Digital Information and Navigation Kiosk Application Based on Progressive Web Apps and Leaflet Technology

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Digital information and navigation kiosk applications offer a solution for communities to access updated information and navigate to locations within a specific environment. This app allows users to easily search for and access information about various locations such as lecture halls or faculty residences. The Agile Software Development method was used in the development of the app, facilitating rapid, iterative progress, and quick adjustments based on user feedback. The application provides details regarding various administrative departments and features for searching locations, accessing information, and identifying points of interest. Designed as a Progressive Web App (PWA) and Leaflet Technology, it combines the best features of web and mobile applications, allowing users to access them through a web browser while providing offline capabilities and an app-like user experience. The PWA design ensures that the app is fast, reliable, and can be accessed from any device using a web browser. This enables efficient information dissemination and rapid navigation within the environment.

Keywords—Kiosk, Information, Navigation, Progressive Web App, Leaflet

1. INTRODUCTION

In this era, digital information and navigation technologies have become fundamental aspects of human life. Modern society can no longer overlook their significant role in enhancing productivity and improving quality of life. Advancements in digital platforms and navigation systems have seamlessly integrated into daily routines, transforming how people access information, communicate, and navigate around the world. From Global Positioning System (GPS) systems guiding us to destinations with precision to digital assistants providing real-time updates and solutions, these technologies have redefined their convenience and efficiency. In industries, such as transportation, logistics, and urban planning, digital navigation tools are indispensable for optimizing operations and ensuring accuracy.

The development of kiosk applications has become a vital innovation that enhances the way individuals interact with digital services in various settings. These applications have transformed traditional processes by offering user-friendly interfaces, streamlined operations, and increased accessibility. From self-service checkouts in retail stores to ticketing kiosks in transportation hubs and interactive information systems in public spaces, kiosk apps have redefined convenience and efficiency. They provide quick, real-time solutions, reduce wait times, and improve the customer experience. With advancements in touchscreen technology, integration with digital payment systems, and seamless connectivity to cloud-based databases, kiosk applications are empowering businesses to optimize operations while meeting the evolving demands of modern users.

Several studies have focused on the development of kiosk applications. In [1, 2, 3, 4], they develop Kiosk information systems based on web applications. Aljohi *et al.* [5] studied the effectiveness of digital kiosks in targeting specific audiences in contrast to centrally managed mobile phone applications. According to [6, 7] the quality of the E-Kioks service can be assessed

from six focuses, namely ease of use, trust, the functionality of the interaction environment, readability, content and appearance of information, and citizen support.

This study aims to develop an application that functions as a digital kiosk, which will serve as an alternative means of delivering information to a broader audience. The Digital Kiosk acts as a medium for disseminating digital information, utilizing the principles of human-computer interaction to ensure that its usage has a positive impact within the University environment. Application development will utilize a web-based application designed to run through web browsers so that it can be accessed online. To support the development of the Kiosk, researchers will use Progressive Web Apps (PWA) [8 - 13] and Leaflet Technology [20], enabling the application to be installed on devices similar to native applications. The app was designed as a Progressive Web App (PWA), offering the convenience of web and mobile apps. Users can access this via a web browser while enjoying offline functionality and an app-like experience. This enables efficient information dissemination and rapid navigation within the environment.

