DEVELOPMENT OF AN ELECTRONIC EXAMINATION PLATFORM USING FACE RECOGNITION METHODS

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ABSTRACT:
Online systems face a major challenge in efficiently monitoring participants and students throughout lectures, particularly during exams. Establishing robust approaches and technologies is essential for identifying unjust, unethical, and illegal conduct in educational environments, particularly during academic courses and examinations. This study introduces a novel online proctoring system that employs deep learning to continuously supervise physical locations without requiring a human proctor. The system utilizes face detection and recognition algorithms to implement biometric procedures, including facial recognition. This work presents a novel approach for face recognition training, which involves an incremental training procedure. This eliminates the requirement for an additional step, resulting in reduced computation cost and time. In order to achieve high accuracy, the suggested model evaluated three distinct face detectors: HOG, MTCNN, and Yoloface. The assessment of the suggested model demonstrates that the HOG approach has surpassed the others. The proposed approach yields a significantly high accuracy rate.

KEYWORDS: Computer-Based-Examination, Face Recognition, Deep Learning, E-Learning, Web-Based-Examination.

1. INTRODUCTION

Physical training involves tasks such as attending lectures, sitting for entrance examinations, participating in semester exams, and engaging in other educational activities that take place in physical classrooms and settings. Teaching and learning in physical spaces present numerous drawbacks, including limited flexibility for students, teachers, and staff, the need for dedicated physical space, accessibility challenges in terms of space and time for students and staff, difficulties related to disabilities, higher financial costs, transportation obstacles, negative impacts on individuals and the environment. Online education has various advantages, including the convenience and accessibility for individuals to engage in classes from the comfort of their own homes, at their desired time and location. Additionally, it involves lower costs and has a much-reduced environmental impact, among other advantages. Undoubtedly, online learning has the ability to mitigate or diminish all the drawbacks associated with traditional in-person education outlined above.

While online learning presents several benefits, traditional in-class learning remains the prevailing approach to teaching and learning. Massive open online courses (MOOCs) offered online have been a compelling motivation for individuals to register for and successfully finish courses and getting degrees through online platforms [1]. Many renowned educational institutions worldwide provide students with a chance to enroll in online courses and obtain certifications upon successful completion. However, it is important to note that MOOCs primarily function as a means to augment one's knowledge, rather than serving as a replacement for the conventional education acquired at schools and colleges. The use of MOOCs has been continuously increasing and is expected to gain a larger share of the traditional classroom education.

The introduction of the Electronic Examination Framework in the 1990s has led to significant enhancements in electronic testing. Thanks to rapid breakthroughs in software engineering and ongoing improvements in hypothesis testing, it has been linked with a diverse array of research methodologies. Significant assessments, such as the nationwide confirmation test, PC rank, and government job tests, commonly utilize exam papers and standardized answer sheets that are scored electronically. The financial impact on examination budgets is a result of the costs involved with paper exams and administration. However, computerized evaluation is progressively becoming a cost-efficient, effective, and influential tool [2]. Exam scores indicate the specific aspect of the lecture that each student retains or finds particularly engaging [3].

China is credited as being the first to construct a complete "imperial examination" system throughout the entire country, as documented in historical sources. The main aim of this test was to choose capable legislators. In 1905, the "Qing Dynasty" put a stop to the esteemed examination system, which had been initiated by the "Sui Dynasty" 1300 years prior in 605. In 1806, Britain implemented this test system with the aim of recruiting civil officers. The examination arrangement was associated with instructions [4].

The E-Exam management system consists of three key stakeholders: students, instructors, and a head administrator. An expert oversees the entire process, including the formulation of questions, the collection of responses, and the evaluation of grades. The plan necessitates the involvement of a Trusted Third Party in order to ensure clarity on the part of the supervisor. Supervisors assess the abilities of students and teachers, thereby exposing their individual characteristics. The fair chief reaches obscurity without a legitimate supervisor [5].

Electronic testing and training improve the precision of answers and reduce the time it takes to respond. To prevent cheating during tests, the questions and answers are randomized. Electronic technology enhances the authenticity of financial administration exams by verifying student identities and ID cards. Our intention is to engage in the study of budgetary administration education and assessment. We want to develop a versatile terminal-based educational and assessment platform. Tablet PCs and cell phones have the ability to overcome obstacles, including financial management education, promote information technology, and enhance financial board training [2]. Artificial intelligence (AI) has transformed our world and surroundings by imbuing intelligence into many everyday tasks [6], [7], [8], while it does pose certain challenges [9]. Machine and deep learning have greatly expedited progress in various domains, including education [10], healthcare [11], [12], transportation [13], [14], communication networks [15], disaster management [16], smart cities [17], and numerous others.

