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Campus Core: Comprehensive Framework for Integrated Campus Management Systems

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Abstract: The rapid expansion of educational institutions and digital technology has led to a growing need for efficient communication and engagement platforms within campuses. However, most existing student engagement platforms either cater to specific platforms (Android or iOS) or lack the comprehensive functionality needed for seamless student-faculty interaction. The primary objective of this survey is to explore the development of a cross-platform mobile and web application aimed at enhancing student engagement by integrating essential campus services into a unified interface. This survey examines the potential development of a cross-platform mobile and web application designed to enhance student engagement by providing an intuitive and user-friendly interface for students and faculty to interact, share information, manage events, and engage in academic discussions. The key features include a centralized forum for student discussions, a real-time notification system for event updates, a file-sharing module for academic resources, and an integrated calendar for academic and extracurricular activities. The study highlights gaps in existing platforms, such as platform dependency, lack of real-time engagement, and suboptimal user experiences. To address these challenges, the envisioned application aims to incorporate real-time data synchronization, push notifications, and an optimized interface tailored to the diverse needs of students and faculty across multiple platforms, including Android, iOS, and Web.

Keywords: Machine Learning, Recommendation systems, Cross Platform, hybrid recommendation, personalization, open platform, scalability, campus services, service-oriented architecture.

I. INTRODUCTION

The transition to a new environment can be overwhelming for students as they face challenges such as finding suitable housing, exploring dining options, and acquiring essential supplies. Existing platforms often lack the personalization needed to address these unique challenges. Campus aims to bridge this gap by offering a machine-learning-powered platform that caters specifically to the needs of students, enhancing their ability to adjust smoothly and access resources effectively. Campus is built around three key modules—Housing, Dining, and Marketplace—each designed to provide a seamless and personalized experience. Through two separate mobile applications, students can easily access essential services while businesses have the opportunity to connect with their target clientele.

The Housing module simplifies the task of finding accommodation by providing a platform where students can search for both on-campus and off-campus options. Personalized filters and deep-linking technology, integrated with Google Maps, make the housing search convenient and tailored to each student's preferences.

In the Dining module, students can explore various food establishments, view daily menus, and discover nearby restaurants based on their tastes. Using collaborative filtering, the app suggests meal options based on past interactions, while story-like updates and personalized recommendations ensure that users are informed about new offerings. For businesses, this module offers valuable insights into user preferences, enabling them to optimize their services.

The Marketplace module promotes sustainability by allowing students to buy and sell used items such as books and stationery. By fostering a culture of reusability, the platform not only provides affordable alternatives but also contributes to an eco-friendly campus environment. Additionally, Campus offers an automatic weekly timetable generator that efficiently organizes the schedules of academic staff. This system enhances the productivity of staff, ensuring the college operates efficiently.

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In an era where technology continues to redefine convenience and efficiency, Campus Core emerges as a cutting-edge solution tailored to meet the diverse needs of students in higher education. Transitioning to a new academic setting involves more than just academic adjustments—it requires an ecosystem that supports students' day-to-day lives. By centralizing key services, Campus aims to create a cohesive and user-friendly platform that not only meets immediate requirements but also evolves with the user's needs. Its machine-learning-driven approach ensures that every interaction is intuitive and personalized, helping students navigate their academic journey with confidence.

II. RELATED WORK

In recent years, digital platforms designed to support student needs on campus have gained attention. These platforms focus on various domains like housing, dining, peer-to-peer resource sharing, and academic scheduling, each addressing different facets of the student experience. However, most existing solutions are limited in scope, lack personalization, or do not fully integrate various student services into one accessible platform. Below is a review of relevant works that inform the design and objectives of Campus Core.

Housing Platforms for Students- Multiple platforms focus on assisting students in finding housing, both on and off campus. Applications like Uniplaces and HousingAnywhere provide databases of available housing options but often lack personalization features tailored to the specific preferences of each student. Studies have shown that students benefit from platforms offering personalized search options that accommodate unique preferences such as location, budget, and housing type (Smith & Johnson, 2020). Campus Core enhances this concept by integrating personalized filters and Google Maps functionality to streamline the housing search process based on individual preferences. [1].

