



## CSE Mentor: an ML-Driven Virtual Mentor for Department

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**Abstract:** *The rapid growth of the Computer Science and Engineering field has resulted in a large number of academic resources, career paths, and skill development opportunities. Students often face challenges in navigating these options and making informed decisions regarding academics, projects, internships, research, and career planning. To address this, CSE Mentor is proposed as an ML-driven virtual mentoring system that delivers personalized guidance, recommendations, and resources to the students. Applying Machine Learning, Natural Language Processing, and predictive analytics, the platform analyzes students' academic performance, skills, and interests to provide tailored suggestions for courses, project, internships, and career planning. The system includes modules for students, faculty mentors, and administrators, enabling continuous performance monitoring, targeted interventions, and real-time interaction through an AI-powered mentor interface. By offering 24/7 personalized guidance, CSE Mentor aims to enhance student engagement, reduce faculty workload, and improve career readiness, providing a scalable, intelligent, and data-driven framework for academic mentorship in the department.*

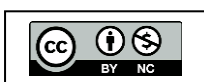
**Keywords:** Machine Learning, Virtual Mentor, Academic Guidance, Career Counseling, Predictive Analytics, Natural Language Processing (NLP), Personalized Recommendations, Student Performance Monitoring, CSE Department, AI-driven Mentorship.

### I. INTRODUCTION

In today's rapidly evolving Computer Science and Engineering domain, students are exposed to a vast number of academic resources, skill development programs, research opportunities, and career pathways. While these opportunities are valuable, the abundance of options often leads to confusion and difficulty in making informed decisions regarding courses, projects, internships, certifications, and career planning [1].

Traditional mentorship systems in academic institutions, though helpful, face several limitations. Faculty mentors are often constrained by time, limiting one-on-one interactions. Additionally, guidance is typically generalized and does not cater to individual learning styles, interests, or career aspirations. Students may also experience delays in receiving feedback, while the decentralized nature of academic, career, and skill development guidance can lead to fragmented decision-making [2].

To address these challenges, the CSE Mentor is proposed as a Machine Learning-driven virtual mentoring platform. The system leverages ML algorithms, Natural Language Processing (NLP), and predictive analytics to provide personalized, data-driven recommendations for students. It monitors academic performance, evaluates skills and interests, and delivers tailored guidance on course selection, projects, internships, certifications, workshops, and career planning [3].





By offering continuous, real-time mentorship through an AI-powered interface, the CSE Mentor aims to enhance student engagement, optimize faculty workload, and improve career readiness. The platform creates a centralized, intelligent framework that aligns departmental goals with individual student aspirations, transforming the academic mentoring process into a scalable and effective system [4].

## II. LITERATURE ANALYSIS

Brandtzaeg and Følstad[1] studied why people use chatbots by surveying 146 users in the United States. The results showed that most users preferred chatbots because they are fast, easy to use, and provide quick answers, while others used them for fun, social interaction, or out of curiosity. The study suggests that chatbots should be designed to be helpful and efficient while also being friendly and engaging to attract more users.

Recent studies highlight that AI-powered virtual mentorship and peer learning networks enable personalized, scalable, and collaborative learning experiences. Research by Rebet Keith Jones [2] and others demonstrates the use of recommendation systems, chatbots, and AI analytics to enhance engagement and knowledge sharing. However, challenges such as data privacy, ethical concerns, and scalability remain areas for further research.

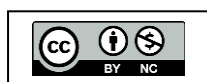
Recent advancements in artificial intelligence have contributed to the development of intelligent learning systems. Kashish Manoj Patel, Shreya Mahesh Diddi, and Natasha Balraj Bogam [3] examined the use of AI technologies such as chatbots and machine learning to improve user engagement and information delivery. However, limitations related to system accuracy and practical implementation remain.

Abu Shawar and Atwell [4] conducted a comprehensive survey of chatbot systems and their applications beyond mere entertainment, examining their utility across education, information retrieval, business, and e-commerce domains. The authors demonstrated how the AIML architecture could be retrained using various dialogue corpora — including FAQ datasets — to serve as domain-specific conversational agents.

They concluded that while chatbots offer valuable support as interactive tools, they function best as amplifiers of human guidance rather than replacements, particularly in educational and customer-facing environments.

