

Merapi Volcano Refugee Management Information System

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ABSTRACT

The Mount Merapi Refugee Management Information System is a system designed to provide information related to the evacuation process in emergencies or disaster situations. The main purpose of this system is to assist and ensure safety and efficiency in the evacuation process. This system can include various elements, such as emergency monitoring, early warning, evacuation plans, evacuation routes, barracks capacity, rescue team coordination, and the latest information for the affected communities. This system is used to optimize the evacuation process of residents when Mount Merapi erupts. By utilizing communication technology, this system provides real-time information on volcanic activity developments, determines evacuation zones in the Merapi disaster area, and provides guidance and notifications to communities around Mount Merapi through various communication channels. The integration of geospatial data and mapping enables the identification of the best evacuation routes, while a user-friendly interface facilitates access and interaction for users. This system is expected to improve evacuation efficiency, minimize risks, and enhance the safety of communities in areas affected by Mount Merapi disasters. The Evacuation Information System is expected to improve coordination, rapid response, and community safety in dealing with emergency situations.

Keywords: *Information System, Evacuation, Disaster, Merapi, Prototyping.*

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INTRODUCTION

Indonesia is one of the countries with the highest risk of natural disasters in the world because it is located on the Pacific Ring of Fire (Nur Rahmawati & Triyono, 2025). Mount Merapi, one of the most active volcanoes in Indonesia, erupts periodically, directly impacting the safety and lives of the surrounding community. One of the major challenges during an eruption is how to manage refugee data and disaster information quickly, accurately, and in an organized manner.

The rapid growth of digital technologies in Indonesia presents opportunities to enhance disaster mitigation efforts. Information systems can support emergency reporting, monitor volcanic activity, identify evacuation points, and manage refugee data in real time (Sugiarto & Syech Abu Bakar, 2023). Prior research demonstrates that interactive and

user-centered disaster information systems can strengthen community preparedness and expedite decision-making by local authorities (Fardiah et al., 2023). Nevertheless, many existing systems remain inadequate because they are not developed through iterative and user-focused methodologies.

To address these limitations, this study adopts the prototyping model, which facilitates continuous refinement of system features based on user feedback (Aziz, 2024). This approach is particularly relevant in dynamic emergency contexts such as Merapi eruptions where system requirements may evolve rapidly.

Accordingly, this research aims to design and develop an Android-based refugee management information system for the Mount Merapi disaster area using the prototyping model. The system seeks to improve real-time coordination, enhance the accuracy of refugee data, and strengthen communication between disaster response teams and affected communities. It is expected to provide BPBD, SAR units, and residents with timely access to evacuation routes, shelter information, and emergency reporting services.

METHOD

The system development method used in this study is prototyping, an iterative approach in software engineering that focuses on building initial models (prototypes) which are continuously evaluated and refined based on user feedback until the final system is produced (Siswidiyanto et al., 2020). This method is particularly suitable when user requirements are not yet fully documented or remain dynamic during the development process, while also reinforcing user-centered involvement—an essential aspect for public service-based systems, especially in emergency contexts such as disaster refugee management.

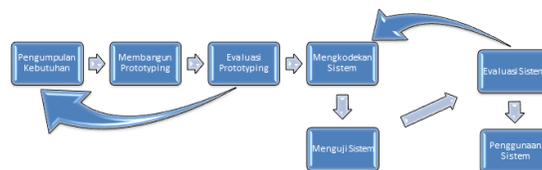


Figure 1. Process model adapted from Prototyping.

The prototyping model consists of several stages, beginning with requirements gathering to identify system needs through observation, documentation, or stakeholder discussions, resulting in a list of initial requirements. Next, a prototype is developed to represent the system's initial workflow and interface, functioning as a communication tool between developers and users to visualize the intended features, after which evaluation and revisions are conducted based on user feedback. (Jason et al., 2020) Once the prototype is approved conceptually, full system development is carried out through coding using the Flutter programming language. Flutter was used as the main framework for application development because it allows efficient development using a single codebase while

maintaining good performance on Android devices. This framework also simplifies interface design and ensures consistency across different device specifications. Firebase was selected as the database system since it supports real-time data updates and flexible data structures, which are important for managing dynamic information such as emergency reports and refugee data during disaster situations. The completed system is then tested using the black-box method to ensure all functionalities work properly. Finally, a user evaluation is performed, and if the system meets the success criteria, it is approved for full deployment and use by users and administrators in the field (Adi Kurniyanti & Murdiani, 2022).

