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Web-Based System for Creation and Management of Multiple Choices Based Quizzes and Questionnaires

Mohamed A. Elshafey

Lecturer, Department of Computer Engineering, Military Technical College, Cairo, Egypt

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Abstract - *One of the major aspects of the educational process in any educational organization is the capability to perform continuous evaluation of its students in different subjects to stand on their academic level through quizzes and monitoring feedback from students about different interests through questionnaires. This paper presents a design and implementation of a proposed Quiz Maker and Management System (QMMS), which can be applied in any educational organization to perform on demand multiple choices based quizzes, offline training and questionnaires for students. The proposed system supports three basic modules: one for administrator and/ or educational affairs in the organization, the second for teachers, and the last for students. The first module responsible for basic data of educational subjects and users with different permissions. The second module makes facility for teachers to construct multiple choices based quizzes/questionnaires. The last module, through which students can solve quizzes or answer questionnaires. The proposed system is implemented as a web based application using C# ASP.net language based on a data base engine implemented on SQL Server. The proposed system and all its three modules are described through waterfall model: requirement analysis, design, implementation, testing and verification, and maintenance.*

Key Words: Quiz maker, System Analysis and Design, ERD, Sequence Diagram, Data Flow Diagram, USE Case Diagram and Data Dictionary

1. INTRODUCTION

The importance of continuous evaluation and assessment of students, to stand on their academic level and even more for selections of pioneers from them in a specific field, leads to the necessity of existing of a quiz maker system in any educational organization. On the other side, any commercial quiz maker system on the shelf have limitations on its functions and capabilities and more cannot be upgraded. So the availability of a customized quiz maker and management system, designed and developed by its staff, is a must. This customized system will of course fulfil the main requirements of its hosting organization with high upgradability feature to match regular needs and changes in the work process and structure of the organization.

Main objective in this paper is to present design and implementation of a proposed Quiz Maker and Management System for any educational organization, which supports educational process and holding scientific competitions and selections. All descriptions in the paper, in following subsections, are mentioned by term quizzes only because multiple choices based questionnaires are themselves multiple choices based questions without automatic corrections and marks, as in case of quizzes, just selecting the required choice for a specified question for questionnaires.

2. SOFTWARE DEVELOPMENT LIFE CYCLE

A life cycle model represents all the activities required to make a software product transit through its lifecycle phases and it also captures the order in which these activities are to take. In paper waterfall model is followed in presenting the proposed system.

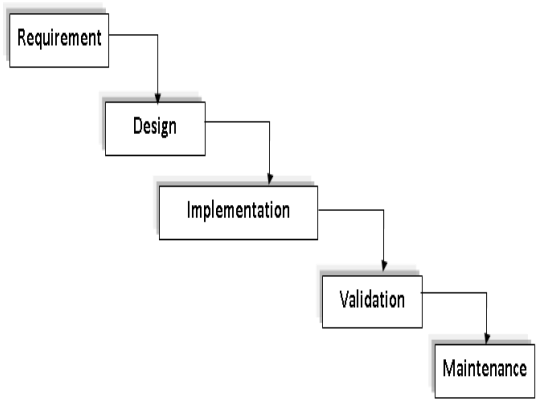

Fig -1: Phases o waterfall model

Before requirement analysis phase is started and even before starting this project, a feasibility study, which involves the analysis of the problem and collection of the relevant information relating to the product is performed. The design and implementation of the proposed system, is made by staff of the hosting educational organization, which will make it more suitable and easy to be applied, maintained and updated. The proposed system will be hosted on the domain based educational computer network of the organization, which covers some educational buildings and provide educational services for students during educational process. The proposed system is a web-based application, which is technically implemented as web forms that runs on the web server of the educational computer network and interacts with a database (DB) engine on a data base server to store and retrieve data. So financially it will cost nothing and technically, it is feasible and applicable [1, 2].

3. PROPOSED QUIZ MAKER AND MANAGEMENT SYSTEM (QMMS)

3.1 Analysis phase of the proposed QMMS

The goal of the requirement analysis and specification phase is to understand the exact requirements of the customer and to document them properly. It is the most important phase, upon which the next following phases rely and even the effectiveness of the whole system.

Many meetings with the manager of the educational computer network, with staff of the educational affairs in educational organizations and a lot of discussions are hold, many questions and answers are written and recorded. Also discussions with students and teachers are performed to stand on their requirements, needs, hopes and even dreams.

Even more, a commercially purchased program in [3] is applied and used for a while to give an illustrative example on how can these types of software system are implemented and applied.

Generally and simply, main suggestion is to design and implement an application software system that can give teachers the ability to:

- Put questions in banks for different educational subjects,
- Create multiple choices quiz-based exam(s) for both training and/or real exams,
- Do analysis of the results after solving exams.

and also ability to students to:

- Take assigned exams in their assigned times, assigned specifications and monitor results,
- Take assigned training exams and track progress in educational level.

So, the proposed system will contain two main modules (student and teacher modules associated with their essential data), in addition to an administrative module.