Artificial intelligence has the potential to completely transform online learning and proctoring, without any exceptions.

The COVID-19 epidemic has resulted in significant disruption throughout several aspects of our existence. Governments worldwide have implemented laws to decrease the spread of human infections by regulating physical interactions in the domains of education, employment, and recreation [3]. The current circumstances have necessitated the transition of education, as well as many physical activities and enterprises, from physical locations to online platforms [18].

Education institutions worldwide, including schools, universities, and other training programs, have transitioned to online learning. Nevertheless, numerous obstacles hinder the extensive use of blockchain technology by governments and the general population. An inherent challenge with online systems is effectively monitoring attendees and students throughout classes, particularly during assessments, due to the absence of physical presence. It is imperative to develop methodology and technology that give dependable instruments for detecting unjust, unethical, and criminal behavior in educational environments, particularly during classes and examinations. The existing study on this subject is constrained, primarily consisting of software offered by commercial firms that provide restricted and proprietary software solutions. Utilizing a range of open-source tools and activities is essential for enhancing creativity, diversity, and complexity in the realm of online learning software systems. Stanford and Berkeley have developed Massive Open Online Courses (MOOCs). Even without a certificate, students may still be validated online. Various institutions utilize electronic examinations to provide students with genuine certificates. Organizations such as ETS2, which is a global leader in content-based learning and subject-specific capabilities, serve as examples. CIS and Microsoft's career affirmation programs, together with ECDL, which is the leading organization for testing PC office abilities and providing "European Computer Driving Permit" certification, serve as other examples [19]. The electronic examination system is innovative in the field of education. Evaluations of current targets are overseen by e-examination systems. The majority of prestigious institutions utilize Reason/redid solutions to oversee E-exam platforms such as SAP, Oracle, and Blackboard. The e-question bank infrastructure has been upgraded to automatically generate inquiry papers. A proposal was made for an electronic examination framework for the staff of King Abdul-Aziz University in Saudi Arabia. This framework is expected to be beneficial not only for institutions within Saudi Arabia but also for those abroad [20].

PC and Internet-based tests, sometimes known as e-exams, have been employed by universities and other educational institutions as a means to effectively reach and assess a wide range of individuals. We examine the interconnected π-math structure, identify fundamental verification and safeguard characteristics, and develop a theoretical framework for evaluating the security of e-exam conventions. We illustrate the principle using ProVerif by deconstructing two conventions. The primary "secure electronic exam framework" mentioned in the text has significant deficiencies. The second convention, Remark, fulfills all the security requirements for release board access control as stated in reference [21].

Colleges increasingly adopt electronic tests. This exposes tests to vulnerabilities related to data and communication technology. The e-exam framework security features are discovered and defined. We conduct an analysis of an actual online examination administered by the University Grenoble Alpes (UGA) to assess students and evaluate our criteria. The screens are used to verify UGA-directed exam executions. The analysis of our screens revealed instances of academic dishonesty among students and inconsistencies between the exam details provided by UGA and their actual implementation [22].

The implementation of the electronic exam system serves as a reliable measure of progress in assessing students' performance in educational institutions and universities. The use of electronic tests via a free application called "Model" permits several facets of e-learning, including e-tests.

The research problem is identifiable by the following inquiries:

1. Does the deployment of the electronic examination system ensure objectivity and fairness in the assessment of students?
2. Are there any challenges and barriers that need to be thoroughly examined and researched in order to effectively identify and offer solutions for their implementation by colleges and other academic establishments?
3. Are the eligibility criteria for implementing the college's computerized testing reachable by research participants, and how does this impact the process of implementation's effectiveness? These factors have revolutionized the approach to education and provided a compelling rationale for embracing the new format of examinations. Utilizing e-Exams can effectively address several major issues associated with traditional exams, resulting in improved exam quality through cost, time, and effort savings. The difficulties addressed by conducting e-Exams are summarized in Table 1. Additionally, several other articles have also referenced these benefits of e-Exams [13] [14] [15].

