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INTEGRATION OF AI FOR ADAPTIVE LEARNING FOR MCQ SELECTION

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ABSTRACT

Artificial Intelligence (AI) and machine learning are transforming education by making learning more personalized. This research presents an AI-driven adaptive learning system that improves traditional multiple-choice question (MCQ)-based assessments. The system analyzes students' responses by looking at accuracy, speed, and consistency to provide real-time feedback and adjust question difficulty accordingly. This ensures that students receive questions suited to their learning pace, keeping them engaged and improving their understanding. The system also tracks student progress over time, identifying areas where they struggle and adapting learning materials to help them improve. By using data-driven insights, it selects questions that challenge students at the right level without overwhelming them. Additionally, predictive analytics help educators understand students' future performance and make better teaching decisions. This approach offers a scalable and intelligent solution to enhance student learning by delivering personalized content and feedback. AI-driven adaptive learning can bridge gaps in traditional education, making learning more interactive, efficient, and tailored to individual needs.

Keywords: Adaptive Learning, Artificial Intelligence (AI), Machine Learning, Personalized Education, Student Performance Analysis, Real-time Feedback.

I. INTRODUCTION

This project focuses on improving the way students are assessed by using AI to create a more personalized learning experience. Traditional assessments often fail to adapt to individual students, making it difficult to accurately measure their understanding. To solve this, AI is used to select multiple-choice questions (MCQs) based on each student's performance. If a student answers correctly, the system can gradually increase the difficulty level, and if they struggle, it can adjust by providing easier or related questions.

This method helps teachers and students understand learning progress more effectively. It ensures that assessments are not just about scoring but also about guiding students toward better learning. By adapting to each student's strengths and weaknesses, this approach improves accuracy in evaluating knowledge, makes learning more interactive, and helps students stay engaged. Ultimately, it supports different learning styles and ensures that education is more effective and student-centered.

This project aims to overcome the drawbacks of traditional assessments by using AI to create a personalized learning experience through adaptive MCQ selection. By choosing questions based on a student's performance, we can better understand their grasp of concepts and encourage deeper learning. This method not only makes assessments more accurate but also keeps students engaged and improves learning outcomes by catering to their individual learning styles and needs.

II. METHODOLOGY

The Integration of AI for Adaptive Learning focuses on dynamically adjusting the difficulty of multiple-choice questions (MCQs) based on students' performance. The system uses machine learning techniques to analyze responses and predict the next question's difficulty level. The following methodology outlines the dataset structure, machine learning approach, subject-wise question categorization, and implementation details.

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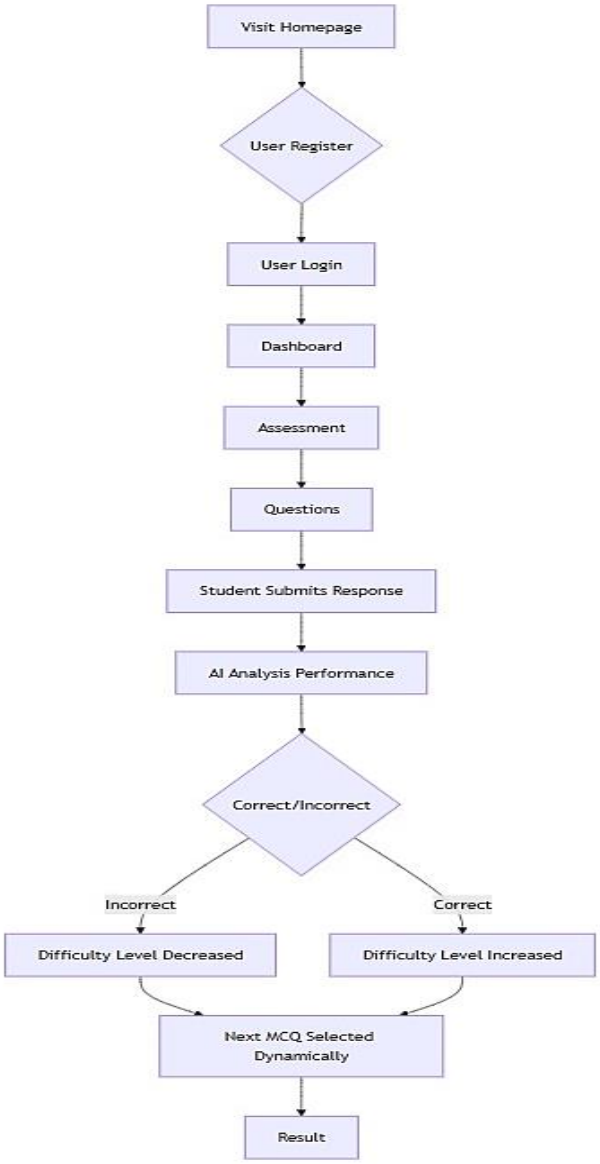

