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Introduction and Background

This document contains Medha Innovation and Development Pvt. Ltd., project description for designing an integrated solution to meet the requirements for an Intelligent Question Bank and Student Performance Improvement System. For details of the requirements, refer Appendix - A.

The Approach to Develop Solution

The approach for developing the solution to satisfy the listed requirements contains the following:

- Your understanding of the requirements.
- The solution framework and its components.
- Proposed solution architecture, with the technology components that will enable the solution.

Understanding of the Requirements

Based on the listed requirements (Appendix-A), the basic understanding that can be drawn is that the solution is for the Education domain, specifically meant to create an Intelligent, Self-Learning System for Students to take tests and receive feedback by the way of further reading references/videos/articles etc.

The Stakeholders of the Solution

1. Teachers can enter questions in the question bank.
2. Students can enter questions in the question bank, register for a test and go through a number of exercises associated with the test.
3. System admins (list the admin functions here).
4. Data analysts (list the activities the data analysts are expected to perform).

The Major Components of the Solution

1. Individual Questions

With each question having a LEVEL of DIFFICULTY (KPI).

Note: The KPI is not a static value, it depends on how many students are answering a question correctly, the KPI of a question will be adjusted dynamically based on students response to that question.

2. Question Bank

A question bank into which teachers can enter questions, and assign a difficulty level at the time of entering the question.

3. Student Registration

A student registration module that will allow a student to register for a specific test.

4. Auto Generated Test Papers

The test papers that will be generated automatically based on multiple factors, such as the Student's grades and the questions to show based on the LEVEL of DIFFICULTY of the question, and the scheme of the exam prepared by the instructor.

5. Practice Exercises

The practice exercises are those exercises that are associated with student tests.

6. Student Grades

The Student Grades are calculated based on specific methodology that will also provide percentiles.

7. Recommendation Engine

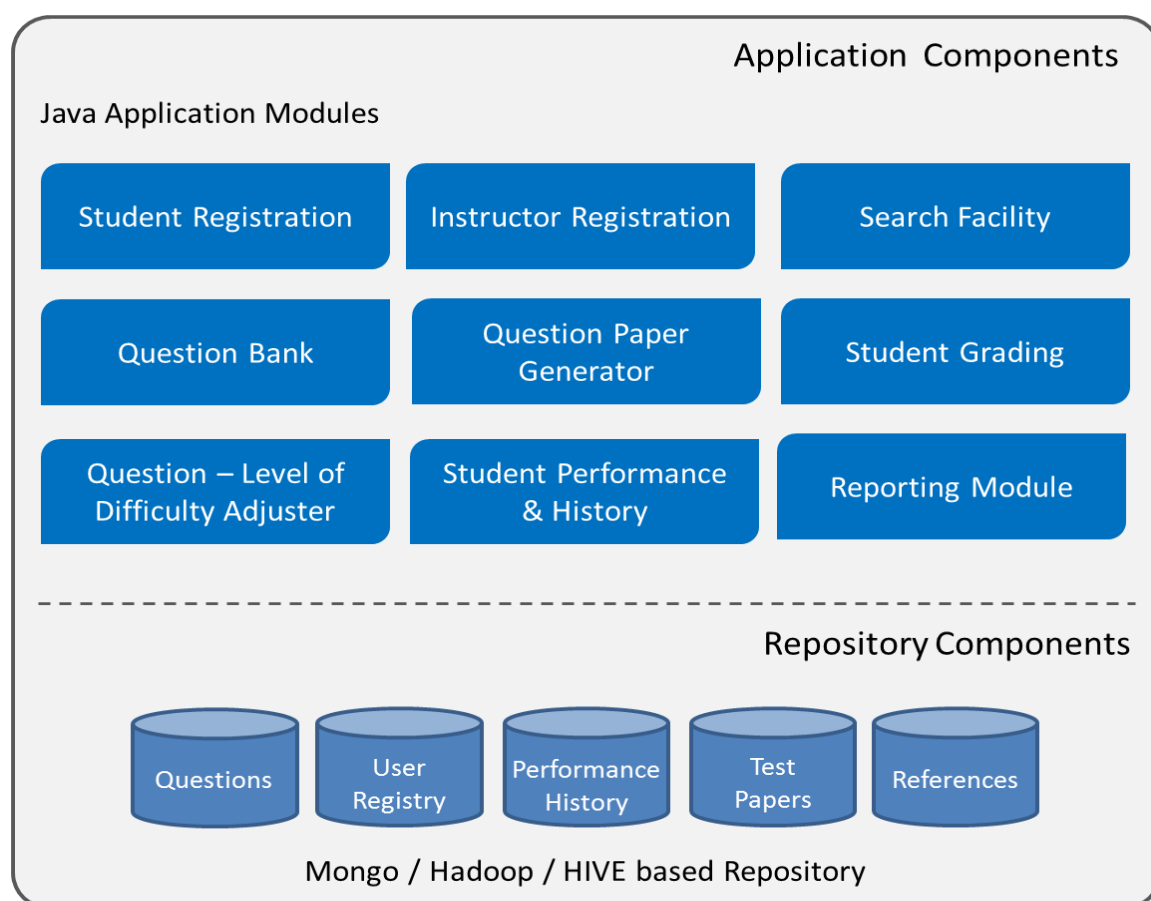
The recommendation engine is the one that will recommend further readings / references / videos / articles based on how a student performs on a test.

Functions Enabled by the Solution

1. The registered student can use the app to search question(s) and try answering it.
2. The students can select some recommended (by the system) questions and take a test.
3. The student study the related, that can be system recommended videos, books etc. online.
4. The teacher can also search and select some questions and push to student for exercise.
5. The teacher use "test paper auto generation" to get a paper and push to students for exercise.