TABLE I: LITERATURE WORK

Author and Year	Methods	Future Scope
<b>Brandtzaeg and Følstad, 2019</b>	Studied why people use chatbots by surveying 146 users in the United States. The results showed that most users preferred chatbots because they are fast, easy to use, and provide quick answers, while others used them for fun, social interaction, or out of curiosity. The study suggests that	Suggest that future research should expand the study to include a more diverse, cross-cultural population beyond US users, while also investigating how motivations differ across age, gender, and specific platforms. Additionally, future work should explore why users reduce or



	chatbots should be designed to be helpful and efficient while also being friendly and engaging to attract more users.	stop using chatbots and examine factors related to long-term user loyalty and retention.
<b>Rebet Keith Jones, 2023</b>	Explored AI-powered virtual mentorship and peer learning networks for teacher professional development. Methods include AI-driven analytics, recommendation systems, virtual agents, and collaborative platforms to enable personalized, scalable, and collaborative mentorship.	Enhance AI personalization, improve multimodal interactions, create hybrid AI-human mentorship models, ensure cultural inclusivity, ethical data practices, and support experiential learning. Policy frameworks and cross-cultural adaptation recommended.
<b>Kashish Manoj Patel, Shreya Mahesh Diddi, Natasha Balraj Bogam, 2024</b>	Proposed an AI-augmented reality-based virtual mentorship system for student learning. Methods include contextual support, personalized learning pathways, real-time feedback, gamification, AI avatars, NLP, and AR technologies to improve understanding of AI concepts.	Future work includes emotion recognition, multilingual support, virtual reality integration, and further personalization to make learning inclusive, adaptive, and interactive for diverse student backgrounds.

### III. ALGORITHM

Natural Language Processing (NLP) plays a crucial role in the CSE Mentor system by enabling the platform to understand, interpret, and respond to student queries in a meaningful way. The NLP component allows the virtual mentor to provide personalized guidance on academic content, project suggestions, internships, certifications, and career advice by analysing both structured and unstructured data.

#### 1. Purpose of NLP in CSE Mentor:

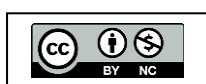
- To process and understand student inputs in natural language, such as questions, feedback, or preferences.
- To extract key information from student academic records, course descriptions, research papers, and online resources.
- To provide context-aware recommendations tailored to a student’s performance, interests, and career goals.

#### 2. Algorithm Workflow

- The NLP module in CSE Mentor follows these steps:
- Data Collection: Gather textual data from student queries, faculty notes, course materials, and departmental announcements.

##### Text Preprocessing:

- Tokenization: Split text into words or phrases.
- Stop word Removal: Remove common words that do not add meaning (e.g., “the”, “is”).



- Stemming/Lemmatization: Reduce words to their root forms (e.g., “running” → “run”).
- Feature Extraction: Convert processed text into numerical representations using methods like:
- Intent Recognition: Classify the purpose of the student query (e.g., seeking course guidance, internship advice, skill development resources).
- Semantic Matching: Match student queries with the most relevant resources, courses, or recommendations using similarity measures and embedding-based retrieval.
- Recommendation Generation: Generate personalized suggestions for academic activities, projects, workshops, or career paths based on student profile and historical performance.

### 3. Tools and Libraries

NLP and ML Libraries: NLTK, spaCy and scikit-learn for preprocessing and classification.

#### Models:

- A Large Language Model(LLM) via Groq is used to understand user queries and generate responses.
- Predictive Analytics Integration: Combining NLP insights with ML models to predict suitable courses, projects, and internships.
- By integrating NLP, the CSE Mentor system can interact with students naturally, understand their needs, and provide context-aware, personalized guidance, making the virtual mentorship process intelligent, adaptive, and scalable.