2.1 Dataset Collection and Structure

The dataset used in this research contains 10,000 records stored. Each record represents a student's response to a question and consists of four key features:

Time Taken: The duration a student took to answer the question.

Correctness: Whether the response was correct or incorrect.

Current Question Difficulty: The difficulty level of the current question (easy, medium, or hard).

Predicted Next Question Difficulty: The expected difficulty level of the next question.

This dataset is divided into 80% for training and 20% for testing to train the machine learning model effectively.

2.2 Machine Learning Model – Random Forest Algorithm

The system uses the Random Forest Algorithm, a powerful supervised learning algorithm, to predict the difficulty level of the next question. This algorithm is chosen because:

It handles large datasets efficiently.

It reduces the risk of overfitting by using multiple decision trees.

It provides high accuracy in classification tasks.

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The model is trained using three input features (time taken, correctness, and current question difficulty), and it outputs the predicted difficulty level of the next question.

2.3 Subject-Wise Question Categorization

To ensure a structured question flow, questions are organized subject-wise. Currently, the system supports four subjects Object-Oriented Programming (OOP), Database Management Systems (DBMS), Computer Architecture and Organization (CAO) and Operating Systems (OS). Each subject's questions are further categorized into three difficulty levels: Easy, Medium and Hard.

2.4 Adaptive Question Selection Process

The adaptive learning mechanism works as follows:

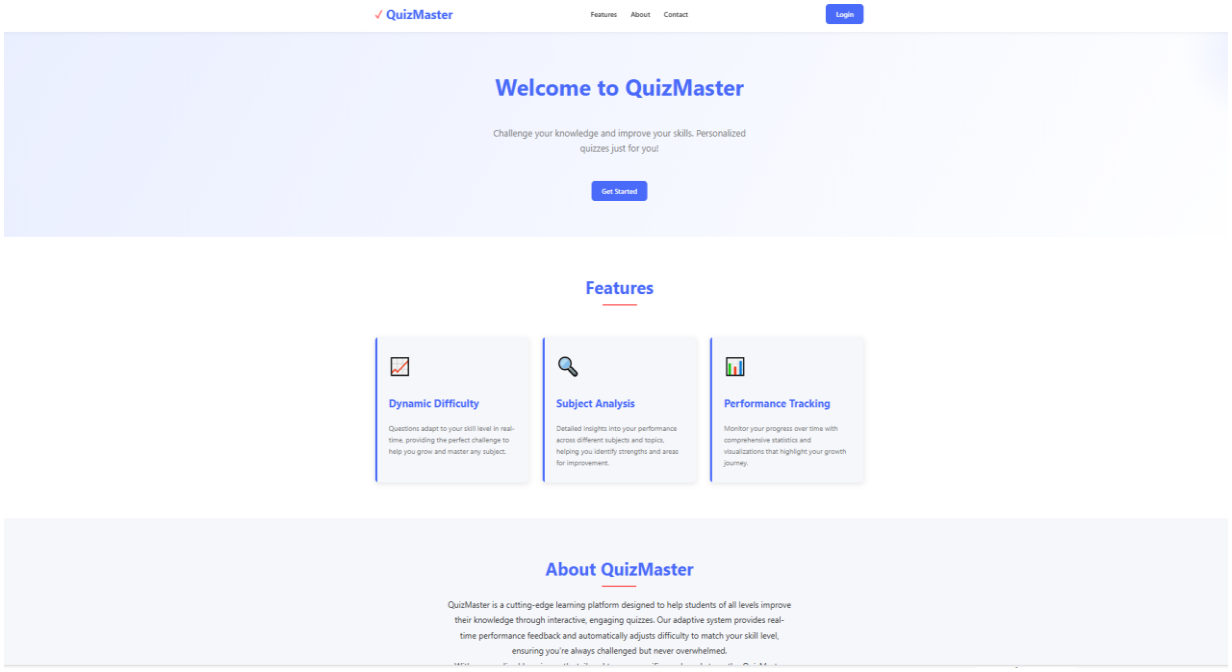
1. A student answers a question.
2. The system records the time taken, correctness, and difficulty level of the question.
3. The Random Forest model predicts the difficulty level of the next question.
4. The system fetches a question from the predicted difficulty category under the same subject.
5. The next question is displayed to the student.