2. RESEARCH METHODS

2.1 Agile Software Development

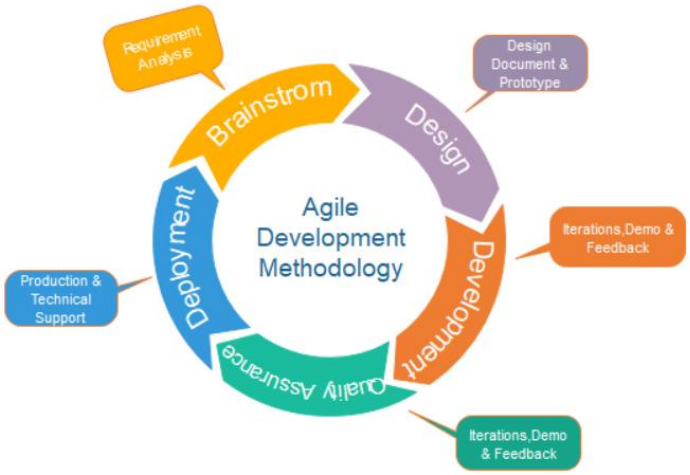

Figure 1. Agile Software Development

The Software Development Life Cycle (SDLC) is a structured approach used to develop software systems or applications. Agile Software Development is one of the models used in SDLC, allowing development teams to respond efficiently and quickly to changing requirements. The stages are as follows [14], [15], [16].

a. *Requirement Gathering*: In this stage, the requirements related to the development of the Digital Information and Navigation Kiosk Application for Klabat University Based on Progressive Web Apps must be identified.
b. *Design Requirements*: Once requirements for the Digital Information and Navigation Kiosk Application for Klabat University Based on Progressive Web Apps have been identified, the next step is to detail the requirements.
c. *Construction*: The development process begins when the team has determined the relevant requirements for developing digital information and navigation kiosk applications for Klabat University based on progressive web apps. Designers and developers collaborate to design functional applications.
d. *Testing*: In this phase, the researcher tested the performance quality of the Digital Information and Navigation Kiosk Application for Klabat University Based on Progressive Web Apps and identified weaknesses and potential issues.

e. *Deployment*: After the development phase, the team releases the Digital Information and Navigation Kiosk Application for Klabat University Based on Progressive Web Apps for use within the university environment.
f. *Feedback*: After releasing the Digital Information and Navigation Kiosk Application for Klabat University Based on Progressive Web Apps, the final step is to evaluate the feedback for necessary improvements and enhancements.

2.2. Application Architecture

Figure 1 illustrates the web application being developed. Users access the Web App using kiosks located at specific locations within the Klabat University environment.