Table 1: The Benefits of the Electronic Exams.

Recipients	Advantages
Students	Reduced stress, equitable grading, and prompt timing
Teachers	Question banks, instant grading, and reaction time analysis
Department	Minimize the use of physical documents and prevent cheating by implementing randomized question selection.

The main objectives of this paper are to enhance the quality of exams by utilizing information and communication technologies in an already successful teaching environment, with the aim of reducing costs, saving time, and minimizing effort. Additionally, this paper aims to encourage further research in the field of e-Exam systems.

The original scientific contribution involves the implementation of the first e-Exam platform officially utilized in the Kurdistan Region of Iraq. This platform successfully meets the needs of both lecturers and students through its flexible client/server network architecture, user-friendly web-based application, intuitive user interface, various question types, multimedia support, automated grading, prompt score availability, resume capability, and auto-submit feature.

Therefore, this work is delivered in the subsequent structure. The following part will give the literature review. We shall adhere to the conceptual design of our built e-Exam platform by utilizing the activity diagram and data flow diagram. Next, the text proceeds to elucidate the intricacies of the primary subsystems that are interconnected and collaborate harmoniously to facilitate the delivery of e-Examinations. The solution for conducting e-Exams will be implemented. A final section summarizing the key findings and suggesting directions for more research rounds out the paper.

1.1 RESEARCH PROBLEM

The electronic exam system is a promising method for evaluating students' performance in educational institutions. However, research questions include ensuring objectivity and fairness, identifying obstacles in implementation, and assessing the availability and impact of requirements on the success of the implementation process in colleges.

2. LITERATURE REVIEW

Since its introduction in 2008, online proctoring software has grown in popularity among higher education institutions (ProctorU, 2020) [23]. This is particularly because of the Covid-19 pandemic, which caused several courses to switch from in-person to online instruction (Coghlan et al., 2021) [24]. While some online proctoring software use artificial intelligence (AI) and machine learning algorithms to identify suspicious behavior by analyzing recordings of online exams, other software (Safe Exam Browser, 2020) restricts the number of programs a computer can run during an exam (Coghlan et al., 2021). [24]. While universities perceive the advantages of online proctoring as appealing, students have occasionally expressed concerns about feeling uncomfortable due to being monitored and their privacy being infringed upon (Hubler, 2020) [25]. It is worth mentioning that as online proctoring software advances, students are discovering novel methods to evade the vigilant monitoring of these platforms (Binstein, 2015) [26].

Several approaches have been proposed to meet the need for online exam proctoring. In reference [28], eight measures are proposed to reduce occurrences of cheating, but in reference [29], a method is outlined that entails sending live photos of every classroom to a streaming video server. The monitor data in [30] comprises of uninterrupted video and audio streaming, together with the gathering of screen pictures. The participant's identification is verified by comparing the obtained data during the sign-in process. In [30], a desktop robot, equipped with a 360-degree camera and motion sensor, sends video recordings to a monitoring center when it detects incriminating occurrences. In a recent study [31], researchers introduced a completely automated online and ongoing proctoring system to detect instances of cheating among participants in online exams. This encompasses the identification of impostoring, which refers to the act of someone else taking the exam on behalf of the authorized participant.

Within the scope of the Electronic Examination structure, approaches, such as the collection of sensitive duplicate examination questions from authors and the conversion of these questions into a computer-based examination format are employed. A database was created to store the records of understudies and test questions. The questions were uploaded and an examination was made up. Students were able to join in to take the examination and download their scores [27]. E-exam operates as a restricted series of events. The occasion of presenting an e-exam run is appropriate for explaining and verifying the properties of the e-exam using both the Model checking and the Model monitoring. By employing a method for model checking, such as ProVerif, all possible sequences of events are thoroughly examined in a White-Box design to verify the security of a protocol model or identify any flaws. By employing an observational approach, individual runs are analyzed in a "discovery style" to determine if there are any deficiencies in the protocol implementation or any malicious behaviors in the execution [22].

