

Barangay Disaster Response Support System (BDRSS) with Fingerprint Identification Technology for Barangay San Antonio

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Abstract: The Philippines is one of the most disaster-prone countries in the world and these disasters offer significant challenges for the country. Barangay San Antonio, Parañaque like most barangays in the Philippines also experience challenges when responding to disasters such as, inefficient information dissemination, poor resource allocation, and difficulties in tracking and identifying victims. To aid Barangay San Antonio the researchers proposed the development of the “Barangay Disaster Support System” with Fingerprint Identification Technology. The system aims to improve disaster response and recovery by providing real time information dissemination, inventory and resource management tools and biometrics-based identification for locating missing persons. In addition to biometric identification there is also the integration of Global Positioning System (GPS) mapping and evacuation routes, SOS emergency alerts and missing persons list. The system seeks to streamline communication, coordination and resource deployment among barangay officials and the residents to improve disaster response efficiently and minimize casualties. Through this initiative, the study aims to showcase the utility of biometric identification in the context of disaster response and aims to set a precedent for smart, community-based disaster resilience strategies. The group used the Scrum Methodology in the development of this project. The results of the UAT conducted by the group shows an overall positive result, with most residents praising the simplicity of the application, while maintaining its functionality. The system was able to streamline communication, coordination and improve the resource deployment in the barangay.

Key Words: Barangay Disaster, Barangay Disaster Response, Barangay Disaster Response Support System, Biometrics

1. INTRODUCTION

The world witnessed an increase in disastrous events across the globe. Thus, a significant problem that challenges nations is natural disaster vulnerability. Natural disaster vulnerability requires effective disaster management and response to lower its impacts, to ensure quick and proper responses, and realize recovery in a short amount of time (Pathirage, et al., 2012) (Wassenhove, 2006).

The Philippines ranks as the most disaster-prone country in the world as of 2023 (World Risk Report, 2023). The country's vulnerability to natural disasters can be attributed to its geographical and geological location in both the Pacific Ring of Fire and typhoon belt. Furthermore, the impact of climate change increased the susceptibility of the country to experience greater frequency and intensity of typhoons, floodings, earthquakes, etc. These disasters can be considered as one of the biggest challenges for the nation to attain its goal on sustainable development and eradicate poverty. The vast damage to agriculture, industrial facilities and infrastructures afflict the government's national budget to allocate its resources to deploy immediate emergency relief to devastated provinces and localities. Consequently, the human and societal impact are evident in the disruption of communities, loss of lives and property and mental trauma.

A comprehensive strategy for managing disaster addresses a shift from reactive role into proactive role in response efforts. In the actual occurrence of disasters, the disaster response phase primarily focuses on rescue of individuals from imminent danger and stabilizing their mental and physical states. This also includes ensuring the proper implementation of disaster preparations such as prompt and efficient issuance of early warnings and immediate evacuation of persons and property from areas that pose a threat (Bello et. al, 2020). As community residents and volunteers are at the front line of disasters, how effectively they carry out disaster preparedness and response activities, with

the support from their local government, significantly influences the outcome of a disaster.

The Philippine government acknowledges the function of barangays in disaster response. As the political unit in the grassroots level, the Barangay Disaster Risk Reduction and Management Committee (BDRRMC) was mandated to implement RA 10121 also known as Philippines Disaster Risk Reduction and Management (DRRM) Act of 2010, which states implementing guidelines and programs within the barangay level mitigating the effects of a disaster (NDRRMC, 2022). Each barangay is required to have their BDRRM Plan which follows the implementing guidelines outlined in National Disaster Risk Reduction and Management Plan: (1) Disaster Prevention and Mitigation; (2) Disaster Preparedness; (3) Disaster Response; and (4) Disaster Rehabilitation and Recovery. (Domingo & Manejar, 2018). This ensures that roles/responsibilities of each barangay members are fully recognized, and programs/activities are aligned to the vulnerabilities and priorities of their locality, allowing problems to be defined correctly and responsive measures to be designed and implemented.

