

Development of an Automated Grading System for Essay and Objective Question

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Abstract—Paper-based examination is the most used method in conducting examinations. It is very time consuming as teachers spend a lot of time marking and grading examination scripts, which may not be as accurate as it should be. If the time for grading can be managed, there would be no delay in releasing students' results. As a result of the inaccuracy that comes from paper-based assessment, online examination/CBT is a valid replacement in educational institutions. An Automated Grading System for essay questions was designed and developed using UML Tool (Use Case Diagram) and implemented using HTML, Javascript, PHP, and MySQL. A web-based system was developed to aid in grading objective, and essay (structured and descriptive) questions using keywords. The system accepted a minimum of three keywords depending on the question type, giving an accurate result. The developed system will aid in reducing the time spent grading students' sheet and also in digitizing students' record keeping in the cloud, reducing the use of paper and physical storage space.

Index Terms—Examination, Automated Grading System, Question, Online, Manual, Institution

I. INTRODUCTION

An examination is a written test, oral question, or practical task that tests a person's knowledge or skill to ascertain a learner's level of intellectual competence. The examination context can be presented in two ways - the Traditional/Manual method and the Online Electronic method [1]. The manual method consists of materials like biro and paper and is marked and graded by the teacher. It is a less effective approach for a fair and well-conducted examination. Most institutions use the manual method of examination. This entails printing examination questions, written answers by the students, and submitting and grading examination scripts. Although this is the most commonly used method in institutions, it has been criticized by many scholars because of its inaccuracy and time consumption [1], [6]. Some faults include issues

relating to the exchange of scripts, missing scripts, muddling students' grades, and mishandling scripts [2]. Also, the manual method also consumes time and resources, especially when the students are many.

The Online electronic Method, web-based/CBT (Computer Based Test), is more favourable for students. The Online electronic examination is a web application designed to allow students to take their examinations using computers connected to the internet. It is a lot more convenient and less time consuming because the system will grade the examinations, and the results will be released on time. Also, the issues raised with the manual exam method will be eliminated [1].

If an effective and efficient online examination system is developed and results are computed and released in record time, then there will be utmost synchronization within the uni-versity system. The results can be stored in a central database for documentation and future evaluation. Furthermore, this method will help the academic staff to reduce the time spent marking examination papers and preparing results. As such, they would have sufficient time to conduct quality research [1]. Online examinations would also come a long way in benefiting the educational system in producing graduates who are already computer literate.

Therefore, this study developed an online examination system that would examine students within a time frame, considering objective and essay (structured and descriptive) questions and generating the results at the end of the examination. This system grades subjective questions using keywords and objective questions using options.

II. RELATED WORKS

There are various examinations written in Nigeria by Nigerian students at all levels. Most of these examinations

are National Examination Council (NECO), Interim Joint Matriculation Board Examination (IJMB), Joint Universities Preliminary Examination Board (JUPEB), Joint Admission and Matriculation Board (JAMB), and National Business and Technical Examinations Board (NABTEB). At the same time, we have one for West Africa (West African Examinations Council (WAEC). It is an examination body for the West African sub-region, established in 1952, and the council conducts the West African Senior School Certificate Examination (WASSCE). The examination is taken by students in senior secondary schools (SS3). At the same time, JSSCE is the WAEC examination written by JSS3 (Junior Secondary) students to confirm their graduation from senior and junior secondary schools, respectively [3], [8], [9]. There are different types of examinations, such as Multiple choice, Closed exams, Restricted exams, Open book exams, Take home exams, Essay exams, and Case study exams [3].

According to reference [4] an intelligent electronic assessment system for subjective examinations was developed. This system was designed using a matching ratio of the answer that the students imputed. This system used four modules: preprocessing, keyword expansion, matching, and grading. Synonyms of all the entries imputed by the examiner was also considered and not just key words. Natural Language Tool Kit in python was used in developing this system. The system is quite robust, the system under development would also use synonym and matching words. However, the system would be developed as a web based system.

Reference [5] also designed and implemented an online examination system for grading objective and essay-type questions. They used the keyword match approach using SQL MATCH AGAINST syntax. This system was designed to have two layers: the presentation layer and the core module. The presentation layer is the layer that represents the space where devices, such as computers, phones, etc., can interact with the system. The core module consists of the administrator, department, and student modules. The Apache Webserver was also used to implement the system. This system can only grade the students correctly when the students input matches the keyword, thereby marking down the student.

Reference [6] developed an automatic scoring subjective question system using domain ontology and natural language processing technology. Knowledge points relating to the domain in question were collected to analyze their relationships carefully to know if the ontology terms are associated. The relationship between each term is then established. After that, instances were created for the classes, and validity was valued. Reference [1] developed a system to grade exams question automatically. However, the system they developed would only grade multiple-choice questions. The system was developed using the browser/server framework using Microsoft Visual Studio 2008; C# was used for the coding, while the Microsoft SQL server served as the Database. This study handles only objective questions, consideration was not given to essay questions.