One crucial component of distance learning is the digital assessment. It is incredibly quick, efficient, and uses less of the material resources that are typically squandered. A database that runs over the internet must be established in order to use for an online test system. This article assesses the questionnaire, looks at the design system's basic idea, which contains the system's key components, and deliberates on the development of algorithms and the security of the system. The system safely transmits the encrypted responses to the bit stream to avoid unauthorized access and intrusion. The technology is specifically developed to survey and analyse student facial expressions and actions through an already installed camera, with the aim of reducing occurrences of academic dishonesty. The online examination is specifically tailored to accommodate basic computational skills.

The system does not support or manage individual exams and advanced computer courses. Therefore, it is not feasible to assess a student's individual skills using an advanced system or categorize them purely based on how online self-evaluation differs from objective evaluations in terms of influence. The evaluation of the students' written abilities is not carried out, as suggested by the results. The exam system's self-assessment employed a novel methodology. The online method uses keywords to match with the responses. It operates in a comparable manner to objective questions. Objective assessments should exclusively be employed to address descriptive or subjective inquiries. This paper presents a comprehensive explanation of the structure and execution of an advanced internet surfing system. The clever online exam system's primary goal is to use dependable algorithms to verify the identity of students by analysing their face characteristics. The proposed technique also highlights the degree of intricacy associated in selecting questions from a question bank. Proposal for the establishment of the Intelligent Self-Assessment System.

3. THE METHODOLOGY AND DESIGN OF THE DEVELOPMENT EXAM PLATFORM

This website is a great resource for learning about a variety of web-based and portable applications that are helpful for qualitative researchers. All aspects of data management, including collection, processing, analysis, and project management, can benefit from these systems. In qualitative research, digital tools help close traditional divides between the researcher and the participant as well as between the field and the laboratory.

3.1. ADDIE MODEL

The ADDIE Model, which was developed at Florida State University as an educational aid and stands for analysis, design, development, implementation, and evolution. It can be used to create volunteer training that is flexible. The iterative process employs a regressive design model to help you visualize the goals you intend to attain and the measures you can take to accomplish objectives that mentioned in Figure (1).

3.2. THE SOFTWARE DEVELOPMENT CYCLE

Often known as the software development process, refers to the series of steps followed in creating software. Software development refers to the activities carried out at each stage of the software development process. The text provides a comprehensive overview of the entire application development lifecycle, including analysis, design, development, implementation, evolution examination, and application development. It consists of a detailed plan illustrating the process of creating, maintaining, and replacing specific software. The waterfall model, depicted in Figure (1), was employed as a framework consisting of five distinct processes.

Figure 1: The Addie model systematic process.

System analysis is a crucial process that determines the desired functionality and requirements of a system. It involves evaluating the system's capabilities, tasks, and performance. Design involves creating a user requirement document, which guides cost, schedules, evaluations, and milestones. The development phase involves creating the system's internal organization, modules, and classes. The implementation phase involves teacher training and evaluation of educational materials.

3.3 FACE DETECTION AND RECOGNITION METHODS

Various techniques are employed for their exceptional precision in the process of recognition. The approaches being referred to are HOG and Facenet. Both methods belong to the field of deep learning and utilize a Convolutional Neural Network (CNN) architecture for machine learning.

The verification processes were conducted using the identical dataset generated by two distinct face identification methods, namely MTCNN and YOLOface. Both of these techniques exhibit high precision in detecting faces in real dataset images, even in challenging lighting and position situations, with a success rate over 93%.

The paper utilized a HOG technique to enable the system to authenticate a user's face. The one-shot model is designed to translate face images to a Euclidean coordinate system. The resulting embeddings are then fed into the network, together with the feature vectors collected via SVM. The training approach use triplet loss to cluster photographs of the same user by minimizing the distance between the positive sample and the anchor image, while increasing the difference between the anchor image and an opposite sample.

The proposed design seeks to achieve precise and rapid verification by utilizing a dataset and ensuring resilience to fluctuations in pose and illumination. Figure 2 presents the comprehensive layout of this technique, comprising five primary elements.

In this study, we suggest implementing a method called incremental training to enhance the face recognition process by incorporating users' faces over time. Incrementalism is the approach of gradually teaching user faces by using an image of the user's face taken during the lecture session. Upon each registration on the platform, the system first detects the user's face image and subsequently compares it with the user's live image, which is continuously captured by the webcam. This process ensures the precision of face detection and verification, even when faced with different poses and lighting conditions. User authentication and identification are performed using the HOG facial recognition model, known for its excellent accuracy. SVM is used to extract features.

