

AUTOMATIC QUESTION PAPER GENERATOR SYSTEM WITH BLOOM'S TAXONOMY CATEGORIZATION

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Abstract

Examination process is an important activity for educational institutions to assess student performance. Thus the nature of the exam questions would determine the quality of the students produced by the institutions. Preparing the exam Questions is very challenging, tedious and time consuming for the instructors. Thus with the help of this project a solution is presented in form of Automatic Question Paper Generator System(QGS) which makes use of shuffling algorithm as a randomization technique. This system includes several modules like user administration, subject selection, Course Outcomes specification, question entry, question management, paper generation, and paper management. The design process performs the scrutiny and composes the examination paper using an efficient algorithm with a high rate of success. With this algorithm, the user needs to specify the subject, the question type and the Course Outcomes. From the entered input, the examination paper will be generated automatically. The final question paper will be stored as a .pdf file. In addition, the system will provide automatic detection of Bloom's Taxonomy level of each question, to aid educators in preparing examinations that are aligned to learning outcomes.

Key Words: Automation, Question Paper Generation, Randomization, Shuffling

1. Introduction

Traditionally the question papers are prepared by the faculty of the college using their experience and knowledge. This process will consume more time. The main problem here is there is a chance of getting flawed question papers because of instability of setting the topics, narrow syllabus etc. To generate these question papers one has to put a lot of effort and it is more comprehensive. In this paper a novel approach of generating question paper is proposed in which a computer is involved instead of teacher. Generating question paper automatically plays a pivotal role in achieving grades to the students as well as to the institution.

In this paper, security of the generated question paper is concerned. So whenever a teacher generates question paper an e-mail will be sent to the administrator and the person who generated that question paper which includes the .pdf file and a one-time password (OTP) to download or delete the question paper in the application. Another issue is that anyone cannot modify the question in the database. Here permissions are provided to every user so that a teacher can modify only the questions of the subjects that he/she teaches.

1.1 Question Paper Generator System (QPGS)

This paper introduced the usage of shuffling algorithm in Automatic Question Paper Generator System to overcome the issue stated. The main role

of the shuffling algorithms is to provide randomization technique in QPGS thus different sets of question could be generated without repetition and duplication. Randomization technique is a method that has grown enormously over the past 20 years [1]. It uses a huge question bank with based on the course outcomes elements which refer to the Bloom's Taxonomy.

1.2 Bloom's Taxonomy

Bloom's Taxonomy consists of 6 elements of learning outcomes which include knowledge, comprehension,

application, analysis, synthesis and evaluation. Bloom's Taxonomy segregates how people learn into three domains [4]. First is the cognitive domain which underlines intellectual outcomes. This domain is further divided into categories or levels. The key words used and the category of questions asked may assist in the establishment and encouragement of critical thinking, especially in the higher levels which is very useful for teachers. Further information about the levels and keywords is depicted in the Table 1.1. There levels are written in higher order of thinking skills to the lower order of thinking skills.

Table 1.1: Description of bloom's taxonomy levels

Taxonomy	Description	Action Verbs
Create	This level mainly focuses on producing a new or original work.	Design, Produce, Imagine, Invent
Evaluate	Whether student is able to make judgements based on the concepts he has learned in classroom.	Compare, Critique, Recommend, Test
Analyze	This level extricates facts and inferences so that organizational structure may be understood.	Examine, Dissect, Investigate, Order
Apply	Tests how to use the concepts learned in classrooms on novel situations at workplace.	Organize, Use, Illustrate, Act
Understand	Here the questions will test the students how to Comprehend the meaning, interpretation of problems. State a problem in one's words.	Cite, Describe, Outline, Ask
Remember	This type of questions recalls or retrieves previously learned information.	List, Define, Know, Tell

1.3 Outcome based Education

Now a days teaching institutions has a key point to consider while setting the syllabus and question papers. In order to improve the student's knowledge, they came up with a novel concept called outcome based education which provides quality education to the students. Here there will be two outcomes, firstly course outcome which gives detailed information about the subject taught to the student, another is the program outcome which elucidates the objectives for the program held by the educational institution. Each question or topic to be covered in the subject has to follow the rules of course outcomes and program outcomes. In this system this outcome based questions are generated according to the course outcome (CO) level.

