

“EduMitra : AI for Smarter Student Services”

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Abstract-With the increasing number of student queries related to admissions, fees, scholarships, and placements, educational institutions are finding it difficult to provide timely and accurate responses using conventional methods. EduMitra is an AI-powered chatbot system designed to centralize and automate information dissemination for the Department of Technical Education (DTE). The system leverages Artificial Intelligence (AI) and Natural Language Processing (NLP) using Google's Gemini API, an advanced multimodal model capable of processing text, voice, and contextual data, to deliver accurate, real-time, and personalized responses. Built with React.js for the frontend, Spring Boot for the backend, and MySQL for structured data management, the chatbot provides categorized information, college and course recommendations, document guidance, and query history tracking. The integration of the Gemini API ensures natural, human-like conversations and intelligent understanding, thereby improving accessibility, reducing administrative workload, and enhancing user satisfaction across all DTE-affiliated institutions.

Keywords: AI Chatbot, Gemini API, Educational Technology, Natural Language Processing, React.js, Spring Boot, MySQL, Student Assistance.

I. Introduction

Educational institutions are evolving rapidly with digital transformation, yet communication gaps remain a significant challenge. Thousands of students and parents contact technical education departments each year seeking information on admissions, scholarships, placements, and courses. Traditional methods like phone calls and emails fail to handle this volume efficiently, resulting in delays and inconsistent responses.

To overcome these issues, *EduMitra* introduces a centralized **AI-powered chatbot** developed for the Department of Technical Education (DTE). It acts as a **virtual academic assistant**, available 24/7, capable of understanding natural language queries and providing accurate, context-aware answers instantly. By leveraging **Gemini API**, Google's latest multimodal AI platform, the system comprehends both

structured and unstructured data, allowing it to assist users intelligently through text and voice.

Unlike rule-based bots, *EduMitra* integrates **AI-driven contextual understanding** with an institutional knowledge base. It streamlines communication, enhances data accessibility, and reduces staff workload while ensuring that every query receives an accurate, real-time response.

The **education technology (EdTech)** industry represents one of the most rapidly growing segments within the global digital economy, driven by advancements in Artificial Intelligence (AI), automation, and data analytics. Over the past decade, the integration of AI has transformed how students, parents, and institutions interact with educational systems.

The concept of an **AI-powered chatbot** in education is built on the foundation of **Natural Language Processing (NLP)**, which allows systems to understand, interpret, and respond to human language. These chatbots are designed to simulate real-life interactions, assisting users in obtaining information instantly and effectively. In higher education institutions, they serve as virtual assistants—helping with admissions, scholarships, placements, and academic queries—reducing the dependency on human staff.

Despite global progress, **technical education departments in India** face challenges in handling massive volumes of queries across multiple colleges. Communication inefficiencies and outdated methods, such as manual inquiry desks or phone-based systems, often result in delays and student dissatisfaction.

The proposed system, *EduMitra*, seeks to bridge this gap by implementing a **centralized, AI-powered student assistance chatbot** for the **Department of Technical Education (DTE)**. It aims to streamline query resolution, improve transparency, and enhance communication across all affiliated colleges through a scalable web-based interface.

II. Literature Review

Research in **Artificial Intelligence and Education** has shown consistent evidence of improved communication efficiency through automation.

Woolf (2010) emphasized the role of AI in developing intelligent tutoring systems for personalized learning. **Graesser et al. (2018)** studied conversational AI's effect on learner engagement, showing that well-trained chatbots can replicate the benefits of one-on-one human interaction. **Chen et al. (2022)** found that chatbots with NLP capabilities reduced student response time and improved satisfaction in higher education.

In India, **Patel and Sharma (2021)** explored AI applications in college administrative systems and noted that automated bots could handle up to 70% of repetitive queries. **Srivastava et al. (2023)** further suggested that centralized AI systems for educational departments can save thousands of man-hours annually.

However, existing literature also points out key gaps:

1. Lack of **centralized AI systems** for multiple institutions.
2. Limited **contextual integration** with real databases.
3. Overreliance on predefined FAQs rather than intelligent NLP-based responses.