The image is downscaled to reduce computational expenses and accommodate the user's internet capabilities. During the dataset collection process, continuous face detection is carried out every time an image is recorded at random intervals. Subsequently, a continuous user verification process will be conducted whenever a single face is identified in the taken image. The system's prototype is designed to assess the outcomes of the proposed approach. Prior to being inputted into the Addie model, the face detection and face embedding stages undergo progressive training. The increase in input image size does not have a linear relationship with the accuracy of face detection. This is because the collected image will be shrunk to a fixed size of 160x160 pixels, regardless of the input size used by the model. The Python environment is used to construct the processes of face detection, face verification, and training. The OpenCV library is utilized to facilitate image processing tasks such as altering image dimensions and implementing facial detection and recognition. The assessment utilizes the pre-trained HOG-face-detection model and the OpenCV library.
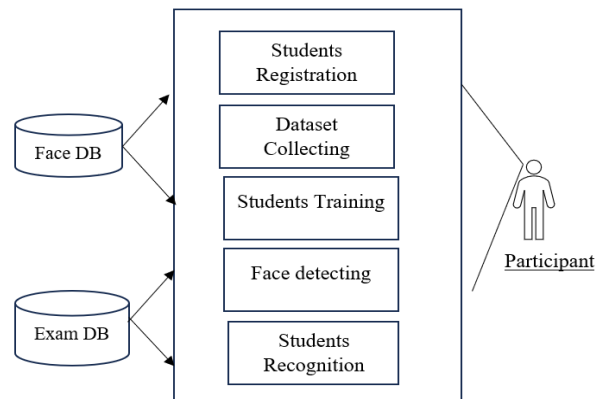

Figure 2: The Architecture of Electronic Examination System

3.4. The System Building

The levels comprise an initial level, an intermediate level, and an advanced level. The User Interface, which serves as the introduction level of the system, is created using HTML. The central level connects the introductory level with the informational level. The main layer is commonly known as the application level or business logic. The intermediate layer was constructed using the functions of PHP. the system component that is responsible for the storage and management of data in a database is designed by the level of information. The database uses the framework. The MySQL database server is the framework used to construct this system. The framework's engineering is depicted in the following fashion.
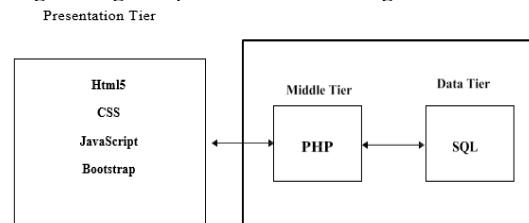

Figure 3: Displays the Architecture of Used Programming languages.

3.5. Employ Case and Context Diagrams

Using case diagrams is a graphical technique used to gather and analyse requirements. They stand for the functional specifications that the system needs to meet. Use focus states to investigate the system from the outside in. The process of acquiring requirements enhances use cases. They are subjected to examination and revision continuously during the process. Moreover, this map presents a compilation of using cases, Actors, and their interconnections. It illustrates the participation of

External entities, like as players, interacting with the system. In this sense, the term "players" might encompass several entities, including users, managers, banks, consumers, or any system, such as a central database. Figures (4 and 5) explain the employee and context diagram.
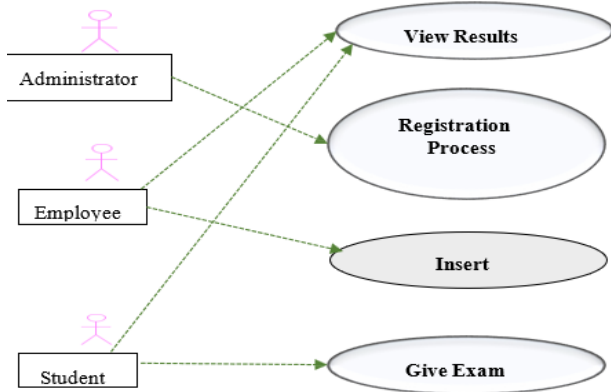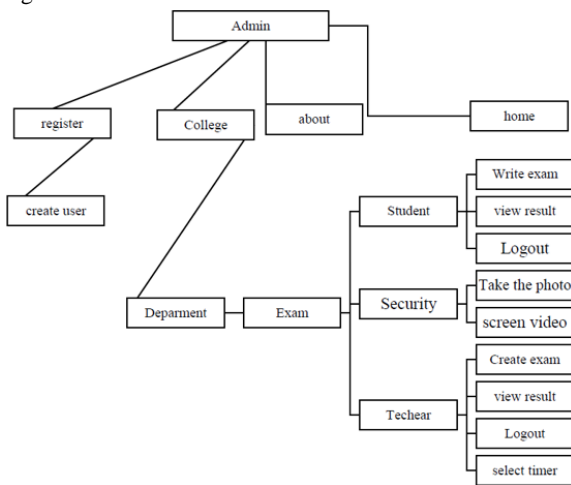

