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E-Exam Cheating Detection System

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E-Exam Cheating Detection System

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1445/ 2023

Dedication

I dedicate this work to my Mother and Father, who is impossible to thank them adequately for everything they have done…

May Allah reward you.

Declaration

I certify that this thesis submitted for the degree of Master, is the result of my research, except where otherwise acknowledged, and that this study (or any part of the same) has not been submitted for a higher degree to any other university or institution.

Signed: 

Mohammad Emad AbdAlteef Amer

Date: 12/08/2023

Acknowledgment

In the beginning, all thanks and praise be to Allah, with his generosity, I finished this paper. A deep appreciation and gratitude to my project supervisor who dedicated himself to the successful completion of this dissertation.

I would like to thank everyone who helped and guided me throughout my research. Who, without their guidance, patience and support, this thesis would not have been possible. I also owe a lot of thanks to my brothers and sisters.

Thanks to all my friends and colleagues.

We extend our sincere thanks to the Deanship of Information Technology at my dear university for their help and cooperation.

Abstract

With the spread of the internet and technology over the past decades, e-learning has been growing rapidly day by day. In the other hand, cheating in exams is a worldwide dilemma, regardless of the levels of technological advances. Online exams are an essential and fundamental component of e-learning. Students' exams are given in remote e-learning without any kind of monitoring or physical observation. because of students' ability to cheat easily during electronic exams. E-learning universities depend on face-to-face examination process on campuses under supervised conditions. This dissertation looks at methods used by a student to cheat on remote exams (E-Exam) by a constant authentication which ensures that the authorized person is only the test taker throughout the entire exam session; And the use of online proctors point out effective methods for detecting cheating in distance examination. In this thesis, we built an electronic exam management system that can detect cheating in the E-Exam. The work of this system can be divided into two stages, the first stage when the examinee is; before an examinee being allowed to attend a session, uses a Faceprint to authenticate the examinee. Face Recognition is also used during the E-Exam session. As a result, we can determine whether an examinee is cheating or not cheating in an exam by these two criteria: the examinee's total on-screen time and the number of times the examinee is off-screen. In this thesis, a new approach was used to be applied in electronic test management systems.

Contents

Table of Figures

List of Tables

List of Symbols and Terminology

Symbol:	Definition
D-Exam:	Distance exam
E-Exam:	Online exam
FID:	Face print Image Data
FIVS:	Face print Image Views
FMD:	Face print Minutiae Data
FMV:	Face print Minutiae View

Chapter 1:

Introduction

1.1 Introduction

The Internet has been around for a long time in our lives compared to the era that passed without it, where in the past times, peoples used to finish their tasks without using the internet, for example students in schools and universities previously were handing over their duties and done their exams without using another source as the internet to help them (Ezedikachi, 2021).

Exams are used to assess student learning and can be classified into three types: traditional exams, electronic exams, and distance exams (E-Exams). Traditional exams are static questionnaires given in the class, while Electronic Exams are Internet based questionnaire. E-Exams are a way of delivering questions to students who are not physically present in a traditional exam-taking environment where those questions are selected randomly from questions, each student gets different set of questions, with a preset time limit by which they should be answered.

E-exam represents new challenges for teachers, such as how to prevent students from cheating. E-learning institutions depend on an examination process in which students take a face-to-face examination in a physical place. This research investigates all types of methods used for cheating in E-exam and resolves this problem by either detection or prevention. To detect and prevent cheating, a proctor needs to physically authenticate students' IDs before starting the exam, but this is not enough. Additionally, a continuous process of monitoring and controlling over all students during the exam period is needed (Bawarith, 2017).

Nowadays is different, Cheating and fraud with the internet is spread in quickly specially in school exams. Therefore, online learning also reinforced

this phenomenon, until we can say that technology facilitated cheating and educational deception. Where students become able to reach to answers of their exams and the content, they need by using smart phones (Simmons, 2018). Also because of this big deception, commercial business is grown by using some sites, until became say that Online tests have also meant a booming business for companies that. Where these sites solve the exams for the students and sell it and trade in this business through paying the subscription fee (NEWTON, 2020).

After all of this as we saw, this research is intended to treat this issue and to reach a technological solution to reduce this phenomenon, so we are striving to build a system prevent students from entering the exams without passing the required steps.

1.2 Problem Statement

Cheating in exams have reached a high stage of prevalence and becoming a widespread phenomenon in the world, and many studies have been conducted to combat it. However, the cheating problem in E-Exam is still not solved. To prevent cheating, a proctor needs to physically authenticate students before starting the exam, and continuous authentication is needed. Additionally, monitoring and controlling over all students while taking the exam is needed. This study aims to investigate how to solve the cheating problem through prevention and detection.

1.3 Motivation

When we talk about electronic cheating in exams, what drives us to think about this problem and what are the consequences if this problem continues?

Educational cheating, which has become like a game in everyone's hands, is a huge problem. And it is considered the reason for the nation's decline and delay. We are at least trying to reduce this problem as much as possible in schools and universities, especially since this generation is open to the world and aware of technology. So, this will make it easier to deal with the system plan.

The measure of the motivation for doing this work is to reduce electronic deception and academic educational cheating. Therefore, we will resort to building an effective technological system through execution it reduces the process of electronic cheating during the examinations by passing and overcoming some of the required stages. Through this work, we will seek to bring out a rising generation away from cheating and fraud that is developing from the nation's renaissance.

1.3.1 Objectives

We aim from this paper to achieve the main goal which is reduce the electronic cheating in exams through:

1. Use an advanced technological method to monitor remote examinations and reduce cheating in electronic examinations.
2. Use a modern algorithm to build an effective system, which uses an online proctor.

1.4 Methodology

In order to satisfy these goals, we have investigated all kind and approaches used in cheating in E-Exam. Continuous authentication as well as an online proctor are required to detect and prevent cheating. Before being allowed to take an E-Exam, a username/password and a picture of a student's face are used to prove the examinee. To continuously guarantee that the examinee is the intended person as well as utilizing Face Recognition technology during the E-Exam session.

1.5 Thesis Outline

The structure of this thesis is as follow:

Chapter 2: Theoretical Framework & Literature Review.

Chapter 3: E-Exam Management Model Implementation.

Chapter 4: The Methodology of the Model.

Chapter 5: System Evaluation and Outcomes.

Chapter 6: Conclusion and Future Work.

Chapter 2:

Theoretical Framework & Literature Review

2.1 Introduction

In this chapter, we will explain theoretical framework which includes exams, electronic exams, cheating on exams and the reasons of it, the relation between Corona virus and cheating, Authentication, face recognition, then we broach both Foreign and the Arabic studies.

2.2 Exams

Evaluation or assessment is a process used to evaluate and gain feedback on how knowledge or skills are impacting students. It is also a tool used to evaluate what students have learned. Unfortunately, in the last two decades, there has been an alarming increase in the number of examination misconduct cases. The increasing number of examinations malpractices has raised concerns about the level of cheating in the country. It has been observed that there is no single method or technique for cheating in examinations. (Ndunagu , 2013)

2.2.1 Electronic Exams

Electronic Examination is a technology that was designed to address the various problems that arise during the examinations process. Some of these include the high cost of conducting the exams, examination leakages, lack of flexibility, long time for retrieval of results, and so on. This research aims to restore students' confidence and improve the academic standard in the Palestine.

During the 1960s, educational computing was initially envisioned as allowing students to do tests and exams on their own instead of using paper and pencil. This would enable students to type in a response or a list of options. Other

ways to enable assessments to have also been suggested. Some oral language examinations have included using a computer to record and present performances. In the UK, students were also able to record their progress using portable computers. An exam should measure the performance of a computer system. There are various ways that this could be done, such as delivering an exam on a stand-alone computer or using a local area network (LAN).

