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Research paper

The Framework for Web-Based Automated Online Question Paper Generator through JEE

Vinayak Hegde[1*], Lavanya V Rao[1], Shivali B S[1]

[1] Department of Computer Science, Amrita School of Arts and Sciences, Mysuru, Amrita Vishwa Vidyapeetham, India.
**Corresponding author E-mail:h_vinayak@asas.mysore.amrita.edu*

Abstract

Examinations are an indispensable part of a student's life. In the conventional mechanism, the question paper generation is time-consuming work for the faculty members of the educational institution. Every educational institute mandatorily expects exam setters to follow its own typesetting format. We have designed the automated question paper setting software to be user-friendly so that, paper setters can overcome from the typographic problem. Presently in most of the educational institutions question papers are set manually. It is time-consuming work and there may be chances of repetition of the same questions. So, in order to make the question paper generation more convenient to use, the web application is developed using Java Enterprise Edition (JEE) that can be accessed from LAN/Intranet.

The application comes with the Admin Module and Teachers Module. The Admin grants access to the users by registering them. The faculty can access the system once they are registered. The faculty can enter questions in the database daily as per their free time. In this way, the question pool can be generated. The questions are approved by the chairperson and substandard questions are discarded. The question paper is then generated by selected course experts. The Fisher-Yates Shuffling algorithm used to choose questions randomly from the pool of questions from the database. Text Mining Algorithm aids in duplicity removal from the paper. The generated question paper will be in Word Format. In our application, we assure better security, removal of duplicity, cost-effectiveness, and human intervention avoidance. It can be used by small-scale and large-scale institutions.

Keywords: *Automated, question paper, shuffle, Fisher-Yates Shuffling, Online Question Paper, JEE*

1. Introduction

The quality in the question paper showcases the eminence of the educational institute. As per our observation, problems identified in manual question paper setting, the question paper setter's sets the question paper which is out of the educational institute/university defined template and many repetitions are also found in the question paper. The manually created question papers may be low quality and relatively concentrated on few areas of syllabus [1]. The examination process is not only evaluating the learning ability of the student, it exhibits the teacher capability in his or her teaching in the classroom. [2]

1.1. Conduct of examination

The conduct of examination is the continuous and predominant process in the educational sector. Every educational sector works on preparing the question papers for internal test, class tests and end semester examinations. The unprejudiced question papers provide a healthy atmosphere for students to prove their ability. The classroom test, the periodical test is to assess the students learning ability to observe the outcome of the objectivity. Every time preparing the question paper is a very tedious task.[3] The automated software can help teachers to concentrate on the quality of the questions rather than indenting the questions in the question paper.[4] By preparing the standard question paper teacher can analyse the results of the student where faculties came to know where exactly students need an extra training to improve them. [5]

1.2. Role of teacher in preparation of manual question paper

Every teacher plays a vital role in preparing the question paper one way of the other. The senior and experienced teachers are trusted to prepare the question paper as per the university blueprint. In the question papers setting base camp following problems are identified.

TABLE 1: Problem Statement

Problem Statement			
The question paper setting process	The Problem Statement	Cause	Effect
The question paper setting at the central location	Getting appropriate questions as per university guidelines	Question setters not strictly stick to the university instructions	Uniform balanced question paper is not maintained
Question paper setting at the base camp	No standardization in the selection process	Proper processes are not maintained to set the questions.	Question paper become more substandard.

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Problem Statement			
The question paper setting process	The Problem Statement	Cause	Effect
Finalizing the question paper and scrutiny	Questions are repeated and portions are covered only within two units	The scrutinizers are not focusing on grammars and similarity in the questions	There is a possibility of duplication of questions in the paper .

1.3. Problem faced in manual question paper generation

Problems pertaining to question paper preparation at the paper setting camp are really a tedious job for few sets of subject experts. University with many affiliated colleges finds really tough task to manage various programmes and various subjects to set question paper in a standard format is a herculean task. The following problems are identified in manual question paper generation.

- Manual question paper generation process consumes more time and cost
- Even though question banks are provided, more effort and time is necessary to retrieve the question according to the need of the university defined curriculum
- There is no proper timing and defined schedules are maintained to generate the question paper
- It is very difficult to question setters to correct the grammar of the question and avoid similar meaning between the two questions

1.4. Role of Online web-based question paper generation

The application allows the user to create question banks for various programs, courses, and chapters it stores the data in an organized way. The user can create tests with the desired criteria. The application allows you to create questions from any subject, chapter, unit that you want. This application is very useful for people especially teachers who are spending a lot of time in creating tests for their students. The questions and their category that are fed into the online test creator can be customized to fit the purpose. [6]

