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SMARTNEXUS – One Platform for Every Campus Stakeholder: From Discovery to Administration

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Abstract*—SMARTNEXUS is a unified web-based college ecosystem platform designed to support students and campus stakeholders throughout the complete student lifecycle. The platform addresses the fragmentation of college information across multiple websites, admission portals, and campus management systems by integrating college discovery, admission decision-making, and post-admission campus engagement within a single digital environment. Before admission, SMARTNEXUS enables students to search and compare colleges, analyse historical cutoff data, receive personalized recommendations through transparent multi-criteria scoring, verify college information, and organize admission preferences using an intelligent option form builder. After admission, the platform provides a centralized student dashboard offering access to academic information, announcements, events, clubs, feedback mechanisms, and issue and complaint tracking. The proposed system utilizes free and open-source technologies, including React, Vite, Python, FastAPI, PostgreSQL, Pandas, NumPy, and scikit-learn. Its recommendation engine employs a transparent scoring model that combines eligibility, historical cutoff matching, branch preference, location suitability, fee alignment, and college quality indicators. The platform follows a layered architecture comprising presentation, application, data, and analytics services. Existing research primarily addresses either college recommendation or campus utility management, whereas SMARTNEXUS integrates both functionalities into a unified student lifecycle architecture. This paper presents the system design, recommendation methodology, functional modules, implementation approach, and evaluation framework for developing an integrated and student-centric digital campus ecosystem.

I. INTRODUCTION

Selecting an appropriate college and academic branch is a critical decision in a student's educational journey. Students completing secondary or higher secondary education, diploma

programs, or entrance examinations must evaluate several factors, including eligibility criteria, academic performance, historical cutoff scores, fees, geographical location, branch preferences, campus infrastructure, and placement opportunities. However, the information required for informed decision-making is generally distributed across multiple platforms, such as admission portals, college websites, educational ranking platforms, brochures, and other informal sources. Consequently, students spend considerable time collecting, organizing, comparing, and interpreting this fragmented information.

The challenges continue after admission, as campus communications, academic activities, feedback mechanisms, and complaint resolution systems are frequently managed through separate channels. Students must navigate different platforms to access announcements, register for events, join clubs, submit complaints, and provide feedback. Similarly, college administrators often lack centralized tools for student management, campus activity coordination, complaint tracking, and student engagement analytics. This fragmentation creates a disconnected digital experience for both students and institutional stakeholders.

SMARTNEXUS is proposed as a unified digital ecosystem that connects the complete student journey through five stages: Discover, Decide, Join, Engage, and Participate. The platform provides pre-admission support through college search, branch filtering, eligibility assessment, transparent recommendations, college comparison, information verification, and admission preference organization. Following admission, the same ecosystem provides a centralized student dashboard, campus services, activity management, and transparent issue resolution.

The proposed platform integrates college recommendation and campus administration within a common architecture, enabling continuity between admission decision-making and post-admission engagement. This paper presents the system architecture, recommendation methodology, functional module design, implementation approach, and evaluation framework of SMARTNEXUS, with the objective of providing an integrated, transparent, and student-centric digital campus experience.

II. RELATED WORK

A. KSIT Nexus: Integrated Campus Utility Application

Prashanth et al. [1] presented KSIT Nexus, an integrated campus utility application designed to simplify student activities through a common digital platform. The system combines anonymous complaint management, reading room seat tracking, a query chatbot, study group discovery, and digital notice boards. It emphasizes privacy protection, accessibility on low-end devices, and institutional data storage. The platform demonstrates how multiple student-facing services can be integrated into a single application to improve campus engagement and administrative coordination. However, its primary focus is on post-admission campus services, with limited support for college discovery and admission decision-making.