### NLP Algorithm in CSE Mentor

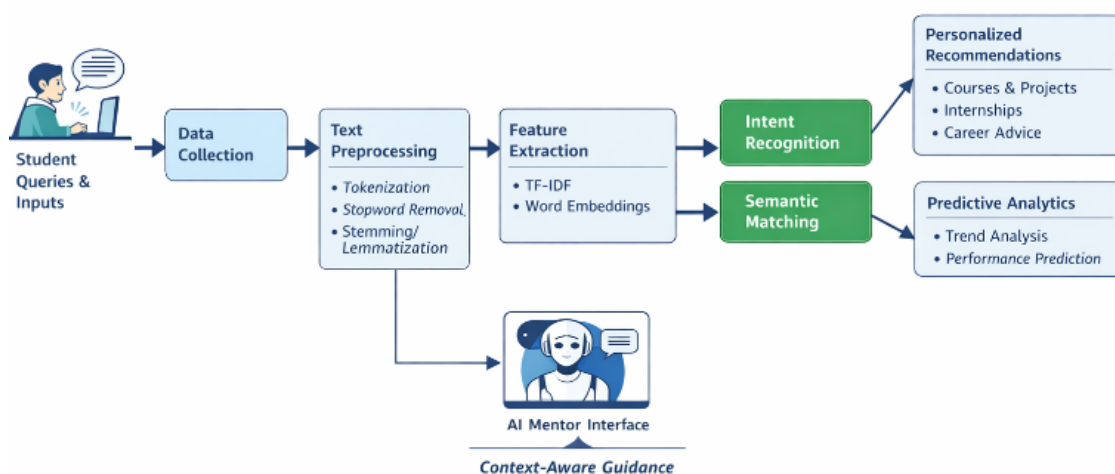


Figure 1: NLP Algorithm



### IV. WORKING METHODOLOGY

The CSE Mentor operates as an ML-driven, web-based virtual mentoring platform that provides personalized academic and career guidance to CSE students. The working methodology integrates data collection, Machine Learning, Natural Language Processing (NLP), predictive analytics, and real-time student interaction to create an intelligent mentorship ecosystem. The system is divided into modules for students, faculty, and administrators, ensuring a smooth flow of information and decision-making.

#### 1. Student Module

The Student Module serves as the primary interface for students to access resources, track progress, and receive personalized recommendations. Its workflow includes:

##### Registration and Profile Setup:

- Students create accounts and input personal details, academic records, skills, and career preferences.
- The system builds a digital profile to tailor recommendations

##### Resource Access:

- Displays updated syllabus, timetables, notices, and departmental achievements.
- Integrates Google Classroom codes, workshop schedules, unit test results, and placement records.

##### ML-Driven Recommendations:

- Uses student data and historical trends to suggest courses, projects, certifications, internships, and skill development sessions.
- NLP algorithms process student queries and provide context-aware guidance.

##### Progress Monitoring:

- Generates auto-updated performance reports, merit lists, and ranking analysis for self-assessment.

##### Interactive AI Mentor Interface:

- Provides 24/7 guidance through chat-based queries and responses.
- Integrates predictive analytics to anticipate student needs and recommend resources proactively.

#### 2. Faculty Module

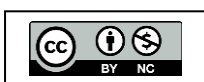
The Faculty Module allows mentors to manage student data, departmental resources, and mentoring tasks efficiently:

##### Dashboard Access:

- Faculty can view student profiles, academic performance analytics, and attendance records.

##### Content and Resource Management:

- Upload notices, workshops, aptitude session details, and placement updates.
- Update departmental achievements, vision, mission, and course outcomes.



**Mentorship Analytics:**

- Analyse student performance trends and provide personalized interventions.
- Coordinate with the ML system to generate targeted recommendations for students.

**3. Administrator Module**

The Administrator Module ensures system integrity and smooth operation:

**User Management:**

- Manage student and faculty accounts, access permissions, and data security.

**Database Management:**

- Maintain and update academic records, syllabus, timetable, and departmental data.

**System Monitoring:**

- Track ML model performance, recommendation accuracy, and system usage analytics.

**4. Data-Driven Guidance Cycle**

The CSE Mentor follows a continuous guidance loop:

**Data Collection:**

- Gather academic records, student queries, and departmental resources.

**Processing and Analysis:**

- Preprocess textual data using NLP and extract features for ML models.

**Recommendation Generation:**

- Predict suitable courses, projects, and internships based on student profiles.

**Feedback Integration:**

- Student interactions and faculty updates refine ML models to improve future guidance.

By combining structured data, NLP-driven insights, and predictive analytics, the CSE Mentor provides a scalable, intelligent, and personalized mentorship experience. This methodology ensures continuous support, timely interventions, and enhanced career readiness for CSE students.

