AI Learn Mate – AI Powered Educational Learning Platform

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***Abstract*—Artificial Intelligence (AI) is transforming modern education through intelligent learning systems and automation. AI LearnMate is an AI-powered educational platform developed to improve digital learning experiences using smart technologies. The system provides AI-based lecture summarization, automatic quiz generation, speech-to-text transcription, and personalized recommendation services. Technologies such as React Native, Node.js, FastAPI, PostgreSQL, Groq API, Gemini API, and Deepgram API are integrated into the platform. The system helps students reduce manual learning efforts, improve revision efficiency, and enhance personalized learning experiences. AI LearnMate represents a scalable and intelligent educational solution for modern digital learning environments.**

***Index Terms*—Artificial Intelligence, NLP, React Native, FastAPI, PostgreSQL, Quiz Generation, Speech Recognition, Recommendation System**

I. INTRODUCTION

Artificial Intelligence (AI) is one of the fastest-growing technologies in the modern world and is widely used in various fields such as healthcare, banking, transportation, and education. In recent years, the education sector has rapidly adopted digital learning systems and smart educational platforms to improve learning experiences and accessibility for students. Traditional educational systems mainly focus on content delivery and lack intelligent automation and personalized learning support.

Students often face problems while managing lengthy study materials, revising lecture notes, preparing for examinations, and understanding complex educational topics. Existing educational platforms do not provide advanced AI functionalities such as lecture summarization, automatic quiz generation, speech-to-text conversion, and personalized recommendations. These limitations increase manual learning efforts and reduce learning efficiency.

To overcome these problems, AI LearnMate is developed as an AI-powered smart educational learning platform that integrates Artificial Intelligence technologies with modern software systems. The platform provides intelligent educational support through AI-based lecture summarization, automatic quiz generation, speech-to-text transcription, and recommendation systems. The system uses React Native for frontend development, Node.js and Express.js for backend services, FastAPI for AI microservices, and PostgreSQL for database management.

The AI LearnMate platform improves accessibility, reduces manual learning efforts, enhances student engagement, and supports personalized digital learning experiences. The project demonstrates the practical implementation of Artificial Intelligence in modern education and provides a scalable and intelligent learning environment for students.

II. PROBLEM STATEMENT

In the modern education system, students face difficulties while managing large amounts of study materials, revising lecture notes, and preparing for examinations. Traditional educational systems mainly focus on content delivery and do not provide intelligent automation or personalized learning support. Manual note preparation and lengthy revision processes consume significant time and reduce learning efficiency.

Existing educational platforms lack advanced AI functionalities such as automatic lecture summarization, AI-based quiz generation, speech-to-

text transcription, and personalized recommendation systems. Students often struggle to understand lengthy educational content and revise audio lectures effectively. Additionally, current systems do not provide adaptive learning support based on student learning behavior and performance.

To solve these problems, AI LearnMate is proposed as an AI-powered smart educational platform that integrates Artificial Intelligence technologies with modern software systems. The platform provides intelligent educational services including lecture summarization, automatic quiz generation, speech-to-text conversion, and personalized recommendations to improve learning efficiency, accessibility, and student engagement.

III. OBJECTIVES

The main objective of AI LearnMate is to develop an AI-powered smart educational platform that improves digital learning experiences through intelligent automation and personalized educational support. The platform aims to reduce manual learning efforts and enhance learning efficiency using Artificial Intelligence technologies.

Main Objectives

1. To develop an AI-powered educational learning platform.
2. To generate lecture summaries automatically using AI and NLP techniques.
3. To create AI-based quizzes from educational content.
4. To provide speech-to-text conversion for audio lectures.
5. To generate personalized educational recommendations based on user activities.
6. To improve student engagement and learning efficiency.
7. To provide intelligent automation in digital learning systems.
8. To develop a scalable and secure educational platform using modern software technologies.

IV. LITERATURE SURVEY

Artificial Intelligence (AI) and Natural Language Processing (NLP) technologies are widely used in modern educational systems to improve learning efficiency and intelligent automation. Research studies show that AI-powered educational platforms help students through personalized learning, automated assessments, and smart content management systems.

Many researchers have proposed AI-based systems for lecture summarization, recommendation systems, speech recognition, and automated quiz generation. NLP techniques are used to analyze educational content and generate meaningful summaries from lengthy lecture materials. AI-based recommendation systems help students receive personalized educational suggestions based on their learning activities and performance.