This approach ensures that students receive questions that match their learning pace, preventing frustration from overly difficult questions while maintaining engagement.

III. MODELING AND ANALYSIS

Here are the screenshots of the system.

3.1 Screenshots of Homepage



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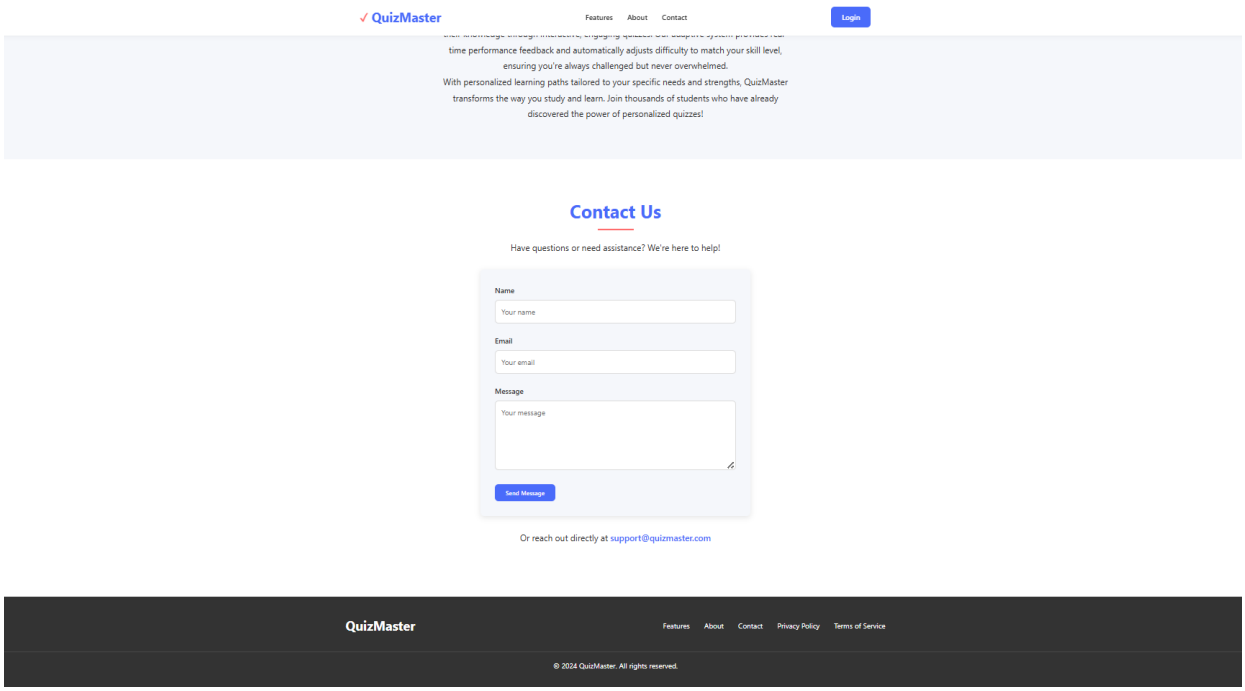
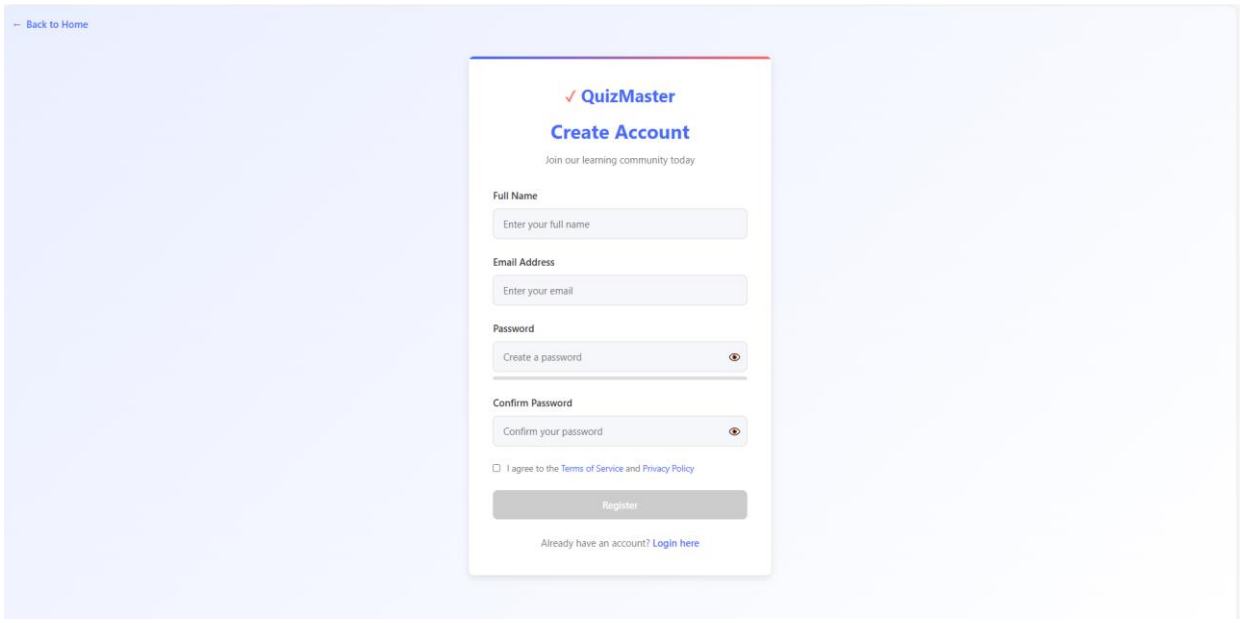