Reference [7], developed a framework to improve an existing

system. The system was built to overcome the influence of local Indian languages in English essays. This system was built majorly for a language (English language). As such, it will take into cognizance the language's structure (grammar, syntax, semantics, e.t.c) before awarding any grade. The proposed framework for this system was such that the system could accept the Indian language in place of the English language. Once the Indian language is imputed, the system can identify the language as Indian, match it with what is in the database, and input the equivalent English word.

From the literature reviewed, we observed that there is no system that has been able to grade student's essay questions with keywords and synonyms. Hence the need to develop a system that in the case where the keywords does not match with the input from the students, the students will not be awarded the full grade rather, will be awarded some marks for the synonyms or nearest in meaning to the word in context.

III. METHODOLOGY

The method adopted for this research involves extracting subjective and objective questions and their corresponding answers from past standardized questions. After getting these, the keywords in each response were extracted alongside synonyms in that domain and used to develop the system. The system was designed to match the keyword against the synonyms to award marks.

The designed system was implemented using HTML, CSS,

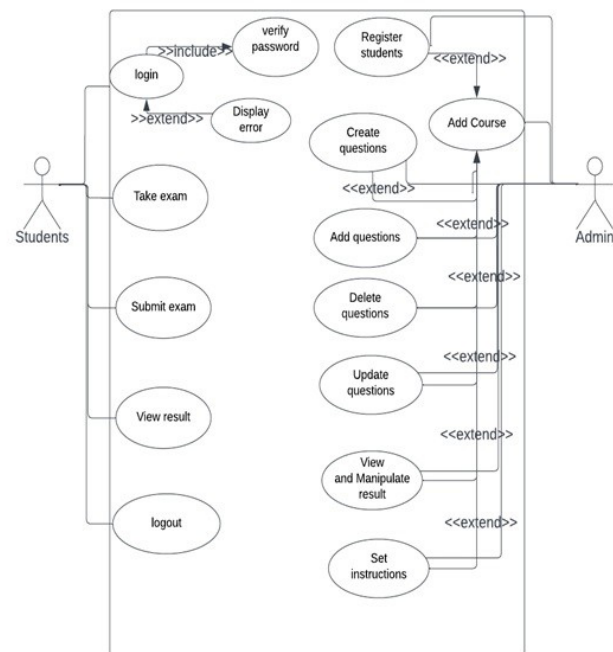


Fig. 1. Usecase Diagram

and JAVASCRIPT for the frontend, while the back end was developed using PHP, MySQL, and PHPMYADMIN. The Xampp server was used to access the MySQL database.

The system implemented in this study is a web-based system that allows students to log in, take the exam, and view their results. It will enable the admin to login, register students, manipulate questions (create, add, delete and update questions) and view the students' results. At the same time, the system itself automates the marking, as shown in the Use Case diagram in "Fig. 1". The use case diagram describes the activities of the user and admin in the designed system.

The examination questions are in two forms: essay and objective. The objective questions are those questions that the examiners give options. The students are expected to choose answers that best suit the questions from the array of options. In most cases, the student is given a minimum of three options and a maximum of five options. From the array of answers, only one answer is correct. To implement this section in the study, JavaScript was used. "Fig. 2" shows the code section for grading the objective questions.

```

<div>
<label for='objMark'>Mark:</label><input type='number' name='objMark' required>
</div><br>Supply Objective response options below:
<hr>
<div>
<label for='optionA'>A. </label><input type='text' name='optionA' required>
</div><br>
<div>
<label for='optionB'>B. </label><input type='text' name='optionB' required>
</div><br>
<div>
<label for='optionC'>C. </label><input type='text' name='optionC' required>
</div><br>
<div>
<label for='optionD'>D. </label><input type='text' name='optionD' required>
</div><br>
<div>
<label for='answer_Obj'>Correct Answer:</label>
<select name='answer_Obj'>
<option value='A'>A</option>
<option value='B'>B</option>
<option value='C'>C</option>
<option value='D'>D</option>
</select>

```

Fig. 2. Screenshot of the code for the Objective grading.

The examiner would also input the right answer. Once the answer chosen by the student corresponds with that input by the student, the student is awarded the mark already preset by the examiner. "Fig. 3" shows the section interface where the examiner imputes the questions, answers, and correct answers.

The essay questions considered in this study were grouped into structured and descriptive questions. Structured questions are the kind of essay questions where the answers expected from the students are defined. The question type is such that the examiners ask the students to 'state', 'name', or 'list' some items. The system was designed such that the answers supplied would be awarded marks once there was a match between the student's input and what was in the database. "Fig. 4" shows the interface where the examiner inputs the

Fig. 3. Objective interface

Fig. 4. Structured essay input screen

questions and matching answers for the structured essay questions and correct answers.

