

Short Paper*

iAlerto: A Web and Mobile Alert System for Pasig City Disaster Risk Reduction Management Office (PCDRRMO) with mobile GPS service integration

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Abstract

Purpose – The study aimed to develop a web and mobile application to improve the incident or emergency reporting of the residents in Pasig City and to better support the disaster response of PCDRRMO.

Method - The study employed the scrum methodology in software development. Android Studio was used to develop the mobile application, while Code Igniter was used for the web application. PHP was used as a backend scripting language together with MySQL database and XAMPP web server for testing. The functionality of the system was evaluated by 20 IT professionals and 20 residents and DRRMO employees of Pasig City using the ISO-9126 functionality sub-characteristics criteria.

Results - The PCDRMMO was able to collect information from Pasig City residents and barangays that would be useful for decision-making and generating reports. The web application enables the management of users' profiles, barangay's evacuation centers, incident reports, sends alerts or announcements and generates reports. Also, the mobile applications utilize GPS mobile service to determine the exact location of the incident. In the software evaluation, the overall system proves to be functional as perceived by the respondents as manifested by the mean rating of 4.48.

Conclusion - The design of the developed multi-platform applications was found feasible to improve the incident or emergency reporting of the residents in Pasig through the use of a mobile app. The system proves to be functionally acceptable as perceived by the respondents, which implies that the design framework of the study can be feasibly implemented.

Recommendations - An SMS module must be integrated into the system to allow people with no Internet connection to receive announcements from PCDRRMO before, during, or after a disaster. Survey response feature that will solicit feedback from people by sending them a multiple-choice survey to perform wellness checks during critical events.

Keywords – disaster management, emergency response, incident reporting, web and mobile application, GPS

INTRODUCTION

Disasters and emergencies can happen anytime, anywhere, to anyone, but the severity of the human and material damage caused by these mishaps can be reduced when it is properly managed. In the Philippines, people often ask for help during emergencies by calling emergency hotlines such as 911. 911 is the primary nationwide emergency hotline number of the Philippine National Police (PNP) service, and it is available nationwide 24/7, but other types of emergencies have existing separate phone numbers that are available throughout the country (Viray, 2016). However, this process may be time-consuming as the respondent needs to provide necessary details such as their name (if applicable), address, contact number, and a brief description of the incident. Then the respondent will have to wait for another phone call so that they can know whether the report has been received by the intended emergency response team. Furthermore, the call center agent has no way of knowing whether or not the emergency call is authentic. It is also vital that public safety officers can employ timely and reliable technologies to inform their communities in the case of an emergency.

The City of Pasig is one of the local government units (LGUs) in the National Capital Region (NCR) that is considered to have the highest man-made and natural disaster levels. Based on the interview of the administrator of Pasig City Disaster Risk Reduction Management Office (PCDRRMO), there are thousands of documented emergencies and disasters around Pasig every year (Evangelista, 2020).

Currently, residents must call the PCDRRMO's emergency hotline to report a problem and provide the necessary information to receive a prompt response. However, most of the time, PCDRRMO's rescue units are having a hard time mobilizing their responders because, the sender of the report cannot provide the precise location of the incident, thus resulting in emergency response delays (Balatero, 2020).

Moreover, PCDRRMO is using social media to provide information to the residents if there are any upcoming or ongoing emergencies or disasters. Therefore, not all residents may receive the relevant information in real time. Many technological advancements are designed to improve the way large-scale emergencies and emergency services are handled. Technology plays a key role in the prevention, preparation, and response operations of emergencies (Milosh, 2020). Although the concept of making web and mobile app is not quite new, the need to effectively communicate and to properly convey the information seamlessly from the respondents to the responder and vice versa would be of great help in disaster preparedness, response, and mitigation.

OBJECTIVES

The general objective of this study is to develop a Web and Mobile Alert System for Pasig City Disaster Risk Reduction Management Office (PCDRRMO) with mobile GPS service

integration.

In line with this, the project aimed to achieve the following specific objectives:

- To develop a system that
 - provides web and mobile registration system of residents and barangays
 - enables registered residents to send incident or emergency reports and can communicate with the rescue team through a mobile app
 - reduces response delays of rescue team by getting an accurate location of the incident or emergency
 - allows PCDRRMO authorities to send alerts or announcements to their communities before, during, or after a disaster or emergency
- To evaluate the functionality of the system using ISO 9126 functionality sub-characteristics.

