POLYTECHNIC UNIVERSITY OF THE PHILIPPINES

DisasterWatch PH: A Community-Centric

Disaster Monitoring and Reporting Mobile Application

A Thesis

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CHAPTER 1

THE PROBLEM AND ITS SETTING

Introduction

The Philippines is found in the Pacific Ring of Fire and along the typhoon belt, and because of that, the country often experiences natural disasters such as earthquakes, typhoons, floods, and fires. These disasters often result in huge human and economic losses, severely impacting communities and infrastructure. In order to have an effective disaster preparedness and response, real-time, accurate, and localized disaster information is essential. However, the current systems often fail to provide timely and thorough data, which is very important in minimizing the damaging effects of these events (Hallegatte, 2012).

Recent technological advancements have greatly improved disaster monitoring and response capabilities, especially in remote sensing, geo-mapping, and artificial intelligence (Golian et al., 2010; Rathod et al., 2022). In disaster-prone areas like the Philippines, there is still a gap in community engagement and the availability of localized real-time data (Estuar et al., 2021). By offering a community-based platform that allows users to report ongoing disasters—specifically earthquakes, fires, floods, and other related incidents—directly from their mobile devices, DisasterWatchPH seeks to close this gap. To provide real-time disaster information, the app utilizes GPS and geo-mapping technology, which enhances situational awareness and enables better decision-making during emergencies (Perera et al., 2019).

The researchers chose Android as the main platform for the app as it is the most popular mobile operating system used in the Philippines, holding an 80.29% market share in the country (StatCounter, 2024). This guarantees that DisasterWatchPH will be able to reach a large number of audiences, especially those who are in areas that are prone to disasters. In cities like Parañaque, the population is well-equipped to engage with digital platforms, as evidenced by the high literacy rate of 98.9% and the high penetration of mobile phones, according to demographic data from the Philippine Statistics Authority (2024).

DisasterWatchPH also addresses the need for a systematic and reliable approach to reporting. Popular social media sites are most often used by netizens for updates that lack the accuracy and verification that is needed for effective disaster response (UNISDR, 2015). DisasterWatchPH aims to improve disaster resilience in the Philippines by empowering citizens to contribute to disaster monitoring and giving authorities a tool to compile and analyze this data.

Alongside the DisasterWatchPH application, which is tailored for the citizens, there will also be a companion app called the DisasterWatchPH Responders App, which is tailored towards responders. Although this application is designed for the use of the responders, the DisasterWatchPH Responders App will use the same database as the DisasterWatchPH. The DisasterWatchPH Responders App has similar functionalities and design of DisasterWatchPH but serves a different purpose: enabling the effective handling and addressing of disaster reports for the authorized responders. By integrating these two applications, the DisasterWatchPH system will be a solution for community reporting and disaster response. Only registered and confirmed responders will have

access to the DisasterWatchPH Responders App and will not be made available to the public.

Updated Features Addressing Identified Issues:

- **Improved Geo-Mapping:** Integration of Mapbox provides real-time disaster updates, location pinning, and enhanced visualization through marker clustering.
- **Community Engagement:** The community feed with sorting, commenting, upvote, reputation scores, and reporting system features fosters active user participation and accurate reporting.
- **Media Handling and Submission:** Upgraded camera features and media compression ensure reliable and verifiable disaster reports with minimized technical barriers.

DisasterWatchPH utilizes GPS and geo-mapping technologies for real-time situational awareness, significantly enhancing decision-making during emergencies. Alongside, the DisasterWatchPH Responders App streamlines report handling for disaster response teams, enabling effective coordination between the community and authorities.

Theoretical Framework

The Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003) is used as the theoretical foundation for this study in order to understand the factors that affect user acceptance and adoption of DisasterWatchPH and the DisasterWatchPH Responders App. UTAUT offers a thorough lens for analyzing user behavior toward new technologies by combining aspects of several technology acceptance theories. The model identifies four primary constructs that directly influence users' behavioral intention to use technology, ultimately impacting its actual usage:

Performance Expectancy: This reflects the user's belief that using the technology will enhance their performance in achieving desired outcomes. This refers to real-time disaster reporting, exact disaster geolocation, instant access to emergency contact numbers, and prompt notifications for DisasterWatchPH and the DisasterWatchPH Responders App.

Effort Expectancy: This pertains to the perceived ease of use. For DisasterWatchPH, this includes an intuitive user interface, simplified disaster reporting process, and easy navigation. The app's effort expectancy includes real-time tracking of responder's vehicle, ease in handling and managing disaster reports, as well as marking reports as "finished."

Social Influence: This is about the perceived social pressure to use the technology. The support of the local authorities and the community leaders can help DisasterWatchPH develop social impact. The disaster response team can use the DisasterWatchPH Responders App and include it into their official duties.

Facilitating Conditions: This relates to available resources and support for using the technology. For DisasterWatchPH, this includes smartphone accessibility, reliable internet connectivity, and technical support. For the DisasterWatchPH Responders App, facilitating conditions include integration with existing disaster management infrastructure and vehicle tracking systems.

UTAUT acknowledges that user characteristics such as age, experience, and voluntariness of use can moderate the influence of these constructs on technology adoption. In the context of DisasterWatchPH and the DisasterWatchPH Responders App:

- Age may influence the ease of app adoption, with younger users potentially showing higher adoption rates.
- Experience with similar apps or disaster reporting systems may affect effort expectancy.
- Voluntariness may be less relevant in disaster situations, but could affect initial app installation rates.

Figure 1. UTAUT

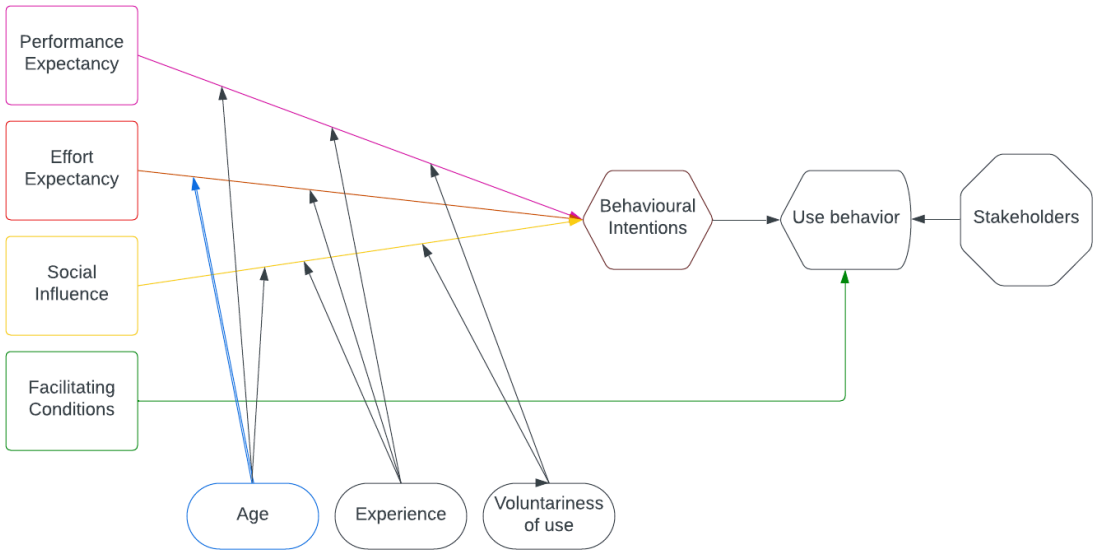


Figure 1 illustrates the Unified Theory of Acceptance and Use of Technology (UTAUT) model, which serves as the theoretical framework for this study. The model depicts the key constructs and their relationships in predicting user acceptance and behavior towards DisasterWatchPH.

By employing UTAUT, this study aims to gain a deeper understanding of the factors driving user adoption of DisasterWatchPH and the DisasterWatchPH Responders App, providing valuable insights for designing and implementing strategies to enhance their acceptance and effective use within the Parañaque City community.

Conceptual Framework

This study utilizes an Agile development methodology, specifically the Scrum framework, as its conceptual framework for developing DisasterWatchPH and the DisasterWatchPH Responders App. This approach emphasizes iterative development, continuous feedback, and close collaboration between developers and users to ensure the apps remain aligned with evolving needs and requirements.

Key components of the Agile Scrum approach for DisasterWatchPH include:

- **Sprint Planning:** Two-week sprints will be used to develop and refine app features. Each sprint will focus on specific user stories derived from the UTAUT constructs.
- **Daily Scrum Meetings:** Brief daily meetings will ensure team alignment and quick resolution of obstacles.
- **Sprint Review and Retrospective**: At the end of each sprint, the team will demonstrate new features to stakeholders and gather feedback. This aligns with the user-centered design principle and supports the iterative improvement of performance expectancy and effort expectancy.
- **Product Backlog:** A prioritized list of features and improvements, informed by UTAUT constructs and user feedback, will guide development.
- **Continuous Integration and Deployment:** Regular integration of new code and frequent deployments will allow for rapid user testing and feedback collection.

Figure 2. Agile Software Development

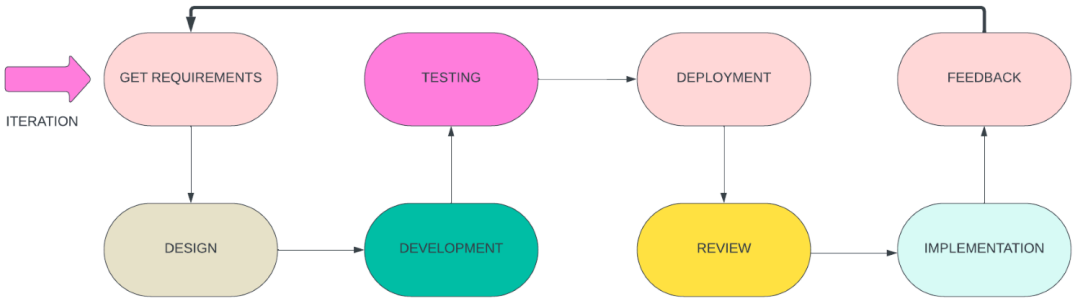


Figure 2 illustrates the Agile Software Development methodology that will be employed in the development of DisasterWatchPH. This iterative approach includes key phases such as requirements gathering, design, development, testing, deployment, review, implementation, and feedback. The circular arrangement emphasizes the continuous, cyclical nature of the development process, allowing for regular refinement and improvement of the application based on user feedback and changing requirements.

By leveraging Agile principles, DisasterWatchPH can be developed in a manner that is responsive to user needs, adaptable to emerging technologies, and capable of swift deployment of critical updates. This approach will result in a more effective, user-centric application that can play a vital role in community-based disaster risk reduction and management. Both DisasterWatchPH and the DisasterWatchPH Responders App will share a similar codebase but will diverge in user roles and permissions. While DisasterWatchPH focuses on community reporting, the DisasterWatchPH Responders App enables response teams to track reports and manage their status in real time.

Statement of the Problem

This study addresses several critical issues related to disaster management in the Philippines, which have been highlighted by both existing research and practical experiences:

1. **Insufficient Real-Time Disaster Information**: Current disaster monitoring systems in the Philippines often suffer from delays in information dissemination, which can significantly hinder timely response and decision-making (Hallegatte, 2012). DisasterWatchPH aims to provide real-time updates on disasters, leveraging community input and GPS technology to deliver accurate and immediate information.

2. **Limited Community Engagement in Disaster Reporting**: Traditional disaster reporting mechanisms primarily rely on official channels, which may not always capture the localized impacts of a disaster (Estuar et al., 2021). This limitation can lead to gaps in the data available to authorities and the public. DisasterWatchPH seeks to address this by enabling community members to directly report disasters, thereby increasing the scope and accuracy of disaster data.

3. **Challenges in Identifying Nearby Disasters**: People often have trouble in figuring out how close and relevant the ongoing disasters are to their current location, especially in densely populated areas or rural areas (Krzhizhanovskaya et al., 2011). DisasterWatchPH's geo-map function can help the users in making better decisions in emergency circumstances by providing a clear and up-to-date visual representation of the reported disasters in the nearby areas.

4. **Inadequate Access to Emergency Services**: Timely access to emergency services during a disaster is crucial. However, locating the appropriate emergency contacts can be hard or challenging, especially for those that are in unfamiliar or remote areas (UNISDR, 2015). DisasterWatchPH allows users to have immediate access to emergency contact numbers, allowing for a quicker response and potentially saving lives.

5. **Issues with User Authentication and Report Verification**: To ensure authenticity, DisasterWatchPH requires users to upload a valid ID and complete facial verification during sign-up, while the DisasterWatchPH Responders App requires responders to submit a valid ID and facial verification during registration and a one-time manual account verification after registration. Ensuring the authenticity of disaster reports is essential to maintaining the integrity of disaster response efforts. Many systems currently in place do not adequately address the verification of user-submitted data (Perera et al., 2019). DisasterWatchPH incorporates a robust user authentication process, including valid ID submission, facial verification, email verification, and one-time manual account verification (for new emergency responders accounts only), to ensure that reports are credible and that users' data is secure.

By addressing these problems, this study aims to develop and evaluate the effectiveness of DisasterWatchPH in enhancing disaster preparedness, response, and community resilience in the Philippines.

Scope and Limitations of the Study

This study aims to develop and implement a comprehensive, community-centric disaster monitoring and reporting application for the Disaster Risk Reduction and Management Office (DRRMO) of Parañaque City, Philippines. The project includes the development of two complementary applications: **DisasterWatchPH** for community users and **DisasterWatchPH Responders App** for disaster response teams. These applications aim to streamline disaster reporting, enhance responder accountability, and improve community safety and disaster preparedness.

Scope of the Study

1. DisasterWatchPH (Main App)

- **Disaster Reporting:**

  Users can report disasters categorized as **Earthquakes**, **Fires**, **Floods**, and **Others**. The reporting feature supports two modes:

  - Reporting for the user's current location (auto-detected via GPS) or for another location (manual pinning on the map).
  - Reports must include evidence in the form of photos or videos (supporting up to 45 seconds of media). Media is automatically compressed and removed from the user's device after submission to conserve storage space and prevent misuse.
  - Reports are time-sensitive, with unaddressed reports archived after 8 hours.

- **Community Feed:**
    - Displays a feed of all moderator-approved disaster reports (To prevent sensitive images from being displayed), enabling community members to view, comment on, and interact with reports by upvoting or reporting misleading reports.
    - Reports can be filtered by disaster type (Fire, Flood, Earthquake, and Others) and status (Active, Resolved).
    - Pagination ensures efficient navigation across numerous reports.
- **Geo-Mapping:**
    - An interactive map displays disaster locations in real time. Users can toggle disaster types and filter markers to show active incidents.
    - A legend is available to guide users in identifying markers by disaster type and status.
    - Users receive automatic notifications if they enter a disaster zone, enhancing personal safety.
- **Notifications:**
    - The app sends alerts for disasters within 1 kilometer of the user's current location.
    - Unique notification sounds are implemented to indicate when responders are en route to the user's pinned disaster location.
- **Weather Integration:**
    - The app provides localized, real-time weather updates to enhance preparedness for potential disasters.

- **Emergency Services Integration:**
    - This app displays contact numbers for emergency services.
    - ThIs enables users to directly call emergency numbers through the app's interface.
- **User Authentication and Verification:**
    - Users must sign up with personal details (First Name, Last Name, Email, Contact Number, Address, Password).
    - Account verification includes email validation, ID upload, and facial verification during sign-up. Email addresses cannot be changed after verification to prevent identity misuse.
    - Profiles can be edited, with strict validation for mandatory fields such as contact numbers (must start with "09" and have 11 digits).
- **Security and Data Privacy:**
    - User data is encrypted during storage and transmission to ensure compliance with data protection standards.

2. DisasterWatchPH Responders App

- **Restricted Access:**
    - The app is exclusive to verified disaster response teams. Responders must upload their valid ID and complete facial verification during sign-up and a one-time manual account verification after sign-up for authentication and accountability.

- **Disaster Response Management:**
    - Responders can:
        - View reports submitted by community users and respond to them.
        - Track their vehicle in real time while responding to a disaster.
        - Update the status of a report (e.g., "Fire Out," "Severity Increased").
        - Request reinforcements, notifying other responders during high-severity incidents.
        - Cancel a response if needed without marking the report as completed.
- **Enhanced Features:**
    - Notifications for responders entering a disaster zone.
    - Export functionality for detailed report history and archived versions. Exported reports include incremental updates with all associated changes and details.
    - Improved marker updates and streamlined user interface for efficiency.

- **Clustering and Pagination:**
    - Markers on the map are clustered for better visibility and navigation. Pagination allows responders to efficiently manage a large number of reports.

