

Design and development of an android-based cultural heritage application: A case study of fakfak, west Papua

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ABSTRACT

This study aims to design and develop an Android-based cultural heritage application to introduce and preserve cultural sites in Fakfak Regency, West Papua. The application provides information on cultural heritage sites, map locations, and navigation routes to these sites. The development process followed the Waterfall model, encompassing requirements analysis, design, coding, testing, and maintenance stages. Application testing was conducted using the Black Box method to evaluate system functionality and usability testing with a Likert scale to measure user satisfaction. The test results indicate that the application is easily accessible, provides accurate information, and features a user-friendly interface, achieving an average user satisfaction rate of 90%. This application is expected to serve as an effective tool for preserving and promoting cultural heritage in Fakfak Regency.

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1. INTRODUCTION

Cultural heritage preservation is essential for maintaining cultural legacies and ensuring their long-term benefits—socially, culturally, and economically (Koohafkan & Altieri, 2011). It has expanded beyond the scope of physical protection to include education and promotion as crucial elements (Labadi et al., 2021). The loss of cultural heritage can have profound effects on both the community identity and economic potential of a region. In Fakfak Regency, located in West Papua, cultural heritage—comprising historical sites, buildings, artifacts, and cultural areas—forms an integral part of the community's identity. However, the potential of this rich heritage remains underutilized. Many historical relics in Fakfak have been neglected or altered, diminishing their cultural significance and contributing to a lack of awareness, especially among the younger generation. Preliminary data shows that around 60% of Fakfak's residents are unaware of the cultural heritage sites in their region, primarily due to limited access to adequate information (Fakfak, 2022). This lack of awareness not only hinders community engagement in preservation efforts but also restricts the growth of tourism—a sector that could bring significant economic benefits by attracting visitors interested in exploring Fakfak's unique cultural history. As heritage sites remain unpreserved and underexplored, Fakfak risks losing an essential part of its identity and the economic opportunities that could stem from cultural tourism.

The rapid growth of technology, particularly Android-based devices, offers an opportunity to modernize and simplify cultural heritage preservation efforts (Purwanto et al., 2021). This technology provides users with instant access to information anytime, anywhere, eliminating the need for traditional resources like books or guides (Abdillah et al., 2020).

This research aims to design and develop an Android-based application focused on introducing and preserving cultural heritage in Fakfak Regency. The application is intended not just

as an informational tool but also as an interactive educational medium to raise public awareness about cultural preservation's importance. By utilizing technologies such as React Native, Firebase for database management, and Expo MapView for interactive mapping, the application aspires to present engaging and accessible information (Aruna et al., 2024).

The study builds on prior research, such as (Metafani & Djamaludin, 2020) investigation of a cultural heritage application in Tangerang, which highlighted the effectiveness of Android applications in enhancing public awareness. However, this study does not fully integrate advanced technology to enhance user experience and community participation, which are key elements in fostering greater engagement with cultural preservation. Similarly, (Prasetyo & Suwindiatrini, 2020) conducted research on how to utilize information and communication technology, specifically Android devices, as a tool for collecting cultural heritage data easily and efficiently. Additionally, (Adriyani et al., 2023) emphasized the significance of digital map integration in cultural heritage applications for providing direct access to site locations and related information. Another study by (Magfirah et al., 2023) developed an Android application to introduce the local culture of Fakfak Regency, utilizing Firebase as the main database and Java programming language for application development. Employing the waterfall software development model—a systematic approach from requirements analysis to maintenance (Sommerville, 2011).

Technology integration is a key innovation in this study, distinguishing the application from previous research. It utilizes React Native for cross-platform compatibility, ensuring smooth performance across various Android devices with faster load times and reduced maintenance. The app also uses Firebase for real-time data synchronization, allowing seamless updates and ensuring the latest information on cultural heritage sites is always accessible. Additionally, Google Maps is integrated for interactive mapping, enabling users to explore heritage sites through real-time navigation and access detailed information, fostering deeper engagement with cultural preservation.

