Campus Route Map

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Abstract

The Campus Route Map project is a user-friendly indoor navigation system designed to improve accessibility within the campus. It simplifies navigation for students, faculty, and visitors by providing a structured, digital mapping solution. Unlike traditional paper-based maps, this system leverages Flutter for mobile development and PHP with MySQL for backend support. It offers an efficient, cost-effective alternative to augmented reality (AR)-based navigation, ensuring seamless and reliable guidance across campus locations. With its static map-based navigation and intuitive interface, the Campus Route Map enhances campus mobility, making navigation more efficient and accessible.

Keywords: Indoor Navigation, Campus Mapping, Digital Wayfinding, Smart Campus, Location-Based Services, User Accessibility, Mobile Navigation, Route Optimization, Cost-Effective Navigation, Educational Infrastructure, Technology Integration.

1. Introduction

Large educational institutions like College have expansive campuses with multiple buildings, departments, laboratories, and administrative offices. Navigating such a campus can be a challenge, particularly for first-time visitors, new students, and faculty members unfamiliar with the layout. Traditional navigation methods, such as printed maps, signboards, and verbal directions, often lead to confusion and inefficiency, making it difficult for individuals to reach their desired destinations on time. The Campus Route Map project is designed as a digital navigation system tailored for the campus, allowing students, faculty, and visitors to efficiently locate classrooms, seminar halls, auditoriums, administrative offices, and other key facilities. Unlike Augmented Reality (AR)-based navigation systems, which require additional hardware, specialized software, and higher maintenance costs, the Campus Route Map focuses on a static map-based navigation system. It ensures accessibility for all users, regardless of their technical expertise or device compatibility. options, and user preferences to enhance navigation within the campus.

1.1 Methods

1.1.1 Digital Campus Mapping and Data Collection

The system begins with collecting and digitizing the campus map, including building layouts, classroom locations, and major landmarks. This data is integrated into a structured static map-based navigation system, allowing users to select their destinations and receive optimized routes. Administrators ensure that the map is updated periodically to reflect any infrastructure changes.

1.1.2 User-Friendly Navigation System

The Campus Route Map application provides a simple and intuitive interface where users can enter their current location and desired destination. The system then generates a static map, labeled landmarks, and directional arrows to help users reach their destination efficiently. Unlike GPS-based solutions, this system is designed for indoor navigation, ensuring accuracy within campus buildings. [1-5]

1.1.3 Destination Search and Route Optimization

Users can search for specific locations such as classrooms, labs, auditoriums, and administrative

offices. The system processes the request and presents an optimized path, considering the shortest and most accessible routes. It also highlights key checkpoints along the way, ensuring smooth navigation. [6-10]

1.1.4 Mobile Application Development and Accessibility

The mobile application is built using Flutter for cross-platform compatibility, ensuring that it functions seamlessly on both Android and iOS devices. The backend is developed using PHP with MySQL, managing user data, route information, and feedback storage. This ensures an efficient, lightweight, and scalable navigation system that can be expanded in the future. [11-15]

### 1.1.5 Feedback Collection and Continuous Improvement

To enhance the system's accuracy and usability, a user feedback mechanism is implemented. Users can report map inaccuracies, request new route additions, or suggest improvements. The administrative team regularly reviews feedback and deploys updates to maintain an efficient and up-to-date campus navigation experience.

