces and Local Binary Patterns Histograms. This system is able to detect the examinee's face with or without eyeglasses. Once examinee's eyes were not detected and eight series of camera shots were taken, a voice prompt will inform the examinee to avoid doing such movement. If

this scenario happened more than the threshold, one image will be sent to the server for evaluation if cheating was committed. Also, a voice prompt will be given again if the examinee's captured sound is more than the allowable volume or threshold. If the sound is more than the threshold it will be saved for evaluation if cheating was committed.

The system and method disclosed herein identifies possible cheating behavior and helps to focus or direct the proctor to a specific individual or examinee. The proctor, in turn, makes the final decision as to whether a person is cheating after being focused on a situation that has been determined to have a high likelihood of cheating or other dishonest behavior. In this way, a single monitor or proctor can oversee numerous examinees while providing effective and focused support. Alternatively, the decision as to whether
a person is cheating may be made by a computer program or algorithm configured to provide a detailed analysis of the examinee's behavior.

Eigenfaces and Fisherfaces Algorithm

The Eigenfaces method took a holistic approach to face recognition: A facial image is a point from a high-dimensional image space and a lower-dimensional representation is found, where classification becomes easy. The lower-dimensional subspace is found with Principal Component Analysis, which identifies the axes with maximum variance. While this kind of transformation is optimal from a reconstruction standpoint, it does not take any class labels into account. Imagine a situation where the variance is generated from external sources, let it be light.

The Fisherfaces method learns a class-specific transformation matrix, so they do not capture illumination as obviously as the Eigenfaces method. The Discriminant Analysis instead finds the facial features to discriminate between the persons. It is important to mention, that the performance of the Fisherfaces heavily depends on the input data as well. Practically said if one learns the Fisherfaces for well-illuminated pictures only and it try to recognize faces in bad-illuminated scenes, then method is likely to find the wrong components just because those features may not be predominant on bad illuminated images. This is somewhat logical, since the method had no chance to learn the illumination.

Local Binary Patterns

The Local Binary Patterns methodology has its roots in 2D texture analysis. Its basic idea of Local Binary Patterns is to summarize the local structure in an image by comparing each pixel with its neighborhood. It takes a pixel as center and threshold its neighbors against. If the intensity of the center pixel is greater-equal its neighbor, then it is denoted with 1 otherwise, 0. It will end up with a binary number for each pixel, just like 11001111. So with 8 surrounding pixels, user end up with 2^8 possible combinations, called Local Binary Patterns or sometimes referred to as LBP codes.

In this study, algorithm was developed to detect acts of cheating. The system is able to capture examinee's movement that will be evaluated if cheating was committed. If probability of cheating movement is displayed, the system will capture the movement with a series of shots. If the image captured was more than the threshold, there will be a voice prompt to the examinee to avoid doing such movement and the images will be evaluated if cheating was committed. Threshold is set on the sound captured during the whole examination. If the sound is more than the threshold, a voice prompt will be given to the examinee to lower down the volume. When series of this happen, captured sound will be evaluated if cheating was committed.

F- Measure

The F-measure can be viewed as a compromise between recall and precision. It is high only when both recall and precision are high. It is equivalent to recall when $\alpha = 0$ and precision when $\alpha = 1$. The F-measure assumes values in the interval [0,1]. It is 0 when no relevant documents have been retrieved, and 1 if all retrieved documents are relevant and all relevant documents have been retrieved.

The researcher used the F measure to evaluate the validity of the system. Using the guiding principle of the F measure the researcher computes the number of true positive, false positive, true negative and false negative based on the evaluation of the manual proctoring and using the automated system.

Technology-Aided Cheating in ODeL: What Else Do We Need to Know?

Variety of test design versions, randomization of items in the question pool, password protection and limit of access to online test, assessment deployment in a secure web browser (respondus lockdown) with a "one question per screen" technique, and oral exams via live chats are some of the suggestions given by the students to further the security of the online assessment process.

The design of assessment which consists of the standards to measure the aptitude and capabilities of students should be carefully and effectively thought of.

Online proctoring using screen viewers or screen capture and using web cameras could ensure proper monitoring of students in their assessment.

The strategies enumerated will not completely eradicate academic dishonesty in an online environment. However, majority of the students agree that it is the healthy attitude towards learning that could probably be the best preventive measure against academic dishonesty Gerard G. Ravasco (2012).

This study has incorporated the randomized questionnaire and has the standards to measure the aptitude and capabilities of student. In the study the system also has a randomized type of examination and be able to measure the capabilities of students in five major subjects. Also, the study can determine students who are good in Mathematics or English including the school where they came from based on the statistical report generated by the system.

A Special Report, Promoting Academic Integrity in Online Education

Some organizations offer what they call a secure online testing solution, wherein they lock down their browser so that when the students are taking the test, they can't get outside that browser onto the internet. However, that still begs the question of whether or not it is the right person taking the test.

It was clear that a real solution to the testing dilemma had to include: convenience for the student; affordability for the institution; genuine anytime, anywhere functionality; minimal hardware requirements for the student; and last, but most important, security, positive ID of the test-taker, with minimal opportunity for cheating Christopher Hill (2010).

In this study all of these solutions were incorporated in the software.

Online Assessment System with Offline Capabilities

An assessment system can be described as a system that evaluates examinee's performance and attainment. The online assessment system is a rapidly expanding system. Although there are many online assessment systems available, most of them only work online, i.e., as long as there is internet connectivity. These assessment systems need continuous communication with the server. Users of typical online web applications are only able to use the applications while they have a connection to the internet. When they go offline, they cannot access any of the information on the web page.

With offline access, web applications can be viewed from the desktop using local storage and data access when disconnected from the internet. Internet connection is not always available that leads to loss of data when the internet gets disconnected.

The internet connection can also get disconnected when the user goes beyond the range during wireless connection. Offline access creates an additional layer of reliability, extends the reach of web applications, and improves application performance by moving important data closer to its users Supriya Lohgaonkar and Sharad Sharma (2012).

Both the online assessment with the offline capabilities and the intelligent proctoring is included in the study.

A Review of Models for Computer-Based Testing

Today, CBT is a broad-based industry that encompasses a large variety of assessment types, purposes, test delivery designs, and item types appropriated for educational accountability and achievement testing, college and graduate admission testing, professional certification and licensure testing, psychological testing, intelligence testing, language testing, employment testing, adult education, military use. The delivery of CBT has also undergone many changes from the early days of "dumb" terminals connected to a mainframe or minicomputer. CBTs can be administered on networked PC workstations, personal computers (PCs), laptops, netbooks, and even hand-held devices such as smart phones and tablet computers.

Testing locations or sites include dedicated CBT centers, classrooms or computer labs in schools, colleges, and universities; temporary CBT testing facilities set up at auditoriums, hotels, or other large meeting sites; and even personalized testing in the privacy of one's home, using a PC with an Internet connection and an online proctoring service Richard M. Luecht and Stephen G. Sireci, (2011). Database contains question banks, examination information, and examinee information. All questions are assigned with the unique ID and stored into the question bank. Questions are randomly selected from the five subjects, Mathematics, Science, English, Filipino and General Information. This study can assure test takers that they will be rated equally and correctly.

Measuring Student Achievement: A Study of Standardized Testing and its Effect on Student Learning

Standardized testing is a test administered and scored in a consistent or standard manner, administered under standardized or controlled conditions that specify where, when, how and for how long children respond to the questions. The questions, conditions for administering, scoring procedures, and interpretations are consistent. A well designed standardized test provides an assessment of an individual's mastery of a domain of knowledge or skill. It is intended to assess a student's knowledge base, in an academic domain, such as science or mathematics.

When taking a standardized test, it is assumed that the substance of the test and the administering of the test will be the same for all takers. With this uniformity, a certain measure of fairness and objectivity is achieved and it is believed that elements of biases are removed. Identical tests with five Measuring Student Achievement identical degrees of difficulty and identical methods of grading are propagated as the most fair and objective means, of assessing how a student is progressing in their learning. Because standardized tests are created to be unbiased and objective, they supposedly ensure that the score a student receives, is an accurate measurement of ability and progress.

Validity and reliability are critical components test makers need in order to create assessment tools, which create usable inferences about the knowledge and skills of students in a particular area. The validity of a test is determined by how well the test measures, what it was designed to measure; and how accurate the results are. Whereas reliability refers to whether or not the results of the tests are consistent; students achieve similar scores no matter how many times they take the test. Tests that are proven to provide both valid and reliable inferences are then norm-referenced, which means the student's knowledge and skills can be compared to a national sample of students in the same grade level. The efficiency and affordability of standardized tests, for evaluating teachers and students, led to these tests becoming the primary tool used by legislators and administrators, in evaluating the effectiveness of schooling on children, as well as to provide data to better manage school systems and develop education curriculum Jeremiah Gawthrop, (2014).

This study has an equal platform to measure the students knowledge the same with the system. In the study exam takers are equally rated since after the exam, scores can be generated immediately. The proposed solution is to combine the use of a time-based solution and the use of the web cam to randomly take snapshots of the examinee and send it to the server thus reducing bandwidth consumption and removing the need to monitor each examinee manually.