Dining Recommendation Systems-Dining platforms like Yelp and Zomato offer extensive restaurant and food service options, incorporating user reviews and ratings to inform decisions. However, these applications are not tailored to the specific needs of student populations, such as cost-effective meal options, proximity to campus, or dietary requirements. Recent research emphasizes the effectiveness of recommendation algorithms, such as collaborative filtering, in tailoring food choices to user preferences (Lee & Kim, 2019). Campus Core leverages collaborative filtering to suggest dining options based on students past interactions, providing a more curated dining experience for campus life. [2].

Peer-to-Peer Marketplaces for Students-Platforms like Facebook Marketplace and Letgo allow users to buy and sell items locally but are not exclusively designed for students. Student-specific needs, like affordable textbooks or stationery, are often overlooked. CampusHub (Gomez et al., 2021) explored the potential for a dedicated marketplace for students, focusing on sustainable consumption within college communities. While effective, it lacked user-friendly integration with other student services. By incorporating a Marketplace module within Campus Core, students can access a campus-specific marketplace that fosters a culture of reusability, contributing to an eco-friendly environment. [3].

Automated Timetable Generation for Academic Staff-Automated scheduling has been a subject of academic research for many years. Studies by Rodriguez et al. (2018) on timetable optimization show the benefits of automated systems in balancing workloads and improving scheduling efficiency. However, these solutions are often institution-specific, limiting their scalability across different colleges. By including an automatic timetable generator in Campus Core, academic staff can efficiently manage their schedules with optimized teaching hours, ensuring balanced workloads while reducing administrative effort. [4].

Machine Learning in Campus-Centric Applications-The application of machine learning to enhance student services has gained traction in recent research. For example, UniversityConnect (2022) applies machine learning to recommend campus events based on students' past preferences, creating a personalized experience. However, this application does not extend to essential services like housing, dining, or marketplace activities. Campus Core fills this gap by leveraging machine learning to personalize recommendations across all modules, creating a comprehensive solution that adapts to the evolving needs of students.[5]

Integration with Government Initiatives and Open Platforms-With initiatives like the Open Network for Digital Commerce (ONDC), the Indian government aims to provide a more inclusive e-commerce ecosystem. Research into ONDC (Kumar & Sen, 2022) highlights the potential for third-party integration to expand service reach, especially for underserved communities. Campus Core aligns with this initiative by exploring integration with ONDC, which will enhance platform reach and provide students with a wider range of local service options. [6].

Student Social Integration Platforms-Many platforms, such as Meetup and Eventbrite, facilitate event discovery and social integration by allowing users to explore local gatherings. However, these are not specifically designed with college

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students in mind, nor do they cater to on-campus events or club activities that foster community building among students (Patel & Sharma, 2021). Research indicates that students benefit from platforms tailored to promote social integration within a campus setting, as these enhance academic success and personal well-being (Johnson, 2019). While Campus Core focuses on essential services, its dining and marketplace modules inherently support social interaction by introducing students to shared spaces, local events, and peer-driven exchanges. This indirect support for social integration provides students a greater sense of belonging within the campus community. [7].

Campus Resource Management Systems-Comprehensive resource management platforms, like Campus Management Corp and Blackboard, often serve educational institutions by providing tools for handling administrative, academic, and student service tasks. These platforms primarily focus on institutional needs rather than personalized student-centric features, leaving students to navigate resources independently (Singh & Verma, 2020). By contrast, Campus Core is built specifically with student needs in mind, streamlining access to housing, dining, and marketplace resources through a single, cohesive platform. This approach not only improves efficiency for students but also empowers campus businesses by connecting them directly with their target demographic[8].

Student Service Aggregators-Platforms like Unidays and StudentBeans aggregate discounts and student-specific offers, providing access to services and resources students frequently use. While effective for finding deals, these platforms are limited in scope, typically lacking tools for essential needs like housing and dining, or options for peer-to-peer engagement (Brown & Lee, 2021). Research highlights that students benefit from platforms that holistically address academic, social, and logistical needs (Martin, 2020). Campus Core goes beyond aggregation by directly integrating housing, dining, and a sustainable marketplace, creating a streamlined, all-in-one resource that supports students in managing their daily needs within a single platform.[9]