Through this application, it is expected that the people of Fakfak Regency will become more familiar with, understand, and support the preservation of local cultural heritage, ensuring its continued preservation and transmission to future generations. With the ease of access to information provided by this application, it is hoped that the community will become more concerned about the preservation of cultural heritage and actively participate in efforts to preserve local culture.

2. RESEARCH METHOD

Research Design

This study employs a development research approach to design and develop an Android-based application for introducing and preserving cultural heritage in Fakfak Regency. This method ensures the application is functional and culturally relevant, benefiting the community by enabling them to recognize, learn about, and preserve local heritage. Figure 1 illustrates the System Overview of the developed application.

The application features a two-way communication system between users and the database, supporting two user levels: a) Admin Level: Admins manage cultural heritage data stored in Firebase, including updating, adding, and deleting data. Changes are synchronized instantly to ensure accurate information; b) User Level: Users can access detailed information about cultural heritage sites and navigate to their locations via Google Maps.

This design ensures easy access to comprehensive information while helping users locate cultural heritage sites efficiently.

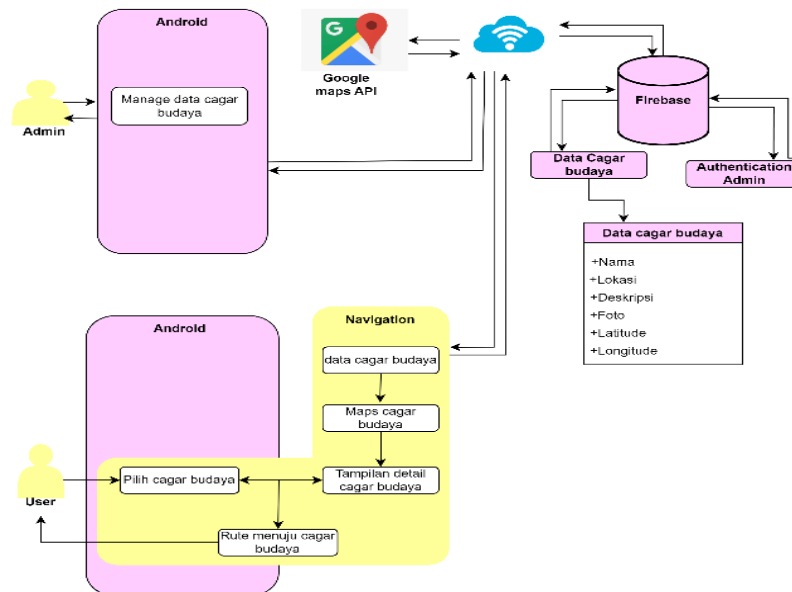


Figure 1. System overview

Development Model

The application development process employed the Waterfall software development model (Sommerville, 2011). This model was selected for its clear and systematic stages, comprising requirement analysis, design, coding, testing, and maintenance (Saravanos & Curinga, 2023). Each stage is executed sequentially and in a structured manner (Arridha et al., 2020), ensuring that the resulting application effectively achieves the goals of cultural heritage preservation and introduction.

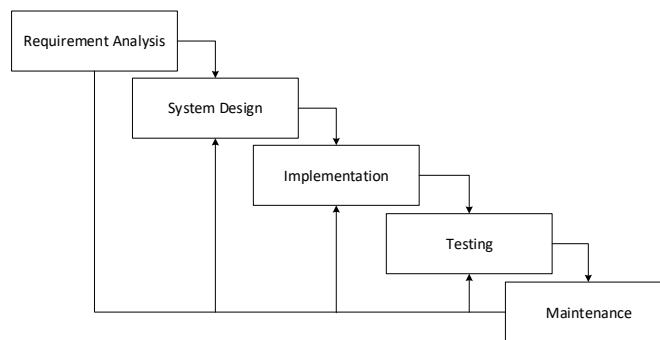


Figure 2. Waterfall model

Research Stages

This research followed several main stages aligned with the waterfall model (Arridha et al., 2022), including:

