

# Automated Question Paper Generation System

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## Abstract—

**I**n today's age, education is the most important way of achieving success. When we discuss education, it is imperative to mention tests and examination. Examinations prepare students in their quest for knowledge. So, having a proper examination paper and format is quite necessary. Now the traditional method of generating question paper has been manual. In this method certain officials chalk out the question paper. But this method can be ineffective at times owing to bias, repetition and security concerns. We have proposed an Automated process of Question Paper Generation which is fast, streamlined, randomized and secure. Every task performed by this system is automated so that storage space, bias and security is not a concern anymore. Furthermore, we have proposed a new algorithm which ensures total randomization of questions and avoids repetitions. The proposed system can be helpful to many educational institutes and NGO based institutes.

**Keywords—** question paper generation; paperless; automation; randomization; information communication technology.

## I. INTRODUCTION

A design of suitable automated system for generating question papers and managing related data may prove vital in an Educational Institute. In this paper, we have proposed an integrated automated system that stores questions related to a particular course and prints a question paper based on its syllabus and curriculum. We have implemented a role-based hierarchy which restricts access to the users. The system also deploys security mechanisms that prohibit duplication of question papers. There are provisions to enter and edit data suitable to any educational organization with complete freedom for specifying courses, semesters, syllabus and pattern. This enables an educational institute to generate question ensuring security and non-repetitiveness of question papers and is a boon for organizations with limited staff and resources. Our system aims to provide fast operations, data storage and high security for all its tasks.

The evolution of traditional and existing Question Paper Generation systems and the need for an automated system is unravelled in Section II. In Section III, we have proposed our revised system of Automated Question Paper Generation. Section IV describes the real-time implementation and results of the system. Further, Section V concludes the paper and comments on the key points of the system.

### A. Paper-based vs Paperless Systems

Table I Paper-based vs Paperless Systems

Paper-based System	Paperless System
Human process	Automated process
Low Security	Higher Security; Encryption
Patterns or repetitions may occur	Totally random and unbiased process
Slow as human labor involved	Faster due to computer based automation

### B. Automation

Automation means to replace the manual operations with computer procedures and other machines. Automation is aimed at increasing productivity, manufacturing prowess. It also reduces costs, labour and eliminates human error [2].

### C. Types of Automation

Automation helps to increase productivity and reduces costs in industries. Automation plays a crucial role in manufacturing industries. Automation can be of different types: -

- Information technology (IT)
- Computer-aided manufacturing (CAM)
- Numerically controlled (NC) equipment
- Robots
- Flexible manufacturing systems (FMS)
- Computer integrated manufacturing (CIM)

### D. Information Communication Technology (ICT)

ICT refers to technologies that use telecommunication to facilitate transmission of information. Internet and wireless networks can be thought of as medium for ICT. ICT has presented new communication resources over the years [2].

### **E. ICT in Automation**

ICT are capable of sustaining powerful automation as they provide an unparalleled infrastructure [2]. ICT plays important role in automation because of following reasons -:

- a) ICT allows user to access resources from any location at any time and improves the System Performance [2].
- b) ICT facilitates access to remote resources and allows effective utilization of the resources [2].
- c) Communication channels are efficiently optimized [2].
- d) ICT enhances the quality of education which proves vital [2].

## **II. LITERATURE SURVEY**

### **A. Existing Paper-based Systems**

The existing system for Question Paper Generation requires human staff to chalk out questions that appear in the question paper. These teachers or professors select the questions according to the syllabus and pattern as prescribed by the curriculum. The question paper then may be referred to a higher authority who has the final say in these matters [5].

### **B. Limitation of Paper-based Systems**

As most human working processes, this system suffers due to bias. There might be some questions which are repeated in many question papers as the professor has a personal inclination towards them. So there is no guarantee of pure randomly generated question paper. Other problems that may plague this system are non-availability of staff and resources, natural calamities and accidents. Also, the security of the system can be easily compromised if leverage over the person responsible for generating question papers is obtained.

Other limitations include: -

- a) Lack of storage space
- b) Prone to damage
- c) Inefficient document transportation
- d) Supply costs
- e) Poor environmental credentials
- f) Limited collaboration
- g) Editing problems

### **C. Existing Question Paper Generation Systems**

The research paper 'Framework for Automatic Examination Paper Generation System' has provided a thorough insight into the process of automated paper generation [3]. As the manual generation of a balanced question paper by an individual is quite complex, the blending of technology into teaching and learning process is inevitable. A simple and efficient way for an examination paper generation is provided. A three tier model is provided in this framework [3].