B. EduSelect: College Recommendation System

Raut and Shete [2] developed EduSelect, a machine learning-based college recommendation system that generates personalized college suggestions using students' academic qualifications,

interests, and geographical preferences. The system provides college profiles, advanced search filters, admission information, financial details, and updates to admission criteria. The study highlights challenges associated with recommendation accuracy, scalability, data management, and changing admission requirements. Although EduSelect supports the college selection process, it does not provide an integrated environment for post-admission campus activities and administrative services.

C. College Recommendation System Pune

Patil et al. [3] proposed a college recommendation system that compares different approaches, including rule-based filtering, content-based filtering, collaborative filtering, and machine learning classification. The system considers academic performance, course preferences, geographical location, budget constraints, college fee structures, historical cutoff scores, and admission requirements. Its prototype includes college discovery, advanced search, location-based filtering, college comparison, and branch selection. This research provides a foundation for developing the recommendation and cutoff analysis components of SMARTNEXUS by demonstrating the importance of matching student preferences with institutional information.

D. Research Gap and SMARTNEXUS Contribution

The reviewed studies address two major areas of educational technology: college recommendation and campus utility management. College recommendation systems primarily assist students in evaluating institutions, comparing academic options, and identifying suitable courses, whereas campus management applications focus on communication, complaint resolution, and student engagement after admission. These functionalities are generally implemented as separate systems, requiring students to use multiple platforms throughout their educational journey.

SMARTNEXUS addresses this gap by integrating college discovery, eligibility assessment, historical cutoff analysis, transparent recommendations, college comparison, information verification, and admission preference management with post-admission campus services. The platform also incorporates centralized administrative management, student feedback, issue tracking, and engagement analytics. This unified approach aims to provide continuity throughout the student lifecycle while improving information accessibility, decision-making, and campus administration.

III. SYSTEM ARCHITECTURE

A. Overview

The proposed SMARTNEXUS framework follows a layered architecture that integrates college recommendation, admission decision support, and campus administration within a unified platform. The architecture consists of four primary layers: presentation, application, data, and analytics. Each layer performs specific functions while communicating with the other layers

through defined interfaces. This modular design supports maintainability, scalability, data consistency, and the independent enhancement of individual components.