Computer-based examinations are a part of e-assessment, which is a process that uses technology to improve the efficiency and effectiveness of tests. According to Ripley, the use of technology can help improve business efficiency and educational transformation. E-assessments that are driven by business efficiency usually support the same types of assessments that are done on paper. However, where the goals are educational transformation, the e-assessment may take on various forms and designs to suit the needs of the individual (NEWHOUSE, 2013).

There are many examples of electronic exams such as examinarium system. So, Students can complete their exams anytime, anywhere using the examinarium system. It works by allowing teachers to create their own exams in advance. Unlike traditional exams, exams in examinarium are conducted in a separate, secure facility (instruction for teaching, 2021).

2.2.2 Cheating on Exams

Cheating can be defined as The Academic Integrity Act defines cheating as a breach of academic integrity that happens when a student gains an unfair benefit by using dishonest methods. The incentive/pressure to cheat is the same in a traditional environment as it is in an online one. In a traditional

environment, cheating is minimized when the professor is present during the exam. In an online environment, cheating is not always possible since the instructor has no control over the devices and materials that the students can use during the course (Watson & Sottile, 2009).

Understanding why students cheat is not an easy task, as psychological theories play key roles in developing moral reasoning. In 1971, psychologist Robert Kohlberg proposed a six-stage theory of moral reasoning, which divided into three levels. The first three phases determine the kinds of judgments one should make when dealing with moral issues (Ananzeh, 2021).

Over the years, college campuses have been plagued by cheating. Today, students are more likely to engage in dishonest behavior due to the rise of the Internet and word processing.

Due to the rise of web-based assessments, the opportunity to improve grades through illegitimate means has become a concern. A study conducted in 2009 by Guyette, King, and Piotrowski revealed that students tend to cheat in on-line courses. The question is, do web-based assessments make students more prone to cheating? (Guyette & Piotrowski, 2009).

2.2.3 Reasons for the Increase in Cheating

There are many reasons why students choose to steal or plagiarize. Most of these are motivated by the desire to get a good grade, dissatisfaction with the assignment, or fear that they will not be caught. However, these reasons are not acceptable reasons to commit academic dishonesty. It is also important to note that professors are not interested in evaluating the work of their students (RIT, 2020).

2.2.4 Corona Virus and Electronic Exams

Due to the outbreak of the coronavirus, many schools decided to move to online examinations. In today's world, colleges are working to ensure that students have the proper resources and technology to take exams. However, they also have to manage the academic integrity of their students. Due to the outbreak of the pandemic, many education departments had to quickly develop an alternative strategy for exams. Although the school's administration had already updated its policy regarding the use of online exams, the department would still have to adapt its strategy in order to keep up with the changes. Many universities, including Northwestern, are currently using the web-based learning system Canvas to allow students to take and submit online exams. There are various types of exams that can be found on the platform, and they can be converted into various smaller quizzes. Students might also be asked to collaborate with their professors on using video and other tools to help prevent cheating and plagiarism. According to Instructure, the company's usage of its Canvas platform has increased by around 40% since the beginning of the semester. Although the transition to online exams is expected to be seamless for most students, some students might encounter issues with their connection or their schedule. Experts also suggest that students communicate with their professors about any issues they might have (kerr, 2020).

2.3 Authentication

Authentication is a process of proving a user before allowing access to a system and resources. Ensuring only those with authorized persons with the correct credentials can gain access to secure systems. Authentication helps

grant access to the right user at the right time with confidence. But this doesn't occur in isolation (Magnusson, 2023). So, authentication goals in E-Exam plays an important key in security.

Authentication has two kinds: static authentication and continuous authentication. Sabbah, Saroit, and Kotb provide a new way for e-examination authentication, which enables institutions to manage cheating-free e-examinations which provides virtual, interactive, and secure E-examination sessions. The system checks a user's identity whilst trying to access the system resources, as well as an online proctor to interactively and remotely monitors the examinees throughout their examination using a webcam and video call (Sabbah, Saroit, & Kotb, 2011).

2.3.1 Face Recognition

Facial recognition is a biometric identification technique that uses unique characteristics of an individual's face to identify them. It works by comparing the Faceprint to a database of known faces, and if there's a match, the system can identify the individual. It is often used for security purposes but can also be used for more mundane tasks. Some facial recognition systems are equipped with artificial intelligence that can learn to identify individuals even if their appearance has changed (Dwivedi, 2018).

2.4 Literature Review

2.4.1 Foreign Studies

King, Guyette Jr & Piotrowski (2009) define cheating as:

An academic transgression that involves taking an unfair advantage that can result in a misrepresentation of a student's abilities and grasp of knowledge. This issue commonly relates to plagiarism, false self-representation, and online assistance (Guyette & Piotrowski, 2009).

In another study McCabe, Butterfield & Trevino (2006) says:

There are various causes of academic dishonesty and cheating, and the main factors that influence these behaviors can be classified as contextual factors and individual factors. In most cases, the perception of peers' behavior is the most influential factor in influencing students' cheating behavior (McCabe, Butterfield , & Trevino, 2006).

The exam type is also a factor that influences cheating behavior. According to a report by Bretag, Rundle & Harper, the most common way of cheating in exams is through multiple-choice questions. However, instructors stated that the discovery of cheating in exams was relatively low (Harper, Bretag, & Rundle, 2021).

In another study published by Journal of Nursing Education Perspectives wrote by Stonecypher, Willson titled: **Academic Policies and Practices to Deter Cheating in Nursing Education** aimed to This study focused on the evidence that supports the development of effective strategies and methods to prevent cheating in nursing schools (Stonecypher & Willson, 2014).

In another study presented by IEEE Education Engineering (EDUCON) titled: **Best Practices in E-Assessments** with a special focus on cheating prevention aimed to provides helpful guidance for teachers who want to introduce e-

learning in their classes. It highlights the various technical considerations that should be taken into account when implementing e-assessments (Cieliebak & Magid, 2018).

2.4.2 Arabic Studies

The researchers Khan & Balasubramanian prepared a study entitled: **Students go click, flick and cheat… e-cheating, technologies and more** aimed to The study aims to identify the factors that contribute to the rise of e-cheating and how they affect the student attitude towards it (Zeenath & Balasubramanian, 2009).

The researchers Bashitialshaaer, Alhendawi & Lassoued titled: **Obstacle Comparisons to Achieving Distance Learning and Applying Electronic Exams during COVID-19 Pandemic** aimed to analyze the barriers and opportunities that distance learning institutions face in order to succeed during the coronavirus pandemic (Bashitialshaaer , Alhendawi , & Lassoued, 2020).

In another study published by IEEE through the researchers El Kadi, Abdelfatah, Tabsh titled Faculty Perception of Engineering Student Cheating and Effective Measures to Curb It said that Most faculty members think that academic dishonesty is more common in-class work than in proctored exams. They believe that the use of harsher punishments and more frequent proctoring is the most effective method to reduce it (Tabsh, El Kadi, & Abdelfatah, 2019).

Chapter 3:

E-Exam Management Model Implementation

3.1 Introduction

In this chapter, we give an overview of the algorithm we used in the system, how it works and the methodology of the Research.

3.2 Face Recognition

Face recognition is a computer technology that is used to identify and verify individuals based on their facial characteristics. It is a type of biometric identification that is used in a variety of applications, including security, law enforcement, and social media.

There are several approaches to face recognition, including eigenface, fisherface, and deep learning. Eigenface and fisherface are methods that use principal component analysis (PCA) to extract features from the face and compare them to a database of reference images. Deep learning is a type of machine learning that involves feeding a system to recognize faces using a large dataset of labeled images.

One of the main challenges in face recognition is handling variations in facial appearance due to factors such as lighting, pose, and expression. To address these variations, face recognition algorithms may use techniques such as feature normalization and face alignment.