Figure 4: The Fundamental Role for Each Actor.

Figure 5: The diagram depicts an electronic examination system.

3.6. Model prototype

Figure (6) illustrates the boundaries and extent of the project for the electronic-examination system and elucidate the primary objective of the system and its associated organizations.
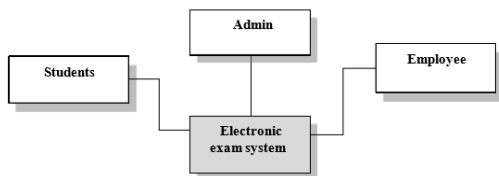

Figure 6: The Use Case Diagram for The Proposed System.

3.7. Database Design Proposal

The database was organized using the notion of the social database paradigm. MySQL is the database server utilized in the database generation process.

4. THE IMPLEMENTATION OF THE PROPOSED ELECTRONIC EXAMINATIN PLATFORM

The primary objective of the adopted e-Exam platform is to improve traditional university academic paper-based examinations by utilizing an electronic program that includes several question formats.

The electronic test is a complete online application. The proposed system employed a system architecture comprising of three processors: Administrators, Employees, and Students. Manager supplied by employees, students , instructors, and subjects. The employees-level configuration wizard possesses the capacity to create new examinations and modify existing exams. The staff handler is able to efficiently upload queries and corresponding responses regarding the issue. The Student Wizard is an exclusive website where students can register for the entrance exams that assess their qualifications for admission. In order to accomplish this task, several programming languages were utilized, including Python, JavaScript, HTML, PHP, and MySQL.

4.1 implemented electronic exam environment

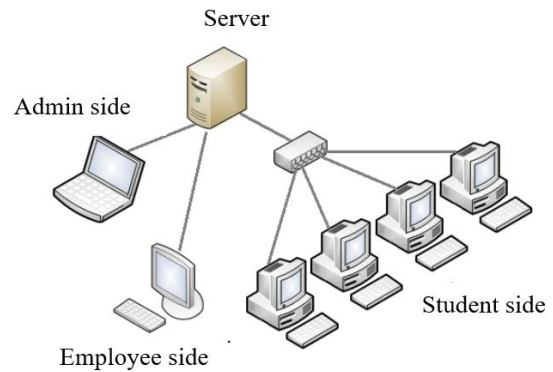Figure (7) displays the overall structure of the e-Exam environment that has been implemented.

Figure7:Diagram illustrating the implemented electronic examination environment.

The electronic Exam environment was constructed using a client/server network architecture and relied on three primary sides as follows:

• **Accessing the system with administrative privileges:** Successful login requires the matching details of login with the created Database. Otherwise, the system will display an error message. On this platform, the administrator has the authority to delete or add employees and students.