In recent years, technology has emerged as a crucial tool in disaster response, revolutionizing the way emergency services, humanitarian organizations, and governments tackle crises. Actual monitoring of natural disasters is possible through drone technology, radars and satellite imaging technologies (Bhandari, 2022). In line with the RA 10121 the Philippines has also opted to adapt the use of technology such as the implementation of NDRRMC monitoring board, for centralized information repository for disaster related information, and the Project Noah where it provides assessments on the natural hazards to prevent and mitigate disasters. (NDRRMC, 2022) Several initiatives from varying locations such as Japan, have tried to use technology as a way for proper dissemination of information such as J-Alert, for TV, Radio and Mobile Alerts, while also including emails with Emergency Alert Mail.

The objective of the study is to develop a Disaster Response Support System with Fingerprint Identification for Barangay San Antonio to aid the responses of barangay officials during the times of disasters to address critical issues such as poor information dissemination, inefficient resource allocation, and difficult rescue operations. Its scope will focus on the Disaster Response phase of the Barangay Disaster Risk Reduction and Management Plan (BDRRMP). Fingerprint identification technology was used to cater to persons with disability (PWD) and senior citizens and it will be faster to identify the victim especially if injured.

2. METHODOLOGY

The group implemented a Scrum Framework in the development of this project. Scrum is an agile development framework that prioritizes communication and cooperation between team members by establishing a flexible yet committed approach in accomplishing tasks. framework due to their implementation of various decision-making processes done in real-time during the development cycle which helps coordinate communication between team members with different roles.

The development of various features was divided into Sprints, periods of time designated for developing the software. Hron and Obwegeset (2018) discusses this further by discussing the division of Sprints into smaller features called backlogs, which are essential parts of the overall feature or module being developed. Members of the development team must select the backlog, giving each member a sense of freedom in selecting the backlog being developed, and responsibility to accomplish the task given within the agreed upon time frame. Instead of daily standup meetings, the group conducted scheduled meetings every Monday, Wednesday, and Friday to keep track of the development of the project, and allow members for days to focus on the project at their own pace.

Meetings were scheduled through Google Calendar which involves the thesis adviser, the development team, and at times, the Officials of

Barangay San Antonio. This allowed the group to be notified about upcoming meetings. Other tools used were messenger and Zoom. Lastly, the group communicated with the Officials of Barangay San Antonio using Viber as this is the application commonly used by our contact person.

2.1. Scrum Team

The Scrum Team was divided into three key roles: the Scrum Master The leader of the project whose job is to assist the members of the development team when they encounter issues in the development cycle. The Scrum Master for this project is Jan Daniel Lee Ng. The project owner is the member that commonly communicates and coordinates with the residents and officials of Barangay San Antonio throughout the development, usually discussing any progress or points for clarification with the client. Mahalakshmi and Sundarajan (2013) delves into this even further by defining the product owner as the mediator between the customer and the development team who is responsible for identifying key requirements that must be prioritized by the development team. The project owner for this project is Archie Alquiros. The development team members are tasked with programming and creating the software for the client.

2.2. Development Phase

The phases of the Scrum are divided into four (4) distinct phases.

2.2.1. Requirement Analysis

The group gathered information about the needs and the various issues faced by Brgy. San Antonio with their current disaster response process. The group created a list of features that are required in the application being developed. This was done through various interviews with the officials of Barangay San Antonio by asking questions relevant to the development of the BDRSS. This contextualizes the client's needs and allows the

group to gain perspective on various features they may need in the software being developed. This was conducted face to face where data was recorded on the product owners' phone and transcribed on a later date.

2.2.2. Backlog Release

The second phase is the Backlog release where the group created various prototypes of the application which is to be presented to the Barangay Officials. The prototypes of the application were included the features that may be contained in the backlog release for the final output, as well as various features to be developed by the group. The prototypes were presented to the Barangay Officials to confirm if the User Interface and the features found in the application meets their requirements and needs. A backlog represents a part of a sprint activity that must be accomplished within the allotted time that will be discussed by the group. Each development team member chose a feature they will work on once the planning and scheduling of the backlogs are completed.

2.2.3. Sprint Works

The third phase of the development cycle is Sprint Works where the team begun working on the Backlogs selected by each member. This phase focused on the development of all features covered in the BDRSS of Barangay San Antonio. Each member selected a module to work on at an agreed upon time. The development of each module span from 2 to 3 weeks. The group slowly integrated the APIs found in the Design Architecture into the final output using Android Studio, as well as other development applications to create the final output.