Speech recognition technologies are also becoming important in digital education systems. Modern AI APIs such as Deepgram API and speech recognition models convert audio lectures into readable text formats, improving accessibility and helping students revise lecture content efficiently.

Research papers published by IEEE, ACM, and Elsevier explain how Artificial Intelligence can transform modern education through adaptive learning systems and intelligent educational support. These studies highlight the importance of AI technologies in improving digital learning environments, reducing manual educational efforts, and enhancing student engagement.

Based on these research studies and modern technologies, AI LearnMate is developed as an AI-powered smart educational platform that integrates lecture summarization, quiz generation, speech-to-text conversion, and recommendation systems to provide intelligent and personalized learning experiences.

V. PROPOSED SYSTEM

AI LearnMate is proposed as an AI-powered smart educational platform that integrates Artificial Intelligence technologies with modern software systems to improve digital learning experiences. The system is designed to provide intelligent educational support through automation, personalized learning, and smart content processing.

The platform allows students to upload educational materials such as lecture notes, PDFs, and audio lectures. The uploaded content is processed using AI technologies to generate lecture summaries, quizzes, speech transcriptions, and personalized

recommendations. The system helps students reduce manual learning efforts and improve revision efficiency.

AI LearnMate uses React Native for frontend mobile application development, Node.js and Express.js for backend API services, FastAPI for AI microservices, and PostgreSQL for database management. Advanced AI APIs such as Groq API, Gemini API, and Deepgram API are integrated for Natural Language Processing, speech recognition, and intelligent content generation.

The proposed system improves accessibility, enhances student engagement, and provides adaptive learning support through intelligent educational automation. The modular and scalable architecture of the platform also supports future enhancements and cloud deployment.

VI. SYSTEM ARCHITECTURE

The AI LearnMate platform follows a multi-layer system architecture designed to provide scalability, security, and efficient communication between different modules. The architecture consists of four main layers: Frontend Layer, Backend Layer, AI Service Layer, and Database Layer.

1. Frontend Layer

The frontend application is developed using React Native and Expo framework. It provides a user-friendly mobile interface where students can register, log in, upload study materials, access summaries, attempt quizzes, and view recommendations.

Technologies Used
- React Native
- Expo Framework

2. Backend Layer

The backend layer is developed using Node.js and Express.js. It manages authentication, API routing, business logic, educational content management, and communication between frontend and AI services.

Technologies Used
- Node.js
- Express.js
- JWT Authentication

3. AI Service Layer

The AI service layer is developed using FastAPI. This layer handles intelligent educational functionalities such as lecture summarization, quiz generation, recommendation systems, and speech-to-text processing.

AI APIs Used
- Groq API
- Gemini API
- Deepgram API

4. Database Layer

The PostgreSQL database stores user information, educational content, quizzes, summaries, recommendations, and system logs securely.

Database Technology
- PostgreSQL

Architecture Workflow
1. User interacts with frontend application.
2. Frontend sends requests to backend APIs.
3. Backend communicates with AI microservices.
4. AI services process educational content.
5. Generated outputs are stored in PostgreSQL database.
6. Results are displayed to users through the mobile application.

Features of Architecture
- Scalable system design
- Secure API communication
- Independent AI microservices
- Efficient database management
- Cross-platform mobile support

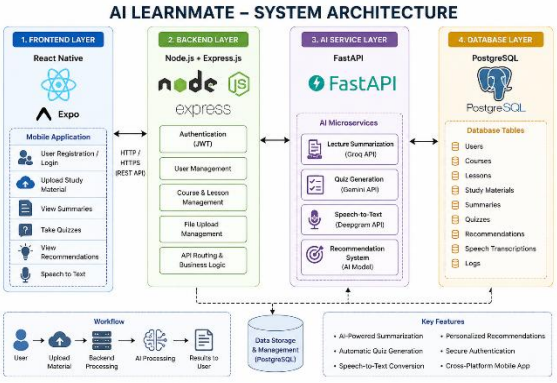


Fig 6.4 System Architecture Diagram

DATABASE DESIGN

The AI LearnMate platform uses PostgreSQL as the relational database management system for secure and efficient data storage. The database stores user information, educational content, quizzes, summaries, recommendations, and speech transcription data. Proper relationships between database tables ensure data consistency and smooth communication between different modules of the system.