These are essay questions where students are expected to air their opinion or view about a subject matter with respect to what they have been taught. The candidate's understanding of the subject matter is taken into consideration here. The system was designed such that the keywords from several definitions are highlighted and then matched with the synonyms in the database. The need for several definitions arose because if one definition is used, the system will not be robust enough to capture the description of students.

For descriptive questions, the grades are awarded based on the number of matches found in the system. Take, for

instance, the definition of a computer. A computer is an electronic device that takes raw data as input from the user and processes these data under the control of a set of instructions (called program), gives the result (output), and saves output for future use. The definition highlights words such as electronic device, data, input, process, instructions, and the result. Synonyms close to these words would be picked out. For instance, electronic (device, machine), data (facts, figures, information), input (data, details, facts), Process (procedures, methods), Instructions (software, program) Results (output).

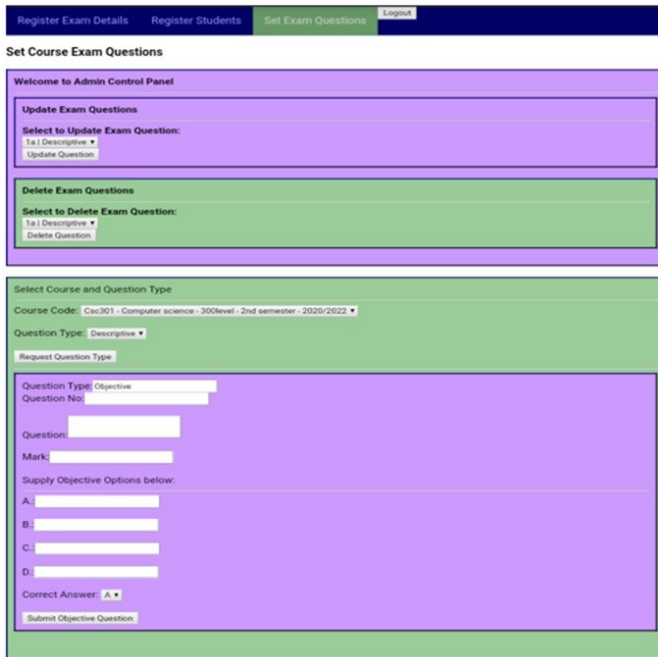


Fig. 5. Set Examination Questions

Another example is the definition of a noun. A noun is commonly defined as the name of any person, animal, place, or thing. A noun is a naming word (identify, refer, represent, label, or tag).

It is the examiner’s responsibility to add those eligible for the exams to the system. This is so that students do not randomly take exams they did not register for. Also, the students cannot access the exams until the time the exams are scheduled to hold. This was done to avoid leakage in the exam questions.

IV. RESULTS AND DISCUSSION

The developed system has five modules: the Login page, details of the examination, set examination page, preview page for the examination, students login, and the students examination page.

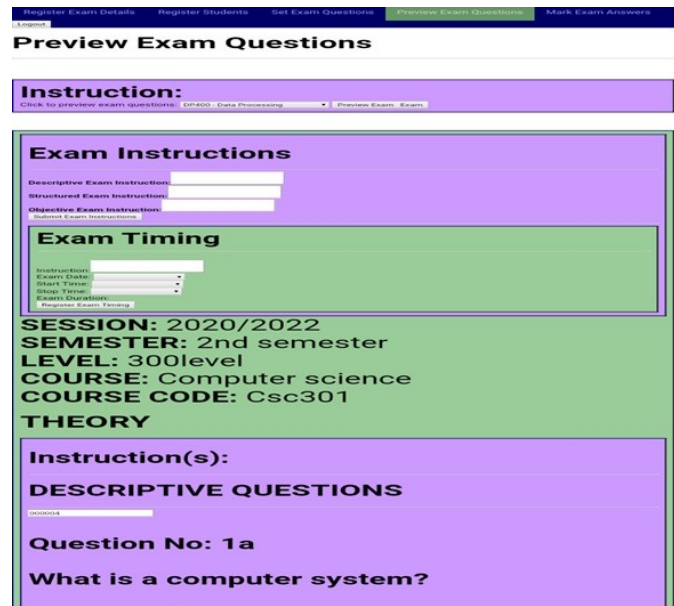


Fig. 6. Preview Exam Page

A. Login Page:

This login page handles the Admin login panel and requires the Administrator to input their login credentials to enable them to access the system. It is the admin’s responsibility once access is granted to feed in the details of each examination to be taken (the questions, the corresponding answers, the marks to be awarded to the questions, and register the students eligible for each examination, etc.). This is shown in Figures “Figures 5, 6, 7”.

