A Multi-form Multiple Choice Editor Exam Tool Based on HTML Website and Artificial Intelligence Techniques

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Abstract: Problem statement: The educators argue that in the post modern world changes in the nature of work, globalization, the information revaluation and today's social challenges will all impact on educational priorities and thus will require a new mode of assessment. **Approach:** The objectives of this study were to: (1) Present a novel software package tool to create multiple choice and true/false exam forms. (2) Provide exams key solutions automatically (3) Meet special instructors' needs by allowing to easily incorporating multimedia elements into the exam questions, as well as the word processor editing functions and (4) Save both instructors time and money. **Results:** The multiform exam can be created randomly from question database or manually with shuffled answers for each question. The tool was built based on website and HTML interface using the multimedia applications, two different languages English/Arabic inserted to be used on the same time, efficient Artificial Intelligence techniques and Algorithms are used. The tool had been designed, implemented and tested by experienced instructors, with the result that efficiency, accountability and saving time improved. **Conclusion/Recommendations:** The transform from paper to electronic resulted in greatly enhanced user satisfaction. Editor exam tool can be used via internet without the need to download and install it to users machine, it's a time saving system when multiple versions of random exams are required. This should highly motivated, instructors and teachers to utilize technology and IT to enhance exams and performance.

Key words: Exam editor, generator questions, key solution, multi forms, random, multiple choice exam

INTRODUCTION

With today's' increasing focus on technology in the classroom, more products and services are being offered to the educators. Computer labs have become a mainstay in almost every educational institution and both instructors and students are finding that handheld computers are useful in a variety of their daily tasks[1]. The Information Technology (IT) recently plays a semantic role in our daily life; it becomes one of the main parts of the life requirements. The number of users in the area of the information technology is increasing rapidly[2]; as a result, tremendous software package tools appeared in the last decade helping the users in various applications. New terms related to the information technology are raised recently such as e-government, e-universities, e-learning, e-exam, showing the important role of IT in the daily life[3].

The main characteristic of the education sector is the tremendous number of users that is included: Students, Instructors as well as Staff Members. Therefore, it is demanded to plan and design effective learning environments and experiences supported by information technology, in order to use technology as enhancing tool added to the instructor's performance[4]. Methods of assessment are important aspects of every course, handling assessments manually incurred major overhead in making and processing those assessments. So, in most courses, assessments or quizzes are usually kept to the minimum necessary to an accurately assessed progress or competence. With the web based classroom, it is easy to construct systems that automatically correct and handle exams and that reduce the time taken to carry out other forms of assessments. Assessments have two main purposes: To evaluate student's progress and to help students learning. Some of other uses for assessments are

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testing teaching effectiveness, encouraging educators to reflect on their teaching and material and provoking students to learn[5].

Various software tools are offered to solve various complicated problems for both instructors and students. Using electronic systems for assessment can improve the assessment process in the following ways, which are the aims of this study[6]:

Reducing and saving time: Using software tools to create and correct exams and assignments will reduce and save development and correction time. The feedback and results can be immediately returned to students. This will enable students to determine their deficiencies.

Reducing resources needed: The assessment can be electronically, created, collected and corrected, therefore, Human resources, papers and printing time will be reduced, that means saving cost and time also which is important when number of students is huge in some courses mainly in university's pre-requests.

Keeping records: Students data and correction results can be automatically stored in the database system and accessed by instructors and students any time it needed.

Increasing convenience: The ability to use the assessment with minimum effort such as creating exam, correcting exams and ease of analyzing the results will enhance the instructors and students more convenience and satisfaction.

Support two question types: Multiple choice or true/false, or both of them in the same exam.

In this study, an efficient software package tool based on Artificial Intelligence algorithms is introduced[7], it creates multi multiple-choice and true-false exams forms and automatically creates the key solutions for each form and get students' results automatically. It is what most teachers and instructors expect for. Transferring traditional exams will help teachers or trainers making interactive exams with multimedia enhancement to track exams results with insightful reports. The Editor Exam tool will support two question types, randomization of the questions and answers, import multimedia applications such as audio files and record narration for the examination, import media files to the exam, deploy the examination virtually anywhere and provide the result tracking system to collect the results automatically[8].

As the Exam Editor is found to assist the instructors to create their exams form, it also has many

facilities that the users can utilize, the major advantages of this tool are: (1) To compile exams from an existing database of questions and images, (2) To add original questions or images to the database, (3) To administer exams on paper (4) To print exams in batches with shuffled questions, (5) And finally to view, print and generate solutions sheets. The tool based on client-server network[7] which requests information from the server in order to respond to the client by acting on that request and returning results Hypertext Transport Protocol server as shown in Fig. 1.