2. Tables and Figures
2.1. Tables

Below Table 1 provides the categorization of attributes related to the Campus Route Map System, namely, user details, location data, and navigation status, which are further divided into specific classifications. Based on these attributes, the system determines the most efficient route, accessibility options, and user preferences to enhance navigation within the campus. This table plays a crucial role in structuring the system, ensuring efficient guidance, and improving overall user experience, ultimately enhancing the accuracy and reliability of campus navigation. Table 1 shows Campus Route Map System Using, Figure 1 shows Flow Chart of Campus.
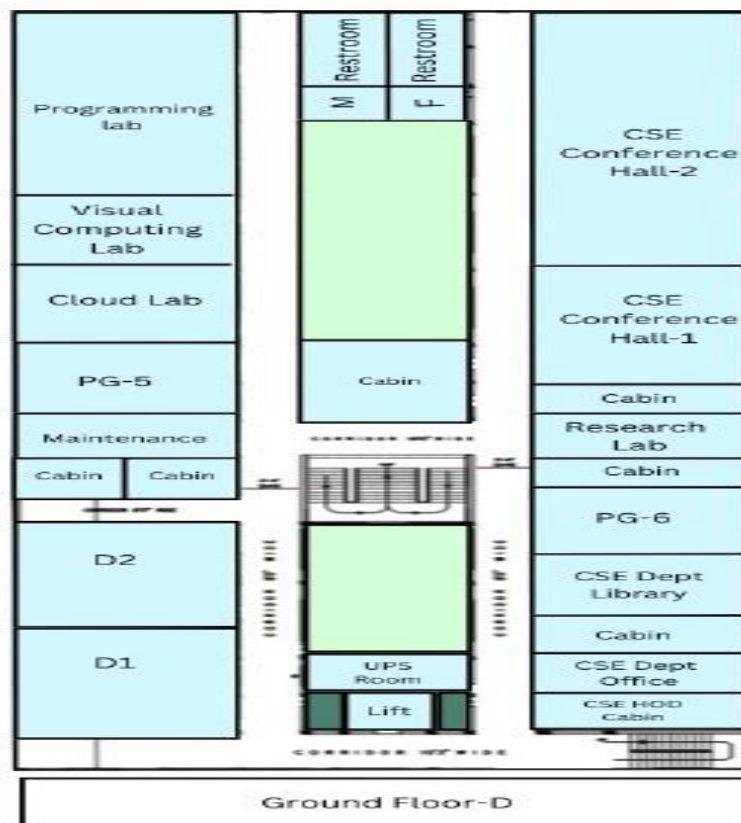

Figure 1 Flow Chart of Campus

Table 1 Campus Route Map System Using Key Metrics

Component	Specification	Purpose
Computer/Server	Intel Core i5/i7, 8GB RAM, 256GB SSD/HDD	Hosting the navigation system and database
Programming Language	Dart, PHP	Developing the backend and frontend
Database	MySQL	Storing campus maps, user data, and navigation details securely
Web Technologies	HTML, CSS, JavaScript, Bootstrap	Designing the frontend interface
Authentication	Login System with Role-Based Access	Ensuring secure user access and navigation preferences