Limitations of the Study

1. **Disaster Types:**
    - The application supports reporting of **Earthquakes**, **Fires**, **Floods**, and **Others**.
2. **GPS and Location Accuracy:**
    - Location accuracy is dependent on the user's device GPS capabilities, which may vary due to signal strength, hardware limitations, or environmental factors.
3. **Notification Radius:**
    - Notifications are limited to disasters within a predefined 1 kilometer radius, potentially excluding some relevant nearby events.
4. **Platform Availability:**
    - The application is exclusively available for Android devices with GPS capabilities. Compatibility with other operating systems is not supported.
5. **Media Constraints:**
    - Videos are limited to 45 seconds.
6. **Responders App Accessibility:**
    - The Responders App is not publicly available and is limited to authenticated members of the disaster response teams.

The DisasterWatchPH application aligns with the ISO 25010 by effectively addressing the specific needs of the Disaster Risk Reduction and Management Office (DRRMO).

1. **Functional Suitability** – By focusing on reporting Earthquakes, Fires, Floods, and other related incidents ensuring relevant and reliable functionality.
2. **Interaction Capability** – Provides a user-friendly experience with simplified and intuitive interface, GPS-based location pinning, and streamlined disaster reporting options.
3. **Security** – User authentication is secured through the user of email or phone login with the utilization of an OTP verification during account creation process. In addition, user data is encrypted before storing it into the database.
4. **Compatibility** - The application is compatible with GPS-enabled android mobile devices, ensuring accurate location-based services.
5. **Maintainability** - The focused scope on specific disaster types supports easier maintenance and allows for future updates and expansions.

Significance of the Study

The development of the DisasterWatchPH, community-based disaster monitoring and reporting application, is essential for many individuals. The importance of this study is emphasized by the following:

Residents in Disaster-Prone Areas. These people will benefit from the app's real-time notifications about nearby disasters, such as earthquakes, fires, and floods, allowing them to take immediate action to protect themselves. DisasterWatchPH also provides direct and quick access to emergency hotlines, allowing the users to have fast communication with the local emergency services.

Commuters and Travelers. DisasterWatchPH will help commuters and travelers by giving real-time disaster updates, which helps the commuters plan safer routes and avoid areas that are affected by a disaster. This reduces the risk of getting stranded or caught in dangerous situations. The notifications feature also keeps the users informed and updated about new or ongoing disasters, allowing them to make decisions that can ensure their safety while traveling.

Local Government Units (LGUs). DisasterWatchPH can help the Local Government Units (LGUs) track nearby disasters in the area more effectively. Using the application will enable them to deploy resources more efficiently by giving priority to areas that are more impacted by the disasters. The geo-map feature of the DisasterWatchPH provides a real-time visualization of disaster extents, which can help the LGUs in coordinating rescue operations and resource distribution, especially crucial during large-scale emergencies where timely action is essential.

Disaster Response and Management Offices (DRRMOs). The app enables the DRRMOs to prioritize and identify the most affected areas, ensuring that the resources are allocated where they are most needed. The real-time geo-map feature can help improve the coordination of rescue efforts and enable faster and more efficient response in emergency circumstances.

Businesses. The app helps businesses take actions and protect their assets and employees that might affect their operations by providing timely notifications about reported disasters. They can minimize losses and implement backup plans by using the information provided by the app, ensuring that company continuity is maintained even in the case of a disaster.

Institutions. The app helps institutions stay informed about possible disasters that might affect their personnel and facilities. By receiving real-time updates, institutions can take proactive measures to safeguard their operations and ensure the safety of their staff and students, minimizing disruption and enhancing overall preparedness.

Definition of Terms

This section provides definitions of terms used in this study for better understanding.

1. **Database:** A usually large collection of data organized especially for rapid search and retrieval (as by a computer).

2. **Disaster Reporting:** The act of submitting information about an ongoing disaster event.

2. **Early Warning System**: A set of capacities needed to generate and disseminate timely and meaningful warning information to enable individuals, communities, and organizations threatened by a hazard to prepare and act appropriately.

3. **Geo-Map:** A visual representation of geographical data, often displayed as an interactive digital map.

4. **GPS (Global Positioning System):** A satellite-based navigation system that provides location and time information in all weather conditions.

5. **Mobile Application (App):** A software program designed to run on mobile devices such as smartphones and tablets.

6. **OTP (One-Time Password):** An automatically generated numeric or alphanumeric code used to authenticate a user for a single transaction or login session.

7. **Push Notification:** A message that pops up on a mobile device, often used to deliver time-sensitive information.

8. **Real-Time Information Sharing:** The process of disseminating information immediately as it becomes available.

9. **Scrum:** An agile framework for developing, delivering, and sustaining complex products, with an emphasis on software development.

10. **User Authentication:** The process of verifying the identity of a user to ensure they are who they claim to be.

11. **User Experience (UX):** The overall experience of a person using a product, especially in terms of how easy or pleasing it is to use.

12. **User Interface (UI):** The means by which users interact with a software application, including visual elements, input controls, and navigational components.

CHAPTER 2

REVIEW OF RELATED LITERATURE AND STUDIES

This chapter provides a discussion of the past studies and principles related to this paper.

Disaster risk management and reporting applications

According to Durango and Labrador (2022), the frequent occurrence of natural disasters in the Philippines has necessitated the development of an effective disaster risk reduction and management systems. Real-time information disaster response is needed, and that led to the creation of a mobile application that aims to help the authorized disaster risk reduction personnel to provide accurate disaster updates, evacuation plans, and precautionary measures. They developed a mobile monitoring system incorporating drone technology to capture and disseminate real-time data. This system was evaluated using ISO 9126/ISO/IEC 25010 standards and Kano's Model, resulting in positive user feedback regarding its usability, functionality, and reliability. The system has achieved Quality Scores (Q-scores) of 2.06 for usability, a 2.02 for functionality, and a 1.8 for reliability, with an overall grade of DQ. These kinds of innovations are beneficial in enhancing community preparedness and responsiveness, especially in places that are prone to disasters like the Philippines.

In a different study, Anastacio et al. (2022) developed a comprehensive framework for disaster risk reduction and management (DRRM) using both mobile and web applications. This framework is known as MASA, and it aims to enhance community preparedness and response to disasters by providing an integrated platform for information dissemination, emergency alerts, and real-time data collection. MASA integrates government-to-citizen (G2C) services, guaranteeing and ensuring that

citizens are well-informed and actively involved in DRRM processes. The mobile and web-based functionalities' framework facilitates communication and coordination among the emergency responders and the affected communities, leveraging technology to mitigate disaster impacts effectively. Overall, MASA demonstrates a practical approach to combining technology and community engagement for improved disaster resilience.

The AlertQC system, an incident management system created for the Quezon City Disaster Risk Reduction and Management Office, was also presented by Gonzales et al. in 2021. This system aims to enhance disaster response and management by providing a web and mobile platform for reporting incidents, disseminating information, and coordinating relief efforts. The AlertQC system took advantage of mobile technologies in order to allow real-time reporting and response, which is critical for having timely decision-making and effective resource allocation during a time of disaster. Citizens are allowed to report incidents and receive timely updates, fostering a collaborative approach to disaster resilience while also promoting community engagements. Overall, AlertQC demonstrates the potential of technology in improving disaster risk reduction and management by enhancing communication, coordination, and community involvement.

According to the study of Budimir, Bee, and Paul in 2021, mobile phone technologies are important to Disaster Risk Management (DRM) as they emphasized how the widespread use of mobile networks and the growing penetration globally provides new opportunities to lower risk of disasters, particularly in low- and middle-income nations where the effects of natural disasters can often be disastrous. The SHEAR program's reflections of these technologies show how the use of mobile

phones helps facilitate the rapid data collection, enhance communication, and support early warning systems, particularly in areas that are prone to disasters. For instance, a technology developed by FloodTags by using real-time Twitter data in the Philippines is being used to map out flood impacts and advise disaster response actions. Furthermore, the integration of mobile technologies with local knowledge and with the active participation of the community will not only improve the data quality but also fosters collaboration between scientists, government officials, and vulnerable communities. This collaborative approach, supported by mobile technology, is important for improving resilience and reducing casualties and economic damages in areas that are prone to disasters.

A lot of research has been done in these past few years about Information Technology (IT) and how it is used in various cases such as in disaster management, showing how important it is for reducing the effects of disasters, especially in developing nations like Ghana. The study of Kelly and Addo in 2023 emphasized the vulnerability of Ghana to multiple natural and man-made disasters, which includes floods, earthquakes, fires, and epidemics. Although these occurrences are frequent, the study finds a significant gap in their disaster preparedness and response, mainly due to the insufficient IT infrastructure and policy frameworks. According to Kelly and Addo (2023), listening to the radio is the most effective way of reporting on disasters and disseminating information, followed by watching television, as well as the use of the internet. In order to improve the coordination, information sharing, and effective response during emergencies, they encourage the use of advanced ICT tools into disaster management. They also highlight the necessity of government and

community-level initiatives to connect the IT infrastructure gap and enhance preparedness for disasters and emergencies.

In 2021, Ardianto and his colleagues developed a prototype design for a disaster management application that is based on Android. This application aims to facilitate emergency response and disaster management by providing quick, precise, and accurate information. Indonesia's high incidence of disasters underscores the need for such a system, given the country's geographical susceptibility to natural disasters. The app's user-friendly design enables the users to identify where the emergency officers can be located. The users can also request for assistance using the SOS feature of the app, which sends notifications to the officers to activate their GPS for tracking. In order to ensure that the application satisfies the needs of both emergency responders and disaster victims, the design process involved gathering stakeholder demands and developing a prototype through multiple iterations.

Social Media as a tool for disaster reporting

In a study conducted by Malawani et. al. (2020), numerous social media accounts have been active in regarding posting information concerning typhoons. In addition, their study has found that the victims turned to social media to express and communicate.

According to Saroj & Pal (2020), due to web 2.0, people have used social media more than before where people share their thoughts, emotions, pictures and videos, and during crises, social media often gives out information faster in comparison to other media. moving on to the findings of Muniz-Rodriguez et. al. (2020), social media have been useful for public health during emergency response to natural disasters, they have found that social media helped with spreading information, giving out warnings, identifying needs after a natural disaster, they have also found that social media also had or lacked misinformation and rumor control during natural disasters.

In a similar study by Ogie et. al. (2022) that focused on social media use in disaster recovery, their findings have suggested that social media platforms were used as a support system during disasters but mostly during hurricanes (33%), earthquakes (20%), floods (12.7%), and typhoons (7.6%). Social media were used as a support system for (1) donations and financial support, (2) solidarity and social cohesion, (3) post-disaster reconstruction and infrastructure services, (4) socioeconomic and physical wellbeing, (5) information support, (6) mental health and emotional support, and (7) business & economic activities.

GPS-Based Disaster Reporting App

According to Sinogaya (2024), communities in the Philippines are vulnerable to flooding and landslides, yet there is a lack of data collecting and risk assessments. Although the Philippines has initiatives like DREAM, NOAH, and Phil-LiDAR that provides advanced surveying equipment and geoscience expertise, the Naga landslide that occurred revealed a major gap in the systems: the absence of home location data, which hindered rescue efforts. To improve disaster planning and response, it's crucial to

integrate hazard maps with demographic data, and policymakers must allocate funds for climate and disaster risk assessments and land use planning. For this purpose, they must provide plantilla items in LGUs and SUCs, ensure capacity-building, and encourage local collaborations for data collection.

Caballero and Delos Santos (2021) developed a system equipped with various Information and Communication Technologies (ICTs) such as broadband connectivity, mobile application, web application, client-server network architecture, SMS and Geolocation Technology to advance the operations in the DRR and incident response activities: The Bandilyo App. The app enables precise location-specific data reporting and real-time communication, even in places with poor internet connectivity. This is in areas that are prone to natural calamities like the Philippines, where communication infrastructure may be compromised. By reaching remote areas through SMS, the Bandilyo App improves disaster response efficiency and supports long-term planning with reliable data.

In 2024, Syukron, et. al. analyzed 45 disaster support mobile apps, finding that the map feature was the third most-discussed topic, with 567 reviews. Although only 21 apps included a map feature, it drew significant feedback, mostly negative. Users criticized the maps for lacking detail, cluttered alerts, and poor usability, with complaints like *“The UI is clunky, maps are slow to load, and warning icons disappear when moving.”* However, some praised the map’s accuracy, quick loading, and ease of use, with one review stating, *“The map feature works very well and provides detailed zooming.”*

In a different context, the study "Revolutionizing Coffee Farming" by Kumar (2024) highlights how GPS-enabled reporting in a mobile app can be adapted for various fields, including disaster management. Their mobile app integrates GPS with deep learning to detect coffee leaf diseases accurately on-site, demonstrating the potential for precise, location-based reporting. Their study highlights how GPS- enabled reporting in mobile app can be adapted for various fields including location-based reporting. Gonzales et al. suggests that similar technology could improve disaster management by providing real-time updates during floods or earthquakes, enabling quicker and more targeted responses. This adaptability underscores the potential of GPS and AI in enhancing disaster response and resilience across different fields.

Community-based disaster risk reduction

A study by Fullero (2024) in Caramoan, Camarines Sur, stated that the primary sources of disaster communication were television broadcasts, while the most commonly used communication strategy was face-to-face interaction with neighbors. Fullero et al. recommends establishing a unified and well-coordinated approach to risk communication and consistently soliciting feedback from the community.

In a similar study done by Cayamanda and Paunlagui in 2022, they conducted a book project that examines flood-vulnerable communities in Davao City, giving focus on improving the community preparedness and the reduction of flood risks by having effective risk communication and management. In their study, they found that using a localized, participatory approach enhances risk reduction by ensuring proper knowledge transfer among stakeholders, with the community as the central actor.

In 2022, Hidayati, et. al conducted research on how the community in Turgo, Purwobinangun, Pakem, Sleman, communicate about disasters. They organized interviews and focus group discussions with community members, including teenagers, adults, the elderly, the search and rescue (SAR) team, and the village leaders. Through that, they found that the Merapi slope community in Turgo utilizes multiple sources for disaster communication, including social media, interpersonal conversations, group communications, and wastai posts (surveillance and reconnaissance posts). Information is shared through WhatsApp groups, YouTube, Twitter, Instagram, direct talks, traditional bamboo drums (kentongan), motorcycle horns, and speakers. The residents responded positively to directives from authorities and complied without resistance. They also found that the opinion leaders, who are typically relied upon for advice, do not play a significant role in disaster communication. Instead, the SAR team is more crucial due to their better understanding of the situation on the ground.

In a study led by Okeukwu-Ogbonnaya et. al. (2024), the researchers investigated how information spreads in communities: in urban, in suburban, and in rural communities. They used a model to replicate how the information flows during normal times and during disasters. They examined sources like social media, local news, government announcements, mainstream media, and print media. The researchers collected survey data from the communities and used graphs to illustrate how information moves from (1) individuals and (2) from getting information from different sources. The study found that rural, suburban, and urban communities each have different characteristics that influenced how they spread information. In the study, they found that the availability of information sources greatly influenced the speed at which

information flows, with having disruptions in any source leading to slower information communication.

Firebase as a tool for android development

Delos Santos (2023, p.4) created an Event-Driven Mobile Application for Gas Leakage Monitoring and Detection using Firebase and IoT. This local study presents an innovative approach to gas leakage monitoring by utilizing Firebase alongside IoT technologies. The system is designed to offer real-time monitoring, alerting users via mobile notifications when gas leakage is detected. *"Firebase, with its real-time database capabilities, was integral in ensuring that alerts were sent instantly to the user's mobile device,"* delos Santos emphasized. This feature allows users to respond quickly to potentially hazardous situations, which highlights Firebase's effectiveness in creating a responsive mobile application. The study also shows that the integration of Firebase helps enhance the app's scalability and efficiency, thus making it a suitable choice for applications that require real-time data processing and communication.

In another study led by Wibowo, et. al. in 2024, they used Firebase to monitor cardiovascular health and developed a Cardiovascular Monitoring System Using Android-Based Mobile Application with Cloud Firebase. The researchers developed an Android-based mobile application that uses cloud Firebase to store and analyze patient data. According to the research, *"Firebase's real-time database was pivotal in providing continuous data flow between the mobile application and the cloud, enabling immediate access to critical health information"*. In order to take timely medical action, this enables medical experts to remotely check on patients' vitals and receive real-time updates. *"The platform's built-in authentication and data encryption mechanisms helped protect*

sensitive patient information, aligning with global healthcare data privacy standards," the authors add, underscoring Firebase's security features.

Synthesis of Review of Related Literature and Studies

The reviewed literature and studies emphasize the role of mobile applications, GPS, and other technologies that helped in enhancing disaster risk reduction and management, particularly in disaster-prone areas. Studies by Durango and Labrador (2022) and Anastacio et al. (2022) highlighted the effectiveness of real-time information systems and a community-driven approach in improving disaster preparedness and response. In addition, mobile technologies such as AlertQC and Disaster Helpline helped in decision-making and resource allocation. And not only that, but social media also played a vital role in spreading information as quickly as possible, and have been a great community support during disasters, although there are challenges like misinformation and spreading rumors must be addressed. Additionally, the integration of Firebase's real-time database capabilities into android applications, as seen in the studies of Delos Santos (2023) and Wibowo et al (2024), supported the development of responsive and reliable systems.