ISO/IEC 9126 Software Quality Standard

Software quality assessment requires the collection of such metrics in order to provide a systematic approach of code evaluation based on a set of predefined rules. Software systems are large, complex beset with maintenance problems, while users expect high quality. However, it is hard to assess to assure quality. The ISO/IEC 9126 standard has been developed to address software quality issues. It specifies software product quality characteristics and sub-characteristics and proposes metrics for their evaluation. It is generic, and can be applied to any type of software product by being tailored to a specific purpose.

Quality is the totality of characteristics of an entity that bear on its ability to satisfy stated and implied needs. By employing the term "satisfaction," ISO/IEC 9126 implies the capability of the software to satisfy users in a specified context of use. ISO/IEC 9126 Software Engineering Product Quality Standard assesses a system's internal and external quality, as well as quality in use [26].

Computers are being used in an increasingly wide variety of application areas, and their correct operation is often critical for business success and/or human safety. Developing or selecting high quality

software products is therefore of prime importance.

Comprehensive specification and evaluation of software product quality is a key factor in ensuring adequate quality. This can be achieved by defining appropriate quality characteristics, taking account of the purpose of usage of the software product. It is important that every relevant software product quality characteristic is specified
and evaluated, whenever possible using validated or widely accepted metrics.
ISO/IEC 9126 (1991): Software product evaluation - Quality characteristics and guidelines for their use, which was developed to support these needs, defined six quality characteristics and described a software product evaluation process model.

ISO/IEC 9126 describes a two-part model for software product quality: a) internal quality and external quality, and b) quality in use. The first part of the model specifies six characteristics for internal and external quality, which are further subdivided into sub-characteristics. These sub-characteristics are manifested externally when the software is used as a part of a computer system, and as a result of internal software attributes. This part of ISO/IEC 9126 does not elaborate the model for internal and external quality below the level of sub-characteristics.

The second part of the model specifies four quality in use characteristics, but does not elaborate the model for quality in use below the level of characteristics. Quality in use is the combined effect for the user of the six software product quality characteristics.
The characteristics defined are applicable to every kind of software, including computer programs and data contained in firmware.

The characteristics and sub-characteristics provide consistent terminology for software product quality. They also provide a framework for specifying quality requirements for software, and making trade-offs between software product capabilities (Barbara Catania et.al, 2016).

This study used ISO/IEC 9126 in evaluating the quality of the developed software in terms of six software quality standards stated in the ISO 9126.

Research Method

Project Description

The College Admission Test With Intelligent Proctoring is intended to handle an intelligent proctoring feature for the entrance examination in the West Visayas State University-Lambunao Campus. The exam takers should meet the examination requirements first in order to take the online examination or else take it locally in the school examination room. There are five categories to be answered for the examination namely: English, Filipino, Science, Math and General Information. The examination is time bound. By clicking submit, all of the examinees' answers are final and the examinee was finished with the exam. Test-takers, instructors, administrators and test developers can all access data and test information anytime as long as they are authorized to access the system.College Admission Test With Intelligent Proctoring can be used for academic institutions like schools, universities and training centers. The type of questions used is in multiple choice format. At the start of the exam, test takers do have their own username and password. After successful log in and verification, test taker will be routed to the practice screen to practice answering questions.

An image is captured at the start and at the end of the examination proper.The system handles operations such as generation of statistical reports as number of registered examiners and examinations result. This system offers features that will detect acts of cheating and prevent or eliminate cheating in the entrance examination.

Eye detection algorithm was developed for the system, specifically applied to the capturing and detecting of any possible acts of cheating.The eye/face movement algorithm works by detecting eye/face movement of the examinee, once detected the system will read the eye/face movement to verify if cheating activity was performed. If unnecessary movement activity was done an audio alert will send a voice message to the examinee to avoid doing such unnecessary movement. Every three seconds that the eye/face movement has been verified that the unnecessary activity was performed, a series of five shots will be captured. The system will automatically select in random manner oneout of five shots be send to the server and the remaining four shots will be saved on the examinee's computer.The server received captured data for the administrator to view real time activity of the examinee.

The audio input algorithm works by detecting the audio input,the system will compare its threshold set value of decibel. If the sound reached the set threshold an audio message will be sent to the examinee to avoid having unnecessary noise.In this study, the researcher set the audio decibel by 132 because of the microphone used. Every device has its own sensitivity of its decibels. Every audio input that has reached the set threshold will be saved for evaluation.

The system automatically captures the dashboard screen of the examinee from the exam properrandomly until the end of the examination. The time interval is set randomly at30seconds, 60 seconds and 90 seconds.

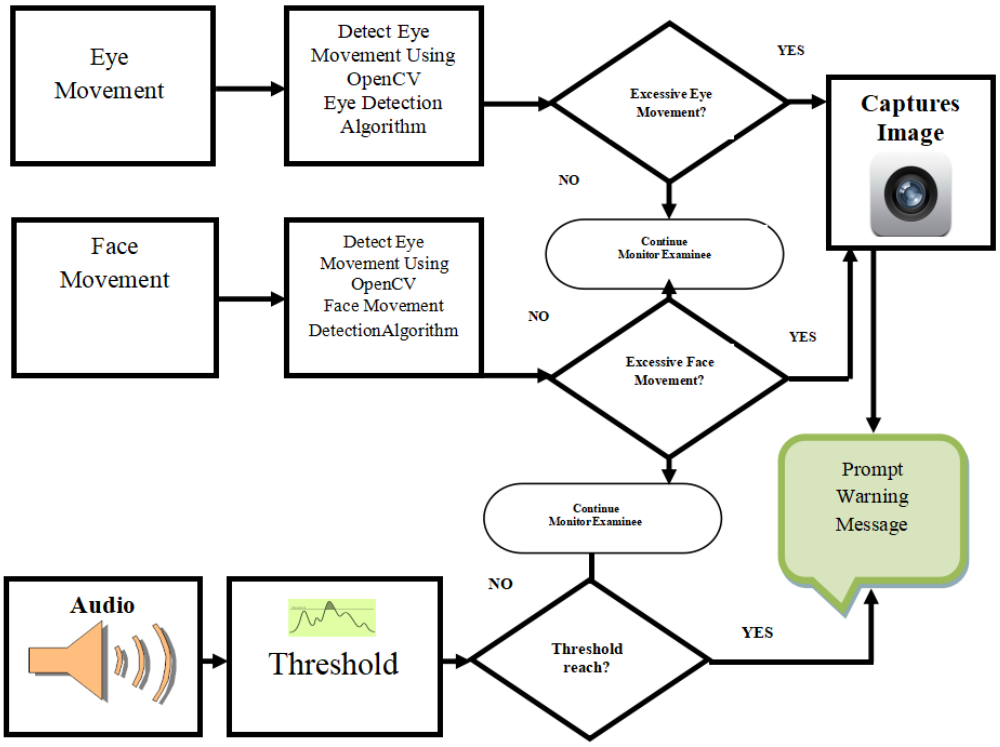

Figure 2. *College Admission Test With Intelligent Proctoring System Process*

The College Admission Test With Intelligent Proctoring System Processis shown in Figure 2.The eye/face movement algorithm works by detecting eye/face movement of the examinee, once detected the system will read the eye/face movement to verify if cheating activity was performed. Every three seconds that the eye/face movement has been verified that the unnecessary activity was performed, a series of five shots will be captured. The system will automatically select in random manner one out of five shots be send to the server and the remaining four shots will be saved on the examinee's computer.

The audio input algorithm works by detecting the audio input, the system will compare its threshold set value of decibel and if the sound reached the set threshold an audio message will be sent to the examinee to avoid having unnecessary noise.

Design Specification

Design Specification describes all data, architectural, interface and component-level design for the software.

The following design specifications are described to illustrate the development of the proposed system.

Use Case Diagram

Use Case Diagram is a representation of a user's interaction with the system that shows the relationship between the user and the different use cases in which the user is involved.

The Use Case Diagram is important to identify functions and how roles interact with the system. The primary purpose of use case diagrams is to highlight the roles that interact with the system and the functionality provided by the system without going deep into inner workings of the system. Also, Use Case Diagram identifies the internal and external factors that might sound simple. However, in large complex projects, a system can be identified as an external role in another use case.