- 1) Requirement Analysis, at this stage, user requirements were identified (Hidayati & Sismadi, 2020), including the type of cultural heritage information to display and desired features such as data search and location navigation. Interviews with cultural experts and local communities were conducted to gather relevant insights.
- 2) System Design, this stage involved designing the application, including system architecture, technology selection (React Native, Firebase, Google Maps), and user interface/user experience (UI/UX) design (Syahputra & Perwitasari, 2024). The focus was on ensuring easy access and intuitive navigation for users.
- 3) Implementation, application development commenced using React Native for Android devices, Firebase as the database, and Google Maps for navigation. An admin system was also developed to manage cultural heritage data. (Pawan et al., 2021)

- 4) Testing. the application was tested to ensure all features functioned properly (Senarath, 2021). Testing included functionality tests, user experience (UX) evaluation, and performance checks. Feedback from users in Fakfak Regency was incorporated for further improvements.
- 5) Maintenance, after the application's launch, maintenance was carried out to fix bugs and update cultural heritage data (Yew & MAHDIN, 2023). New features were added based on user feedback to enhance application usability.

System Design

The following UML diagrams describe the interactions between users and the system:

- 1) Use Case Diagram, the Use Case Diagram illustrates the interactions between actors and the system (Arridha & Roy, 2021). There are two actors in this system: Admin and User. Admin has full access to manage the data, while User can only view cultural heritage information, select heritage sites, and view the map of selected locations. Figure 5 shows the Use Case Diagram for this application.

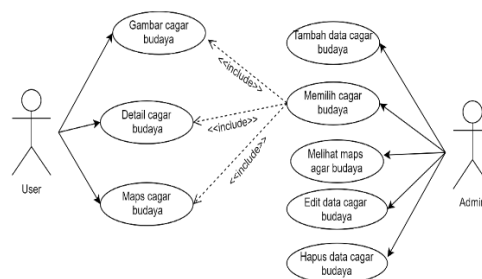


Figure 3. Use case diagram

- 2) Activity Diagram, the Activity Diagram illustrates the flow of activities performed by users within the application (Munthe et al., 2020). Below are the primary activities:
 - a. Activity Diagram for Finding Routes to Cultural Heritage Sites

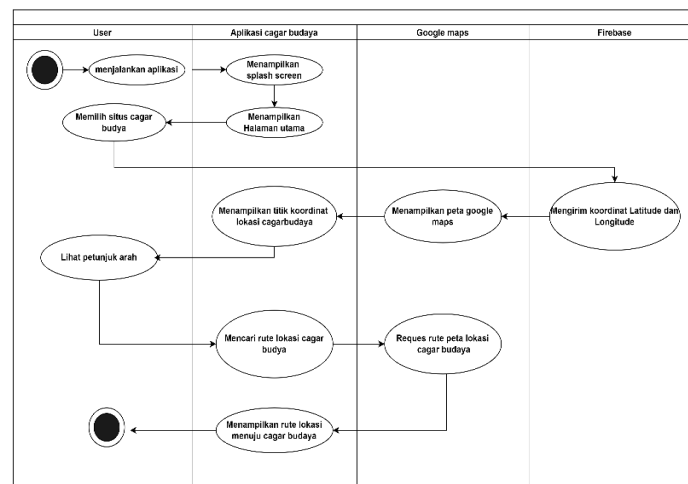


Figure 4. Activity diagram for finding routes to cultural heritage sites

This diagram outlines the steps for a user to select a cultural heritage site, view its details, and opt to see the map. The system displays the heritage site's map and requests route information from the Google Maps API, showing the path from the user's location to the heritage site.