CHAPTER 3

RESEARCH METHODOLOGY

Research Design

This study employs a mixed-methods research design, combining quantitative and qualitative approaches to develop and evaluate the DisasterWatchPH application. The research follows an Agile development methodology, specifically the Scrum framework, as outlined in the conceptual framework.

The study is divided into three main phases:

1. **Development Phase**: This phase involved the iterative development of the DisasterWatchPH system using the Scrum framework. Two-week sprints was used to develop and refine app features guided by the UTAUT constructs: **Performance Expectancy** (real-time reporting, geo-mapping), **Effort Expectancy** (intuitive user interface and experience), **Social Influence** (Community Feed) and **Facilitating Conditions** (Android devices with gps compatibility). Each sprint involved stakeholder consultations with Parañaque DRRMO Officials and the LGUs, this ensures continuous alignment with community needs and technical requirements.

2. **Testing and Implementation Phase**: This phase included testing conducted internally by the development team, focusing on functionality and usability.

3. **Evaluation Phase**: This phase assessed the effectiveness and user acceptance of the DisasterWatchPH and DisasterWatchPH Responders App using both quantitative surveys based on the UTAUT model.

Population and Sample Size

The population of this study consisted of residents of Parañaque City from different barangays, including members from the Local Government Unit (LGU), members of the Disaster Risk Reduction Management Office of Parañaque, and regular citizens of Parañaque. A total of 60 participants were selected for data gathering, which included 3 representatives from the Local Government Unit, 2 officials from the Disaster Risk Reduction Management Office, and 55 Parañaque residents from different barangays. This population was chosen to ensure that the data gathered regarding disaster management is relevant to Parañaque City.

Sampling Technique

This research study used purposive sampling as the sampling technique. Purposive Sampling is a non-probability sampling approach in which participants are selected due to their possession of specific characteristics that are relevant to the research objectives. Participants were selected based on their relevance to the scope and limitations of the study. This sampling method relied on factors such as participant accessibility and availability, making it suitable for this research study due to time constraints and budget. The participants must be residents from the city of Parañaque, and must be an owner or have access to an Android mobile device.

Description of the Respondents

The respondents for this study are from Parañaque City, which consists of three groups:

- 3 representatives from the Parañaque Local Government Unit (LGU)
- 2 officials from the Parañaque City Disaster Risk Reduction and Management Office
- 55 citizens of Parañaque City, representing different barangays (5 of which are local emergency responders such as firemen, ambulance drivers, police or MMDA personnel).

Sources of Data

Primary data sources for this study included:

- Survey responses from key stakeholders participants who tested the DisasterWatchPH and DisasterWatchPH Responders App, collected via Google Forms.
    - Citizens from various barangays in Parañaque City
    - Parañaque City LGU
    - Parañaque City DRRMO officials
- Performance metrics of the application:
    - Response times for disaster reports
    - Accuracy of reported locations (GPS data)
    - App crash rates and error logs

Secondary data sources included:

- Existing literature on disaster management applications and community-based disaster reporting systems, sourced from academic databases such as Google Scholar, IEEE Xplore, and PSA.

- Technical documentation related to mobile application development, geolocation technologies, and Firebase Analytics, obtained from official developer resources and technical forums.

Research Instruments

The primary research instruments for this study were:

1. Quantitative Survey: A structured questionnaire based on the UTAUT model developed to measure user acceptance and satisfaction with the DisasterWatchPH and DisasterWatchPH Responders App. The survey included items related to performance expectancy, effort expectancy, social influence, and facilitating conditions, using a 5-point Likert scale.

2. Post-Survey Feedbacks: After demonstrating the app, the participants provided written feedback through optional open-ended questions in the survey (“Do you have any additional comments or recommendations to help improve the system?”).

3. Application Analytics: Built-in analytics tools within the DisasterWatchPH application, specifically Firebase Analytics, was used to collect data on user engagement, feature usage, and reporting patterns.

Data Gathering Procedure

1. Survey Administration: The quantitative survey was distributed electronically to 60 participants (3 Representatives from the LGUs, 2 DRRMO Officials, 55 Parañaque residents from different barangays.) of the DisasterWatchPH and DisasterWatchPH Responder's App using Google Forms. This platform allowed for easy distribution, collection, and initial analysis of survey responses.

2. Controlled Testing Scenarios: Simulated disaster reporting exercises was conducted with a subset of users to evaluate the application's performance under various conditions.

Statistical Treatments

The statistical methods that the researchers used to analyze the data collected was the Weighted Mean which was paired with a verbal interpretation to provide a clearer understanding of the survey results. The weighted mean was used to determine the average response to each survey question. This helped categorize the average response based on the weighted mean value.

The formula for calculating the mean:

Weighted Mean = $\sum(f \times w) / N$
Where: $\sum$ = sum f = Frequency of responses for each option w = Weight assigned to each response N = Total number of respondents

The Likert Scale:

5-point Likert Scale
5 – Strongly Agree/Masidhing Sumasang-ayon 4 – Agree/Sumasang-ayon 3 – Neutral/Walang kinikilingan 2 – Disagree/Tumututol 1– Strongly Disagree/Masidhing Tumututo

The verbal interpretation is calculated by following the following steps:

1. Range=Highest Value−Lowest Value

   Where:
   Highest Value = 5.0
   Lowest Value = 1.0

   Range = 5.0 - 1.0

   Therefore,

   Range = 4.0

2. The range should be divided evenly to the 5 categories using this formula:

   Interval Width = Range / Number of Categories

   Where:
   Range = 4.0
   Number of Categories = 5

   Interval Width = 4.0 / 5

   Therefore,

   Interval Width = 0.8

3. In order to get the verbal interpretations, the interval width should be added starting from the lowest value (1.0) repeatedly to define the boundaries for each category.

The Verbal Interpretation:

Verbal Interpretation
4.21 - 5.00 – Strongly Agree 3.41 - 4.20 – Agree 2.61 - 3.40 – Neutral 1.81 - 2.60 – Disagree 1.00 - 1.80– Strongly Disagree

Ethical Considerations

1. Informed Consent: All participants in surveys were provided with clear information about the study's purpose and their rights as participants.

2. Data Privacy and Security: User data collected through the application and research instruments was anonymized and securely stored. The study complied with relevant data protection regulations, including the Data Privacy Act of 2012 (RA 10173), which mandates the protection of personal information and ensures that data is processed fairly, lawfully, and transparently. Adequate measures such as encryption, salting, and hashing when data is stored was implemented to safeguard data against unauthorized access, disclosure, alteration, and destruction.

3. Voluntary Participation: Participants were informed that their participation is voluntary and that they can withdraw from the study at any time without consequences.

4. Transparency: The research team maintained open communication with all stakeholders, providing regular updates on the study's progress and findings.

5. Responsible Reporting: Measures were implemented to prevent and address potential misuse of the disaster reporting feature, ensuring the integrity of the data collected. Users submitted one report at a time or until the report is immediately approved by the admin to be displayed in the Community Feed. Admins have the option to reject or remove the disaster report.

Data Analysis

Quantitative data analysis:

- Descriptive statistics was used to summarize survey responses and application usage data. This includes the weighted mean calculations and verbal interpretation of Likert-scale survey responses

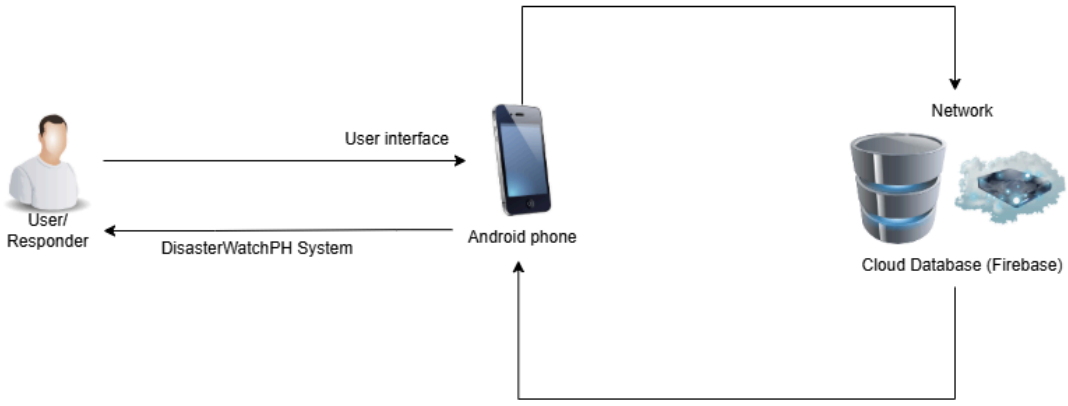
Qualitative data analysis:

- Content analysis of user feedback and comments collected through the application was performed to identify common issues and suggestions.

System Architecture

A diagram that is a visual representation of a software system's components, their interactions, and data flow. These diagrams help communicate the system's design and serve as a blueprint for implementation.

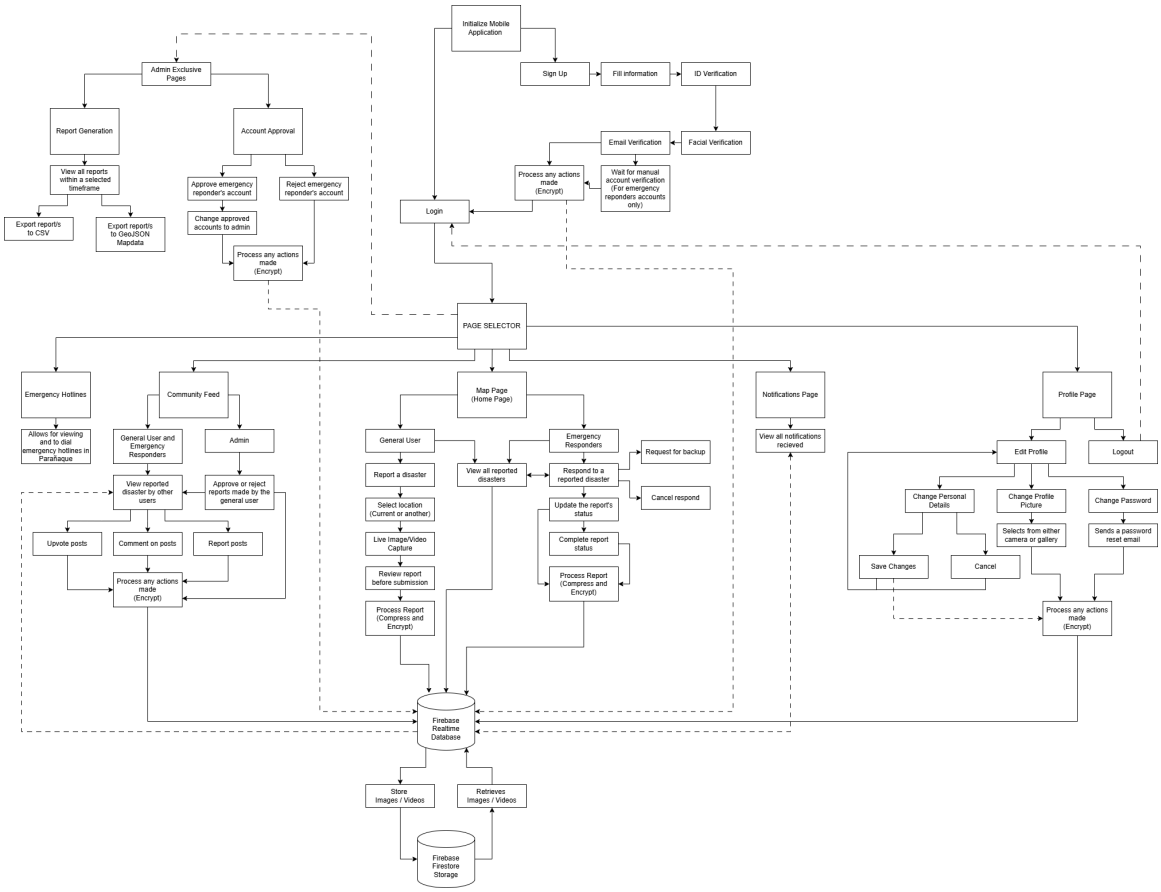
Figure 3.1 System Architecture



Data Flow Diagram

A diagram that visually represents the flow of information within a system or process that provides a clear understanding of the system's structure.

Figure 3.2 Data Flow Diagram

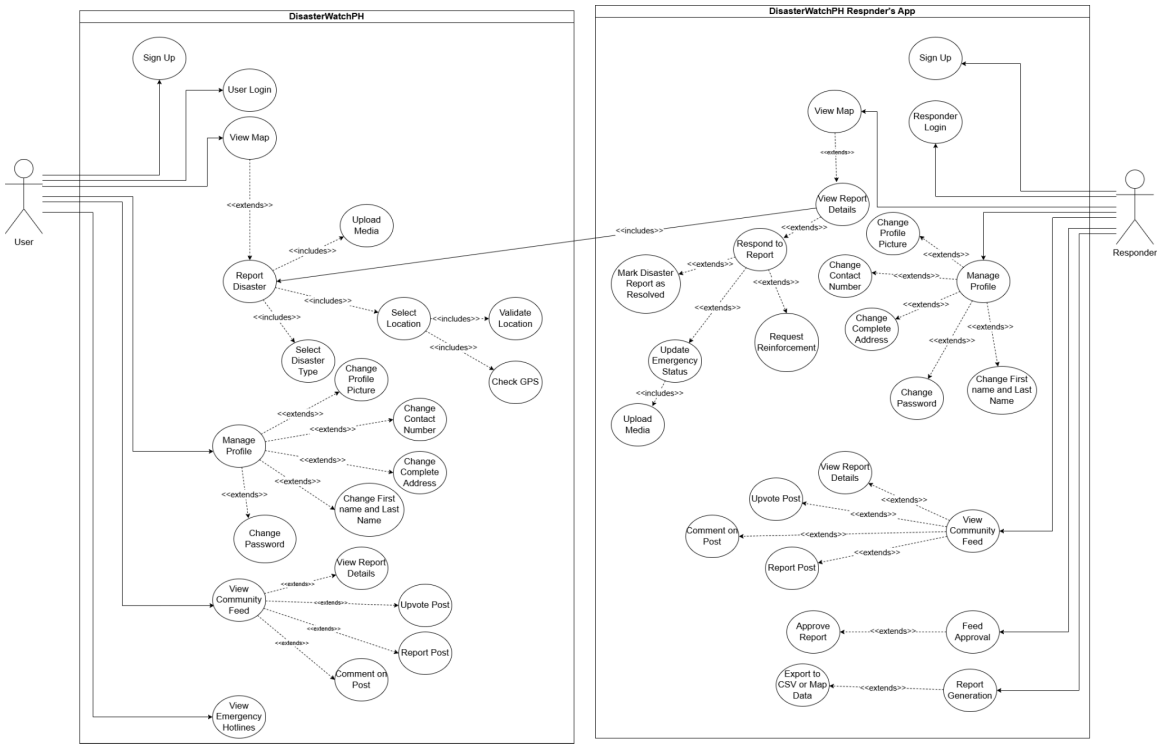


Use Case Diagram

An effective method to summarize a system's interactions with users and their roles. It is a visual representation of the system's interactions with external entities, known as actors. This diagram illustrates the events and their flow among various

elements within the system, providing a high-level overview of the system's behavior and functional requirements.

Figure 3.3 Use Case Diagram



This figure shows the functions, and interactions of the DisasterWatchPh and DisasterWatchPH Responder's App.

Use Case Description

A use case description is a written account detailing how users interact with a system to perform specific actions, ultimately achieving a goal, while also illustrating the system's response from the user's perspective.

Table 1.0.

Use Case Description: User Login

This table describes the process of the user logging in to the system.

Use Case Name:	User Login	
Scenario:	A user needs to login to the system for access.	
Triggering Event:	User clicks “Login” button	
Brief Description:	This use case involves authenticating the identity of the user trying to log in to the system through email address or phone number and password.	
Actors:	User	
Stakeholders:	None	
Preconditions:	User has an active account, and has an internet connection.	
Postconditions:	User gains access to the system if authentication is successful.	
Flow of Activities:	**Actor**	**System**
	1. The user enters an email or phone number and password.	1.1 The system validates the login credentials 1.2 Upon successful login, the system gives access to the user.
Exception Condition	1.1 If login credentials are incorrect, missing, or does not exist, the system denies access and notifies the user through a popup.	

Table 1.1.

Use Case Description: Sign Up

This table describes the process of the user creating an account to be able to login to the system.

