

A PROPOSAL OF ELECTRONIC EXAMINATION SYSTEM TO EVALUATE DESCRIPTIVE ANSWERS

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ABSTRACT: *Electronic (E) examination system is not a novel idea in the educational domain. E-examination systems are used to deal with objective assessments from last several years. Almost, all the top universities of world are using general purpose/customized solutions to manage E-examination systems like SAP, Oracle and Blackboard. The aim of this research is two folds. First part of this research will deal with the development of an E-question bank system to automatically generate the question paper. The second part of this research will deal with to propose subjective E-examination system not only for the faculty of the King Abdulaziz University but it will be beneficial for the faculties of other universities inside and outside of Kingdom of Saudi Arabia. This research also supports to green IT. The proposed systems will simplify the assessment process by automatic setting and marking of exams. It will significantly reduce the complex paper setting and assessment processes by cutting down the time, cost and saving huge numbers of papers. Survey and case study will be used as research design to validate the E-examination system. Multi-tier applications architecture (client, web, and business) will be adopted as per the needs of case study. A subjective E-examination system will be developed and tested to check its practicality for the students of King Abdulaziz University. It is anticipated that the proposed systems will significantly facilitate to instructors and King Abdulaziz University to save time, cost, resources, increase efficiency and improve productivity of exam setting and assessments.*

Key words: Subjective Assessments, Pattern Matching, E-Examination, Question Bank

1. INTRODUCTION

Majority of universities are dealing with issues associated with examination setting and assessment due to increasing number of students. Set a new paper in every examination is one problem and its assessments is another problem. A faculty member needs to set the paper minimum three times per semester for a course i.e., mid-term I, mid-term II and final examinations. Each faculty member has to teach minimum three courses per semester. Examination paper setting and its assessment require lot of efforts, consumes enormous time, more resources and immense pressure on a faculty member. These factors echoes the importance of problem domain selected to conduct this research. Therefore universities are in search of improved examination setting and assessment methods [1]. King Abdulaziz University (KAU) is currently set and assessed the examination papers manually. Therefore, KAU is in need of automatic examination and assessment systems. Following are the main problems that KAU faculty is facing due to manual exam setting and assessment.

- 1) It is tedious process to set exam papers and quizzes in every semester.
- 2) It needs lot of time, cost and resources to set and assess the examination papers especially if the class strength is greater than thirty.
- 3) The paper based examinations are currently scanned to convert them electronically for the review of The Accreditation Board for Engineering and Technology (ABET). This requires extra time, cost and resources.

To cater these three issues, this research aimed to develop an electronic (E) subjective question bank and assessment systems to address the problems of King Abdulaziz University. It is anticipated that this research will not only solve the problems of KAU faculty but in general, it will be helpful for the other universities inside and outside of the Kingdom of Saudi Arabia. The remainder of this paper is

organized as follows: Section 2 illustrates the research objectives. Section 3 describes related work. Section 4 covers the problem & proposes a solution of the current problem. Section 5 validates the proposed solution using survey technique.

2. RELATED WORK

Rashad et al. [2] propose an Arabic web-based exam management system that handles only objective questions. The objectives of developing web based exam are to conduct exams, collect answers, auto-grading and generate a report. A multitier architecture is used to develop the web-based exam. A survey is conducted to validate the system using a sample size of two hundred and fifty. The future work is to add more questions. The main limitations, of the system developed by Rashad et al. [2], are that it does not cover subjective questions, course learning outcomes, complexity and graphic questions like Data Flow Diagram (DFD) and Unified Modelling Language (UML).

An ongoing research is presented by putting together a platform as a test bed for NGN application development [3-4]. A novel component based development model is proposed to develop SIP based mobile applications. The proposed model used as a framework for general purpose application development over the test bed. The objectives of IP Multimedia System (IMS)-based mobile examination system approach is explained with reasons and advantages identified for objective questions. Main components of IMS service architecture with their roles are also described. The approach leads to a highly modular and extensible integrated system. IMS based application is considered to be the next generation mobile applications that enable developers to take advantage of mobile networks resources. IMS-based application is attributed with robustness and improved Quality of Experience (QoE) for mobile users. Such quality is needed to ensure users reliabilities on the system. Future work is to validate novel component based development

model using a case study of IMS test bed to evaluate objective questions [3-4]. The IMS based objective