Generation of Examination Papers is governed by the Syllabus Engine, Pattern Composer and Question Aggregator. The generated question paper is based on the pattern or skeleton of the course. Another component called Bank Management takes care of User Rights and Privilege assignment. Questions are entered through the Question Aggregator. The attributes related to questions are type, marks and complexity. All these attributes are efficiently used during Question Paper Generation [3].

The paper generator selects a question according to the pattern and complexity. This engine also introduces a marking systems wherein any selected question is marked so that it might not be selected again. This prevents repetition of questions in subsequent papers. Finally, generated papers are stored as pdfs [3].

The paper on 'Automatic Question Paper Generation System using Randomization Algorithm' describes a system which uses a shuffling algorithm (existing algorithm) as a randomization technique [4]. The system defines several modules such as user administration, subject selection, difficulty level specification, question entry, question management, paper generation, and paper management [4].

It supports multiple languages. Also, mathematical formulae and diagrams can be integrated in questions. The system has a dual interface viz., web-based and desktop-based [4].

The system introduces a highly efficient shuffling algorithm which uses an array to store randomly generated numbers. The questions are then selected against these array elements, thereby ensuring completely random generated question papers. However, this system fails to utilize the highly efficient marking system. So, questions once selected may be repeated in subsequent papers. This is a limitation of this system [4].

The 'Question Paper Generator System' has provided a ready to use built-in question bank [1]. The paper aptly describes CQZ (Cloze Question Generation) putting more emphasis on the actual type of the questions [1].

Another paper on 'Automatic Test Paper Generation Based on Ant Colony Algorithm' has implemented a complex but highly efficient Ant Colony Algorithm [5]. It requires building of a mathematical model of constraint according to the requirements of the paper. This paper provides an efficient solution with their algorithm [5].

The paper on 'An Integrated Automated Paperless Academic Module for Education Institutes' has stated the importance and working of switching from Paper based systems to Paperless Systems [2]. The importance of automation is very well documented in the context of Task Engineering [2]. The paper also clearly defines the importance of Information and Communication Technology (ICT) in academics and educational organizations [2].

The paper also describes many Access Control Methods such as MAC (Mandatory Access Control), DAC (Discretionary Access Control), RBAC (Role based Access Control) and DTE (Domain Type Enforcement) [2]. Role based Access Control is very helpful in automation due to the user hierarchy comprising of different roles [2].

**D. Analysis**

From above analysis we come to know that we need an integrated Question Paper Generation System with improvements in terms of speed, efficiency, controlled access to the resources, randomization of questions and security. The system should perform tasks in the fastest way without violating the role-based hierarchy and their access rights policy, provide a central database for data storage, ensure security and optimize the overall performance of the System.

**III. PROPOSED SYSTEM**

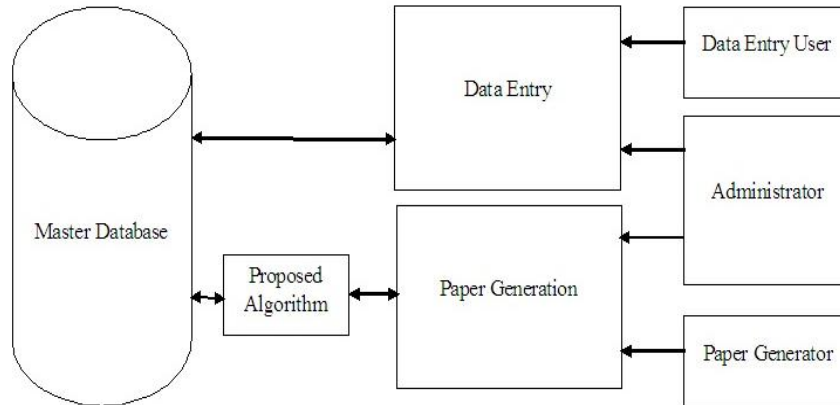


Fig. 1 Architecture of Automated Question Paper Generation System

We have proposed a revised system for Automatic Examination Question Paper Generation which is devised upon the Shuffling Randomization Algorithm and Role-based Hierarchy model. Reference [4] has described a Shuffling Algorithm. Our system has revised this existing algorithm by integrating an efficient question marking system in our proposed algorithm. The role-based hierarchy allows the tasks to be divided among a number of users depending upon their roles. A central administrator will have complete authority over all tasks and users. The interface is provided using Java and MySQL database is used to store questions and related data.