3.2.1 The Importance of Face Recognition

Face recognition technology has several important applications in a variety of fields. Some of the main advantages and benefits of face recognition are:

Security: Face recognition can be used to enhance security by identifying and verifying individuals at airports, border crossings, and other high-security

locations. It can also be used to monitor access to restricted areas and prevent unauthorized entry.

Law enforcement: Face recognition can assist law enforcement in identifying and tracking criminals, locating missing persons, and solving crimes. It can be used to search databases of mugshots and other images to identify suspects.

Social media: Face recognition can be used to automatically tag friends and family in photos on social media platforms, making it easier to organize and share photos.

Healthcare: Face recognition can be used in healthcare settings to identify patients and verify their identity, improving the accuracy and efficiency of medical record keeping.

Customer service: Face recognition can be used by businesses to identify and personalize the customer experience, for example by automatically recognizing a customer's face and offering personalized recommendations or discounts.

Overall, face recognition technology has the potential to improve security, efficiency, and convenience in a variety of settings. However, it is important to carefully consider the ethical implications of its use and ensure that appropriate safeguards are in place to protect individuals' privacy and rights.

3.2.2 How does the Workflow of Facial Recognition System Works?

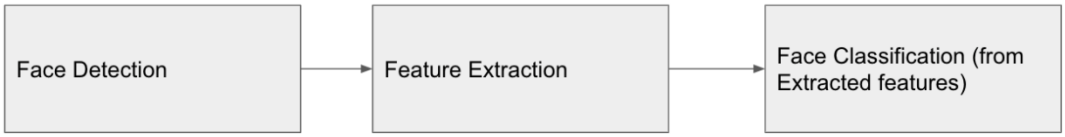


Figure 3—1 WorkFlow of Facial Recognition

Face recognition systems work by capturing a a two-dimensional or three-dimensional image from a camera device. after that, it compares the relevant information of the image in real-time with photos or/and videos in a database, makes it more reliable and secure than the information obtained from a static image. This biometric facial recognition process requires an internet connection, and it analyses mathematically the incoming image without error margin, and then verifies that the biometric data to match the person who must use the service or is requesting access to an application, system, or a building.

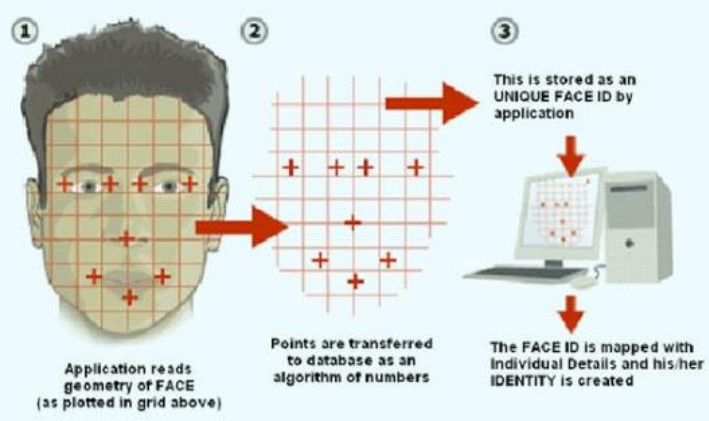


Figure 3—2 Facial Recognition.

3.2.3 The Mechanism Used

The system that we're going to use in our cheating detection project is based on Facial Recognition Technology, which means that students' faces will be identified or verified by this technology. Also, it captures, analyzes, and compares patterns based on the student's facial details.

Our system for online examination uses face recognition to detect cheating by group attendance of students to try to spot if an examinee is looking far to the right or left for reading something not on their computer.

This picture shows the steps which face recognition pass through it.

Figure 3—3 Steps of Facial Recognition

3.3 System Features

The cheating examination system in electronic exams has several features:

1. The system allows the admin a set of monitoring options to know the student's status immediately within the exam, and these cases are:
    - If the student is defined in the system.
    - If the student is not defined in the system.
    - If the student is absent from the exam.
    - If there is more than one person on the same computer.
    - If the student turned his face right or left.

These are the five cases supported by the program and scanned immediately in the database.

2. The system uses face recognition, and at the same time the examination system is within the program, as well as correction programs,

displaying marks and detecting cheating all of this are exist and defined in one program, instead of each task having a program alone.

3. The program is easy to use, and the student does not need any explanations or prior training about how to use the program.
4. The program does not need setup, only you have to copy the program and put it on any computer, then works without defining files or setting up or others.
5. The file size is approximately 70 KB, it runs on any windows operating system, regardless of the capabilities of the computer.

3.4 E-Exam Cheating Detection System Architecture.

E-exam detection system is a program that establishes a connection between the E-learning institute and the students. Institute's instructors upload to the program the questions of the exam.

The work of E-exam detection system can be divided into two phases as depicted in Figure 3.5. The first phase is before being allowed to attend the E-exam session in this phase, username/password and Faceprints must be used to validate the examinee. Face Recognition is used during the E-exam session to ensure that the examinee is who they claim to be.

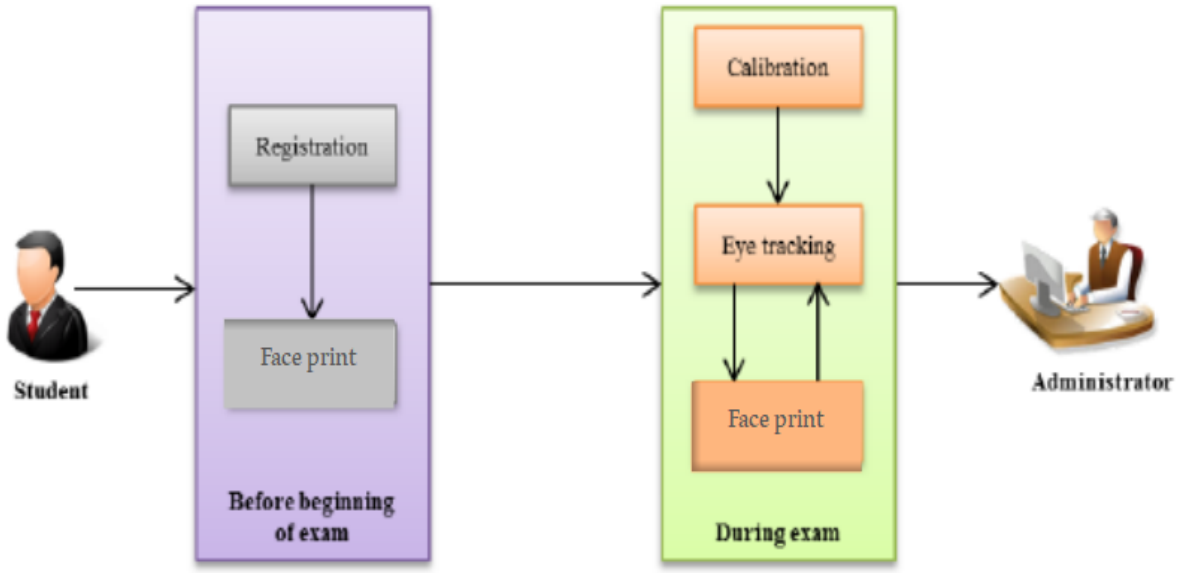


Figure 3—4 E-Exam Cheating Detection System Architecture

3.5 Libraries and Software

- Visual Studio: used to implement face recognition functions, question bank, monitoring, training, and the online-exam system.
- Wamp Server: used to create and host the online database that contains all information and records about the students.
- OpenCv: used for image processing and face features extraction.
- SQL: used to make a reliable connection between visual studio and wamp server.
- EMGU-CV: used for image processing.
- System. Drawing: used to design the GUI pages of the software.