LITERATURE REVIEW

Importance of information management in disasters and emergencies

During emergencies or disasters, information is the most valuable commodity. Everyone requires it to make decisions. It's a crucial factor in an organization's capacity to achieve (or lose) attention and trust. Above all, it is critical to provide prompt and effective aid to individuals who have been impacted by a disaster (Barrantes, 2009).

Mobile applications for disaster communication

Over the previous decade, mobile network coverage has increased dramatically, with around 93 percent of the global population now served by a mobile broadband network (International Telecommunication Union, 2020). Mobile phone ownership has exploded as well, with global smartphone connections doubling in five years and South Asia seeing a sixfold increase (GSMA, 2020). More than 3.7 billion people had access to mobile internet by the end of 2019 (GSMA, 2020). More people and vulnerable communities now have access to communications than ever before due to increased mobile phone coverage, ownership, and use. Such access opens up new possibilities for disaster risk reduction (Budimir et al., 2021).

Mobile apps were created to meet a variety of needs and to introduce a new way of interacting and communicating. As we all know, SMS alert systems are beneficial in some situations for delivering emergency notifications, GPS-related mobile apps assist us in locating ourselves and potential dangers, and other applications are designed as pre-disaster warning devices (Souza & Kushchu, 2010; Shan, 2011).

Related Studies

The Barangay Disaster Preparedness Monitoring Web Application System is a web

application system that will be utilized by the Department of Interior and Local Government in the Philippines. Like our system, it has data collection of barangay disaster preparedness information at the barangay level. However, it focused on the reporting system for the DILG Field Officers from the cities and municipalities and the need to have a monitoring tool and automatic consolidation of data at the national level (Garcia et al, 2016).

A study was conducted which is titled "A Mobile-Based Emergency Reporting Application for the Philippine National Police Emergency Hotline 911: A Case for the Development of 911". Similar to our system, it also aims to shorten the time it takes for responders to reply by decreasing the data collection procedure used during an emergency call (e.g. personal information). It was accomplished by registering the user first before using the mobile app. If the sender is asked for assistance, the user's data becomes visible to the sender. The application also incorporates the geolocation capabilities of cellphones, allowing the source to track the caller's location in real-time (Edillo et al., 2017).

Existing Related Systems

Pasig City used to have a mobile app for emergency reporting called MAsE (Mamayang Aksyon sa Emergency for Pasig City). It is a public service application that can be used by Pasig City residents to report emergencies and other non-emergency issues, along with its panic button, which provides the users' GPS location (PCDRMMO, 2018). However, they are no longer using the mobile app since government authorities cannot send alerts and disseminate information to stakeholders promptly in the event of a disaster or emergency (C3 "Big Brother", 2018).

Similarly, Valenzuela City's local government launched their VC Alert Button mobile application in 2017, allowing registered Valenzuelanos to request emergency services in the event of a fire, medical emergency, or crime incident. However, this mobile app is intended for emergency reporting only, and public safety officials cannot send announcements before, during, and after a disaster for disaster preparedness, management, and mitigation (Decena, 2017).

METHODOLOGY

Software Development

The study used the scrum approach, which is the most commonly used in software development and consists of iterative and incremental procedures to satisfy the customer's preferences and specifications, as illustrated in Figure 1 (Peek, 2021). The researchers meet with the PCDRRMO regularly to discuss adjustments and improvements. Furthermore, the research team met daily to keep innovating and exchanging ideas to develop a well-functioning system.

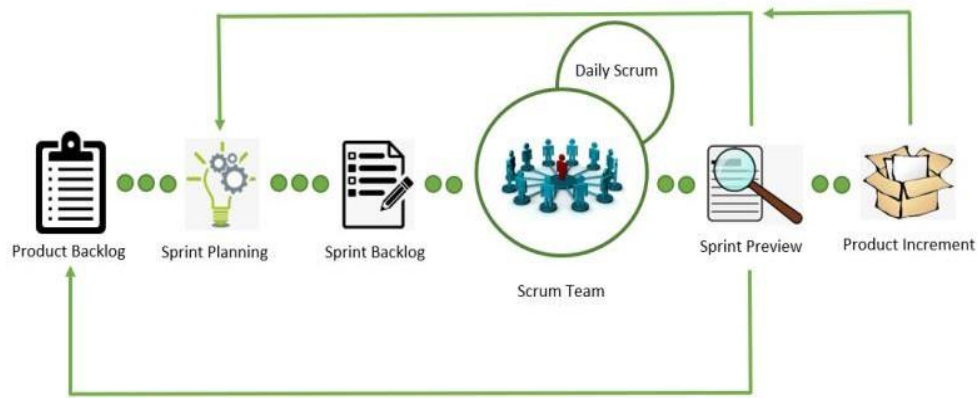


Figure 1. SCRUM Methodology

Project Design

The high-level architecture of the project design is depicted in Figure 2. It integrates different web and mobile applications intended for four (4) different users, including registered Pasig City residents, barangay staff, PCDRRMO rescue team, and administrators. The mobile application utilizes GPS mobile service to determine the exact location of the respondent or incident reporter. These software programs are all linked to a centralized database server that is accessible online. Only online, authorized individuals can have access to the system, preventing prank incident reporting.