Syllabus and pattern of any course is considered for all questions and the subsequent generated papers. Also, the system is fully customizable according to any educational institute and course schemes.

Secure Algorithms are used to store admin and user passwords to enhance security. The shuffling algorithm uses a basic randomization algorithm with a flag system used to mark selected questions. This prevents the questions from being repeated in subsequent examination papers.

On generating a question paper, this paper is converted in to an encrypted pdf and can be sent over all institutions on the click of a button.

**A. General Working**

The system is entirely governed through the login screen. Here the user can login using his credentials. On successful login, various systems are available to the user depending on his/her role in the hierarchy.

For e.g. The administrator has data entry options as well as paper generations option. However, the paper generator can only access the paper generation option.

A data entry user (or the admin) can enter various data and customize the system according to the organization. Courses, syllabus, patterns and questions can be entered and are stored accordingly in the database.

The Paper Generator can then generate the paper for any course, examination and year. These question papers are totally unbiased. Also, it is ensured that questions are not repeated in the same or consecutive papers.

**B. Role-based Hierarchy**

Table II User Roles

Users/Roles	Data Entry	Paper Generation
Administrator	Yes	Yes
Data Entry User	Yes	No
Paper Generator	No	Yes

In automation we need to configure privacy and confidentiality. After comparing various access control models, we found that Role Based Access Control Model (RBAC) is suitable for proposed system.

RBAC involves implementation of user hierarchy by assigning the access control based on senior and junior roles.

In our system, there are basically three types of hierarchies viz., Administrator, Data Entry User and Paper Generator. A Data Entry User can only access the modules pertaining to data entry while a Paper Generator can only generate question papers whenever required. The Administrator is authorized to perform all of the tasks while also being able to create new user accounts and edit them.

#### IV. IMPLEMENTATION AND RESULTS

The Automated Question Paper Generation System is implemented in Java. The fully working system stores courses, questions and patterns of question papers. It then applies the algorithm on the stored question set and prints the question paper in pdf format.

##### A. Presumptions of the System

The system has been developed considering the following presumptions: -

- a) All courses provide a well-defined course content which would be taught or left for self-study.
- b) Each course has its specific code.
- c) All questions belonging to a particular course lie in some question type/category.
- d) The institute can have any number of courses and streams.

##### B. Proposed Algorithm

For N questions available in database

Step 1: Create a List 'L' of N elements

Step 2: Generate a random number 'n' such that  $1 \leq n < N$

Step 3: If  $n \in L$

Go to Step 2

else Store n in the List L

Step 4: Select a question from database corresponding to n, whose flag==true

Step 5: For the question, set flag=false

##### C. Results

We assume that there are total 10 questions in an Examination Paper (all inclusive). We have tested the Paper Generation for various inputs using both algorithms. The inputs are the number of questions of each course. We have calculated the number of papers generated before a question is repeated for the existing algorithm and the proposed algorithm in the worst case scenario. Based on our experimental analysis, we get the following results.

Table III Working of Algorithms for Various Inputs

Input	Number of papers generated before a question is repeated	
	Existing Algorithm	Proposed Algorithm
20	1	2
40	2	4
80	2	8
100	5	10

Based on the results, we have generalized that,

Table IV General Comparison of Algorithms

Minimum Number of papers generated before a question is repeated	
Existing Algorithm	Proposed Algorithm
1	N

Where N is total number of questions (assuming one question selected per paper)

We have concluded that,

Efficiency of Algorithm  $\propto 1 / \text{Probability of repetition of questions}$

So, efficiency is inversely proportional to probability. This proves that a particular question will be used only once before all the questions are selected in the paper.

This generates a random and different question paper each time.

For the proposed algorithm, the probability that a same question paper will be generated is,

$$P(x) = (1/10) * (1/9) * (1/8) * (1/7) * (1/6) * (1/5) * (1/4) * (1/3) * (1/2) * (1)$$

$$= 1/3628800 \quad (\text{assuming 10 questions available and 10 questions per question paper})$$

##### D. Application

The revised Automatic Question Paper Generation System is accessible on personal computer and laptop.