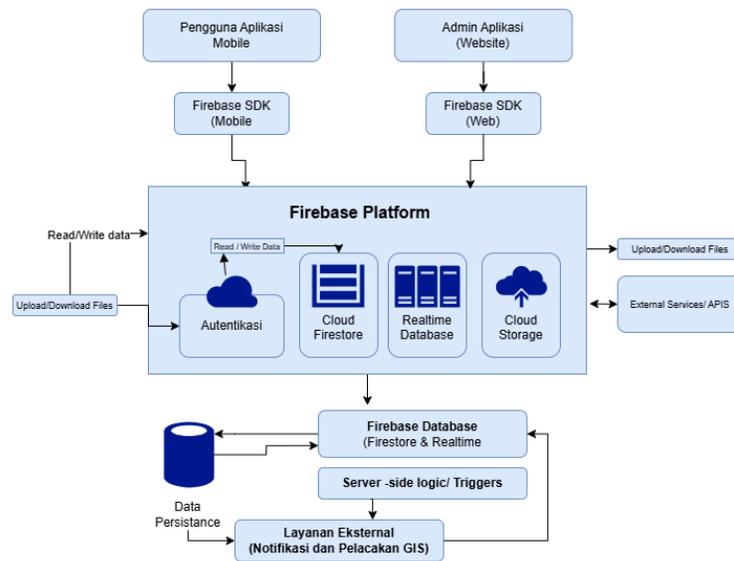


Figure 2. User, Admin and Firebase System Architecture diagram

The data collection method used in this research is quantitative and carried out directly through field observations and interviews with relevant parties. Field observations were conducted in the Mount Merapi disaster-prone area (KRB) in Wonokerto Village. A total of 6 SAR personnel and 8 community representatives were interviewed to gather system requirement data. Interviews explored current communication barriers, availability of evacuation information, and common challenges experienced during eruptions. Based on (Astari et al., 2022) and BPBD data, the Mount Merapi disaster-prone area is divided into three zones: KRB Zone III (red), which is the most hazardous and directly threatened by pyroclastic flows and lava avalanches; KRB Zone II (yellow), which has a medium level of risk; and KRB Zone I (green), which is exposed to secondary hazards such as lahar floods. Wonokerto is categorized within KRB Zone II.

To obtain more informative and practical insights, interviews were conducted with disaster management personnel, particularly members of the Wonokerto SAR Team, to understand the level of preparedness during an eruption. The combination of observations and interviews revealed two major findings: first, residents experienced communication

barriers and difficulty accessing real-time information when contacting BPBD and SAR personnel. Second, there remains a significant information gap between the SAR Team and the community, particularly in relation to real-time updates on Merapi’s activity status, evacuation routes, and the nearest evacuation shelters. Ethical aspects were considered during the development of the system, particularly in relation to the management of personal and emergency-related data. Information such as user identity, location, and incident reports is only accessible to authorized administrators. The system was designed to limit data access and prevent misuse, ensuring that collected information is used solely for disaster response purposes. Most of this information is still concentrated among SAR personnel and has not been systematically distributed to the public.

FINDING AND DISCUSSION

RESEARCH RESULT

This study includes a system requirements analysis consisting of software and hardware needs. The software requirements involve the use of Visual Studio Code as the IDE and coding editor, Flutter as the framework for mobile application development, and Firebase as the NoSQL database, as shown in Table 1. In addition, the hardware requirements emphasize the use of an Acer P214 laptop with an Intel i5 11th-generation processor, 256 GB SSD, and an Android device (Redmi 10 2022) as the testing platform for the system (Yasyfiya & Sutarman, 2025).

Table 1: Software

NO	Software	Requirement
1.	Visual Studio Code	IDE and Coding Editor
2	Flutter	Mobile Application Framework
3	Firebase Database	NoSQL Database Management

In coding the system by designing the User Interface for the Mount Merapi Refugee Management Information System, it was designed to be easily accessible to the public and to prioritize compatibility and ease of use for users to obtain accurate and fast information. The design process page is presented as follows.