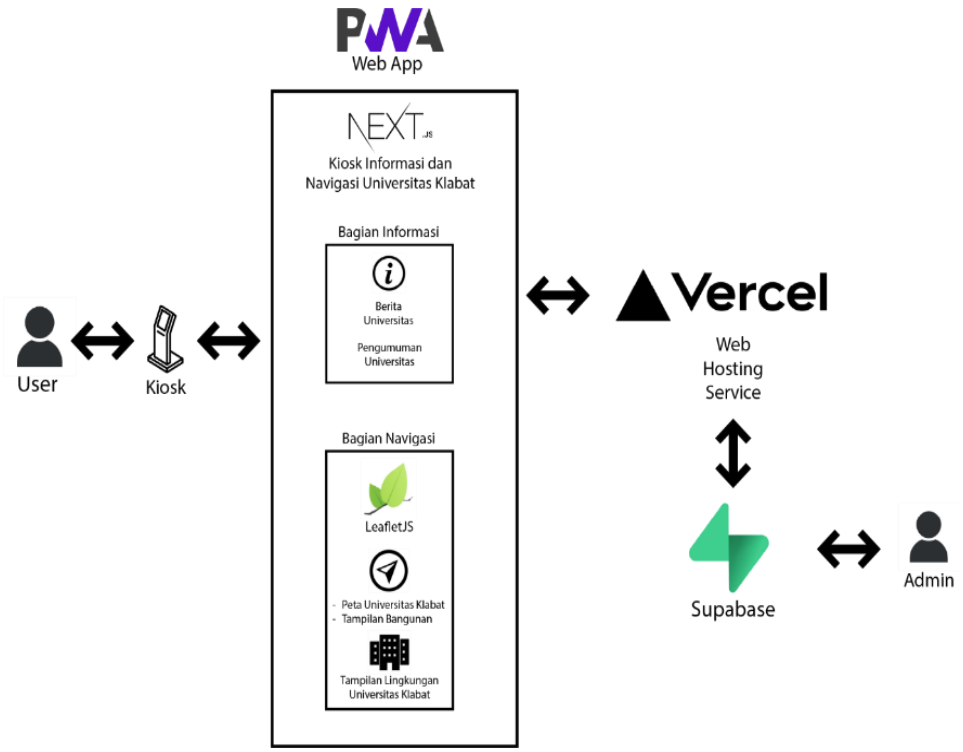

Figure 2. Application Architecture

Figure 2 represents the architecture and workflow of a Progressive Web Application (PWA) designed as a Kiosk Information and Navigation System for Universitas Klabat. The system allows users to interact through a kiosk interface that runs a PWA built with Next.js [17, 18, 19], which is a modern framework for web applications. The application provides an app-like experience with offline functionality that is accessible via a web browser. It consists of two main sections: the Information Section, which displays news and announcements from Universitas Klabat, and the Navigation Section, powered by LeafletJS, which offers an interactive campus map, building locations, and detailed visualization of the campus environment.

The Information Section provides users with the latest news and announcements. It serves as an interactive display where visitors can access updated information regarding events, activities, or general notifications. The content was designed to be visually engaging and easy to navigate, ensuring that users can quickly find relevant details. The navigation section is a map-based interface powered by LeafletJS, which is a widely used open-source JavaScript library for interactive maps. This section presents a dynamic map with markers representing key locations. Users can explore the map to find specific destinations, view details of each location, and plan their routes efficiently.

The application is hosted on Vercel, a platform optimized for deploying Next.js applications, ensuring a fast and scalable performance. For data management, the system uses Supabase [21], a backend-as-a-service platform that stores and manages information, such as announcements, map data, and administrative settings. Administrators interact with the system via Supabase to update content such as news, announcements, or location details, ensuring that the kiosk remains current and functional. Users access the system through the kiosk to retrieve the information they need or navigate the campus, whereas the seamless integration between Vercel and Supabase ensures that the application delivers a responsive and reliable user experience. This system bridges users' needs with administrative efficiency, making it a valuable tool for managing campus information and navigation.

3. RESULT AND DISCUSSION

3.1. Design the Requirements

After the user needs are formulated, the next step is to design the user needs. Researchers use UML to design the application features.

1) Use Case Diagram

Use Case Diagrams are used to describe the system flow and its functionality, explaining the interaction between the system and the user.

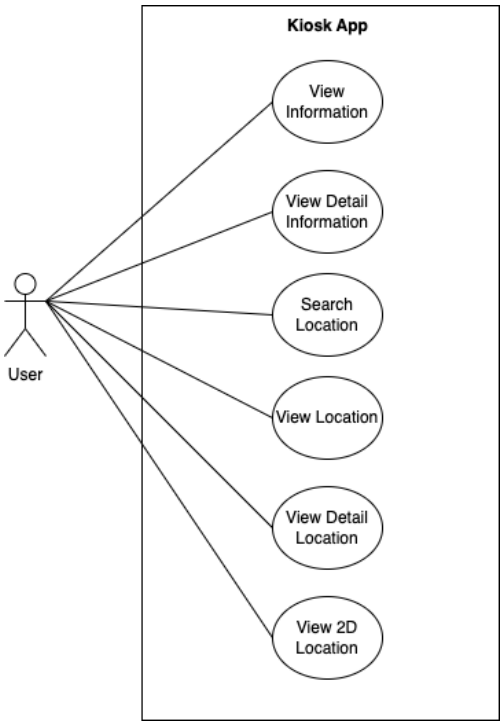

Figure 3. Use Case Diagram

Figure 3 illustrates the activities that can be performed by users. Users can access the information section to view news and announcements from Klabat University, and users can also view the details of the news. Users can view the navigation section containing maps and markers for each location in the Klabat University environment. Users can also search for the desired location, each location marker has information about the location, and the location of the building can be viewed in the form of a 2-dimensional display.