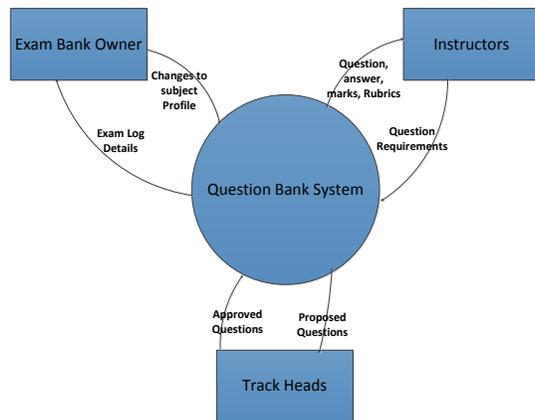


Figure 1- Context Diagram of Question Bank System

examination system presented in [3-4] lacking to provide experimental results.

Zhenming et al. [5] propose a novel web-based online objective examination system for computer science education. System transmits the answers into bit stream after encoding to ensure security and intrusion. It is password protected system and camera is there to monitor the activities of students. The web based examination is developed to handle basic computer skills. The system does not handle subjective exams and advanced computing courses. Therefore subjective skills of the students cannot be assessed using the system developed by Zhenming et al. [5]. Azim et al. [6] described the impact of online subjective assessment on the students as compared to objective assessments. The written ability of students is not checked while conducting the objective examination as per the results extracted by Azim et al. [6]. The study in [6] surveyed 100 private companies related to information technology field to collect the data of the candidates who got promotion after passing the OCP, MCSD or MCSE certifications. There were only few candidates who were promoted to senior positions because of written shortcoming. The subjective assessment system is the solution to check the writing skills of students [6].

A novel approach with subjective assessments for E-examination system is introduced by Sinde and Chokhandre [7]. The web based system uses keywords to match with the answers. It is working like objective questions. A student will get marks if the keywords match otherwise if he/she will get zero if the order of keywords are changed or misspelled. The system does not allow students to write the answers of descriptive/subjective questions and it only deals with objective assessments.

Aimin and Jipeng [8] describe the fundamentals to design and implement a web-based intelligent examination system. The main emphasis of web based intelligent examination system is to use degree of difficulty to select questions from the examination bank. Aimin and Jipeng [8] propose to develop an intelligent examination system for subjective evaluation.

3. RESEARCH OBJECTIVES AND THE PROPOSED SOLUTION

Following are the main objectives of this research.

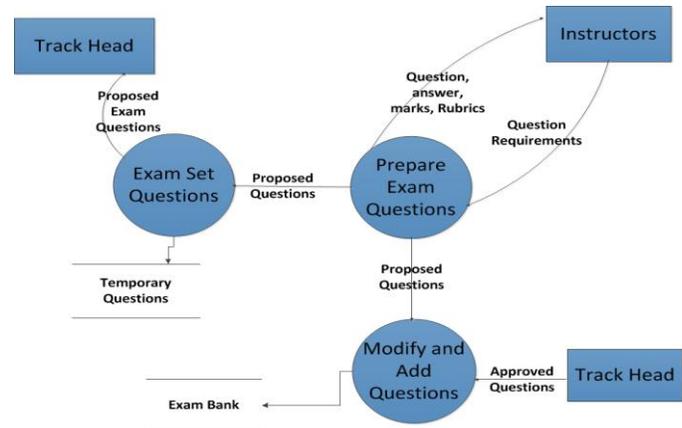


Figure 2- Level Zero Diagram of Question Bank System

1. Measuring the effects of automatic question bank and subjective assessment systems such as accuracy, functionality, efficiency, time, cost, resources, complexity and quality.

2. Propose a strategy to develop an automatic question bank system to generate question papers based on course learning outcomes.

3. Propose a strategy to develop question bank system that generates papers which are composed of equally distributed simple, average and difficult questions.

4. Design an algorithm using patterns to mark subjective papers.

5. Implement prototype model for question bank and assessment systems.

There are two systems to be developed to meet the research objectives.

- Question bank system
- Subjective exam assessment system

Question bank system- the system administrator will be able to add and delete users, subject names, instructor names, learning objectives of questions and marks. Instructors can add, delete and view question details. The track/subject heads can add, delete, modify and view question bank details. The system will generate the question paper randomly for each individual student based on the course learning outcomes and complexity.