6. The student can also make their own test paper by selecting the recommended questions from the list of questions available in the bank.
7. Student will receive a grade based on his/her performance in the test.
8. The level of difficulty of a question, in the question bank, can be dynamically adjusted by the system based on a number of criteria such as the number of students answering the question correctly.
9. Reports that can generated for performance of students per topic, for performance of students over time in a specific topic or for a number of topics, report for an individual student's performance.
10. Teachers and students can enter questions in the question bank.
11. Teachers can create test papers and assign to specific students to test their preparation.

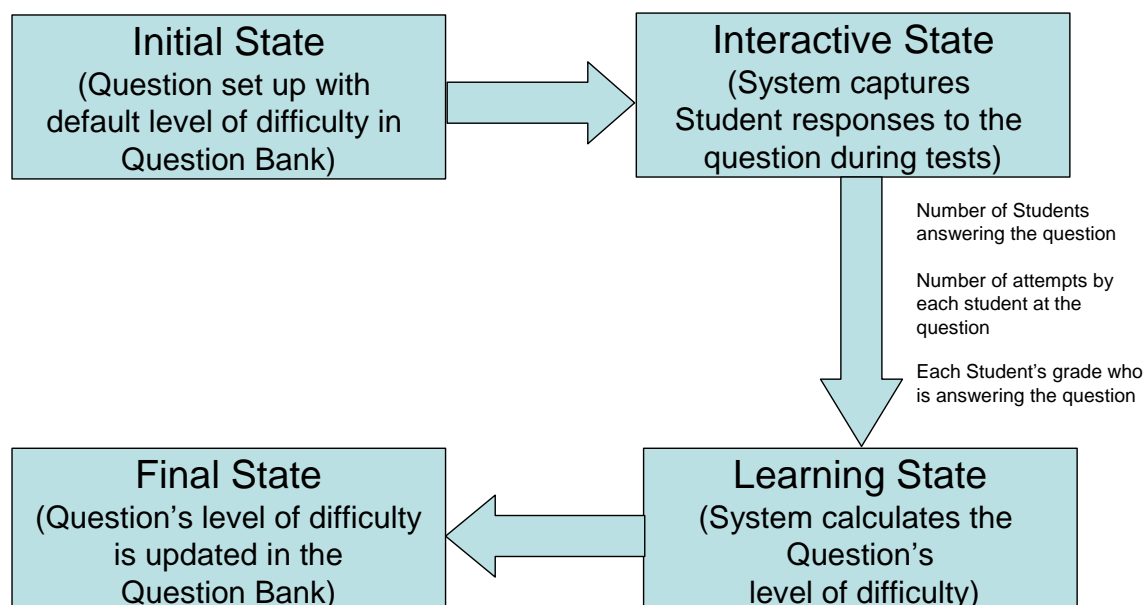
Our Proposed Solution Architecture



The proposed high-level solution architecture diagram shown above will have the following components that will work together to enable the functions required to fulfill the requirements:

- Student registration module
- Instructor registration module
- Question Bank module for entering/editing questions in the bank along with its level of difficulty (KPI) at the time of entering the question. The KPI will be dynamically adjusted based on the performance of students attempting the question. Figure-2 below depicts the process by which the system will self-learn the level of difficulty of a question.

Figure-2: System Self-Learning the level of difficulty of a Question



- Search facility that will allow student and teachers to search for a question based on keywords.
- Test paper generation and testing facility that will generate a question paper for the student based on various factors such as student's past performance, test scheme prepared by teacher and the level of difficulty of the questions available in the bank.

- Recommendation engine that will recommend exercise questions to a student based on his/her performance, recommend further reading/references/videos/articles based on the student's performance.
- Student Grading facility that will calculate the grades of a student based on various factors, such as the student's absolute score on the test, student's performance in comparison with the total number of students taking the same test, the level of difficulty of the questions that were put on the test paper etc.

Note: In a subsequent phase, the student grades can be calculated based on several parameters, such as the student's performance in comparison with the peer group, the number of questions with a high level of difficulty answered correctly by the student, number of attempts taken by the student for a test etc.

Appendix - A: High-Level Requirements

The system is for education purpose, including the application and backend database, big data. We need to design a good model with intelligent machine learning and neural network algorithm, preferred with java or python, which has the following functionality:

1. The existing data is from mysql, including the test bank system with many exam questions and related labels and student's data like their personal information, the history of their daily exercise, the history of their search data, like books, articles, videos etc.
2. The system should analyze these data, when student gets online and finish some questions testing, there will be more questions recommended to him/her automatically very accurately, that means the recommended questions must be suitable to the actual situation of the student.
3. The system can do self-learning, when students do exercise more, the system should recommend questions suitable for new situation, since student has improved in some points, and the module should know that after data analysis.
4. Some question's label in the database can adjust automatically, for example, the difficulty label can be adjusted continuously when more and more student finish the same question testing, according to their testing evaluation, the difficulty KPI should be modified from time to time to reflect the real difficulty to them at that time.

5. When student open a question or after questions testing evaluation, the system should recommend lecture video, book or other material to him/her with high accuracy according to character of question of evaluation details to help improve with these stuffs.
6. When a new student joins the system, the system should use code boot way to try its best to finish above target as accurate as possible.
7. You can use big data (hadoop etc.), data mining, sample training, search engine (solr), machine learning, neural network, open sourced framework etc. but try to reflect the self adaptability to user, e.g., after user finished one or two more examples testing, the recommended questions, books, videos etc should reflect the new situation, you can give solution.
8. Another related task is for test paper generating module, namely the module can analyze the individual student or whole class students (including scores of students) situation as mentioned above, then generate a new testing paper on demand, after the students finish more testing paper, the module should know the new capability situation of the student or the whole class, the new testing paper is adjusted accordingly.