Functional Requirements, which describe function ability or system services, are listed below:

For administrator's module:

- Entering department's data in system's DB.
- Entering student's data or importing from e.g. excel sheet into system's DB.
- Entering term's data into system's DB.
- Entering teacher's data into system's DB.
- Entering subject's Data with its assigned teacher into system's DB.
- Entering exam's type into system's DB.
- Recording Date/Time of each entering process to into system's DB and also holding it in the DB.

For teacher's module:

- Entering subject's content into system's DB.
- Assigning different levels for each subject, according to teacher's point of view.
- Entering questions of a subject into a questions bank in system's DB, with alternative answers for each question and defining the correct answer, (for example, subject contains M questions) and assigning a predefined level to each question.
- Entering exam basic data into system's DB with two possible modes: exam mode (can be solved one time at a predefined time) or training mode (can be solved many times with the capability to view results of each one by the student).
- Assigning weighting factors for each correct, incorrect, unsolved question for each exam in system's DB.
- Selection of exam's questions into a pool of questions: randomly automatic or Manual based on selected levels from questions bank and recording that in system's DB (for example, exam contains N questions, such that N<=M).
- Assigning a group of students, or uploading their IDs from an excel sheet. This group will be assigned to solve a specific exam and recording that in DB.
- Defining count of randomly selected questions Q form exam pool N to each student (for example each student will be assigned to take an exam of Q questions, such that Q<=N).
- Monitoring and reporting results, e.g. to an excel sheet, of all created exams after being solved by students.
- Recording Date/Time of each entering process to into system's DB and also holding it in the DB.

For student's module:

- Displaying available assigned exams from system's DB based on a predefined group of students.
- Starting exam solution task for each student in a predefined time constraints.
- Displaying, for each student, exam's questions Q in a random order and also the associated possible answers of each question should also be displayed in a randomly order inside it.
- Possibility to take exam more than one time after authorization from teacher.
- Monitoring results of permitted exams taken by the student.
- Recording Date/Time of each entering process to into system's DB and also holding it in the DB.

A use case diagram at its simplest is a representation of a user's interaction with the system that shows the relationship between the user and the different use cases, in which the user is involved. A use case diagram can identify the different types of users of a system and the different use cases [1, 2]. Use case diagram for the proposed system are shown below.

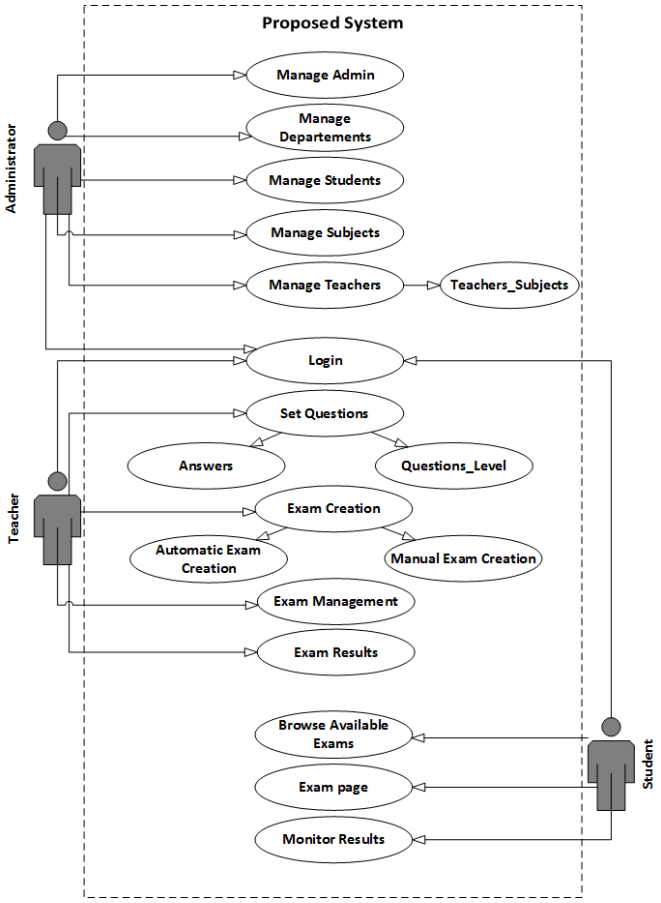

Fig -2: Use case diagram of the proposed system

Special tools and techniques help the analyst make requirement determinations. Tools such as data flow diagrams (DFD) to chart the input, processes, and output of the business's functions. Data flow diagrams are structured analysis and design tools that allow the analyst to comprehend the system and subsystems visually as a set of interrelated data flows. Graphical representations of data movement storage and transformation are drawn with the use of four symbols: a rounded rectangle to depict data processing or transformations, a square to show an outside data entity (source or receiver of data), an arrow to depict data flow, and an open-ended rectangle to show a data store [1, 2].

The next figure shows a context diagram that shows external entities and data flows to and from the system. This diagram do not show any detailed processes or data stores.

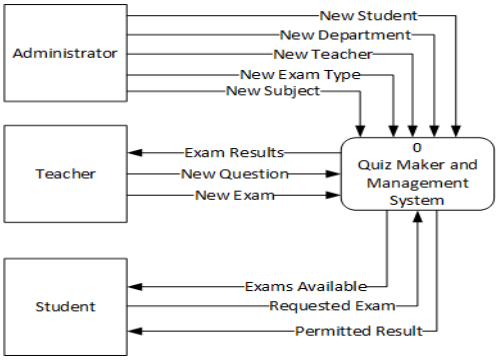

Fig -3: DFD - Context diagram of the proposed system

Diagram 0, which is the next level, shows processes, but keep them general. Data stores are shown at this level.