Subjective exam assessment system-Student will answer the subjective open ended question in the prescribed space provided. The subjective assessment system will automatically assess the answer to match the keywords using a knowledgebase and data mining techniques to grade a student.

Figures 1 and 2 show the context and level zero diagrams for the question bank system. The entities, processes, data stores and data flows of question bank system are displayed in figure 2. Figure 3 and 4 show the context and level zero diagrams of subjective E-assessment system. Exam bank owner, Instructors and Track heads are the main entities of

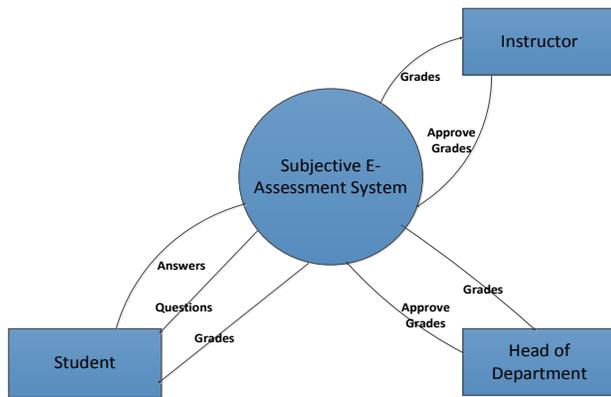


Figure 3-Context Diagram of E-Assessment System

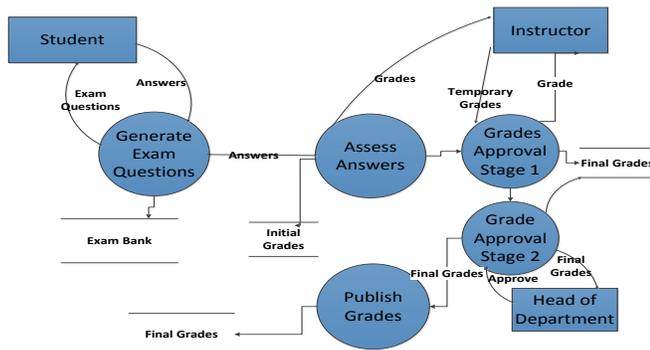


Figure 4- Level Zero Diagram of E-Assessment System

question bank system as shown in figures 1 and 2. Instructors will submit the questions as per the course learning outcomes and level of complexity into ‘Prepare Exam Questions’ process. The questions are stored into ‘Temporary Question’ data store. Track heads will review the exam questions and approve them using ‘Exam Set Questions’ and ‘Modify and Add Questions’ processes. The approved questions and answers are stored into ‘Exam Bank’ data store. Student, instructor and head of the department are the main entities of subjective e-assessment system as shown in the figures 3 and 4. Student will access

Q1: What is Software Engineering? Define and provide example.

Answer: Software Engineering is the use of standard methodologies, techniques and tools to develop economical, reliable and efficient software.

Example: Waterfall is used as a methodology, requirement gathering technique is used to analyze the requirements, Java or C#.Net is used as a tool to develop economical, reliable and efficient software.

Figure 5. Interface of E-Assessment System

the exam paper with open ended questions using the ‘Generate Exam Questions’ process. The proposed e-assessment system will grade answers by matching the key words. Each sentence will be evaluated using pattern matching technique to identify the keywords. Each sentence will accept a fixed number of words in the text box. Another text box will open as a student will enter full stop to enter the next sentence. Figure 5 shows an interface of E-assessment system to display question and enter answers. The answer in figure 5 has specific keywords in definition

and example parts such as methodologies, techniques, tools, Waterfall, requirement gathering, analyze, Java and C#.Net. The exam bank contains range of synonym words for each keyword. The answer will pass to exam bank to match the set of keywords. As more keywords are matched in an answer as high the grades will be awarded. The initial grades are approved by an instructor through the ‘Grades Approval Stage 1’ process. The head of department will submit the final approval through the ‘Grades Approval Stage 2’ process to publish for the students. The grades are stored in ‘Final Grades’ data store.

4. APPROACH, TASKS AND PHASES

A methodical agile approach is used to deliver the project objectives. We will cover all phases of system development life cycle (SDLC) to identify detailed requirements. The project will be closed out by implementing the requirements to achieve project objectives. Following are the main SDLC phases to complete this project.

