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Integrated Community-Based Disaster Response Information System: A Case Study of the Subang Regency BPBD

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ABSTRACT

Subang Regency is an area highly prone to natural disasters such as floods, landslides, and strong winds. In emergency situations, the absence of an efficient and integrated reporting system greatly hinders Badan Penanggulangan Bencana Daerah (BPBD) in carrying out rapid responses, evacuations, and aid distribution. If not addressed promptly, public safety and the effectiveness of disaster management will remain at risk. Therefore, a disaster mitigation application system is needed that allows the community to quickly report disasters through photos, videos, and descriptions directly integrated with the BPBD dashboard. This application is equipped with multi-channel notifications via WhatsApp, SMS Gateway, and alarms, as well as an AI-based heatmap analytics system to predict potential disasters using historical data and weather information from BMKG. In addition, BPBD administrators can verify disaster reports by checking personal biodata linked to the reporter's account. The system development method applied is Agile Development, which includes observation, planning, design, development, testing, and deployment, enabling intensive collaboration and rapid system iterations based on field feedback. With this system, BPBD Subang is expected to be more responsive and resilient in facing disasters.

INTRODUCTION

Subang Regency is classified as a high-risk area for natural disasters such as floods, landslides, earthquakes, and tornadoes. Several incidents highlight its vulnerability, including the landslide in Kampung Cipondok (January 7, 2024), which claimed one life and forced 300 residents to evacuate, as well as the landslide in Cibalandogjaya Village (March 3, 2024), which damaged five houses. (COSTA, 2024). The tidal flood on January 10, 2025, in Legon Kulon and Sukasari affected more than 6,000 people, submerged nearly 2,000 houses, and damaged public facilities. (Nurdin, 2025). This risk is reinforced by Indonesia's position at the convergence of three major tectonic plates, as well as Subang's dynamic geographical and climatic conditions. (Farhan, 2021)(Bencana, 2022). The presence of the Cipunagara and Ciasem Rivers, which frequently overflow, also increases the potential for disasters, making Subang one of the vulnerable areas according to data from Badan Nasional Penanggulangan Bencana (BNPB)(Farhan, 2021). The number of disasters increased from 29 incidents in 2019 to 32 in 2020, with floods being the most dominant. In 2021, flooding in Pamanukan District affected 31,767 people, forced 29,716 residents to evacuate, claimed one life, and submerged nearly 10,000 houses and public facilities. (Lesmanawati & Fardani, 2022). In early 2025, a total of 97 disaster incidents were recorded within just the first three months. The main causes include uncontrolled urbanization, poor drainage, and land-use conversion. Community preparedness remains low, as reflected in the severe impacts of each incident. Therefore, disaster mitigation education, including enhancing disaster risk awareness among members of Saka SAR Subang, is a crucial step. (Priantoro et al., 2024).

Fig 1. Distribution of Disaster Incidents in Subang Regency in 2025

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A research team consisting of three lecturers and four students conducted observations and interviews with BPBD Subang and found that the current SIKILAT Bencana application still has many limitations, such as inefficient data reporting, manual data recaps, low community participation, frequent notification failures, lack of user verification, and the absence of integrated features for the entire disaster management cycle. These issues hinder BPBD's rapid and coordinated response during emergencies.(Hidayat & Rianti, 2024).

Therefore, it is necessary to develop an application that is more responsive, efficient, integrated, capable of verifying reports, and easy for the community to use. Without a reliable and integrated information system, BPBD will struggle to respond to disasters effectively, which could increase the number of casualties and losses.(Emiliawat, 2025). Thus, the development of an efficient, accurate, and easily accessible disaster mitigation system is urgently needed to enhance preparedness and the effectiveness of disaster management in Subang. Addressing this challenge, the SIGANAS MADU application emerges as a transformative solution (Khasanah Izhar, 2023). This system features rapid reporting through photos and short videos, automatic data recaps, AI-based predictive analysis with real-time data from BMKG, intelligent multi-channel notifications, and real-time disaster reporting and verification. The novelty of this research proposal lies in its sustainable ecosystem approach, the use of AI for prediction and personalized notifications, report verification, preparedness education and outreach, as well as an interface accessible to all groups. More than just an application, SIGANAS MADU aims to transform disaster management in Subang into a smarter, faster, more accurate, participatory, and sustainable system.