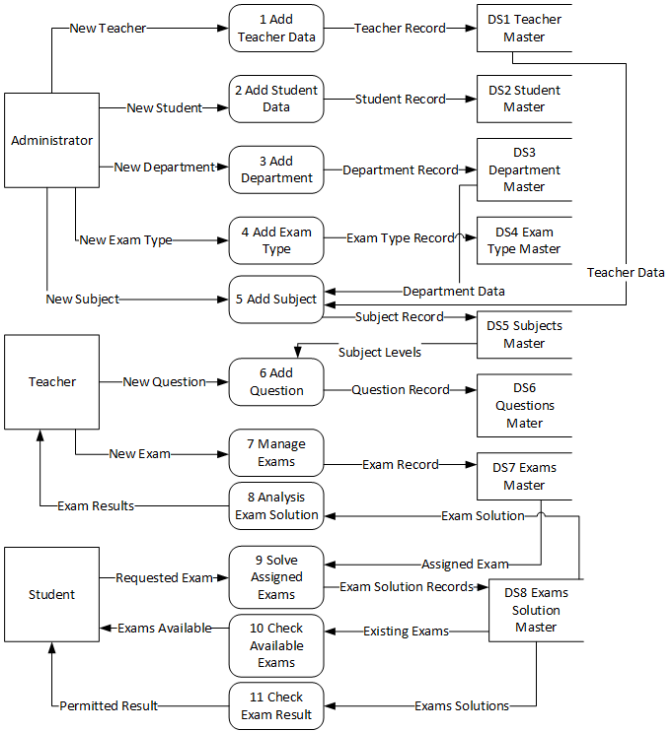

Fig -4: DFD - Diagram 0 of the proposed system

The most important processes, which need more clear analysis and description are process 7, by which teacher can manage exams and process 9, through which students solve their assigned exams. The next two figures shows the child data flow diagrams of these two processes; Diagram 7 and Diagram 9 respectively.