Main Database Tables

1. User Table

Stores user registration and authentication details.

Fields:
- user_id
- name
- email
- password
- role
- created_at

2. Course Table

Stores course-related information.

Fields:
- course_id
- title
- description
- category
- created_by

3. Lesson Table

Stores lesson and study material details.

Fields:
- lesson_id
- title
- content
- video_url
- course_id

4. Quiz Table

Stores AI-generated quizzes and answers.

Fields:
- quiz_id
- lesson_id
- questions
- answers
- score

5. Recommendation Table

Stores personalized educational suggestions.

Fields:
- recommendation_id
- user_id
- suggestion
- generated_at

6. Summary Table

Stores AI-generated lecture summaries.

Fields:
- summary_id
- lesson_id
- summary_text
- created_at

7. Logs Table

Stores user activity and system logs.

Fields:
- log_id
- user_id
- action
- result
- timestamp

8. Speech Transcription Table

Stores speech-to-text converted lecture content.

Fields:
- transcription_id
- lesson_id
- transcript_text
- created_at

Features of Database Design
- Secure data storage
- Efficient query processing
- Relational database management
- Scalable architecture
- Data consistency and integrity

Database Technologies Used
- PostgreSQL

• SQL Queries
• Relational Database Design

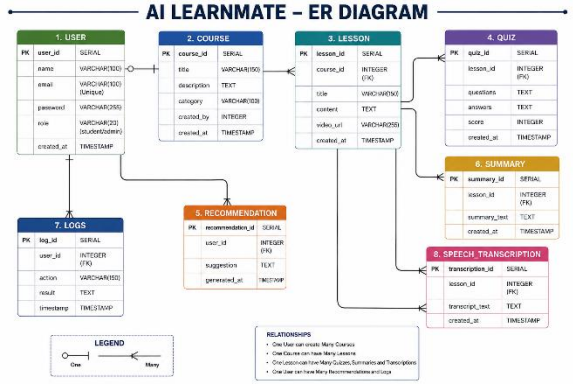


Fig 6.8 ER Diagram

VII. WORKFLOW DIAGRAM

The workflow of AI LearnMate explains the sequence of operations performed by the system from user interaction to AI-generated output. The platform follows a structured process where users upload educational materials and receive intelligent educational support through AI services.

Workflow Steps

1. User Login / Registration

The workflow starts when the user registers or logs into the AI LearnMate platform using secure authentication mechanisms.

2. Upload Study Material

Students upload educational content such as:
• Lecture Notes
• PDFs
• Text Files
• Audio Lectures

3. Backend Processing

The uploaded content is sent to backend APIs developed using Node.js and Express.js. The backend validates user requests and forwards data to AI services.

4. AI Processing Layer

FastAPI AI microservices process educational content using Artificial Intelligence technologies.

AI Operations:
• Lecture Summarization
• Quiz Generation
• Speech-to-Text Conversion
• Recommendation Generation

5. Database Storage

Generated summaries, quizzes, recommendations, and transcription results are stored securely in the PostgreSQL database.

6. Result Display

Processed outputs are displayed to students through the React Native mobile application.

Results Provided:
• AI Summaries
• Quiz Questions
• Speech Transcripts
• Personalized Recommendations

Features of Workflow
• Intelligent automation
• Secure communication
• Fast AI processing
• Scalable architecture
• Personalized learning support

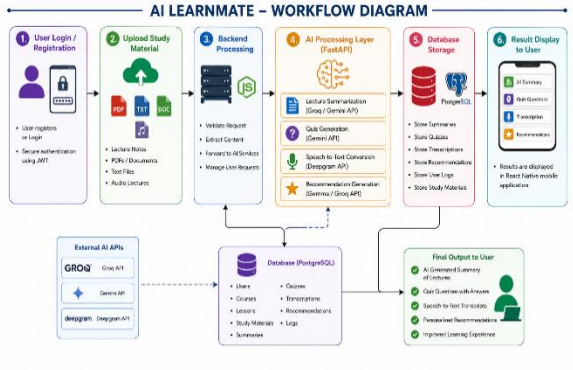
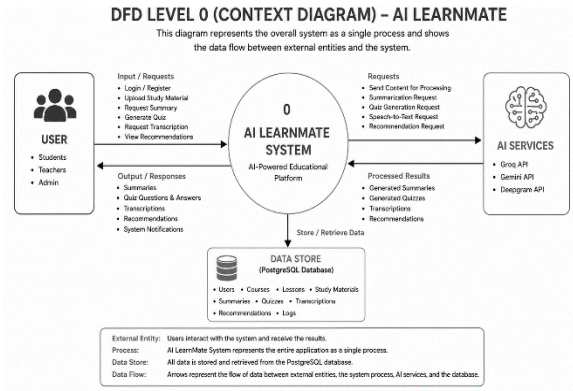