2.2.Figures of Floor Plan Layout
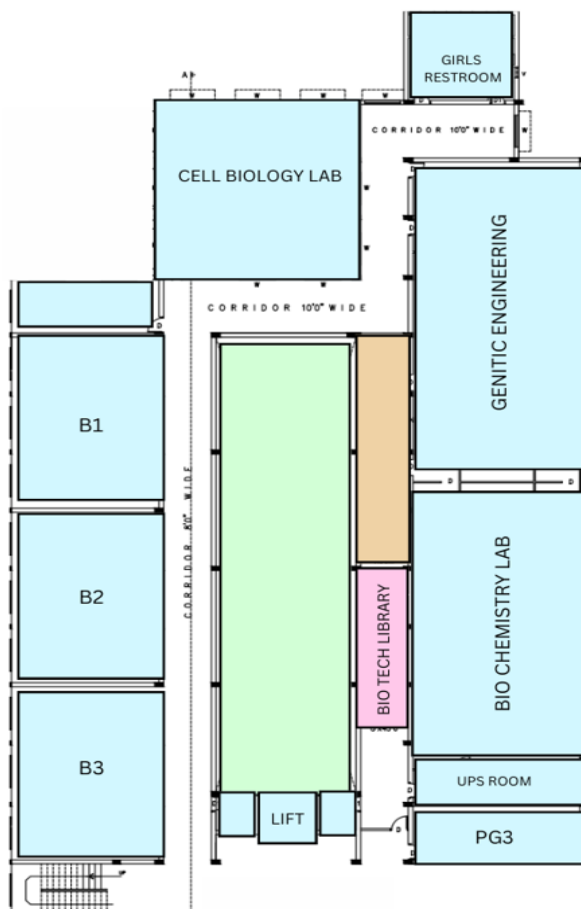
Figure 2 Floor Plan Layout-1
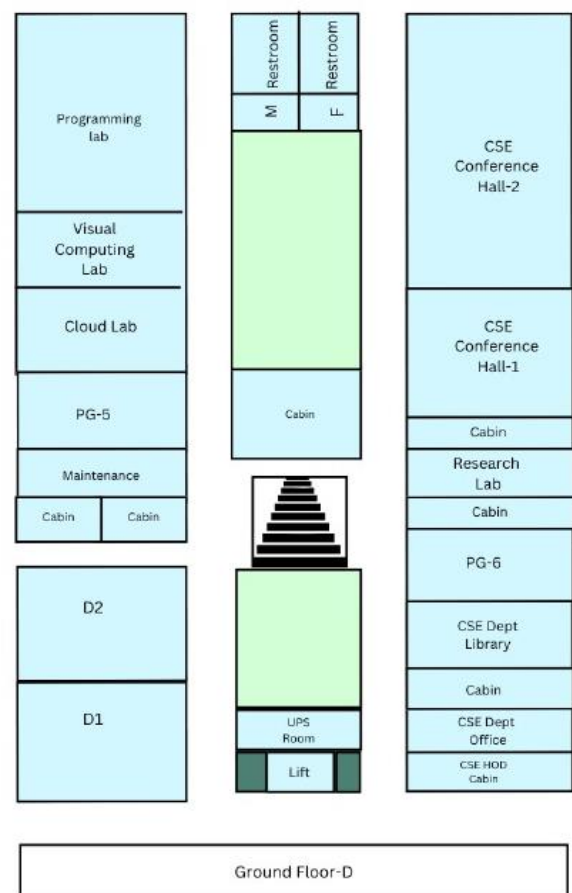
Figure 3 Floor Plan Layout-2
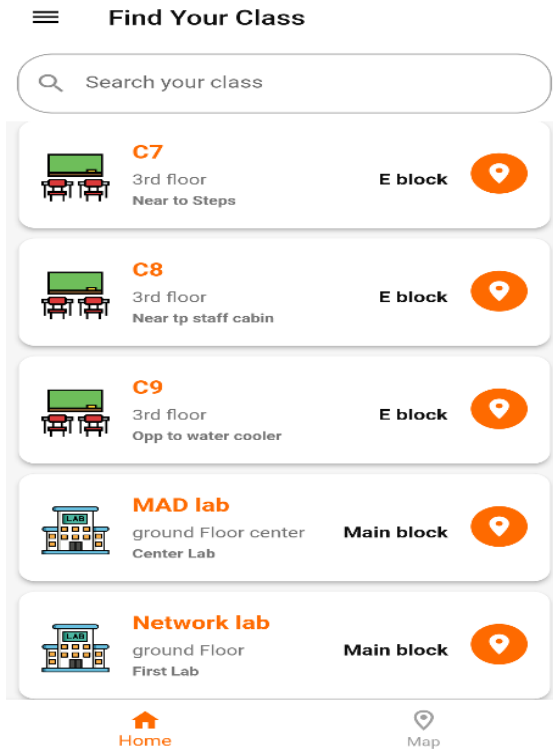
2.3.Output Screenshots
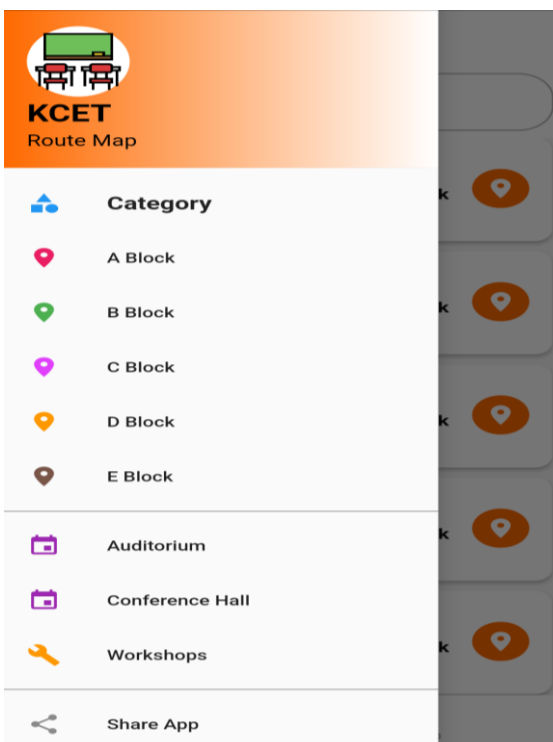