2) Component Diagram

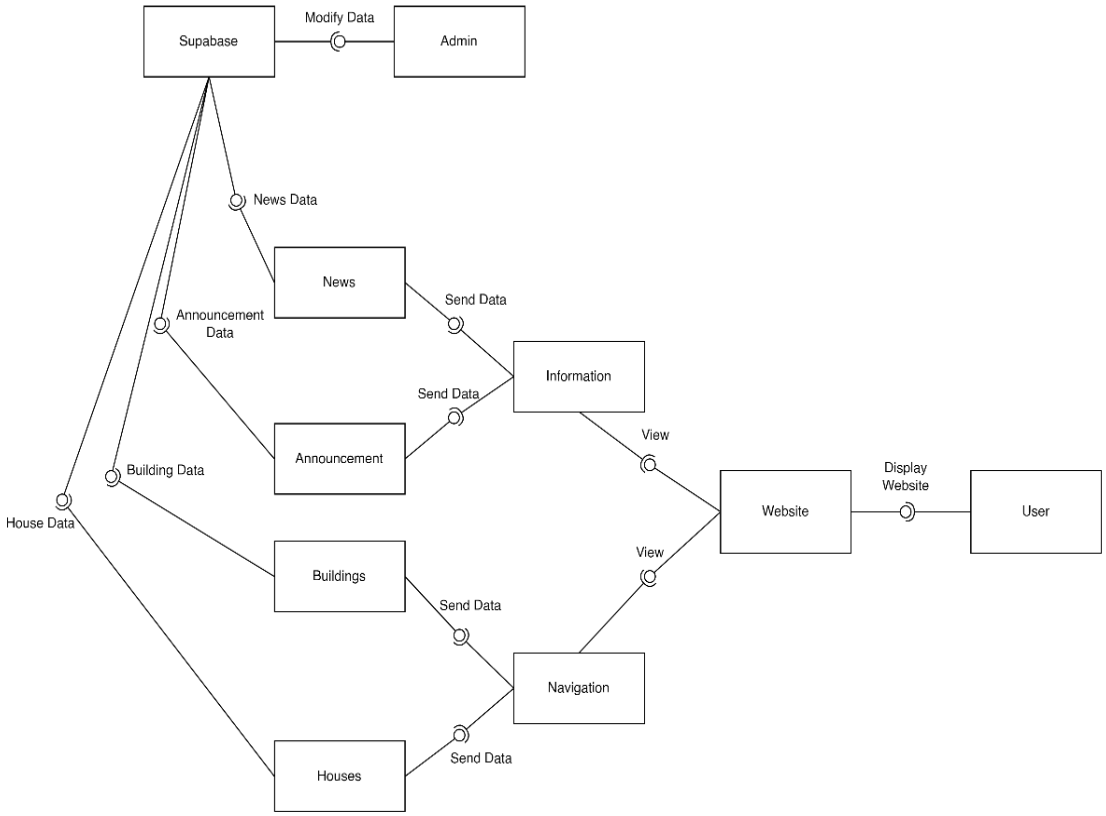

Figure 4. Component Diagram

Component Diagram is a type of UML (Unified Modeling Language) diagram used to describe the components that form a system and the relationships between those components. Figure 4. illustrates how kiosk applications interact. Supabase is a database that stores data on news, announcements, buildings, and houses. The stored data can be changed by admin using the Supabase dashboard. The information section displays news and announcement information based on data that has been stored in Supabase and the Navigation section displays marker data for each location in the Klabat University environment that has been stored in Supabase. The kiosk website displays Information and Navigation sections to the user through a physical kiosk.

3.2. Construction

After user needs are designed using UML, the next step is to build the application. The Interface Display is a display of the website, such as the main page display of the website, the news section display that displays news and announcements from Klabat University, and the navigation display that displays a map and marker display for each location in the Klabat University environment. In this stage, NodeJS is used, which is a JavaScript runtime [18] that allows the JavaScript code to be run as a server to store application data locally.

Figure 5. Home Screen

Figure 5 is the implementation of the interface of the main page. Through this main page, users can access the News (Information) and Navigation pages.