2.2.4. Testing Phase

The final phase is the testing phase where the developers begun testing the integrity of the software created and its reception to the Officials of Barangay San Antonio to see if the program matches their needs and solves the features discussed in the Requirement Analysis phase. The group created test cases for each module that represented various situations and ways to use the system to see how the

system reacts to typical or abnormal use of the system. These test cases were given to each user type: (1) Barangay Tanod/Volunteers (2) Residents (3) Barangay Secretary and (4) Barangay Captain. The testing phase was divided into 4 parts: (1) Unit Testing which tested the functionality of each module found in the system to see if it performed the intended purpose for the client's issues; (2) Integration Testing where the developers begun to combine individual modules into their intended pairings to see if each module is compatible with one another; (3) System Testing where the developers combined all modules created to test the functionality and compatibility of every module in the completed project, and if the completed application can accomplish the tasks for each user role, specifically the barangay officials, needs in the application being developed; and lastly, (4) The User Acceptance Testing (UAT) where the developers combined all modules created to test the functionality and compatibility of every module in the completed project, and if the completed application can accomplish the tasks for each user role, specifically the Barangay Officials.

3. RESULTS AND DISCUSSION

Based on the disaster risk reduction management framework, data gathered, and interviews conducted with the barangay, there were numerous encounters wherein the residents did not evacuate on time, left stranded, and are in need of help during a disaster. It has raised several issues and problems for the barangay and has caused poor decision making and rescue operations. The proposed system has three (3) modules, namely: (1) Disaster Preparedness - Information Dissemination and Communication, (2) Disaster Response - Resource Management, Manpower Deployment, and Rescue Response, and (3) Recovery and Rehabilitation - Report Generation. The system allows geocoding a person's current location and the evacuation centers; creates a route to evacuation centers, and has the ability to integrate fingerprint

technology to tag rescued individuals. Refer to Figure 1 for the conceptual framework that includes each module and what problems each module solved and Figure 2 for the key features of the system.

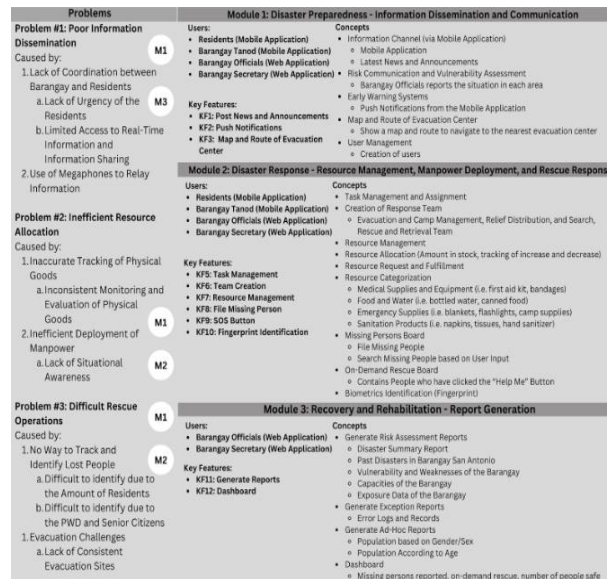


Fig. 1. Conceptual Framework

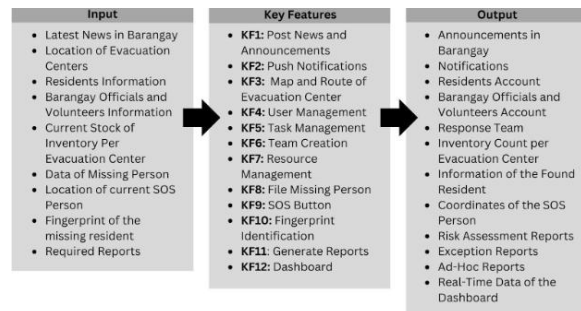


Fig. 2. Key Features

3.1 Disaster Preparedness - Information Dissemination and Communication

The system provides real-time news and announcements created by the barangay and also sends a push notification to the mobile application. It also provides a map and route to the evacuation center for all residents. Refer to Figure 3 for the creation of announcements, Figure 4 for the resident's announcement screen, Figure 5 for the

sample screenshot of a push notification, and Figure 6 for the mapping and routing to evacuation centers.