Fig. Workflow Diagram



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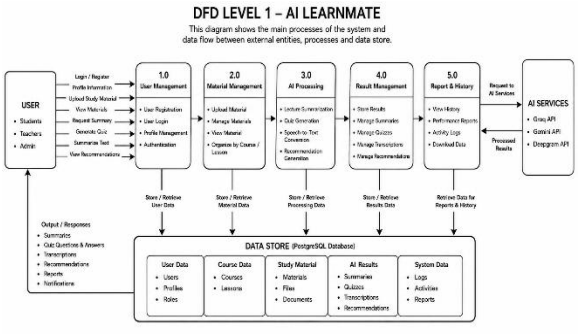

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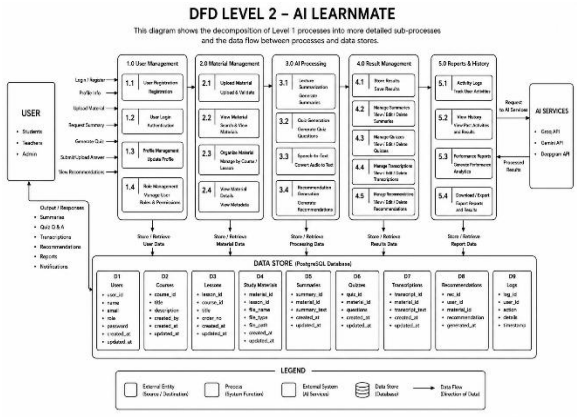

Fig. DFD Level 2

VIII. MODULE DESCRIPTION

The AI LearnMate platform is divided into different functional modules to provide intelligent educational services efficiently. Each module performs specific operations within the system and helps maintain scalability, security, and smooth workflow.

1. User Authentication Module

The Authentication Module manages user registration, login, and secure access to the system. JWT authentication is used for secure session management and API protection.

Functions
- User Registration
- User Login
- Password Encryption
- JWT Authentication
- Session Management

Technologies Used
- Node.js
- Express.js
- JWT Authentication

2. Course Management Module

The Course Management Module handles educational courses, lessons, and uploaded study materials. Students can access learning resources through this module.

Functions
- Add Courses
- Upload Study Materials
- Manage Lessons
- Access Educational Content

Features
- File Upload Support
- Course Categorization
- Educational Content Management

3. AI Summarization Module

The AI Summarization Module uses Artificial Intelligence and NLP technologies to generate short summaries from educational content.

Functions
- Extract Text Content
- Analyze Educational Material
- Generate Summaries
- Simplify Lecture Notes

Technologies Used
- FastAPI
- Groq API
- Gemini API
- NLP Algorithms

4. Quiz Generation Module

The Quiz Generation Module automatically creates quizzes and assessment questions from educational content using AI algorithms.

Functions
- Generate Quiz Questions
- Create Multiple Choice Questions
- Generate Answers
- Store Quiz Results

Features
- Automated Assessment

• Interactive Learning Support
• Performance Evaluation

5. Speech-to-Text Module
The Speech-to-Text Module converts audio lectures into readable text format using speech recognition technologies.

Functions
• Upload Audio Files
• Convert Speech into Text
• Generate Lecture Transcripts
• Store Transcription Data

Technologies Used
• Deepgram API
• FastAPI
• Speech Recognition Algorithms

6. Recommendation System Module
The Recommendation Module analyzes user activities and learning behavior to provide personalized educational suggestions.

Functions
• Analyze User Activity
• Generate Recommendations
• Suggest Educational Content
• Improve Personalized Learning

Features
• AI-based Recommendations
• Adaptive Learning Support
• Personalized Educational Assistance

7. Database Management Module
The Database Module stores user information, educational content, quizzes, summaries, recommendations, and logs securely.