Automated Question Paper Generator System that can reduce time consumption by replacing the conventional method of question paper generation system. It also needs lesser manpower. In our system we allow the administrator to input a set of questions. We also allow admin to provide levels of questions (level1, level2) and complexity for each of these questions. After this, the questions are stored in the database along with their weight age. [6]

2. Related Works

Kapil Naik, Shreyas Sule, Shruti Jadhav, Surya Pandey understanding the importance of examinations have developed software which uses the shuffling algorithm as a randomization technique. The application has Admin and Teachers module. For a paper generation, the user must specify the subject, type of questions and the level of difficulty. After entering the criteria required, the paper is generated. The paper is saved in .doc. [7]

In this paper, F. K. Gangar aims at replacing the manual operations with computer procedures and other machines. The application comes with five modules: Login Module. The question paper generator software can be used for prediction of student performance [11]

Administrator Module, User module and an Exam type selection module. This paper has implemented Randomization Algorithm .The application has a simple user interface, well-formatted question paper generation pattern is followed. Questions are categorized as Memory-based, logic based or application based questions. The questions modifications and updates are allowed. The question paper is generated in .pdf form. [4]

M. Mohandas, A. Chavan, R. Manjarekar, and D. Karekar aim at generating question papers in an easy and efficient manner to help the Educational sector. This application aids in creating random but even questions which cover most of the required chapters .It allows selecting the level of difficulties. The working of the application is as follows, the admin makes a skeleton of the question paper later the faculties must enter the questions into the database. Admin analyses the paper. After analysing the paper can be mailed to the institution. This paper has made use of the Waterfall Model and Fuzzy Algorithm. In this paper, a new fuzzy logic based IQPGS system has been proposed to make the application faster and efficient. [8]

The system proposed by R. Bhirangi and S. Bhoir uses role-based hierarchy which has multiple users with multiple roles to perform thus helping in workload distribution. There are two modules here-The Admin Module and Teachers Module wherein the Admin can enter questions into the database and also generate question papers whereas the teacher can only generate question papers. Shuffling Randomization Algorithm and Role-based Hierarchy model are used here for the generation of question papers. This system is effective because it has a Simple interface and updating data is easy. Question Type can be Knowledge-based, Logic-based, Memory-based and Application-based. Questions can be modified i.e. edited easily. [3]

3. Methodology

3.1 . System Architecture Design:

The proposed question paper generating software is developed on the basis of the type of evaluation system. The architecture (Fig. 1) mainly consists of three layers;

3.1.1. Setting the University functionality:

a) University/College Registration: Initially, in this module, admin register the university name and its various departments like Management and commerce, computer science, visual communication etc.,
b) Programme Registration: The second step to register the various undergraduate and postgraduate programmes offered at the various departments
c) Course Registration: The third step to register the various courses under the offered programme
d) Topic Registration: The fourth step to register chapter and topics under the offered courses.

3.1.2. Pattern composer:

Every university administers the question paper as per its own format and pattern. The enormous challenge for question paper panel member to set the questions as per the university format. Here admin will set the question paper generation pattern as per the pattern of End semester, periodical test and class test. According to the pattern, online question paper pattern composer set the question from the pool according to the specified level of questions.

3.1.3. Question aggregator:

This module is mainly designed for the teacher who enters the questions in the software at the time of generating the pool. They have to choose different types of questions like multiple choice multiple answer, multiple choice single answer, descriptive type questions, short answer questions, fill in the blank, match the following and true/false type questions etc... This module accepts varieties of questions and helps to merge it into a single question paper as per the requirement.

Each question is stored in the database and each time question paper aggregator algorithm arranges the question as per the requirement by accessing the questions from the database. Shuffle algorithms are used to randomly choose the questions in the pool.

The final question paper is generated in the format of pdf or word file as per the defined template

