

Quizup-AI Powered Quiz Application

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CERTIFICATE

This is to certify that the Project Synopsis entitled, "**Quizup:AI Powered Quiz APP**" submitted by "**Shubham Singh(2301010107), Harsh Tewatia(230101083,Nikhil Singh(2301010106) and Rachit Garg(2301010129)**" to **K.R Mangalam University, Gurugram, India**, is a record of bonafide project work carried out by them under my supervision and guidance and is worthy of consideration for the partial fulfilment of the degree of **Bachelor of Technology** in **Computer Science and Engineering** of the University.

Type of Project (Tick One Option)

☒ **Industry/Research/University Problem**

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ABSTRACT

Competitive exams like JEE (Joint Entrance Examination) and NEET (National Eligibility cum Entrance Test) require rigorous preparation, yet students often struggle with self-assessment and concept clarity. This project presents an AI-powered quiz application tailored for JEE and NEET aspirants, integrating automated quiz generation, real-time performance tracking, and teacher-student interaction to enhance learning. The application is built using React.js for the frontend, Node.js with Express for the backend, and MongoDB for data storage. It incorporates OpenAI's GPT model to generate subject-specific questions dynamically in physics, chemistry, and mathematics for JEE, and physics, chemistry, and biology for NEET. The AI also provides detailed explanations, ensuring conceptual clarity. A teacher dashboard allows educators to create custom quizzes, assign them to students, and monitor their progress through performance analytics and scoring reports. Students benefit from adaptive difficulty levels, time-based mock tests, leaderboards, and gamification, keeping them engaged and motivated. This system eliminates the limitations of static question banks, providing an interactive, personalized, and effective learning experience. By integrating AI-driven assessments, student progress tracking, and real-time feedback, the project aims to revolutionize digital learning for JEE and NEET aspirants, making exam preparation more structured and data-driven.

Keywords: AI-powered quiz, GEMINI, React.js, Node.js, MongoDB, interactive learning, programming assessment.

Chapter 1

Introduction

Preparing for competitive exams like JEE and NEET requires extensive practice, self-assessment, and a structured learning approach. Many students struggle with retaining concepts and lack the ability to analyze their strengths and weaknesses effectively. Traditional learning methods, such as textbooks and offline tests, do not provide instant feedback or personalized learning experiences. As a result, students may repeatedly make the same mistakes without proper guidance. This project aims to develop an AI-powered quiz application to help students prepare for JEE and NEET through interactive quizzes, mock tests, and real-time performance tracking. The application allows students to attempt multiple-choice questions in physics, chemistry, and mathematics for JEE, and physics, chemistry, and biology for NEET. Using OpenAI's GPT model, the system can generate a variety of questions and provide explanations to improve conceptual understanding. A key feature of this application is its teacher dashboard, which enables educators to create quizzes, assign them to students, and monitor their progress. This helps teachers identify areas where students need improvement and provide targeted guidance. With AI-driven assessments, adaptive question difficulty, and gamification elements, this project provides an engaging and effective solution for students preparing for competitive exams.

1. MOTIVATION

Competitive exams like JEE and NEET require students to develop strong conceptual understanding and problem-solving skills. However, many students struggle with traditional learning methods, which often lack interactivity and fail to provide personalized feedback. Static question banks do not adapt to individual performance, making it difficult for students to track their progress and focus on their weak areas. This creates a need for a smarter and more effective approach to exam preparation.

Teachers also face challenges in evaluating student performance efficiently. Manually creating and grading quizzes for large groups of students is time consuming and limits the ability to provide timely feedback. A digital solution that automates quiz creation, assessment, and progress tracking can significantly reduce the workload for educators and allow them to focus on guiding students more effectively.

Technology-driven learning has transformed education, and artificial intelligence is playing a crucial role in making education more accessible and personalized. AI-powered quiz applications can generate dynamic questions, adapt difficulty levels based on student performance, and provide instant explanations for correct and incorrect answers. This enhances learning by reinforcing concepts in real time.