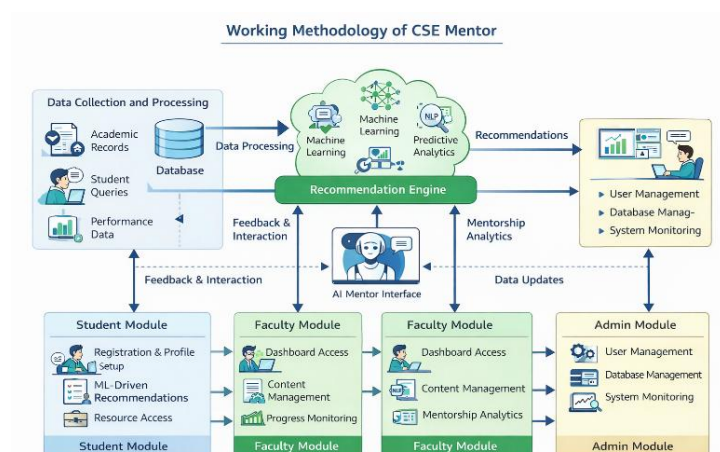
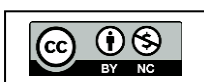


Figure 2: System Diagram



**Flowchart**

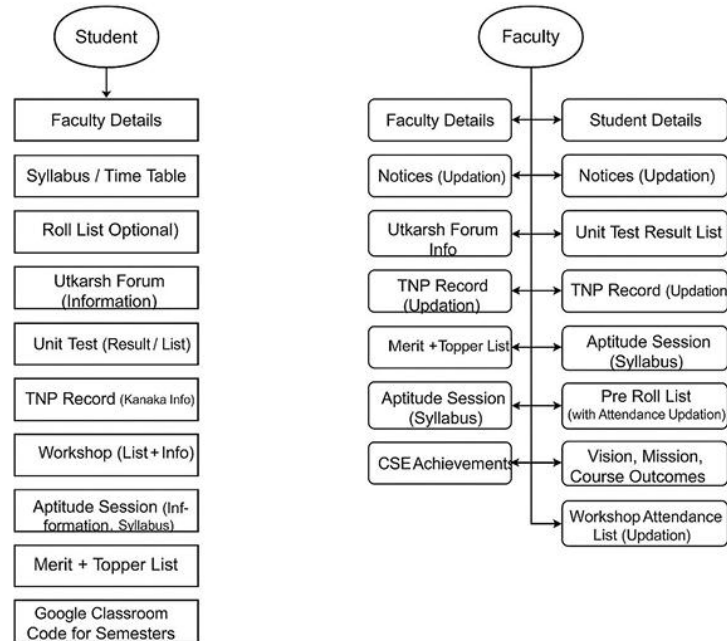


Figure 3: Flow Diagram

**V. FUTURE SCOPE**

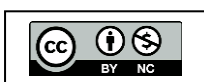
- 1. Placement Prediction:** Using the student's academic performance, skills, and internship data, the system can be made smarter to predict the chances of a student getting placed and suggest what skills they need to improve for better career opportunities.
- 2. Resume Builder:** The system can include an automatic resume building feature where students can generate a professional resume based on their academic records, skills, projects, and certifications stored in the platform.
- 3. Internship and Job Portal Integration:** The platform can be connected with job portals like LinkedIn and Internshala so students can directly apply for internships and jobs based on the recommendations given by the system.

**VI. RESULTS AND DISCUSSION**

The CSE Mentor system was implemented as a web-based ML-driven virtual mentorship platform and evaluated based on its effectiveness in providing personalized guidance to students. The results demonstrate significant improvements in student engagement, academic performance tracking, and career planning support.

**1. Personalized Academic Guidance**

- Students were able to access tailored course recommendations, syllabus updates, and workshop notifications.





- The ML-driven recommendation engine successfully matched student's academic profiles with relevant courses, certifications, and projects.
- Analysis of unit test performance and predictive analytics allowed students to identify areas for improvement and plan study schedules effectively.

### 2. Career and Skill Development

- The platform provided personalized internship and project suggestions based on student skills, interests, and performance metrics.
- Placement and training records, along with aptitude session recommendations, enabled students to prepare proactively for industry requirements
- The NLP-driven interface allowed students to query the system naturally, improving accessibility to resources and guidance.