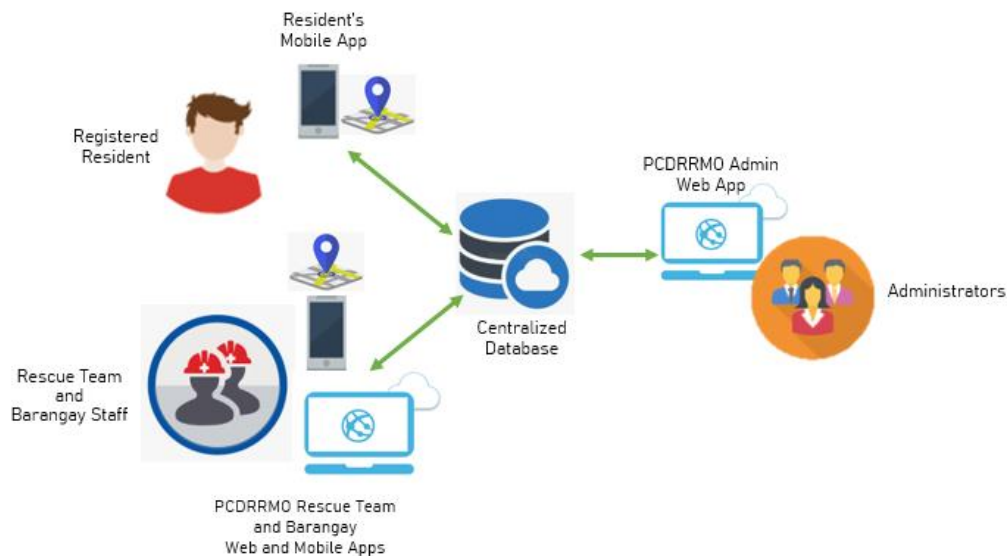


Figure 2. High-level System Architecture

An Android Studio was used to develop the mobile application, while Code Igniter was used to develop the web application. PHP was used as a backend scripting language together with MySQL database and XAMPP web server for testing.

Use Case Diagrams

The researchers used a use case methodology to show the behavior or functionality of a system. It is a collection of possible interactions between a system and a user in a particular environment that are related to a specific purpose (Hoffer et al, 2014).