3.5.1.1 GUI Pages of the Software

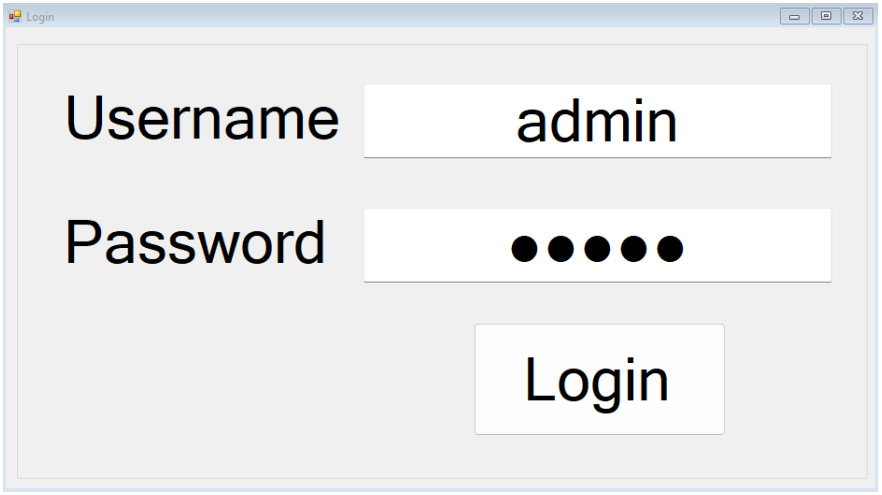


Figure 3—5 Login Page.

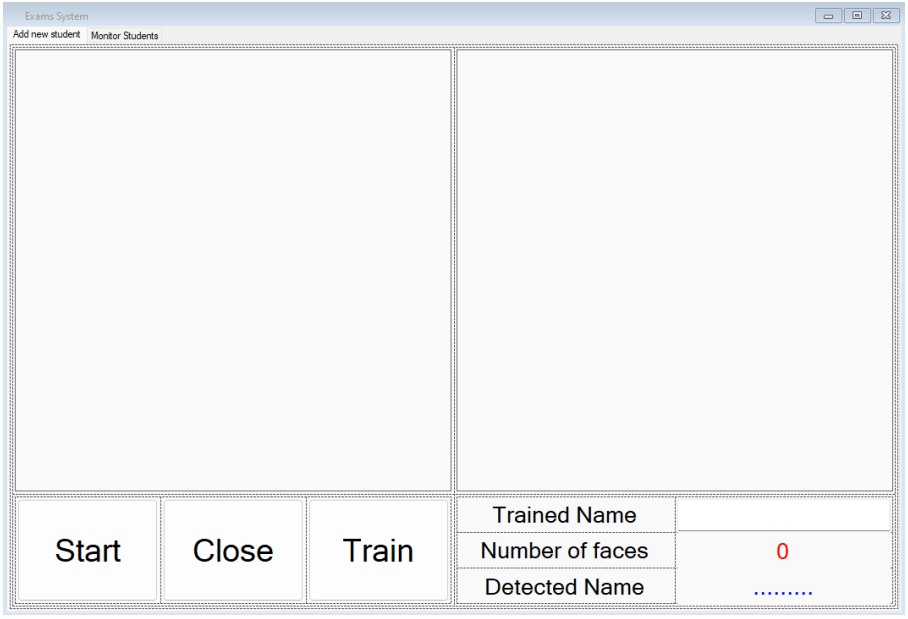


Figure 3—6 Admin Page.

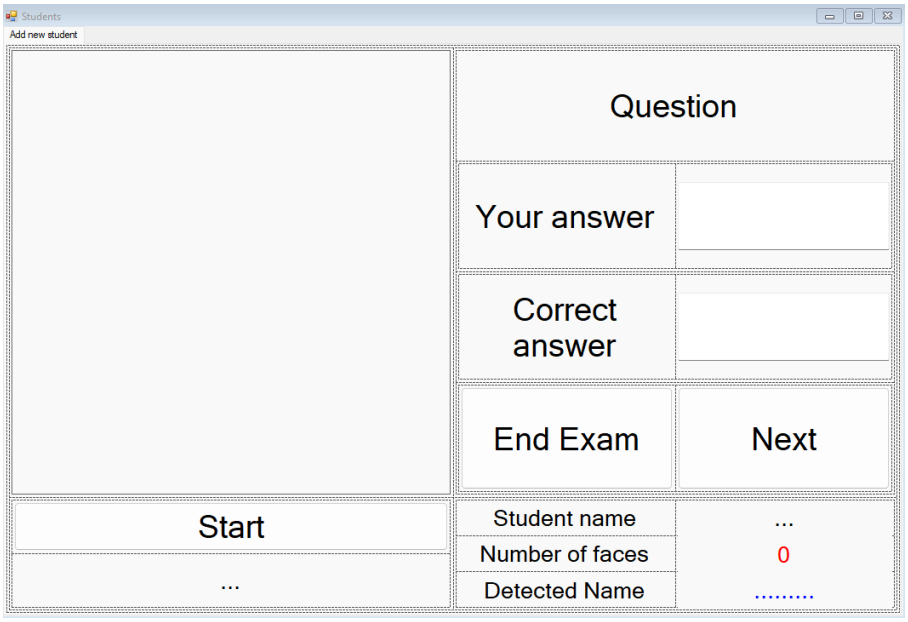


Figure 3—7 Student Page.

3.5.2 Technique of E-Exam Cheating Detection System

E-Exam detection system that we discussed in this research consists of several modules that can perform the functions of the system. Figure 3—8 demonstrates the flowchart of the algorithm of the E-Exam Detection System.