In the client-server applications, the client interacts with user with friendly interface, allowing the user to request general services from the server and display the results from the database of the server; in updated Clients, they provide system security to verify the identity and authorization of the users before implementing their instructions.

Design and analysis:
The database system: The database system is a software package tools used frequently to manipulate and control the organization, storage, retrieval, security and integrity of data in a database. It accepts demands and request from the application and directs the operating system to move and transfer the appropriate data depends on the specific instructions. Several types of Database have been designed and implemented in the market, the main characteristics of these databases are: Data Integrity, Interactive Data Entry, Data Security, Updating and Data Independence, Figure 2 shows the main components of the database it used in this study which consists from: question, answer, exam question, exam group, course group, course, exam and admin.

Use case analysis: The use case analysis phase in general consists from two components: Functional and non-functional. The functional components are those tasks that the system should perform when it operates, while the non-functional terms are those tasks that have nothing to do directly with the functionality of the system or any tasks associated with it. On the other hand, the non-functional components include Usability,
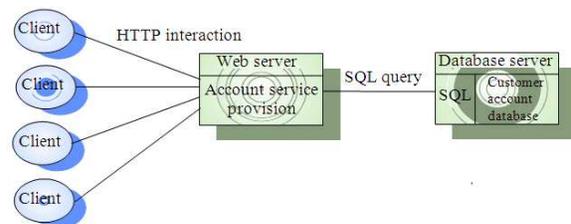
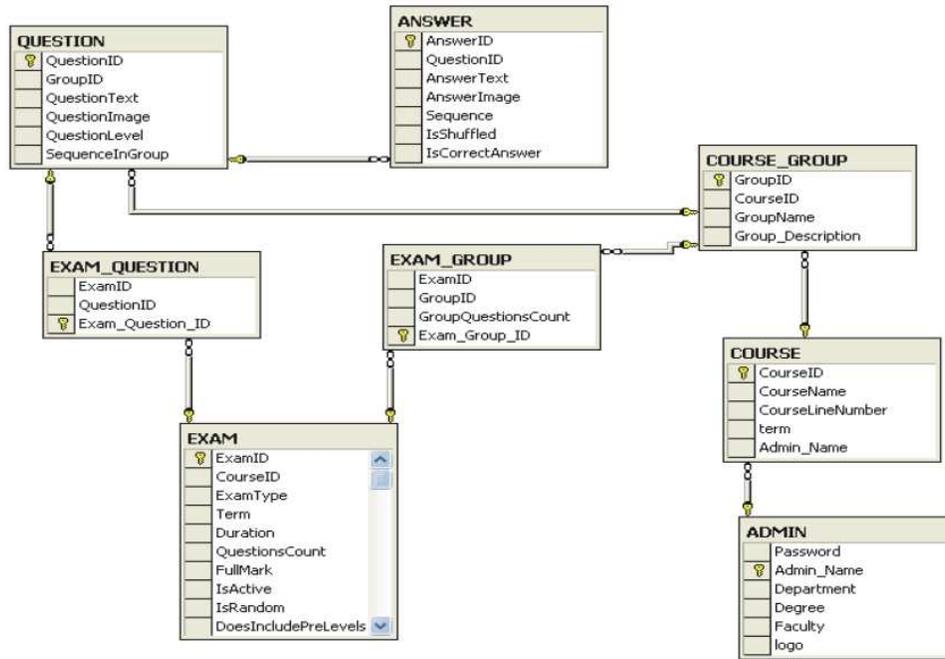

Fig. 1: Hypertext transport protocol server
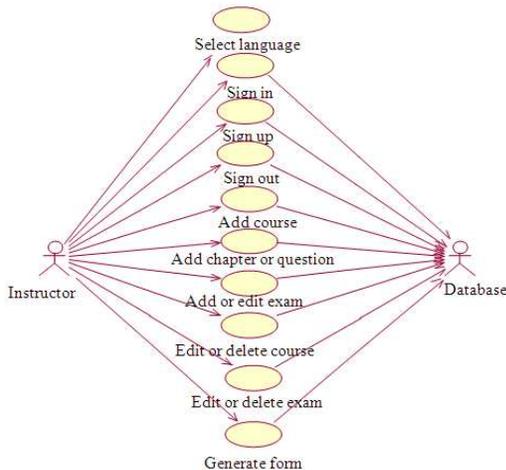
Fig. 2: Database schema and ER diagram

Fig. 3: Use case diagram analysis

Fig. 4: Exam editor: Interaction diagram

reliability, performance and supportability of the system. These terms include: Select Language, sign in, sign up, sign out, add course, add chapter or session, add or edit exam, edit or delete exam and finally generate form, as shown in Fig. 3.