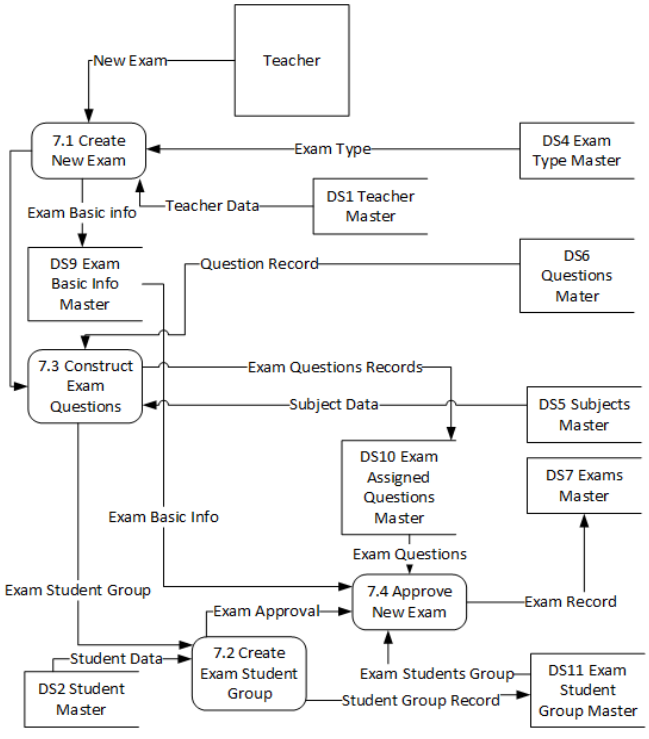

Fig -5: DFD - Diagram 7 of the proposed system

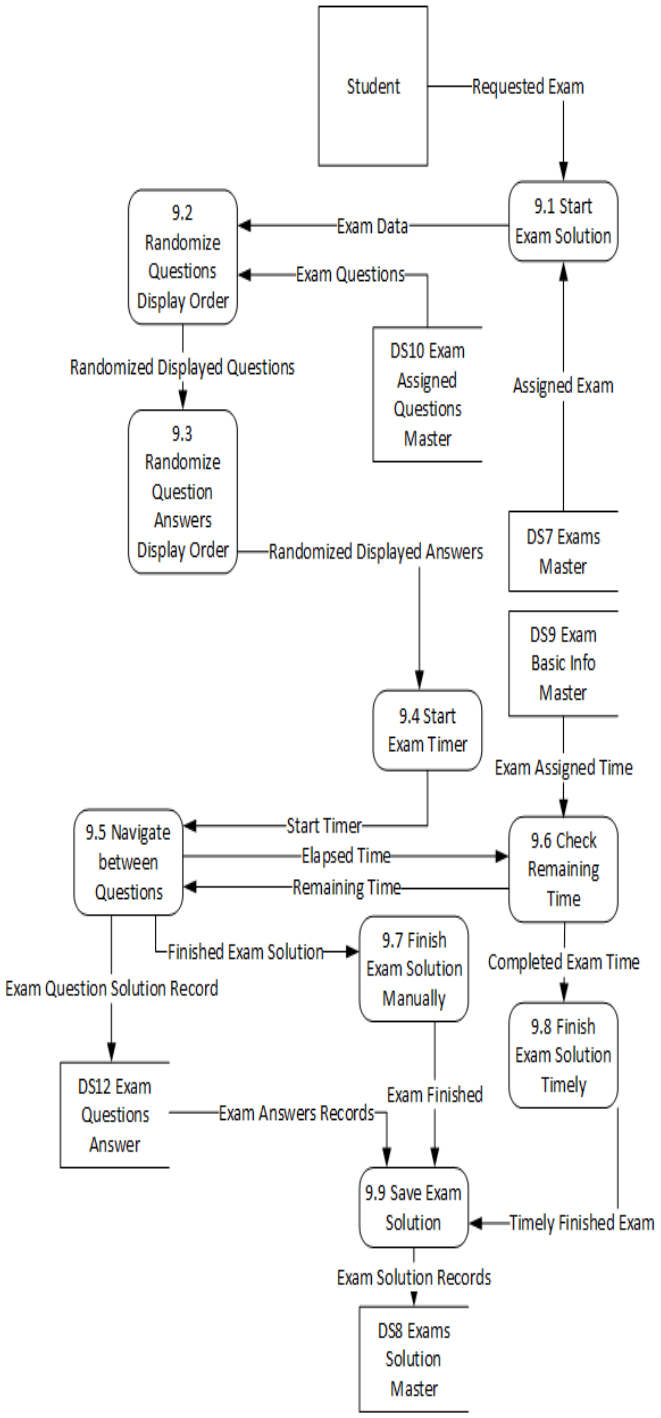

Fig -6: DFD - Diagram 9 of the proposed system

Data dictionary entries created for each data flow diagram, in which the detail of each data flow is described using a data structure. Data structures are usually described using algebraic notation, which uses the following symbols:

- An equal sign (=) means "is composed of."
- A plus sign (+) means "and."
- Braces { } indicate repetitive elements.
- Brackets [ ] represent an either/or situation. Either one element may be present or another, but not both.
- Parentheses ( ) represent an optional element. Optional elements may be left blank on entry screens and may contain spaces or zeros for numeric fields in file structures.

Year Record = Year ID + Year Name

Department Record = Department ID + Department Name

Degree Record = Degree ID + Degree Name

Term Record = Term ID + Term Name

Admin Record = Admin ID + Admin Name + Admin Password

Teacher Record = Teacher ID + Teacher Name + Teacher Phone + Teacher Email + Teacher Password + Degree ID + Department ID

Student Record = Student ID + Student Name + Student Phone + Student Email + Student Password + Department ID

Subject Record = Subject Code + Subject Name + Subject Hours + Department ID + {Teacher ID} + {Subject Levels} + Year ID + Term ID

Question Record = Question ID + Teacher ID + Question Text + Question description + {Question Answer Record}+ Subject ID + Subject Level ID

Question Answer Record = Answer ID + Teacher ID + Answer Text + description [True | False]+ Question ID

Exam Type = Exam ID + Exam Type Name

Student Group = Group ID + Group Name + {Student ID}

History Solution Of Student Of Question In Exam Record = Exam ID + Student ID + Question ID + Answer ID

Exam Student Group Record = Exam ID + Group ID + Exam Date

Exam Record = Exam ID + Teacher ID + Exam Date + Subject ID + Exam Type ID + Monitor_Result_Autherization [Yes | No] + Num_Questions + {Exam Questions Records} + Correct Weight Factor + Incorrect Weight Factor + Unsolved Weight Factor

Fig -7: Data Dictionary of the proposed system

Each use case is a group of scenarios. These scenarios are documented using sequence diagrams, in which objects are represented as vertical lines and messages between objects are shown as directed horizontal lines [1, 2].