LITERATURE REVIEW

According to historical records, West Java is a region frequently affected by natural disasters such as floods and landslides. Over the past ten years, a total of 1,936 incidents have been recorded. (Asiva Noor Rachmayani, 2022). Specifically in Subang Regency, in 2017 alone there were 192 disaster events, including floods, landslides, tornadoes, fallen trees, and fires. (BNPB, 2023a). Geographically, Subang Regency is divided into three regions: the southern, central, and northern areas. The southern region is dominated by mountains and highlands, the central region consists of plains, while the northern region is a lowland area directly bordering the Java Sea (Pemerintah Daerah Kabupaten Subang, 2023). The southern region is largely utilized for state-owned and community plantations, forest areas, and tourist destinations. Meanwhile, the central region has developed into an agricultural area with rubber, sugarcane, and fruit plantations, as well as an industrial zone with various factories, along with residential areas, government centers, and military installations. The northern region, on the other hand, is dominated by irrigated rice fields, fish ponds, and coastal areas. (BNPB, 2023b).

Based on its topographical conditions, approximately 80.80% of Subang Regency's area has a land slope ranging from 0°–17°, while 10.64% falls within a slope of 18°–45°, and the remaining 8.56% has a slope of more than 45° (Soplanit, 2024). Overall, Subang Regency has a tropical climate with an annual rainfall ranging from 3,000–4,000 mm and an average of 100 rainy days per year (BNPB, 2024). This climatic combination, along with fertile soil and numerous river streams, makes most of the land in this region utilized for the agricultural sector (Shera, 2020).

Based on these conditions, serious efforts are required to reduce the broader impacts of disasters through comprehensive and integrated management, so that risks can be minimized and community preparedness can be strengthened (Siregar & Wibowo, 2020). Rinaldi stated that the level of disaster preparedness among Indonesian communities is still relatively low. This is reflected in the high number of casualties and material losses that occur each time a disaster strikes. (Meili & Sembiring, 2025). Preparedness is regarded as a strategic step in disaster management, as it plays a crucial role in determining community resilience. (Supriyati et al., 2024).

METHOD

Fig 2. Ilustrasi Agile Scrum

In developing the system, this research adopts the Agile method, which combines various approaches and practices in software development, emphasizing pressure management, coordination, and speed in the development

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process. This methodology aims to enhance efficiency and improve the team's ability to adapt to changing customer needs (Sopandi et al., 2024). This Agile Scrum method consists of six stages: Requirements, Design, Development, Testing, Deployment, and Review.

Requirements

The initial stage focuses on requirements analysis through interviews with BPBD staff, observation of reporting workflows, and literature studies. The main issues with the current SIKILAT Bencana application used by BPBD are delays in information delivery, minimal verification, and low community participation. The system requirements were then formulated into the proposed business process, which includes photo/video reporting, reporter verification, multi-channel notifications, BMKG integration, heatmap visualization, as well as non-functional aspects such as security and user-friendliness.

Design

The system design covers the Unified Modeling Language (UML) architecture for a mobile application for the community and a web-based dashboard for BPBD, including a Use Case Diagram, Activity Diagram, Sequence Diagram, and Class Diagram. This design serves as a guideline for program implementation and development. (Iqbal et al., 2020).

Development

The program implementation development consists of two parts: a mobile application for the community as disaster reporters, and a web application for BPBD as administrators responsible for managing disaster data and follow-up actions.

Testing

After the development is completed, testing is conducted to ensure that the features function according to requirements and are free from bugs or errors. The testing can be carried out using black-box testing or User Acceptance Testing (UAT).