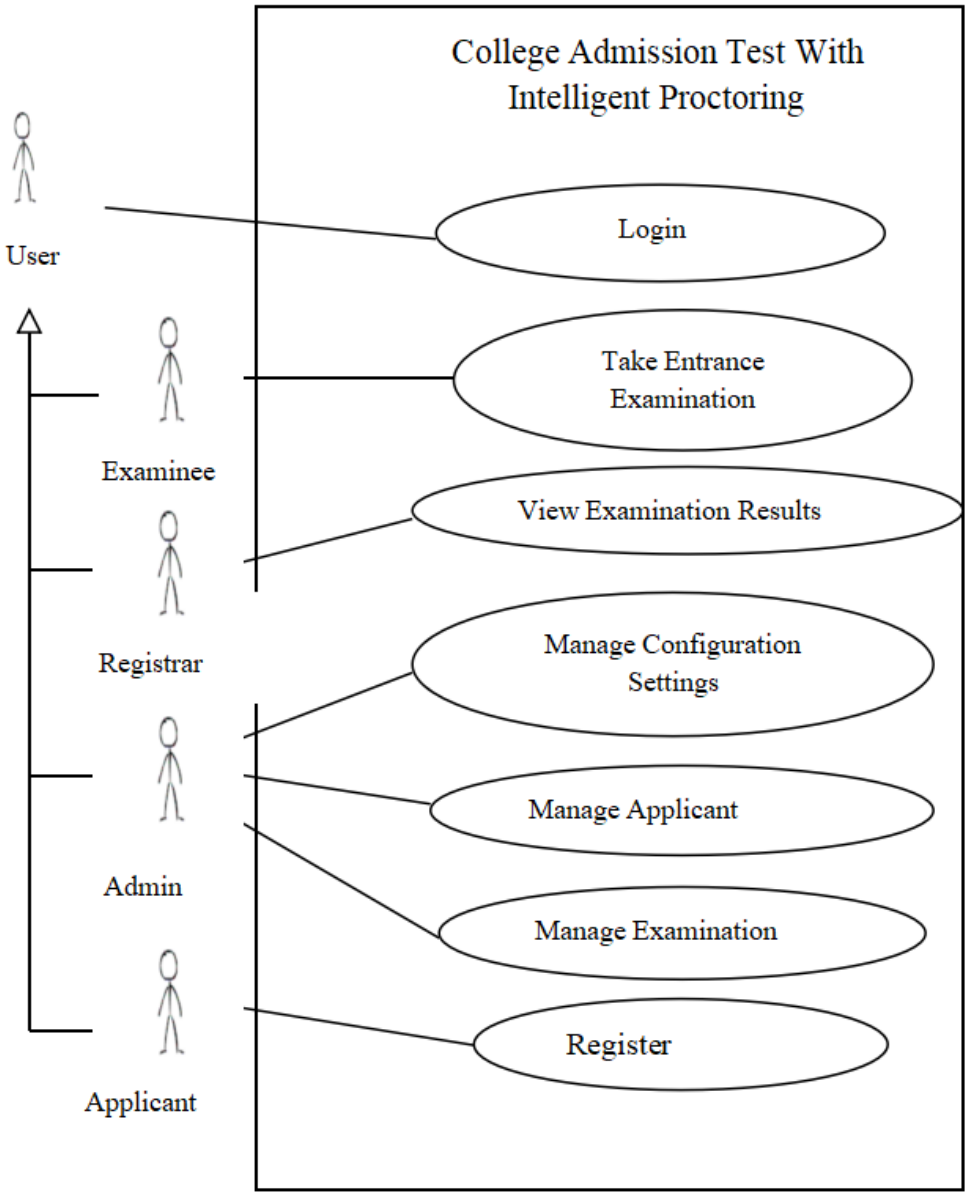

Figure 3. *Use Case Diagram of the System*

The Use Case Diagram of the system is shown in Figure 3.The diagram shows user who will log in to the system; Examinee who will take the entrance examination, Registrar, who can view examination

results; and Admin who is authorized to manage configuration setting and application.

The entities are the applicant, examinee, administrator user and registrar. Applicant fills up needed and required data to be able to take the online entrance examination. Once the application is approved the applicant will receive notification message with examinee code and password to be used to access the online entrance examination. After the approved application, the applicant is now considered as examinee. Examinee will log in using the examinee code and password to be able to access and answer the online entrance examination. Notification message will be sent once needed.

The administrator will be responsible on the audio to be played manually once the system detects early sign of cheating from the examinee. The admissions office will enter the examination's data to the system and will receive the examination's result and captured information from the system. The computer used by the examinee will save the examinee's desktop image captured by the system.

Activity Diagram

Activity Diagrams show the workflow from a start point to the finish point detailing the many decision paths that exist in the progression of events contained in the activity. Activity Diagram represents also the workflows of stepwise activities and actions with support for choice, iteration and concurrency.

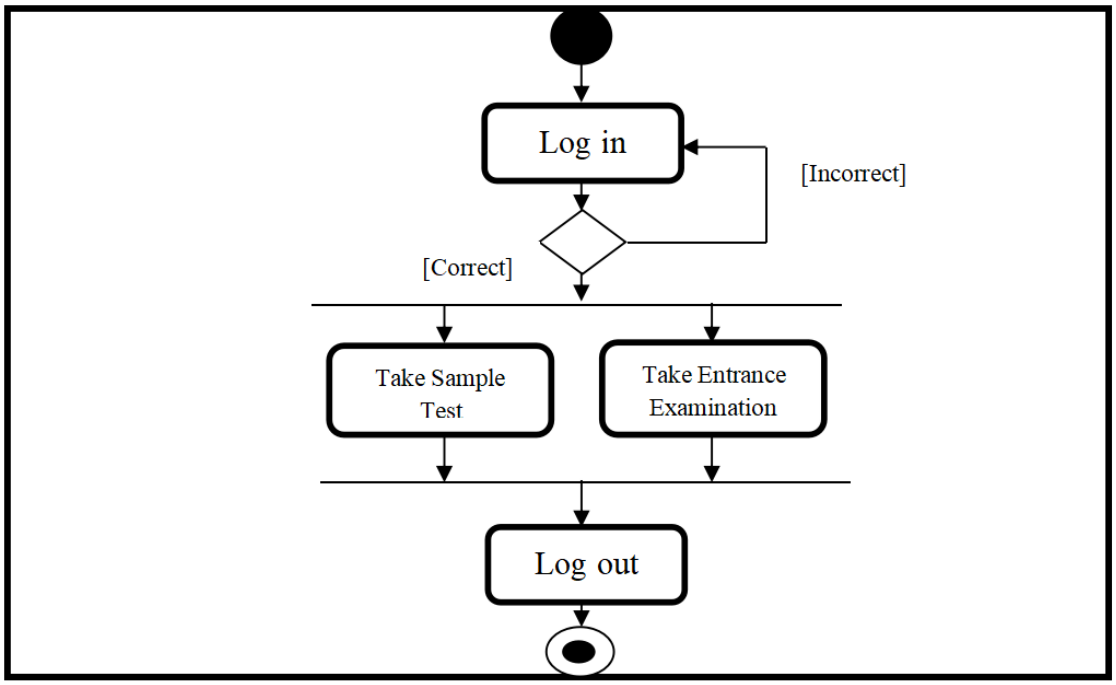

Figure 4. *Activity Diagram for Examinee Login In Page*

The Activity Diagram for Examinee Login In Page is shown in Figure 4.Wherein registered examinee needs to log in to take the entrance examination. If the user account is correct the examinee can either take sample test or take the entrance examination proper. If the user account is incorrect the examinee should log in again.

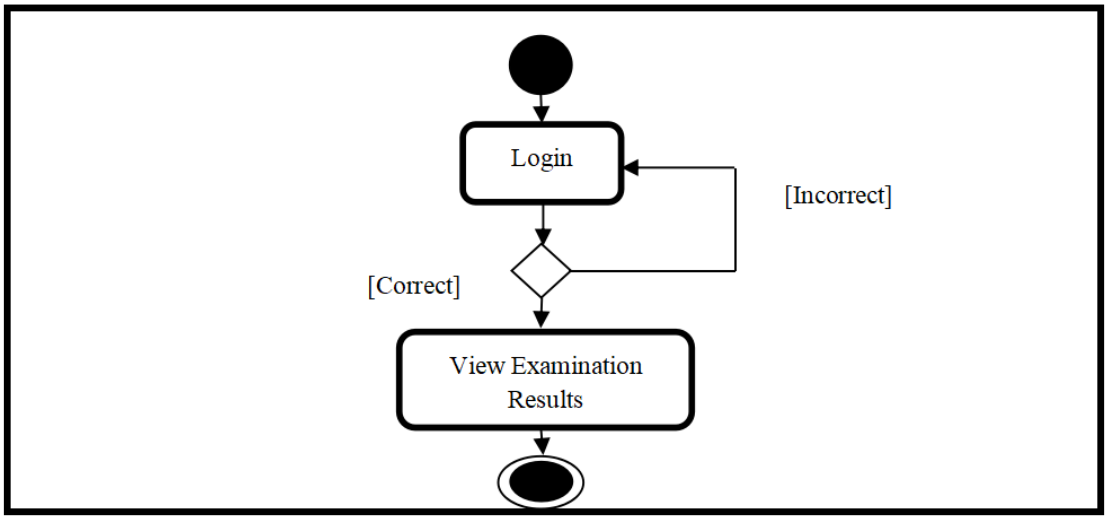

Figure 5. *Activity Diagram for Registrar*

The Activity DiagramforRegistrar is shown in Figure 5.The Registrar needs to log in first to use the system. If the registrar successfully log in into the system, the Registrar can view the Examination Results which displays the examinee who passes the entrance examination.