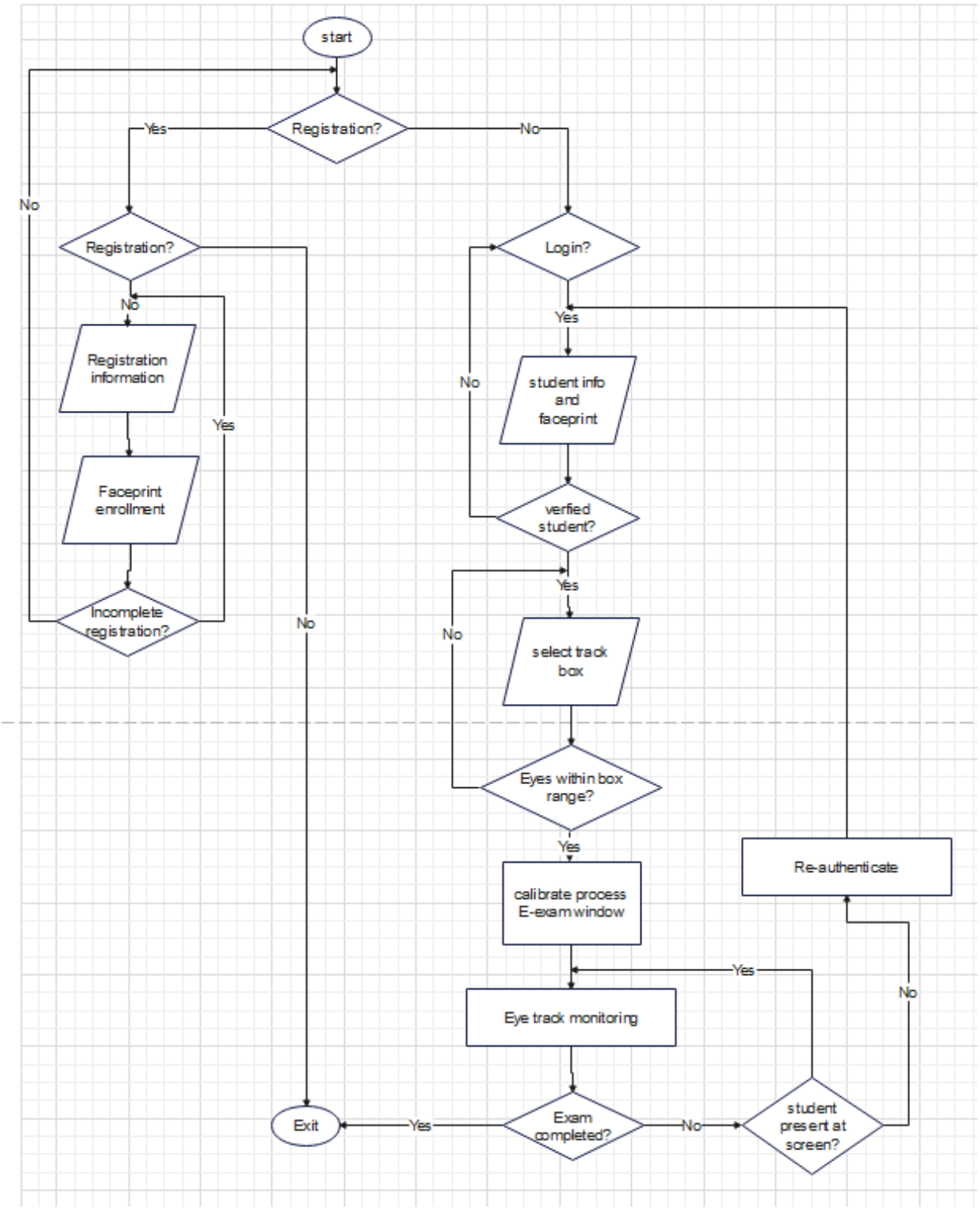


Figure 3—8 Flowchart of the Algorithm of the E-Exam Detection System.

3.5.3 Use case Diagram of E-Exam Detection System

Using a case diagram that describes a set of actions that an E-exam detection system can perform in collaboration with two actors; a lecturer and a student.

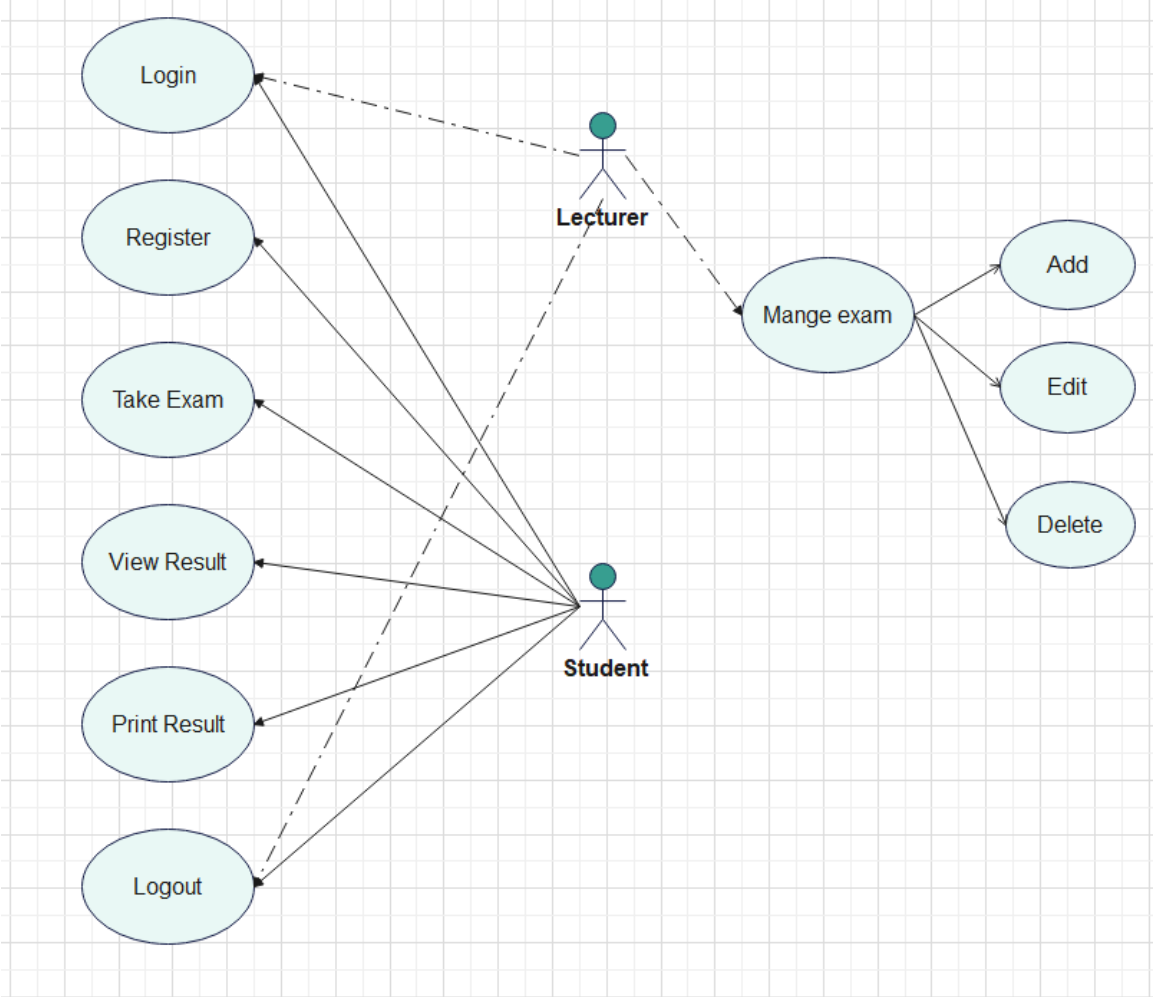


Figure 3—9 Use Case Diagram.

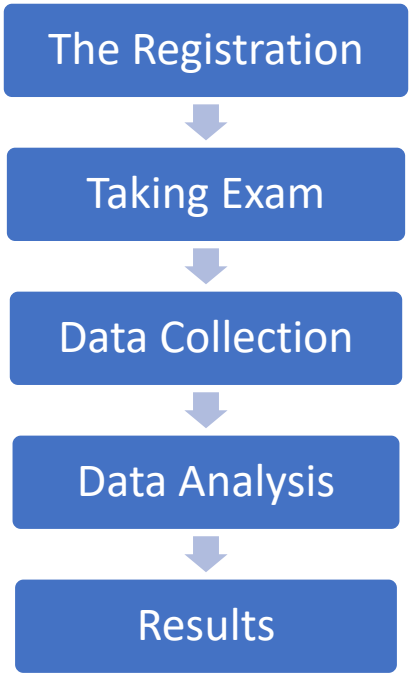
Chapter 4:

The Methodology of the Model

4.1 introduction

The proposed method of E-exam cheating detection system is used to detect any attempt of cheating in exams. In this experiment, we used a Faceprint reader for continuous authentication examinee.

Below, a figure illustrates the process of implementing the model:



4.2 Registration

The system user must create an account and provide their username, password, and Faceprint. After registration, the examinee is able to enroll by the Faceprint to the system.

- Enrollment by Faceprint

  When building an enrollment Faceprint in system, the data flow consists of:

1. Capture a Faceprint Image (scan) from the camera of the device. The resulting Faceprint Image Data (FID) contains one or more Faceprint images, called Faceprint Image Views (FIVs).
2. Extract the Faceprint features. During extraction, Faceprint Minutiae Data (FMD) is created, with each Faceprint stored in a Faceprint Minutiae View (FMV) in the FMD. FMDs are used for identifying users within a collection as well as validating specific users.

The image below shows how the program recorded the number of faces that were shown on the camera after the registration.