Use Case Name:	Sign Up	
Scenario:	A user needs to create an account to be able to login.	
Triggering Event:	User clicks “Sign Up” button	
Brief Description:	This use case involves collecting necessary information about the user as well as credentials to validate the existence of the user.	
Actors:	User	
Stakeholders:	None	
Preconditions:	User has no existing account with the email or phone number, and has an internet connection.	
Postconditions:	User successfully created an account.	
Flow of Activities:	**Actor**	**System**
	1. The user provides the necessary information. 2. The user receives the verification link by email.	1.1 The system checks if an account already exists with the same credentials. 2.1 Upon successful account creation, the system will send a verification link via registered email. 2.2 If the account is verified, the system gives access to the user.
Exception Condition	1.1 If information entered by the user is invalid, missing, already exists, or does not match, the system denies progression and will prompt the user to enter the correct information.	

Table 1.2.

Use Case Description: View Map

This table describes the process of the user navigating through the map

Use Case Name:	View Map	
Scenario:	A user navigates through the map	
Triggering Event:	User logs in	
Brief Description:	This use case involves the user navigating through the map page.	
Actors:	User	
Stakeholders:	None	
Preconditions:	User allow permission to use their device's camera, record audio, GPS, phone book, write to storage, notifications, and have an internet connection.	
Postconditions:	User can view the location of the existing disaster reports.	
Flow of Activities:	**Actor**	**System**
	1. The user checks the checkbox on the legend	1.1 The system will sort the existing reports, and will display reports based on the marks on the legend checkbox. 1.2 If the checkboxes are all marked, the system will display all the existing reports. 1.3 If none of the checkboxes are marked, the system will display none of the existing reports.
Exception Condition		

Table 1.3.

Use Case Description: Report Disaster

This table describes the process of the user attempting to report a disaster.

Use Case Name:	Report Disaster	
Scenario:	A user attempts to report a disaster.	
Triggering Event:	User clicks the “Report” button	
Brief Description:	This use case involves the system asking the user for necessary information for the report such as the location, disaster type, intensity of the disaster, and media (photo or video) to support the disaster being reported.	
Actors:	User	
Stakeholders:	None	
Preconditions:	The user allows the system to access their device camera and GPS, and has an internet connection.	
Postconditions:	The user successfully submits their report and the system will update both the users within vicinity and the responders about the report.	
Flow of Activities:	**Actor**	**System**
	1. The user reports a disaster to a location. 2. The user submits the report.	1.1 The system prompts the user to select the necessary information of the disaster (fire, flood, earthquake, or others), and the level of intensity. 2.1 The system prompts the user to capture a media (photo or video). 2.2 If the system captures a successful media capture, the system will display the review report details. 2.3 The system displays a popup for a final confirmation to submit the report. 2.4 If the system successfully receives a disaster report, a notification will popup to inform both the users within the vicinity and the responder about the report, and will display the report with an icon on the map according to the location provided.
Exception Condition	1.1 If the user has a pending report, the system displays a popup “You already have a pending report” to avoid spam. 1.2 If information entered by the user is incomplete, the system displays a popup to inform the user to provide details.	

Table 1.4.

Use Case Description: Manage Profile

This table describes the process of the user editing their personal information in and/or login credentials in the system.

Use Case Name:	Manage Profile	
Scenario:	A user needs to update their First Name, Last Name, Profile Picture, Password, Contact Number, and Complete Address within the system.	
Triggering Event:	User navigates to the User Profile Page.	
Brief Description:	This use case involves the system updating their data on the user.	
Actors:	User	
Stakeholders:	None	
Preconditions:	The user must have an existing verified account, and has an internet connection.	
Postconditions:	The user and the system successfully updated the personal information and/or the login credentials.	
Flow of Activities:	**Actor**	**System**
	1. The user navigates to the User Profile Page 2. The user proceeds to Edit Profile and provides necessary information to be updated.	1.1 The system displays the user's current profile picture, personal information, and contact information. 2.1 The system processes the provided information. 2.2 The system displays a popup to confirm the changes made. 2.3 The system confirms the successful update.
Exception Condition	The system prevents the user from making changes in their email address.	

Table 1.5.

Use Case Description: View Community Feed

This table describes the process of the user interacting with the Community Feed

Use Case Name:	View Community Feed	
Scenario:	A user interacts with other users through the community feed.	
Triggering Event:	User navigates to Community Feed	
Brief Description:	This use case involves the user viewing report details, upvoting posts, reporting posts, and commenting on posts, on Community Feed.	
Actors:	User	
Stakeholders:	None	
Preconditions:	The user must have an existing verified account, and has an internet connection.	
Postconditions:	The user successfully makes interaction with other users.	
Flow of Activities:	**Actor**	**System**
	1. The user heads to the Community Feed page.	1.1 The system displays all the latest active approved reports by default.
	2. The user sorts the contents by disaster type (all, fire, flood, earthquake, or others), order (latest or oldest), and by status (active or resolved).	2.1 The system displays the reports according to the sort filtering chosen by the user.
	3. The user clicks the “View Previous Versions” on a post.	3.1 The system displays a popup with the details of the previous version of the report.
	4. The user clicks the “upvote” button	4.1 The system processes the upvote and will add it to the reputation of the original poster of the report.
	5. The user clicks the “Report” button	5.1 The system displays a popup asking the user if the report is “False or Misleading Information”, “Spam”, “Inappropriate content”, “Other”. 5.2 The system processes the report and will decrease the reputation point of the original report poster.
Exception Condition	If the user receives another report from the same user, a toast will display with the message “You have already reported this post”.	

Table 1.6.

Use Case Description: View Emergency Hotlines

This table describes the process of the user attempting to make a call through the emergency hotlines page.

Use Case Name:	View Emergency Hotlines	
Scenario:	A user attempts to make a call to emergency hotlines	
Triggering Event:	User navigates to the emergency hotlines page to make a call to talk to an agent	
Brief Description:	This use case involves the user making a call to one of the emergency hotlines available.	
Actors:	User	
Stakeholders:	None	
Preconditions:	The user must have an existing verified account, have allowed the app to use their phone book, have a sim card with signal, and have an internet connection.	
Postconditions:	The device used by the user will contact the emergency hotline.	
Flow of Activities:	**Actor**	**System**
	1. The user clicks the phone icon on the right of the preferred hotline number	1.1 The system directs the user to the phone book.
Exception Condition	Some devices automatically call the hotline selected, but some devices just auto inserts the number selected in the dialer.	

Table 1.7.

Use Case Description: Respond to Report

This table describes the process of the responder responding to an active report.

Use Case Name:	Respond to Report	
Scenario:	A responder responds to an active report.	
Triggering Event:	Responder clicks the “Respond to Emergency” button to respond.	
Brief Description:	This use case involves the responder responding to an active disaster report.	
Actors:	Responder	
Stakeholders:	None	
Preconditions:	The responder must have an approved and verified account, open GPS, and have an internet connection.	
Postconditions:	The responder travelled to the report location and attended to the issue.	
Flow of Activities:	**Actor**	**System**
	1. The responder clicks the icon of an active report displayed on the map.	1.1 The system displays a popup that displays information of the report (media, disaster type, location, status, time, and date).
	2. The responder clicks the “Respond to Emergency” button.	2.1 The system finds the fastest way to the report location. 2.2 The system displays the distance and the ETA of the responder to the report location.
	3. The responder clicks the destination location icon	3.1 The system displays a popup that displays information of the report, as well as the “Update Emergency Status”, “Mark

		as Complete", and "Cancel Response" buttons.
	4. Responder clicks the "Update Emergency Status" button	4.1 The system displays information from the report. 4.2 The system allows the responder to change the intensity of the disaster type.
	5. Responder clicks the "Take a picture or video" button	5.1 The system displays a popup that allows the responder to choose between photo or video to take. 5.2 The system takes the new media taken and replaces the previous media displayed.
	6. Responder clicks the "Update Report" button	6.1 The system displays a popup with the message "Are you sure you want to update this report?" 6.2 The system updates the information that is displayed on the Community.
	7. Responder marks the report as complete	7.1 The system changes the status of the report to "resolved" 7.2 The system removes the report from the map
Exception Condition	If the responder attempts to update a report without media, the system will notify the responder and prompt them to take a photo or video.	

Table 1.8.

Use Case Description: Feed Approval

This table describes the process of the responder approving a disaster report to be displayed in the Community Feed.

Use Case Name:	Feed Approval	
Scenario:	A responder receives the report of a user, and approves the report to be displayed on the Community Feed.	
Triggering Event:	A user submitted a new report	
Brief Description:	This use case involves the user submitting a disaster report, and awaiting for the responder approval to be able to show in the Community Feed.	
Actors:	User, Responder	
Stakeholders:	None	
Preconditions:	There must be a report from the user, and the responder account must be verified and approved.	
Postconditions:	The report of the user is successfully displayed in the Community Feed.	
Flow of Activities:	**Actor**	**System**
	1. The user submitted a report through the DisasterWatchPH app	1.1 The system takes the information of the report and sends it to the DisasterWatchPH Responder's App. 1.2 The report is displayed on the Feed Approval page with the status "Pending"
	2. The responder approves the report.	2.1 The report is displayed to the Community Feed to allow other users to see.
	3. The responder sorts the reports by status (pending, approved, rejected)	3.1 The system displays the reports according to the status selected in the filter.
Exception Condition	If a report is not approved by the responder, the report will not show in the Community Feed but will still be shown to the responders.	

Table 1.9.

Use Case Description: Report Generation

This table describes the process of the responder exporting a report to their device.

Use Case Name:	Report Generation	
Scenario:	A responder attempts to export the disaster report records to their device.	
Triggering Event:	Responder navigates to the Report Page	
Brief Description:	This use case involves all the reports received by the system in a time frame, and the report generation by exporting to CSV or GeoJSON map data.	
Actors:	User, Responder	
Stakeholders:	None	
Preconditions:	Responder account must be approved and is connected to an internet connection.	
Postconditions:	The report file is successfully stored into the device storage.	
Flow of Activities:	**Actor**	**System**
	1. Responder navigates to the Report Generation Page	1.1 The system displays the total number of reports received by disaster type, status, and location (barangay)
	2. Responder exports the data	2.1 The system will create a copy of the file and export it to the device storage with all the necessary information taken from the user and responder.
Exception Condition		

Activity Diagram

A virtual representation of the flow of control within a system or process, providing a clear and structured view of the system's behavior. It is more advanced than a flowchart, as it includes unique capabilities such as swim lanes, branching, parallel flow, control nodes, expansion nodes, and object nodes.

Figure 3.4 Activity Diagram: User Login

This process shows the flow of activity when the user is logging in, authenticating the account, and logging out.

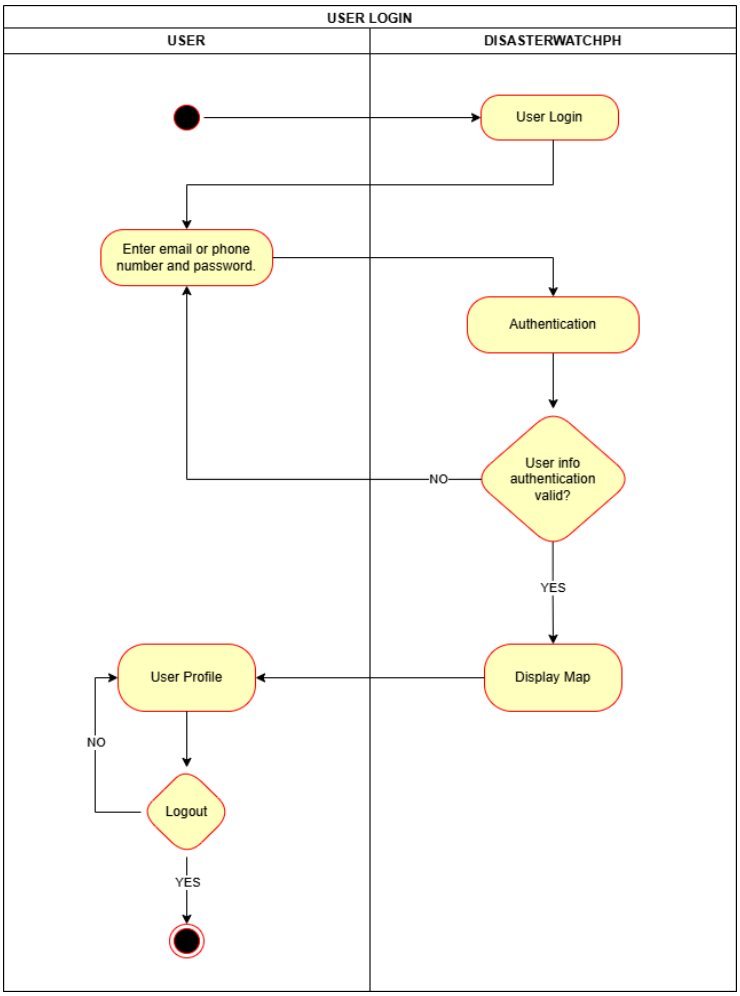


Figure 3.5 Activity Diagram: Sign Up

This process shows the flow of activity when the user is creating an account.

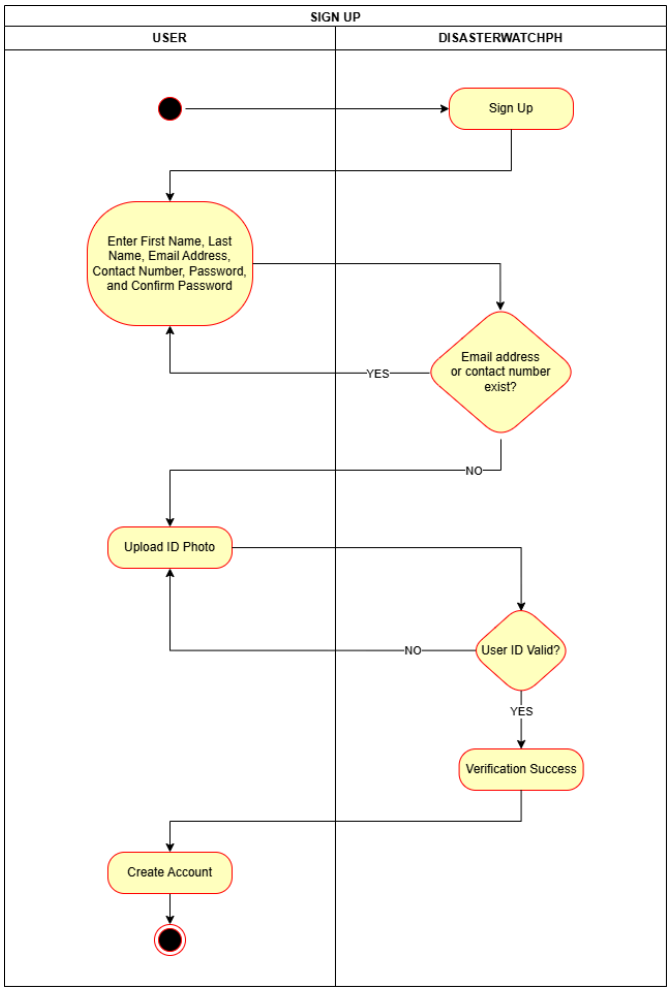


Figure 3.6 Activity Diagram: Report Disaster

This process shows the flow of activity when the user is reporting a disaster incident.

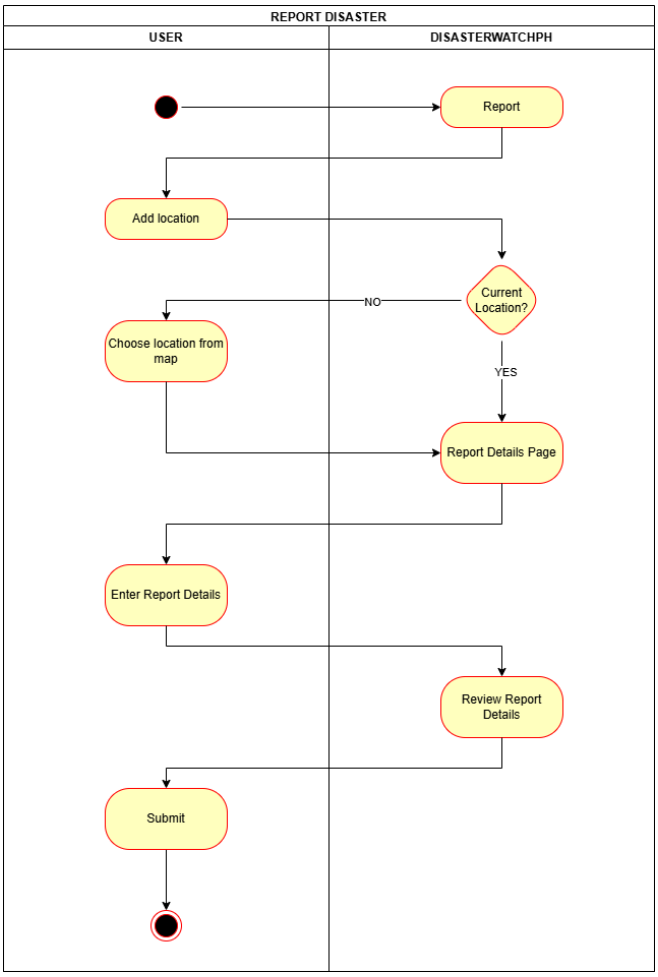


Figure 3.7 Activity Diagram: Manage Profile

This process shows the flow of activity when the user needs to change their user profile.

