Development of multiple computer-based testing system using open source programing model

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Abstract. The traditional methods of examination process is often characterized by human errors, question leakage and recording of score. In this study, the active application for generating multiple exam modules based on different types of e-exams have been presented. The first user is the instructor who submits the required exam questions based on suitable scores and different evaluation scales. The final user is the student who can find many selected e-exam modules by using PC screen interface. An Immediate scoring system can follow the final score. The used tools in the present system involves a Hypertext Markup Language (HTML), Visual Basic 6 language and MySQL correlated with oracle and system implementation. Many types of e-exam are considered such as True & False, answer in one word multiple choices, matching between words in two columns and dragging into the screen. The system has been tested successfully based on multiple e-exam modules. The result of this system observed an efficient examination process due to robust generating and managing tests and less human error in the condition of multi-student with multi-lecturer.

Keywords. Data Access Object (DAO), Computer Based Examination System (CES), examination system design, e-learning, digital learning

1. Introduction

Computer based Examination System (CES) is very important due to time saving mode, immediate scoring, efficiency and quick feedback of multiple-choice question exams. It is considered an effective solution to test and evaluate huge number of students based on Internet capabilities. This method offers to the student the opportunity to enhance their productivity and efficient time management when answering questions. CES is a very useful tool to set the same students test conditions for all participants [1]. CES features include offering different exam formats, keeping student exam questions and responses in the databases and the ability to create randomized questions with question banks. This method can improve the efficiency of academic institutions. It reduces the stationeries and labor cost and improve the forms of questions types by making the test questions more diverse [2]. Computer based Examination involves various automated examination systems. They are developed with one or more limitations such as lack of flexible timing functionality, lack of scalability, lack of robustness and near-reliability [3, 4].
The software provides the following test options: one, or multiple choices, drag and drop, matching, true / false, or fills in the blank with one word. It can be used as a module in an e-learning platform. Such platforms are used more often nowadays by schools and universities. The nature of technology is that, everything becomes almost transparent once it is rooted in every autonomous college. E-exam is very useful tool to have transparency, reliability and efficiency in autonomous college examination system [5]

The present information technology means of examining students is the use of electronic systems in place of manual or paper method which was characterized by massive examination leakages, impersonations, demand for gratification by teachers, bribe-taking by supervisors and invigilators of examinations [6]

The new technologies gave birth to the current use of the e-examinations powered by the computers and other physical Information Technology (IT) products such as microcomputers, mainframe computers, the Internet, mobile phones. Technology can further be described as a process because it involves series of actions that could lead to the achievement of a successful conduct of e-examinations [7]

In this paper, the developed software is use for the Computer based Examination System allowed to create powerful, flexible and multiple online exam system.

The present work involves a methodology and system design, teacher and student process work flow, the used languages such as Hypertext Markup Language (HTML), Visual Basic 6 language and MySQL correlated with oracle and system implementation. The result of this system observed an efficient examination process due to robust generating and managing tests and less human error in the condition of multi – student with multi – lecturer.

2. Related Works
Numerous similar systems exists today, such systems are designed to suit the needs of a particular university with a predefined strength of student's related works to the project are listed below:

Horea lustin in 2004 prepared a paper for multiple choice examination system. He used database design and implementation for General Chemistry. This research presents the main aspects and the implementation of the classification system, database design and software implementation of multiple choice examination system for general chemistry in order to generate student evaluations tests [8].

Ayo et al, in 2007 proposed a model for e-Examination subjected to online entrance examination. This model was designed and used in Covenant University and they found that the system has the potentials to minimize the problems that are associated with the examination traditional methods [9].

Fluck et al, in 2009 proposed a case study examination system using computational instruments. This study proposed a new system using a customized an open source version of live CD. The new system provide e – Examinations to be applied securely on laptop computers of the user and was supervised without specialist skills of information technology [10]

Temitayo et al, in 2013 proposed a Computer – Based System for tests applied in the examination of University Academic Enterprise. This work is a web-based online examination system application. The system is designed to facilitate and manage the processes of examination and provide the result report. The conceptual design presents the Use Cases and the Model of Entity Relationship (ERM) and the Data Flow Diagram (DFD).