### 3. Faculty and Administration Impact

- Faculty mentors could monitor student performance trends, update departmental resources, and provide targeted interventions.
- Administrators were able to manage system data, monitor model performance, and ensure seamless updates of academic and placement records
- The system reduced the workload of faculty by automating routine mentorship tasks, while providing timely insights for student support.

### 4. Student Engagement and Feedback

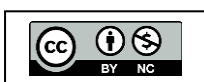
- Students reported improved clarity in course and career planning due to personalized recommendations.
- The interactive AI mentor interface encouraged frequent engagement and self-assessment through progress reports, merit lists, and unit test analytics.
- Timely notifications and automated alerts helped students stay updated with departmental activities, workshops, and placement schedules.

### 5. Challenges and Limitations

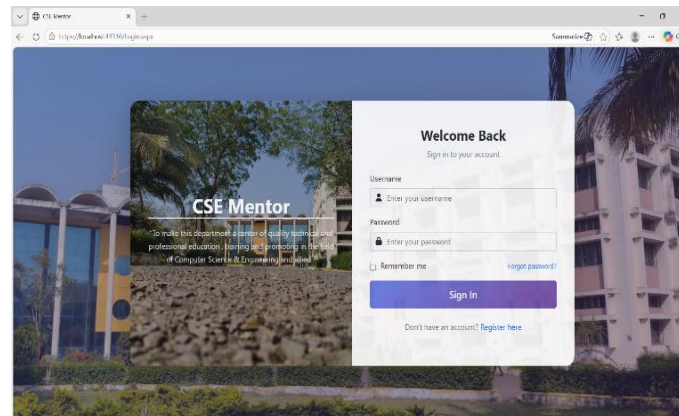
- Initial setup required accurate and complete student data to ensure recommendation accuracy.
- The system's effectiveness relies on continuous updates from faculty and administrators for optimal guidance.
- NLP-based query interpretation occasionally required refinement to handle ambiguous or complex student inputs.

### 6. Discussion

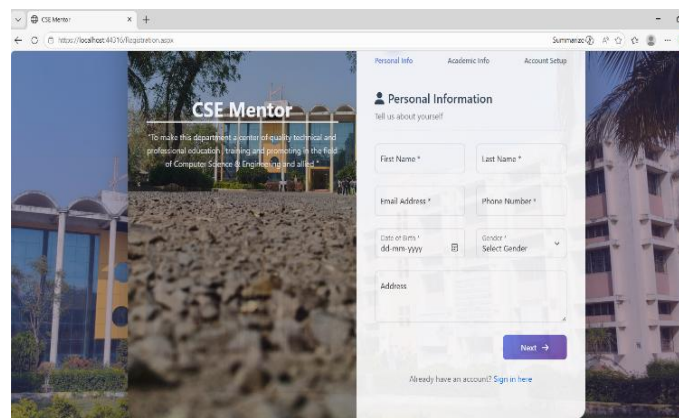
The results indicate that the CSE Mentor can effectively bridge the gap between students and faculty guidance, providing a centralized, intelligent, and scalable mentoring solution. By



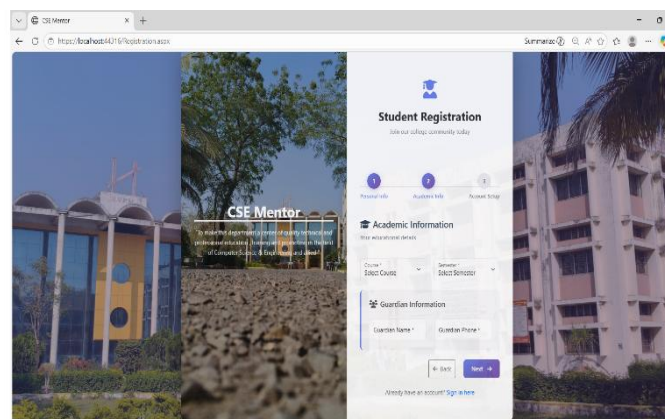
integrating ML, NLP, and predictive analytics, the platform enhances decision-making, reduces information overload, and supports continuous academic and career development. The discussion highlights that such a system can serve as a model for other departments seeking to implement data-driven virtual mentorship programs.