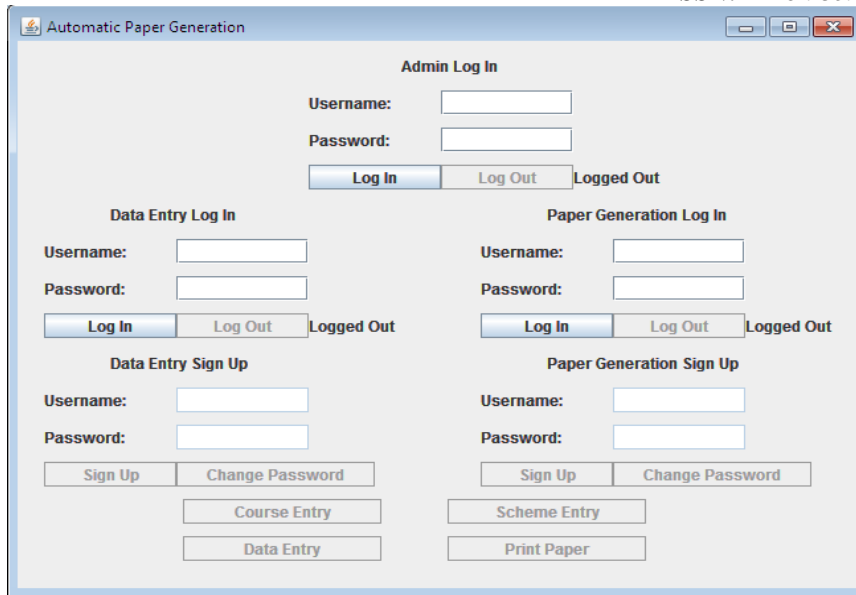


Fig. 2 Login Screen of Automated Question Paper Generation System

Fig. 2 represents Login Screen of system through which admin and users can login.

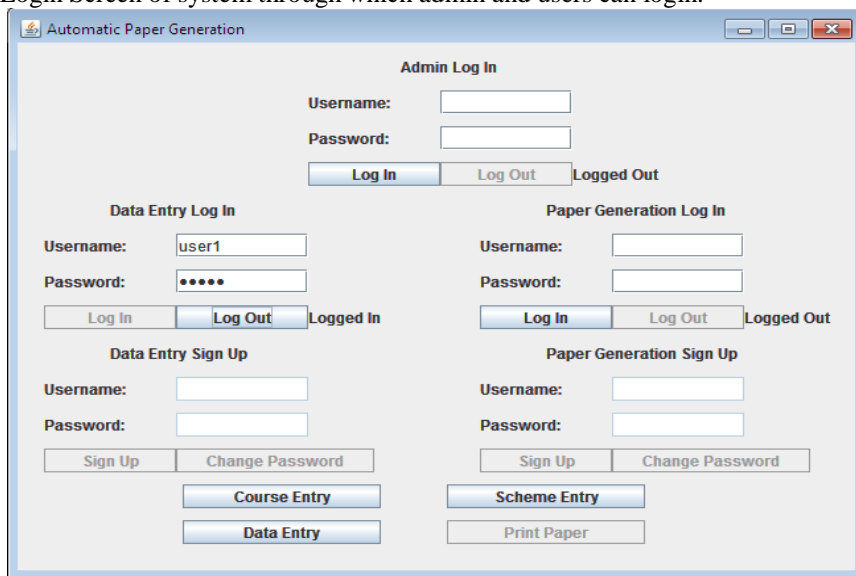


Fig. 3 Data Entry User Login View

Fig. 3 represents the Login Screen when a Data Entry User logs in.