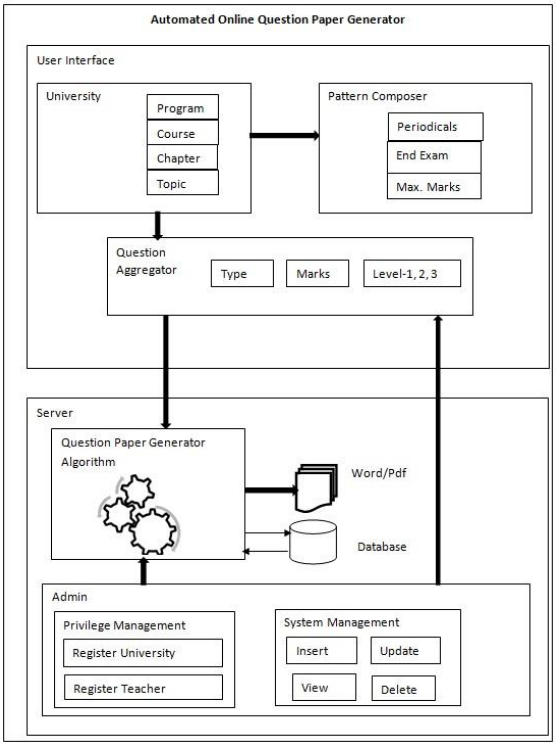


Fig. 1: System Architecture

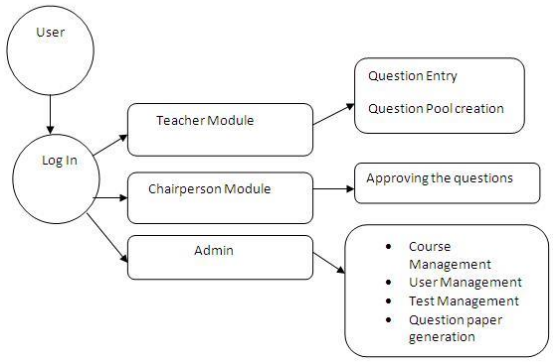


Fig. 2: System Functional Model

3.2. Modules

3.2.1 Admin login: Admin is responsible for creating the login credentials for all faculty members in the organization. Admin register the university, department, various programmes, chapter, and topics. If any modification with respect to the above, administrator can grant any changes. Admin also responsible to manage the course, user, test and question paper. Refer the Fig.2.

3.2.2. Faculty login: As per the login credentials provided by the admin, the faculty from the respective educational institute can insert the questions as per the programme and courses defined to them. Every individual faculty can add the question with the interval of time to increase the number of questions in the pool. Faculty can edit, delete the questions from the pool. Before entering the questions faculty members have to choose the Institute name, department, programme, semester, course, question type and level of questions.

3.2.3. Categorizing the questions: The questions are categorized as per its complexity and marks.

- Easy - Level 1 1 marks to 2 marks
- Moderate - Level 2 3 Marks to 5 marks
- Difficult – Level 3 8 marks to 10 or 12 marks

These above-mentioned categories are entered by the faculty while entering the questions. [8]

3.2.4. Question Approval: The good quality of the questions is approved and substandard questions can be rejected. The questions audit can be done by the department head.

3.2.5. Generic Template: This Automated question paper generation software can be used by any organization by changing the template design.

3.2.6. Generating the question paper: The admin is responsible for generating the question paper for the respective educational institute. Question paper can be generated unbiased as per the blueprint by choosing the level of the question paper and allotment of marks. When admin chooses the number of questions in each level and type of questions it selects the pool where type and level of the questions are selected and question ids are stored in an array and Fisher-Yates shuffle Algorithm is used to randomly select the questions and preview are generated. Once admin approves it generates the question paper in word format as per the required total number of marks.

4. Implementation

4.1. Java Enterprise Edition (JEE) Server architecture:

The automated web-based online question paper is generated through the lightweight JEE tools [9]. Here we have used the Tomcat server as a web server. Server-side coding JSP is used and client-side HTML5, CSS is used. MySQL is used as a database server. In this process client sends a request to the server, after processing, the server responds back to the client. After validation, data will be saved in the database. The three-tier architecture is shown in the Fig.3. [9]

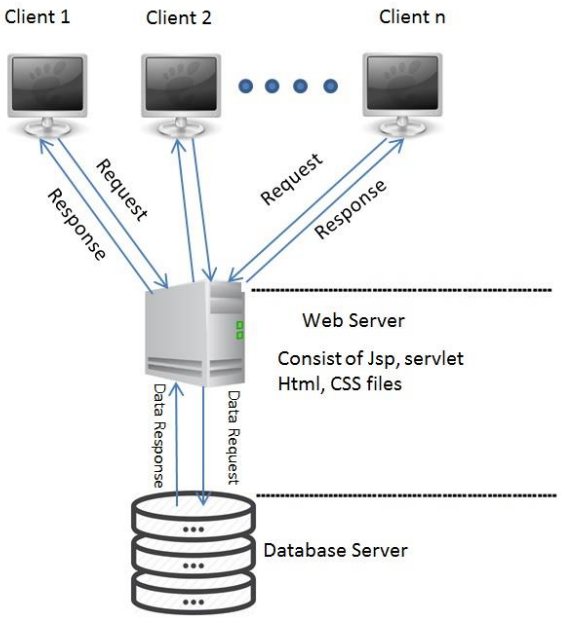


Fig. 3: The Three-tier architecture of JEE Server

4.2 Algorithmic Implementation*:*

Consider the random permutation of questions Q = [q(0), q(1), . . . , q(n − 1)] ∈ A which can be computed as follows:

Algorithm Generate a random permutation P ∈ A.

1. Set Q := 1n (identical permutation). (1)

2. For k := n, n − 1, . . . , 2 do: (2)

Set i: = Z(k) (random i ∈ {0, 1, . . . , k − 1}). Swap p(i) with p(k − 1).