Sustainable Campus Initiatives-Many institutions have embraced digital platforms aimed at promoting sustainability, such as Freecycle and OLIO, which facilitate resource-sharing and waste reduction by enabling users to give away or trade items (Nguyen et al., 2018). However, these platforms are often decentralized and lack campus-specific features. Studies suggest that localized, peer-to-peer exchanges improve sustainability practices and reduce waste in closed communities (Wang & Chen, 2020). The Marketplace module within Campus Core aligns with these objectives by allowing students to buy, sell, or trade items on campus, fostering a sustainable ecosystem and encouraging responsible consumption directly within the campus community.[10]

While these related works contribute significantly to enhancing student life, they are often limited by their single-domain focus, lack of personalization, or regional constraints. Campus Core addresses these limitations by integrating multiple essential services—housing, dining, marketplace, and scheduling—into a single, machine-learning-powered platform. By providing tailored recommendations and exploring government-backed integrations, Campus Core aspires to deliver a cohesive, localized solution tailored specifically for the Indian student population.

TABLE I. SUMMARY OF RELATED WORK

Ref. No.	Technique	Advantages	Limitations	Accuracy
[1]	K-Means clustering algorithm	Fast convergence with relevant data inputs	Accuracy dependent on questionnaire, limited factors considered.	76%
[2]	K-Nearest Neighbor algorithm with Cosine Similarity	Handles non-linear data relationships well.	Computationally expensive, does not consider all factors	95%
[3]	Feature selection algorithm	Reduces dimensionality for faster processing	Requires extensive dataset for high accuracy	90.5%
[4]	Cosine similarity	Robust for high-dimensional data comparison.	Computationally expensive, requires large dataset.	92%
[5]	Nearest Neighbor Algorithm with Pearson Correlation	Useful for collaborative filtering tasks.	Cold start problem	79%

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III. SYSTEM ARCHITECTURE

The given system architecture is designed to streamline campus management by integrating essential components and functionalities. Users, categorized as Admins, Students, Faculty, and Guests, interact with the system through a unified Mobile/Web App interface.