RESULT

Requirements

a. Interview

The interview process was conducted directly with BPBD, represented by Mr. Ceceng Supriatna, an IT staff member at BPBD. From the interview, it was revealed that the problems faced by BPBD include the ineffectiveness of disaster reporting from the community. According to Mr. Ceceng, one of BPBD's staff members, the main challenges encountered are as follows:

1. The disaster reports from the community do not reach BPBD directly.
2. Disaster handling is not carried out in real time or immediately, as the reporting process is delayed, and in some cases, the reports never reach BPBD.
3. Reports from the community must pass through multiple parties—such as the village office and the subdistrict office—before finally reaching BPBD. This process is clearly ineffective and hinders BPBD's ability to provide a rapid disaster response.

b. Observation

Fig 3. Interview and Observation with BPBD Representatives

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The observation was carried out directly at the BPBD Subang Regency office by monitoring each reporting process conducted by the community. The results showed that BPBD had previously implemented an application called SIKILAT for community-based disaster reporting. However, the application proved ineffective and was not used in the long term due to BPBD's limited budget for its operation. These reporting challenges increased the risk of casualties, as BPBD was not adequately prepared or responsive in addressing emerging natural disaster issues.

Design

This system design includes an analysis of the current business processes and the proposed business processes, both from the perspective of the community as service recipients and BPBD as the service and assistance provider. The mobile application development uses React Native, while the web application development uses Laravel.