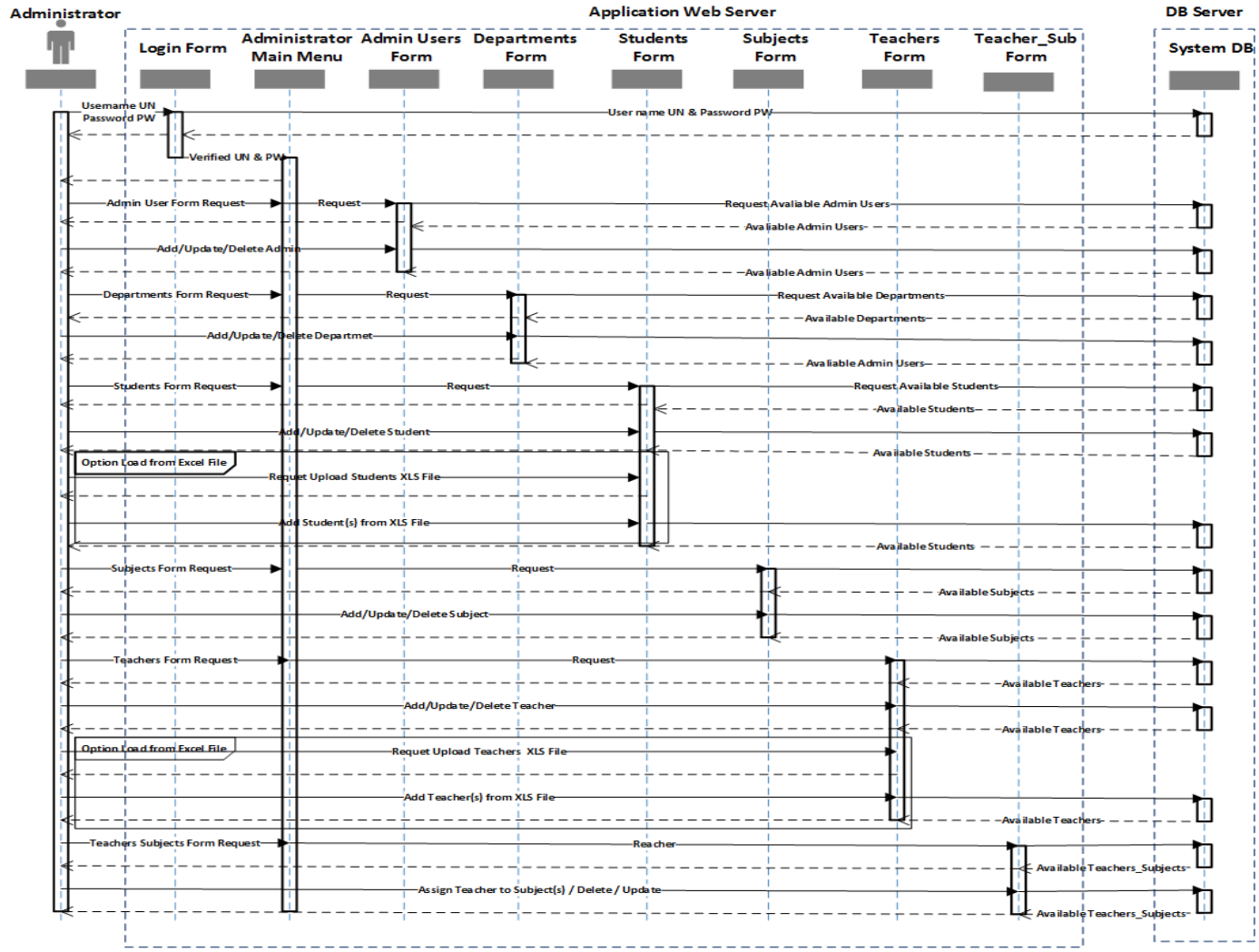

Fig -8: Sequence diagram of the administrator in the proposed system

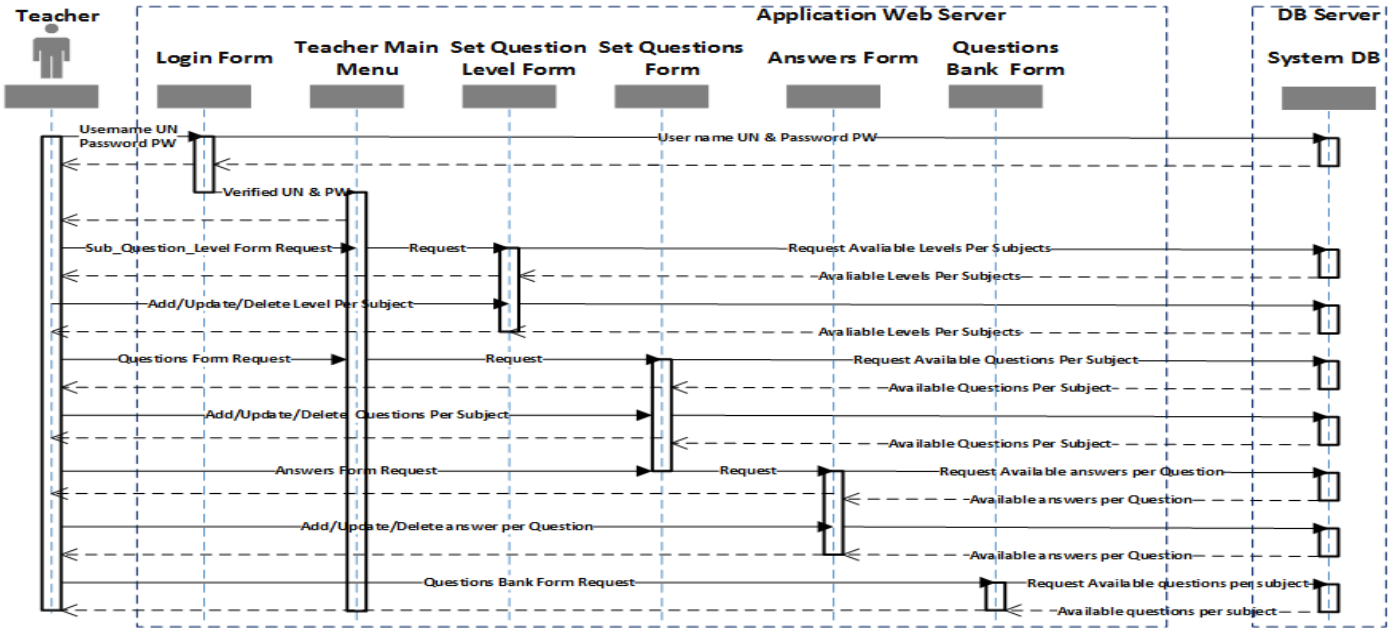

Fig -9: Sequence diagram (part1) of the Teacher in the proposed system

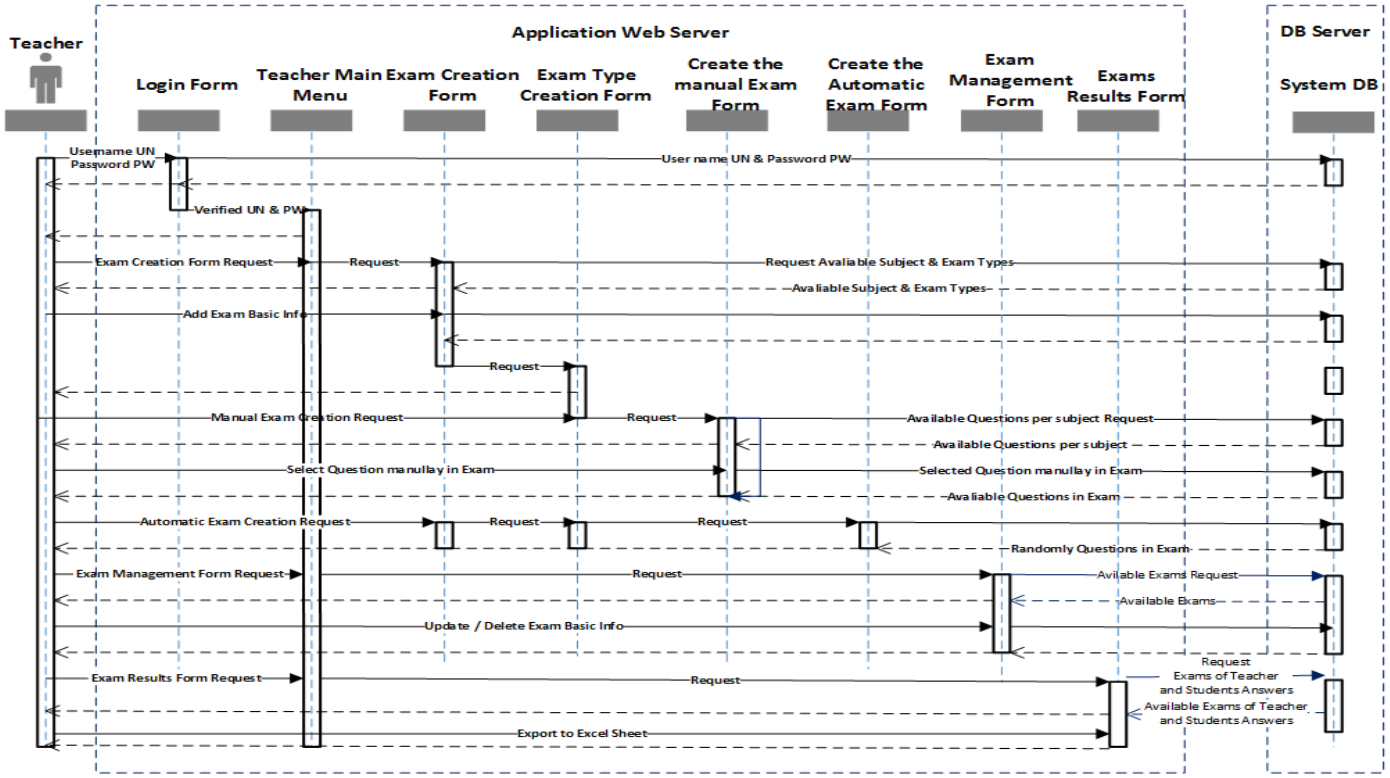

Fig -10: Sequence diagram (part2) of the Teacher in the proposed system

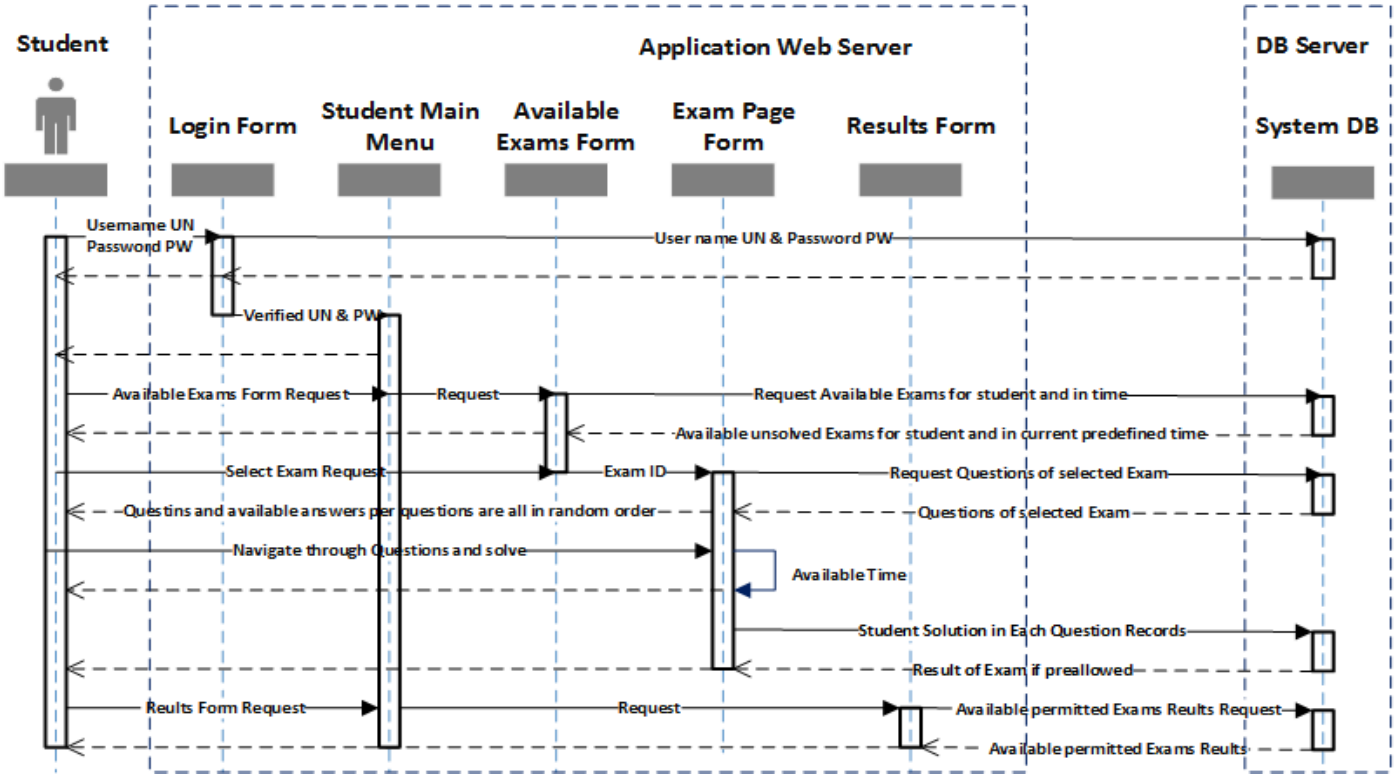

Fig -11: Sequence diagram of the Student in the proposed system

3.2 Design phase of the proposed QMMS

Design elements describe the desired system features in detail, and generally include screen layout diagrams, pseudo-code, and a complete entity-relationship diagram (ERD) [4] of databases that will store much of the data needed by decision makers in the organization. These design elements are intended to describe the system in sufficient detail, such that skilled developers and engineers may develop and deliver the system with minimal additional input design. The ERD of the

proposed system, which meets with the analysis requirements are presented in Fig -12.

The goal of the design phase is to transform the requirement specification into a structure that is suitable for implementation in some programming language. In this phase, procedures are designed for users to help them accurately enter data so that data going into the information system are correct. In addition, the analyst provides for users to complete effective input to the information system by using techniques of good form and web page or screen design.