The Use-Case analysis is related to those requirements since they present the Cases of the system use. The Use-Case analysis functions are: Find the actors, Find the Use-Cases, Evaluate the Use-Cases, Determine the actor-to Use-Case relationships and finally, build the use-case model diagram.
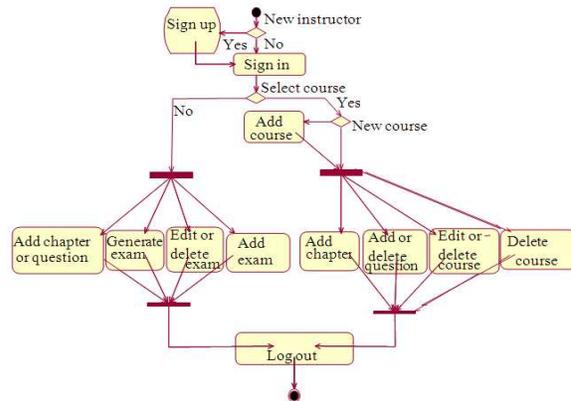
Interaction diagrams analysis: The interaction diagrams are responsible for determining the system behavior in terms of dynamic and static issues. The interaction diagrams describe four aspects: Activity diagram, Sequence diagram, dynamic diagram and collaboration diagram.

The dynamic diagram means how the system is going to interact with inner as well as the outer elements in order to achieve its functionalities while operating. The activity diagram represents the business and operational workflows of a system and it is a variation of the state diagram where the "states" represents operations and the transitions represent the activities that happen when the operation is completed, as shown in Fig. 4.
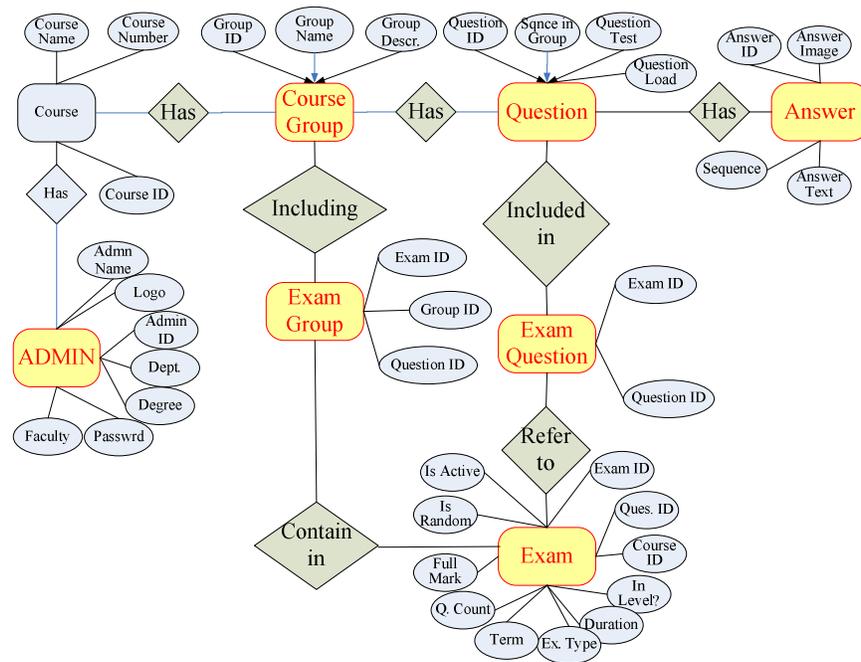
Fig. 5: Entity relationship diagram

The database application is defined as the stand-alone application program which is capable to interact with the database through database engine or driver. Here, it has been used the rational rose in the analysis and design. The rational software is a very powerful tool used in object oriented Software Development. The Unified Modeling Language (UML) is an object-oriented language for specifying, visualizing, constructing and documenting the artifacts of software systems. Figure 5 shows the entity relationship diagram of the proposed tool, using rational rose and UML[9].

The sequence diagram is the interaction diagrams, that emphasizes time order of messages passed through the system. Finally, the collaboration diagram emphasizes the organization of the objects participating in the interaction.