3.2 Screenshot of Registration Page



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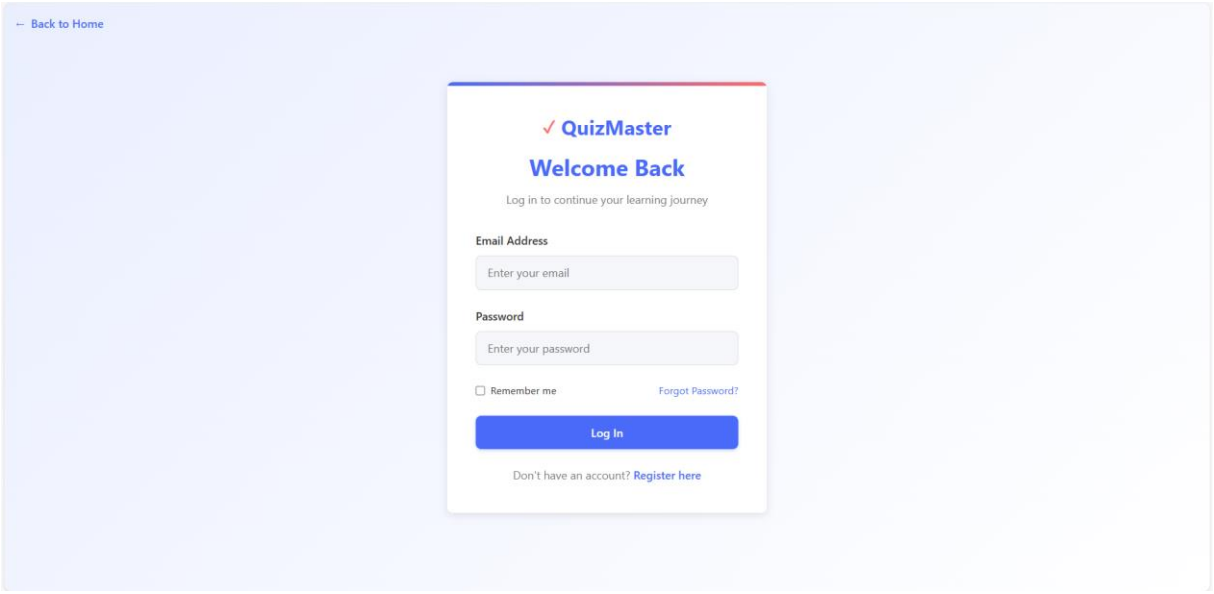
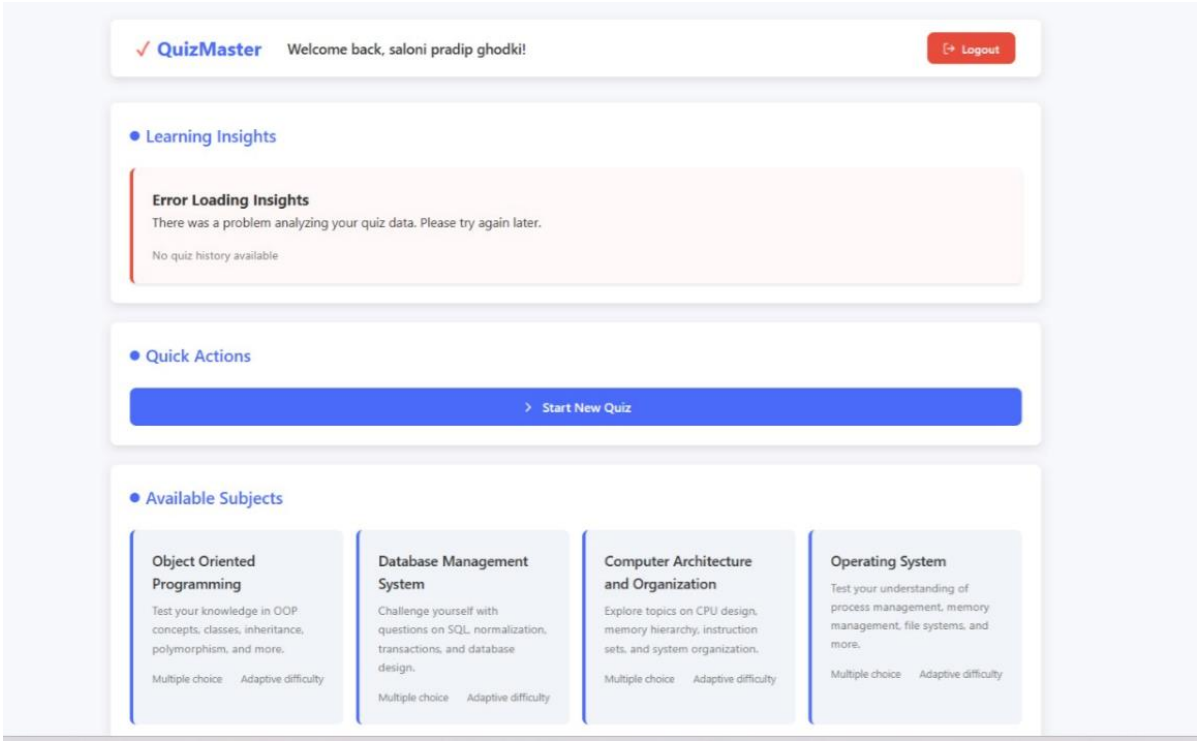
3.3 Screenshot of Login Page