Functions
• Store User Data
• Manage Educational Records
• Store AI Results
• Maintain System Logs

Technologies Used
• PostgreSQL
• SQL Queries

8. Admin Management Module
The Admin Module manages platform activities, users, reports, and educational resources.

Functions
• Manage Users
• Monitor Activities
• Maintain Educational Content
• Generate Reports

Features
• User Management
• Activity Monitoring
• Content Administration
• System Maintenance

IX. DEPLOYMENT

The AI LearnMate platform is deployed using cloud-based infrastructure to provide scalable, secure, and reliable educational services. The system follows a modular deployment architecture where frontend applications, backend APIs, AI services, and databases operate independently and communicate through REST APIs.

1. Frontend Deployment
The frontend mobile application is developed using React Native and Expo framework. The application supports cross-platform mobile devices and provides an interactive user interface for students.

Frontend Features
• User Registration and Login
• Upload Study Materials
• View AI Summaries
• Attempt Quizzes
• Access Recommendations

Technologies Used
• React Native
• Expo Framework

2. Backend Deployment
The backend APIs are deployed using Node.js and Express.js technologies. The backend manages authentication, API routing, database communication, and interaction with AI services.

Backend Responsibilities
• User Authentication
• Course Management
• API Request Handling
• Database Operations
• AI Service Communication

Technologies Used
• Node.js
• Express.js
• JWT Authentication

3. AI Service Deployment
AI microservices are deployed using FastAPI framework. These services handle intelligent educational functionalities such as lecture summarization, quiz generation, recommendation systems, and speech-to-text conversion.

AI Functions
• Lecture Summarization
• Quiz Generation
• Speech-to-Text Conversion
• Recommendation Generation

AI APIs Used
• Groq API
• Gemini API
• Deepgram API

4. Database Deployment
The PostgreSQL database is used for storing educational content, quizzes, summaries, recommendations, logs, and user information securely.

Database Features
• Secure Data Storage
• Relational Database Management
• Efficient Query Processing
• Scalable Architecture

Technology Used
• PostgreSQL

5. Cloud Hosting
The AI LearnMate platform is hosted on Render cloud hosting services. Cloud deployment improves scalability, accessibility, and remote availability of the platform.

Advantages of Cloud Deployment
• Remote Accessibility
• High Scalability
• Better Performance
• Easy Maintenance
• Secure Hosting

Deployment Workflow
1. User accesses React Native application.
2. Frontend sends requests to backend APIs.
3. Backend communicates with AI microservices.
4. AI services process educational content.
5. Results are stored in PostgreSQL database.
6. Processed outputs are displayed to users.

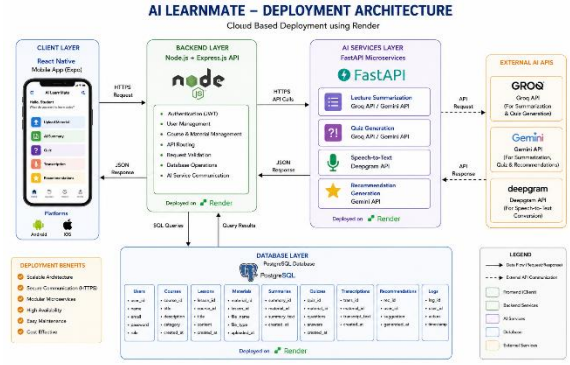

Fig. Deployment Architecture Diagram

X. TESTING AND RESULTS

The AI LearnMate platform was tested using different software testing methods to verify system functionality, performance, security, and reliability. Testing ensured that all modules worked correctly and generated accurate AI-based outputs.

1. Unit Testing
Unit testing was performed on individual modules to verify their functionality independently.

Tested Modules
• Authentication Module
• Quiz Generation Module
• Summarization Module
• Recommendation Module
• Speech-to-Text Module

Result
All modules executed successfully without major errors.

2. Integration Testing
Integration testing verified communication between frontend, backend, AI services, and database systems.

Tested Integrations
• Frontend to Backend APIs
• Backend to AI Services
• Backend to Database
• AI Services to External APIs

Result
All integrated components communicated successfully and exchanged data correctly.

3. API Testing
API testing was performed to validate request handling, authentication, and response generation.

API Features Tested
• User Login API
• Upload API
• Summary Generation API
• Quiz API
• Recommendation API

Result
The APIs generated secure and accurate responses with proper status codes.