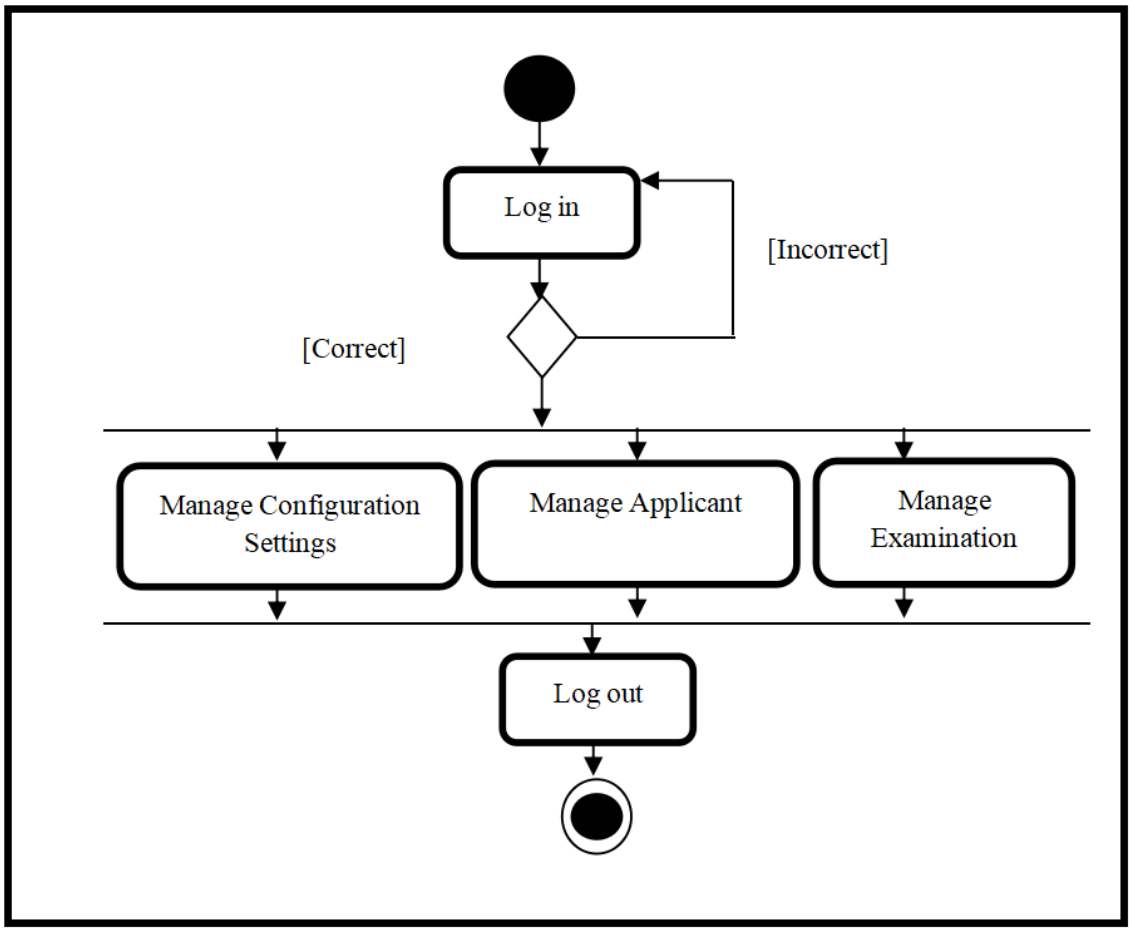

Figure 6. *Activity Diagram of Admin*

The Activity Diagram of Admin is shown in Figure 6.The Admin Manage Configuration Settings for audio detection. The audio detected should not exceed the audio threshold set. On the Manage Applicant, Admin add, edit and update applicant details. On the Manage Examination Admin add, edit and update questions and answers.

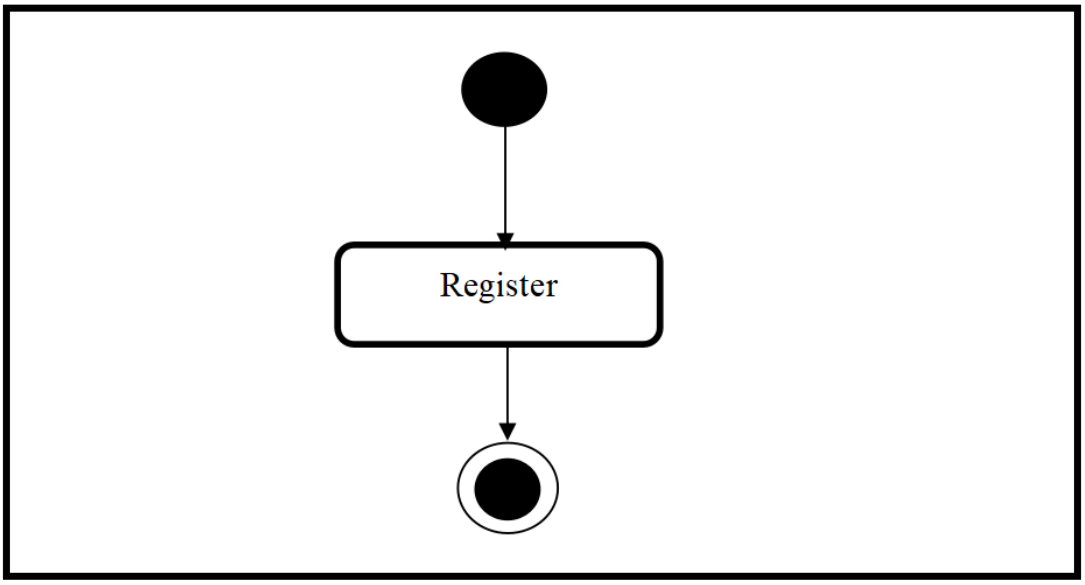

Figure 7. *Activity Diagram of Applicant*

The Activity Diagram of Applicant is shown in Figure 7.The applicant needs to register with the correct username and password given before taking the exam.

Sequence Diagram

Sequence Diagram shows how the sequence of messages that implement a service or transaction. Depicts the objects and classes involved in the scenario and the sequence of messages exchanged between the objects needed to carry out the functionality of the scenario.

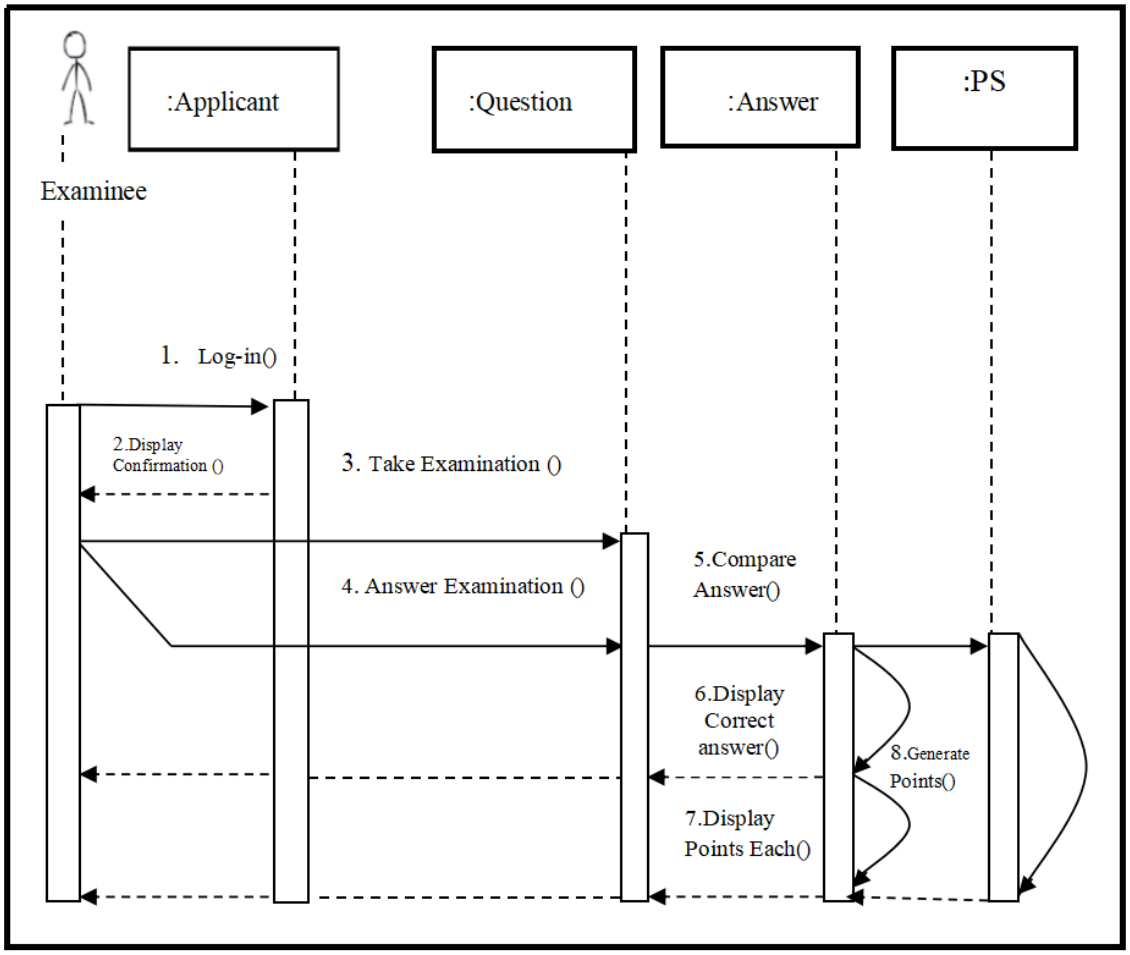

Figure 8. *Sequence Diagram of Examinee*

The Sequence Diagram of Examinee is shown in Figure 8.The examinee will log in and the system will validate authentication data. The system will display error message if the username or password is invalid. If the log in details is correct a welcome message is displayed by the system.The examinee can then practice taking examination before taking the actual exam.If the examinee is finished with the practice examination, he/she is now ready to take the exam proper. There are five subject category to answer in the exam namely: English, Mathematics, Filipino, Science and General Information. The system will capture the examinee's image from the start up to end of the examination.