This form is due to Durstenfeld [10], it is usually called Fisher-Yates shuffle,

4.3. Step by step implementation of the Fisher-Yates shuffle algorithm:

Select the type of the questions 'T'

1. Enter the number of questions 'N' required to be inserted in the question paper with respect to type 'T'
2. Selects the total number of questions available in specified type 'T' by searching the question serial ID in the database and store it in an array 'A'
3. Selects the total number of questions available in specified type 'T' by searching the question serial ID in the database and store it in an array 'A'
4. The random generated number 'K' is swapped one by one from the first location of an Array 'A' until all question number 'N' is generated by subtracting the Array 'A' size each time by one. [N-1].

4.4. Mathematical Representation:

For 'n' number of elements
Select Random integers Xi
For i=1 to n
With i<= Xi<= (n+1-i)
At stage i
the number of move to next position step is at least
(Xi-1)
When the Motion is iterated through an array or a linked list
The expected number of those steps is at least

$$\sum \mathrm{E}[(\mathrm{Xi}-1)] = \sum\left(\frac{\mathrm{i}+1}{2}-1\right) = \frac{\mathrm{i}-1}{2} = \frac{\mathrm{n}(\mathrm{n}-1)}{4} = \mathrm{O}(\mathrm{n}^2)$$

A program demonstrating Fisher Yates Algorithm

```
import java.util.*;
public class Shuffle_Algo
{
      static int[] fisherYatesShuffling(int []arr, int n)
       {  int []a = new int[n];
            int []ind = new int[n];
            for(int i=0; i<n; i++)
            ind[i] = 0;
           int index;
           Random randm = new Random();
    for(int i=0; i<n; i++)
    {          do
       {              index = randm.nextInt(n);
       }
    while(ind[index] != 0);
       ind[index] = 1;
       a[i] = arr[index];       }
    return a;
  }
   public static void main(String agrs[])
  {
    Scanner ss = new Scanner(System.in);
    System.out.println("Enter the array size:: ");
    int n = ss.nextInt();
   System.out.println ("Enter the array elements: ");
    int []a = new int[n];
    int []res = new int[n];
    for(int i=0; i<n; i++)
    {
       a[i] = ss.nextInt ();
    }
    res = fisherYatesShuffling(a, n);
    for(int i=0; i<n; i++)
    {
      System.out.print(res[i]+" ");
    }
    ss.close();
  }
}
```

Following screenshots, Fig.4., Fig.5.gives glimpses of the interface design, part of the implementation.

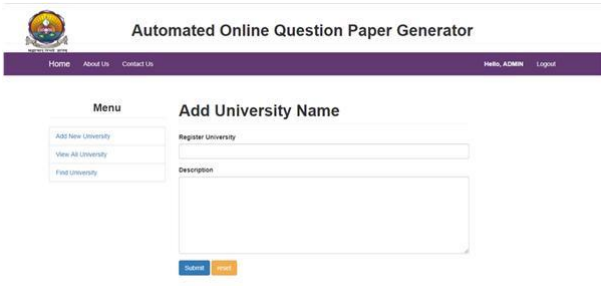


Fig.4: Adding university name

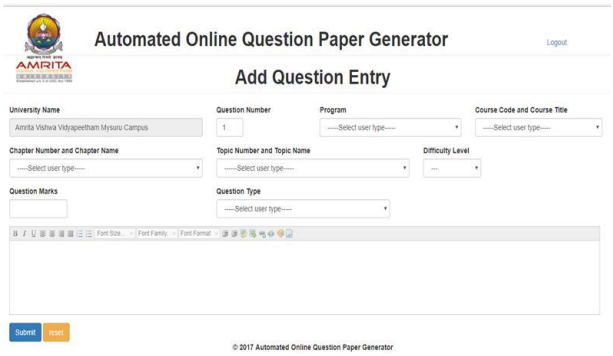


Fig.5: Inserting the questions in the software

5. Conclusion

The Automated Web-based question paper generation software saves a lot of time of the faculty members in comparison with manual question paper creation. Day by Day technology is growing with its own potential. In proportion to that, the higher education sector has to adopt ICT and internet technology to win a race between the institutions. With the increase in the number of courses, a number of students and programmes handling is a challenging work. Automated web oriented question paper can be generated using server sided coding using JSP, Servlet, EJB etc., with technology Java Enterprise Edition. Admin is responsible for adding the university, departments, programmes, courses and generating the question paper. Shuffle algorithm is used generate the question paper. At last the question paper is generated through pdf or word file document. In future this application can be enhanced by implementing the Natural Language Processing to generate question paper through the pool of key words from the academic course plan rather than adding the questions in the pool.

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