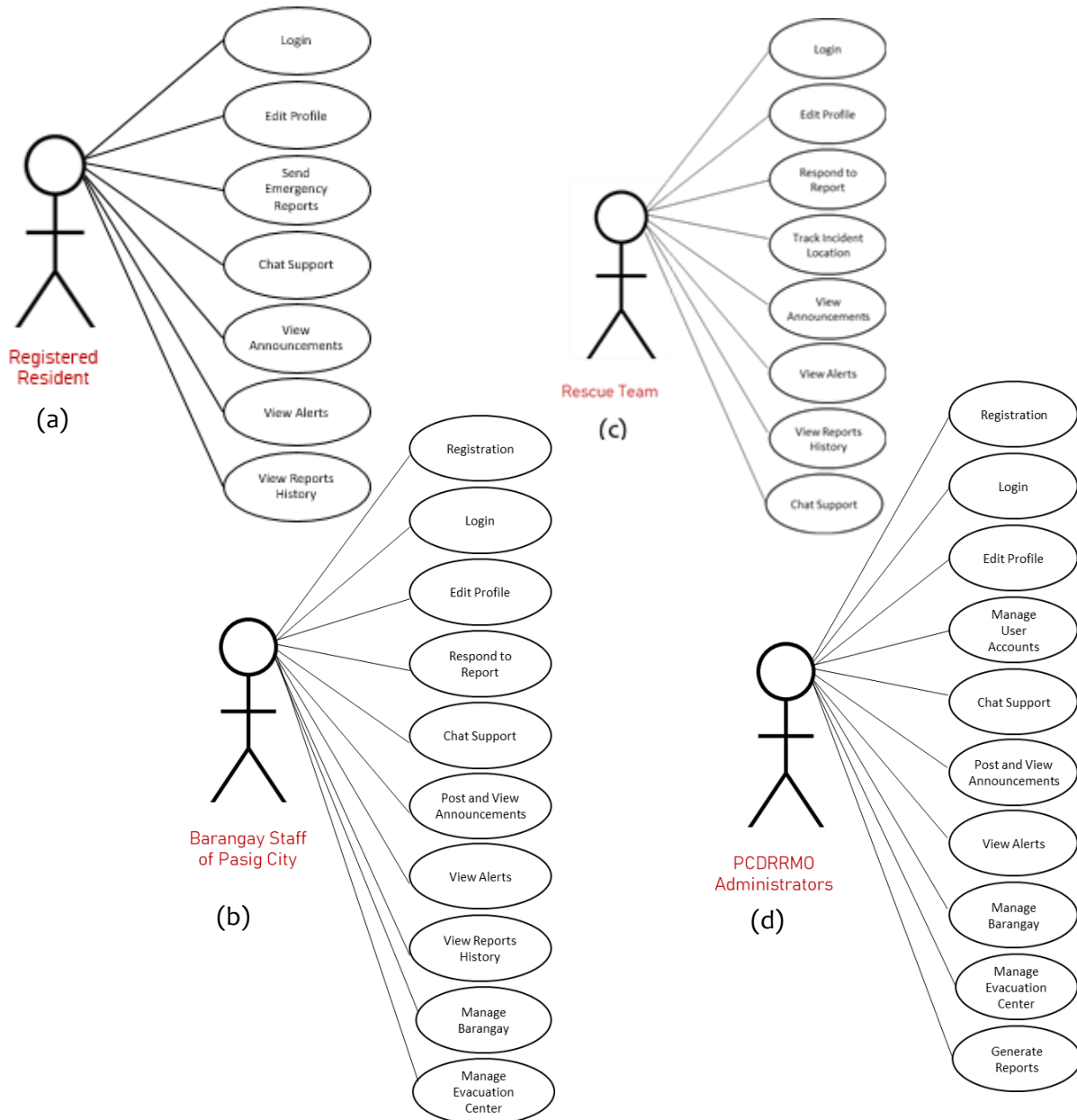


Figure 3. Use-case diagrams of the system users - (a) Registered resident, (b) Barangay Staff, (c) PCDRRMO Rescue Team, and (d) PCDRRMO Administrators

Figure 3 illustrates the use-case diagrams of the four (4) different users of the system. Generally, it shows that all users may have similar and distinct functions in the system. All users must log in to gain access to the system. Also, editing profiles, chat support, and viewing of

announcements and alerts sent by the authorities are common interactions by all users of the system. On the other hand, the send incident report feature is only applicable to registered residents using a mobile app, while they respond to report and track the incident location features are intended for the PCDRRMO rescue team and barangay staff. Only the barangay staff and PCDRRMO administrators can send alerts or announcements, facilitate registration systems for all residents and barangays in Pasig City, and manage barangay and evacuation centers using the web and mobile apps. However, only the PCDRRMO administrators can manage user accounts and generate relevant reports for decision-making and disaster planning.

Software Evaluation

A survey and tests were conducted to determine the functionality of the developed system using the ISO-9126 functionality sub-characteristics criteria, including suitability, accuracy, interoperability, compliance, and security. Table 1 shows the frequency of distribution of respondents. The study used a purposive sampling technique. Actual demonstration of the system was conducted in the presence of the evaluators, consisting of 20 IT professionals and 20 residents and DRRMO employees of Pasig City, having a total of 40 respondents.

Table 1. Frequency of Distribution of Respondents

Respondents	Frequency	Percentage
IT Professionals	20	50%
Residents and DRRMO officers of Pasig City	20	50%
Total	40	100%

Table 2. Likert Scale

Rate	Verbal Interpretation	Range
5	Strongly Agree	4.60-5.0
4	Agree	3.60-4.59
3	Neutral	2.60-3.59
2	Disagree	1.60-2.59
1	Strongly Disagree	1.00-1.59

Table 2 shows the numerical rating used by the respondents during software evaluation. It was used to rate the responses in the evaluation based on the level of functionality. Also, it

shows the range and its corresponding verbal interpretation of the meaning. It is used to interpret the results of the survey questionnaire. The mean is defined as the average of n numbers computed by adding the sum function of the number and dividing it by the sum function of n. The n is referred to as the number of respondents that evaluated the system.