• **Utilizing employee credentials to access the system:** After an employee's name and password have been recorded, individuals can access the system as an employee and perform tasks associated with their job. Only when the login credentials match the data in the database is the registration procedure considered successful. If not, a notice of an error will appear. The tasks performed by employees include creating exams, adding questions, deleting questions, and checking exam outcomes for students as shown in Figure (8).
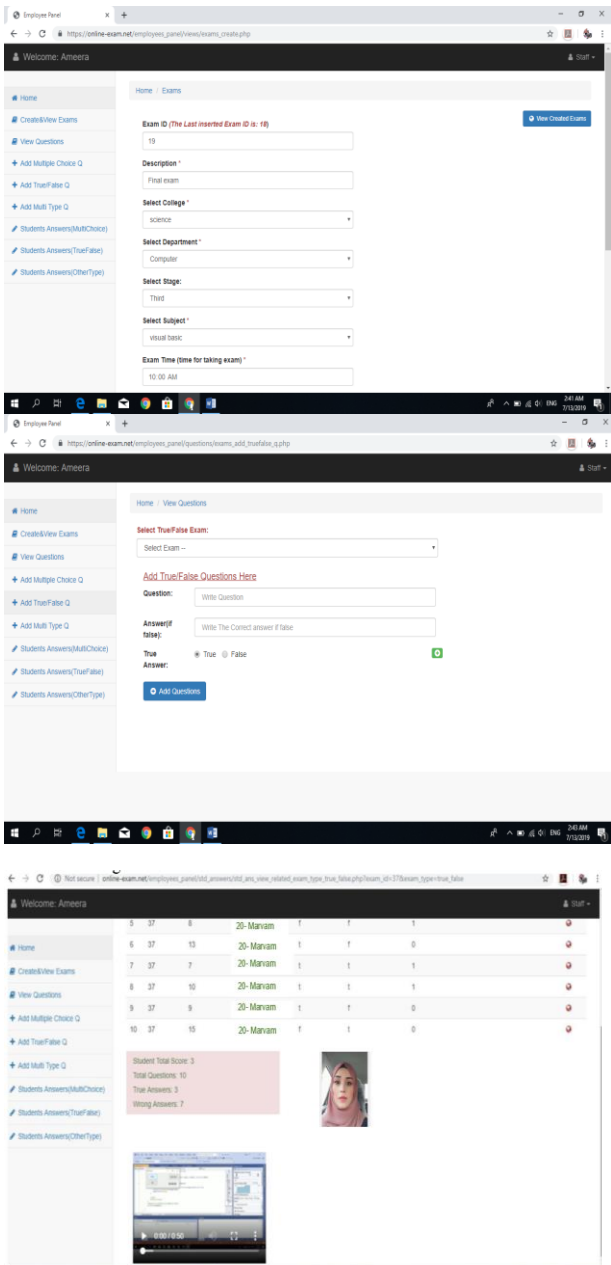
Figure 8:Adding, Choosing and Checking the Students Answer.

- **Accessing the system using student credentials:** The administrator will record the information of each student throughout the registration process. This will enable the selected student to access the system without the need for further registration. The registration process is considered successful only if the login details provided by the user match exactly with the information stored in the database. The student's photo undergoes verification to confirm its correspondence with the data provided. In this scenario, the student's computer will capture a continuous video of the student's face by the web cam during the duration of the test to prevent any instances of cheating. If any irregularities occur, an error message will be shown.

4.2 students engage in the following primary procedures:

Student Enrollment: This includes all of the information about each student that is needed to finish the enrollment process, like their password and student email address.

Online Security Examination: Record a screen video of the student during the entire examination period.

- Using face recognition technology, the student's picture is taken and compared with their login image.

- Students will complete the examination by responding to the questions.

Ensure that the student video is uploaded prior to commencing the exam in order to prevent cheating.

- Upon completing all the exams questions within a specified time range, the students' results will be released within the next day.

4.3 Database design

To maximize the effectiveness of MySQL server technology, it is crucial to guarantee that the database is properly configured. The filenames chosen for tagging all database tables should accurately represent the function of each table, hence enhancing the overall design system. The initial phase of the design process involves determining the tables to be constructed and the specific data that each table should store, based on the project's requirements and characteristics. Figures (9 and 10) display the Administration database and the examination answers database.
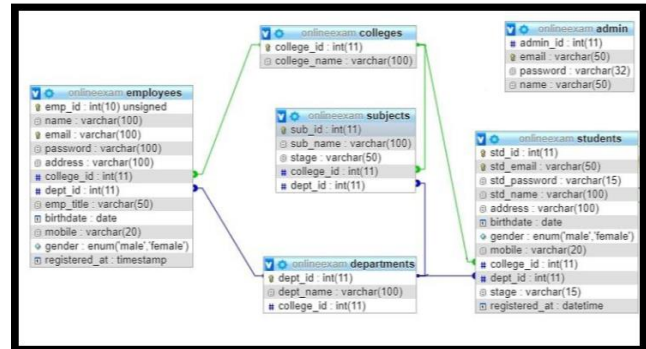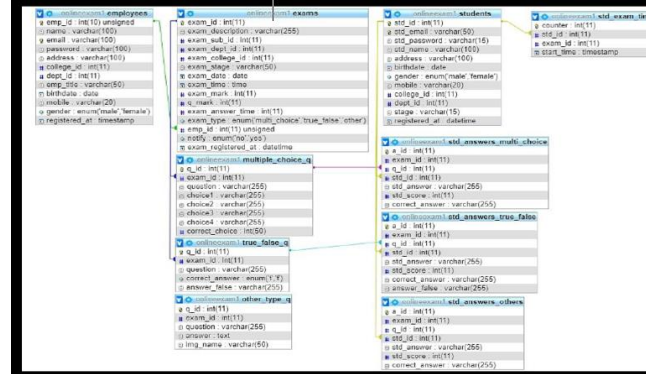