2. LITERATURE SURVEY:

Kapil Naik worked on "Automatic Question Paper Generator based on randomization Algorithm" [2]. It includes a lot of features like add or modify questions in database difficulty level specification etc. The main

advantage of this system is that it uses shuffling algorithm with Randomization technique which eliminates the repetition of questions completely. However, it has some disadvantages such as no generation of multiple types of questions and no specificity of course outcomes.

Shivank Pandey and K.C. Rajeshwari [3] developed an Automatic Question Paper Generation System with the help of some light J2EE tools. It uses B/S architecture to generate a question paper. Here the input will be given to the system in text file which consist of all questions and the output will also be given as a text file by the system which includes Bloom's Taxonomy levels along with the questions.

Suraj Kamy, Madhuri Sachdeva Navadeep Proposed a system [4] which works based on fuzzy logic algorithms. This system takes the input of questions in XML format and will do some fuzzy logic calculations which produce the questions with their respective Bloom's Taxonomy levels. The main drawback of this system is that it can categorize only

multiple choice questions but not text based questions.

Ashwini Gyaneshwar Gaikwad surveyed on Automatic question paper generation systems [5]. They researched about all the techniques that are possible to generate a question paper without any repetition of questions. The main disadvantage of any question paper is that anyone can't generate both multiple choice questions and text based questions; format of the question paper is always in text format which is less secure because it is editable.

In all the previous methods they proposed various algorithms for generating the question paper and to categorize the bloom's taxonomy. In this paper some

of the disadvantages that discussed above are solved. This system uses efficient algorithms for generation of question paper with an elimination rate of 85%. The algorithm proposed for categorization of bloom's taxonomy produces more accuracy than the previous methods. One of the best advantage this system is that it can produce questions of text based answers with course and program outcomes.

3. PROPOSED SYSTEM:

This project consists of different modules which are User Profile module, Question Bank module and Question paper module. These modules play different operations for the project which is shown in Fig 3.1.

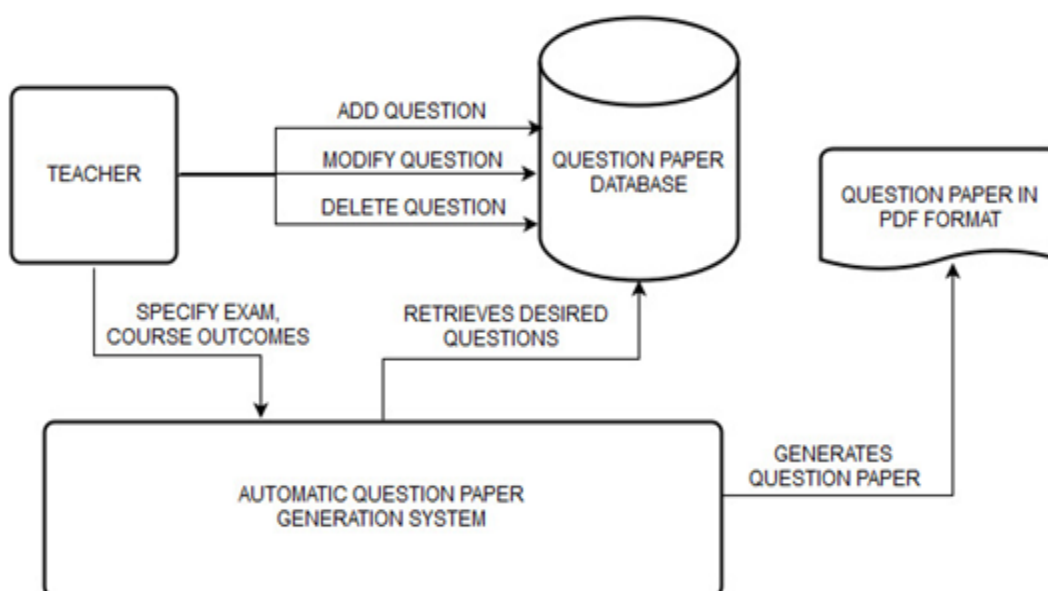


Fig 3.1: Proposed System Architecture

3.1 Teacher Profile

User profile consists of different operations related to the user such as registration of the user in which validation of username, e-mail id and mobile number also implemented. Once the user has been registered he/she can login with the credentials provided at the time of registration. Here user has the flexibility to alter his profile and add the subjects which he/she is teaching.

