A Major Project Proposal on

NextGen Prep

Submitted in partial fulfillment of the requirements for the degree of

Bachelor of Engineering in Software Engineering at Pokhara

University

By

Anil B.K

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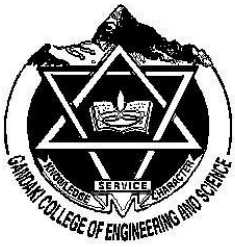

Department of Research and Development

GANDAKI COLLEGE OF ENGINEERING AND SCIENCE

Lamachaur, Kaski, Nepal

(June 19, 2025)

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APPROVAL CERTIFICATE

This project entitled "**NextGen Prep**" prepared and submitted by "**Anil BK**", **"Kriti Adhikari"** and "**Nirakar Bikram Rana**" under the supervision of "**Er. Krishna Khadka**" in partial fulfillment of the requirements for the Degree of Bachelor of Engineering in Software Engineering has been examined and is recommended for approval and acceptance.

Date of Evaluation: June 19, 2025

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Er. Krishna Khadka

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Er. Santosh Panth

Research Management Committee, **Gandaki College of Engineering and Science**

ABSTRACT

Entrance examinations in Nepal require focused preparation, consistent practice, and timely feedback, yet many students lack access to personalized, data-driven learning platforms. **NextGen Prep** is a mobile-based entrance preparation system designed to address this gap by providing adaptive, student-centered learning experiences. The platform offers chapter-wise MCQ practice with intelligent practice modes that dynamically adjust question difficulty and recommendations based on a learner's performance. In addition, it provides full-length mock examinations with fixed question sets to simulate real exam conditions. By tracking progress and topic-wise strengths, the system delivers personalized guidance to enhance preparation efficiency. **NextGen Prep** also integrates AI-assisted features, including an interactive chatbot for instant doubt resolution, automated summarization of study materials, and access to notes and previous exam questions. A comprehensive analytics dashboard allows students to monitor learning trends, evaluate performance, and make informed improvements. Built using React, React Native, FastAPI, and PostgreSQL, the platform combines adaptive learning, data analytics, and modern mobile technologies to create an engaging, personalized, and scalable entrance preparation solution for students.

Keywords: Entrance Preparation, Adaptive Learning, AI-Assisted Education, MCQ Testing, Performance Analytics, Personalized Learning

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CHAPTER 1

INTRODUCTION

1.1 Background

Preparing for entrance exams is often a challenging and stressful process for students, particularly when they lack personalized guidance and adaptive study tools. Traditional learning methods tend to be static and do not adjust according to each student's strengths and weaknesses, which can limit effective preparation. With recent advances in technology, machine learning and artificial intelligence have introduced powerful ways to enhance educational support. Shi [1] demonstrated how data mining can analyze student performance data to customize learning paths and resources. Yanes et al. [2] showed that machine learning algorithms can personalize learning experiences, leading to better engagement and improved results. Additionally, Winkler et al. [3] highlighted the role of AI-powered chatbots in education, which provide instant answers and help students resolve doubts efficiently. Romero and Ventura [4] discussed how learning analytics can track student progress in detail, identifying weak areas and helping learners focus their efforts more effectively. Inspired by these research findings, **NextGen Prep** aims to provide a mobile platform that offers adaptive MCQ practice, intelligent doubt assistance, and comprehensive performance analytics. This approach helps students prepare more confidently and efficiently for entrance exams in Nepal.

1.2 Problem statement

Students preparing for faculty entrance exams in Nepal often struggle due to the lack of personalized learning tools and real-time doubt resolution. Existing study methods are mostly static and do not adapt to individual strengths and weaknesses, making preparation less effective. This project proposes the development of a mobile entrance

preparation platform, **NextGen Prep**, that offers adaptive MCQ practice, intelligent doubt assistance, and comprehensive performance analytics to help students prepare more efficiently and confidently.

1.3 OBJECTIVE

This project will serve the following objectives:

- To build a mobile app for entrance exam preparation with adaptive MCQs, AI-based doubt support, and performance analytics for personalized learning.

1.4 IMPLICATION

NextGen Prep provides personalized and adaptive entrance exam preparation, making studying more efficient and accessible, particularly for students without easy access to coaching centers. The platform delivers smart insights and resources that help learners focus on their weak areas, enhancing their chances of success. By centralizing study materials and using performance-driven guidance, **NextGen Prep** promotes equal learning opportunities and empowers students to prepare confidently and effectively for their exams.

CHAPTER 2

LITERATURE REVIEW

Many educational apps in Nepal support students in exam preparation and academic decisions. Some notable platforms include Mero Sikai, Sikshalaya, ExamSathi, and Edusanjal.

MeroSikai

Mero Sikai is a mobile app designed for Nepali students preparing for SEE, +2 board exams, and various entrance tests. It offers chapter-wise practice questions, model papers, and detailed solutions aligned with the national curriculum, helping learners build strong conceptual foundations and track their progress [5].