- b. Activity Diagram for Viewing Cultural Heritage

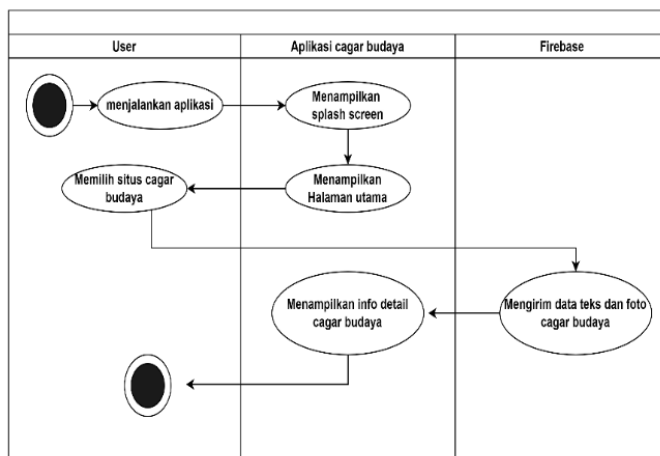


Figure 5. Activity diagram for viewing cultural heritage

This diagram represents the user's activity when viewing information about a selected cultural heritage site. After selecting a site, the system displays detailed information about it.
 c. Activity Diagram for Viewing All Maps of Cultural Heritage Sites

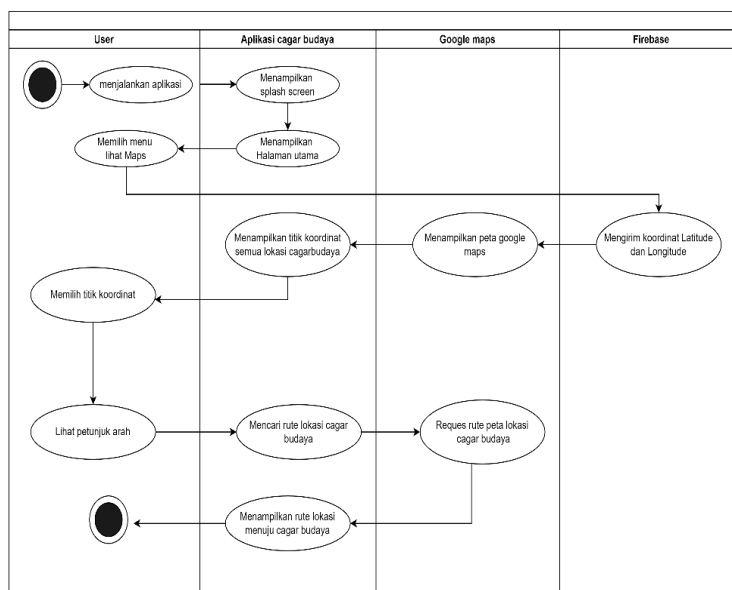


Figure 6. Activity diagram for viewing all maps of cultural heritage sites

Users can select a menu option to view all cultural heritage site maps. The system shows a map with the coordinates of heritage sites retrieved from Firebase.
 d. Activity Diagram for Adding Cultural Heritage Data

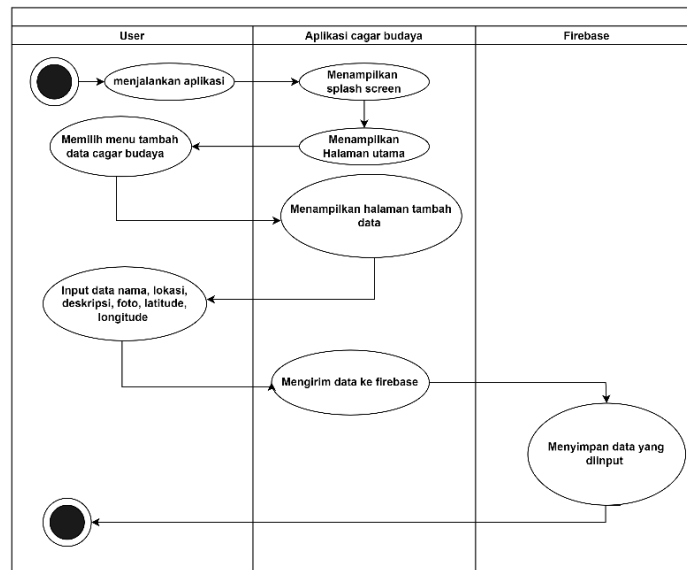


Figure 7. Activity diagram for adding cultural heritage data

This activity is restricted to admins. The admin selects the menu to add data, inputs the required information, and the system sends the data to Firebase for storage.