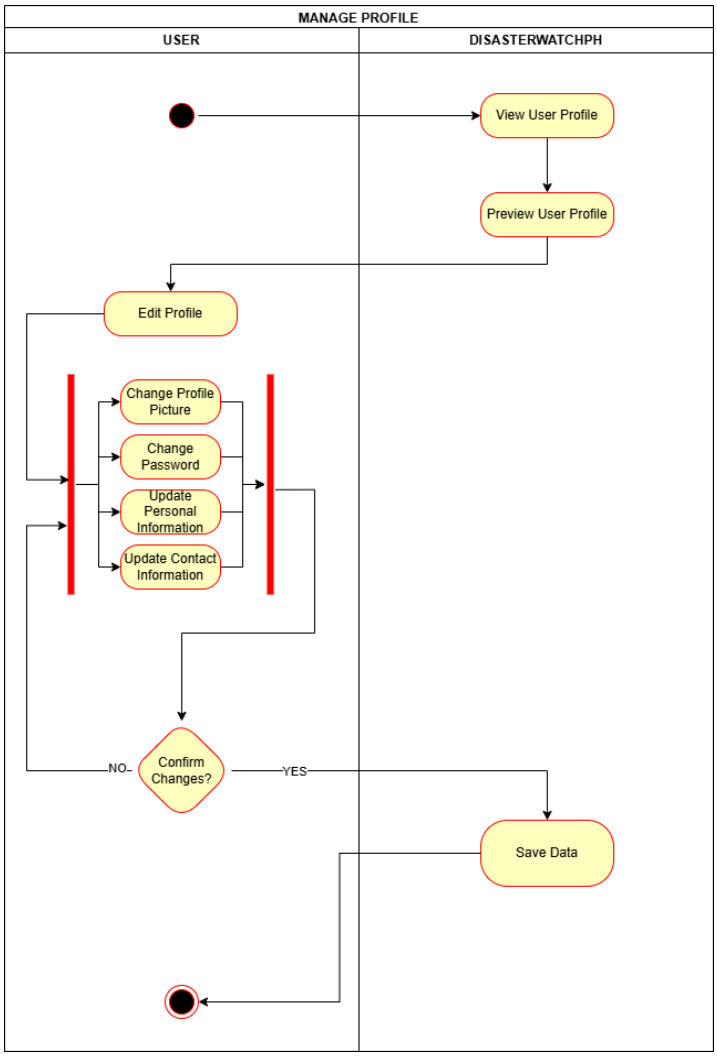


Figure 3.8 Activity Diagram: View Community Feed

This process shows the flow of activity when the user needs to interact with the Community Feed.

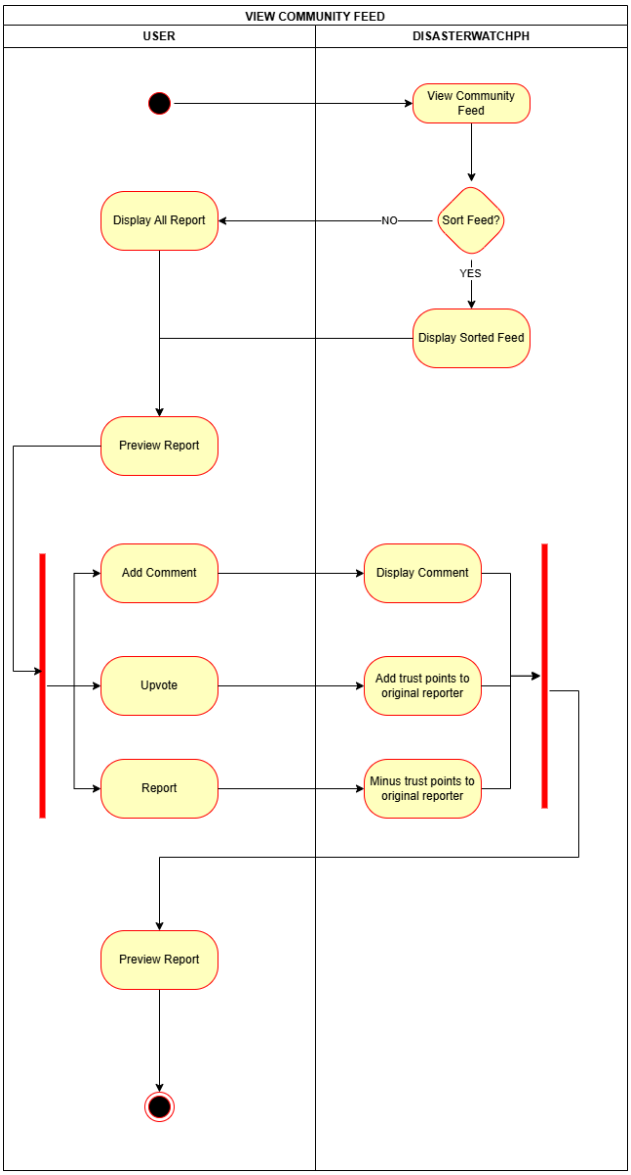


Figure 3.9 Activity Diagram: View Emergency Hotlines

This process shows the flow of activity when the user needs to call for an emergency hotline

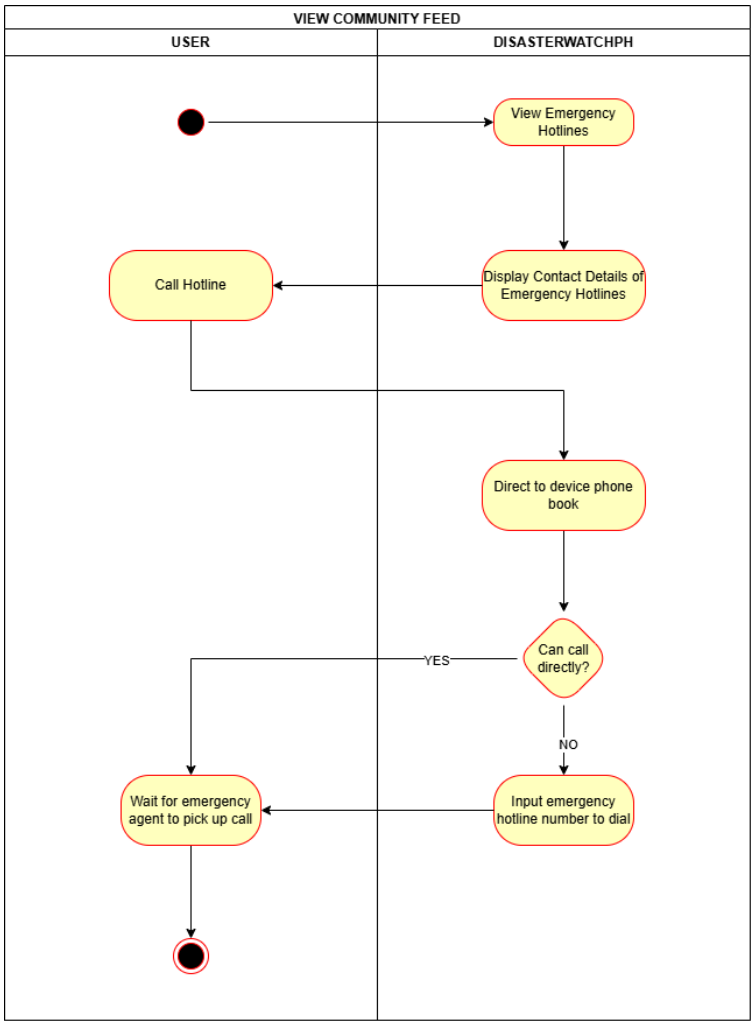


Figure 3.10 Activity Diagram: Respond to Report

This process shows the flow of activity when the responder needs to respond to a report.

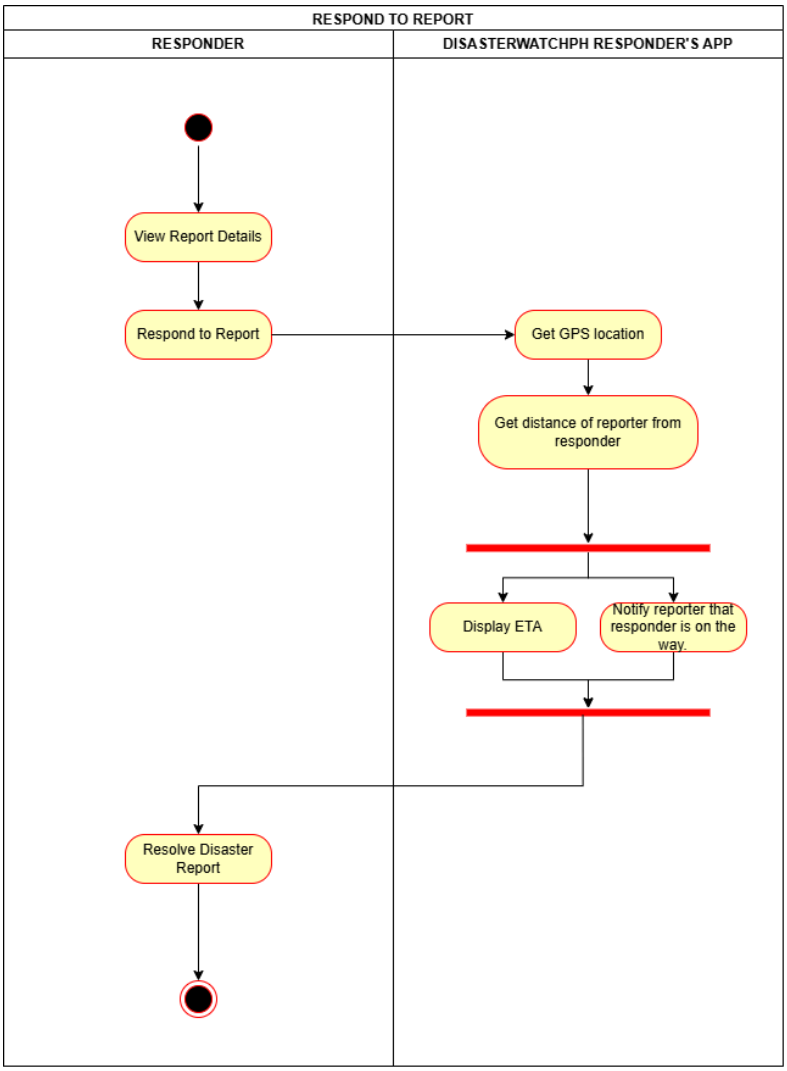


Figure 3.11 Activity Diagram: Feed Approval

This process shows the flow of activity when the responder needs to approve the disaster report to be displayed in the Community Feed.

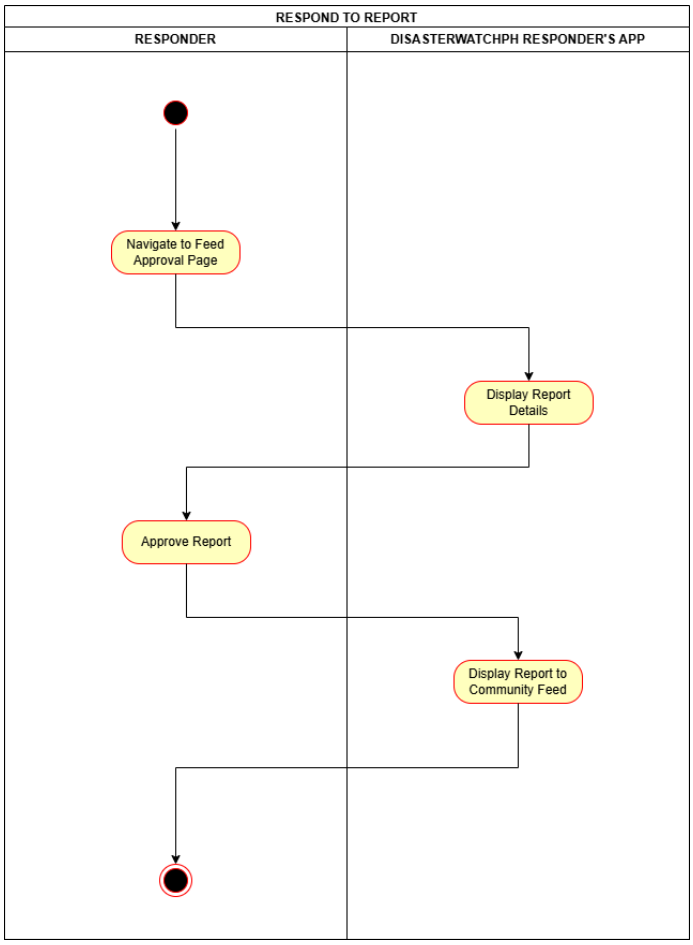
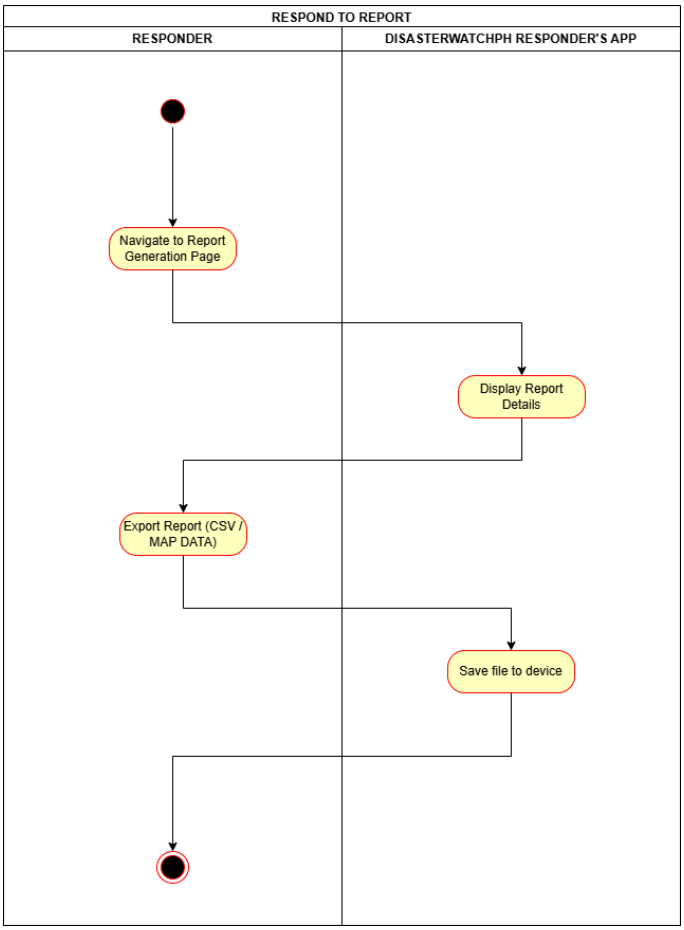


Figure 3.12 Activity Diagram: Report Generation

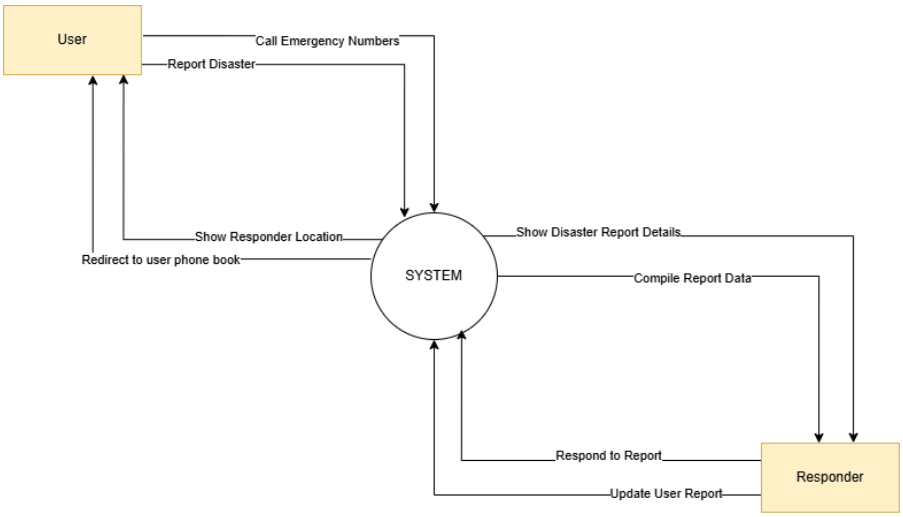
This process shows the flow of activity when the responder needs to export the records to their device.