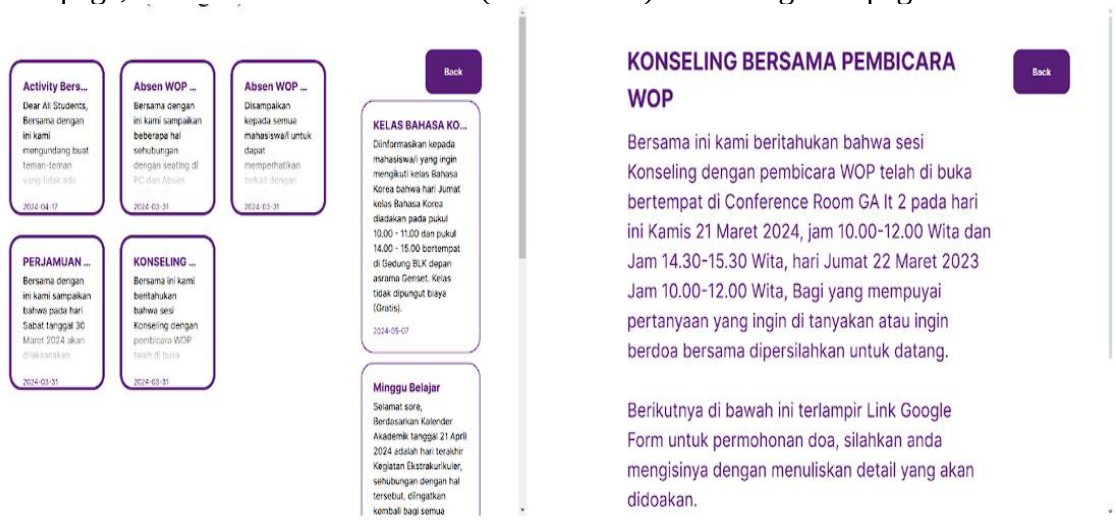

Figure 6. News and News Detail Screen

Figure 6 implementation of the news display and detailed information that has been selected by the user.

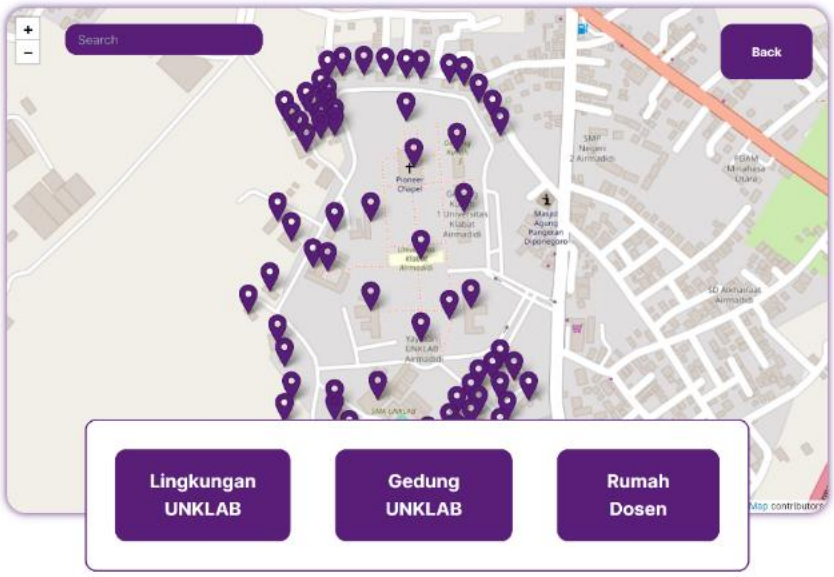

Figure 7. Navigation Screen

Figure 7 illustrates the interface of the navigation section within the Universitas Klabat kiosk application, which was designed to provide an interactive and user-friendly map experience. Powered by LeafletJS, the map displays a detailed layout of the campus, with markers representing key locations, such as university buildings, staff residences, and outdoor areas. Users can interact with these markers to access additional information such as the name or description of a specific location. For example, in the left panel, the location "Kiosk GA" is highlighted, while the right panel shows a popup with detailed information about staff residence.