Once the examinee started taking the actual examination, the intelligent proctoring starts to capture cheating movements. Likewise, it takes shots and records audio. Once the examinee is finished with the examination, the examinee needs to click the submit button.

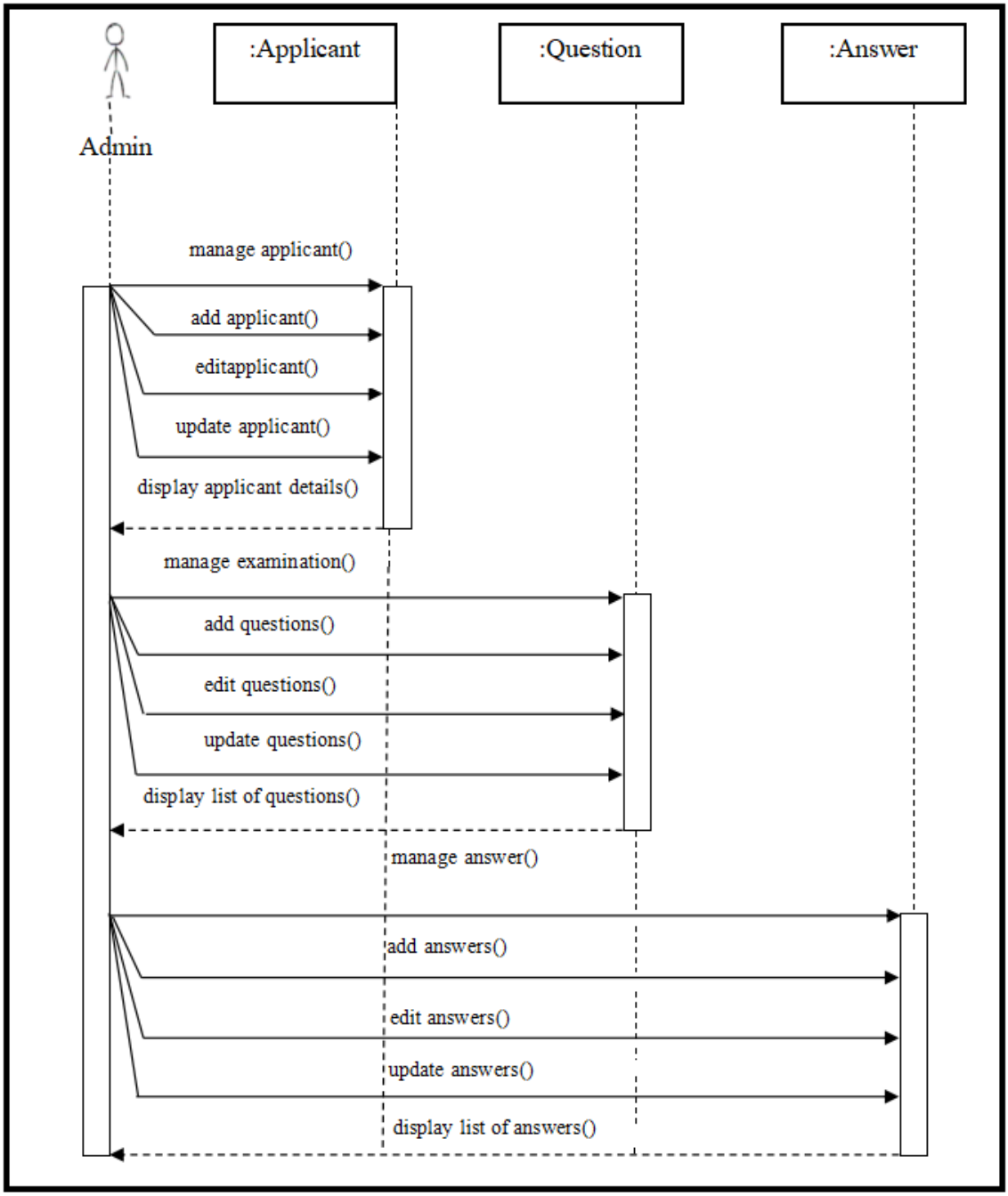

Figure 9. *Sequence Diagram of Admin*

The Sequence Diagram of Admin is shown in Figure 9.The Admin is the person who manages the task for adding, editing, and updating for applicant. The Admin is in charge also for adding, editing, and updating of questions. Although questions are given by the committee, still the admin will be the one who will feed in the questions to the system. Eventually, the admin is responsible for adding, editing, and updating answers to the system.

Deployment Diagram

Deployment Diagram shows execution architecture of systems that represent the assignment

deployment of software artifacts to deployment targets usually nodes.The diagram also shows the physical relationship among software and hardware components. A structure diagram that specifies a set of constructs that can be used to define the execution architecture of systems that represent the assignment of software artifacts to nodes. Nodes typically represent either hardware devices or software execution environment. While, artifacts represent concrete elements in the physical world that are the result of a development process.

Deployment diagram shows the hardware for the system, the software that is installed on that hardware, and the middleware used to connect the separate machines to one another. The importance of deployment diagram are: it can visualize hardware topology of a system, it will describe the hardware components used to deploy software components and will describe runtime processing nodes.

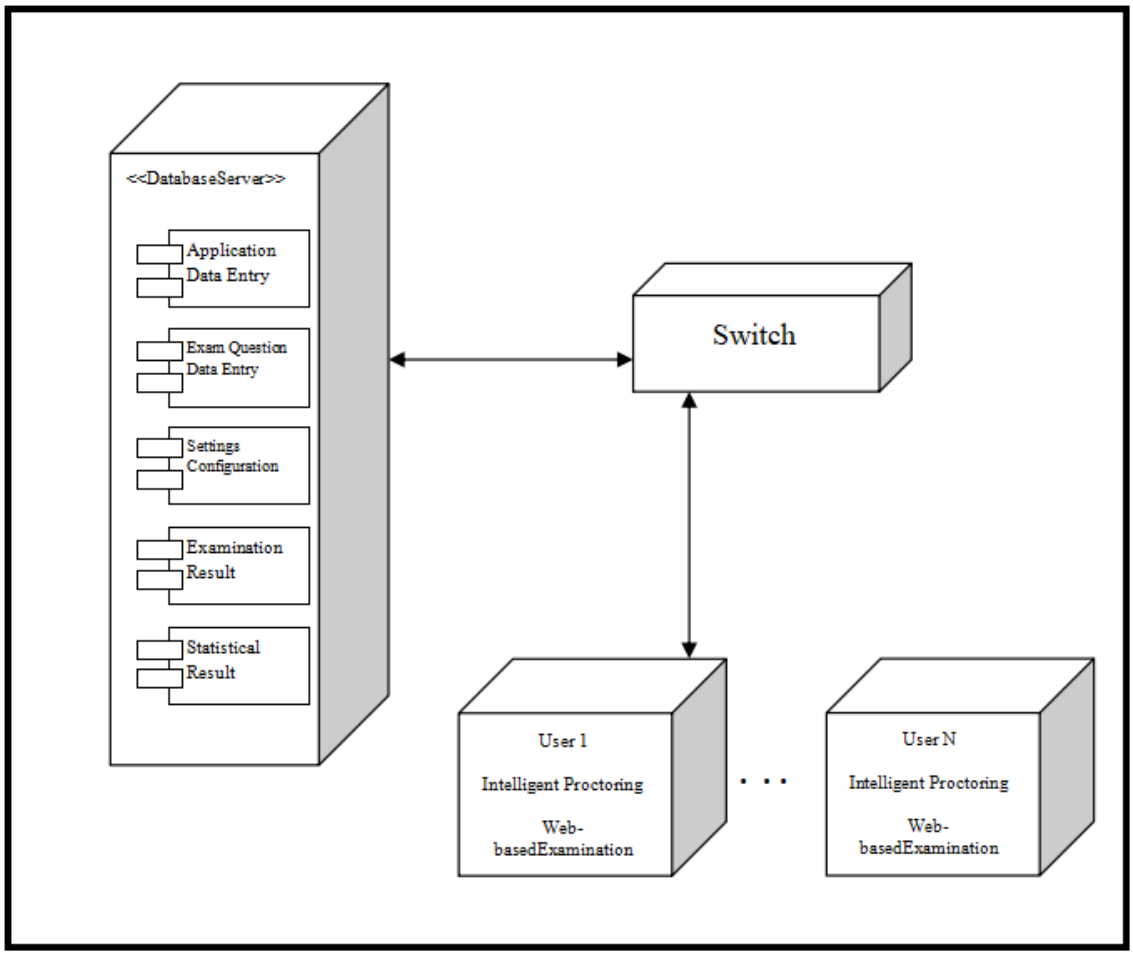

Figure 10. *Deployment Diagram of the System*

The Deployment Diagram of the System is shown in Figure 10, where in it shows the physical relationships among software and hardware components. Applicant Data Entry, Exam Questions Data Entry, Examination Results are being deployed to the database server. Here, the applicant will take the examination under the web application. Intelligent Proctoring starts to capture signs of cheating once the examinee successfully log in.Thehardware minimum specifications of the system are: RAM 2.0gbWDC WD5000BPVT-22HXZT3 ATA Device, Standard VGA Graphics Adapter
At least 1.3M WebCam, Generic PnP Monitor, Qualcomm Atheros AR8152/8158 PCI-E Fast Ethernet Controller (NDIS6.20), Intel(R) Core (TM) i3-2350M CPU @2.30GHz and High Definition Audio Device. For the software side these are the software minimum specifications: MS Visual Basic 6.0, MySQL Server 5.0, mysql connector odbc 3.51.12, MySQL Maestro Version 8.3, Netbeans 8.0.2, Java

8.0, opencv 2.4.11, Adobe Dreamweaver CS6, Google Chrome Version 51.0.2704.103, Apache Server and XAMMP Control Panel Version 2.5.