a. Current Business Process

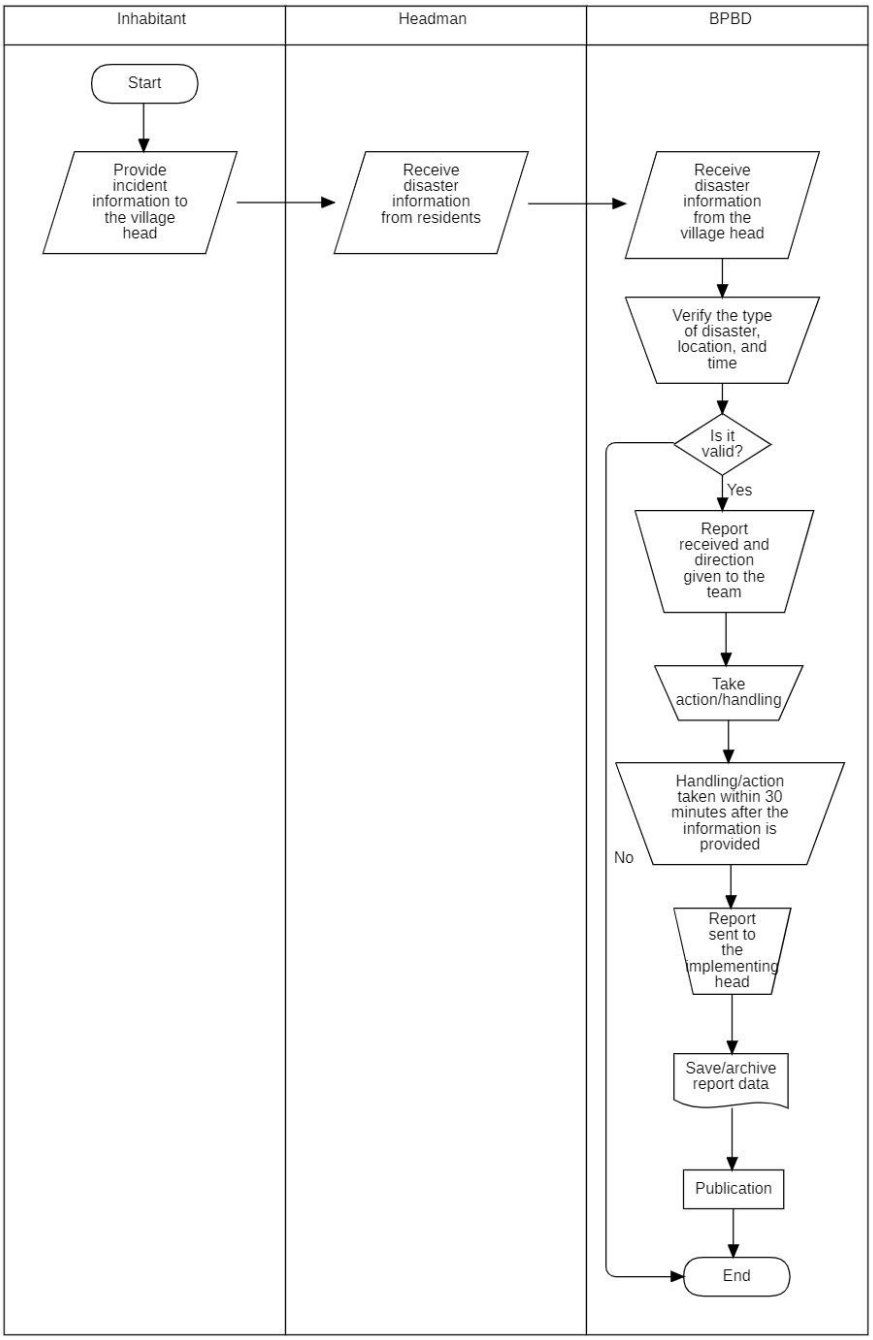

Fig 4. Current Disaster Reporting Business Process

Based on Figure 4, there are three actors involved in disaster reporting: community members, the village head, and BPBD. The community reports disaster events to the village office, which then forwards the information to BPBD.

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BPBD subsequently takes follow-up action to handle the disaster. Once the disaster response is completed, BPBD prepares a reporting archive and issues a publication.