Context Flow Diagram

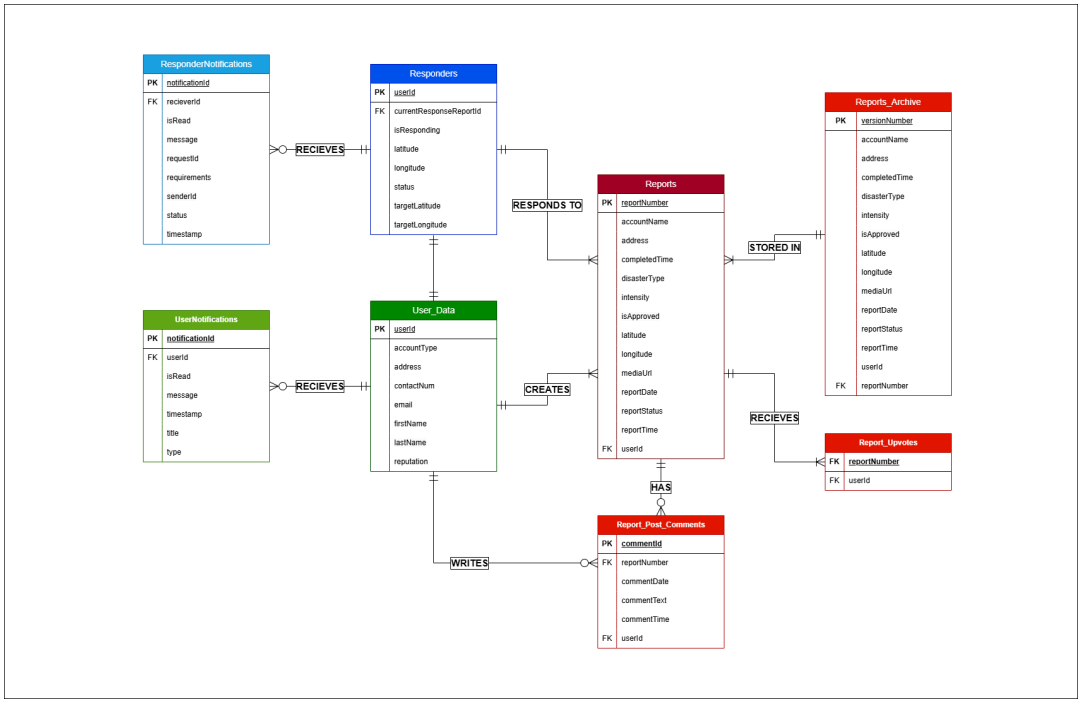
This diagram is a visual representation that shows the interactions between the entities (user and responder) and the system. It provides a simple overview of the system's relationship with the entities with the help of arrows.

Figure 3.13 Context Flow Diagram



Entity Relationship Diagram

Figure 3.14: Entity Relationship Diagram



User Interface Design

The researchers developed a user interface design plan, in line with the system requirements for the DisasterWatchPH and the DisasterWatchPH Responders App.

DisasterWatchPH User Interface Design

Figure 3.15 User Interface Design - Login Page

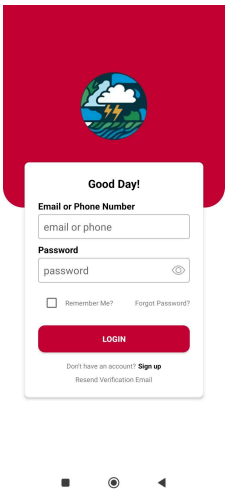


Figure 3.16 User Interface Design - Sign Up Page

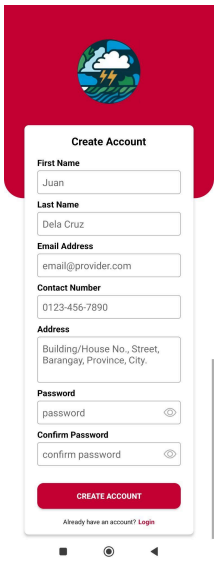


Figure 3.17 User Interface Design - Sign Up Verification Page

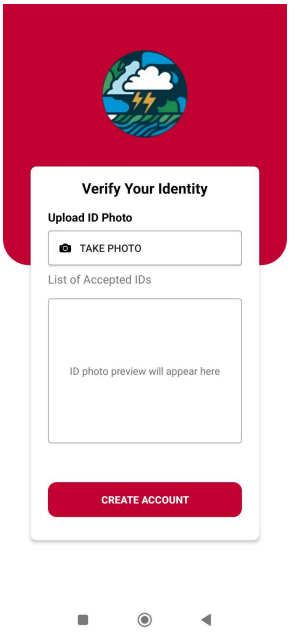


Figure 3.18 User Interface Design - Map (Home) Page

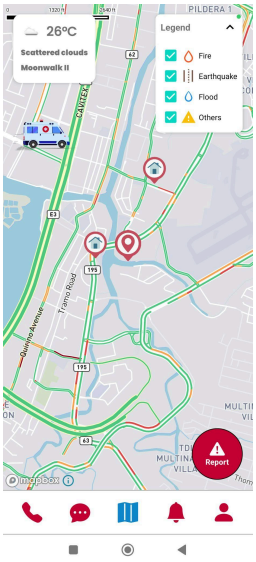


Figure 3.19 User Interface Design - Pop-up Notification

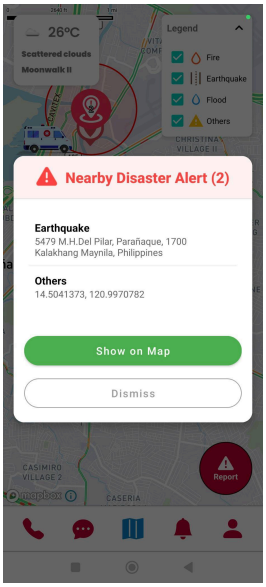


Figure 3.20 User Interface Design - View User Profile Page

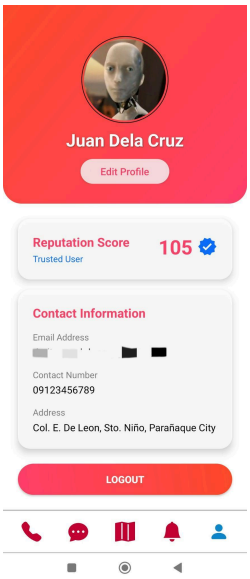


Figure 3.21 User Interface Design - Edit User Profile Page

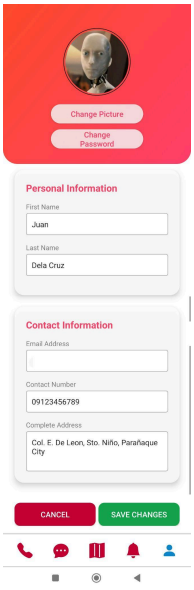


Figure 3.22 User Interface Design - Pop-up Report Incident/Disaster

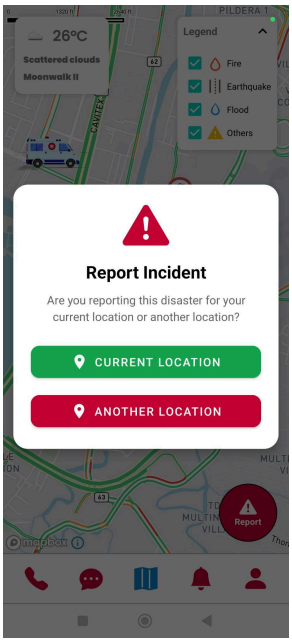


Figure 3.23 User Interface Design - Submit Report Details Page

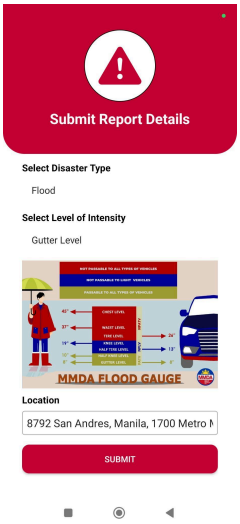


Figure 3.24 User Interface Design - Review Report Details Page

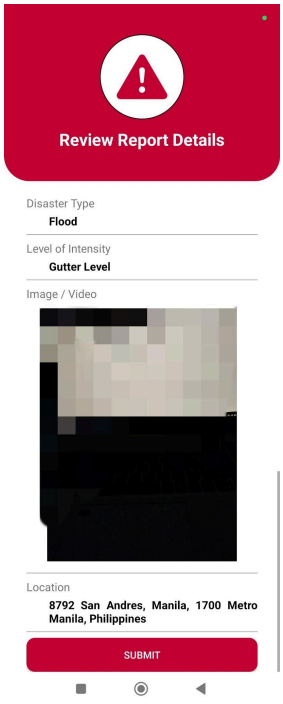


Figure 3.25 User Interface Design - Notifications Page

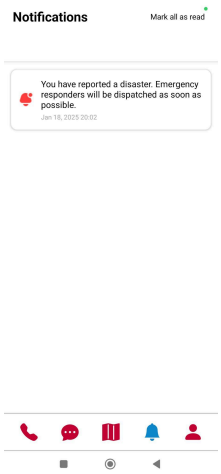


Figure 3.26 User Interface Design - Community Feed Page

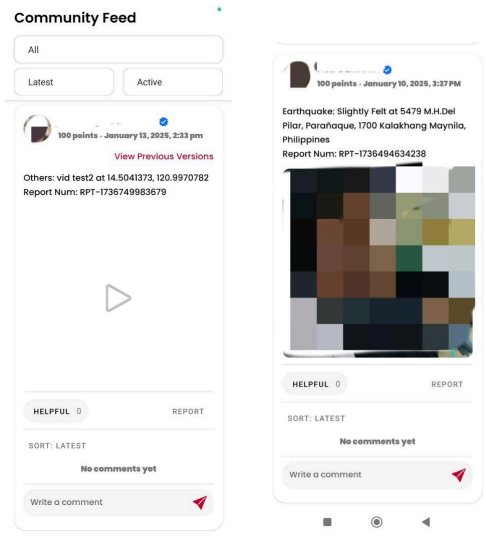


Figure 3.27 User Interface Design - Emergency Hotlines Page

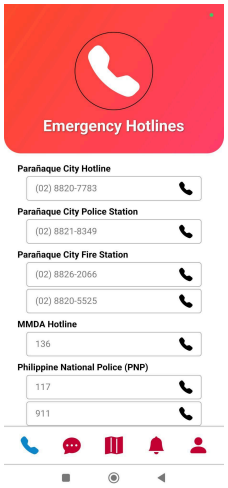


Figure 3.28 User Interface Design (Responders App) - Account Approval

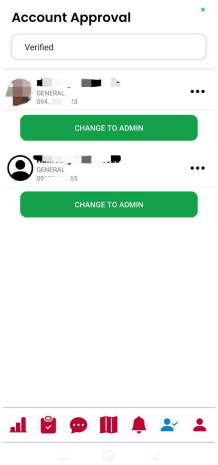


Figure 3.28 User Interface Design (Responders App) - Feed Approval

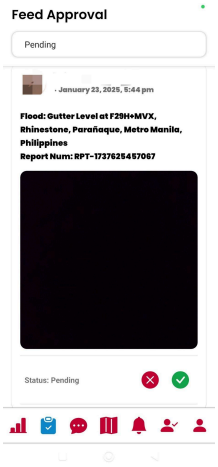


Figure 3.28 User Interface Design (Responders App) - Report Generation

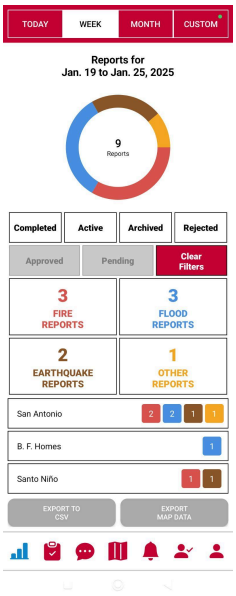


Figure 3.28 User Interface Design (Responders App) - Report Details

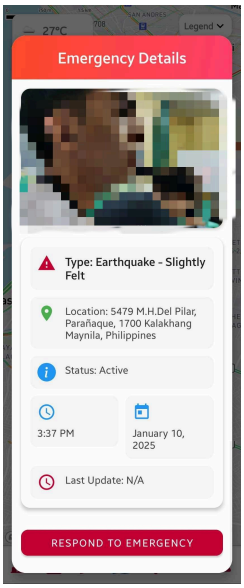


Figure 3.28 User Interface Design (Responders App) - Update Report

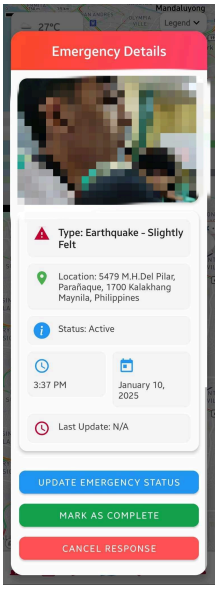


Figure 3.28 User Interface Design (Responders App) - Map while responding

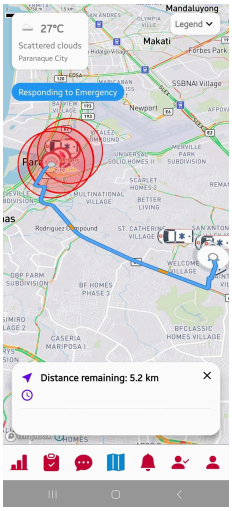


Figure 3.28 User Interface Design (Responders App) - Request Reinforcement

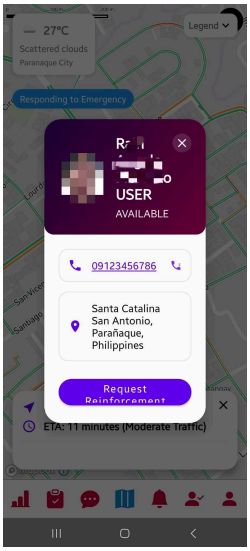


Figure 3.28 User Interface Design (Responders App) - Request Reinforcement Declined

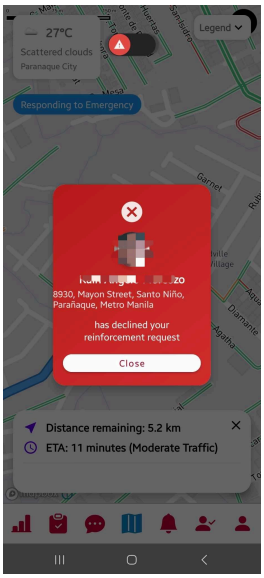


Figure 3.28 User Interface Design (Responders App) - Request Reinforcement Accepted

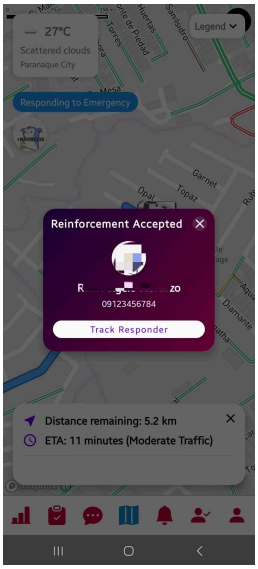
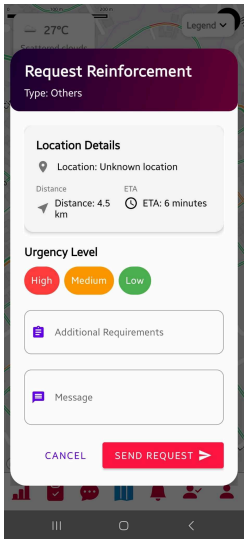


Figure 3.28 User Interface Design (Responders App) - Request Reinforcement Details



Software Requirements Specification (SRS)

Technical Requirements

Development Environment

- Language: Kotlin, Java
- Minimum SDK: API 24 (Android 7.0)
- Target SDK: API 34 (Android 14)
- Build Tools: Gradle 8.0
- IDE: Android Studio

Core Dependencies:

- Firebase (Authentication, Realtime Database, Storage)
- Mapbox SDK
- OpenWeatherMap API

- AndroidX Components
- Material Design Components

Storage Requirement:

- Download Size:
    - DisasterWatchPH: 129mb
    - DisasterWatchPH Responders App: 112mb
- App permissions:
    - access to camera
    - access to audio
    - show notifications
    - access location
    - internet / Data connection
    - read/write to storage
    - access to phone/dialer (DisasterWatchPH)

Cost Analysis and Infrastructure Requirements

Building a scalable and efficient infrastructure means detailing the cost analysis of tools and services. This section provides an overview of the current development infrastructure, projected production costs, and strategies for cost optimization. The focus is on Firebase and Mapbox, chosen for their ease of integration, real-time capabilities, and scalable pricing models. This analysis ensures that the application remains cost-efficient as it scales with user adoption.

1. Current Development Infrastructure

Table 1a.

Cost Analysis for Mapping Services (Mapbox)

Usage Overview (Free Tier)		
Service	**Current Usage**	**Free Tier Limit**
Navigation SDK	4/100 monthly active users	100 monthly active users
Directions API	125/100,000 requests	100,000 requests
Maps SDK	10/25,000 monthly users	25,000 monthly users
Geocoding API	201/100,000 requests	100,000 requests
		Current Cost: PHP 0 (within free tier)

Table 1b.