Design and implementation: Artificial Intelligence (AI) is a science used widely to reduce the complexity of the design and increase the operation performance, for this purpose, we interested to use Case Base Reasoning (CBR) and the most popular search algorithm A^* in order to increase the speed operation, especially when the amount of data become huge. As a result, the performance is increased and the design becomes more flexible and more usable[10,11]. The design and implementation of the tool however, enables the instructor to select the title of the exam, the number

of chapters which will be included, how many questions should be added and enable the instructor to determine the complexity of each question (high, medium, low levels), furthermore the instructor will determine the alternative choices for each question, one of these choices is the corrected one, at the same time, the correct answer is inserted into the key solution in the database system. When the user attempts to create an exam, the tool provides him/her with various options such as, how many chapters will be included in the exam and how many questions will be generated, how many questions also will be inserted, how alternative solution should add for each question and many others. By the end of this task, the system asks the instructor; how many forms are needed with their key solutions. The generated forms are different from each other with regard to the order of questions and the alternatives. In general the following flowchart discusses the main components of this process:

Select how many chapters (i) will include in the material
    For each chapter insert the (n) question
        Insert the choices as possible answer
            Determine the correct answer
        Determine the complexity of the Question
    Repeat (n)
Repeat (i)

Fig. 6: New user's sign up form

When the user finished the above code, it means that the database is completed with all questions with their alternative solutions even they are pictures, photos, text, sounds or even movies for special cases. By this end, the user is ready to create or generate the exam he deserved with multiple forms and will generate on the same time their solutions automatically. The selection of the questions and their key solutions are executed from the following procedure:

Select how many chapters (i) will include in the exam
Select how many questions (n) will include in the exam
    Select the % of complexity (high, medium, low)
    From each chapter select (k) questions
    Use A* search algorithm to define k questions
    For j = 1 to k forms
        Generate k forms
        Change the order or questions by A*
        Generate the key solution for each form
    Repeat (n)
Repeat (i)

Different samples of the exams are generated for the purpose of the exam tool. Once the system is active in the main server or installed in the system, the installed shield application will allow the user to create a new account as shown in Fig. 6, note that this sign up form will be active in the main server too. This could help the administrator to monitor if anything is going wrong with the system.

After signing up, the user can enter the system with his/her new account using the sign in form as shown in Fig. 7.

To create a sample exam, the user has many options such as add a new course, chapters, questions or edit course, delete question, or edit question as shown in Fig. 8. The user's interface is designed in an easy way to select each option independently; the possibility to change the interface between languages is already taken in mind to attract as much users as possible in order to distribute this tool for the most instructors in the area of education, either in schools or universities.

Fig. 7: Sign in form II

Fig. 8: Add Course Form

Fig. 9: The addition new chapter's form

After adding a course in the database, the user could add new exam by defining the chapters that he/she will insert questions from, Fig. 9 shows the chapter's forms in case the user interests to add new chapter(s) in a specific exam.

The exam questions are viewed in this page and the answer sheet can be saved as well as the exam form. Each time the start button is pressed, a new form will be

generated and viewed by pressing the start button twice and the output will appear as shown in Fig. 10, where in Fig. 10 the exam is generated as the user required with multi form exams.

In this form the user is already defined the name of the course and the specific chapter that will add it is questions with possibility to add new images for each question.

At this end, the user should have already all options of the new exam and could create new exam by different questions, Fig. 11 shows the property of the new exam such as exam's type, term of exam, duration, number of questions, exam's mark. The user also has the option to choose between if the system will generate the exams randomly or the user would like to choose it manually.

In this step, the user could select how many chapters will insert in a specific exam and how many questions should be added from each chapter.

Each time a new form of exam is generated, a correspondence key solution should be generated too, an example of a new exam is shown in Fig. 12 and it is a key solution for Fig. 13. Note that the user has the ability to define how many forms the system will generate and for each form its key solution. This advantage is very important in case of multi form exams, where the randomization of questions and their alternative solutions is very important; the system could manipulate and generate the questions and the answers on the same time without any mistakes.

Fig. 12: Generated new exam form

Fig. 10: Add new question with its answers.