The programming tools were Microsoft Visual Studio 2012, Hypertext Markup Language (HTML) and Microsoft SQL Server as a database backend. The model performance observe a high flexibility, robustness and reliability with easy to use graphical user interface. [11]

Archana et al, in 2013 developed an effective computer examination system for academic use. The system used Net Beans IDE 7.2 and Java Servlet Pages (JSP) as an integrated development environment and MySQL as the database back end as a programming tools [12]

Mustafa Yagci in 2014 designed online adaptive exam application which determine a different specific question sets automatically for each student and measure their efficiency. The proposed model prevents the student's confusion while answering questions [13]
Jiang in 2015 proposed a collage Japanese examination system using online UML. This work studied the Japanese education and teaching requirements, then carrying on the examination by using UML. Finally, a specific database have been implemented based on the system requirements. This system ply a positive role in improving the Japanese teaching level and management information level [14].

Michael Ajinaja in 2017 used component-based software engineering to implement a computer based testing system. This work used a central computer as a server to supply and store the questions [15]

Singh in 2016 developed a computer based examination system security to facilitates and manage the examination process for any type of examination such as academic institution, company and school. The examiner can use multi-language questions in the test [16].

Ejim Samson in 2017 applied a computer based examination system in Cisco Training Centre. He provides solutions of the identified challenges in the existing system. The system was designed based on OOAD methodology and implemented by applying rapid PHP IDE in additional to Windows 10 [17].

Manurung et al, in 2019 developed a Computer Based Test (CBT) System for online student academic examination. The proposed system is developed to facilitate and manage the examination processes based on the surrounding challenges. The Model design of this system is adopted from Thiagaraja which involve four – D model: (1) define, (2) design, (3) development, (4) disseminate. The aim of this study is create computer based test system for student examination and showed the affectivity of the system. [18]

3. Methodology and system design

The present methodology is used to enhance e-examination to improve the distance learning effectiveness. The application in this work is developed using different programming models. The computer is acting the system operation as a medium for teachers to construct and manage the test and students to take the exam. For front-end interface, the Visual Basic 6 language has been used. HTML has been used for web-document design and MySQL is used for database design. The system component will be discussed in the following sections.

A. Visual Basic 6

In order to implement a user interface, the Visual Basic 6 has been used to create a graphical user window to simplify the user applications. The specific assumptions to build this window are:

i. It must be able to integrate the developed environment.
ii. The concept of system development must be the same.
iii. The windows elements must be readable and clear.
iv. Able to connect with the internet and to call explorer.
v. Visual Basic 6 data access object DAO must use.

Visual Basic 6 data access object DAO enable to manipulate the database structure. The DAO properties are defined by Microsoft Access database which includes the access database engine [19]. Due to multiuser environment, the system design environment involves the ability to update the account and control the transaction fails [20]. Visual Basic interface developed to serve the examination system and linked with the HTML.

B. HTML

Hypertext markup language HTML is the specific code which enable the browser to read the document online. This code developed for multiple accesses of the examination files. The functional codes prepared to handle simultaneous readers using file locking function as a tool to control the multiuser processes [21,22].

C. MySQL

MySQL is a simple, powerful features, open-source and multiuser access database [23]. The essential system design specification is to build the exam questions and selection processes from the questions based on tier of database and random selection capability. MySQL database must be performed based on high security and time saving operation. This task randomize the pattern of the set of question [24, 25].

D. Oracle database
Oracle database is a relational database management system that used for object oriented features implementation. It has extended to object relational model which is able to store complex models in relational database [25]. In the present work, implementing oracle with MySQL helps to manage the data explosion. The rapid data access growth due to multiusers of examiners and students cause an increment in database scalability, security, performance and availability.

Based on the presented languages, the authors implement the proposed system to use it in multiusers condition. The next step will present the system implementation.

4. System implementation

This work involves performing the design and implementation of software package written with Visual Basic 6 language and linked to a database using the instrument DAO. The aim of this work is to build a program to conduct electronic exams. The database of the present system involves two parts, the first part is the questions storage which prepared by the teachers. The second part belongs to the student that doing the exams by using this program and the responses. The study objective is to extend a standard e-exams application to the form of a multiusers. The steps to implement the system are:

i. Design a database that can schedule each type of questions, and a timetable for the set of questions that are randomly selected for each examiner, as well as a table for each examiner to conduct the exam which involves a private information.

ii. Specify the private part for lecturer. In this step, the interface window will be designed and developed based on the presented assumptions using the visual basic program. This window monitored and controlled by the lecturer and provide to the lecturer to give the permission to the student to access the exam. It can allow to the students to feed the access information. Mainly the window is the login which is contain the name and password that is used to enter the exam. When the student's access information is matched, he (or she) will be welcomed and allowed to do the exam.

iii. The second part include the windows that used by a student which involves a link to open the exam page. The below flowcharts shown the system process.