4.1 Requirements and Planning Phase

Requirements and planning phase identifies detailed requirements, to find out problems in the topic in hand to complete this research, through extensive literature review. The fundamental objective of this phase is to construct a foundation for the research problem. The literature review conducted is such that it consists of the evolutionary stages of the research in the area. This phase will help to explore the state of art research methodologies, techniques and tools used in the area in hand. Interview and survey will be used in King Abdulaziz University Saudi Arabia to identify requirements including course learning outcomes and key student outcomes. The output of this phase will be detailed requirements and selection of desired tools and techniques (to be implemented to complete this research). Case study research method is applied on this research to validate the results.

4.2 Design and Implement Phase

Following are the main tasks completed during the design phase.

- Propose architecture of question bank and E-assessment systems.
- Design database, interfaces and algorithm of the proposed systems.

The proposed systems will be developed during this stage to achieve the research objectives. The proposed system is validated using a case study.

5. RESEARCH METHODOLOGY

A scientific or critical study intended to identify and translate knowledge is called research. Research is divided into two domains that are basic and applied research. March and Smith [9] recognized two types of sciences in their research framework namely natural science and design science. Design science invents findings with the objective to help human beings. According to the March and Smith [9], theorization and justification are the main behaviors of natural science. As an applied research, design/release and evaluate are the main behaviors of design science. Applied research is defined as introducing a novel advancement or innovation in an existing knowledge as described by Jarvinen [10]. Jarvinen [10] also proposes that an evaluation of a novel advancement or innovation is needed to validate it. A demo version or even a

proposal can be considered as research output as a substitute of a final outcome or product. This project can be categorized as an applied research. The choice of an appropriate research method is a necessary phase in a research design. Yin [11] categorized research methods in five types. These types are experimental, survey, archival analysis, historical study and case study. The selection of an appropriate method is on the basis of three conditions i.e., nature of research question, degree of control over behavioral actions and extent of focus on contemporary actions. The 'What' phrase is an important research question in all research methods and it is satisfied in an exploratory study with respect to first condition. In research, the 'What' phrase is also used in the form of 'How'. The 'How' phrase is an important research question and it is mostly used in a survey and archival studies. The real actions are hard to control with respect to second condition. Since, the objective of this research is to propose intelligent question bank and automatic descriptive examination systems. Therefore, the focus of this research is on contemporary actions with respect to third condition. The suitable research methods for this research are survey and case study on the basis of arguments with respect to three conditions for the choice of appropriate research methods.

Qualitative and quantitative are two approaches used in research methods [12]. Qualitative research is defined as a form of research that concludes results not by using statistical methods or any other way of measurement [13]. Quantitative research is defined as a form of research that looks for statistical methods, calculations, and generality of results. It is considered by few researchers that both research methods can be simultaneously used effectively in a research [13]. Therefore, both the approaches will be used in this research.

6. CONCLUSION

The current examination process is manual and it is cumbersome for universities and faculties from many aspects. There are several problems associated with the manual examination process such as time consuming, costly, enormous resources, lot of efforts and huge pressure on instructors. There is a need of research to automate examination process to address these problems associated with the manual examination process. This research is conducted to automate the examination process.

The objective of this research is two folds. It will be accomplished by proposing two systems i.e., intelligent question bank and descriptive E-assessment. This paper is written to show the preliminary work that is completed prior to implementation. The proposed intelligent question bank system will be populated by the questions and answers provided by the instructors for each course. The questions will be entered after selecting the question code, course learning outcome, level of complexity and marks. The questions will be stored in the primary bank pool. Each specialization track (like Software Engineering track) has a subject head or track coordinator. The track head can approve, modify and delete the question. The questions with the relevant information will be stored in the final exam bank pool after the approval of subject head.

The E-assessment system will generate different exam paper for each student. The answers of students will be matched (using the pattern matching technique) with the keywords in exam bank pool by the E-assessment system. Next text box

will appear in front of student to enter the second sentence as soon as he/she will enter full stop to complete a sentence. The grades will be sent to instructors by the E-assessment system. It will be displayed by the system after the approval of instructor and department head. Future work is to implement the proposed system to validate the research outcomes in terms of cost saving, time reduction, improve efficiency, resource saving, accuracy and quality of automatic examination process.

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