Figure 4 Route Map of Class
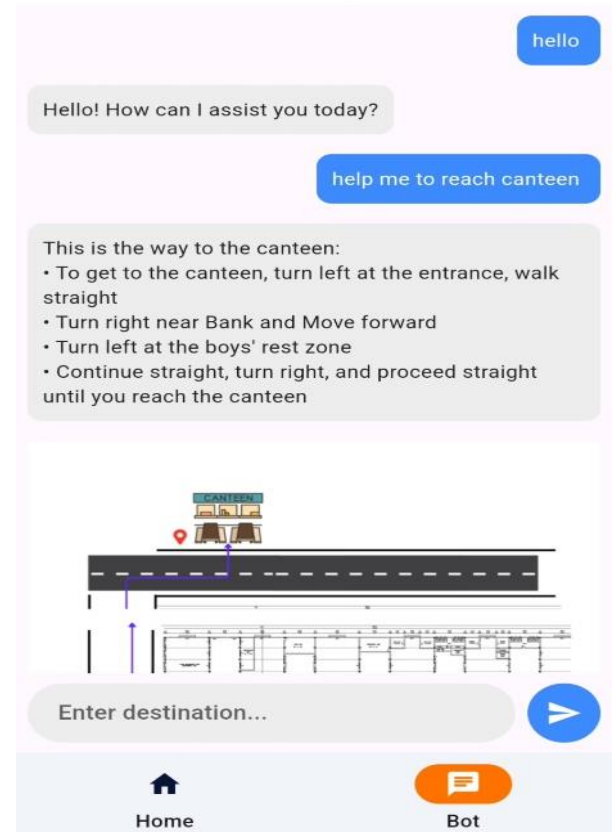

Figure 5 Route Map-2
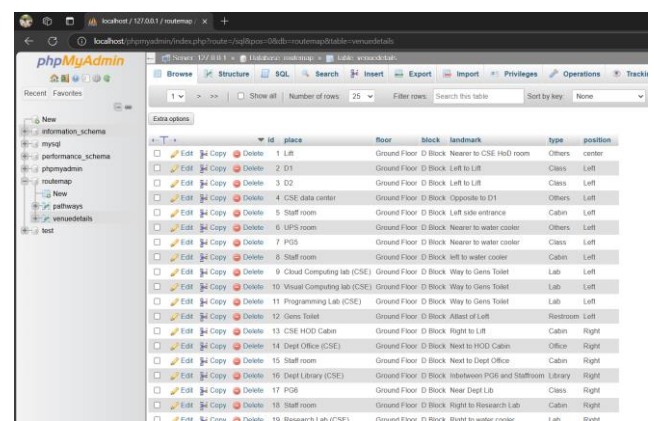

Figure 6 KCET Route Map

Figure 7 Admin Page

3. Results and Discussion
3.1.Results

The Campus Route Map System was tested in a real-world scenario to evaluate its efficiency in guiding students, faculty, and visitors across the campus. The evaluation focused on navigation accuracy, ease of

location search, and overall system reliability under different operational conditions. Table 1 presents the system's performance results. The navigation assistance and route generation process were observed to be efficient, significantly reducing the time required to locate various campus destinations. The average response time for processing a location request was recorded at 2.5 seconds, ensuring a seamless user experience. Additionally, the accuracy of route mapping was found to be high, minimizing misdirection's and enhancing wayfinding efficiency. The system effectively streamlined campus navigation, making movement within the institution more structured and hassle-free. The digital maintenance of location records, ensuring a user-friendly experience for students, faculty, and visitors. Figure 2 shows Floor Plan Layout-1, Figure 3 shows Floor Plan Layout-2, Figure 4 shows Route Map of Class, Figure 6 shows KCET Route Map, Figure 7 shows Admin Page [16-21]

3.2.Discussion

From the results, it can be concluded that the Campus Route Map System is an efficient model for managing and streamlining campus navigation. The system's ability to accurately provide route guidance and reduce confusion demonstrates its effectiveness in enhancing the overall accessibility and efficiency of campus movement. The structured approach to location-based navigation and optimized routing ensures that users can quickly and easily find their destinations, improving the overall user experience within the campus.

Conclusion

The Campus Route Map project provides an efficient, user-friendly, and cost-effective solution for campus navigation, addressing the common challenges faced by students, faculty, and visitors. By leveraging modern technologies such as Flutter for mobile development and PHP with MySQL for backend services, the system ensures seamless and accurate navigation within the campus. Unlike AR-based navigation, this static map-based approach is more accessible, scalable, and maintenance-friendly, making it an ideal choice for academic institutions. The project enhances campus accessibility, operational efficiency, and user experience, aligning with Campus vision of integrating smart technologies into its infrastructure. Moving forward, the system can be further enhanced ensuring continuous improvements in digital campus navigation.

References

[1] Sinha, S., & Gondkar, S. (2021). A novel hybrid positioning approach for indoor navigation using BLE and Wi-Fi. International Journal of Intelligent Systems Technologies and Applications.