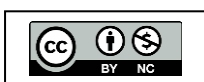
Home Page 1

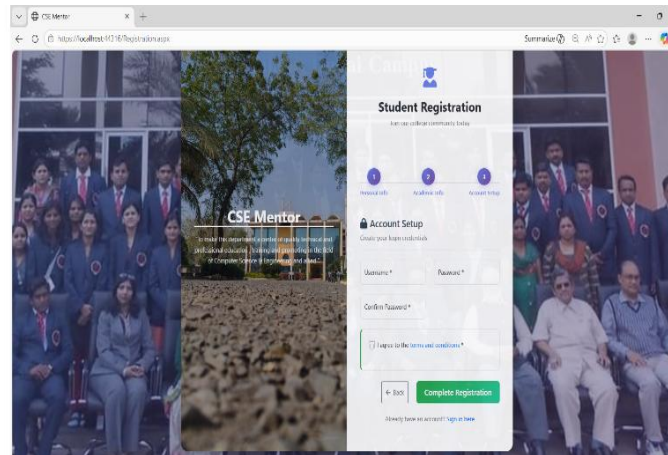


Registration Page 2.1

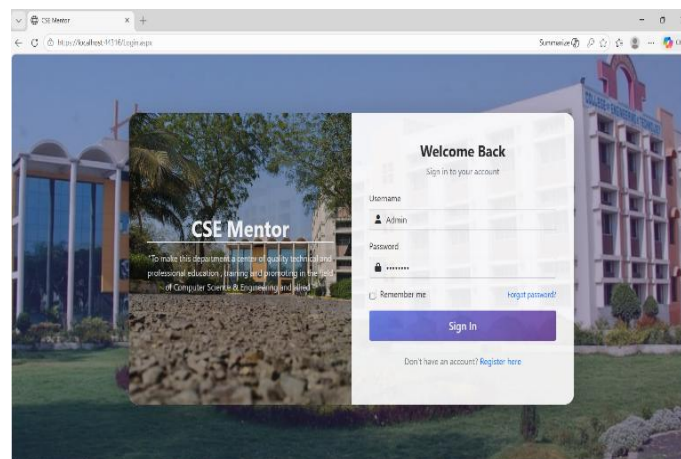


Registration Page 2.2

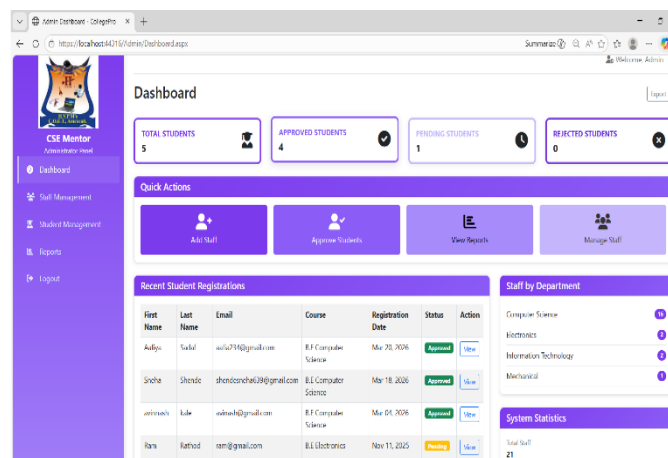




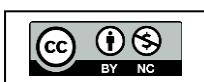
Registration Page 2.3

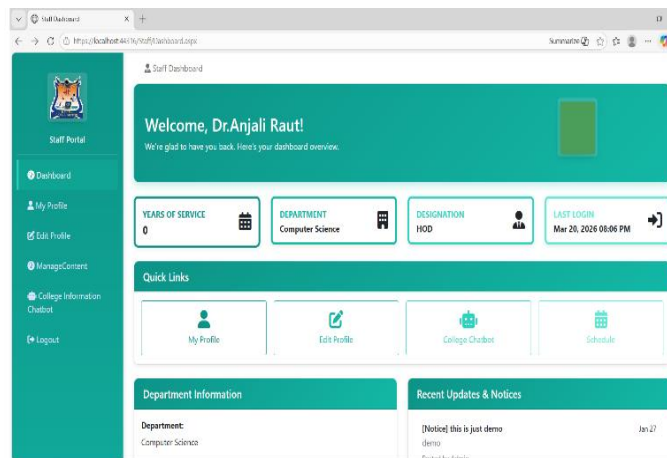


Login Page 03

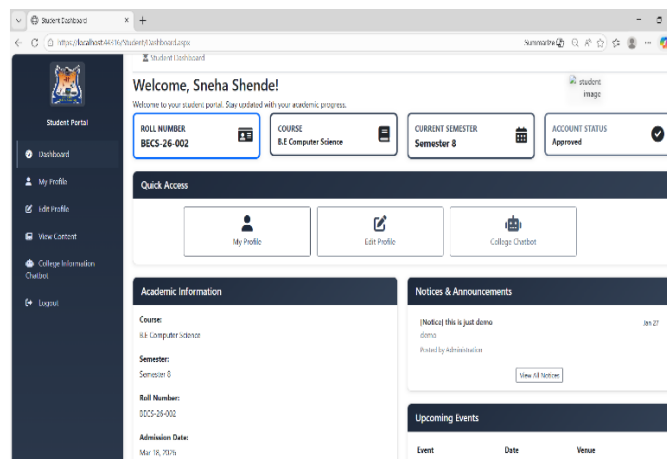


Admin Dashboard 04

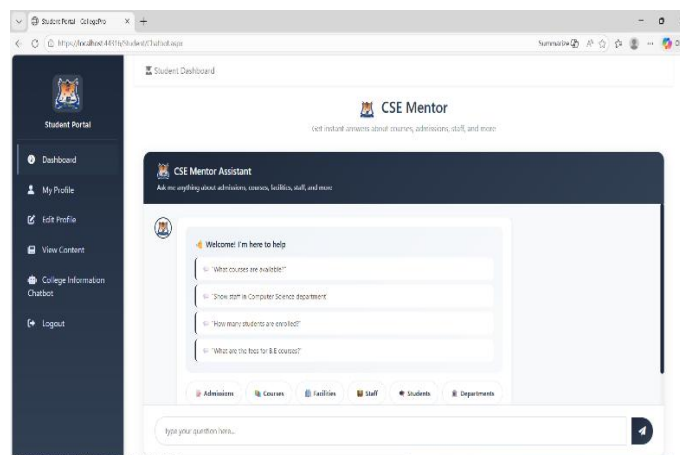




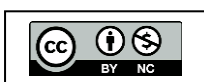
Staff Dashboard 05

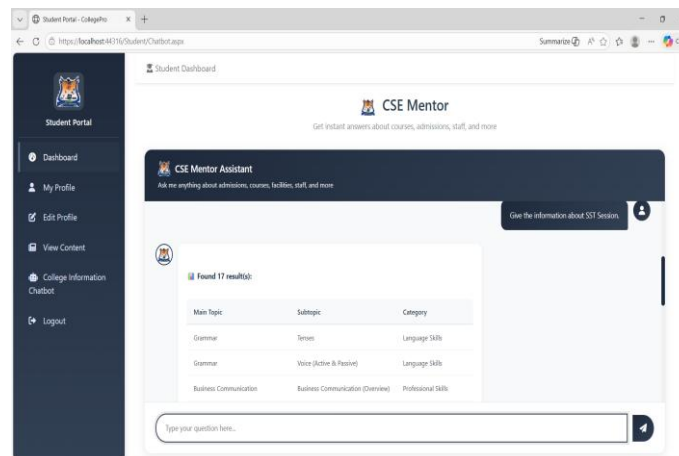


Student Dashboard 06



College Information Chatbot 07





Result 08

## VII. COCNLUSION

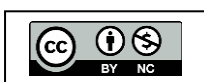
The CSE Mentor project demonstrates how Machine Learning, Natural Language Processing (NLP), and predictive analytics can be effectively integrated to create an intelligent, personalized virtual mentoring system for the students. By centralizing academic, skill development, and career guidance, the platform addresses key limitations of traditional mentorship, including limited faculty availability, delayed feedback, and lack of personalization.

The system successfully provides students with tailored recommendations for courses, projects, internships, certifications, workshops, and career planning, while enabling faculty mentors to monitor student performance, update resources, and offer targeted interventions. The ML-driven mentor interface ensures 24/7 accessibility, continuous engagement and proactive self-assessment.

Overall, CSE Mentor enhances academic and career readiness, reduces faculty workload, and improves decision-making for students. The project highlights the potential of intelligent, data-driven virtual mentorship as a scalable solution for modern academic environments and lays the foundation for further enhancements, such as integrating advanced predictive models, real-time collaboration tools, and cross-departmental mentorship features.

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