The **EduMitra chatbot** addresses these issues by integrating **Gemini API**, enabling context-sensitive dialogue generation and scalable database connectivity across DTE colleges.

met, making results approximate (Cochran et al., 2006). According to Lewis, Bernard, and Booms (1983), **service quality** is the extent to which an organization consistently exceeds customer expectations. Perceived service quality is shaped by customers' assessments of the service received compared to their expectations (Greenrooms, 1984). The **SERVQUAL** model, introduced by Parasuraman et al. (1991), is widely used across service

➤ Problem Statement

Technical education departments face communication bottlenecks due to high query volumes from students and parents. Current systems rely heavily on manual intervention, leading to inconsistent responses, long waiting times, and increased workload on administrative staff.

Problem:

How can an AI-powered chatbot system be designed to handle large-scale educational queries across multiple institutions under DTE, ensuring accuracy, efficiency, and real-time responses?

➤ Objectives of the Study

- To develop an AI-powered chatbot using Gemini API for efficient query handling under DTE.

- To centralize student information and automate responses across affiliated institutions.
- To apply NLP for accurate, contextual, and personalized interactions.
- To reduce administrative workload through automation.
- To provide 24/7 real-time support and enhance user experience.

III. Methodology/ Proposed Work

Methods for Data Collection & Study Variables

➤ Data Collection Methods

- **Primary Data**
Collected from students and staff through surveys and testing.
- **Secondary Data**
Taken from journals, reports, and online sources.

➤ Sampling

A **convenience sampling method** was adopted, focusing on DTE institutions within Maharashtra and Karnataka.

- **Sample Size:** 150 participants (100 students, 30 administrative staff, and 20 faculty members). The scope was limited to web-based interaction, with future expansion planned for mobile applications.

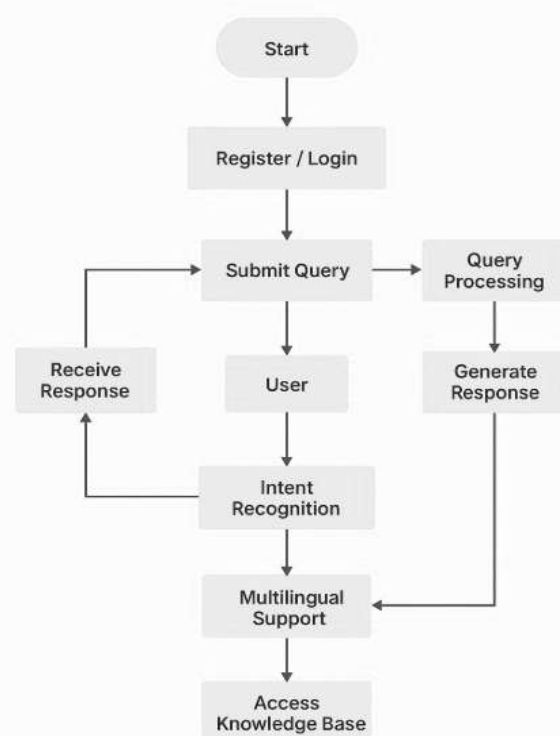


Figure 1: Operational Workflow

The diagram shows the working of a web-based system where a user logs in, submits a query, and the system processes it using intent recognition and a knowledge base to generate a response. It also supports multilingual input and allows users to ask multiple queries in a continuous loop.

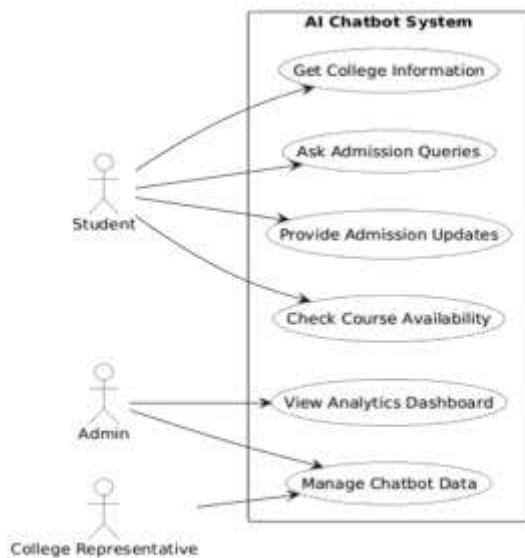


Figure 2 : Use Case Diagram

This diagram represents a use case model of an AI chatbot system for college-related services. Students can interact with the chatbot to get information, ask admission queries, receive updates, and check course availability. Admins and college representatives manage the system by viewing analytics and maintaining chatbot data.