This research applies UML (Unified Modeling Language) as the basis for designing the system. The Use Case Diagram is utilized to visualize the interactions between actors and the system. (Rizdqi Akbar Ramadhan et al., 2022) There are two actors involved, namely Admin and User.

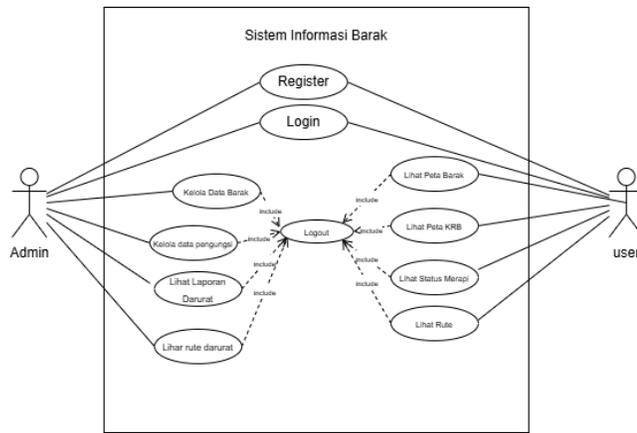


Figure 3: Use Case Diagram

The admin has access rights to register, log in, manage shelter data, manage refugee data, view and edit emergency reports, and manage evacuation routes. Meanwhile, the User can access information on shelters, view the disaster-prone area (KRB) map, check Merapi status, and view evacuation routes. All actor activities are connected to the logout feature. The Use Case Diagram of the refugee management information system is presented in Figure 2.

Table 2. Core System Features

NO	Actor	Feature	Description	Results
1.	User	Login and Register	Submit Account for the Application	

2	User	Emergency Report	Submit incident type, location, photo, and description	
3	User	Evacuation Route	Display real-time route to nearest shelter	
4	User	KRB Map	Visualize disaster-prone zones	
5	Admin	Shelter Management	Add and update shelter data and capacity	

6	Admin	Admin Page	Manage and coordinate all important data and information during the disaster management process	
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DISCUSSION

During the system testing phase, an evaluation was conducted using the Blackbox method, which aims to ensure that each Blackbox Test tests the main features of the Android-based Mount Merapi Refugee Management Information System application without regard to internal code. This testing helps to ensure that the application works according to user expectations (Persada & Anggara, 2024).

This method is used to test the reliability and stability of the system by testing the application's response to various usage situations performed by users and administrators. The test results illustrate the success or problems of features on different versions of Android.

Table 3: Black Box Test Results

NO	Test Component	Expected Result	Redmi 10	Vivo F9	Samsung S24
1	Register	Register as Admin and register as User	Success	Success	Success
2	Login	Login as Admin into the system, Login as User into the system	Success	Success	Success
3	Dashboard	Display menu for Admin and display menu for User	Success	Success	Success
4	Admin	Add Shelter Data, Add Refugee Data, View Citizen Reports	Success	Success	Success
5	User	View KRB Map, View Merapi Status, View Evacuation Tips	Success	Success	Success

6	SOS	Fill in Report Type, Select Incident Location, Add Description, Send Emergency Report	Success	Success	Success
7	Shelter	Display list of available shelters, list of refugee preparation items, Send report to shelter	Success	Success	Success

When compared with existing disaster information services provided by local authorities, such as BPBD information portals or centralized command systems, this application offers a more direct and interactive approach. Users are not only passive recipients of information but can actively submit emergency reports and access evacuation routes based on their current location. This interactive capability reflects the advantage of applying a prototyping method, where system features were adjusted according to user needs identified during field observation and interviews

Nevertheless, several limitations remain in the current version of the system. The application has not yet been connected to real-time seismic or weather monitoring data, so early warnings still depend on manual updates. In addition, continuous internet access is required for optimal performance, which may become a constraint during severe disaster conditions. These limitations indicate the need for further system enhancement in future research.

From an implementation perspective, the system has the potential to support disaster management coordination at the local level. If integrated with official disaster management platforms, the application could assist government agencies in managing refugee data more systematically and improving information flow between responders and the community during emergency situations.

CONCLUSION

This research resulted in the development of an Android-based information system designed to support refugee management during Mount Merapi eruptions. Using the prototyping method, the system was developed through iterative refinement and user involvement, ensuring that its features align with actual needs in the field.