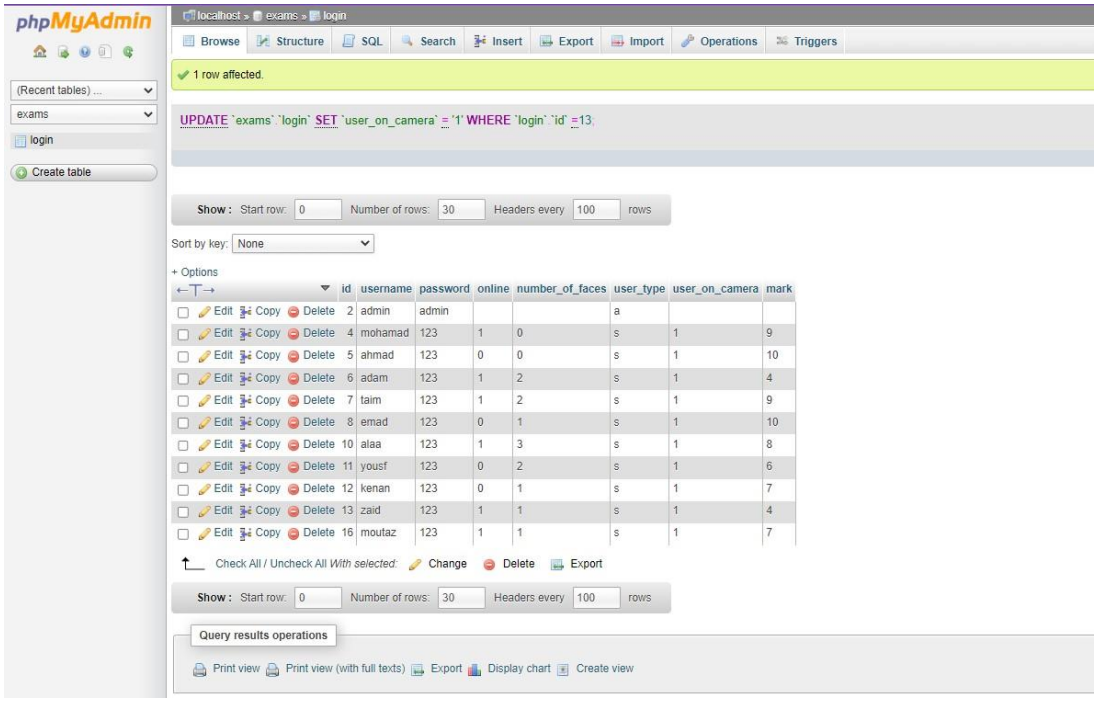


Figure 4—1 Show No. of Faces After Registration

4.2.1 Training

The implemented software depends on facial face recognition algorithm which depends in turns on a training phase. The training process must be done manually by the admin of the system during registering a new user. The admin takes multiple photos for each new student with different orientations and positions to ensure that they system will recognize the student in all positions. In this phase, the photos are stored in a local storage system using grey-format, while the list of names are stored in a local-host database. For simplicity, the list of the names is stored in a text-file to simplify the process of storage and recovery.

4.2.1.1 Features extraction

When the train process is done by the admin, the software will extract the most important features of the trained face such as the relative distance between the eyes, relative radius to area, etc. The extracted features are stored automatically in a built-in database of the implemented software with a unique ID connected to the list of the names and stored photos.

4.3 Taking the Exam

In this phase, the examinee must be located within the tracker's trackbox, which is a graphical component that illustrates an examinee's position relative to the screen. After calibration, the examinee will be ready for the authentication process.

Figure 4—2 Trackbox

When any student starts the exam, the software will continuously extract the same features and compare them with the stored features to recognize the name of the student. When an initial match is detected in the extracted features, the system will recall the stored photos of the recognized student to guarantee the best possible matching between extracted features, stored features, and stored photos.

4.3.1 Questions and Exams

For simplicity, multiple questions and answers were added to the software as a case study to validate the reliability of the implemented system. These questions are stored in a que and the software selects the questions randomly like a question-bank.

When the question appears to the student, the software recalls the stored solution, and when the student submits his answer, the answers will be compared automatically. During this time, the program keeps monitoring the face of the student, number of faces, the orientation of the face and multiple

extra observations. If any abnormal action is done by the students, the system will automatically record this action and store it in SQL database.

4.4 Data collection

SQL database is used in this project to store the data of the students including their names, IDs, grades, and login information. In addition, all data captured during the exam includes the face of the student doing the exam, number of faces, the orientation of the face, the number of times and duration an examinee looks away from screen, and multiple extra observations. These records can be accessed by the system’s admin and teachers to judge and monitor if there are any abnormal actions by the student.

Chapter 5:

System Evaluation and Outcomes

5.1 Introduction

In the previous chapter, the methodology for the suggested system has been pointed out. In this chapter, we will analyze the system for enhancement, and figuring out the user requirements for the system. And we will discuss the result that we reach to.

5.2 System Analysis

The analysis of the proposed system is the stage where the author distributes questions in a form of questionnaires, explaining the requirements of the system as functional and non-functional requirements.

5.2.1 Functional Requirements

Functional requirements are the description of the feature requirement that are related to what the system should provide for users, which, describe an interaction between the system and its environment. Functional requirements include a description of the required features, provision of associated online reports or queries as well as a detail of data to be held in the system description what the system must do and the steps to be taken to perform an action. However, Online Examination system is a system that must be capable of allowing users to take exam online, logging in and out of the system, checking and reviewing their results, among other functions; all these features are considered as functional requirements.

5.2.2 System Actors and Description

By looking at the interpretation of the user requirements that are collected from the Students of Education Group, the actors for the suggested system are as follows:

- Proctor
- Examinee

5.2.2.1 Roles of the Actors for the Proposed System

Student:

After registration, the student is a key user of the proposed system; the following are the functions a student can perform:

1. Preview results.
2. Review the profile.
3. Take exams.
4. Print results.

Lecturer:

Lecturer is the second user of our proposed system; the following are the functions a lecturer can perform:

1. Managing questions.
2. Review results.
3. Detect cheating.
4. Feedback.

Actor	Functional requirement type	Description
Student	Login	A student can access the system using a valid username and password.
	Register	Enabling new students to register to the system.
	Take exam	After registering and logging into the system, students shall be able to take their exam.
	View result	Enabling students to view their results.
	Print result	allowing students to print their exam results.
	Logout	allowing students to log out from the system.

Table 5—1 Functional Requirements

5.2.3 Non-Functional Requirements

The non-functional merits of the system are not directly related to the core characteristics of the system. In general, non-functional requirements of the system are those related to implementation quality such as security and

usability which can be noticed during system running; and future development such as supportability.

Following are the main non-functional characteristics of the suggested system:

1. **Availability:** In the context of cheating detection, availability refers to the uninterrupted and consistent access to the cheating detection system. It ensures that the system is always accessible for monitoring exams and detecting any cheating attempts. An available system will be operational during the entire exam period, minimizing the chances for cheating.
2. **Accessibility:** Cheating detection refers to providing equal access to the cheating detection system for all users involved in the examination process. This includes exam administrators, proctors, and students. The system should be designed to accommodate users with disabilities and provide them with equal opportunities to participate in exams without any disadvantage.
3. **Usability:** is crucial in a cheating detection system to ensure that it is user-friendly and intuitive. A well-designed user interface will facilitate efficient monitoring and analysis of exam data, making it easier for administrators and proctors to identify potential cheating behaviors. Intuitive controls and clear instructions will help users navigate the system effectively.
4. **Performance:** is important in cheating detection to ensure that the system can handle a large volume of exam data and process it quickly and accurately. A high-performance system will be able to

analyze exam data in real-time or with minimal delay, allowing for prompt detection of cheating incidents.