b. Proposed Business Process

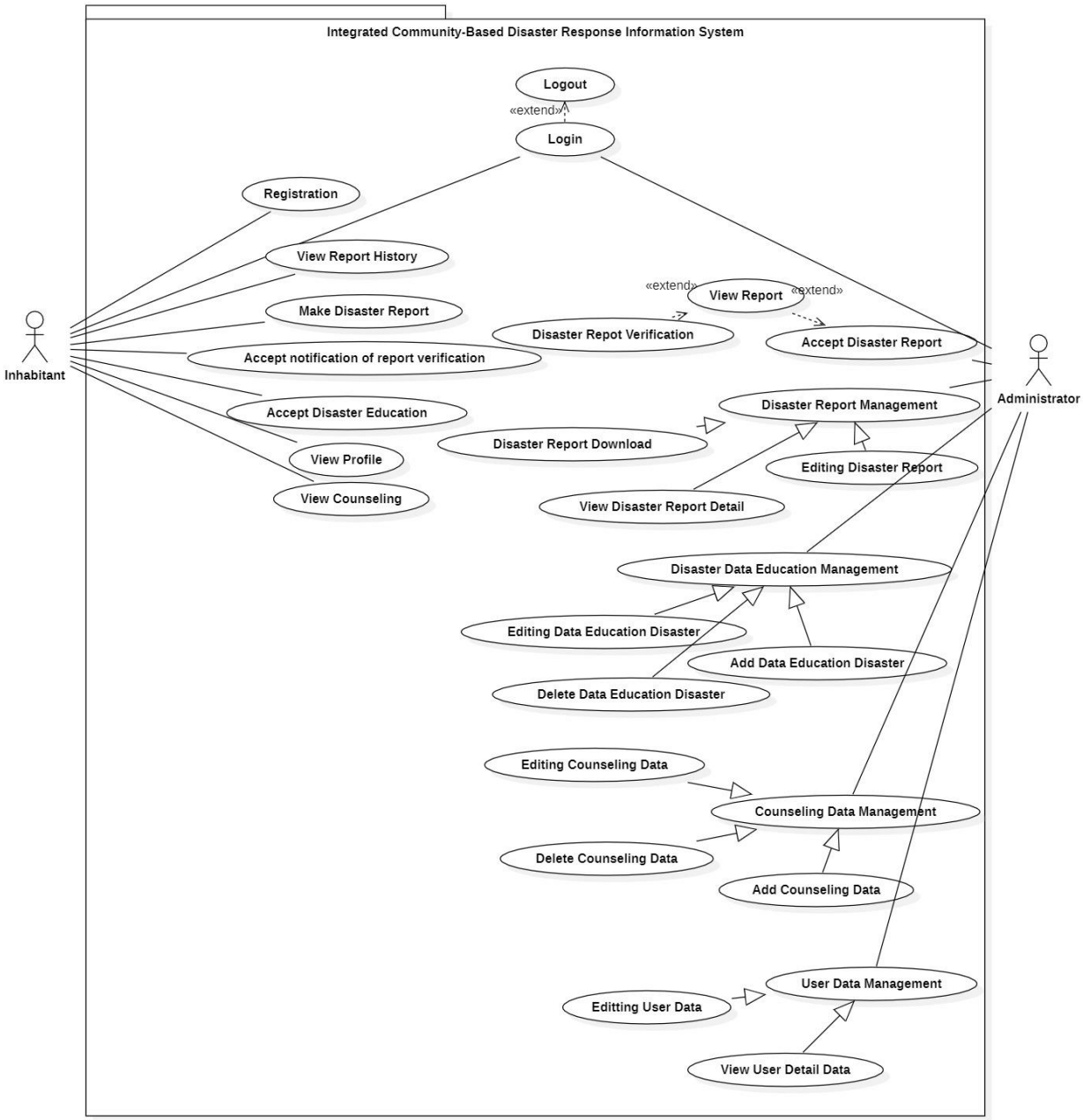

Fig 5. Usecase Diagram

Based on Figure 5, the use case diagram involves two actors: the community and BPBD as the administrator. Several key features are provided in the mobile application for the community as reporters, including a registration feature with verification of ID cards (KTP), family cards, and selfies to ensure that reporters are validated as Subang residents, of sufficient age, and to prevent false or hoax disaster reports. In addition, the mobile application includes a disaster reporting feature with data entries such as the reporter's selfie, disaster photos, disaster videos, disaster descriptions, and automatic geotagging to detect the reporter's location, enabling BPBD to navigate disaster response more effectively to the reported site. Furthermore, the application provides disaster education and outreach information to enhance community knowledge and capacity in disaster prevention and mitigation.

The key features of the BPBD administrator's web application include account verification and validation of community reporters to ensure that all application user data is valid and belongs to Subang residents. In addition, the BPBD real-time dashboard is equipped with a smart heatmap feature to monitor regional conditions and conduct early

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detection as well as prediction of potential disasters in Subang Regency. Other features include smart multi-channel notifications such as alarms, AI-based bot calls, WhatsApp messages, and SMS gateways whenever disaster reports are submitted by the community. Administrators can also manage user data, as well as provide disaster education and outreach. Administrators can also manage user data, as well as provide disaster education and outreach.

DISCUSSION

Implementation

a. Mobile Application Implementation

The following is the interface implementation of the mobile application used by the community.

Fig 6. Login Screen

The login page serves as an entry portal for both resident and administrator accounts. A resident account can only be activated once the resident has completed the registration process.

Fig 7. Registration Screen (Photo, ID Card, Family Card)

Addition to entering personal information, prospective users are also required to upload a selfie photo, an ID card (KTP) photo, and a Family Card photo to facilitate data authentication and verification by the administrator. Once the registration is completed, the prospective user only needs to wait for approval from the BPBD administrator before being able to log in.

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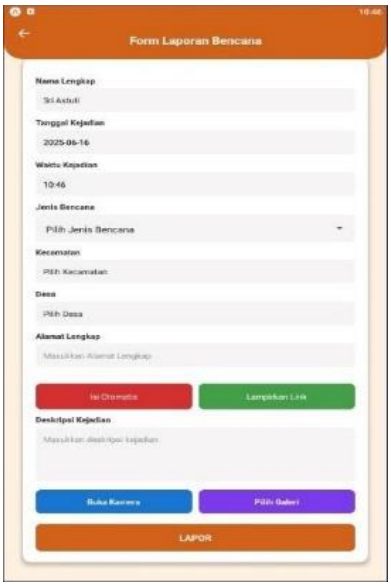
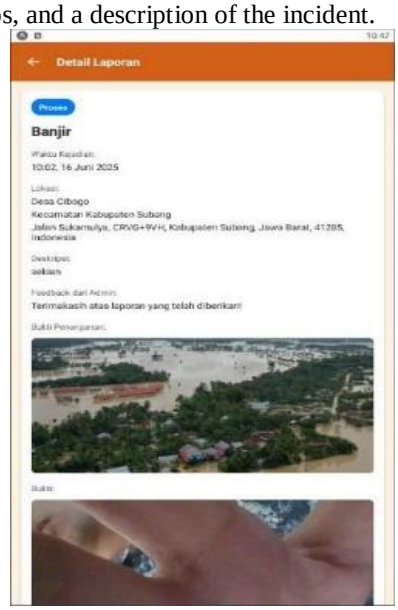


Fig 8. Disaster Report Form Screen

The disaster report form page is used by residents to report disasters in real time. This form includes disaster data, the reporter's location, photos, videos, and a description of the incident.