3.1.2 Update Profile

User after successful logging in can update his/her profile which includes personal data as well as teaching subjects. At the time of registration every

user will be assigned with no subjects for this reason every user has to update his/her profile at least once.

3.1.3 Add/Modify questions in Question Bank

Whenever teacher wants to Add or modify the questions as question paper consists of all the questions only from the database he/she will add or modify the questions in question bank. To ensure security there is a constraint which is that only concerned faculty will have the privilege to modify or delete the questions in question bank.

3.1.4 Generate Question paper

After having all the enough questions in question bank, the user may request to generate the question paper. Now the system checks if required questions

are present in the database or not. If every constraint is satisfied, then it generates question paper as well as an OTP which will be sent to the user and the administrator. A key point needed to consider is that it will require an active internet connection.

3.1.5 Download or delete question paper

There will be a list of all the generated question papers. Administrator and the concerned faculty only will have the privilege to download or delete the question paper as the OTP will be available to those two members only.

3.2 Question Paper Database (Question Bank)

Question bank is the database where the questions are stored in the order of unit and subject. This project provides flexibility to the users with respect to the database. On the other hand, it is important to have security to the questions in the database. Keeping in mind about all these concerns, the users can modify, add and delete questions from the question bank of their respective subject only.

3.3 Automatic Question Paper Generation System

Whenever the teacher requests to generate question paper, this system finds all the questions of the respective subject and unit. It then generates random numbers of that question and retrieves questions

from question bank based on the random numbers. Then it creates a document and prints all the retrieved questions with its respective details.

3.4 Question Paper

After all the questions are adequate for the generation of question paper teacher can choose to generate question paper of appropriate examination. To ensure the security of question papers a random password will be generated after every successful generation of the question paper which will be used to download and delete the question paper from the server. One cannot generate multiple question papers for the same subject and examination at the same time.

3.5 Pre-processing

Every question will be preprocessed before it is inserted into the database. Stop words are removed from the question and then it is tokenized.

3.6 Shuffling Algorithm

Here shuffling algorithm is used to select unique questions from the question bank. The nature of this algorithm is shown in Table 3.1, for a set of N (the total number of question in the database) elements for generating a random alteration of the numbers 1–N.

Table 3.1: Shuffling Algorithm

- | |
|--|
| <ol style="list-style-type: none"> 1. Create an array of N locations. 2. Generate random number. 3. if (loc==0)
Store generated number
else
Compare the generated number with previous number in array.
if matching value found,
go to step 2;
else
Store the no in next location. 4. Repeat step 2 for N numbers. 5. Select questions from DB matching with values from array location one by one. |
|--|

This shuffling algorithm works in a brilliant way such that there is no chance of getting the same question again in the question paper. Initially it generates a random number and places it in an array, later on after every successful generation of random number it checks that the generated number is present in the array or not.

3.7 Algorithm for bloom's taxonomy categorization

In this paper, a novel approach is proposed to categorize the questions into bloom's taxonomy levels which is shown in Table 3.2.

The algorithm proposed in this paper is robust in producing accurate results. Initially it is pre-processed and then it is divided into words in which every word is compared with the keywords in each level of the bloom's taxonomy. If any word matches with this keyword the respective level is concatenated to the

resultant string. This process is continued until the question ends and final resultant string is sent to the database along with its respective question.

Table 3.2: Algorithm for bloom's taxonomy categorization

```

1. Remove Stop Words from the question given.
2. Apply POS Tagging to the output of the Step 1.
3. if (Word == NOUN or VERB or ADVERB)
Go to step 4;
    else if (Word == End of String)
Go to step 6;
    else
Go to Step 3;
4. Compare the word with keywords of bloom's taxonomy levels.
5. Append the Bloom's taxonomy level to the result String.
    Go to Step 3;
6. Print result String.

```

3.8 Database Structure

A database is necessary for providing security and to maintain all the questions and question paper along with appropriate permissions. This project database consists of three tables

- User Table.
- Question Bank table.
- Question Paper Table.