5. **Reliability:** Reliability is essential for a cheating detection system to identify cheating behaviors consistently and accurately. A reliable system will have minimal false positives and false negatives, ensuring that genuine cheating attempts are flagged while avoiding unnecessary disruption to honest students. Reliability also ensures that the system operates consistently and without errors during the exam period.
6. **Extensibility:** Extensibility is relevant to cheating detection systems as it allows for the incorporation of new cheating detection techniques or enhancements. An extensible system can adapt to changing cheating methods and provide ongoing improvements to combat new forms of cheating. This flexibility ensures the system remains effective and up to date in detecting emerging cheating techniques.
7. **Supportability:** Supportability is important for a cheating detection system to provide technical support and assistance to users. This includes prompt responses to user inquiries, effective troubleshooting, and maintenance to ensure the system operates smoothly during exams. Adequate supportability helps administrators and proctors address any issues that may arise during the cheating detection process.
8. **Operational:** Operational aspects focus on the efficient operation of the cheating detection system within the exam environment. This includes factors such as system administration, monitoring, and resource management to optimize the system's performance during

exams. Proper operational practices ensure that the system operates smoothly and effectively, enhancing its ability to detect cheating.

9. **Security:** is critical in a cheating detection system to protect the integrity of exam data and prevent unauthorized access or tampering. The system should have robust security measures, including authentication mechanisms, encryption, and access controls. These measures safeguard the confidentiality, integrity, and availability of exam data, ensuring the system is resistant to hacking or manipulation.
10. **Backup:** Backup procedures are essential in a cheating detection system to ensure the availability and recovery of exam data in case of any system failures or data loss. Regular and systematic backups of exam data will minimize the risk of losing critical information, providing a means to restore data and maintain the continuity of cheating detection operations.
11. **Interoperability:** Interoperability is relevant in a cheating detection system to facilitate integration with other exam management systems or data sources. Seamless data exchange and compatibility with different platforms or systems enable the sharing of relevant information, enhancing the overall effectiveness of cheating detection efforts.
12. **Documentation:** Documentation is crucial in a cheating detection system to provide clear instructions, guidelines, and reference materials for administrators and proctors. Comprehensive documentation enables users to understand and effectively use the system's features, functions, and troubleshooting procedures. Well-

structured documentation supports the proper usage and maintenance of the cheating detection system.

Actor	N-Functional requirement type	Description
Lecturer	Login	Enabling lectures to log into the system as lectures/admin privileges user.
	Register	Lecturers have the ability to register to the system.
	Manage Exam (Add/Edit/Delete)	A lecturer can perform adding, editing and deleting questions related from the system.
	Logout	The lecturer can log out of the system.

Table 5—2 Non-Functional Requirements

5.3 Results

In this table, the result of the examination student's case will be determined, either cheating or not cheating, based on comparing the number of times a student looked outside the screen and the time spent.

And to complete this, the test will be conducted on 50 students as the table below explains.

5.3.1 Experiment Description

We suggest the location to be in a lab that contains 10 Laptops for fifty students seeking various kinds of disciplines. five sessions, each session takes fifteen minutes to complete.

5.3.1.1 Equipment

The lab will be pre-equipped with PC devices that contain webcams and a server to collect a database.

5.3.1.2 The participants

The participants will be 50 school students those age about 9-12 years.

5.3.1.3 The scenario

The students will be asked to sign up for an account, take exams to a variety of questions.

5.3.2 System Test

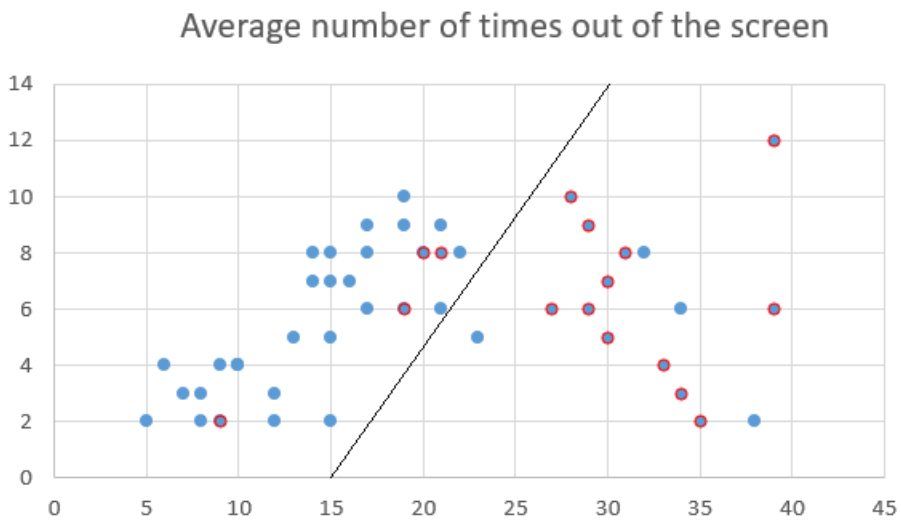


Figure 5—1 Scattered plot of 50 Samples for Test with a Separation Line

Mathematically, a slope of a line is the change in y coordinate with respect to the change in x coordinate.

The net change in y-coordinate is represented by Δy and the net change in x-coordinate is represented by Δx.

Hence, the change in y-coordinate with respect to the change in x-coordinate is given by,

m = change in y/change in x = Δy/Δx

Where “m” is the slope of a line.

The slope of the line can also be represented by

tan θ = Δy/Δx

So, tan θ to be the slope of a line.

Generally, the slope of a line gives the measure of its steepness and direction. The slope of a straight line between two points says (x_1,y_1) and (x_2,y_2) can be easily determined by finding the difference between the coordinates of the points. The slope is usually represented by the letter 'm'.

Slope Formula

If $P(x_1,y_1)$ and $Q(x_2,y_2)$ are the two points on a straight line, then the slope formula is given by:

Slope, m = Change in y-coordinates/Change in x-coordinates

$$m = (y_2 – y_1)/(x_2 – x_1)$$

Therefore, based on the above formula, we can easily calculate the slope of a line between two points.

In other term, the slope of a line between two points is also said to be the rise of the line from one point to another (along y-axis) over the run (along x-axis). Therefore,

Slope, m = Rise/Run

Slope of a Line Equation

The equation for the slope of a line and the points also called point slope form of equation of a straight line is given by:

$$y - y_1 = m(x - x_1)$$

Whereas the slope-intercept form the equation of the line is given by:

$$y = mx + b$$

Where b is the y-intercept.

x-axis is presented by t. The y-axis present n. So the line equation is given by:

$n = m\,t + b$

Let t be the exam time and n be the number of times out of the screen, then the equation of the line is:

$$n = m\,t + b$$

Where m is the slope of the line and b is the intercept. They can calculate as follows.

$$m = \Delta n/\Delta t = (14 - 0)/(30 - 15) = 0.933$$

$$b = n - m\,t = 0 - 0.933 * 15 = -14$$

Therefore, the equation of the line is:

$$n = 0.933\,t - 14$$

Any sample s (ts , ns) can be classified using equation 4 as follow:

$$S \in \{\ non - cheating \quad if\ ns - 0.93\,t + 14 > 0$$

$$Cheating \qquad if\ ns - 0.93\,t + 14 < 0\ \}$$

By other words, if the point position in the left side of separation line, then it can be considered as non-cheating case. So, if the point position in the right side of separation line, then it can be considered as cheating case.

The confusion matrix given by:

	Predicted No	Predicted Yes
Actual No	25	4
Actual Yes	4	12

Table 5—3 The Confusion Table.