The interface also includes categorized navigation buttons at the bottom, allowing users to explore different sections such as Lingkungan UNKLAB (campus environment), Gedung UNKLAB (university buildings), and Rumah Dosen (staff housing). A search

bar at the top enables users to quickly locate specific locations or individuals by typing relevant keywords. Additionally, a "Back" button provides easy navigation to return to the previous screen or main menu. This intuitive design makes the application a valuable tool for campus navigation, helping students, staff, and visitors efficiently locate their destinations and familiarize themselves with the campus layout.

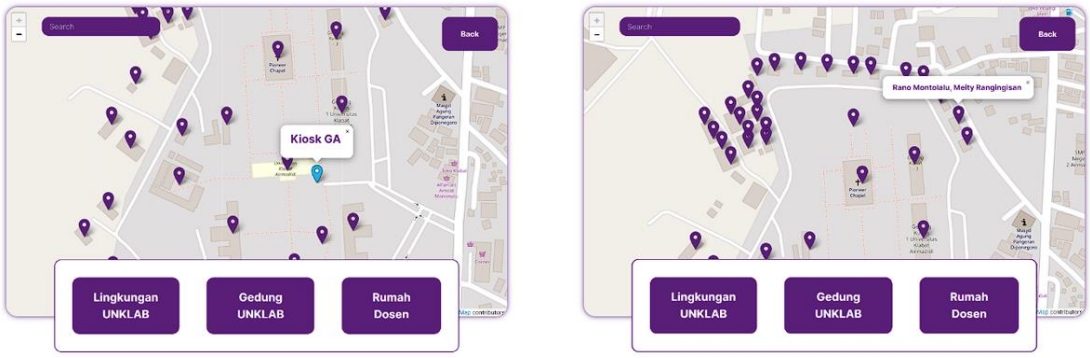

Figure 8. Location Screen

Figure 8 shows the implementation of the marker display of the physical locations and kiosks in the Klabat University environment.

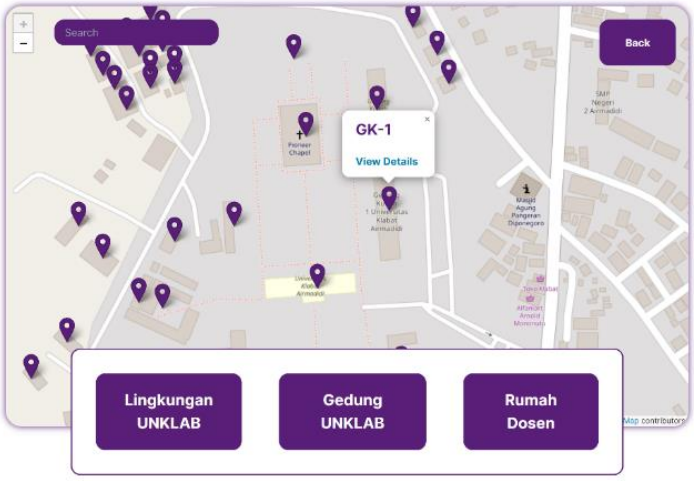

Figure 9. Location Detail Screen

Figure 9 implementation of the user-selected Building Location Details display.

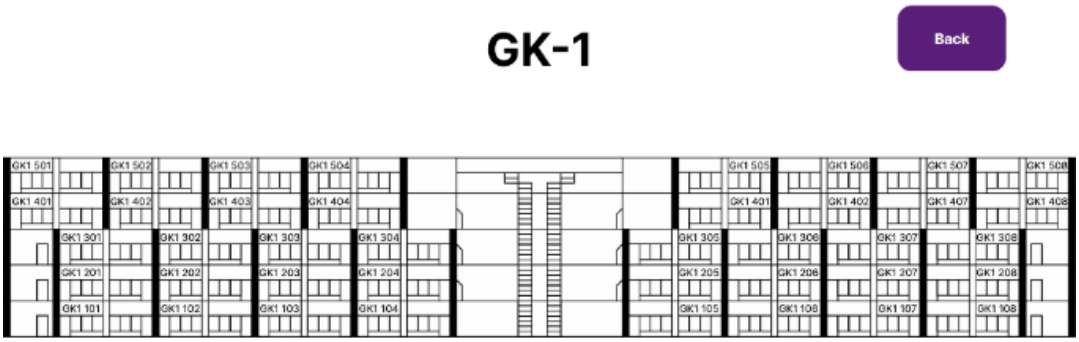

Figure 10. 2-D Building Screen

Figure 10 implementation of a 2-dimensional view of the building selected by the user.