RESULTS AND DISCUSSION

Presentation of the Developed System

The developed system has four different modules including the admin module, barangay staff module, PCDRRMO rescue team module, and the registered users' module.

A. Admin Module

The admin module is a web application comprised of different sub-modules such as Dashboard, My Account, Announcements, Alerts, Evacuations, Barangays, Reports, Users Management, and Transaction Logs.

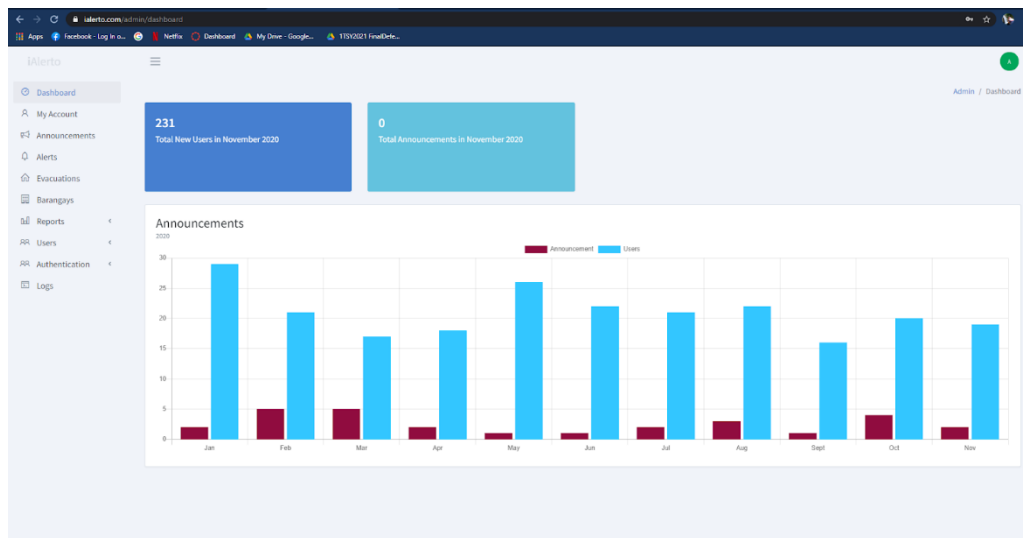


Figure 4. Dashboard – Admin Module

Figure 4 shows the dashboard of the admin module. The default screen provides a graphical representation of the total number of registered users and the total number of announcements posted in a month. Also, the admin can update his/her account details through the My Account and can post announcements to the registered users via Announcements as shown in Figure 5.