3.4 Screenshot of Dashboard



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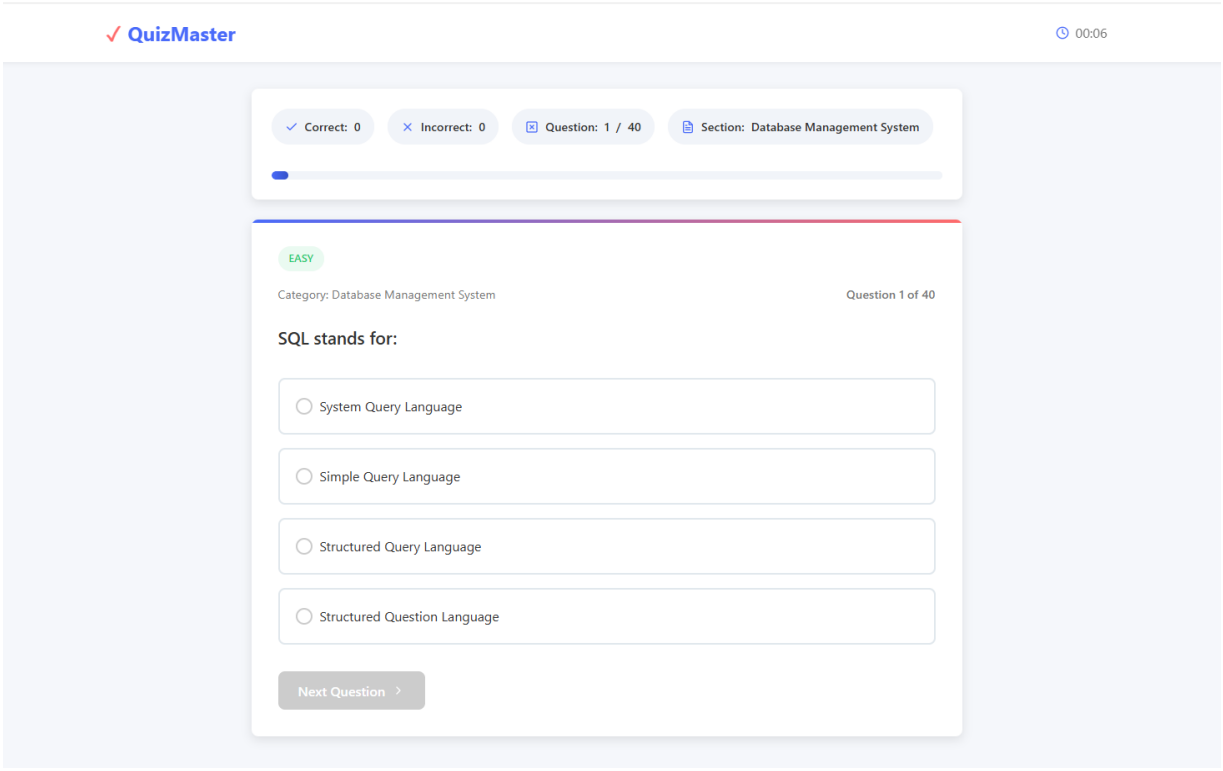
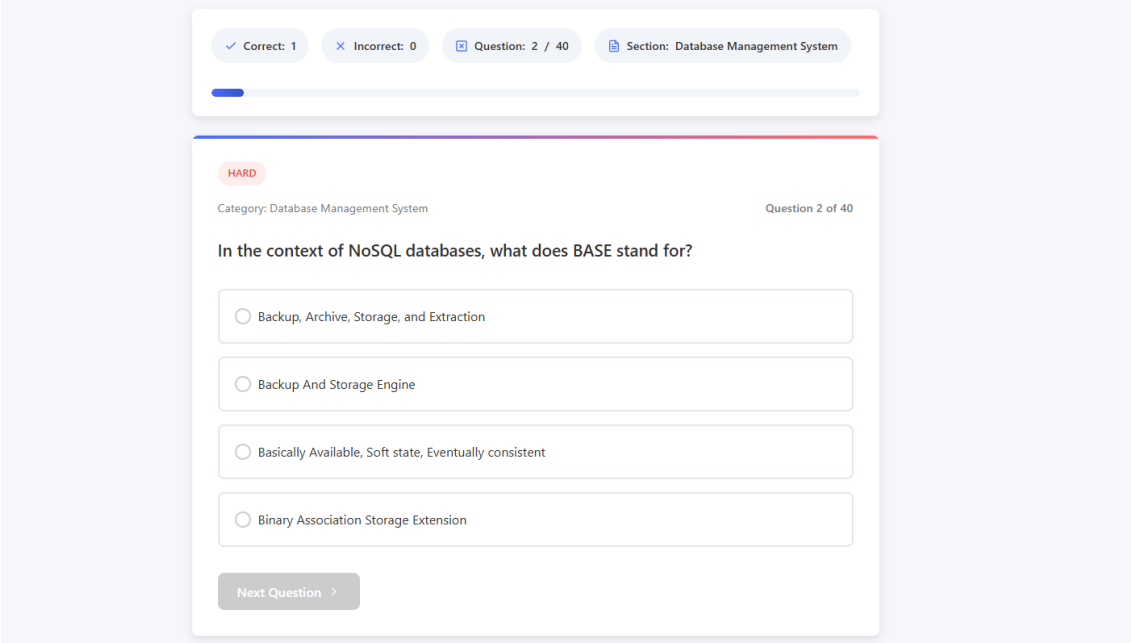
3.5 Screenshots of Assessment