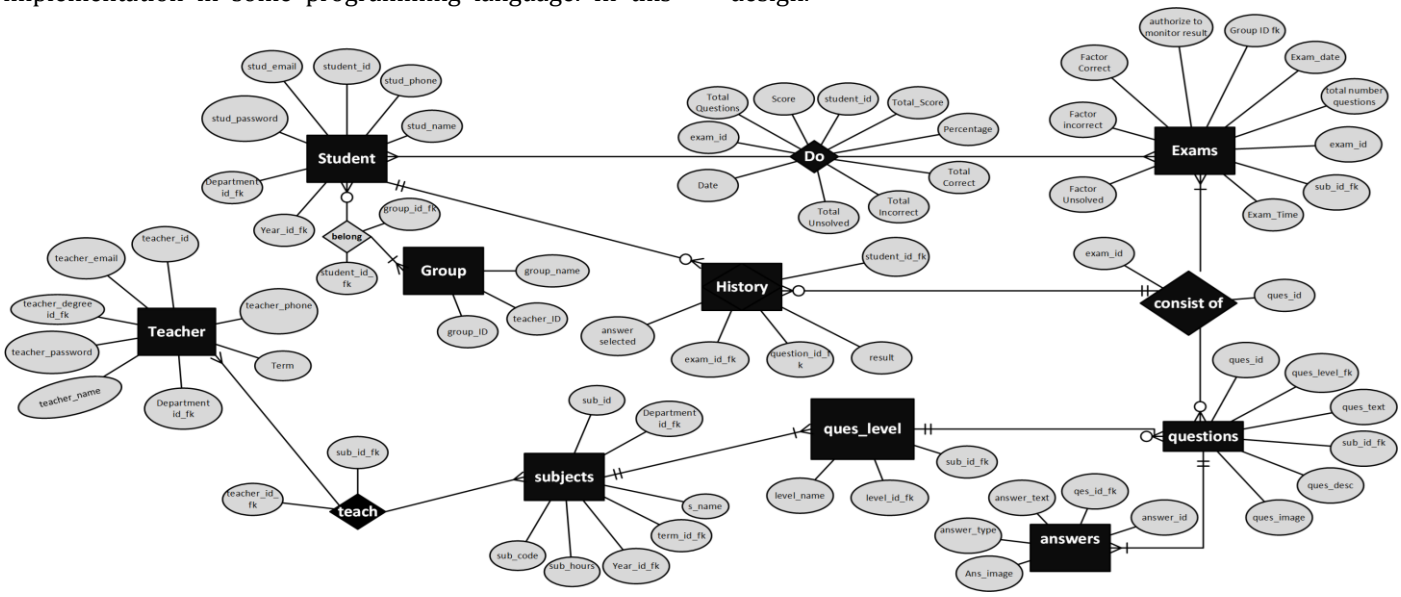

Fig -12: ERD of the proposed system

An important part of the logical design of the information system is devising the human–computer interaction (HCI). The interface connects the user with the system and is thus extremely important. In the proposed system, the user interface is designed with the help of users to make sure that the system is audible, legible, and safe, as well as attractive and enjoyable to use. Examples of physical user interfaces include a keyboard (to type in questions and answers), onscreen menus (to elicit user commands), and a variety of graphical user interfaces (GUIs) that use a mouse or touch screen. Main forms of the proposed system are snapshotted and presented in testing and verification phase.

3.3 Implementation phase of the proposed QMMS

The proposed system contains an application model and a database model. The application model is implemented as web pages in ASP.NET framework using C# language on Microsoft visual studio IDE 2012 and the database model is implemented using Microsoft SQL server 2012. Microsoft FrontPage is also used for more interactive and easy web form design and implementation.

3.4 Testing and validation phase of proposed QMMS

The proposed system is tested and validated using real test study data in all its web pages of all cases. The following figures are screenshots of the master web pages of the system.

Fig -13: Login web Page

Fig -14: Administrator's master web page

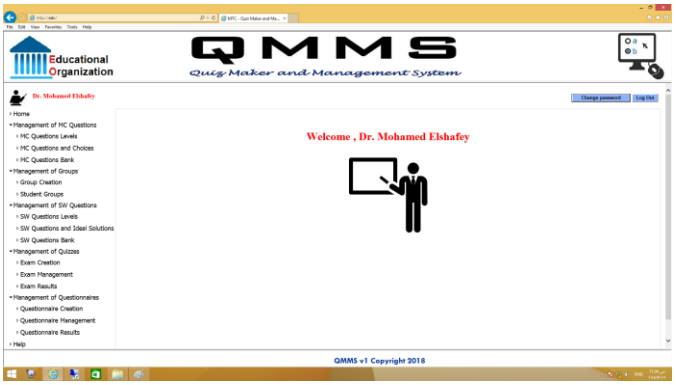

Fig -15: Teacher's master web page

Fig -16: Student's master web page

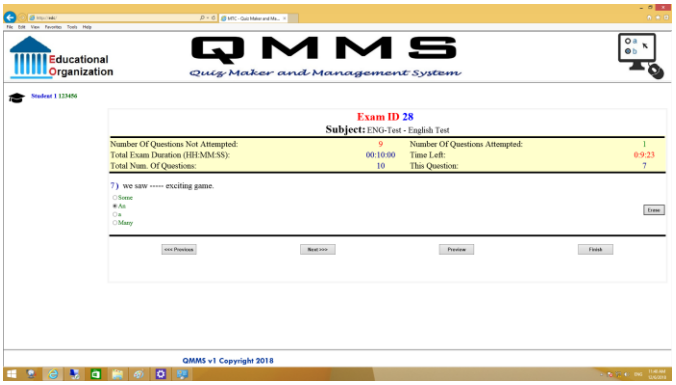

Fig -17: Student's exam web page

3.5 Maintenance phase of the proposed QMMS

There are an additional help desk attached to the infrastructure of the proposed web based system. A tutorial manual for each module of the three modules are implemented in the master web page of each module. The availability of the source code of system and the database engine makes its updatability and maintainability an easy task, when needed.

4. CONCLUSION

The proposed Quiz Maker and Management System provides an effective system, which joins there main and effective users in the educational process: education affairs in the educational organization, the teacher and the student. In the proposed system random selection and random browsing of questions and possible answers for each exam is supported for each student. It supports both quizzes in exam/training mode and questionnaires. A lot of features are assigned for exam creation for powerful management and analysis. Uploading and downloading capability to/from system is supported in formatted excel sheets. The system is totally maintainable and upgradable to be a mobile application (Future application).

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BIOGRAPHY

Mohamed Abdelmoneim Elshafey received a Bachelor degree in computer engineering and Mastersdegree from the MTC, Cairo, Egypt, in 1998 and 2004, respectively. He also received the Ph.D. degree in Electrical and Computer engineering from Bauman Moscow State Technical University, Russia, in 2015. He is currently a faculty member at the Department of Computer Engineering, MTC. His research interests are in System Analysis, Information processing Software Engineering, Web Development, Satellite Onboard Data Handling, Image Compression, Telemetry Data Compression and Analysis.