4. Database Testing
Database testing verified data storage, retrieval, and consistency within PostgreSQL database.

Database Operations Tested
• Insert Operations
• Update Operations
• Delete Operations
• Query Execution
• Relationship Validation

Result
The database managed educational records securely and efficiently.

5. Security Testing
Security testing verified authentication and secure communication mechanisms.

Security Features Tested
• JWT Authentication
• Password Encryption
• API Security
• Session Validation

Result
The system successfully protected user data and prevented unauthorized access.

6. AI Functionality Testing
AI testing verified intelligent educational services generated by the platform.

AI Features Tested
• Lecture Summarization
• Quiz Generation
• Speech-to-Text Conversion
• Recommendation Generation

Result
The AI services generated accurate summaries, quizzes, transcriptions, and personalized recommendations successfully.

Performance Results
• Fast API response time
• Stable frontend performance
• Efficient AI processing
• Secure database operations
• Reliable cloud deployment

Advantages Observed
• Reduced manual learning efforts
• Faster revision process
• Improved personalized learning
• Intelligent educational support
• Better accessibility for students

XI. ADVANTAGES

The AI LearnMate platform provides intelligent educational support through Artificial Intelligence technologies and modern software systems. The platform improves learning efficiency, accessibility, and personalized educational experiences for students.

Main Advantages

1. Intelligent Learning Support
The platform provides AI-powered educational assistance through automated summaries, quizzes, recommendations, and speech transcription services.

2. Automatic Lecture Summarization
AI LearnMate automatically generates short and understandable summaries from lengthy educational content, helping students revise topics quickly.

3. AI-Based Quiz Generation
The system automatically creates quiz questions and answers from uploaded study materials, improving student self-assessment and exam preparation.

4. Speech-to-Text Conversion
The platform converts audio lectures into readable text format, making revision easier and improving accessibility for students.

5. Personalized Recommendations
The recommendation system analyzes user activities and provides personalized educational suggestions based on learning behavior.

6. Reduced Manual Effort
Students do not need to prepare notes manually, as the AI system automates summarization and content generation processes.

7. Improved Learning Efficiency
The intelligent educational features help students save time and improve understanding of educational content effectively.

8. Cross-Platform Mobile Support
The React Native application supports Android and iOS devices, allowing students to access learning resources from anywhere.

9. Secure System Architecture
The platform uses JWT authentication, secure APIs, and PostgreSQL database management to protect user information and educational records.

10. Scalable Cloud Deployment
The cloud-based deployment architecture supports scalability, better performance, and remote accessibility for users.

Overall Benefits
- Faster revision process
- Smart educational automation
- Better accessibility
- Personalized learning experience
- Improved student productivity
- Efficient educational management

XII. LIMITATIONS

Although the AI LearnMate platform provides intelligent educational support and automation, the system still has certain limitations related to AI processing, internet dependency, and external services.

Main Limitations
1. Internet Dependency
The platform requires a stable internet connection for accessing cloud services, AI APIs, and online educational content.

2. Dependency on External AI APIs
AI functionalities such as summarization, quiz generation, and speech-to-text conversion depend on external APIs like Groq API, Gemini API, and Deepgram API.

3. AI Accuracy Limitations
The accuracy of AI-generated summaries, quizzes, and recommendations may vary depending on the quality and complexity of educational content.

4. Large File Processing Time
Large PDFs, audio files, and lengthy educational materials may require higher processing time during AI analysis.

5. Cloud Service Dependency
The platform depends on cloud hosting services for deployment, scalability, and remote accessibility.

6. Limited Offline Functionality
Most intelligent educational features are not available in offline mode because AI processing requires server communication.

7. Speech Recognition Challenges
Speech-to-text conversion accuracy may decrease in noisy audio environments or unclear voice recordings.

8. Resource Consumption
AI processing and cloud communication may consume higher system resources and internet bandwidth.

Overall Limitations
• Requires continuous internet connection
• External AI service dependency
• Processing delay for large files
• Limited offline support
• AI output may vary in accuracy

Conclusion
Despite these limitations, AI LearnMate successfully provides intelligent educational support and significantly improves digital learning experiences through Artificial Intelligence technologies and smart automation systems.