Sikshalaya

Sikshalaya provides comprehensive information on colleges, courses, scholarship opportunities, and admission procedures across Nepal. By filtering institutions based on location, field of study, and fee range, it simplifies the college search process for students and parents [6].

ExamSathi

ExamSathi focuses on entrance exam readiness by offering large banks of MCQs, timed quizzes, and past exam papers for programs like engineering and management. Its performance tracking features allow students to identify weak areas and adapt their study plans accordingly [7].

Edusanjal

Edusanjal is a well-established educational portal with a mobile app that delivers updated college information, scholarship alerts, and exam schedules. It also provides curated study materials and community discussions to help students stay informed and motivated [8].

PrepAir

PrepAir is a mobile application focused on entrance exam preparation in Nepal. It provides topic-wise MCQs, mock tests, live tests, and short practice sets for various entrance and professional exams. The platform helps students regularly assess their preparation through structured practice and revision features [9].

LiveGuru Nepal

LiveGuru Nepal is an online learning platform mainly targeting medical entrance examinations. It offers a large MCQ question bank, practice tests, past exam questions, and performance tracking tools. The platform supports structured exam preparation through digital tests and guided study materials [10].

Impact of Adaptive Real-Time Quiz Platforms

The KuisQ system is made adaptive using an algorithm based on Item Response Theory. It adjusts question difficulty in real-time according to student performance, response time, and errors. The system increases complexity for proficient students or simplifies questions for those struggling. This ensures a personalized, continuously optimized challenge for each learner [11]

Personalized MCQ Generator for Adaptive Learning by Using Leveraging RAG Method in Gen AI

The system is made adaptive by integrating a Retrieval-Augmented Generation (RAG) framework with a Large Language Model. It uses a student performance matrix to analyze answers, identify strengths and weaknesses. Based on this analysis, it dynamically retrieves relevant educational material and generates new MCQs. The model uses prompt engineering (Chain-of-Thought, Self-Refine) to adjust the difficulty and focus of subsequent questions in real-time, personalizing the quiz for each learner. [12]

CHAPTER 3

TOOLS AND METHODOLOGY

3.1 REQUIRED TOOLS

To build **NextGen Prep**, we will use the following software and resources:

- **React and React Native**

  Cross-platform framework for building the frontend, including the admin web app and mobile app for Android and iOS.

- **FastAPI**

  Backend development for API endpoints, business logic, and user/authentication management.

- **PostgreSQL**

  Relational database to store user profiles, question banks, test results, and analytics data.

- **Data Processing and Analytics**
  - **Matplotlib / Seaborn** – Used to generate visual analytics such as performance graphs, accuracy trends, heatmaps, and learning progress reports.
  - **Pandas** – Handles dataset loading, cleaning, filtering, aggregation, and structured data manipulation throughout the system.

- **LLM-based generation layer**
  - DeepSeek API for Prompt-driven MCQ generation from templates

- **ML Libraries**

  Scikit-learn, PyTorch (or TensorFlow) for:

  - **Item Response Theory (IRT):** Estimate a learner's overall ability level (θ).
  - **Knowledge Tracing:** Track mastery of individual concepts over time.
  - **Contextual Multi-Armed Bandit with Thompson Sampling:** Selects the next question by balancing exploration and exploitation using the learner's current state (ability, mastery, recent performance) to maximize learning gain.

- **Figma**

  UI/UX design and prototyping of mobile screens and workflows.

- **Draw.io**

  Creation of system architecture diagrams and data flow

- **MS Word / Google Docs**

  Documentation, report writing, and proposal preparation.