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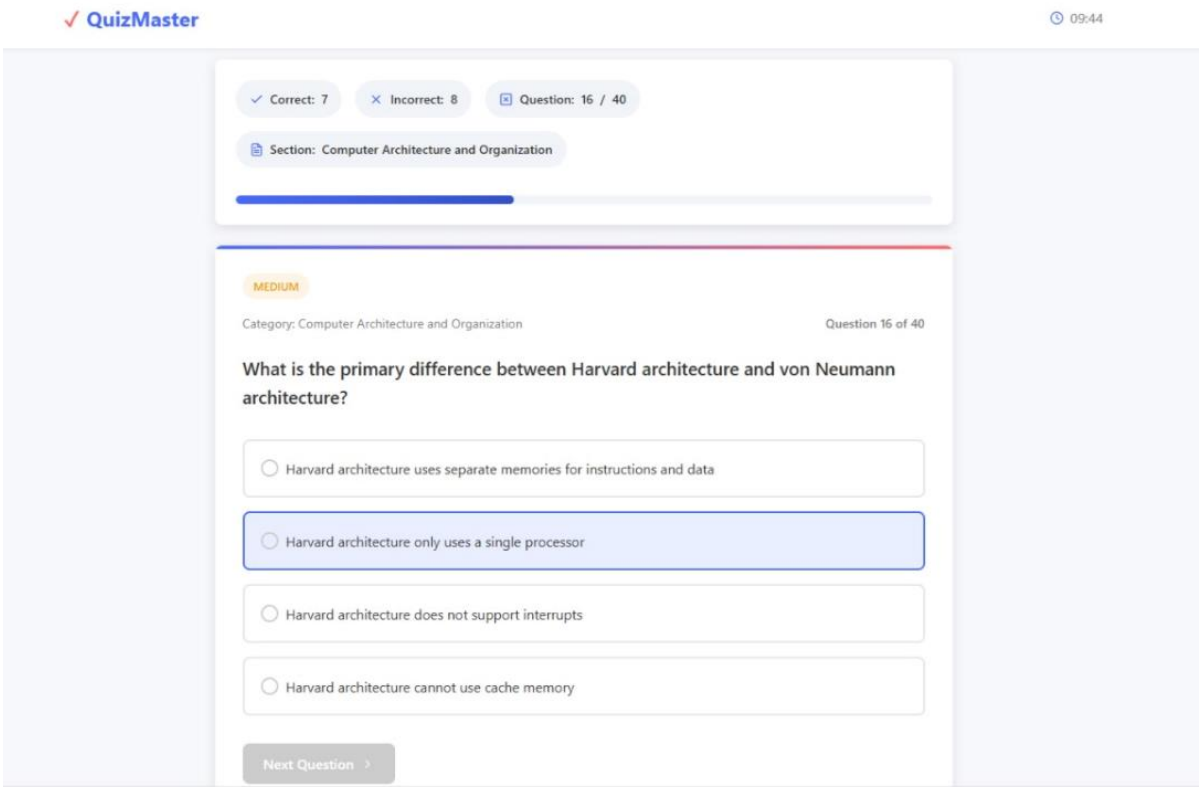
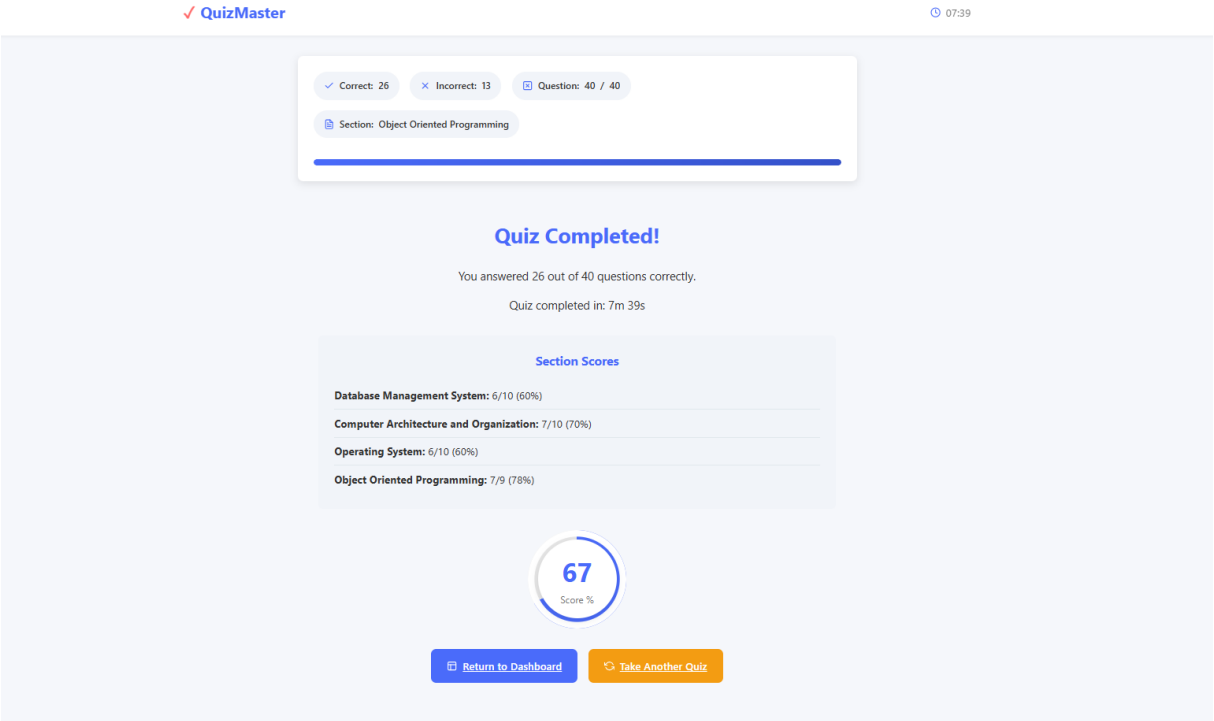