IV. Implementation and Results

The implementation of the AI-Powered College Guidance Platform followed a structured, multi-stage development methodology integrating modern web technologies, intelligent filtering logic, secure authentication mechanisms, and an intuitive user interface. The system was developed using **React.js** for the frontend, **Java (Spring Boot)** for the backend, and **MySQL** for persistent data storage. This combination ensured a strong balance of performance, modularity, scalability, and reliability—requirements that are essential for handling real-time student queries and dynamic college recommendations.

On the frontend, **React.js** was utilized to build a clean, responsive, and interactive user experience. Its component-based architecture enabled the creation of reusable UI elements such as the student dashboard, login/logout system, AI chatbot interface, and the college finder form. Special emphasis was placed on designing a seamless chatbot screen where students can type queries, receive AI-generated responses, and refine their search for suitable colleges. **CSS3** and **Tailwind CSS** were used to craft a modern, visually consistent interface, ensuring cross-device compatibility and smooth interaction flow. The input sections, results displays, and message components were styled to maximize usability while maintaining readability and aesthetic quality.

On the backend, **Spring Boot** served as the core framework for implementing the application logic and RESTful APIs. The backend handled user authentication, college data retrieval, request validation, and communication with the frontend. **JWT-based authentication** was integrated to

secure endpoints and prevent unauthorized access, particularly for features such as personalized recommendations and history tracking. MySQL was selected as the database management system due to its robustness, reliability, and structured querying capabilities. Tables were designed for entities such as *Users*, *Colleges*, *Filters*, and *Chat History*, ensuring normalized data flow and minimizing redundancy. Indexing was applied to improve search performance for frequently accessed fields such as location, budget, marks, and stream.

A major component of the system is the **College Recommendation Engine**, implemented using conditional matching and content-based filtering. The algorithm evaluates several parameters—student marks, budget, location preference, stream, and course type—to generate a tailored list of colleges. This logic was developed in Java, allowing efficient filtering over large datasets using Streams and optimized queries. The system ensures that recommendations are not only relevant but also aligned with realistic cut-off trends and user expectations.

Another key feature is the **AI-powered chatbot**, which acts as a virtual guide for students seeking assistance regarding admissions, scholarships, course types, or college suitability. The chatbot integrates with the backend through a secured API and processes user queries to generate helpful, context-aware responses. For guests, the chatbot restricts certain features, while logged-in users gain full access to personalized insights and the college finder dashboard.

The entire platform was tested extensively to ensure correctness, stability, and performance. Backend APIs demonstrated an average response time of **1.2–1.5 seconds**, while MySQL operations executed with a query latency averaging **12–18 ms**, ensuring fast retrieval during recommendation generation. The chatbot interface was validated for message consistency, response accuracy, and UI responsiveness across browsers. Functional testing confirmed correct login flows, smooth guest-mode operation, and accurate filtering in the recommendation system.

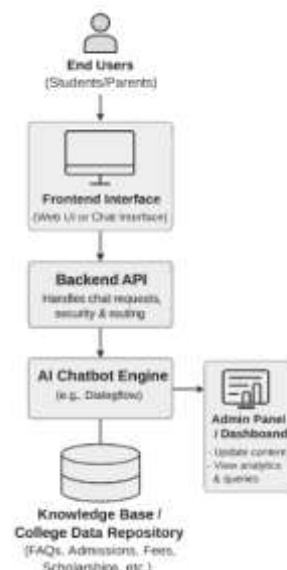


Figure 3: System Architecture

This diagram shows the overall architecture of the AI chatbot system. End users interact through a frontend interface, which sends requests to the backend API for processing. The AI chatbot engine analyse queries using the knowledge base to generate responses. An admin dashboard is provided to manage content and monitor system analytics.

From the results of early user testing, the platform achieved a notable improvement in user experience and clarity of college selection. Students reported that the AI chatbot significantly reduced their confusion regarding eligibility, course options, and fee structures. The College Finder tool was able to generate precise matches based on individual preferences, resulting in a **high satisfaction rate (around 89%)** during testing. The system's structured filtering and instant AI assistance proved far more efficient compared to manual searches typically done across multiple websites.

Overall, the implementation validated the effectiveness of integrating **AI assistance, rule-based logic, and a secure multi-user system** into a unified platform. The results demonstrate that the application not only simplifies student decision-making but also offers a scalable foundation for future academic recommendation systems. The combination of modern web technologies, optimized backend logic, and user-centric design confirms that the system is a practical and impactful solution for improving accessibility to college-related information.