3.2 BLOCK DIAGRAM

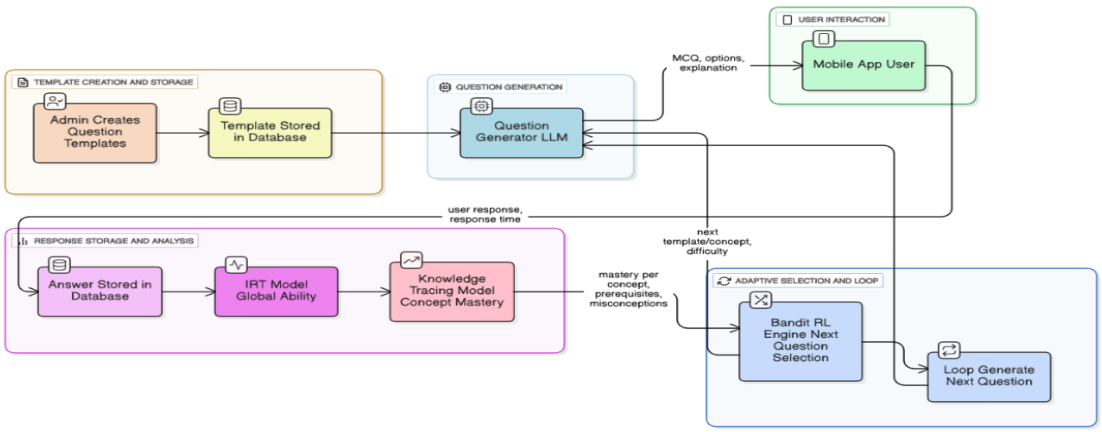

FIGURE 3.1: BLOCK DIAGRAM OF ADAPTIVE AND PERSONALIZED SYSTEM

Mobile App User

The learner accesses the adaptive quiz system through a mobile application, which serves as the primary interface for presenting questions, collecting responses, and tracking interaction data such as response time and attempt history.

Question Generator (LLM)

A Large Language Model generates the final textual form of each question. It ensures linguistic variety, contextual relevance, and alignment with the selected concept and difficulty level provided by the adaptive engine.

Template Database

The system maintains a repository of question templates that define question structure, format (e.g., MCQ, fill-in-the-blank), and associated knowledge concepts. These templates provide controlled input to the LLM, ensuring consistency, validity, and curriculum alignment.

Knowledge Tracing Model

The knowledge tracing model estimates a learner's mastery level for individual concepts based on historical performance data. It enables fine-grained tracking of learning progress and identifies strengths, weaknesses, and prerequisite gaps.

Item Response Theory (IRT) Model

The IRT model computes the learner's global ability level by analyzing correctness and response time patterns. It provides a statistically grounded estimate of overall proficiency, supporting fair difficulty calibration across questions.

Bandit Reinforcement Learning Engine

A reinforcement learning–based multi-armed bandit engine selects the optimal next question by balancing exploration of weak or unpracticed concepts and exploitation of concepts the learner is likely to answer correctly. This mechanism optimizes learning efficiency over time.

Adaptive Selection Loop

The adaptive selection loop integrates outputs from the knowledge tracer, IRT model, and prerequisite mappings to select the next question template and difficulty level. Learner responses are continuously fed back into the system, enabling real-time updates to the learner profile and sustaining personalized adaptation.

3.3 METHODOLOGY

For the development of NextGen Prep, we will adopt the Agile methodology to promote flexibility, continuous improvement, and responsiveness to user needs. The project will progress through iterative development cycles, each focusing on delivering specific features such as the MCQ practice engine, intelligent practice mode, AI chatbot integration, performance analytics dashboard, and resource summarizers. In each cycle, we will define clear goals, gather feedback during development, and refine features based on user and stakeholder input. This iterative approach ensures that NextGen Prep evolves efficiently, stays aligned with user expectations, and delivers high-quality, tested features that support effective student preparation.

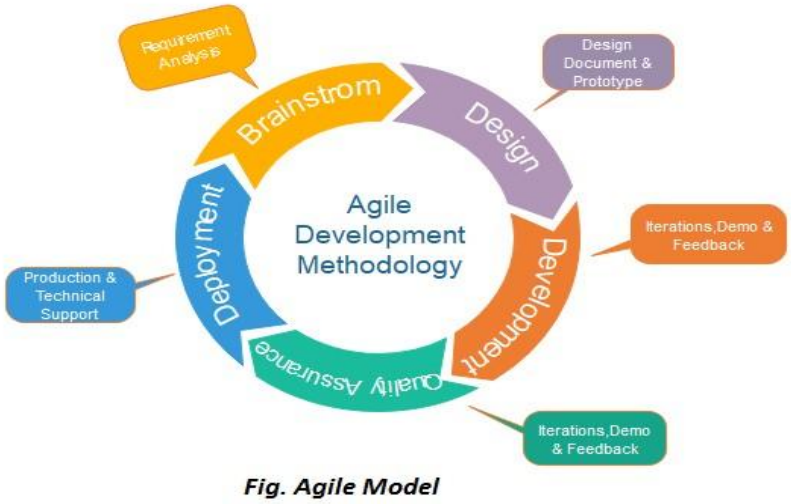

Fig. Agile Model

FIGURE 3.2: AGILE MODEL [14]

3.4 TESTING PLANS

Software testing is a critical element of software quality assurance and represents the ultimate review of specification, design and code generation. Software testing is an activity to check whether the actual results match the expected results and to ensure that the software system is defect free. It involves execution of a software component or system component to evaluate one or more properties of interest.

3.4.1 OBJECTIVE OF TESTING

- The first and the foremost objective of the software testing are to ensure that it fulfills all the requirements of the user, which means firstly understanding the user requirements and then ensuring it behaves in the similar manner.
- To providing a better user experience.
- To evaluate security related issues for the app under test.
- To evaluate the overall performance of the app.
- To uncover an as-yet-discovered error.