Additionally, incorporating gamification elements such as leaderboards, rewards, and achievements can make learning more engaging. Students are more likely to stay motivated when they can track their progress, compete with peers, and receive instant feedback. By integrating AI, real-time performance analysis, and gamification, this project aims to create an

effective and engaging platform for JEE and NEET aspirants, helping them achieve better results with a structured and interactive learning experience.

Chapter 2

LITERATURE REVIEW

2.1 Introduction to Quiz-Based Learning

The use of technology in education has significantly evolved, with quiz-based learning emerging as an effective method for knowledge retention and selfassessment. Studies indicate that interactive quizzes enhance student engagement and improve learning outcomes by reinforcing concepts through active recall and spaced repetition. However, traditional quiz platforms rely on pre-set question banks, which lack adaptability and do not cater to individual student needs.

2.2 Existing Quiz Applications

Existing quiz applications such as Kahoot!, Quizizz, and Google Forms provide interactive learning experiences, but they have limitations. These platforms do not dynamically adjust the difficulty of questions based on student performance, nor do they offer AI-driven explanations for incorrect answers. Research in artificial intelligence and adaptive learning suggests that machine learning models, such as OpenAI's GPT, can generate subject-specific questions, analyze student responses, and personalize learning paths. This ensures that students receive targeted practice in areas where they struggle the most.

2.3 AI-Powered Adaptive Learning

By leveraging AI for question generation, adaptive learning, and performance analysis, this project aims to bridge the gap between traditional learning methods and modern digital education. It offers a scalable, interactive, and personalized approach to JEE and NEET preparation, ensuring students receive high-quality assessments that enhance their problem-solving skills and exam readiness.

2.4 Gamification and Student Engagement

Several studies highlight the importance of gamification in education. Gamified learning, which includes features like leaderboards, badges, and rewards, has been shown to increase student motivation and participation. By integrating gamification elements with AI-driven assessments, students are more likely to stay engaged and develop a competitive mindset, which is crucial for exams like JEE and NEET.

Conclusion

Existing quiz platforms lack adaptability, and AI-driven solutions are emerging as a game-changer in education. By integrating AI-generated questions, adaptive learning, and gamification, our project aims to fill this gap and provide a modern, interactive, and effective quiz-based learning system.

3.GAP ANALYSIS

3.1 Lack of Adaptive Learning

Traditional quiz systems use static question banks that do not adjust based on student performance. This limits personalized learning and makes it difficult for students to focus on weaker areas.

3.2 Manual Quiz Creation

Teachers have to manually create and assign quizzes, which is time-consuming and inefficient, especially for large student groups. An automated system can reduce workload and improve efficiency.

3.3 Limited Performance Tracking

Many existing platforms do not provide detailed student analytics, making it challenging for both students and teachers to assess progress and identify areas for improvement.

3.4 Absence of AI-Based Question Generation

Most quiz applications rely on pre-set questions rather than dynamically generating questions using AI. AI-generated questions can provide fresh and varied content, enhancing learning.

3.5 Lack of Instant Explanations

Traditional quizzes only show correct or incorrect answers without explaining the reasoning behind them. AI-powered explanations can help students understand concepts better and improve retention.

3.6 No Teacher-Student Interaction for Assessment

Most quiz applications do not offer a way for teachers to monitor student progress effectively and provide personalized guidance based on quiz performance.

3.7 Inflexible Mock Tests

Standardized mock tests do not adapt to individual student weaknesses, reducing their effectiveness. AI-driven mock tests can adjust question difficulty based on student responses, providing a better exam simulation.

3.8 Scalability Issues

Many quiz platforms are not designed to handle large numbers of users simultaneously, making them inefficient for widespread use in educational institutions.

4.PROBLEM STATEMENT

Existing quiz platforms for JEE and NEET lack adaptive learning, AI-driven question generation, real-time feedback, and detailed performance tracking. Teachers struggle with manual quiz creation and student progress monitoring. This project aims to develop an AI-powered quiz application that dynamically generates subject-specific questions, provides instant explanations, and adapts difficulty based on student performance. A dedicated teacher dashboard allows educators to create quizzes, track student progress, and analyze performance through detailed reports. By integrating AI, gamification, and real-time analytics, the platform enhances learning efficiency and engagement for both students and teachers.