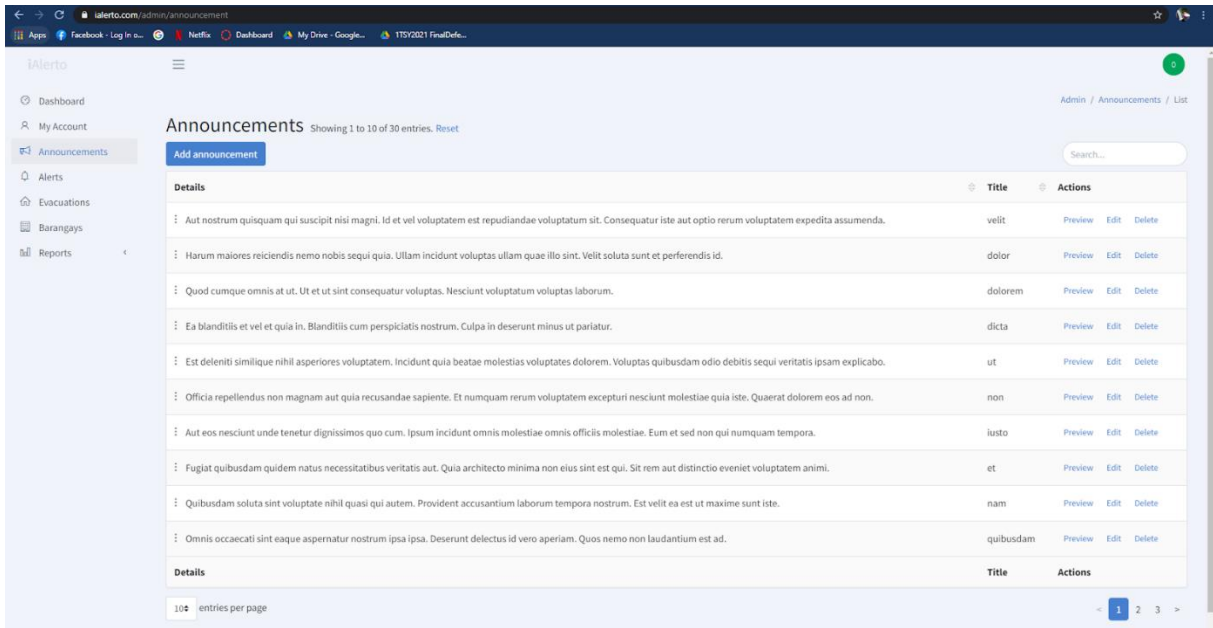


Figure 5. Announcements – Admin Module

Figure 6 shows the Barangays sub-module where the admin can add barangay names assign their respective available evacuation centers and attach vicinity photos.