The system provides essential functions such as emergency reporting, access to evacuation routes, shelter information, and disaster-prone area mapping. Based on functional testing and user feedback, the application can help improve access to critical information and facilitate communication between the community and disaster response teams during emergency situations.

Although the system has shown positive results, further development is still required. Future work may include the integration of real-time disaster monitoring data,

offline functionality, and a web-based dashboard to support broader coordination among disaster management stakeholders.

REFERENCES

- Adi Kurniyanti, V., & Murdiani, D. (2022). Perbandingan Model Waterfall Dengan Prototype Pada Pengembangan System Informasi Berbasis Web. *Jurnal Fusion*, 2(08), 631–637.
- Astari, D., Banggur, W. F., Santi, N., & Najib, N. (2022). Pemetaan Zona Bahaya Aliran Piroklastik Gunung Merapi, Jawa Tengah dan Sekitarnya menggunakan Aplikasi Titan2D. *Jurnal Geosains Dan Teknologi*, 5(1), 76–82. <https://doi.org/10.14710/jgt.5.1.2022.76-82>
- Aziz, F. (2024). Implementasi Rad Method Pada Aplikasi Penyewaan Lapangan Futsal Berbasis Delphi Dan Firebird Database. *Advances in Computer System Innovation Journal*, 2(1), 11–20. <https://doi.org/10.51577/acsijournal.v2i1.501>
- Fardiah, D., Darmawan, F., Rinawati, R., Supaat, V. E. M., & Abdullah, S. I. (2023). JCC sebagai Komunikasi Digital Terpadu Informasi Kebencanaan di Jawa Barat. *Jurnal Komunikasi*, 18(1), 52–73. <https://doi.org/10.20885/komunikasi.vol18.iss1.art4>
- Jason, W., Budiman, E., Setyadi, H. J., Taruk, M., Bambang, M., & Prafanto, A. (2020). Integrasi Location Based Service Informasi Bencana Alam Kota Samarinda. *Jurnal Rekayasa Teknologi Informasi (JURTI)*, 4(2), 182.
- Nur Rahmawati, L., & Triyono. (2025). Dinamika Trauma Psikologis Pada Remaja Penyintas Erupsi Gunung Merapi. *PAEDAGOGY: Jurnal Ilmu Pendidikan Dan Psikologi*, 5(1), 1–23.
- Persada, A., & Anggara, A. (2024). Aplikasi Sistem Informasi Posyandu Pada Desa Plumbun, Indramayu Berbasis Android. *INFOMATEK: Jurnal Informatika, Manajemen Dan Teknologi*, 26(2), 183–192. <https://doi.org/10.23969/infomatek.v26i2.19009>
- Rizdqi Akbar Ramadhan, Abdul Kudus Zaini, & Bima Kristian Pranoto. (2022). Edukasi Pemrograman WEB Fundamental Sebagai Ilmu Wajib Era Industri 4.0. *Jurnal Pengabdian Masyarakat Dan Penerapan Ilmu Pengetahuan*, 3(1), 11–15. <https://doi.org/10.25299/jpmpip.2022.10591>
- Siswidiyanto, S., Munif, A., Wijayanti, D., & Haryadi, E. (2020). Sistem Informasi Penyewaan Rumah Kontrakan Berbasis Web Dengan Menggunakan Metode Prototype. *Jurnal Interkom: Jurnal Publikasi Ilmiah Bidang Teknologi Informasi Dan Komunikasi*, 15(1), 18–25. <https://doi.org/10.35969/interkom.v15i1.64>
- Sugiarto, & Syech Abu Bakar, N. P. (2023). Kepuasan Pelanggan terhadap Aplikasi Over The Top (OTT): Studi pada Vision+. *CoverAge: Journal of Strategic Communication*, 14(1), 50–62. <https://doi.org/10.35814/coverage.v14i1.5331>
- Yasyfiya, R. A., & Sutarman. (2025). SISTEM PEMESANAN DAN PENCARIAN FOOD COURT BERDASARKAN LOKASI PENGGUNA BERBASIS ANDROID. *Jurnal Informatika, Manajemen Dan Teknologi*, 26(November 2024), 203–216. <https://doi.org/10.23969/infomatek.v26i2.19139>