e. Activity Diagram for Editing Cultural Heritage Data

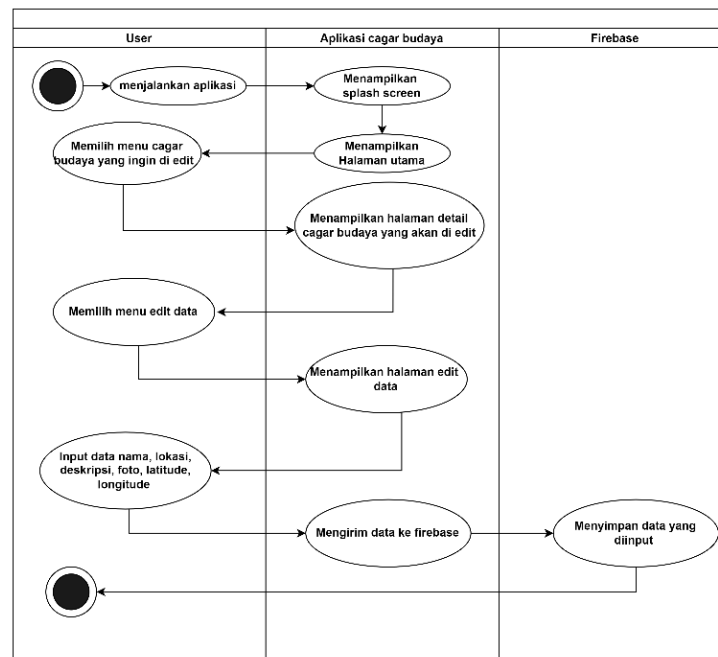


Figure 8. Activity diagram for editing cultural heritage data

Admins can edit existing cultural heritage data. After selecting the heritage site to be edited, the admin updates the information, which is then saved back to Firebase.

f. Activity Diagram for Deleting Cultural Heritage Data

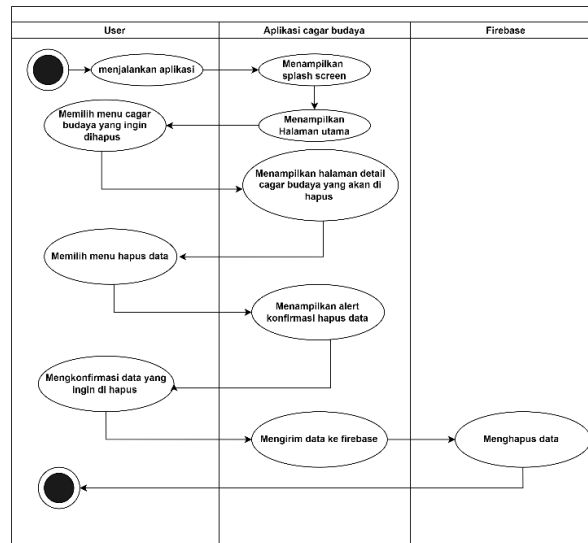


Figure 9. Activity diagram for deleting cultural heritage data

To delete cultural heritage data, the admin selects the site to be deleted and confirms the deletion. Once confirmed, the data is removed and updated in Firebase.