Figure 9:Database Framework of The Administration.

Figure 10: The Exam Answers Database's Structure.

5. EXPERIMENTAL RESULT

This study involves a comparison of the previously described facial detection algorithms. Increasing the size of the image will result in a greater burden on the system and could perhaps lead to inaccurate detections. The comparative outcome is displayed in Table (2) and Table (3). By analyzing the evaluation data from both tables, we can confirm the earlier assertion that an increase in image resolution does not necessarily lead to improved performance in face detection. The evaluation result of face detection using the suggested image size is presented in Table (3). The results demonstrate superior accuracy in comparison to the others.

Table 2: The evaluation results of face detection methods using recommended-resolution images.

Method	Dataset (Img. Qty)	Detecting Time (Sec.)	Accuracy
MTCNN	1295	5.87	82.66%
YOLOface	1295	1.54	95.80%

HOG	1295	1.68	96.06%

Figure (11) displays the preliminary phase of the evaluation process for the face detector. The presence of the face is identified in all of the image datasets. The face detection approach was evaluated sequentially after processing all the photos. This study utilizes a dataset of 1295 photos from four distinct users. These photographs are sorted into various categories, as illustrated in Table (2). After the completion of the face embeddings, the dataset containing the face embeddings is then utilized to train the model. Once the training procedure is completed, the test images are validated using the learned model. The recorded parameters include the time of detection, embedding, training, and testing, as well as the dataset size and the accuracy rate. Figure (11) displays the preview of face verification.
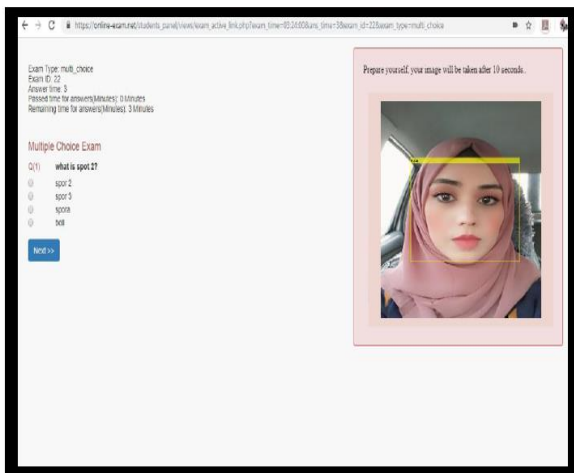

Figure 11: Matching and Verifying the Student's Image with his Data.

CONCLUSION AND SUGGESTIONS

The study compares electronic exams to paper exams, revealing differences in students' performance and time saved. It highlights the benefits of e-Exams, such as reduced costs, environmental preservation, and less exam supervision. However, the occurrence of cheating in electronic tests can be diminished by implementing contemporary techniques of face detection and enhancing facial recognition technologies. The HOG approach demonstrates superior performance compared to the other mentioned methods. Hence, this method should be given greater consideration for utilization in face recognition. Although the MTCNN and YOLO-face comparison exhibit a little disparity in their rating results. YOLO-face has surpassed MTCNN in both detection accuracy and speed, based on the datasets utilized. The method that demonstrates superior performance will be deemed suitable for meeting the requirements in the establishment of an effective proctoring system with a high level of accuracy.

The recommended model exhibits a high degree of user-friendliness. Utilizing facial recognition algorithms as part of exam security measures significantly decreases the occurrence of cheating. Furthermore, the camera offers a comprehensive perspective of every aspect. The model underwent testing by professors and university students, all of whom noted its user-friendly nature, time and effort-saving capabilities for academics and students, ability to detect instances of fraud, and presentation of inconclusive findings.

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