State Transition Diagram

A state diagram shows the behavior of classes in response to external stimuli. Specifically a state diagram describes the behavior of a single object in response to a series of events in a system. A diagram consisting of circles to represent states and directed line segments to represent transitions between the states.

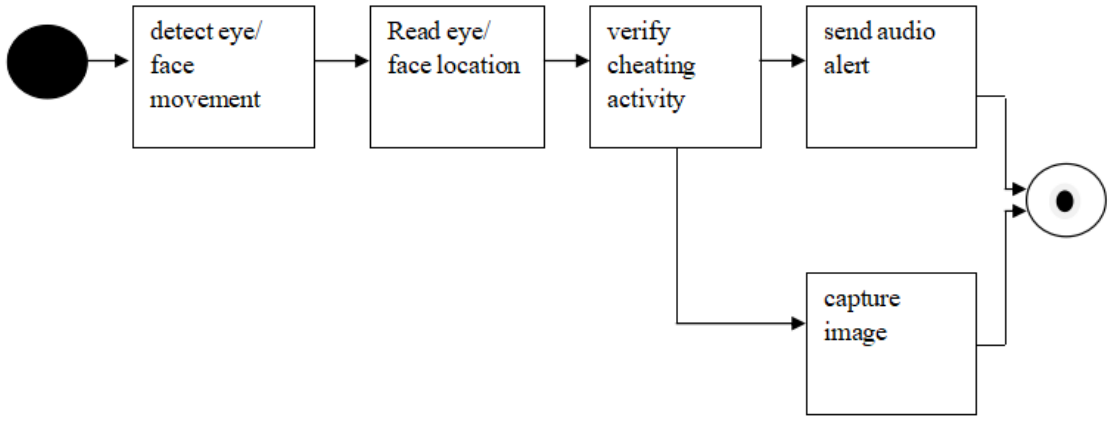

Figure 11. *State Transition Diagram of Eye/ Face Detection*

The State Transition Diagram of Eye/ Face Detection is shown in Figure 11 where once the examinee click start after familiarizing and navigating the screen for trial page, the intelligent proctoring starts working to detect eye/ face movement and read eye/face location. Then, verify if there is a sign for cheating activity and audio alert which will be sent to the examinee and image will be captured for evaluation.

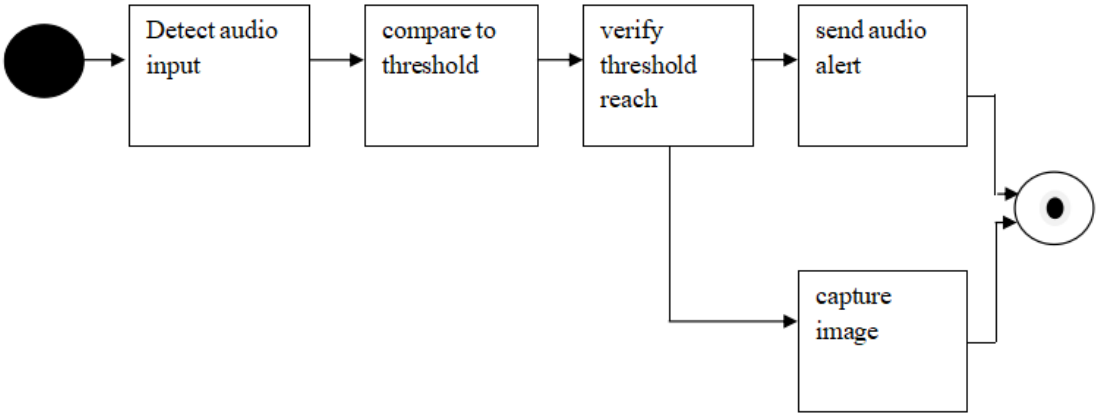

Figure 12. *State Transition Diagram of Audio Detection*

The State Transition Diagram of Audio Detection is shown in Figure 12 where once the examinee click start after familiarizing and navigating the screen for trial page, the intelligent proctoring starts working to detect audio input and compare it to the threshold being set. Then, verify if the audio threshold is been reached and audio alert which will be sent to the examinee and image will be captured

for evaluation.

Project Development

The appropriate methodology was identified by the researcher and was used to plan, design and implement the systems development process.

The spiral model also known as the spiral life cycle model was chosen by the researcher as system development model. This is a systems development lifecycle (SDLC) model is widely used in information technology. This model of development combines the features of the prototyping model and the waterfall model. The method will follow a step by step logical method, and is composed of several significant phases. Each phase requires a proper documentation and deliverables to ensure the validity of the process. The diagram below shows how the development goes through.

Figure 13. *Spiral Model (Systems Development Life Cycle Model)*

The Spiral Model shown in Figure 13 shows the requirement analysis which includes identifying problems that exist in the related systems or prior arts and problems identified during the data gathering.Proper documentation is observed by the researcher from the start until the final revision of the study. After the problem identification, objectives, scope and limitations in the conduct of the study were determined by the researcher, the new system requirements are defined in much detail as possible. This usually involves interviewing a number of users representing all the external or internal users and other aspects of the existing system. Based on the interview conducted with the WVSU-Lambunao Campus Registrar and the WVSU-Main Campus the researcher found out that there are number of proctors who were in-charge in conducting sequence or entrance examination. Test questionnaires were carefully done and budget is allocated in the printing of test materials.

A preliminary design is created for the new system. Based on the preliminary data gathering and investigation of the researcher, the preliminary design was created. Algorithm to be used to solve challenging technical issues in the existing problem determined in the prior arts was one of the concerned.The researcher developed the face detection algorithm for the system to determine acts of cheating.

During the prototype and feedback, a first prototype of the new system is constructed from the preliminary design. The first prototype was tested in the computer laboratory of the School of Information and Communications Technology, WVSU-Lambunao Campus.

The evaluation of the first prototype in terms of its strengths, weaknesses, and risks based on the system testing was used in planning and designing the second prototype. Constructing and testing of the second prototype was done. Based on the first prototype, the server experienced problems while receiving the captured images due to the large file size. The system captured series of images stored locally for further verification in case cheating is determined by the system on all exam sessions. Improvements and enhancements of the system were performed and evaluated by experts. Audio was also restricted in as much as there is a respective audio level to be maintained.

The spiral model phases was applied to both development and future maintenance of the system. The existing prototype is evaluated in the same manner as was the previous prototype. Series of system testing was done with the system to eliminate errors and for the system to meet the required performance. System improvement is performed each time after testing was performed.

The preceding steps are reiterated until the user and evaluators are satisfied that the refined prototype represents the final product desired.

The maintenance and support phase ensures that the final system was constructed, based on the refined prototype.Phases were repeated several times until the issues were resolved and the final design prototype was successfully achieved. The final system was thoroughly evaluated and tested by the users and evaluators.

Routine maintenance was carried out on a continuing basis to prevent large-scale failures and to minimize downtime.

Project Evaluation

The system was tested for accuracy, precision and recall using F-Measures. It was also tested using ISO 9126 for its functionality, reliability, usability, efficiency, maintainability and portability.

The precision and accuracy of the system were computed based on the series of system testing done in West Visayas State University.

There were 30 students of West Visayas State University who were taken as respondents whose responses were taken to determine the accuracy of the system with the use of F-measure.

The respondents were divided into two groups each time the system testing performed. The first group ofrespondents were permitted to do cheating, to test the system if it catches their cheating activities. Second group were not permitted to do cheating also to test the system if it will not sense any cheating activities. Series of system testings were performed with the expert who validated the result. The findings of the system were compared to the evaluation of the expert as well as to the testimony of the user if cheating was committed or not.F-measure was used to compute the precision and accuracy of the automated system proctoring compare to the manual system proctoring. The results were tabulated and compared by getting the number of True Positive, True Negative, False Negative and False Positive.

Table I

The F-Measure Matrix

Set	Cheated	No Cheating	Total
Manual	TP	FN	P
Automated	FP	TN	N
Total	P	N	P+N

Table Ipresents the matrix where; True Positive (TP) granted by both the manual and automated; True Negative (TN) granted by the manual denied by the automated; False Negative (FN) denied by both manual and automated; and False Positive denied by the manual, granted by the system.

To determine the accuracy of the study, the following computations are presented: Accuracy is the proportion of the total number of predictions that were correct. It is calculated using the equation:

$$\text{Accuracy} = \frac{TruePositive+TrueNegative}{Positive+Negative}$$

Recall or Sensitivity or True Positive (TPR) – it is the proportion of positive cases that were correct identified, as calculated using the equation:

$$\text{Recall} = \frac{True\ Positive}{True\ Positive+False\ Negative}$$

Precision P – it is the proportion of the predicted positive cases that were correct, as calculated

using the equation.

$$\text{Precision} = \frac{True\ Positive}{True\ Positive + False\ Positive}$$

F-Measure – it compares some average of the information retrieval precision and recall metrics.

$$\frac{1}{F} = \frac{1}{2}\left(\frac{1}{R} + \frac{1}{P}\right) = \frac{P+R}{2PR}$$

$$F = \frac{2PR}{P+R}$$

To evaluate the quality attributes of the system based on the standards set by ISO 9126, the Software Quality Model in terms of six main characteristics of good software, namely: functionality, reliability, usability, efficiency, maintainability and portability were used as its criterion bases.