Cost Analysis for Firebase Services (Free Spark Plan Usage)

Cloud Firestore		
Metric	**Usage**	**Free Tier Limit**
Storage	1 GiB (~20M messages)	1 GiB
Document writes	600,000	20,000/day (600,000/month)
Document reads	1,500,000	50,000/day (1,500,000/month)
Document deletes	600,000	20,000/day (600,000/month)
		Current Cost: PHP 0

Realtime Database		
Metric	**Usage**	**Free Tier Limit**
Storage	1 GB (~20M chat messages)	1 GB
Data transfer	10 GB (~200M chat messages)	10 GB
		Current Cost: PHP 0

Authentication		
Metric	**Usage**	**Free Tier Limit**
Monthly active users	Up to 50,000	50,000
SAML/OIDC users	Up to 50	50
Phone Authentication	Based on SMS sent	Dependent on region
		Current Cost: PHP 0

Cloud Storage		
Metric	**Usage**	**Free Tier Limit**
Storage	5 GB (~2,500 high-res photos)	5 GB
Data transfer	Data transfer	1 GB/day
Operations	2,100,000	20K uploads/day, 50K downloads/day
		Current Cost: PHP 0

Cloud Functions		
Metric	**Usage**	**Free Tier Limit**
Invocations	2,000,000	2,000,000/month
GB-seconds	400,000	400,000/month
CPU-seconds	200,000	200,000/month
Networking egress	5 GB	5 GB
		Current Cost: PHP 0

Hosting		
Metric	**Usage**	**Free Tier Limit**
Storage	10 GB	10 GB
Data transfer	10 GB	360 MB/day
		Current Cost: PHP 0

2. Projected Production Costs

Table 2a.

Cost Analysis for Mapping Services (Mapbox)

Pricing Overview		
Service	**Free Tier Limit**	**Cost Beyond Free Tier**
Map Loads	50,000 map loads/month	$5 per 1,000 additional map loads
Geocoding API	100,000 requests/month	$0.75 per 1,000 additional requests
Cost Estimate in PHP: Assuming an exchange rate of 1 USD = 58.76 PHP		

Note: Prices are based on Mapbox's pricing as of January 2025.

Service	**Cost Beyond Free Tier (USD)**	**Cost Beyond Free Tier (PHP)**
Map Loads	$5 per 1,000	~PHP 294 per 1,000
Geocoding API	$0.75 per 1,000	~PHP 44 per 1,000

Note: Actual costs may vary based on usage patterns and current exchange rates.

Table 2b.

Cost Analysis for Firebase Blaze Plan (Pay-as-you-go rates)

Cloud Firestore		
Metric	**Cost**	**Cost in PHP (per unit)**
Storage	$0.18/GB/month	~PHP 10.58/GB/month
Document writes	$0.18/100K	~PHP 10.58/100K
Document reads	$0.06/100K	~PHP 3.53/100K
Document deletes	$0.02/100K	~PHP 1.18/100K

Realtime Database		
Metric	**Cost**	**Cost in PHP (per unit)**
Storage	$5/GB/month	~PHP 294/GB/month
Download	$1/GB	~PHP 58.76/GB

Authentication		
Metric	**Cost (USD)**	**Cost in PHP (per unit)**
Additional users	$0.01/user/month	~PHP 0.59/user/month
First 50,000 users	Free	Free
Phone authentication	Based on SMS sent	~Varies by region ~PHP 7.03/SMS/user

Cloud Storage		
Metric	**Cost (USD)**	**Cost in PHP (per unit)**
Storage	$0.026/GB/month	~PHP 1.53/GB/month
Download	$0.12/GB	~PHP 7.05/GB
Upload	$0.05/GB	~PHP 2.94/GB

Cloud Functions		
Metric	**Cost (USD)**	**Cost in PHP (per unit)**
Invocations	First 2M free	Free
Additional invokes	$0.40/million	~PHP 23.50/million
Compute time	$0.00001/GB-second	~PHP 0.00059/GB-second
Network egress	$0.12/GB	~PHP 7.05/GB

Hosting		
Metric	**Cost (USD)**	**Cost in PHP (per unit)**
Storage	$0.026/GB/month	~PHP 1.53/GB/month
Data transfer	$0.12/GB	~PHP 7.05/GB

Justification for Firebase and Mapbox

Firebase and Mapbox were chosen for their ease of integration and robust real-time capabilities. Firebase offers a comprehensive suite of tools that simplify backend development, including authentication, real-time databases, and cloud storage, all of which seamlessly scale with usage. Mapbox provides advanced mapping and navigation services with high customization options, essential for creating an engaging user experience.

Scalability

Both Firebase and Mapbox adopt a **pay-as-you-go model**, allowing the application to scale with user adoption and increasing demand. This approach minimizes upfront costs while supporting growth as usage expands.

Future Optimization

While Firebase and Mapbox meet current requirements, future growth may necessitate transitioning to Google Maps API to leverage its expanded feature set and global reliability. The team will continuously monitor costs and performance to implement the most cost-effective and efficient solutions as the user base grows.

CHAPTER 4

RESULTS AND DISCUSSION

This chapter presents an evaluation of the developed system, focusing on survey results and analysis to assess its effectiveness and usability. It highlights key insights gained from evaluation, providing a clearer understanding of the system's effectiveness and value to the beneficiaries.

The researchers conducted an electronic survey to collect data insights from the users of the DisasterWatchPH and DisasterWatchPH Responders App. A total of 60 participants answered the survey, providing insights about the system. The surveys were divided into 2 types: for the general users and for the emergency responders. With the help of the data collected through this survey, the researchers aim to assess whether the system successfully addresses the problems identified and fulfills its objectives.

1. Insufficient Real-Time Disaster Information

Table 1a.

For General Users

Real-Time Disaster Information	Weighted Mean	Verbal Interpretation
1. The app provides real-time updates on disasters and other disaster-related issues. *Ang app ay nagbibigay ng nasa tamang oras na impormasyon tungkol sa mga sakuna at iba pang kaugnay na isyu.*	4.85	Strongly Agree
2. Notifications are timely and relevant to my location. *Ang mga abiso ay napapanahon at nauugnay sa aking lokasyon.*	4.69	Strongly Agree
3. The information provided is accurate and reliable. *Ang impormasyong ibinibigay ay tama at maaasahan.*	4.85	Strongly Agree
4. Weather integration helps me prepare for potential disasters. *Ang pagsasama ng ulat ng panahon ay nakakatulong upang ako'y makapaghanda sa mga posibleng sakuna.*	4.80	Strongly Agree
5. The app updates disaster reports automatically when new information becomes available. *Ina-update ng app ang mga ulat ng sakuna nang awtomatiko kapag may bagong impormasyon*	4.82	Strongly Agree

The table shows that in terms of Real-Time Disaster Information, the users strongly agree that the DisasterWatchPH provides real-time updates on disasters and other disaster-related incidents with a weighted mean of 4.5, that the notifications are timely and relevant to their location with a weighted mean of 4.69, that the information provided by the app is accurate and reliable with a weighted mean of 4.85, that the weather integration helps with their preparation for potential disasters with a weighted mean of 4.80, and that the application updates disaster reports automatically when new information becomes available with a weighted mean of 4.82.

Table 1.b.

For Emergency Responders

Real-Time Disaster Information	Weighted Mean	Verbal Interpretation
1. The app provides detailed real-time updates about reported disasters. *Ang app ay nagbibigay ng detalyado at real-time na update tungkol sa mga iniulat na sakuna.*	4.8	Strongly Agree
2. Notifications for new or updated reports are timely and relevant. *Ang mga abiso para sa mga bagong ulat o update ay napapanahon at nauugnay.*	4.8	Strongly Agree
3. The app improves situational awareness through geo-mapping updates. *Pinapabuti ng app ang kamalayan sa sitwasyon sa pamamagitan ng mga geo-mapping update.*	4.8	Strongly Agree
4. Real-time updates allow me to prioritize incidents effectively. *Ang real-time na mga update ay tumutulong sa akin na unahin ang mga insidente nang epektibo.*	4.8	Strongly Agree
5. I receive critical disaster information that aids quick decision-making. *Tumatanggap ako ng mahalagang impormasyon tungkol sa sakuna na tumutulong sa mabilis na paggawa ng desisyon.*	4.8	Strongly Agree

The table shows that in terms of Real-Time Disaster Information, the emergency responders strongly agree that the DisasterWatchPH Responders App provides detailed real-time updates about reported disasters with a weighted mean of 4.8, that the notifications for new or updated reports are timely and relevant with a weighted mean of 4.8, that the app improves their situational awareness through geo-mapping updates with a weighted mean of 4.8, that the real-time updates allows them to prioritize incidents effectively with a weighted mean of 4.8, and that they receive critical disaster information that aids quick decision-making with a weighted mean of 4.8.

2. Limited Community Engagement in Disaster Reporting

Table 2.a.

For General Users

Community Engagement in Disaster Reporting	Weighted Mean	Verbal Interpretation
1. The community feed encourages interaction and sharing of disaster updates. *Ang community feed ay naghihikayat ng interaksyon at pagbabahagi ng mga update tungkol sa sakuna.*	4.78	Strongly Agree
2. Sorting and commenting features make it easier to share and interact with reports. *Ang mga tampok na pag-aayos at komento ay nagpapadali upang magbahagi at makipag-ugnayan sa mga ulat.*	4.75	Strong Agree
3. Disaster categories (e.g., Fire, Flood) make it easy to classify reports. *Ang mga kategorya ng sakuna (hal. Sunog, Baha) ay nagpapadali sa pag-uuri ng mga ulat.*	4.82	Strongly Agree
4. I feel confident contributing to the app, knowing that my reports help others. *Ako'y kumpiyansa sa pag-aambag sa app dahil alam kong nakakatulong ang aking mga ulat sa iba.*	4.84	Strongly Agree

The table shows that in terms of Community Engagement in Disaster Reporting, the users strongly agree that the DisasterWatchPH encourages them to interact and share disaster updates with a weighted mean of 4.78, that the sorting and commenting features of the app made it easier to share and interact with the reports with a weighted mean of 4.75, that the disaster categories made it easy to classify the reports with a weighted mean of 4.82, and that the app helps them feel confident in contributing to the app with the knowledge that their reports can help others with the weighted mean of 4.84.

Table 2.b.

For Emergency Responders

Responding To Disaster Reports	Weighted Mean	Verbal Interpretation
1. It is easy to accept and respond to disaster reports using the app. *Madaling tanggapin at tumugon sa mga ulat ng sakuna gamit ang app.*	4.8	Strongly Agree
2. I can update the status of reports efficiently. *Madaling ma-update ang status ng mga ulat.*	4.4	Strongly Agree
3. The app allows me to coordinate effectively with other responders. *Pinapadali ng app ang pakikipag-ugnayan sa iba pang mga tumutugon.*	4.6	Strongly Agree
4. Real-time vehicle tracking makes coordination easier during emergencies. *Ang real-time na pag-track ng sasakyan ay nagpapadali sa koordinasyon sa panahon ng mga emergency.*	4.8	Strongly Agree
5. The app simplifies the process of requesting reinforcements for high-severity incidents. *Pinapasimple ng app ang proseso ng paghingi ng karagdagang tauhan para sa mga insidenteng may mataas na tindi.*	5.0	Strongly Agree

The table shows that in terms of responding to disaster reports, emergency responders strongly agree that the DisasterWatchPH Responders App makes it easy to accept and respond to disaster reports with a weighted mean of 4.8, that they can update the status of reports efficiently with a weighted mean of 4.4, that the app allows them to coordinate effectively with other emergency responders with a weighted mean of 4.6, that the real-time vehicle tracking makes coordination easier during emergencies with a weighted mean of 4.8, and that the app simplifies the process of requesting reinforcements for high-severity incidents with a weighted mean of 5.0.

3. Challenges in Identifying Nearby Disasters

Table 3.a.

For General Users

Identifying Nearby Disasters	Weighted Mean	Verbal Interpretation
1. The geo-map helps me identify disasters near my location. *Ang geo-map ay tumutulong upang matukoy ang mga sakuna malapit sa aking lokasyon.*	4.87	Strongly Agree
2. The map provides clear visual updates on disaster locations. *Ang mapa ay nagbibigay ng malinaw na visual na update tungkol sa lokasyon ng sakuna.*	4.78	Strongly Agree
3. Notifications alert me when entering a disaster zone. *Ang mga abiso ay nagbibigay babala kapag papasok ako sa isang lugar ng sakuna.*	4.78	Strongly Agree
4. I can view the severity and details of nearby disasters on the map. *Makikita ko ang antas ng tindi at mga detalye ng mga sakuna malapit sa akin sa mapa.*	4.82	Strongly Agree
5. The app allows me to plan safer routes during disasters *Ang app ay tumutulong upang makapagplano ng mas ligtas na ruta sa panahon ng sakuna.*	4.82	Strongly Agree

The table shows that in terms of identifying nearby disasters, the users strongly agree that the DisasterWatchPH helps them identify disasters near their location with a weighted mean of 4.87, that the map feature of the app provides clear visual updates on disasters locations with a weighted mean of 4.78, that the notifications alerts them when entering a disaster zone with a weighted mean of 4.78, that the app allows them to view the severity and details of nearby disasters on the map with a weighted mean of 4.82, and that the app allows them to plan safer routes during disasters with a weighted mean of 4.82.

Table 3.b.

For Emergency Responders

Identifying Disaster Zones	Weighted Mean	Verbal Interpretation
1. The geo-map helps identify the most affected disaster zones. *Ang geo-map ay tumutulong sa pagtukoy ng mga lugar na lubos na apektado ng sakuna.*	4.6	Strongly Agree
2. Notifications for entering disaster zones are useful and reliable. *Ang mga abiso para sa pagpasok sa mga lugar ng sakuna ay kapaki-pakinabang at maaasahan.*	4.8	Strongly Agree
3. The map clustering feature makes it easier to manage multiple incidents. *Ang clustering feature ng mapa ay nagpapadali sa pamamahala ng maraming insidente.*	4.6	Strongly Agree
4. The app highlights areas requiring immediate attention. *Itinatampok ng app ang mga lugar na nangangailangan ng agarang pansin.*	5.0	Strongly Agree
5.. Disaster zones are clearly labeled by type and severity on the map. *Ang mga lugar ng sakuna ay malinaw na naka-label batay sa uri at tindi sa mapa.*	5.0	Strongly Agree

The table shows that in terms identifying disaster zones, the emergency responders strongly agree that the DisasterWatchPH Responders App helps in identifying the most affected disaster zones with a weighted mean of 4.6, that the notifications for entering disaster zones are useful and reliable with a weighted mean of 4.8, that the map clustering feature makes it easier to manage multiple incidents with a weighted mean of 4.6, that the app highlights the areas that requires immediate attention with a weighted mean of 5.0, and that the disaster zones are clearly labeled by type and severity on the map with a weighted mean of 5.0.

4. Inadequate Access to Emergency Services

Table 4.a.

For General Users

Access to Emergency Services	Weighted Mean	Verbal Interpretation
1. The app provides emergency contact numbers based on my location. *Ang app ay nagbibigay ng mga numero ng contact para sa mga serbisyong pang-emergency base sa aking lokasyon.*	4.89	Strongly Agree
2. The emergency contact details are relevant and up-to-date. *Ang mga detalye ng contact ng emergency ay nauugnay at napapanahon.*	4.85	Strongly Agree
3. It is easy to access emergency services through the app. *Madaling ma-access ang mga serbisyong pang-emergency sa pamamagitan ng app.*	4.89	Strongly Agree
4. The app provides direct calling options for emergency services. *Ang app ay nagbibigay ng direktang opsyon para sa pagtawag sa mga serbisyong pang-emergency.*	4.78	Strongly Agree
5. Emergency contact details are categorized by type of service needed. *Ang mga detalye ng emergency contact ay nakaayos ayon sa uri ng serbisyong kinakailangan.*	4.84	Strongly Agree

The table shows that in terms of access to emergency services, the users strongly agree that the DisasterWatchPH provides emergency contact numbers with a weighted mean of 4.89, that the emergency contact details are relevant and up-to-date with a weighted mean of 4.85, that it is easy to access emergency services through the app with a weighted mean of 4.89, that the app provides direct calling options for emergency services with a weighted mean 4.78, that the emergency contact details are categorized by type of service needed with a weighted mean of 4.84.

Table 4.b.