3.8.1 User Table

This table consists of all the data about users which includes name, email id, mobile number and attributes like teaches subject to provide appropriate permissions to the user. Here attributes which are related to the user are stored. They are

- **User ID:** This will act as a primary key for the table.
- **Username:** Username which will be used at the time of login
- **Password:** Password for the user which will stores in the md5() hash form.
- **Email ID:** Email id which is used to send the mail after successful generation of question paper
- **Mobile Number:** Mobile number of the user
- **Teaches:** Subjects which will be taught by the user.

3.8.2 Question Bank Table

This table has attributes such as question, Unit, Subject, CO, bloom's taxonomy and a unique ID to identify each and every question uniquely. Here attributes Unit, Subject and ID combine to form a composite key. This table consists of attributes which are discussed below.

- **ID:** This ID works as a unique identity of a question in a particular unit of a subject in the respective semester.
- **Semester:** Stores about the information to which semester it belongs.
- **Subject:** Gives the detail about the question of which subject it belongs to.
- **Unit:** Gives the number of unit in a subject.
- **Question:** This attribute holds the question to be stored in the database.
- **Marks:** Number of marks allocated for this question.
- **Course Outcome:** Specified course outcome of the question.
- **Bloom's Taxonomy:** Gives the detail about the question comes under which taxonomy level.

3.8.3 Question Paper Table

This table is mainly used to provide the security to the question papers which consists all the information about the question paper i.e. Question paper name and One Time Password (OTP) for that generated question paper. This table consists of two attributes namely

- **Filename:** This attribute stores the filename of the question paper generated.
- **Password:** An OTP to which will be used to download/delete the question paper.

3.9 Use case Diagram

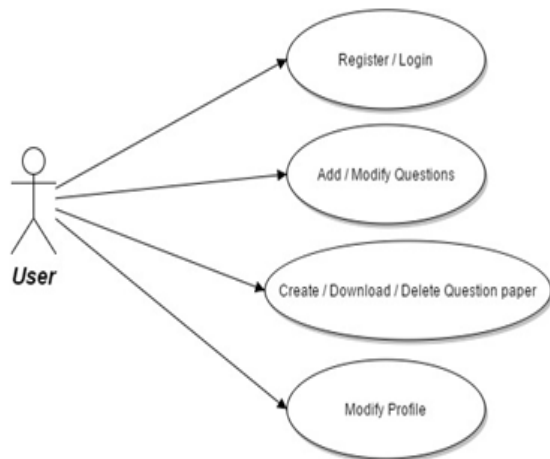


Fig 3.3 Use case Diagram

Use case diagram is a picture that describes all the possible actions to be performed by a user. Each and every action is explained in detail below

3.9.1 Register / Login

User will have to register or login to access this website. To ensure authorization this feature is implemented.

3.9.2 Add / Modify Questions

Only an authorized user can modify the questions in database i.e. one must have to teach the subject to have the right to modify the questions. Whereas every user can view the questions in database.

3.9.3 Create / Download / Delete Question Paper

An authorized person i.e. one who teaches subjects and registered in the website will have the right to create a question paper. But to download and delete question paper user must have an OTP which will be sent to their mail after successful generation of question paper.

3.9.4 Modify profile

Every user will have the permission to change their profile at any point of time. He / she can modify their profile which include attributes like subject, name, password, email and mobile number.

4. EXPERIMENTAL RESULTS AND OBSERVATIONS

By adopting all the specified algorithms, a system have been implemented which generates question papers according to the user's requirements. A sample question paper of internal exam is shown in Fig 4.1 and Fig 4.2 a screenshot of viewing questions from the question bank is shown in Fig 4.3.