. Fig 9. Disaster Report Detail Screen

This page displays the detailed results of reports submitted by residents to the BPBD regarding disasters.

b. Website Implementation

The following is the interface implementation of the web application used by BPBD administrators.

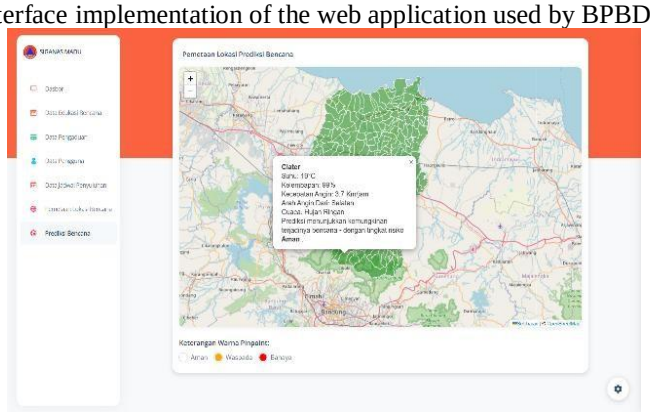


Fig 10. Admin Heatmap Dashboard Screen

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The heatmap page functions to predict disasters in Subang Regency based on several parameters from the BMKG, including air temperature, humidity, wind speed, and rainfall.

Fig 11. Disaster Education Data Screen

The disaster education page provides educational materials designed by the BPBD with the aim of enhancing public knowledge, awareness, and skills in handling, preventing, and evacuating during natural disasters.

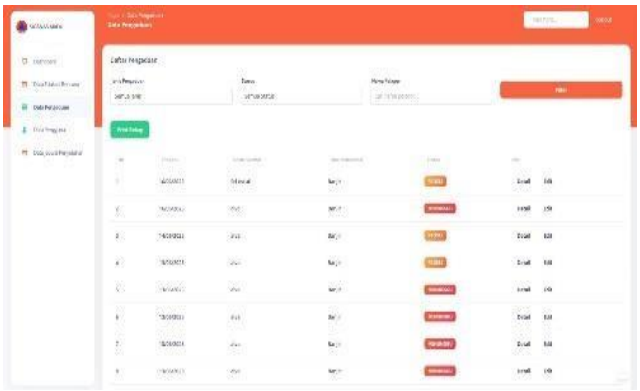

Fig 12. Disaster Report Data Screen

The disaster data report page is a disaster recap page that compiles the history of disasters that have occurred in Subang Regency. This disaster data recap report can serve as a reference for follow-up actions and future BPBD programs, as well as an indicator of disaster-prone areas within Subang Regency

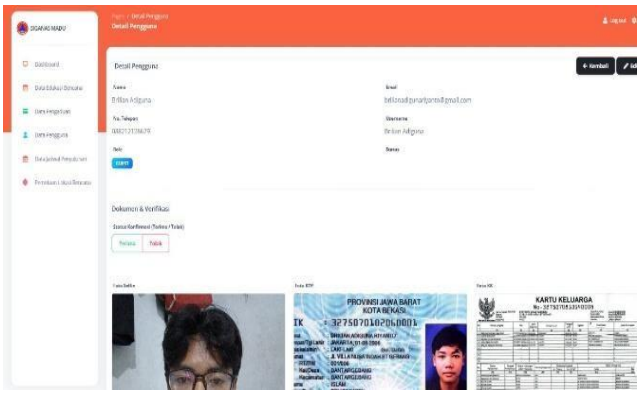

Fig 13. User Data Verification Screen

This page is the user data verification page managed by the BPBD administrator. The BPBD admin can review user registration data such as personal information, ID card (KTP) photo, family card (KK) photo, and a selfie. These details serve as the basis for the admin's consideration in verifying user eligibility, ensuring that registered users in the Siganas Madu application are valid, genuine residents of Subang, of sufficient age, and that their personal data and selfies match the owner of the KTP/KK.