Fig. 11: Create new exam

Fig. 13: The key solution for specific form

Table 1: A survey of 11 items distributed to 30 users

Item #	Min	Max	Mean	Std. deviation
The program is easy to use	1.00	30.00	15.50	8.80
The Interface of the program is friendly	3.00	5.00	4.40	0.77
The facilities that you need are embedded in the program	1.00	5.00	4.13	0.93
The language availability makes the program helpful	2.00	5.00	4.03	1.00
The Multimedia components are available in the program	3.00	5.00	4.26	0.63
It is easy to switch between Arabic and English Language	1.00	5.00	4.06	1.00
The required time to produce sets of questions is convenience	3.00	5.00	4.10	0.60
The multiform is useful in this program	1.00	5.00	4.00	1.17
The multiple-choice and true false are important forms of my exams	3.00	5.00	4.80	0.48
This program will save much time working on exam	2.00	5.00	3.83	0.94
I suggest this program for other colleagues	2.00	5.00	4.13	0.93

Note that Fig. 13 is the Third form from Four forms in total. The number of forms is dependant on the user who is the instructor in this case.

On the same time the proposed tool is capable to create the again the key solution for specific exam form, which in our case is Form 3/4.

It was an important issue at the end of this study to assess proposed tool to see if it might offer any help for the instructors and teachers. Therefore, it is attended and remained one semester giving the opportunity for different instructors to use the tool. Then, after survey consisted of (11) items were distributed to various instructors randomly selected from local secondary and elementary schools as well as in JUST, the Hashemite University and Yarmouk University for different academic years within 2006-2009, in order to get their feedback and comments regarding the facilities and the complexity of the tool, as shown in Table 1. From the table it showed that the questions are related to the relation between the user and the tool, they are focused on the interfacing of the tool, the facilities of the tools that can offer to the user, the switching between languages, the Multimedia components that can the user use, the multi-forms of questions and their key solutions on the same time. Finally, the instructor might suggest this tool to be used by another instructors or colleagues in various sectors of educational systems.

MATERIALS AND METHODS

The proposed tool is developed and implemented in Jordan University of Science and Technology through the academic year 2006-2007. It used various supporting technologies including visual studio .net, asp.net, oledb and ado.net, SQL server, visual basic.net, html and JavaScript, Rational Rose. The JavaScript is a scripting language enables web authors to design interactive sites. It can interact with HTML source code, enabling web authors to spice up their sites with dynamic content. It is supported by recent browsers from Netscape and Microsoft, through Internet Explorer.

RESULTS

The proposed Editor Exam Tool makes off line and online examinations and gets students' results automatically in case of on line exam. It is what most teachers and instructors expect for an efficient solution to host exams anywhere and anytime, transferring traditional exams will help instructors, for making interactive exams with multimedia enhancement to track exams results with insightful reports. The proposed editor exam tool have supported two question types, randomization of the questions and answers, importing the audio file or record narration for the examination, import media file to the exam, deploy the examination virtually anywhere and provide the result tracking system to collect the results automatically. The results of the research indicated that the proposed Editor Exam has the following advantages:

- The tool supports two different languages on the same time, Arabic and English, with possibility to add other new languages
- It does support special characters such as €, ¥, ∞, ™, ©, µ and any other characters.
- Support multimedia components
- Multi forms of exam could be produced
- The questions are distributed based on chapters
- The instructors have the ability to choose questions from the database system

The results indicated that the instructors' level of satisfaction was very high as shown in Table 2, the mean on the scale was (4.17) and STDEV (.17). The highest mean was (4.8) and STDEV (.48) for "The multiform is useful in this program" which indicates the importance of it to providing the instructors with different forms. The second highest mean was for the item "The program is easy to use" and this is essential for the instructor.

Table 2: Statistics analysis of the proposed program

	N	Min	Max	Mean	Std. deviation
Satisfaction	30	3.91	4.55	4.17	0.17
Valid N (Listwise)	30				

DISCUSSION

It considered that there are many other tools and packages have been implemented for similar targets. The main advantage of this proposed tool was to fulfill the main requirements and demands of the instructors and teachers who will use this tool face to face, which were achieved. The proposed tool has suggested to be used mainly in the educational institutions that teach in Arabic and English, to use two languages on the same time is great advantage in this case.

The editor exam can be used in different sectors such as finance, agriculture, engineering and medicine. The ability of inserting multimedia components can give the tool more advantages also.

CONCLUSION

The proposed study presents an exam editor system built for instructors to help them create and managing their exams as well as saving their own questions for further use. This software was developed using various supporting technologies including visual studio .net, asp.net, ado.net, SQL server 2000, visual basic.net, html and JavaScript. Exam editor is an online system that can be used via the internet without the need to download and install it into the user's machine. This system deals with pictures, questions and answers. It is a time-saving system when multiple versions of random exams are required. Also, using the Microsoft word program to generate the final reports, gives the users more efficient outputs. In this project we tried to define the problem, analyze and design the system, implement and test the output.

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