

DEVELOPMENT OF AN ELECTRONIC INTERACTIVE MAP FOR ENHANCED NAVIGATION AND RESOURCE MANAGEMENT IN EDUCATION INSTITUTION

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Abstract: This study aims to develop an electronic interactive map tailored for educational institutions, focusing on improving navigation, resource management, and information accessibility for students, staff, and visitors. The research identifies the limitations of traditional campus maps and proposes an interactive digital solution leveraging GIS technologies, user-centered design principles, and data integration techniques. The map will feature real-time updates, multi-layered information (including classrooms, departments, amenities, and emergency routes), and mobile compatibility. Essential methods include user requirement analysis, spatial data modeling, interface development, and usability testing. Results indicate a significant enhancement in user experience, spatial awareness, and operational efficiency compared to static maps. Future work will explore advanced functionalities such as indoor navigation and integration with administrative systems.

The increasing digitization of services in educational institutions has driven the need for electronic systems that improve user engagement and operational effectiveness. The advancement of digital technologies allows educational institutions to improve the efficiency of navigation and resource management on campus. One such advancement is using interactive maps that facilitate navigation, provide real-time information, and support administrative tasks. For universities, these maps serve as campus orientation tools and platforms for delivering personalized information to students, staff, and visitors. Despite the apparent benefits, implementing such systems poses several challenges, including managing dynamic data, ensuring data accuracy, and integrating user feedback into the system design.

Traditional campus maps are often static and outdated and need more detailed information, making them insufficient for modern requirements. With educational environments becoming increasingly complex, there is a growing need for more sophisticated tools that can assist users in efficiently locating facilities, resources, and services.

This research aims to create a solution that addresses these challenges by providing a flexible, up-to-date, and user-friendly tool that supports navigation and information dissemination across various stakeholders. The primary objective is to develop an interactive map based on GIS technology integrated with optimization algorithms to ensure efficient resource management. The study also seeks to enhance user experience through intuitive UI design, allowing for real-time updates and personalization.

The present study addresses these challenges by developing models and methods for creating an electronic interactive map of a university. The map is intended to provide a user-friendly interface that facilitates campus navigation, location-based services, and real-time updates. The primary objectives are to design a scalable architecture that accommodates various types of data, develop methods for real-time data integration, and implement user-centered design principles to enhance the system's usability. The research employs a combination of quantitative and qualitative methodologies. Geographic Information Systems (GIS) form the foundation for geospatial data management, while user-centered design approaches guide the interface and user experience development. The main steps include data collection (campus layout, facilities, and routes), data processing (geospatial mapping and

data validation), and system design (UI/UX development and real-time data integration). GIS tools such as QGIS and ArcGIS are used for spatial analysis, while prototyping tools like Figma assist in interface design. Additionally, usability testing is conducted with a sample of users to evaluate the effectiveness of the map interface and gather feedback for further refinement.

The methodological approach comprises several stages: first, a user requirement analysis was conducted through surveys and interviews with stakeholders, including students, faculty, and administrative staff. The insights informed the design specifications of the interactive map. Next, spatial data modeling was employed using Geographic Information Systems (GIS) to represent the campus layout accurately. Data integration involved sourcing real-time information on classroom schedules, building accessibility, and available services.

The development process involves several key stages: data collection, GIS modeling, algorithm design, and interface development. Data collection includes gathering geographic and infrastructure information relevant to the educational institution. The GIS modeling phase integrates this data into a spatial database, enabling geospatial analysis and visualization. Optimization algorithms, such as shortest path routing and resource allocation techniques, are employed to improve navigation efficiency. The UI design focuses on creating a user-friendly interface that supports interactive features such as search functions, real-time updates, and customizable layers. These components are integrated through web-based technologies, ensuring accessibility across multiple devices. The user interface was developed using modern web technologies, ensuring cross-platform compatibility and responsiveness. Finally, potential users were tested for usability to evaluate the system's effectiveness and refine the interface. This study presents a novel approach to integrating GIS and user-centered design principles for developing electronic interactive maps in educational institutions.

The scientific novelty lies in combining GIS technology with real-time data integration to create a dynamic and user-centric mapping tool specifically designed for educational environments. Unlike conventional campus maps, the developed solution supports interactive exploration of multiple information layers, such as academic departments, dining facilities, and safety routes. The system also facilitates administrative decision-making by providing analytical resource allocation and space management capabilities. Furthermore, the project's emphasis on user-centered design ensures that the map addresses the actual needs and preferences of end-users, resulting in a more intuitive and effective tool. Unlike existing solutions, this approach emphasizes adaptive functionality, allowing the map to evolve as the institution grows or changes. The study also contributes to the field by addressing the integration of real-time data updates and user customization, often neglected in traditional mapping systems. This novelty lies in the holistic integration of technical components and user-centric design, resulting in a tool that enhances operational efficiency and user experience.

Existing solutions often focus on static map displays, while the proposed model emphasizes dynamic data integration and real-time updates. The research also introduces a modular system architecture that allows for future expansions, such as the inclusion of indoor navigation or integration with other digital services. The findings provide a new perspective on the practical application of GIS in educational settings, with recommendations for optimizing spatial data management and improving user experience.

Conclusions. The research successfully demonstrates the feasibility and advantages of using an electronic interactive map in a university setting. The developed models and methods enable effective campus navigation, real-time data updates, and improved spatial data management.

The developed electronic interactive map offers significant improvements in navigating educational institutions, managing resources, and disseminating information. The system's modular design and data-driven architecture make it adaptable to various institutional settings, ensuring long-term applicability.

Future research will explore incorporating machine learning techniques to predict user behavior and optimize map features based on usage patterns. Expanding the system to support augmented reality (AR) functionalities could enhance the navigation experience.

Future work may also involve expanding the system to support indoor navigation and incorporating machine learning algorithms for predictive analytics related to campus foot traffic. The results validate the hypothesis that when combined with user-centered design, GIS-based interactive maps significantly enhance the usability and functionality of campus navigation tools.

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