Testing

Black-box testing is a type of functional testing in which the evaluation focuses on the requirements or design specifications of the software being tested. The purpose of this testing is to ensure whether the system operates as

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expected or not. (Iqbal & Haryati, 2022). This black-box testing is focused on two types of users: community users and administrators.

Table 1. Black-Box Testing Results for Community Users

No	Test Description	Expected Results	Valid/Invalid	Score
1	Login with user access	The system displays the user dashboard	√	100
2	Register to create a user account	The user is successfully registered and receives an account	√	100
2	Submit a disaster report	The system provides a notification that the report has been sent	√	100
3	View disaster education information	The system displays various disaster education information	√	100
4	View disaster outreach information	The system displays various disaster outreach information	√	100

Based on Table 1 (Black Box testing) above, it can be concluded that overall, the results of the mobile system functionality tests—covering authentication, complaints, and disaster report recaps for residents—showed excellent performance, achieving a 100% score for each system feature tested.

Table 2. Black-Box Testing Results for Administrators

No	Test Description	Expected Results	Valid/Invalid	Score
1	Login with admin access	The system displays the admin dashboard page	√	100
2	Manage user data	The system displays the admin dashboard page	√	100
3	Manage disaster report data	The system can add, edit, and delete disaster reports from users/community	√	100
4	Manage disaster education information	The system can add, edit, and delete disaster education data	√	100
5	Manage disaster outreach information	The system can add, edit, and delete disaster outreach data	√	100

Based on Table 2 (Black Box testing) above, it can be concluded that overall, the results of the web system functionality tests—covering authentication, user data management, disaster report management, disaster education management, and disaster report recaps for BPBD—showed excellent performance, achieving a 100% score for each system feature tested. This User Acceptance Testing (UAT) was conducted by granting users the ability to provide direct feedback through a questionnaire. (Iqbal & Piarna, 2022) .

Table 3. UAT Testing Result

Statements	Score				Percentage (%)			
	A	B	C	D	A	B	C	D
System Aspects								
1. The heatmap dashboard displaying the disaster status in Subang Regency is easy to understand and use	2				100			
2. The admin interface in the disaster reporting and monitoring management system is easy to use and supports timely disaster response.	2				100			
3. The admin interface in the user, disaster education, and outreach management system is comfortable and easy to use for disaster follow-up actions.	2				100			
4. The user interface in the disaster reporting system is very easy to understand and can be used quickly and effectively.	10				100			
5. The user interface for viewing disaster education and outreach information is very easy to understand, informative, and visually comfortable.	10				100			

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Based on Table 3, the results of the UAT show that the system aspect received an average score of 100%, indicating agreement that the development has a good layout, an attractive user interface, and is visually comfortable. For the user aspect, the score was also 100%, demonstrating that the system is easy to understand and helps users effectively. Regarding the interaction aspect, 100% of respondents agreed that the system is easy to use. This system is recommended for use by BPBD Subang, achieving a 100% score from the UAT conducted with administrators using the provided questions and tested by 2 respondents, as well as from the UAT conducted with users using the provided questions and tested by 10 respondents.

CONCLUSION

This study found that Subang Regency is highly vulnerable to disasters, while the previous reporting application (SIKILAT Bencana) was ineffective in supporting rapid response. As a solution, SIGANAS MADU was developed with features including real-time reporting via photo/video and geotagging, reporter data verification, BMKG integration, multi-channel notifications, and a monitoring dashboard, which have been validated and achieved 100% user satisfaction. The contribution of this research lies in providing a more responsive, accurate, and participatory disaster management information system model based on mobile and web platforms. The implications of the findings indicate that SIGANAS MADU can accelerate the reporting process, increase community participation, and strengthen coordination within BPBD Subang, with potential for replication in other disaster-prone areas. However, this study is limited to the development and functional testing stages with a small number of respondents, so its effectiveness in real disaster situations has not yet been comprehensively tested. Therefore, further research should focus on field implementation trials, integration with IoT technology for early detection, big data-based predictive analysis, and evaluation of its impact on reducing casualties and disaster-related losses.

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