The basis of evaluation used by the researcher is the five (5) point Likert Scale. The result of the evaluation was done with the help of the expert statistician. Mean and Standard Deviation were used also to evaluate the results.

Data Gathering Instrument

This research used the experimental and comparative evaluation for the testing of the parameters of intelligent proctoring.

The system was evaluated by IT experts in the academe and industry, randomly selected from WVSU campuses, Master and Doctor of Psychology and thirty students of West Visayas State University-Lambunao Campus.

A letter was secured by the researcher to formally address the respondents and to assure them that their responses will be treated with utmost confidentiality and will be used solely for research purposes. The questionnaire for the user has 20 questions to determine the level of the effectiveness of the system.

The researcher used the five (5) point Likert Scale as the basis for evaluating the system. The results were tabulated with the help of the expert statisticians and standard deviation and mean to determine the level of the effectiveness of the system.

The questionnaire for user was developed and validated by experts. The questionnaire for IT Experts in the academe and industry was modeled based on ISO 9126 Software Quality Evaluation. Psychologist validation where done during series of systems testing wherein the image captured by the system where evaluated and verified.

Validity of the Instrument

Instrument validation was determined and submitted to an expert and panel of jurors for content validation.

The researcher look into the design of the system and the target into which it was designed and therefore decided that the students of West Visayas State University Lambunao Campus who were the respondents of the study was to evaluate the system as its end user together with the ten industry experts.

The recommendations and suggestions of the jurors were considered in the final questionnaire.

Respondents of the Study

The researcher selected the respondents of the study with the guiding principle that research needs to collect knowledge and evaluation from individuals who have a particular expertise on the study. The respondents of the study were the students of WestVisayas State University Lambunao Campus and ten experts composed of Information Technology and Computer Science specialist, who were both randomly selected from WVSU campuses.

Table II

Respondents of the Study

Classification	Population	Respondents
Users	185	30
Experts	10	10
IT Experts	7	
Psychologist	2	9
Total	195	39

The distribution of respondents is shown in Table II. There were thirty students and 7 IT experts and 2 Psychologist whose proficiencies are in line with the study. The respondents were chosen to evaluate the system based on the ISO 9126 Software Quality Model standard characteristics and sub characteristics guidelines.

To determine the effectiveness of the system the F-Measure was used for the 30 samples gathered. The results were gathered, evaluated and compared form manual with the automated system.

Data Analysis Procedure and Statistical Treatment of Data

The response on the items to the questionnaires were evaluated and tabulated.The data were analyzed and interpreted with the used of the following statistical tools.

a. F-Measure was used to determine the preciseness and accuracy as to the number of number of test taker who cheat or did not cheat based on the findings of both system and user. It is computed through $F = \frac{2PR}{P+R}$.

b. Mean was used to determine the level of the effectiveness of the system. It is computed by adding up all the values in the series and dividing them by their count.

c. Standard Deviation gives an idea of how close the entire set of data is to the average value. Data sets with a small standard deviation have tightly grouped, precise data.

Scores are read and interpreted based on this Likert Scale:

Table III

Likert Scale Used

Range	Description
4.21-5.00	Very Effective
3.41-4.20	Effective
2.61-3.40	Moderately Effective
1.81-2.60	Ineffective
1.00-1.80	Very Ineffective

Results and Discussion

Evaluation of the System through F-Measure

The study used the F-Measure to evaluate the accuracy and precision using the results from the 30 samples from the series of system testing and classified as true positive, true

negative, false positive, and false negative.

The result of the respondent's response is shown on the table below.

Table 3.0 Matrix of F-Measure

Examinee Number	Examinee Side	System Side	Result
1	True	Positive	True Positive
2	True	Positive	True Positive
3	True	Positive	True Positive
4	True	Positive	True Positive
5	True	Positive	True Positive
6	False	Negative	False Negative
7	True	Positive	True Positive
8	True	Positive	True Positive
9	True	Positive	True Positive
10	True	Positive	True Positive
11	True	Positive	True Positive
12	True	Positive	True Positive
13	True	Positive	True Positive
14	False	Negative	False Negative
15	True	Positive	True Positive
16	True	Positive	True Positive
17	True	Positive	True Positive
18	True	Positive	True Positive
19	True	Positive	True Positive
20	True	Positive	True Positive
21	True	Positive	True Positive
22	True	Positive	True Positive
23	True	Positive	True Positive
24	False	Negative	False Negative
25	False	Negative	False Negative
26	True	True	True Positive
27	False	Positive	False Positive
28	True	Positive	True Positive
29	True	Positive	True Positive
30	True	Positive	True Positive

Legend:

Examinee Side True = Cheated False = No cheating
System Side Positive = Cheated Negative = No Cheating

Table 3.0 presents the matrix to test the accuracy of the system, thirty samples were randomly chosen. Twenty five (25) of the respondents are classified as true positive (detected by both manual and automated); zero (0) of the respondents are true negative (detected by manual undetected by the system); four (4) of the respondents are classified as false negative (undetected by manual and detected by the system); and one (1) of the respondents is classified as false positive (undetected by the manual and detected by the system.)

Computation:

Total number of samples = 30

No. of True Positive = 25
No. of True Negative = 0
No. of False Negative = 4
No. of False Positive = 1

True Positive = $\frac{25}{30} = 0.83$

True Negative = 0

False Negative = $\frac{4}{30} = 0.13$

False Positive = $\frac{1}{30} = 0.03$

Accuracy = $\frac{TP+TN}{TP+FN+FP+TN} = \frac{0.83+0}{0.83+0.13+0.03+0} = \frac{0.83}{0.99} =$ 0.84 or 84 %

Figure shows that computed result for accuracy is 0. 84 or 84 %, which mean that the system is accurate.

Precision = $\frac{TP}{TP+FP} = \frac{0.83}{0.83+0} = \frac{0.83}{0.83} = 1$

The computed result of the precision is equal to 1.

Recall = $\frac{TP}{TP+FN} = \frac{0.83}{0.83+0.13} = \frac{0.83}{0.96} = 0.86$

The computed result of recall is equal to 0.86.

F Measure $\frac{1}{F} = \frac{P+R}{2PR}$

F = $\frac{2PR}{P+R} = \frac{2(1)(0.86)}{1+0.86} = \frac{1.72}{1.86}$

F Measure = .92 or 92 %

The F Measure value using the harmonic mean of precision and recall is 0.92 or 92 % which implies that both manual result and system result are precise and accurate.

Evaluation of the System Output by Potential Users

Table 4.0. Evaluation of the Users to College Admission Test With Intelligent Proctoring.

The resulting mean and standard deviation of the collected questionnaires from 30 randomly selected students were computed.

USERS	QUESTIONS																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	5	5	4	4	4	5	4	4	4	5	5	5	4	5	4	5	5	5	4	5
2	5	5	5	4	4	5	4	4	4	5	5	5	4	4	5	5	4	5	5	5
3	5	5	4	4	4	5	4	4	4	5	5	5	5	5	4	5	5	5	4	5
4	5	5	4	5	4	5	5	5	4	5	5	5	5	4	5	5	4	5	4	5
5	5	5	4	4	4	5	4	5	4	4	5	5	4	4	4	4	5	5	5	5
6	4	5	4	4	4	5	4	4	4	4	5	5	5	5	4	5	5	5	4	5
7	5	5	5	4	5	5	4	5	4	5	5	5	5	4	4	5	5	5	5	5
8	4	5	5	4	5	4	4	5	5	5	5	5	4	5	5	5	5	4	5	5
9	5	5	5	5	5	5	4	5	4	5	5	5	5	5	5	5	5	4	5	5
10	5	5	4	5	4	5	5	5	5	5	4	4	5	5	4	5	5	5	5	5
11	5	5	4	5	5	5	4	5	5	4	4	5	5	5	5	5	5	5	4	5
12	5	5	4	5	5	5	5	5	5	5	5	4	4	5	5	5	5	5	5	5
13	5	5	5	4	4	5	5	5	4	5	5	4	3	4	4	5	5	4	5	5
14	5	5	4	4	4	5	5	5	5	5	5	5	4	4	4	5	5	5	5	4
15	5	5	4	4	5	5	5	5	5	5	5	5	5	5	4	5	5	5	4	5
16	5	5	5	5	5	5	5	5	5	5	5	5	4	4	5	5	5	5	5	4
17	4	5	5	5	5	5	5	5	5	5	5	4	5	5	5	5	5	5	5	4
18	5	5	5	5	5	5	5	5	5	5	5	4	4	4	4	5	5	5	5	4
19	5	4	4	4	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
20	5	4	5	4	4	5	5	5	5	5	5	5	5	5	5	4	5	5	5	4
21	5	4	5	5	4	5	5	5	5	5	4	5	4	4	4	5	5	4	5	5
22	5	5	5	5	5	5	4	4	4	5	5	5	5	5	5	5	5	5	5	5
23	4	4	5	5	5	5	5	5	5	5	5	5	4	5	4	5	4	5	4	5
24	5	4	4	5	5	5	5	4	5	5	5	5	5	5	5	4	5	5	5	5
25	5	5	5	5	5	5	5	5	5	5	5	5	4	5	4	5	5	4	5	4
26	5	5	4	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5
27	5	5	5	5	4	5	4	5	5	5	5	5	5	5	5	5	5	5	4	5
28	5	5	5	5	4	5	5	5	5	5	5	5	4	5	5	5	5	5	4	5
29	5	5	4	4	5	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5
30	5	5	4	4	5	5	5	5	5	5	5	5	5	5	4	5	5	5	4	5
	4.87	4.83	4.50	4.50	4.53	4.97	4.60	4.73	4.70	4.87	4.90	4.87	4.53	4.70	4.50	4.93	4.90	4.83	4.60	4.83
	0.3457	0.3790	0.5085	0.5085	0.5074	0.1826	0.4983	0.5208	0.4661	0.3457	0.3051	0.3457	0.5713	0.4661	0.5085	0.2537	0.3051	0.3790	0.4983	0.3790
															SD =	0.4137	Total Mean	=	4.74	