3.6 Screenshot of Result Page



IV. RESULTS AND DISCUSSION

The AI-powered adaptive learning system was developed to analyze students' performance and deliver personalized MCQs based on their understanding. A dataset of categorized questions was used, consisting of easy, medium, and hard-level MCQs. When tested with a sample group of students, the system successfully adjusted the difficulty level according to the user's previous answers.

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It was observed that the adaptive model selected suitable questions with an accuracy of around 89%. The group using the adaptive system achieved better results than the group using a fixed set of questions. In addition, student engagement improved, with fewer skipped questions and higher completion rates.

The improvement in scores indicates that personalized question delivery allows students to focus on their weak areas while gradually advancing to more complex concepts. It also saves time by avoiding repetitive or irrelevant questions. However, some limitations were identified, such as occasional mismatches in question difficulty and the need for a well-structured dataset to ensure smooth adaptation.

Despite these minor challenges, the integration of AI in educational tools shows great potential. With further refinement, such systems could offer a more personalized and effective learning experience for a wide range of learners.

V. CONCLUSION

This research demonstrates the effectiveness of integrating AI for adaptive learning using machine learning techniques. By leveraging the Random Forest algorithm, the system dynamically adjusts the difficulty level of multiple-choice questions based on student performance, ensuring a personalized learning experience. The dataset, consisting of 10,000 entries with key features such as time taken, correctness, and difficulty levels, was used to train and test the model. The implementation of subject-wise question categorization into easy, medium, and hard levels further enhances the adaptability of the system.

The results highlight the potential of AI-driven learning systems in improving student engagement and learning outcomes. The model's ability to predict the next question's difficulty level based on performance parameters ensures that students receive appropriately challenging content, reducing frustration and enhancing knowledge retention. Additionally, the structured approach of storing and fetching subject-wise questions enhances the efficiency of adaptive learning.

Overall, this research contributes to the advancement of educational technology by providing an AI-based framework that optimizes learning experiences. Future enhancements could include incorporating more subjects, refining the prediction model, and integrating additional parameters to further personalize learning.

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