3.4.2 TEST CASES

Table 1: TEST CASE

Test Case ID	Purpose	Test Case	Expected Result
TC1	Chapter Test	Complete MCQ test and submit	Show score and correct answers.
TC2	Mock Exam	Run full mock exam until time runs out	Auto-submit test and display final score.

TC3	Intelligent Practice	Answer several questions wrong in one topic	Next questions focus on that weak topic.
TC4	AI Doubt Assistant	Ask chatbot a subject-related question	Receive a relevant answer or resource suggestion.
TC5	Performance Analytics	View analytics after tests	Display charts for accuracy, speed, and topic-wise scores.
TC6	Previous Attempts	Open “History” and select a past tests	Show past test details: score, date, and review options.
TC7	Topic Filter	Filter MCQs by selected topic in practice mode	Display only questions from the chosen topic.

3.5 Use-Case Diagram

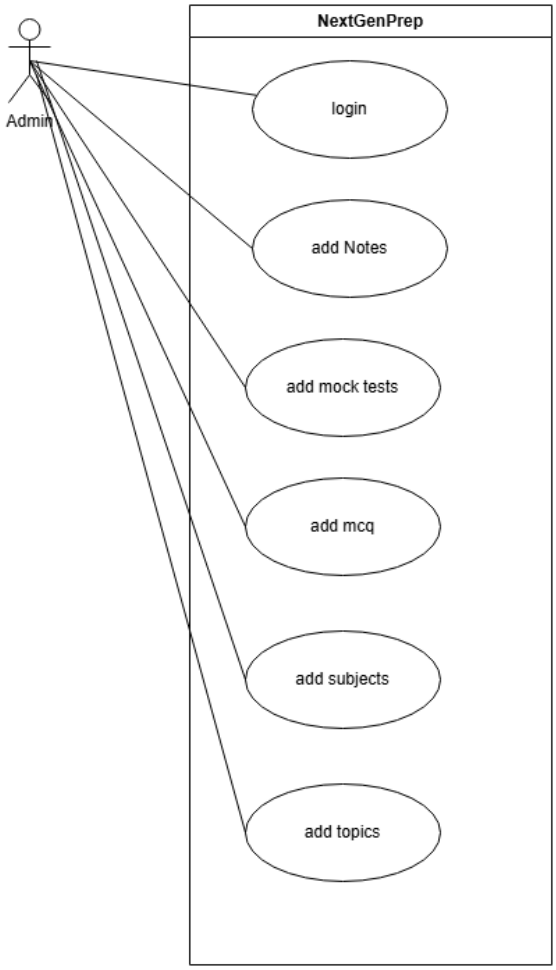

FIGURE 3.3: USE CASE DIAGRAM FOR ADMIN

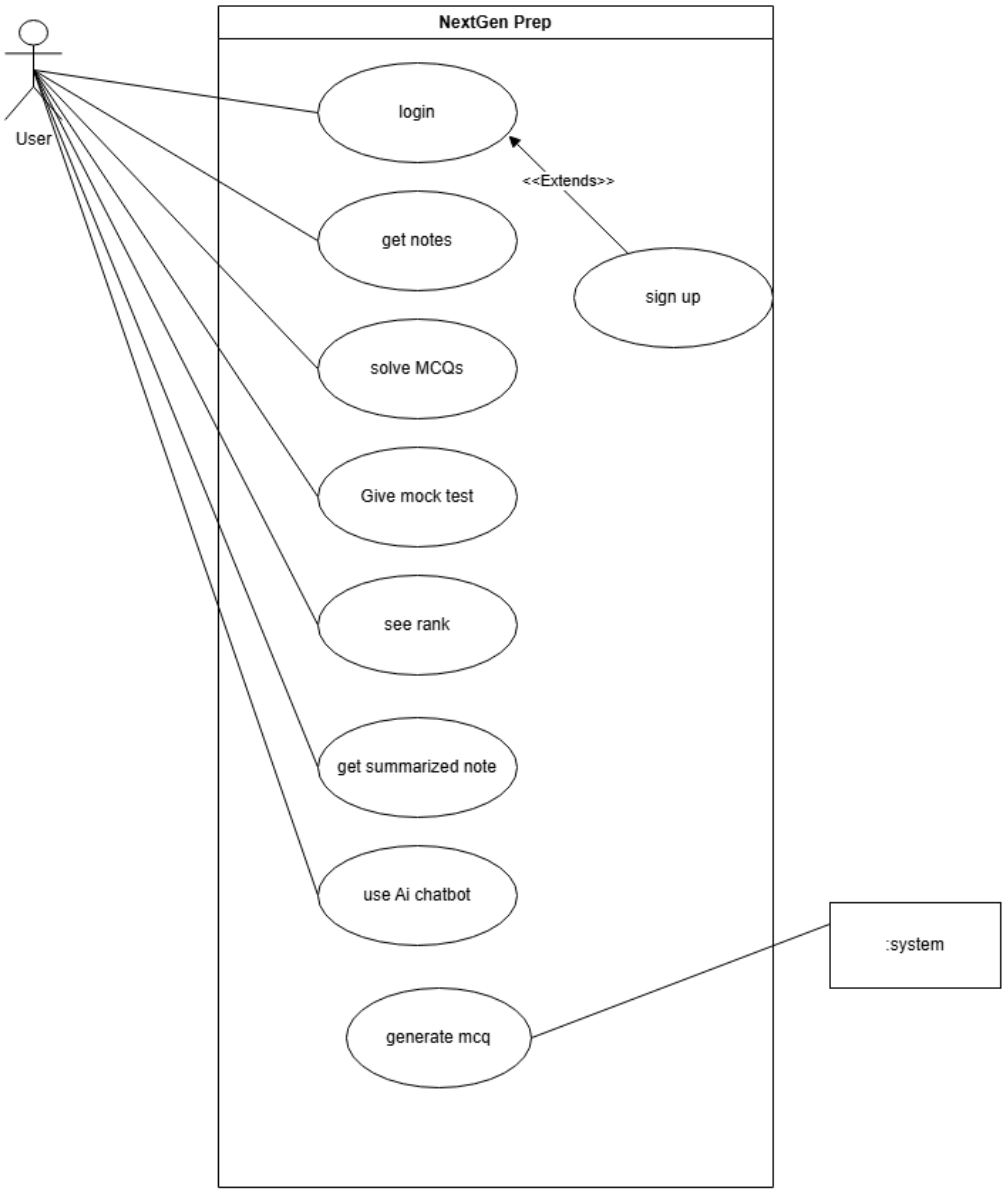

FIGURE 3.4: USE CASE DIAGRAM FOR STUDENT

USE CASE: NextGen Prep

Actors:

1. **Student:** A user who prepares for entrance exams using NextGen Prep's features.
2. **Admin:** Manages content (questions, notes, resources), handles user issues, and maintains the system.

Secondary actor:

1. **System**: Generate MCQs questions.

Use Cases:

1. **Login:** Students and admins log in using secure authentication.
2. **Logout:** Users can log out from the system at any time.
3. **Practice MCQs:** Students can solve subject-wise and chapter-wise multiple-choice questions.
4. **Take Mock Tests:** Students attempt full-length mock exams simulating real test conditions.
5. **Ask AI Chatbot:** Students ask doubts or request summaries, which the chatbot answers using Gemini API.
6. **Track Performance:** Students view their performance via dashboards and analytics.
7. **Access Study Materials:** Students browse past papers, notes, and concept summaries in one place.
8. **View Result History:** Students can view previous test results and performance trends.
9. **Update Profile:** Students can edit their personal and academic details.
10. **Manage Content (Admin):** Admins add, update, or delete questions, notes, and test content.