Therefore, $TN = 25, FP = 4, FN = 4, TP = 12$ and. In addition, the performance of the Table is measured as follows:

The performance results in the previously mentioned table are measured as follows:

1. The Sensitivity: This measurement is used to indicate the positives as follows: =

$$TP / (TP + FN) = 75\%$$

= This measurement is used to indicate the negatives as follows:

$$TN / (FP + TN) = 86.2\%$$

· Precision which means Positive Predictive values. $= TP / (TP + FP) = 75\%$

· Accuracy This measurement is used to indicate the True Value as follows:

$$= (TP + TN) / (TP + TN + FP + FN) = 74\,\%$$

· F-measure: This measurement is used to indicate the merge of precision and sensitivity which is: $= 2 * TP / (2 * TP + FN + FP) = 75\%$.

Chapter 6:

Conclusion and Future Work

6.1 Introduction

In the previous chapter, which is considered the most important part of this research as it contains the results. In this chapter, we summarize the results of the previous chapter.

6.2 Conclusion

In this research we have discussed the issue of cheating in e-exams through deploying the concept of cheating and studying the cases related to our main subject. As a result of this research, we reached a technique to reduce cheating cased in e-exams.

This research suggests building a system to manage e-exams through preventing and detecting cheating in e-exams by performing a continuous authentication and an online proctor by using Face recognition to authenticate the examinee.

This system has been developed using Java programing language as well as SQL Server Data base. result, we can classify the examinee status as cheating or non-cheating according of two parameters: the total time the examinee is on out screen and the number of times the examinee is out of screen. The approach that is proposed in this research is a novel technique applied in the E-exam management systems.

To evaluate this proposed work, a series of experimental test conducted.

In the previous chapter, which is considered the most important part of this research as it contains the data that concluded from the experiment. The data was analyzed and studied mathematically to calculate the accuracy and efficiency of the system. While the human overwatch is considered, the

accuracy was calculated. A group of 50 students represent the sample of the experiment. Separation line between cheating and non-cheating cases is presented mathematically.

The research has been conducted through two levels, the first level was conducted as a trial and the second level as performed as a test. In the test level, we obtained the following results:

The tests yielded the following results: sensitivity is 100%, specificity is 60%, precision is 71.4%, accuracy is 80 %, and f-measure is 83.3%.

6.3 Future Work

There are several ways that might be used to expand this work; Fingerprint could be used to access the system; this system could be implemented using internet instead of an application. Vocal print could be merged with the system.

Summary

With the spread of the internet and technology over the past decades, e-learning has been growing rapidly day by day. Online exams are an essential and fundamental component of e-learning. because of students' ability to cheat easily during electronic exams.

This dissertation looks at methods used by a student to cheat on exams (E-Exam) In this thesis, we built an electronic exam management system that can detect cheating in the E-Exam. The work of this system can be divided into two stages, the first before an examinee being allowed to attend a session, uses a Faceprint, a username and a password to authenticate the examinee. The second stage is a continuous authentication which ensures that the authorized person is only the test taker throughout the entire exam session.

In this research we have discussed the issue of cheating in e-exams through deploying the concept of cheating and studying the cases related to our main subject. As a result of this research, we reached a technique to reduce cheating cases in e-exams.

This research suggests building a system to manage e-exams through preventing and detecting cheating in e-exams by performing a continuous authentication and an online proctor by using Face recognition to authenticate the examinee.

we can classify the examinee status as cheating or non-cheating according of two parameters: the total time the examinee is on out screen and the number of times the examinee is out of screen. The approach that is proposed in this research is a novel technique applied in the E-exam management systems.

To evaluate this proposed work, a series of experimental tests has been conducted. The implemented software depends on facial face recognition algorithm which depends in turns on a training phase. The training process must be done manually by the admin of the system during registering a new user. The admin takes multiple photos for each new student with different orientations and positions to ensure that the system will recognize the student in all positions. In this phase, the photos are stored in a local storage system using grey-format, while the list of names are stored in a local-host database. For simplicity, the list of the names is stored in a text-file to simplify the process of storage and recovery.

ملخص

مع انتشار الإنترنت والتكنولوجيا خلال العقود الماضية، شهد التعليم الإلكتروني نموًا سريعًا يومًا بعد يوم. تعتبر الاختبارات عبر الإنترنت عنصرًا أساسيًا في التعلم الإلكتروني. بسبب قدرة الطلاب على الغش بسهولة أثناء الامتحانات الإلكترونية.

تبحث هذه الأطروحة في الأساليب التي يستخدمها الطالب للغش في الامتحانات (الامتحان الإلكتروني) لذلك قمنا ببناء نظام إلكتروني لإدارة الامتحانات يمكنه اكتشاف الغش في الامتحان الإلكتروني. يمكن تقسيم عمل هذا النظام إلى مرحلتين، الأولى قبل السماح للممتحن بحضور الجلسة، ويستخدم بصمة الوجه واسم المستخدم وكلمة المرور للتحقق من صحة الشخص الممتحن والمرحلة الثانية من خلال التحقق المستمر الذي يضمن أن الشخص المخول هو فقط المتقدم للاختبار طوال جلسة الامتحان بأكملها

لقد تناولنا في هذا البحث مسألة الغش في الامتحانات الإلكترونية من خلال نشر مفهوم الغش ودراسة الحالات المتعلقة بموضوعنا الأساسي. ونتيجة لهذا البحث توصلنا إلى تقنية لتقليل حالات الغش في الامتحانات الإلكترونية.

يقترح هذا البحث بناء نظام لإدارة الامتحانات الإلكترونية من خلال منع واكتشاف الغش في الامتحانات الإلكترونية من خلال إجراء مصادقة مستمرة ومراقب عبر الإنترنت باستخدام التعرف على الوجه لتوثيق الممتحن.

يمكننا تصنيف حالة الممتحن على أنها غش أو عدم غش وفقًا لمعاملين: إجمالي الوقت الذي يكون فيه الممتحن خارج الشاشة وعدد المرات التي يكون فيها الممتحن خارج الشاشة. إن المنهج المقترح في هذا البحث هو أسلوب جديد مطبق في أنظمة إدارة الامتحانات الإلكترونية.

لتقييم هذا العمل المقترح، تم إجراء سلسلة من الاختبارات التجريبية. يعتمد البرنامج المطبق على خوارزمية التعرف على الوجه والتي تعتمد بدورها على مرحلة التدريب. يجب أن تتم عملية التدريب يدوياً من قبل مسؤول النظام أثناء تسجيل مستخدم جديد. يقوم المشرف بالتقاط صور متعددة لكل طالب جديد بمختلف التوجهات والمواقف للتأكد من أن النظام سيتعرف على الطالب في جميع المناصب. في هذه المرحلة، يتم تخزين الصور في نظام تخزين محلي باستخدام التنسيق الرمادي، بينما يتم تخزين

قائمة الأسماء في قاعدة بيانات مضيف محلي. للتبسيط، يتم تخزين قائمة الأسماء في ملف نصي لتبسيط عملية التخزين والاسترداد.

سيقوم البرنامج باستخراج أهم ميزات الوجه المدرب مثل المسافة النسبية بين العينين، ونصف القطر النسبي للمنطقة، وما إلى ذلك. ويتم تخزين الميزات المستخرجة تلقائيًا في قاعدة بيانات مدمجة للبرنامج المنفذ بمعرف فريد متصل بـ قائمة الأسماء والصور المخزنة. عندما يبدأ أي طالب الاختبار، سيقوم البرنامج باستمرار باستخراج نفس الميزات ومقارنتها بالميزات المخزنة للتعرف على اسم الطالب. عند اكتشاف تطابق أولي في الميزات المستخرجة، سيقوم النظام باستدعاء الصور المخزنة للطالب المعترف به لضمان أفضل تطابق ممكن بين الميزات المستخرجة والميزات المخزنة والصور المخزنة.

إذا قام الطلاب بأي إجراء غير طبيعي، فسيقوم النظام تلقائيًا بتسجيل هذا الإجراء وتخزينه في قاعدة بيانات SQL.

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