Fig. 3. Screenshot of Barangay Official Announcement creation page

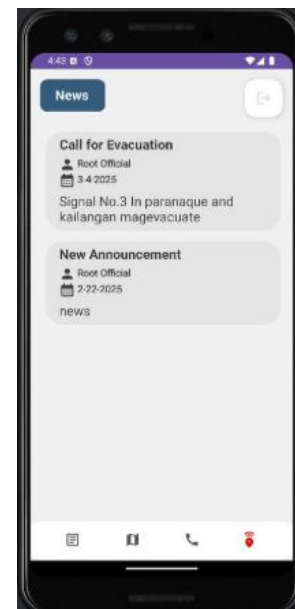


Fig. 4. Screenshot of Resident Announcement Screen

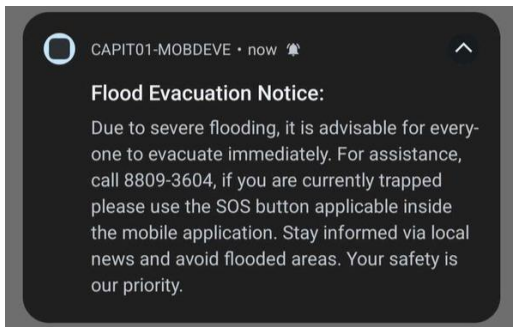


Fig. 5. Screenshot of a sample push notification Announcement

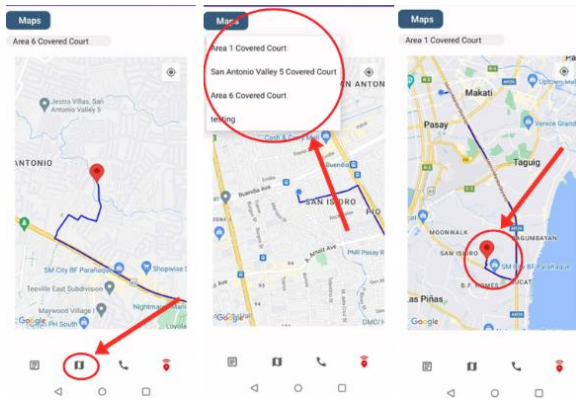


Fig. 6. Screenshot of mapping and routing to Evacuation Centers

3.2 Disaster Response - Resource Management, Manpower Deployment, and Rescue Response

The system can receive SOS requests from residents, and missing person reports from barangay tanod, while also being able to assign teams for different tasks and integrate fingerprint technology to identify rescued individuals. Refer to Figure 7 for the screenshot of the SOS screen, Figure 8 for the screenshot of filing a missing person, Figure 9 for the screenshot of team management page, and Figure 10 for the biometrics identification technology.