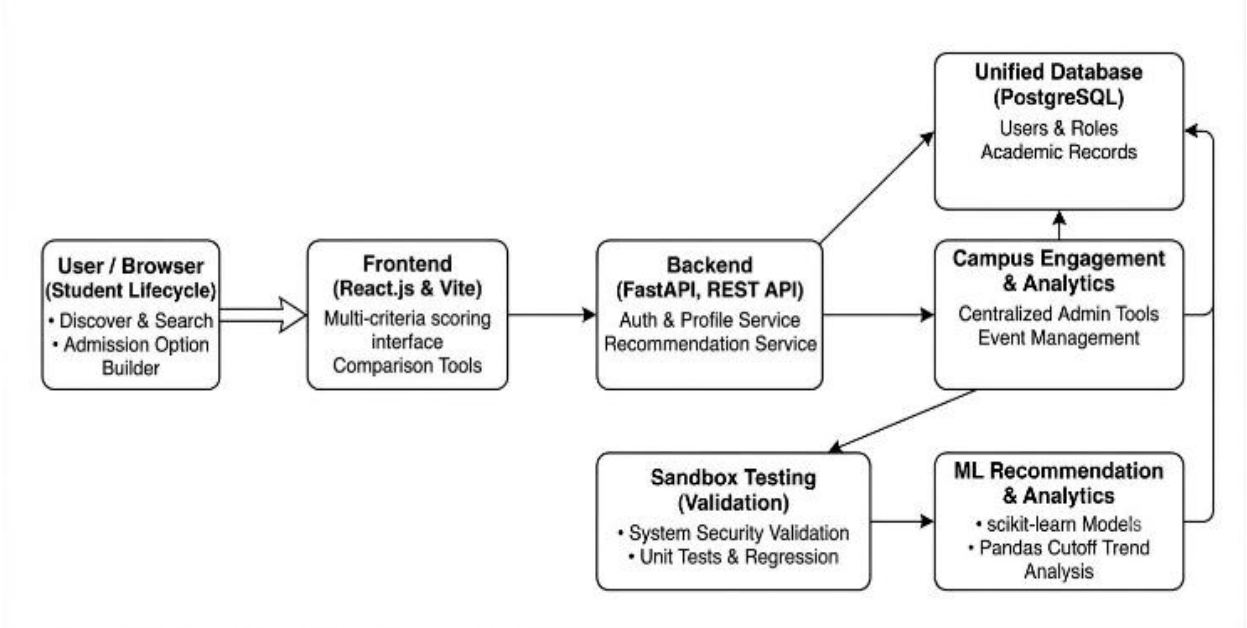

Fig. 1. System Architecture of the SMARTNEXUS Platform

B. Frontend

The frontend is developed using React.js and Vite to provide a responsive and interactive user interface. It supports college search, branch filtering, college comparison, cutoff visualization, recommendation results, and admission preference management. After admission, students can access academic information, announcements, events, clubs, feedback forms, and complaint tracking through a centralized dashboard. Separate interfaces are provided for students, college administrators, and super administrators according to their responsibilities.

C. Backend

The backend is implemented using Python and FastAPI, which provide REST API endpoints for communication between the frontend, database, and application services. It manages user authentication, role-based authorization, student profiles, college information, recommendation processing, option form operations, event registration, complaint management, feedback collection, and administrative functions. The backend acts as the central coordinator of the platform and ensures that users can access only the functions permitted by their assigned roles.

D. Recommendation Engine

The recommendation engine evaluates student profiles against college and branch information using a transparent multi-criteria scoring model. It considers eligibility, historical cutoff matching, branch preference, geographical suitability, fee constraints, and college quality indicators. The engine first filters unsuitable options and then ranks eligible colleges according to their calculated

scores. This approach enables students to understand the factors influencing their recommendations and supports informed admission decisions.

E. Database Management

PostgreSQL serves as the primary relational database for storing student profiles, user roles, college details, courses, branches, historical cutoff records, fee structures, admission preferences, events, clubs, announcements, complaints, and feedback. Relationships between database entities maintain consistency and support efficient information retrieval. The database also stores verification records and administrative activity logs to support information management and platform governance.

F. Data Processing and Analytics

Pandas and NumPy support data cleaning, transformation, numerical processing, and statistical analysis of college and admission information. The analytics component processes historical cutoff records, recommendation outputs, student engagement information, and administrative data. Scikit-learn provides a foundation for future enhancements to recommendation algorithms when sufficient reliable historical and interaction data becomes available. This layer supports data-driven improvements while retaining transparent scoring as the initial recommendation approach.

IV. DETECTION METHODOLOGY

The college recommendation and student support process consists of the following stages:

- Student Profile Collection: Student information, including academic performance, entrance examination scores, preferred courses, geographical preferences, and budget constraints, is collected to support personalized college selection.

- College Data Processing: College profiles, available branches, fee structures, eligibility criteria, and historical cutoff records are processed to remove duplicate entries, handle missing values, and maintain data consistency.

- Eligibility Assessment: Student academic details are compared with the published eligibility criteria of available colleges and branches. Options that do not satisfy the required conditions are filtered out before recommendation scoring.

- College Search and Filtering: Eligible colleges are filtered according to course availability, preferred location, fee range, and other student requirements to reduce the number of relevant options.

- Recommendation Generation: The recommendation engine calculates a transparent multi-criteria score using eligibility, historical cutoff matching, branch preference, location suitability, fee alignment, and college quality indicators. Eligible options are ranked according to their calculated scores.

- Cutoff Analysis and College Comparison: Historical opening and closing cutoff records are analysed across academic years. Students can compare colleges based on admission trends, fees, available branches, facilities, and placement-related information.