XIII. FUTURE SCOPE

The AI LearnMate platform can be further improved by integrating advanced Artificial Intelligence technologies and smart educational features. Future enhancements will help create a more intelligent, scalable, and interactive digital learning environment for students and educational institutions.

Future Enhancements
1. AI Tutor Chatbot
An AI-powered chatbot can be integrated to provide real-time doubt solving, intelligent guidance, and personalized academic assistance for students.

2. Multilingual Support
The platform can support multiple regional and international languages to improve accessibility for students from different language backgrounds.

3. Voice Assistant Integration
Voice-based AI assistants can be added for hands-free interaction and smart educational support through voice commands.

4. Advanced Learning Analytics
Advanced analytics and AI-based performance tracking can help monitor student learning behavior, progress, and academic improvement.

5. Live Classroom Integration
The system can support live online classrooms, virtual meetings, and AI-powered classroom assistance for real-time digital learning.

6. Offline Learning Support
Offline educational features can be developed to allow students to access summaries, quizzes, and study materials without internet connectivity.

7. Cloud Scalability
The platform can be scaled using advanced cloud technologies to support large numbers of users and educational institutions efficiently.

8. AI-Based Personalized Study Plans
Future versions of the system can generate customized study schedules and learning plans based on student performance and learning patterns.

9. Smart Notification System
AI-powered notifications and reminders can help students manage assignments, quizzes, examinations, and study schedules effectively.

10. Integration with Educational Institutions
The platform can be integrated with schools, colleges, universities, and online learning platforms for large-scale educational management.

Overall Future Scope
• Intelligent AI educational ecosystem
• Advanced automation features
• Better accessibility and personalization
• Scalable cloud-based learning platform
• Smart digital education environment

XIV. CONCLUSION

AI LearnMate is an AI-powered smart educational platform developed to improve digital learning experiences through intelligent automation and personalized educational support. The platform integrates advanced Artificial Intelligence technologies such as Natural Language Processing, speech recognition, recommendation systems, and automated quiz generation to provide efficient learning assistance for students.

The system successfully provides AI-based lecture summarization, speech-to-text conversion, personalized recommendations, and intelligent quiz generation using modern technologies including React Native, Node.js, FastAPI, PostgreSQL, Groq API, Gemini API, and Deepgram API. The platform helps students reduce manual learning efforts, improve revision efficiency, and enhance educational accessibility.

The modular and scalable architecture of AI LearnMate ensures secure communication, efficient AI processing, and reliable cloud deployment. Testing results demonstrated stable performance, secure authentication, accurate AI-generated outputs, and efficient database management.

Overall, AI LearnMate represents an innovative and intelligent educational solution that combines Artificial Intelligence with modern software technologies to create a smart digital learning environment. The project highlights the future potential of AI in transforming modern education systems through intelligent automation, adaptive learning, and personalized educational experiences.

APPENDIX

Appendix A: Technologies Used

Technology	Purpose
React Native	Frontend Mobile Application Development
Node.js	Backend Server Development
Express.js	REST API Development
FastAPI	AI Microservices
PostgreSQL	Database Management
Groq API	AI Content Processing
Gemini API	NLP and AI Generation
Deepgram API	Speech-to-Text Conversion
Render	Cloud Deployment

Appendix B: Software Requirements

Development Tools
- Visual Studio Code
- Postman API Testing Tool
- PostgreSQL Database
- Expo CLI
- GitHub

Operating System
- Windows 10/11
- Linux
- Android

Appendix C: Hardware Requirements

Minimum Hardware
- Intel i3 Processor
- 4 GB RAM
- 20 GB Storage

Recommended Hardware
- Intel i5/i7 Processor
- 8 GB RAM
- SSD Storage

Appendix D: APIs Used

1. Groq API

Used for AI-based content processing and educational summarization.

2. Gemini API

Used for Natural Language Processing and quiz generation.

3. Deepgram API

Used for speech recognition and audio transcription.

Appendix E: Screenshots Included
- Login Page
- Registration Page
- Dashboard
- Summary Generation Page
- Quiz Generation Page
- Speech-to-Text Page
- Recommendation Page

Appendix F: Abbreviations

Abbreviation	Meaning
AI	Artificial Intelligence
NLP	Natural Language Processing
API	Application Programming Interface
JWT	JSON Web Token
DFD	Data Flow Diagram
UI	User Interface
DBMS	Database Management System

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