For Emergency Responders

User Authentication And Security	Weighted Mean	Verbal Interpretation
1. The app ensures secure authentication for responders through ID and license verification. *Pinapangalagaan ng app ang ligtas na pag-authenticate para sa mga tumutugon gamit ang ID at pag-verify ng lisensya.*	4.8	Strongly Agree
2. I feel confident that my data is secure in the app. *Ako'y kumpiyansa na ang aking data ay ligtas sa app.*	4.6	Strongly Agree
3. It is easy to access emergency services through the app. *Madaling ma-access ang mga serbisyong pang-emergency sa pamamagitan ng app.*	4.6	Strongly Agree
4. My identity and vehicle information are securely managed. *Ang aking pagkakakilanlan at impormasyon sa sasakyan ay ligtas na pinamamahalaan.*	4.6	Strongly Agree
5. The app's security features meet professional standards for disaster response systems. *Ang mga tampok sa seguridad ng app ay naaayon sa mga pamantayang propesyonal para sa mga sistema ng pagtugon sa sakuna.*	4.8	Strongly Agree

The table shows that in terms of user authentication and security, the emergency responders strongly agree that the DisasterWatchPH Responders App ensures secure authentication for responders through ID and license verification with a weighted mean of 4.8, they they feel confident that their data is secure in the app with a weighted mean of 4.6, that it is easy to access emergency services through the app with a weighted mean of 4.6, that their identity and vehicle information are securely managed with a weighted mean of 4.6, and that the app's security features meet professional standards for disaster response systems with a weighted mean of 4.8.

5. Issues with User Authentication and Report Verification

Table 5.a.

For General Users

User Authentication and Report Verification	Weighted Mean	Verbal Interpretation
1. The app's sign-up process (email, ID, facial verification) ensures user security. *Tinitiyak ng proseso ng pag-sign up ng app (email, ID, facial verification) ang seguridad ng gumagamit.*	4.85	Strongly Agree
2. I feel confident my reports are secure and verified. *Ako'y kumpiyansa na ang aking mga ulat ay ligtas at na-verify.*	4.76	Strongly Agree
3. The app prevents false accounts through proper user verification. *Pinipigilan ng app ang maling ulat sa pamamagitan ng tamang pag-verify ng gumagamit.*	4.78	Strongly Agree
4. The verification process makes the app more trustworthy. *Ang proseso ng pag-verify ay nagpapataas ng tiwala sa app.*	4.84	Strongly Agree
5. My personal information is well-protected within the app. *Ang aking personal na impormasyon ay ligtas na protektado sa app.*	4.84	Strongly Agree

The table shows that in terms of user authentication and report verification, the users strongly agree that the DisasterWatchPH's sign-up process ensures user security with a weighted mean of 4.85, that they are confident that their reports are secured and verified with a weighted mean of 4.76, that the app prevents false accounts through proper user verification with a weighted mean of 4.78, that the verification process makes the app more trustworthy with a weighted mean of 4.84, and that their personal information is well-protected within the app with a weighted mean of 4.84.

Table 5.b.

For Emergency Responders

Responders App-Specific Features	Weighted Mean	Verbal Interpretation
1. The app allows me to export detailed reports for post-disaster analysis. *Ang app ay nagbibigay ng kakayahan na mag-export ng detalyadong ulat para sa pagsusuri pagkatapos ng sakuna.*	4.8	Strongly Agree
2. I can track my team members' locations and responses in real time. *Maaari kong subaybayan ang lokasyon at tugon ng aking mga kasamahan sa real time.*	4.8	Strongly Agree
3. The app supports documentation of completed tasks and outcomes. *Sinusuportahan ng app ang dokumentasyon ng mga natapos na gawain at kinalabasan.*	4.6	Strongly Agree
4. Notifications help me manage my assigned tasks efficiently. *Ang mga abiso ay tumutulong sa akin na pamahalaan ang aking mga itinalagang gawain nang mahusay.*	4.4	Strongly Agree
5. The app simplifies communication between responders during critical incidents. *Pinapasimple ng app ang komunikasyon sa pagitan ng mga tumutugon sa mga kritikal na insidente.*	4.4	Strongly Agree

The table shows that in terms of responders app-specific features, the emergency responders strongly agree that the DisasterWatchPH Responders App allows them to export detailed report for post-disaster analysis with a weighted mean of 4.8, that they can track their team members' locations and responses in real time through the app with a weighted mean of 4.8, that the app supports documentation of completed tasks and outcomes with a weighted mean of 4.6, that the notifications helps them manage their assigned tasks efficiently with a weighted mean of 4.4, and that the app simplifies communication between responders during critical incidents with a weighted mean of 4.4.

6. IT Experts evaluation of the app using the ISO 25010

Table 6.a

For IT Experts - Functional Suitability of the app

A. Functional Suitability	Weighted Mean	Verbal Interpretation
1. The app supports reliable reporting for Earthquakes, Fires, Floods, and other related incidents. *Ang app ay sumusuporta sa maaasahang pag-uulat para sa Lindol, Sunog, Baha at iba pang mga katulad na mga insidente.*	4.90	Strongly Agree
2. The disaster categories align with user needs for disaster management. *Ang mga kategorya ng sakuna ay naaayon sa mga pangangailangan ng mga gumagamit para sa pamamahala ng sakuna.*	4.80	Strongly Agree
3. The reporting process is efficient and supports user-driven inputs. *Ang proseso ng pag-uulat ay mahusay at sumusuporta sa input ng mga gumagamit.*	4.80	Strongly Agree
4. Features like geo-mapping and media uploads enhance disaster reporting. *Ang mga tampok tulad ng geo-mapping at pag-upload ng media ay nagpapahusay sa pag-uulat ng sakuna.*	4.90	Strongly Agree
5. The app ensures accurate real-time disaster location pinning. *Tinitiyak ng app ang tumpak na real-time na pag-pin ng lokasyon ng sakuna.*	4.90	Strongly Agree

The table shows that for IT experts strongly agree that the DisasterWatchPH and the DisasterWatchPH Responders App supports reliable reporting for disasters with a weighted mean of 4.90, that the disaster categories aligns with user needs for disaster management with a weighted mean of 4.80, that the reporting process is efficiency and supports user-driven inputs with a weighted mean 4.80, that the features like geo-mapping and media uploads enhance disaster reporting with a weighted mean of 4.90, and that the the app ensures accurate real-time disaster location pinning with a weighted mean of 4.90.

Table 6.b

For IT Experts - Interaction Capability of the app

B. Interaction Capability	Weighted Mean	Verbal Interpretation
1. The app provides an intuitive user interface that enhances usability. *Ang app ay nagbibigay ng intuitive na user interface na nagpapahusay sa paggamit.*	4.90	Strongly Agree
2. GPS-based location pinning is accurate and easy to use. *Ang GPS-based na pag-pin ng lokasyon ay tumpak at madaling gamitin.*	5.00	Strongly Agree
3. The community feed is interactive and promotes user engagement. *Ang community feed ay interactive at naghihikayat ng pakikilahok ng mga gumagamit.*	4.90	Strongly Agree
4. Sorting and filtering disaster reports improves user navigation. *Ang pag-aayos at pag-filter ng mga ulat ng sakuna ay nagpapabuti sa pag-navigate ng gumagamit.*	4.90	Strongly Agree
5. The map visualization is responsive and provides clear disaster data. *Ang visualization ng mapa ay tumutugon at nagbibigay ng malinaw na datos ng sakuna.*	4.90	Strongly Agree

The table shows that for IT experts strongly agree that the DisasterWatchPH and the DisasterWatchPH Responders App provides an intuitive user interface that enhances usability with a weighted mean of 4.90, that the GPS-based location pinning is accurate and easy to use with a weighted mean of 5.00, that the community feed is interactive and promotes user engagement with a weighted mean of 4.90, that the sorting and filtering disaster reports improves user navigation with a weighted mean of 4.90, and that the map visualization is responsive and provides clear disaster data with a weighted mean of 4.90.

Table 6.c

For IT Experts - Security of the app

C. Security	Weighted Mean	Verbal Interpretation
1. The app's authentication process (email) ensures user security. *Tinitiyak ng proseso ng authentication ng app (email) ang seguridad ng gumagamit.*	4.80	Strongly Agree
2. User data encryption complies with industry best practices. *Ang pag-encrypt ng datos ng gumagamit ay sumusunod sa pinakamahuhusay na kasanayan sa industriya.*	4.80	Strongly Agree
3. The app prevents unauthorized access through robust security measures. *Pinipigilan ng app ang di-awtorisadong pag-access gamit ang matitibay na hakbang sa seguridad.*	4.90	Strongly Agree
4. The verification process (ID and facial recognition) enhances credibility. *Ang proseso ng pag-verify (ID at facial recognition) ay nagpapataas ng kredibilidad.*	5.00	Strongly Agree
5. Data privacy policies align with international security standards. *Ang mga polisiya sa privacy ng data ay naaayon sa mga pandaigdigang pamantayan sa seguridad.*	4.90	Strongly Agree

The table shows that for IT experts strongly agree that the DisasterWatchPH and the DisasterWatchPH Responders App authentication process (email) ensures user security with a weighted mean of 4.80, that the User data encryption complies with industry best practices with a weighted mean of 4.80, that the app prevents unauthorized access through robust security measures with a weighted mean of 4.90, that the verification process (ID and facial recognition) enhances credibility with a weighted mean of 5.00, and that the data privacy policies align with international security standards with a weighted mean of 4.90.

Table 6.d

For IT Experts - Compatibility of the app

D. Compatibility	Weighted Mean	Verbal Interpretation
1. The app functions seamlessly on GPS-enabled Android devices. *Ang app ay gumagana nang maayos sa mga Android device na may GPS.*	4.90	Strongly Agree
2. Disaster location pinning is accurate across various Android devices. *Ang pag-pin ng lokasyon ng sakuna ay tumpak sa iba't ibang Android device.*	4.80	Strongly Agree
3. The app is optimized for different screen sizes and resolutions. *Ang app ay na-optimize para sa iba't ibang laki ng screen at resolusyon.*	4.90	Strongly Agree
4. Integration with GPS ensures precise disaster reporting and monitoring. *Ang integrasyon sa GPS ay tinitiyak ang tumpak na pag-uulat at pagsubaybay sa sakuna.*	4.80	Strongly Agree
5. The app's compatibility supports effective real-time updates. *Ang pagiging compatible ng app ay sumusuporta sa epektibong real-time na mga update.*	4.80	Strongly Agree

The table shows that for IT experts strongly agree that the DisasterWatchPH and the DisasterWatchPH Responders App functions seamlessly on GPS-enabled Android devices with a weighted mean of 4.90, that the disaster location pinning is accurate across various Android devices with a weighted mean of 4.80, that the app is optimized for different screen sizes and resolutions with a weighted mean of 4.90, that the integration with GPS ensures precise disaster reporting and monitoring with a weighted mean of 4.80, and that the app's compatibility supports effective real-time updates with a weighted mean of 4.80.

Table 6.e

For IT Experts - Maintainability of the app

E. Maintainability	**Weighted Mean**	**Verbal Interpretation**
1. The app's focused scope supports easier updates and expansions. *Ang nakatutok na saklaw ng app ay sumusuporta sa mas madaling pag-update at pagpapalawak.*	4.90	Strongly Agree
2. The system architecture is scalable and allows for future improvements. *Ang arkitektura ng sistema ay scalable at nagbibigay-daan para sa mga hinaharap na pagpapabuti.*	4.80	Strongly Agree
3. Bug fixes and updates can be implemented efficiently. *Ang pag-aayos ng mga bug at mga update ay maaaring maisakatuparan nang mahusay.*	4.80	Strongly Agree
4. The codebase supports long-term maintenance and technical improvements. *Ang codebase ay sumusuporta sa pangmatagalang maintenance at mga teknikal na pagpapabuti.*	4.70	Strongly Agree
5. Documentation ensures maintainability for developers. *Ang dokumentasyon ay tinitiyak ang maintainability para sa mga developer.*	4.80	Strongly Agree

The table shows that for IT experts strongly agree that the DisasterWatchPH and the DisasterWatchPH Responders App's focused scope supports easier updates and expansions with a weighted mean of 4.90, that the system architecture is scalable and allows for future improvements with a weighted mean of 4.80, that the bug fixes and updates can be implemented efficiently with a weighted mean of 4.80, that the codebase supports long-term maintenance and technical improvements with a weighted mean of 4.70, and that the documentation ensures maintainability for developers with a weighted mean of 4.80.

CHAPTER 5

SUMMARY OF FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

Summary of Findings

The DisasterWatchPH system, along with its companion DisasterWatchPH Responders App, was developed to address significant gaps in disaster reporting and management in the Philippines. This comprehensive study led to several key findings:

1. **Real-Time Disaster Reporting**: The application empowers users to report disasters such as earthquakes, fires, floods, and other significant emergencies in real time. Utilizing GPS and geo-mapping technologies, the system ensures accurate and localized data, enhancing decision-making for both community members and responders.
2. **User-Centric Design**: A user-friendly interface ensures accessibility for diverse users. Features such as map visualization, disaster reporting, and navigation were carefully designed for intuitive use, enabling seamless interaction with the system.
3. **Robust Security Measures**: Advanced user authentication mechanisms, including ID verification linked to facial recognition, email verification, and encrypted data storage, ensure the credibility of user reports while safeguarding personal information.
4. **Reliable Performance and Compatibility**: The app demonstrates excellent compatibility with Android devices equipped with GPS, ensuring broad accessibility. Performance tests showed stable operation with minimal crash rates, even under various usage scenarios.

5. **Active Community Engagement**: By incorporating interactive features such as upvoting, commenting, and sorting reports in the community feed, the platform fosters participation and collaboration, creating a more engaged and informed user base.
6. **Efficiency in Emergency Response**: The Responders App streamlines disaster management operations. Key functionalities include real-time tracking, status updates, and detailed report management, which enable responders to act swiftly and effectively.
7. **Identified Challenges**: Despite its strengths like restriction to Android devices and a fixed notification radius that could exclude nearby relevant incidents.

Conclusions

Based on the findings, the study draws the following conclusions:

1. **Improving Disaster Preparedness**: DisasterWatchPH significantly enhances disaster preparedness by equipping communities with reliable, real-time information that supports informed decision-making during emergencies. Additionally, the inclusion of the community feed allows users to see reports submitted by others in their area, increasing their awareness of ongoing disasters. This feature fosters a sense of vigilance and encourages proactive measures to ensure personal safety and community resilience..
2. **Technological Integration**: The successful application of GPS, geo-mapping, and Firebase technologies bridges the gap between communities and responders, facilitating effective disaster reporting and management.

3. **Community and Responder Synergy**: The dual-application structure promotes collaboration by enabling citizens to report incidents while providing responders with the tools needed for efficient disaster response.
4. **Trustworthy and Secure System**: The platform's robust security measures build user trust and maintain data integrity, ensuring the credibility of disaster reports.
5. **Adherence to Standards**: Aligning with ISO 25010 software quality standards ensures the platform's functionality, maintainability, and adaptability, making it a scalable solution for disaster management.
6. **Addressing System Gaps**: By integrating real-time reporting with actionable insights for responders, DisasterWatchPH fills critical gaps in existing disaster management systems, empowering communities and authorities alike.

Recommendations

To maximize the system's potential and enhance its impact, the following recommendations are proposed:

1. **Expand Platform Compatibility**: Develop versions compatible with iOS and other operating systems to broaden accessibility and reach a wider audience.
2. **Customizable Notification Radius**: Allow users to adjust the radius for disaster alerts, enabling personalized settings to suit individual preferences and mobility.
3. **Conduct Community Awareness Campaigns**: Collaborate with local government units (LGUs) and community organizations to promote the app, educate the public on its features, and emphasize the importance of accurate disaster reporting.

4. **Integrate User Feedback Mechanisms**: Implement in-app feedback tools to continuously gather user suggestions and address identified issues, ensuring the system evolves to meet user needs.
5. **Expand Disaster Scope**: Include additional disaster categories such as landslides and volcanic eruptions, providing a more comprehensive disaster management platform.
6. **Refine Application Design**: Enhance the app's aesthetic and functional design to improve user experience, ensuring accessibility for both novice and experienced users.
7. **Develop Desktop Compatibility**: Introduce a desktop version of DisasterWatchPH to support administrative and professional disaster management activities. A desktop platform that would allow the other emergency responders and administrators to view a larger and more detailed map of reported disasters, providing a broader perspective for analysis and decision-making. Additionally, it would enable the emergency responders and admins to access and review exported data more effectively on a bigger screen, making it easier to analyze and plan disaster response strategies efficiently.
8. **Provide Automated Image Moderation and Reduce Agency Workload:** Implement an automated image moderation tool to flag or blur sensitive images before they appear in the community feed. This ensures users who prefer a less graphic experience can browse reports comfortably. Additionally, automation can reduce the workload of disaster response agencies by minimizing the need for manual review of sensitive content.

9. **Expand Geographical Coverage**: Gradually roll out the system to disaster-prone areas beyond Parañaque, increasing its utility and impact across the country.

By addressing these recommendations, DisasterWatchPH can continue to grow as a vital tool for disaster preparedness and response, empowering both communities and responders to mitigate the impacts of natural and man-made calamities effectively.

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