3.6 Entity Relation Diagram (ERD)

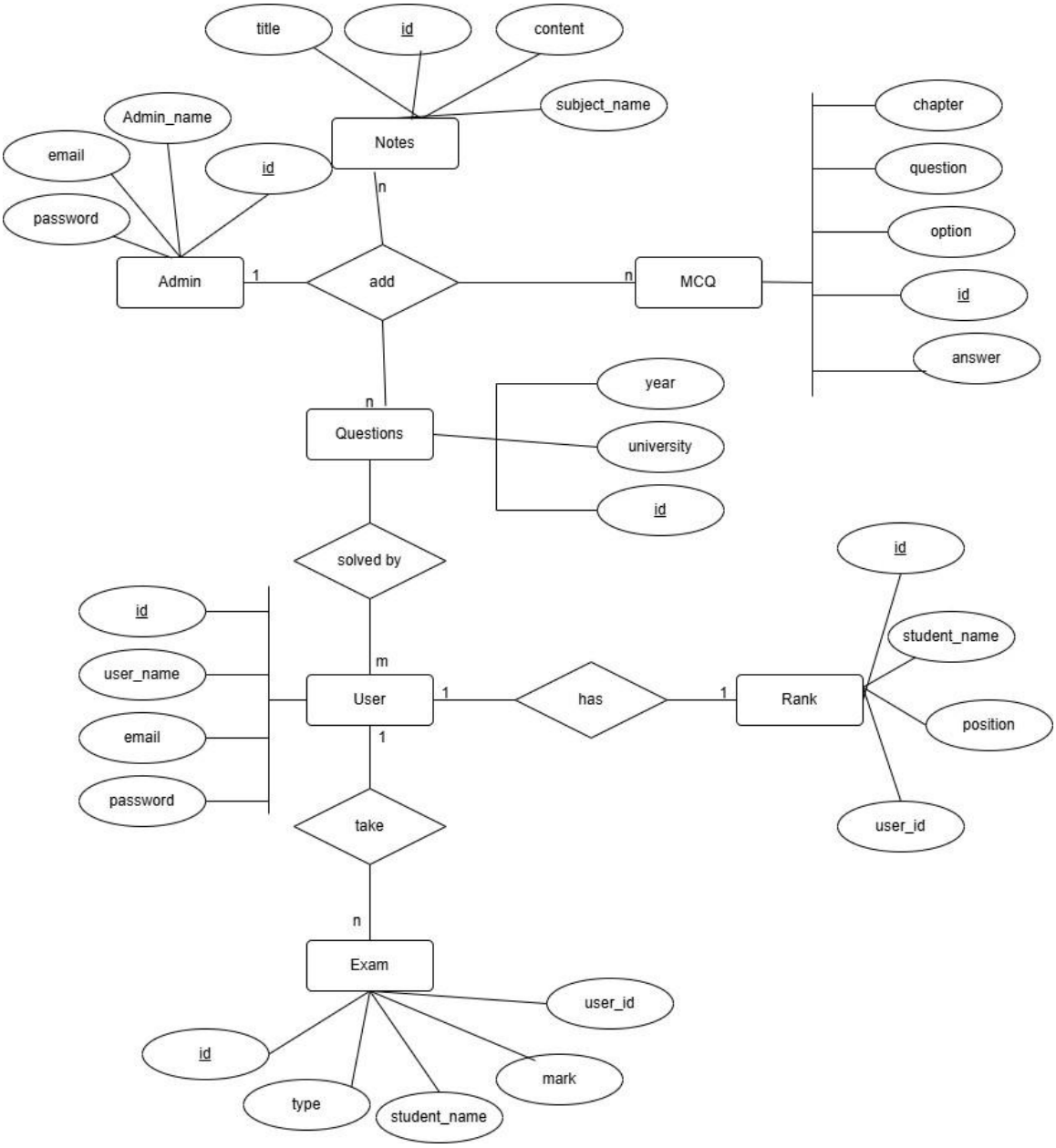

FIGURE 3.5: ENTITY RELATIONSHIP DIAGRAM

3.7 System Sequence Diagram (SSD)

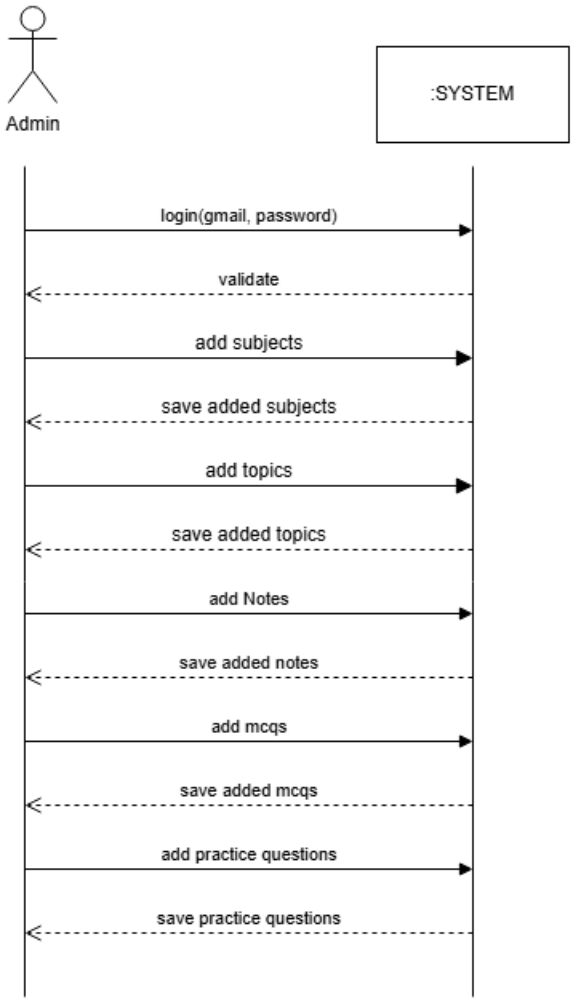

FIGURE 3.6: SYSTEM SEQUENCE DIAGRAM FOR ADMIN

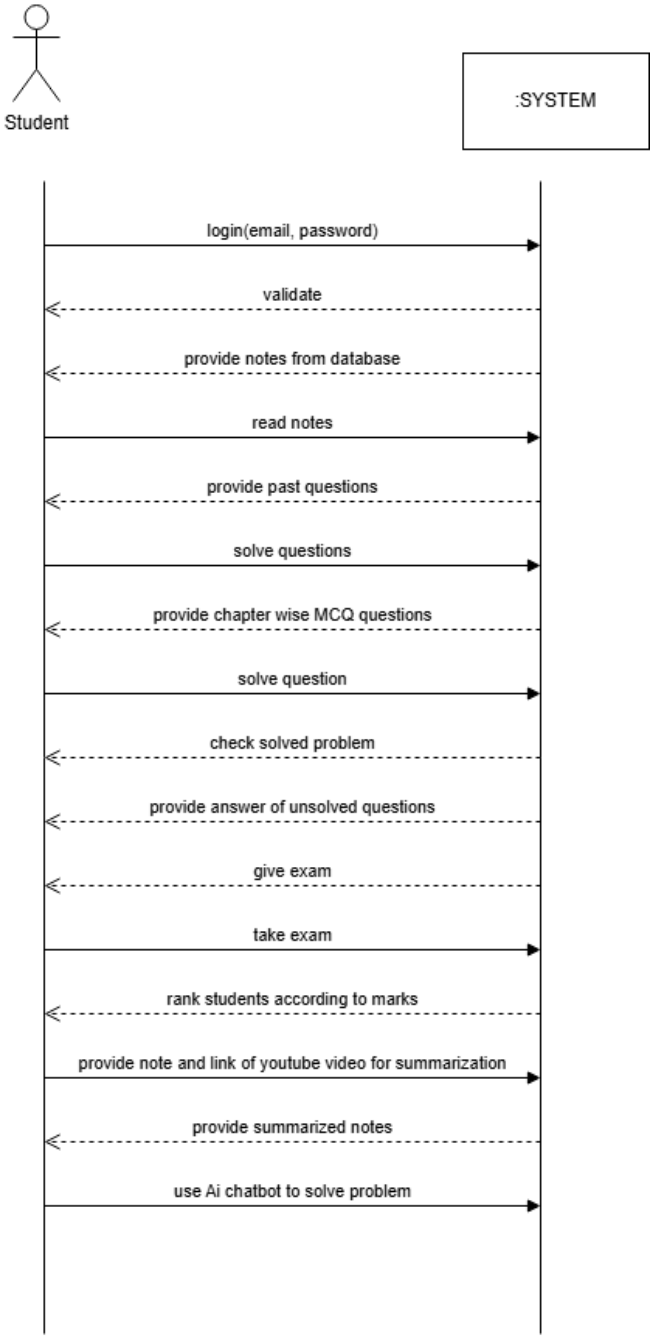

FIGURE 3.7: SYSTEM SEQUENCE DIAGRAM FOR STUDENT

CHAPTER 4

TIME LINE CHART

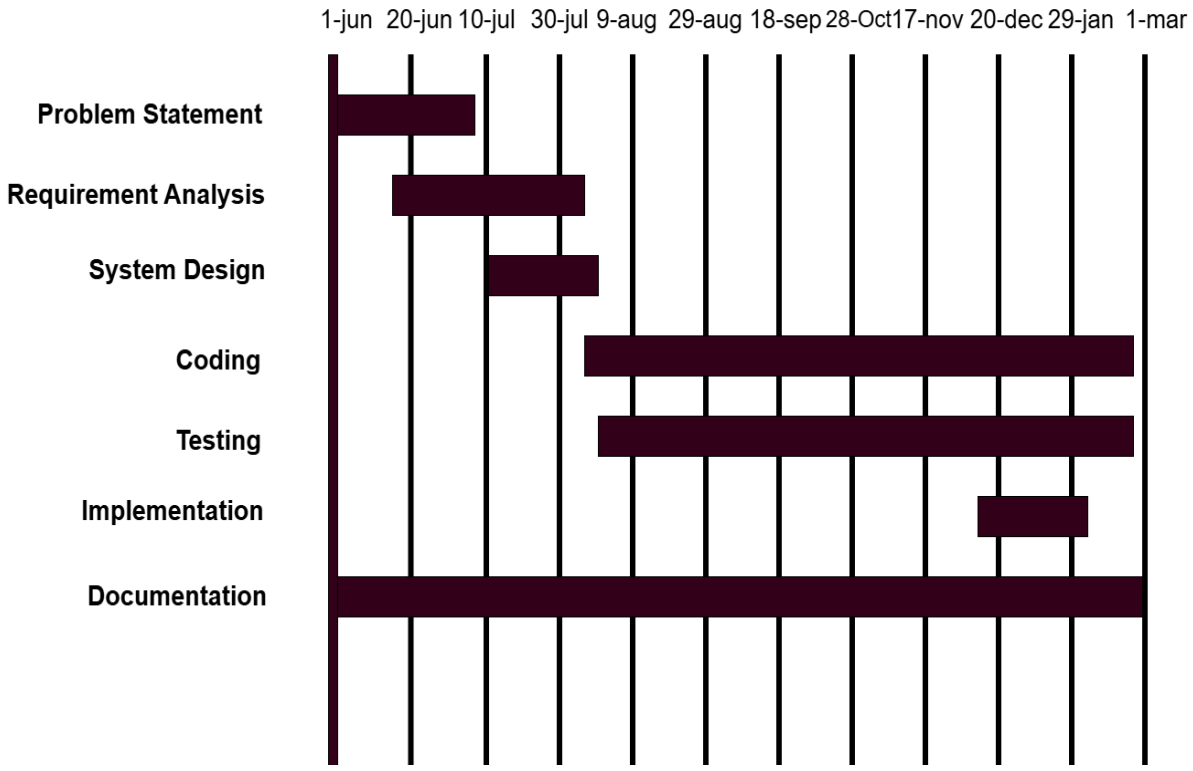

FIGURE 4: TIME LINE CHART

CHAPTER 5

EXPECTED OUTCOMES