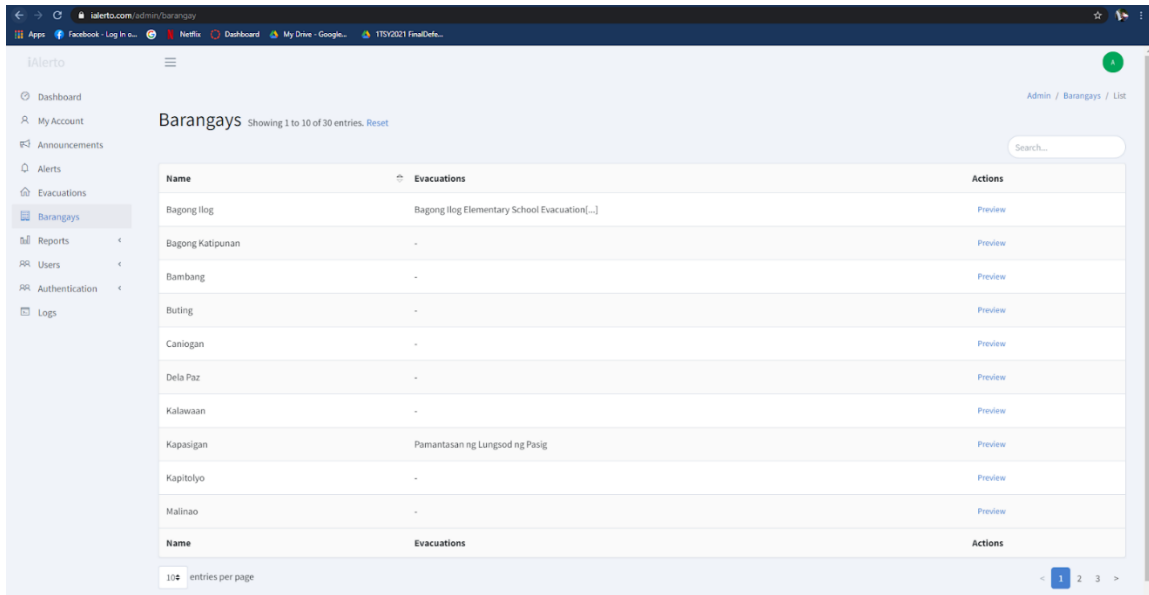


Figure 6. Barangays – Admin Module

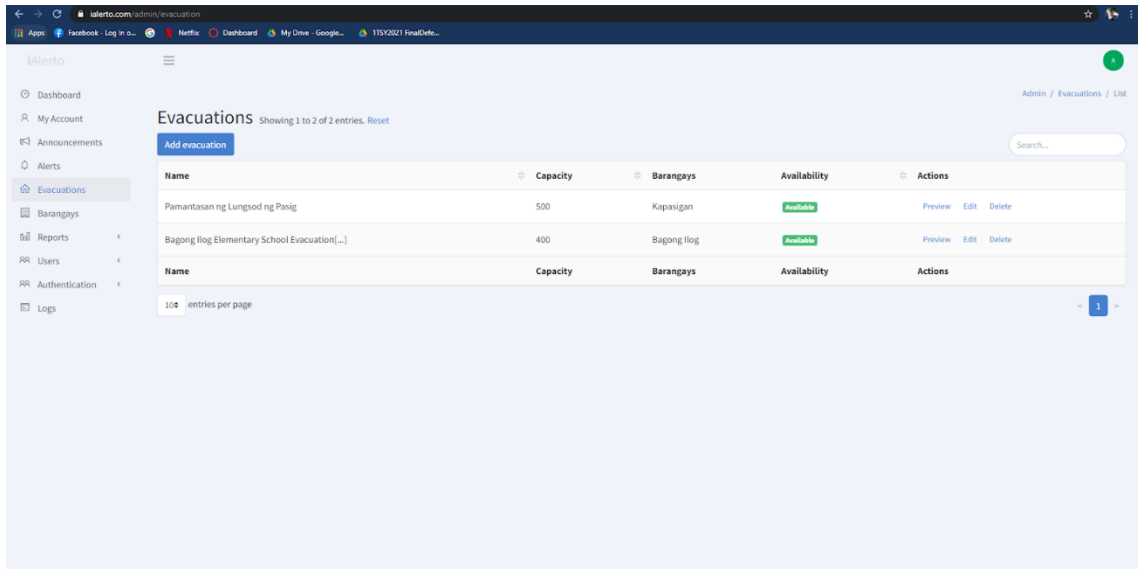


Figure 7. Evacuations – Admin Module

Figure 7 shows the Evacuations sub-module where the admin user can add the name of evacuation centers, assign capacity, and set the availability status.

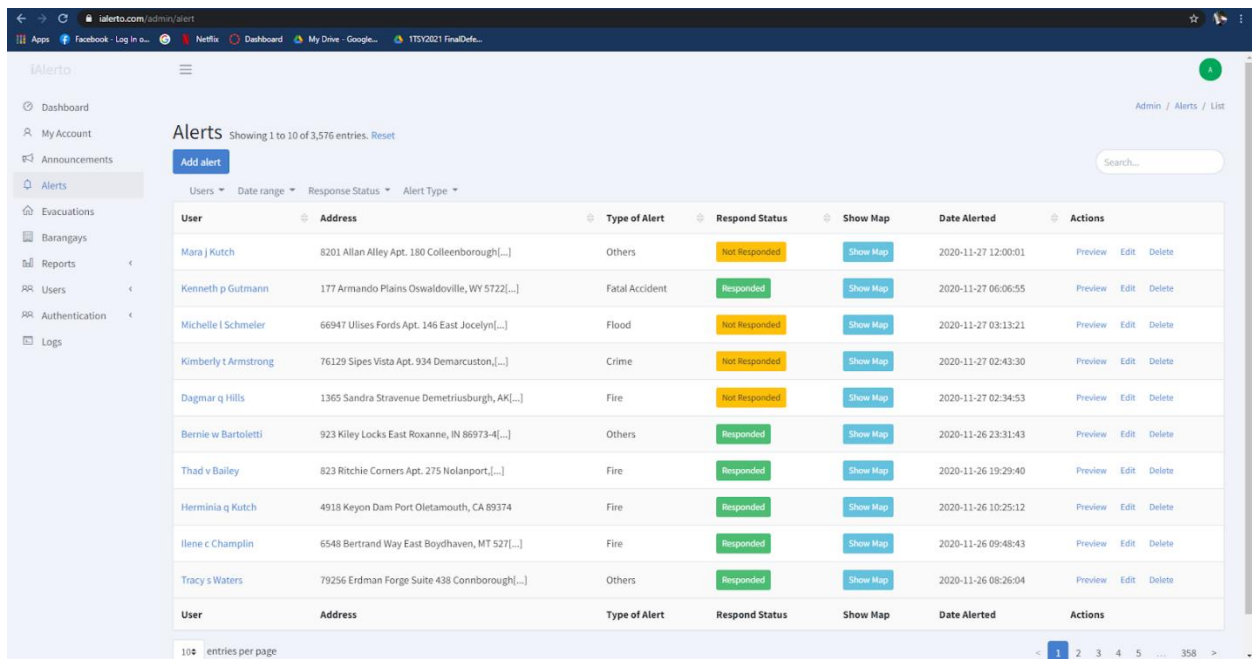


Figure 8. Alerts – Admin Module

Figure 8 shows the Alerts sub-module where the admin can send alerts to their communities and view alert status, whether they have responded or not, along with the relevant information such as the name of the respondent, address, type of alert, location map, date, etc.