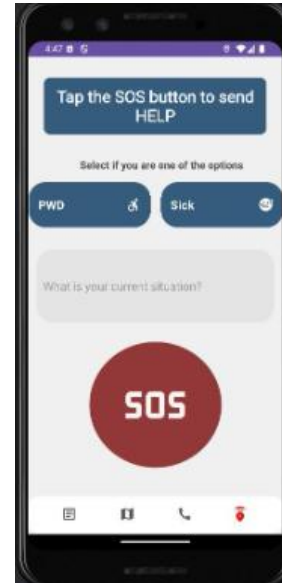


Fig. 7. Screenshot of the SOS screen

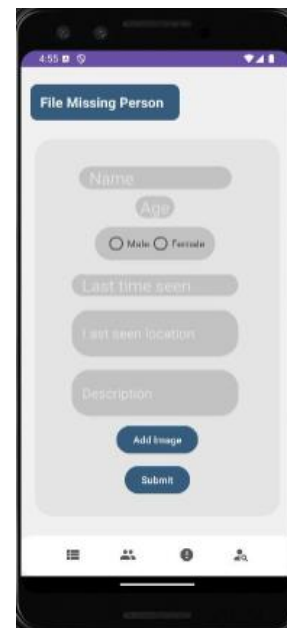


Fig. 8. Screenshot of Filing of Missing Person



Fig. 9. Screenshot of the Team Management Page

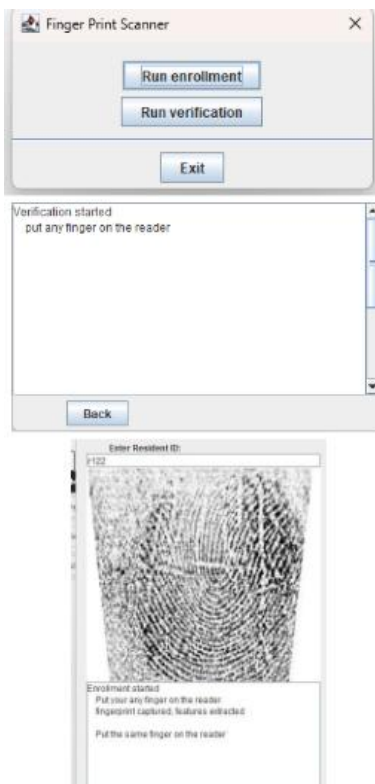


Fig. 10. Screenshot of Fingerprint Identification

3.3 Recovery and Rehabilitation - Report Generation

The system provides downloadable reports as PDF for post-disaster for the barangay to review the events of past to current disasters. The reports are

not limited to disaster reports but also existing proposed reports and evacuee population overview for each evacuation center in the past disasters. These reports provide details, overview, and summary for each disaster which can be used to improve decision making and resource allocation in the future. The downloadable disaster reports are: (1) SOS Cases, (2) Missing Cases, (3) Patrol, (4) Status of Population, (5) Resident Evacuation Transfer, and (6) Incomplete Items. The downloadable existing reports are: (1) Population based on Sex, (2) Population based on Age, and (3) Post Disaster Inventory. Lastly, the Evacuee Profile can be downloaded as a PNG, JPG, or CSV file. Refer to Figure 11 for the screenshot of the Disaster Reports Page, Figure 12 for the screenshot of the Existing Reports Page, and Figure 13 for the screenshot of the Evacuee Population Overview.



Fig. 11. Screenshot of the downloadable Disaster Reports Page

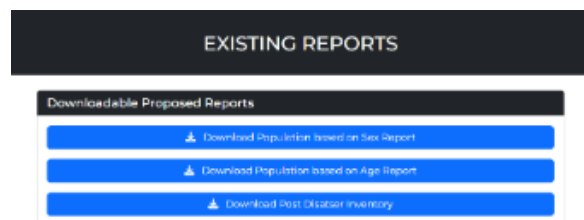


Fig. 12. Screenshot of the downloadable Existing Reports Page



Fig. 13. Screenshot of the Evacuee Population Overview

The results of the UAT conducted by the group shows an overall positive result, with most residents praising the simplicity of the application, while maintaining its functionality. However, the Agree ratings present (4 out of 5 stars) were from residents that found the mobile application took too long to load at times, while some showed confusion with the User Interface of the application. The Agree ratings can be taken into account as a way to improve the overall design and user experience.

The Officials of Barangay San Antonio were also pleased with the output, giving the highest rating (5 out of 5 stars) on all questions in the UAT, with the Barangay Captain Leopoldo Casale stating “We are looking forward to the end result of your project. Job well done!” in his UAT form. This can be taken as a clear indicator that the group meeting the needs of the barangay officials and offering a more centralized and simplified tool that can be used by the officials and the tanods of Barangay San Antonio in preparing and responding to disasters in the community.

4. CONCLUSION

The BDRSS is a transformative tool that empowers Barangay San Antonio to manage disasters more effectively. By leveraging technology to streamline operations, improve coordination, and enhance situational awareness, the system ensures a more prepared and safer community. Moving

forward, the implementation of the BDRSS can serve as a model for other barangays, highlighting the potential of digital solutions in local disaster response efforts. Future improvements could include further automation and broader integration with national disaster response agencies to maximize the system’s impact for the Local Government Unit (LGU).

5. ACKNOWLEDGEMENT

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6. REFERENCES

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