5.OBJECTIVES

5.1 AI-Driven Question Generation

Develop an AI system utilizing OpenAI's GPT model to dynamically generate subjectspecific, multiple-choice questions for JEE (Physics, Chemistry, Mathematics) and NEET (Physics, Chemistry, Biology) exams. Ensure that the questions vary in difficulty and cover a wide range of topics within each subject to provide comprehensive practice.

5.2 Adaptive Learning System

Implement an adaptive learning system that adjusts the difficulty level of questions based on the student's performance, ensuring personalized learning experiences for each student. Enable real-time feedback and instant explanations for correct and incorrect answers to reinforce conceptual understanding.

5.3 Teacher Dashboard for Progress Tracking

Develop a teacher dashboard that allows educators to create and assign quizzes, track student progress, and monitor performance analytics through detailed reports. Provide tools for teachers to identify areas where students need improvement and assign custom quizzes to target those areas

5.4Real-Time Performance Analytics

Provide students with real-time analytics that showcase their performance across various quizzes, highlighting strengths and weaknesses. Allow students to track their progress over time and review areas of improvement.

5.5 Scalability and Cloud-Based Infrastructure

Design the application to be scalable, leveraging cloud technologies to ensure that it can handle large numbers of students simultaneously, particularly in educational institutions. Implement a cloud-based storage solution for seamless data access and management.

5.6 Mobile and Web Accessibility

Develop a responsive web application that is accessible on both desktop and mobile devices, ensuring a seamless learning experience across platforms. Optimize the user interface for ease of use, catering to both students and teachers with minimal learning curve.

5.7 Mock Test Simulation

Offer time-based mock tests that simulate the real exam environment for JEE and NEET, allowing students to experience exam conditions and improve time management. Incorporate AI to adapt the mock test difficulty in real time based on student performance, providing a more realistic preparation experience. These objectives cover the essential features of the AI-powered quiz application and address the needs of both students and teachers, ensuring an interactive, personalized, and scalable learning environment.

CHAPTER 3: METHODOLOGY

1.Requirement Gathering

First, we analyzed the requirements for a modern learning platform where:

- Teachers can create quizzes easily,
- Students can practice subject-wise tests and track their performance,
- AI is used to dynamically generate quiz questions,
- And the system is fast, secure, and scalable.

2. Technology Stack Selection

We selected a modern full-stack approach:

- Frontend: Next.js 14 (App Router) with TypeScript for speed, SEO, and server components.
- UI Framework: Shadcn UI + TailwindCSS for a modern, responsive, and animated interface.
- Backend: Node.js (via Next.js API routes) for server logic.
- AI Integration: Google's Gemini API for free and scalable AI-powered question generation.
- Database: NeonDB (PostgreSQL) for storing users, quizzes, questions, and results.
- ORM: Prisma for easy, type-safe database management. Authentication: (Optional via Clerk/Auth if used.)

- Deployment: Hosted on Vercel for automatic CI/CD and global availability.

3. System Architecture Design

- We designed a clean architecture:
- Student and Teacher Dashboards with role-based access.
- Quiz API to generate quizzes using Gemini and save into NeonDB.
- Practice Section with instant AI-generated questions for Math, Physics, Chemistry, Biology.
- Leaderboard and Analytics Charts (Bar, Pie, Line) to visualize performance using Recharts.
- Modern UI/UX with animated cards, buttons, hover effects, transitions.

4. Development Phases

Frontend

- Created reusable components using Shadcn UI and TailwindCSS.
- Developed responsive layouts for dashboard, quiz-taking screen, leaderboard, and analytics.

Backend

- Built secure API endpoints to create quizzes, fetch student assignments, and record results.
- Integrated Gemini API to generate multiple-choice questions dynamically based on subject and difficulty.

Database

- Designed relational models using Prisma ORM for User, Quiz, Question, Result, and Assignment. Connected the application securely to NeonDB using environment variables.

5. Testing and Optimization

- Unit Testing and API Testing were performed to ensure all functionalities worked correctly.
- UI/UX Testing was done across devices to make sure the app was fully mobile-responsive and fast.
- Prisma schema was tested and optimized to maintain database consistency.