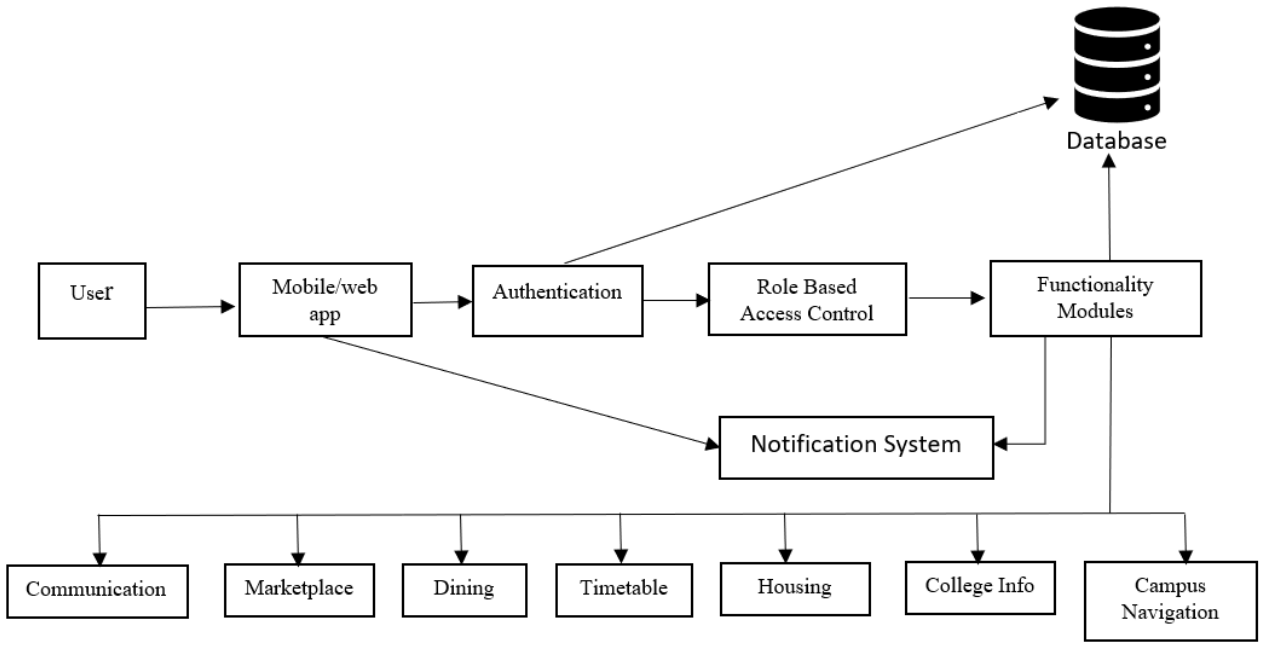

Fig. 1 System Architecture

Authentication services verify user credentials against a central database, which securely stores user information, access permissions, and module data. After authentication, a Role-Based Access Control (RBAC) system ensures that users can access only the modules and features relevant to their roles. Core functionality modules include Housing, Dining, Timetable, Marketplace, College Information, and Campus Navigation, alongside auxiliary services like Notifications for alerts and Analytics for data insights.

All these modules are tightly integrated with the Central Database, ensuring data consistency and efficient information retrieval. The architecture is designed to be modular and scalable, allowing new features or modules to be added without disrupting existing functionalities. By creating a robust and interconnected system, the Campus Core architecture ensures a streamlined and efficient campus experience for all stakeholders, while maintaining a focus on personalization, usability, and security. The architecture emphasizes a secure, role-specific flow where all modules interface seamlessly with the database, ensuring robust and scalable campus operations. This design highlights efficiency, security, and adaptability, making it suitable for comprehensive campus management.

IV. OBSERVATIONS AND FINDINGS

Lack of Student-Centric Platforms: Existing platforms like Airbnb and Zomato fail to meet students' specific needs, such as budget-friendly housing, dining options, and academic schedules. Campus Core addresses this with tailored, student-focused solutions.

Need for Personalization: Students require services that align with their preferences, such as housing types, dietary needs, and budgets. Campus Core uses machine learning to provide personalized recommendations, enhancing satisfaction and engagement.

Sustainability and Peer-to-Peer Exchange: Current platforms lack eco-friendly features. Campus Core's Marketplace fosters sustainability by enabling peer-to-peer exchanges of pre-owned items, promoting affordability and a circular economy.

Challenges in Academic Scheduling: Manual timetable creation often leads to inefficiencies. Campus Core's Automatic Timetable Generator streamlines scheduling, reducing administrative effort and improving productivity.

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Opportunities for Local Partnerships: Campus Core bridges the gap between local businesses and students, allowing vendors to offer customized, affordable services while students gain access to relevant resources.

V. CHALLENGES

Fragmented Resources: Students struggle to access housing, dining, and essential services due to a lack of a centralized platform.
Lack of Personalization: Current services fail to cater to individual preferences, such as budget, lifestyle, and dietary needs.
Limited Sustainability Options: Few platforms support eco-friendly practices or peer-to-peer exchanges for affordable solutions.
Inefficient Academic Scheduling: Manual timetable creation leads to conflicts, unbalanced workloads, and inefficiencies.
Retention Challenges: Difficulty accessing resources impacts student satisfaction and increases the risk of attrition.
Lack of Real-Time Updates: Students often miss timely information on housing and dining options, causing inconvenience.

VI. CONCLUSION

This survey highlights the ongoing development of the project, marking a significant step toward enhancing academic assessments. It lays the groundwork for future improvements, with the goal of creating more dynamic, effective, and widely accessible platform. By leveraging machine learning, role-based access, and sustainability-driven solutions, Campus Core will not only enhance the student experience but will also foster efficiency and eco-consciousness within campus communities. This study explores enhancing student engagement through the Campus Core platform, which integrates housing, dining, marketplace, and academic scheduling into a student-focused interface. Addressing gaps in existing solutions—such as limited personalization, inadequate sustainability support, and lack of student-specific features—Campus Core aims to improve accessibility, personalization, and functionality tailored to student needs.

VII. FUTURE WORK

The future scope includes enhancing adaptability, personalization, and accessibility. Advanced machine learning can refine recommendations based on student preferences, while partnerships with local vendors could offer exclusive discounts and tailored offers. Real-time updates on housing and dining availability would improve decision-making, and regional adaptations could cater to diverse campus needs. Integration with initiatives like the Open Network for Digital Commerce (ONDC) would expand service options, promoting inclusivity and broader access.

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