3) Research Instruments

The instruments used in this study include:

- a. Questionnaire, this was used to gather information about the community's needs and preferences regarding the cultural heritage application in Fakfak. The data were analyzed using thematic coding to identify patterns related to community awareness and expectations of cultural heritage preservation.
- b. Interviews, with cultural experts and local representatives provided insights into the importance of cultural heritage preservation. The data were analyzed using thematic analysis to explore key themes, though some results were not fully documented for integration into the overall analysis.
- c. Application Testing, the developed application was tested to collect user feedback regarding its usability and functionality (Magfirah et al., 2021). User feedback on the developed application was collected through usability testing, focusing on ease of use, navigation, and satisfaction. This testing assessed the application's effectiveness in promoting cultural heritage awareness and preservation in Fakfak.
- d. Data Analysis, data from the questionnaires and interviews were analyzed qualitatively using coding and thematic analysis to identify key issues and perspectives. Application testing data were analyzed to evaluate the application's functionality and user experience, ensuring it met the community's needs for cultural heritage recognition and preservation. The success of the app in achieving its goals of cultural heritage recognition, preservation, and community engagement will be measured through: Usability Testing, this method will assess how well the app meets user needs by evaluating ease of use, navigational flow, and user satisfaction. Success will be determined by the extent to which users find the app intuitive and effective in accessing and preserving cultural heritage information.

Black Box Testing, this testing ensures that all app functions work correctly and as intended, including accessing cultural heritage data and navigating through the app. Success is measured by whether all features function properly, contributing to the goal of providing accurate and accessible cultural heritage information.

3. RESULTS AND DISCUSSIONS

The Results

The research findings include black-box testing results, usability testing outcomes, and application interface results.

- 1) Black-Box Testing Results, Black-box testing was conducted to ensure all application functionalities operated as planned (Guidotti et al., 2018). The results are summarized in Table 1 below:

Table 1. Black box testing results

Test Method	Scenario	Result	Remarks
Login to Application	Navigate to Menu: Dashboard, Maps, About	Displays Dashboard, Maps, About pages	Successful
Click Maps Menu	Navigate to the Maps menu	Displays all cultural heritage points in Fakfak	Successful
Click Heritage Menu	Navigate to the Detail menu	Displays detailed information on cultural heritage	Successful
Click Map Detail Menu	Navigate to the Maps page	Displays coordinates specific to the heritage site	Successful
Click About Menu	Navigate to the About page	Displays application information	Successful
Click Add Data Menu	Navigate to the Add Data page and input required data	Shows notification: "Data successfully added"	Successful
Click Edit Data Menu	Select heritage data to edit, modify, and confirm changes	Shows notification: "Data successfully edited"	Successful
Click Delete Data Menu	Select heritage data to delete, confirm deletion	Shows notification: "Data successfully deleted"	Successful

- 2) Usability Testing Results, usability testing was conducted to evaluate the application's ease of use and user satisfaction, based on feedback (Kushendriawan et al., 2021) from 20 respondents. While this sample size may not be fully representative of the entire Fakfak community, it provided initial insights into user experiences and preferences. The testing used a Likert scale with five options: Strongly Agree (SS), Agree (S), Neutral (N), Disagree (TS), and Strongly Disagree (STS) (Bodur et al., 2024). The results focused on two main aspects: User Interaction and Application Functionality.

Tabel 2. Usability testing results

No	Statement	Total					Total Score
		SS	S	N	TS	STS	
User Interaction with the Application							
1	Application color scheme is visually comfortable	17	3	0	0	0	97%
2	Item placement is intuitive	9	11	0	0	0	89%
3	Application is easy to use	12	8	0	0	0	92%
4	All buttons function properly	15	5	0	0	0	95%
5	Application is stable and rarely crashes	13	7	0	0	0	93%
Average Score							93%
Application Functionality							
1	Provides accurate cultural heritage information	15	5	0	0	0	95%
2	Displays cultural heritage locations effectively	7	13	0	0	0	87%
3	Provides accurate navigation routes	9	10	1	0	0	88%
4	Displays cultural heritage photos effectively	10	10	0	0	0	80%
5	Identifies cultural heritage locations accurately	7	11	2	0	0	85%
Average Score							87%
Overall Average Score							90%

3) Application Interface Results

- a. Splash Screen, Dashboard, and Menu, when the application is first launched on an Android device, users will see the splash screen shown in Figure 10, featuring the text "Cagar Budaya Fakfak". This screen introduces the application to users. After the splash screen, the application will display the dashboard as shown in Figure 11, which contains the main menu for navigating to other features. The application menu, as seen in Figure 12, has three main buttons, Dashboard: Directs users to the cultural heritage menu; Maps: Displays the location of cultural heritage sites in Fakfak; About: Provides information about the application.