[2] Ravi, V., & Sridhar, S. (2020). Development of an indoor navigation system using BLE beacon technology. In 2018 International Conference on Advances in Computing, Communications and Informatics (ICACCI) (pp. 1355-1360). IEEE.

[3] Sharma, R., & Rathi, R. (2019). Design and development of an indoor navigation system using BLE beacon and mobile application. In 2019 5th International Conference on Computing, Communication, Control and Automation (ICCUBEA) (pp. 1-6). IEEE.

[4] Zhang, L., & Lee, H. (2018). Indoor positioning system using Wi-Fi fingerprinting with fuzzy logic for smart buildings. IEEE Access, 6, 18518-18529.

[5] Patel, S., Sharma, K., & Joshi, R. (2021). A comparative analysis of BLE and Wi-Fi-based indoor positioning techniques. In 2021 IEEE International Conference on Smart Technologies (ICST) (pp. 124-129). IEEE.

[6] Kim, J., & Park, S. (2020). A hybrid indoor navigation system using Bluetooth Low Energy and geomagnetic field data. IEEE Sensors Journal, 20(5), 2654-2663.

[7] Liu, C., Wang, Y., & Li, X. (2019). Smart campus navigation using deep learning and computer vision techniques. In 2019 IEEE International Conference on Artificial Intelligence (ICAI) (pp. 198-203). IEEE.

[8] Huang, P., & Chen, L. (2018). Mobile indoor navigation with AR-based user assistance. In 2018 IEEE Symposium on Mixed and Augmented Reality (ISMAR) (pp. 45-50). IEEE.

[9] Gupta, R., & Sharma, M. (2022). Enhancing indoor navigation using machine learning-based Wi-Fi fingerprinting. IEEE Transactions on Mobile Computing, 21(4), 1152-1163.

[10] Kwon, H., & Choi, J. (2021). A real-time indoor navigation system based on Bluetooth Low Energy beacons and particle filtering. In 2021 IEEE International Conference on Pervasive Computing and Communications (PerCom) (pp. 345-350). IEEE.

[11] Wu, D., & Sun, Y. (2020). An IoT-based smart navigation system for university campuses. IEEE Internet of Things Journal, 7(8), 7654-7665.

[12] Singh, A., & Patel, B. (2019). Implementation of a mobile-based navigation system using QR codes and GPS. In 2019 IEEE International Conference on Computational Intelligence and Communication Networks (CICN) (pp. 150-155). IEEE.

[13] Raj, P., & Thomas, J. (2018). A comparative study of Li-Fi, Wi-Fi, and BLE for indoor positioning and navigation. In 2018 IEEE Global Communications Conference (GLOBECOM) (pp. 1-6). IEEE.

[14] Hernandez, M., & Zhao, L. (2017). An interactive campus navigation system using NFC and augmented reality. In 2017 IEEE Symposium on Educational Technologies (EduTech) (pp. 78-84). IEEE.

[15] Kumar, N., & Bansal, R. (2016). Analyzing the performance of BLE and RFID for indoor positioning. In 2016 IEEE Conference on Wireless and Optical Communication Networks (WOCN) (pp. 112-117). IEEE.

[16] Lee, S., & Kim, J. (2022). A hybrid positioning system for indoor navigation using BLE, Wi-Fi, and geomagnetic signals. IEEE Access, 10, 32587-32600.

[17] Wang, T., & Chen, H. (2021). An AI-driven mobile navigation assistant for university campuses. In 2021 IEEE International Conference on Artificial Intelligence and Mobile Services (AIMS) (pp. 101-108). IEEE.

[18] Park, J., & Lee, C. (2020). Efficient indoor positioning using deep learning and sensor fusion techniques. IEEE Sensors Journal, 20(15), 8954-8965.

[19] Zhao, L., & Huang, W. (2019). Li-Fi based indoor positioning system for smart campus applications. IEEE Transactions on Wireless Communications, 18(11), 5232-5245.

[20] Tan, K., & Zhang, Y. (2018). Multi-sensor data fusion for robust indoor navigation in smart buildings. IEEE Transactions on Instrumentation and Measurement, 67(9), 2012-2023.

[21] Bhattacharya, R., & Das, A. (2017). Development of a mobile-based indoor navigation system for university campuses. In 2017 IEEE International Conference on Smart Computing (SMARTCOMP) (pp. 45-50).