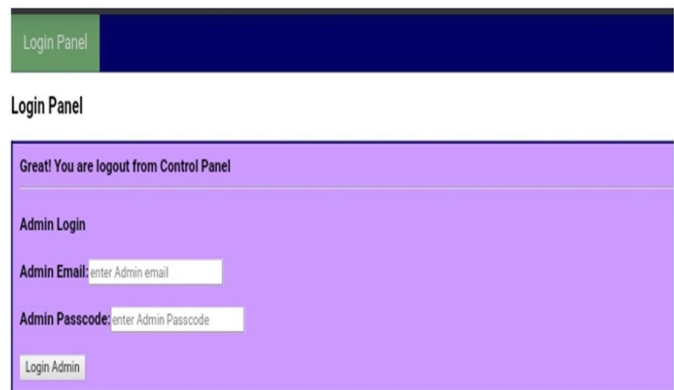


Fig. 7. Admin Login Panel

B. Preview Exam Questions

This module displays what the examination page looks like. The filled details of the examination, which includes the instructions guiding the examinations, the time allowed for the questions, and the details of the examination (such as the course code, course title, type of examination questions, session, semester e.t.c.) are displayed, as shown in 8.

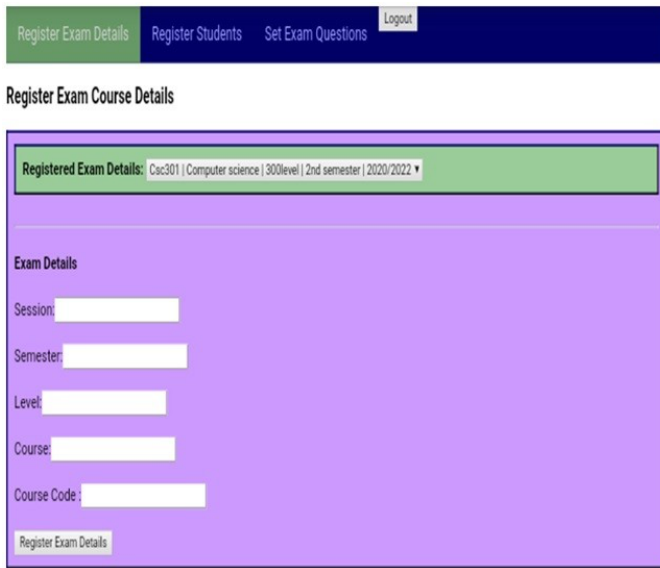


Fig. 8. Details of Exam

C. The Students Login:

“Fig. 9” shows the student’s login page where the student keys in their details (user email and matric no) for the examination to be able to take it.



Fig. 9. Student Login Page

D. Students Examination:

“Fig. 10” shows the interface where the student keys in details (course code and title) of the examination to be taken using the developed system. The student will click on the exam they want to take and request it, and the examination will be shown as well as the duration for that examination

V. CONCLUSION

This study developed an online examination system that would examine students within a timeframe and generate the results at the end of the examination. The system was mainly developed for the simplification and ease of students’ assessment, and this was examined using two question types: essay and objective. The keywords in the answer were highlighted, and their corresponding synonyms were used to match the students’ inputs to the examiner’s inputs. Once there is a correlation, the student is awarded the appropriate marks.

Student Exam Questions

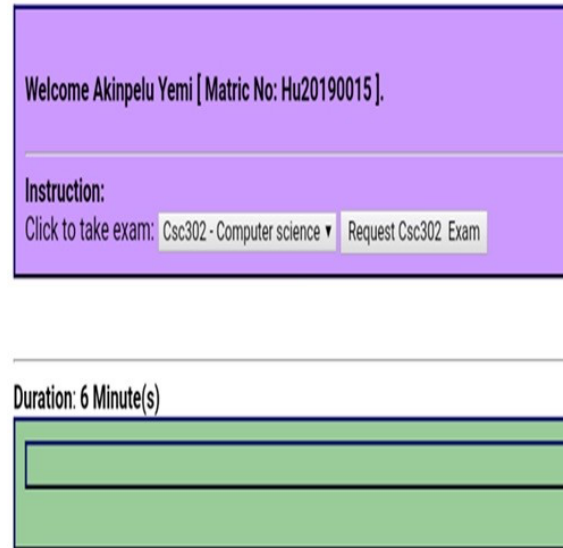


Fig. 10. Student Examination Question

Online examination regarding computers increases test-takers’ motivation. It is a much more secure way of conducting examinations, and many schools and educational institutions have adopted this method of examination. This study ended with designing and implementing a web-based examination system for essays and objectives. Based on the findings, this study recommends that the developed system be evaluated using appropriate tools, and text summarization should be incorporated to get better results. Also, the calculator can be included for mathematical use.

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