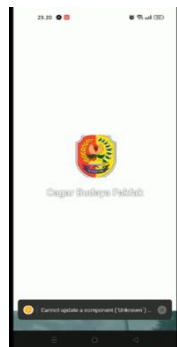


Figure 10. Splash Screen



Figure 11. Dashboard



Figure 12. Menu

- b. Detail Screen, in Figure 13, users can view detailed information about the selected cultural heritage site, as well as see the location of the site. After selecting the heritage site, users can view the geographic coordinates of the site on the map, as shown in Figure 14.



Figure 13. Cultural heritage detail



Figure 14. Cultural heritage location on map

- c. Maps Menu, this menu displays a map with the coordinates of all cultural heritage sites in Fakfak, as shown in Figure 15. The About menu provides information about the application, including its objectives and how to use it, as seen in Figure 16.



Figure 15. Maps of cultural heritage locations



Figure 16. About screen

- d. Admin Menu Interface, the admin login page, as shown in Figure 17, is used to access the data management features for cultural heritage, such as adding, editing, and deleting data. After logging in, the admin can access the admin menu, which contains four main buttons: Dashboard, Maps, About, and Tambah Data (Add Data). The Dashboard, Maps, and About buttons function the same as in the user menu, while the Tambah Data button directs the admin to the page where new cultural heritage data can be added, as shown in Figure 18.



Figure 17. Admin login



Figure 18. Admin menu

- e. Add, Edit, and Delete Data Screens, this page allows the admin to add new cultural heritage data by filling out the necessary information, as shown in Figure 19. On the Edit page, shown in Figure 20, the admin can modify existing cultural heritage data by selecting the data to be changed and entering the required updates. Figure 21 shows the page where the admin can delete cultural heritage data after selecting the data to be deleted and confirming the deletion action.



Figure 19. Add data



Figure 20. Edit data



Figure 21. Delete data

Discussion

This section analyzes the application testing results, user interface feedback, and how the application achieves its goal of introducing and preserving cultural heritage in Fakfak Regency.

- 1) Application Testing, black box testing confirmed that all features (Dashboard, Maps, About, Add Data) function as expected. Usability testing yielded a 93% satisfaction score, indicating the app is user-friendly and responsive.
- 2) Application Functionality, the app scored 87% in functionality, effectively providing cultural heritage information and routes. However, photo quality (scoring 80%) needs improvement to enhance appeal and informativeness.
- 3) Application Interface, the interface received positive feedback for its intuitive design and clear navigation. The Maps feature worked well, though some users suggested improving map loading speed.
- 4) Cultural Heritage Data Management, the app allows admins to manage cultural heritage data efficiently. However, improvements in visual confirmations for data editing/deletion and database optimization are needed.
- 5) Suggestions for Future Development, although the application is already quite good in terms of functionality and design, there are still several areas that can be improved to enhance the user experience and the effectiveness of the application. Some suggestions for further development include: a. Improving photo quality for clearer representation. b. Optimizing map loading speed. c. Adding interactive features like user comments or ratings for enhanced user engagement and feedback.

4. CONCLUSION

Cultural Heritage Recognition Application for Fakfak Regency has been developed as an effective tool to introduce and preserve local cultural sites. This Android-based app offers easy access to cultural heritage information, with an intuitive design that enhances user experience. Usability testing shows high satisfaction, with an average score of 90%, confirming its effectiveness in promoting and preserving cultural heritage. These results suggest the app could serve as a model for local government policies to promote cultural heritage through technology. Its success in engaging the community and providing accessible cultural data makes it a valuable tool for regional and national preservation efforts. The app can be proposed as a policy instrument to increase cultural heritage awareness, support preservation, and integrate technology in community-based heritage promotion in Fakfak and beyond.

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