 DEPARTMENT OF IT::VRSEC IT8001-fdb A.Y. 2016-17		 INFORMATION TECHNOLOGY	
Class: IV/IV B.Tech		Semester: VIII	
Section: A & B		Time: 45 Min	
Exam: Assignment I		Max marks: 10	
Answer ALL Questions		2X5=10	
1. Illustrate and explain all the testing types. Plan each of them with example.		5M	
2. What is testing? Illustrate different types of testing.		5M	
*****ALL THE BEST*****			
Correlation of Course Outcomes in Assignment I Internal Exam			
CO 1 : Identify the reasons for bugs and analyze the principles the field of software engineering company like google and microsoft in software testing to prevent and remove bugs.			
CO 2 : Identify the reasons for bugs and analyze the principles in software testing to prevent and remove bugs.			
CO 3 : Identify the complications in the transaction flow testing methods and anomalies in data flow.			
CO 3 : Identify the reasons for bugs and analyze the principles in software testing to prevent and remove bugs.			
CO 4 : Learn how to transform specifications into sentences and map them into KV charts.			
CO 5 : Identify the reasons for bugs and analyze the principles in software testing to prevent and remove bugs.			
COs Mapping with questions in Assignment I Internal Exam			
CO	Question No	PO mapping	Level of mapping
CO4	1	a,b	Understand & Evaluate & Apply & Create
CO2	2	a,b	Remember & Understand

Fig 4.1: Assignment question paper

A sessional question paper will consist of short answer questions as well as the long answer questions. Here one long answer question will be generated from the cumulative unit.

	DEPARTMENT OF IT::VRSEC IT8001:Software Testing Methodologies A.Y. 2016-17		
Class: IV/IV B.Tech Section: A & B Exam: Sessional I		Semester: VIII Time: 60 Min Max marks: 10	
Answer ALL Questions		2X1=2	
1. Expand STM.		1M	
2. Write any one difference between testing and debugging.		1M	
Answer any TWO Questions		2X4=8	
3. Explain black box testing with an example.		4M	
4. How many testing techniques are there. Explain any two.		4M	
5. Illustrate and explain all the testing types. Plan each of them with example.		4M	
*****ALL THE BEST*****			
Correlation of Course Outcomes in Sessional I Internal Exam			
CO 1 : Identify the reasons for bugs and analyze the principles the field of software engineering company like google and microsoft in software testing to prevent and remove bugs.			
CO 2 : Identify the reasons for bugs and analyze the principles in software testing to prevent and remove bugs.			
CO 3 : Identify the complications in the transaction flow testing methods and anomalies in data flow.			
CO 3 : Identify the reasons for bugs and analyze the principles in software testing to prevent and remove bugs.			
CO 4 : Learn how to transform specifications into sentences and map them into KV charts.			
CO 5 : Identify the reasons for bugs and analyze the principles in software testing to prevent and remove bugs.			
COs Mapping with questions in Sessional I Internal Exam			
CO	Question No	PO mapping	Level of mapping
CO1	1	a,b	Remember
CO2	2	a,b	Remember
CO3	3	a,b	Understand & Evaluate
CO4	4	a,b	Remember & Understand & Evaluate
CO4	5	a,b	Understand & Evaluate & Apply & Create

Fig 4.2: Sessional question paper

Question bank consists of all the data about the questions which includes course outcomes, bloom's taxonomy levels, unit and marks allotted as depicted in Fig 4.3.

Subject Code : 8001		Unit : 1		
S.No	Question	Course Outcome	Bloom's Taxonomy	Marks Alloted
1	What is testing? Illustrate different types of testing.	CO 2	Remember & Understand	5 Marks
2	Illustrate and explain all the testing types. Plan each of them with example.	CO 4	Understand & Evaluate & Apply & Create	5 Marks
3	What is STM?	CO 2	Remember	1 Mark

Subject Code : 8001		Unit : 2		
S.No	Question	Course Outcome	Bloom's Taxonomy	Marks Alloted
1	How many testing techniques are there. Explain any two.	CO 4	Remember & Understand & Evaluate	5 Marks
2	Expand STM.	CO 1	Remember	1 Mark
3	Explain black box testing with an example.	CO 3	Understand & Evaluate	5 Marks

Fig 4.3: A screenshot of question paper database (question bank)

This chapter has shown various screenshots of the implemented system which gives a brief idea about the system. Next chapter deals with the conclusion and what are the future scopes of this system and how this paper can be extended.

5. CONCLUSION AND FUTURE SCOPE

A novel approach for the categorization of questions into bloom's taxonomy is proposed in this paper. This application works as a web application with several features like authorization of users, security of questions as well as question papers. The results show the potential proofs of implementation of efficient algorithm. Our future effort is to implement categorization with more accuracy and to take the input from various domains.

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