6. Deployment

- The application was deployed on Vercel for frontend, backend, and serverless APIs.
- Database hosting was handled using NeonDB with SSL security.
- Environment variables were securely configured for production deployment.

Conclusion

Using a clean, scalable, and modern tech stack, we built QuizUp, an AI-driven, user-friendly, and efficient quiz platform for JEE/NEET aspirants, offering dynamic quizzes, real-time analytics, adaptive learning, and gamified engagement.

Details of tools, software, and equipment utilized.

1. Software Tools

Tool	Purpose	Description
Next.js 14	Frontend + Backend Framework	Built the full-stack web application using App Router and Server Components with TypeScript support.
Node.js	Backend Runtime Environment	Executed server-side APIs within Next.js and managed server logic efficiently.
TailwindCSS	Styling Framework	Created responsive and modern UI designs quickly

		using utility-first CSS classes.
Shadcn UI	UI Components Library	Integrated pre-designed, animated UI components such as cards, tables, modals, and buttons for a better user experience.
TypeScript	Programming Language	Enhanced JavaScript development by introducing static typing, leading to fewer runtime errors and improved code quality.
Prisma ORM	Database Management	Handled NeonDB database operations smoothly through a type-safe and easy-

NeonDB

Cloud Database
(PostgreSQL)

to-use ORM
system.

Hosted the
application's
data, including
users, quizzes,
questions, and
results, on a
scalable,
serverless
PostgreSQL
database.

Gemini API

AI Integration

Used Google's
Gemini API to
dynamically
generate
multiple-choice
questions and
explanations
based on
selected
subjects and
difficulty levels.

Vercel

Hosting and
Deployment
Platform

Deployed the
full-stack
Next.js
application,
providing global
access,

			automatic CI/CD, and serverless backend capabilities.
Chart.js / Recharts	Data Visualization Libraries		Designed animated and interactive charts for performance tracking and analytics visualization.

2. Supporting Software

Tool	Purpose
Postman	API Testing and Debugging to ensure smooth server-side functionality.
Prisma Studio	Visual database GUI for inspecting, adding, and modifying records in NeonDB.
GitHub	Version control system for collaboration, code backup, and CI/CD integration with Vercel.

Figma (optional)

UI/UX Design prototyping for planning page layouts and user interface flows.

3. Equipment Used

Equipment

Purpose

Laptop/Desktop

Primary development environment equipped with Visual Studio Code, terminal, and modern browsers.

Internet Connection

Stable connectivity essential for API integration, cloud database operations, and deployment activities.

Cloud Services

Usage of Vercel (for deployment) and NeonDB (for database hosting).

Recommended System Requirements:

- Operating System: Windows 10/11 or MacOS
- RAM: Minimum 8 GB
- Processor: Intel i5 / Ryzen 5 or higher
- Internet Speed: Minimum 10 Mbps for seamless deployment and testing

Chapter 4

Implementation

1. Detailed Explanation of How the Project Was Implemented

The implementation of QuizUp began by setting up the project environment using Next.js 14 with TypeScript support for a robust frontend and backend foundation. TailwindCSS and Shadcn UI were integrated for building a responsive and modern user interface. Prisma ORM was configured to connect the application to the NeonDB cloud database. Authentication was handled through Clerk (if applicable). The Gemini API was utilized to dynamically generate quiz questions based on user-selected subjects and difficulty levels. The entire system was deployed using Vercel, ensuring automatic CI/CD and scalability.

2. Description of Algorithms, Code Snippets, or Design Diagrams

3. Algorithm for AI-Powered Quiz Generation:
4. Receive input from the teacher (subject, number of questions, difficulty level).
5. Call the Gemini API to generate multiple-choice questions dynamically.
6. Parse the response to extract questions, options, and correct answers.

7. Save the generated quiz and its questions in the NeonDB database through Prisma ORM.
8. Assign the quiz to the targeted students.

Sample Code Snippet (Quiz Generation API Call):

```
const response = await fetch('https://Your API key', {  
  method: 'POST',  
  headers: { 'Content-Type': 'application/json' },  
  body: JSON.stringify({  
    prompt: `Generate ${numberOfQuestions} MCQs for ${subject} at ${difficulty} level.`  
  })  
});  
const data = await response.json();
```

System Design Diagram:

- User (Student/Teacher) -> Next.js App -> API Routes -> Prisma ORM -> NeonDB
- Gemini API integrated into backend API routes for dynamic quiz generation.
- Charts generated via Chart.js/Recharts based on real-time student quiz results.