The system scheme for overall system process shown in figure 1 and figure 2.
The system has been tested through a series of questions the teachers question bank database also, a specific real time questions used to test the flexibility and accuracy of the system. All the processes of teachers and students made it through their own windows. Also, windows illustrate the mechanism adopted in answer to the questions within the approved controls at the educational institution. The functional pages of the teachers and student windows discuss in the next sections.

5. Functional System Pages
The functional requirements of the system pages define the capabilities that a system must be able to perform successfully. The functional requirements reflect the system or component needs. The required functions provide a set of input representation, system behavior and output specifications. The functional
requirements involves data descriptions which represent the required operations of each screen and the work flow process performed on the data. The windows functions show how the system meets the examination regularity requirements. The system has a homepage which is enable the users (students, administrators and teachers) to login to execute their different operations. The teachers and student have been tested their pages, the teachers manage their questions and the random section provide the examination sheet questions. At the same time, the students provide their answers and the system determine the total marks automatically. The next sections discuss a various functional pages used in the present system.

1. The Teacher Main Screen
After the teachers login to the screen, which represent the default page of the system, the system will display the main teacher page. The system provides the sequence of possibilities:

1.1. Teacher Preparing Questions Screen
Each teacher can select the type of questions that he want to prepare and save it in a database.

![Figure 3. preparing teacher examination page.](image)

Also, the teacher can prepare a true/false questions as shown in figure 5.

![Figure 4. selecting question type.](image)
1.2. Selection Questions Screen
In this page, the teacher prepares the questions from type such as answers with one word. Also, there is another type of questions is called the matching.

![Figure 5. true/false preparing questions.](image)

![Figure 6. preparing the answers, a) choice answers, b) matching question.](image)

Also, the system can provide multi choices question or filling with one word questions as shown in figure 7.

![Figure 7. answer types, a) multi choices question screen, b) one word questions.](image)

1.3. Drag and Drop Questions Screen
The system provide the teacher the capability to drag and drop questions. The drag and drop questions include the possibility to use one answer based on multiple answers for multiple targets as shown in figure 8.
2. **Student Main Login Screen**
In the other side, the students enable to login to their own screen in real time. The system provides the sequence of specifications to the students. The student pages are clear to show how to enter their user name and password, the automatic validation will inform the teacher and the system will redirected to starting the examination.

6. **Pages Results for Student testing Screen**
After setting up the examination pages from the teacher, the student windows can provide the examination processes. Based on the teacher preparing question types, the student screen will show the same type based on real time response. All the types of question such as true/false, filling with one word, select one answer, match the question where the student can select the correct one and multi choices question as shown in figure 10.
Figure 10. types of student windows.

The system has been tested and provides all the test requirement to both of students and teachers at the same time.

7. Results and recommendations

It founds from the developed system that most of the requirements have been covered. The developed web tests model is capable to solve the associated problems based on traditional test method with the capability of using multiusers in both of tester side and student side. But the needs to evolutionary process to improve the quality in the educational process which presented in this research can be summarized in the following points:

1- Enhance the time duration based on the student answer and the specific time period for the exam, so there is a flexibility in questions selection and windows facility due to time units when the limitation is exceeded by time duration and close the system.

2- Provide the system with evaluation questions level and placed the questions in a different level of difficulty, it is added based on sub-programs to rank the question based on the evaluated difficulties.

3- Develop the database adoption within the modern systems that large amounts of questions based on the Oracle software correlated with the Visual Basic.
For future work, the present work has not achieved its full potential and there are still a lot of aspects to cover this research. For this reason the authors suggest to continue exploring the fields of semantic web and ontologies due to standardization of this research area which is not defined yet.

8. Conclusions
The growing need for fast communication makes the CES an essential tool for every university. By utilizing an efficient CES, the time and energy used to evaluate every single answer and the need to use paper is lowered. Today, most competitive exams are published on the Internet, hence the need to train students to get used to the online testing environment is vital. The CES is an excellent platform for that, the researchers aim with this work to establish a fail-safe foundation for a multi-user web-based system.

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