- Admission Preference Organization: The option form builder allows students to add, remove, reorder, and prioritize shortlisted colleges and branches according to their preferences.

- Post-Admission Campus Services: After admission, students can access academic information, announcements, events, clubs, feedback facilities, and complaint tracking through the centralized dashboard.

The processed student information and college records are used to generate personalized recommendations and support admission decisions. Following admission, the same platform provides integrated campus services, administrative support, and student engagement facilities within a unified digital environment.

IMPLEMENTATION

The SMARTNEXUS platform is developed using React.js and Vite for the frontend, providing a responsive and interactive interface for students, college administrators, and super administrators. The backend is implemented in Python using FastAPI, which manages authentication, college search, recommendation generation, cutoff analysis, admission preference management, and campus administration services. PostgreSQL serves as the primary database for storing student profiles, college information, historical cutoff records, academic details, events, clubs, complaints, and feedback. Pandas and NumPy support data preprocessing and numerical analysis, while scikit-learn provides capabilities for future enhancements to the recommendation engine. SQLAlchemy is used for database interaction, and JWT-based authentication supports secure user access and role-based authorization. Git and GitHub support version control, while Postman and Swagger facilitate API testing and documentation. Docker supports containerization and consistent deployment across development and production environments. The modular implementation enables the integration of college recommendation, admission decision support, and post-admission campus services within a single platform.

EXPERIMENTAL EVALUATION

A. Datasets and Metrics

SMARTNEXUS will be evaluated using college information, historical admission cutoff records, student preference profiles, and representative campus activity data. Where real institutional data is unavailable, synthetic datasets may be used for functional testing. Evaluation metrics include eligibility correctness, top-k recommendation relevance, ranking consistency, preference alignment, task completion rate, response time, and user satisfaction. Functional testing will cover authentication, college search, cutoff analysis, recommendations, college comparison, information verification, option form management, events, clubs, complaints, feedback, notifications, and administrative operations.

B. Results

Table I presents the evaluation metrics planned for SMARTNEXUS. The values will be recorded after implementation and testing.

TABLE I SMARTNEXUS EVALUATION PERFORMANCE

Evaluation Metric	Value
Eligibility Assessment Accuracy	To be filled
Top-k Recommendation Relevance	To be filled
Ranking Consistency	To be filled
Preference Alignment	To be filled
College Search Response Time	To be filled
Functional Test Success Rate	To be filled
Option Form Operation Success Rate	To be filled
Issue Resolution Tracking Accuracy	To be filled
Task Completion Rate	To be filled
User Satisfaction	To be filled

V. DISCUSSION AND LIMITATIONS

SMARTNEXUS provides an integrated approach to college recommendation and campus administration by connecting pre-admission decision-making with post-admission student services. Its transparent multi-criteria scoring model helps students understand recommendation factors, while historical cutoff analysis and college comparison support informed admission choices. The centralized dashboard simplifies access to academic information, events, clubs, feedback, and complaint tracking.

However, recommendation quality depends on the accuracy and completeness of college information and historical cutoff records. Past cutoff trends cannot guarantee future admission outcomes, and conflicting information may require manual verification. Integration with institutional academic records also requires proper authorization. Further practical testing is necessary to evaluate the platform's scalability, usability, recommendation accuracy, and administrative effectiveness before large-scale deployment.

VI. CONCLUSION AND FUTURE WORK

SMARTNEXUS presents a unified platform connecting college discovery, admission decision support, and post-admission campus administration. It integrates college search, historical cutoff analysis, transparent recommendations, college comparison, admission preference management, student dashboards, campus activities, complaint tracking, and feedback services. Its open-source technologies and layered architecture provide a foundation for institutional customization. Future work includes improving recommendation accuracy, expanding admission system coverage,

developing mobile applications, and integrating career guidance, scholarship discovery, and multilingual support. Further testing will evaluate the platform's effectiveness and usability.

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