3.3. Testing

Researchers conduct application testing to determine whether the application that has been created functions properly or not. At this testing stage, researchers use the Black Box Testing method. Black Box Testing is a software testing method that tests the functionality of an application without paying attention to the internal structure or logic of its program code.

Table 1. Black Box Testing

No.	Features	Description	Input	Expected Output	Result
1.	Home Screen	Testing whether the App can display the home	Accessing the App	Displaying the Home Screen	Success
2.	Information Screen	Testing whether the App can display the news and	Pressing the News Button on	Displaying the news and announcement	Success
3.	Information Detail Screen	Testing whether the App can display the information	Press one of the news	Displaying the Information detail	Success
4.	Navigation Screen	Testing whether the App can display the maps,	Pressing the Navigation on	Displaying the map with markers, search	Success
5.	Location Detail Screen	Testing whether the App can display details of the	Pressing the marker on the	Displaying detailed information about the	Success
6.	*Search*	Testing whether the App can search for houses and	Typing keywords into	Displaying the search marker location	Success
7.	Progressive Web Apps Installation	Testing whether the App can be installed on a device	Press the pop-up install button on	Installing the App into the device	Success

3.4. Deployment

After designing and testing the application, it is prepared for launch using web hosting services, which play a critical role in ensuring the usability and performance of the application. Web hosting enables websites or web applications to be stored on servers and accessed across various devices, such as desktop computers, mobile phones, and tablets, thus making the system widely accessible.

Hosting ensures that files, including images, videos, text, and program code, are securely archived on servers, thereby enabling users to interact with the application reliably and efficiently. However, while web hosting provides the foundation for deployment, the usability and performance of an application remain critical factors that determine its overall success. In this context, kiosk applications should provide a seamless, intuitive experience with features such as fast-loading maps, responsive navigation, and clear instructions. Performance, on the other hand, pertains to the speed, reliability, and responsiveness of the application. A web hosting service must handle multiple simultaneous user requests, maintain quick load times, and provide uninterrupted access. Issues such as slow loading speeds, downtime, or glitches can negatively impact user experience, particularly in public-facing applications such as kiosks, where users expect quick and reliable results. The critical analysis also highlights the importance of scalability and data security. As usage increases, the hosting service must accommodate increased traffic without compromising speed or reliability. In addition, hosting providers must ensure robust data protection mechanisms to safeguard sensitive user information against breaches or unauthorized access.

4. CONCLUSION

The development of a digital information and navigation kiosk application for Universitas Klabat has been completed, providing an effective solution for disseminating information and offering navigation assistance on campus. The application employs Next.js as the primary development framework, selected for its capability to streamline the creation of scalable, high-performance web applications. The mapping functionality, powered by the Leaflet.js JavaScript

library, enhances the application by delivering an interactive map interface. This feature includes precise markers for key locations, such as lecturer residences and campus buildings, ensuring that users can navigate the campus with ease and accuracy.

These kiosks enable users, including students, staff, and visitors, to access real-time information and navigation assistance directly on-site without the need for personal devices. This approach bridges the gap between digital solutions and practical, on-the-ground needs. In conclusion, the digital information and navigation kiosk application represents a significant advancement in campus services, effectively addressing information dissemination and navigation challenges through the integration of cutting-edge technologies. This study demonstrates the potential of combining innovative frameworks like Next.js and Leaflet.js to meet institutional needs while enhancing user experience. Future research should focus on expanding system capabilities, such as incorporating real-time updates, mobile support, and multi-language functionality.

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