As shown in table 4.0, the result of the evaluation was “Very Effective”, query 1, “the examination ystem can accept Application ID and password of examinee to Log In” with the mean of 4.87; query 2, “ the software informs examinee concerning valid and invalid data entry” with the mean of 4.83; query 3, “the waiting time for the system’s response to an authenticity is tolerable” with the mean of 4.50; query 4, “the system can be easily used” with the mean of 4.50; query 5, “ the functions of the buttons and clickable regions are easily understood” with the mean of 4.53; query 6, “examinee can effectively take the exam using the system” with the mean of 4.97; query 7, “the information in the examination is effective in helping me complete the tasks and scenarios” with the mean of 4.60; query 8, “I feel comfortable using this system” with the mean of 4.73; query 9, “the information (on-screen messages, and other documentation) provided with this system is clear” with the mean of 4.70; query 10, “the system is reliable” with the mean of 4.87; query 11, ” unregistered examinee is unable to take the exam’ with the mean of 4.90; query 12, “ the system is stable’ with the mean of 4.87; query 13, “warning messages do really serve its purpose” with the mean of 4.53; query 14, “system design is easy for navigation” with the mean of 4.70; query 15,” I am able to efficiently complete my work using this system” with the mean of 4.50; query 16, “system is easy to understand” with the mean of 4.93; query 17, ” screen information is clear” with the mean of 4.90; query 18, “I am satisfied using the system’ with the mean of 4.83; query 19, “the system gives error messages that clearly tell me how to fix problems” with the mean of 4.60; query 20, “the system functions and capabilities meet my expectations” with the mean of 4.83. Overall result of the system’s level of effectiveness presented an evaluation of 4.74, described as “Very Effective”. The data set are more or less consistent ranging from 4.50 to 4.97. This means that the College Admission Test With Intelligent Proctoring is effective in delivering its service.

Table 5.0. Evaluation of the IT Experts to College Admission Test With Intelligent Proctoring

The resulting mean and standard deviation (SD) of the gathered survey questionnaires from 10 IT Experts were computed.

Criteria	Mean	Standard Deviation	Description
A. Functionality			
a) The software works properly and satisfies the implied needs of a user.	5.00		
b) The software serves its purpose.	4.90		

c) The software is accurate and complete upon result.	5.00		
d) The software complies with all the requirements.	4.90		
e) The software protects its information and property.	3.90		
Total	4.74	0.4722	Very Effective
B. Reliability			
a) The system is capable of maintaining its level of performance.	4.90		
b) The software provides correct link processing.	4.10		
c) The software can re-establish or recover the data in case of failure.	4.90		
Total	4.66	0.5196	Very Effective
C. Usability			
a) The software requires less effort from the user.	4.60		
b) The software is easy to use. (i.e. consistent navigation)	4.70		
c) The software provides easy recognizable logical concepts.	4.20		
d) The system can be easily learned.	4.70		
e) The software operates according to what the user expects.	4.80		
Total	4.60	0.2345	Very Effective
D. Efficiency			
a) The software provides performance based on resources used.	5.00		
b) The software requires less time in processing.	4.50		
c) The software gives appropriate response while performing its actions.	5.00		
Total	4.83	0.2887	Very Effective
E. Maintainability			
a) The software bears on the risk of unexpected effects of revisions.	4.70		
b) The system undergoes several testing.	4.70		
Total	4.70	0.0000	Very Effective
F. Portability			
a) The software is easy to transfer to another environment.	4.80		
b) The software can adapt different environment without applying other functions.	4.80		
Total	4.80	0.0000	Very Effective

Table 5.0 presents the result of the expert's evaluation on the system.

Looking upon the system's functionality, the result was "Very Effective" with the mean score of 4.74.

Looking upon the system's reliability, the result was "Very Effective" with the mean score of 4.66.

Looking upon the system's usability, the result was "Very Effective" with the mean score of 4.60.

Looking upon the system's efficiency, the result was "Very Effective" with the mean score of 4.83.

Looking upon the system's maintainability, the result was "Very Effective" with the mean score of 4.70.

Looking upon the system's portability, the result was "Very Effective" with the mean score of 4.80.

Table 6.0. User and IT Experts Overall Evaluation of the System

Overall Results of Evaluation of the System	
Evaluators	**Total**
Users [30]	4.74" Very Effective"
IT Experts [10]	4.72 "Very Effective"

Table 6.0 shows, that the overall evaluation of the user is 4.74 which means "Very Effective". The overall evaluation of the IT Experts is 4.72 which means "Very Effective.

Conclusion

The objective of the study was to develop a software for an online proctoring that can detect acts of cheating, to provide feedback for examinees who conduct acts of cheating, to provide list of possible examinees who cheat, to test the system using ISO 9126 and to test system for user acceptability and validity. Experimental and comparative evaluation was used to compare the result of testing from manual to automated.

The system is a combination of a web-based application and a desktop application and can run in an intranet environment. The web based environment of the software includes the logging in of the examinee, examination trial page and examination proper. The desktop application environment includes the cheating detection module and client desktop capturing module. The intranet side of the software includes server monitoring module wherein it has camera image result and server monitoring module wherein it has desktop image result.

Face detection algorithm was used to perform the intelligent proctoring feature of the system. OpenCV Open Source Computer Vision serve includes computer vision algorithms. OpenCV was designed for computational efficiency and with a strong focus on real-time applications.

The researcher used the spiral model as a software development life cycle model. The spiral model was originally conceived as a software development process combining elements of both design and prototyping-in-stages, in an effort to combine advantages of top-down and bottom-up concepts.

The system undergoes a series of test before it is presented for evaluation to determine the system accuracy and precision. F- Measure using the harmonic mean of precision and recall was used.

The system was evaluated by ten experts composed of information technology and computer science specialist, randomly selected from WVSU campuses. Also, with Master and Doctor of Psychology and thirty students of West Visayas State University- Lambunao Campus.

The questionnaire that was used for the evaluation of ten experts is based on ISO/EIC 9126 Software Quality Standards. Questionnaire for user evaluation was constructed by the researcher, checked and evaluated by an expert. The summary result of an evaluation by the experts obtained the mean of "4.72" with a description of very effective. While the summary result of an evaluation by users obtained the mean of "4.73" with a description of very effective as a whole which simply implies that the system passed the ISO/EIC 9126 Software Quality Standards.

To find out the precision and accuracy of the manual system as to compare with the automated. The F-Measure using the harmonic mean of precision and recall is 0.92 or 92 % which implies that both manual result and system result are precise and accurate.

The researcher found out that the manual system allows human consideration compared to automated system follows firmly the rules being set.

The overall result of the system level of effectiveness shown with an evaluation rating described as very effective.

This means that College Admission Test with Intelligent Proctoring by the evaluation of the experts and users is very effective in delivering its service.

Conclusions

College Admission Test With Intelligent Proctoring as to its precision and accuracy is precise, accurate and very effective. F-Measures signify that the lower the value of true negative the higher the accuracy of the system. The results of F-Measure using the harmonic mean of precision and recall signifies that the result of automated system is accurate and precise. The College Admission Test With Intelligent Proctoring has accuracy and precision in detecting acts of cheating based on the evaluation using F-Measure. The College Admission Test With Intelligent Proctoring as to its functionality is very effective in providing feedback for examinees who conduct acts of cheating. Also, able to provide list of examinees who was evaluated having acts of cheating. The overall evaluation of the experts and users were "very effective" this mean that the College Admission Test With Intelligent Proctoring meets the Software Quality Standards set by ISO as to its functionality, reliability, usability, efficiency, maintainability and portability. Based on the evaluation of the study, the College Admission Test With Intelligent Proctoring achieved its objectives.

Recommendations

The users must be oriented and be trained on the usage of the system.
Once it is fully implemented by the West Visayas State University the full potential of the software based on its accuracy and precision will be realized. Researchers who would like to conduct a similar study should widen the scope and be able to integrate more useful features. The system implementation can be done to the different campuses of the West Visayas State University and to other interested university after changing some labels and varied details to suit their respective university requirements. As this was the implication of the highly "installable" of the sub-characteristics of portability of the system which was evaluated very effective by the experts.

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