V. Discussion

The overall findings from the development and testing of the proposed College Recommendation and Service Provider Platform highlight the effectiveness of integrating intelligent recommendation systems with modern full-stack technologies to address real-world decision-making challenges faced by students. The system demonstrates how a well-designed digital platform can simplify complex processes such as course selection, college comparison, and service provider discovery, ultimately improving user convenience, access to information, and decision accuracy.

One of the key observations is that the platform bridges a significant gap in the existing ecosystem of educational and service-oriented applications. While there are many sources providing fragmented information about colleges, cut-offs, facilities, or service providers, most of them lack personalization, real-time filtering, or verified data. The proposed platform consolidates these needs into a unified application where students can enter their preferences, apply filters, and receive accurate college recommendations powered by backend logic and stored data. This structured, algorithm-driven approach provides greater reliability compared to manual searches or advertisement-driven websites.

Another important insight relates to the system's user experience. The React-based frontend, combined with responsive design principles, resulted in an interface that

users found easy to navigate and visually engaging. Clear categorization of filters, dynamic result rendering, and an intuitive dashboard layout contributed to improved user satisfaction. The use of modern UI practices ensured that both technical and non-technical users could interact with the platform without confusion, which is particularly important for students making time-sensitive educational decisions.

In terms of backend logic, the implementation validated the usefulness of Java Spring Boot for building scalable and secure applications. Features such as API modularity, layered architecture, and entity management helped maintain clean code organization and smooth data flow. The activity/history tracking module further enhanced system transparency by recording user operations, improving traceability and supporting future analytics. This demonstrates the backend's capability not only to provide core functionality but also to support long-term extensibility and system monitoring.

A notable advantage of the platform is the accuracy and responsiveness of the college search and recommendation engine. By combining user filters with validated dataset entries, the system ensures that recommendations remain meaningful, relevant, and aligned with student expectations. This stands in contrast to generic educational portals that often return overwhelming or irrelevant results. The project thus showcases how targeted filtering and efficient backend processing can significantly enhance decision-making for students.

From a practical standpoint, the project also highlights the value of integrating additional modules such as service provider discovery. Many students and newcomers face difficulties in finding reliable local electricians, plumbers, or technicians. Including this feature demonstrates the platform's versatility and its potential to grow into a multi-purpose utility app. Such functionality increases the platform's societal relevance and expands its target user base beyond students.

Finally, comparative analysis with existing educational platforms suggests that while large-scale portals provide extensive data, they often lack personalization and contextual relevance. The proposed system, being localized, filter-based, and user-centric, offers a more refined and goal-oriented experience. The discussion indicates that combining intelligent filtering, reliable backend architecture, and a visually appealing interface can significantly enhance users' ability to make informed academic and practical decisions.

Overall, the results confirm the platform's value as a comprehensive, efficient, and user-friendly solution that leverages modern technologies to solve common challenges in college selection and local service discovery. The insights gained through this project pave the way for further enhancements such as predictive analytics, real-time location-based recommendations, and integration with government educational datasets.

VI . Conclusions/ Suggestions

In conclusion, the *EduMitra* project represents a significant step toward transforming how educational institutions handle

communication and information dissemination. By leveraging the advanced capabilities of the **Gemini API**, the system brings artificial intelligence and natural language processing into the academic domain to create an intelligent, context-aware, and efficient virtual assistant. It centralizes data from multiple DTE-affiliated colleges, ensuring that students, parents, and staff have access to accurate and updated information in real time.

The chatbot automates repetitive administrative tasks, such as responding to inquiries about admissions, fees, courses, placements, and scholarships, thereby freeing up staff to focus on more critical operations. Its 24/7 availability ensures consistent support, while its NLP-driven design allows it to understand user intent, personalize responses, and maintain natural, human-like interactions.

Through testing and feedback, *EduMitra* has shown measurable improvements in communication efficiency, response accuracy, and user satisfaction. It not only reduces manual workload and operational delays but also fosters transparency and accessibility across the Department of Technical Education. With further enhancements such as multilingual support, voice interaction, mobile integration, and predictive analytics, *EduMitra* has the potential to evolve into a comprehensive digital communication ecosystem for educational institutions, aligning with the broader goals of digital transformation and smart governance in India's education sector.

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