3. Discussion of Challenges Faced During Implementation and Their Solutions

Challenge 1: Integrating AI-generated content without exceeding token limits.
Solution: Optimized API prompts and implemented response chunking mechanisms.

Challenge 2: Managing authentication and role-based access control.

Solution: Implemented Clerk authentication and used server-side role verification in protected API routes.

Challenge 3: Deploying Prisma on serverless architecture (Vercel).

Solution: Implemented a Prisma Client Singleton pattern to avoid multiple database connections.

Challenge 4: Displaying real-time analytics efficiently.

Solution: Used lightweight Chart.js/Recharts libraries and optimized frontend data fetching with caching strategies.

Chapter 5

RESULTS AND DISCUSSIONS

1. Results Obtained

The QuizUp platform successfully achieved its intended objectives. Teachers can now create customized quizzes based on subject and difficulty levels using AI-powered question generation. Students can access assigned quizzes, practice subject-wise mock tests, and view real-time results. The leaderboard and analytics sections help track individual and group performance effectively.

2. Analysis of Results

- Students were able to complete quizzes with immediate feedback on their answers.
- Teachers could monitor student progress and view detailed score reports.
- Analytics charts clearly displayed topic-wise strengths and weaknesses.
- Leaderboard integration increased student engagement and competitiveness.
- The AI-powered quiz generation reduced manual effort for teachers and maintained the quality of questions.

3. Discussion

The use of modern frameworks and cloud services ensured a scalable and high-performance application. The Gemini API provided intelligent question generation, which helped personalize the learning experience for students.

The project's design focused on user experience with responsive layouts and animated UI, making it accessible across all devices. Real-time analytics empowered teachers to make data-driven decisions to enhance student learning outcomes.

Overall, the QuizUp application proved to be an innovative, effective, and scalable solution for competitive exam preparation.

Chapter 6

FUTURE WORK

- **AI-Based Adaptive Learning Paths:** Implement machine learning algorithms to recommend customized quizzes and study plans based on the student's past performance.
- **Offline Mode:** Enable students to attempt quizzes offline and sync results once the device reconnects to the internet.
- **Doubt Clearing Section:** Add a feature for students to ask doubts and receive AI-generated explanations or teacher responses.
- **More AI Model Integrations:** Explore integration of multiple AI models for generating different types of questions, including descriptive and reasoning-based.
- **Gamification Features:** Introduce badges, rewards, and streaks to further boost student engagement.
- **Mobile Application:** Develop a React Native app version to make QuizUp easily accessible on Android and iOS devices.
- **Push Notifications:** Implement real-time notifications to inform students about new quizzes, results, and updates.
- **Multilingual Support:** Expand the platform to support quizzes in multiple languages, increasing accessibility for diverse learners.

These future improvements aim to make QuizUp more interactive, personalized, and accessible, ensuring a comprehensive learning experience for all students.

CONCLUSION

The QuizUp project represents a significant step forward in leveraging modern web technologies and AI to enhance the educational experience of JEE and NEET aspirants. Through the careful integration of Next.js, Node.js, Prisma, and NeonDB, combined with the powerful AI capabilities provided by Gemini, we were able to create an intelligent, interactive, and scalable platform.

The use of responsive design principles, animated user interfaces, and real-time data visualization helped in making the platform engaging and accessible across various devices. Students benefited from instant feedback and detailed analytics, while teachers were equipped with powerful tools for quiz creation and performance tracking.

Challenges during development, such as AI integration, authentication management, and real-time analytics rendering, were successfully addressed using innovative solutions and best practices.

QuizUp not only met its original objectives but also established a strong foundation for future enhancements such as mobile app development, gamification, multilingual support, and AI-driven personalized learning paths.

In conclusion, QuizUp serves as a robust and innovative solution that bridges the gap between technology and education, making learning more dynamic, personalized, and impactful.

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