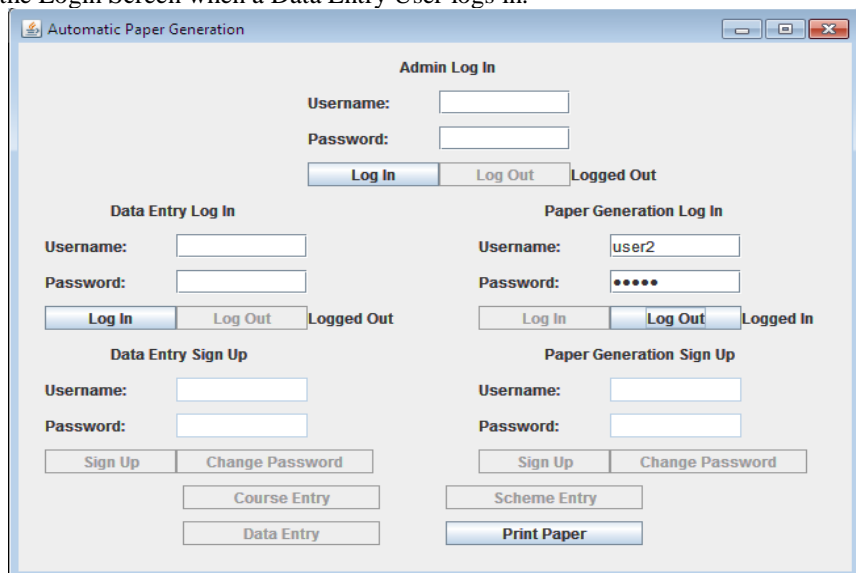


Fig. 4 Paper Generator Login View

Fig. 4 represents the Login Screen when a Paper Generator logs in.

The screenshot shows a window titled "Automatic Paper Generation". It contains several input fields and buttons. At the top, there are fields for "Enter Branch:" (containing "Instrumentation") and "Enter Branch Code:" (containing "IN"), with an "Add Branch" button below them. Below this is a "Branch List" section with a dropdown menu set to "Computer", and "Modify Branch" and "Delete Branch" buttons. Further down, there are fields for "Branch:" (dropdown, "Computer"), "Semester:" (dropdown, "I"), "Enter Course:", "Enter Course Code:", "Enter Course Marks:", and "Theory Exam (Y/N):", with an "Add Course" button below. At the bottom, there is a "Course List" section with a dropdown menu set to "Applied Mathematics I", and "Modify Course" and "Delete Course" buttons.

Fig. 5 Enter Streams, Courses and their corresponding marks

Fig. 5 represents the window where new Streams/Courses and their details can be added, deleted or updated.

The screenshot shows a window titled "Automatic Paper Generation" with a "Question List" section at the top. The list contains four questions: "Define Chemistry.", "What are the differences between Vulcanization and Ore?", "Define Metallurgy.", and "Give steps of Vulcanization.". Below the list are several dropdown menus: "Branch" (set to "Computer"), "Semester" (set to "I"), "Course" (set to "Applied Chemistry I"), "Course Code" (set to "AC-I"), and "Question Type" (set to "2K"). There is an "Enter Question:" text box and three buttons: "ADD", "MODIFY", and "DELETE".

Fig. 6 Question Entry

Fig. 6 displays the window where questions for any course can be entered, deleted and updated.

The screenshot shows a window titled "Automatic Paper Generation" with several dropdown menus and a "Print" button. The dropdowns are: "Branch" (set to "Computer"), "Semester" (set to "I"), "Course" (set to "Applied Mathematics I"), and "Course Code" (set to "AM-I"). Below these are radio buttons for "Winter" and "Summer" (with "Summer" selected), a "Year" field (set to "2016"), and a "Date" field (set to "2016/01/10"). A "Print" button is located at the bottom.

Fig. 7 Generate Question Paper

A Question Paper can be generated for the specified Course and Semester. This system prints the paper in pdf format corresponding to the system time as shown in Fig. 7.

### **E. Features and Benefits**

Following are some of the features of the Question Paper Generation System: -

- a) Simple interface which enhances the ease of updating data.
- b) Generates and prepares the Question Paper in a matter of seconds.
- c) Question Type can be Knowledge-based, Logic-based, Memory-based and Application-based.
- d) Questions can be easily edited.

The Automated Question Paper Generation System provides various advantages to the user when compared to the traditional system. Listed below are some of the advantages of the system: -

- a) User can generate test papers randomly and instantly, thus saving a lot of time.
- b) The algorithm enables randomization of questions.
- c) A new question can be added to the database at any instance and different sets of test papers could be generated without any limitation.

## **V. CONCLUSIONS**

In this paper, an automated model for Question Paper Generation is proposed which is implemented as a real-time application in Samnx Pvt. Ltd., Belapur, Navi Mumbai. The proposed work describes an automated system that progresses from the traditional method of paper generation to an automated process, by providing controlled access to the resources. This is achieved by comprehending users and their roles in the institute. We have also considered the importance of randomization in the task of paper generation. Our system has deployed an efficient algorithm which is totally randomized and avoids repetition of questions in consequent question papers, making it impossible to derive any pattern in the papers. We distinguish between administrators and subordinates by their tasks. Therefore, the resultant automated system for Question Paper Generation provides improvement in terms of controlled access to the resources, random generation of question papers and a secure platform.

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