After analyzing the requirements and defining the goals for **NextGen Prep**, we anticipate the following outcomes:

- Students receive personalized practice paths that adapt to their strengths and weaknesses.
- AI-powered doubt assistance delivers instant, accurate answers and resource suggestions.
- Performance analytics dashboards provide clear insights into accuracy, speed, and topic mastery.
- Mock tests and chapter-wise MCQs simulate real exam conditions, boosting confidence and time management.
- Summarization tools for PDFs which save study time by highlighting key concepts.
- Users can review past attempts to track progress and focus on areas needing improvement.

5.1 WIREFRAME

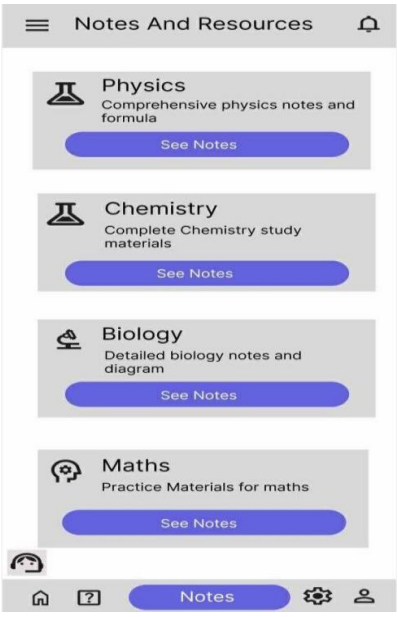

FIGURE 5.1 NOTES PAGE

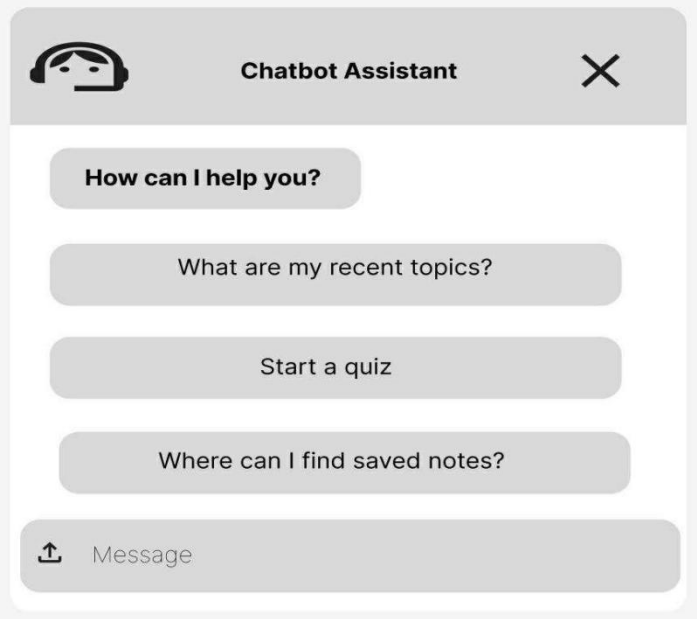

FIGURE 5.2: CHATBOT PAGE

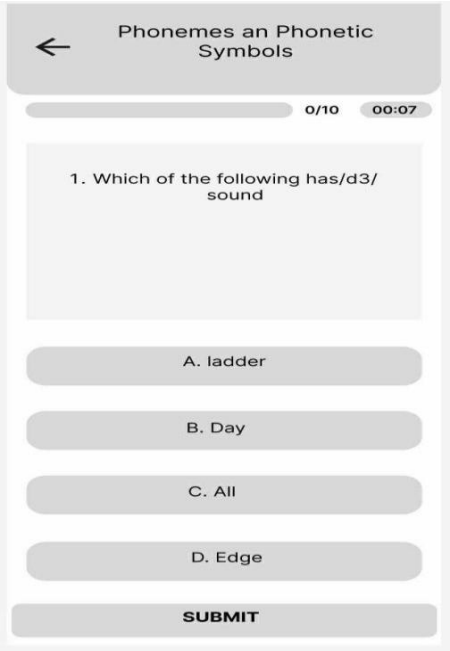

FIGURE 5.3: MCQs PAGE

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