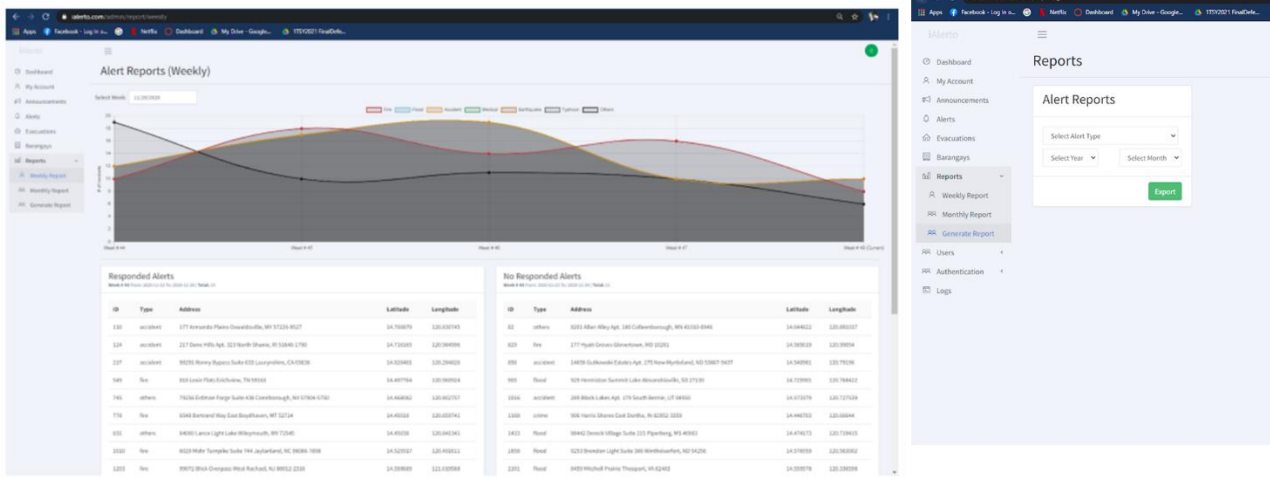


Figure 9. Reports – Admin Module

As shown in Figure 9, the admin can generate weekly and monthly alert reports concerning alert type.

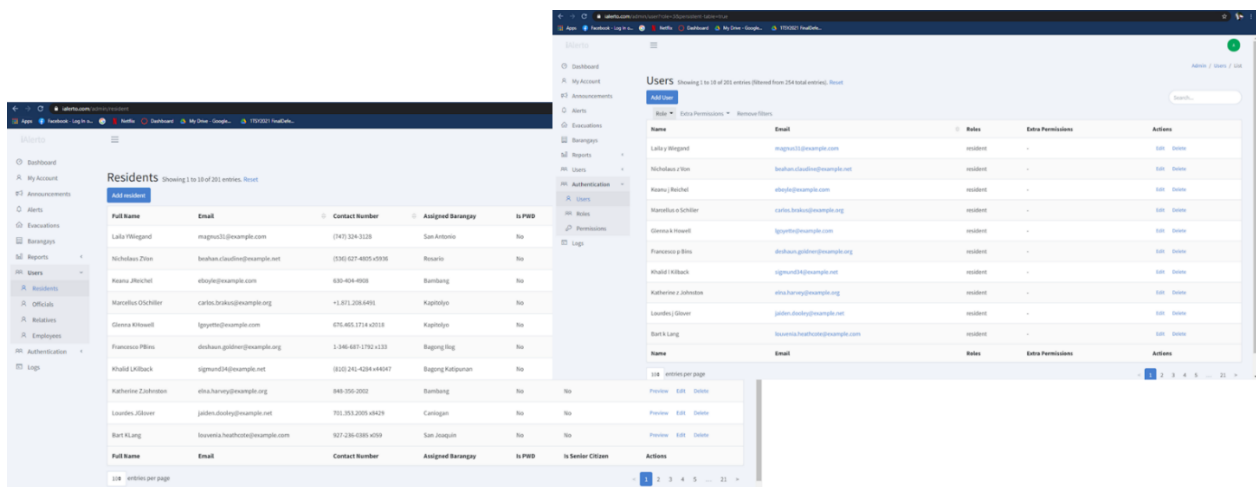


Figure 10. Users – Admin Module

Figure 10 shows the interface where the admin can add resident and system users to the system. An adult family member who has the intellectual capacity to use the application and its purpose is required to register in their respective barangay in Pasig City and can represent a household during the registration process. The user is required to supply their full name, email, date of birth, contact number, address, and proof that they are a resident of Pasig City. The system will take an ID photo of the user as well as biometric fingerprints that can be used as identification during evacuation.

As mentioned earlier, the web application for PCDRMO administrators and rescue

teams has almost the same features as the admin account. The only difference is that the admin user only can add or manage system users.

Moreover, the developed system has two mobile applications intended for residents and rescue teams.

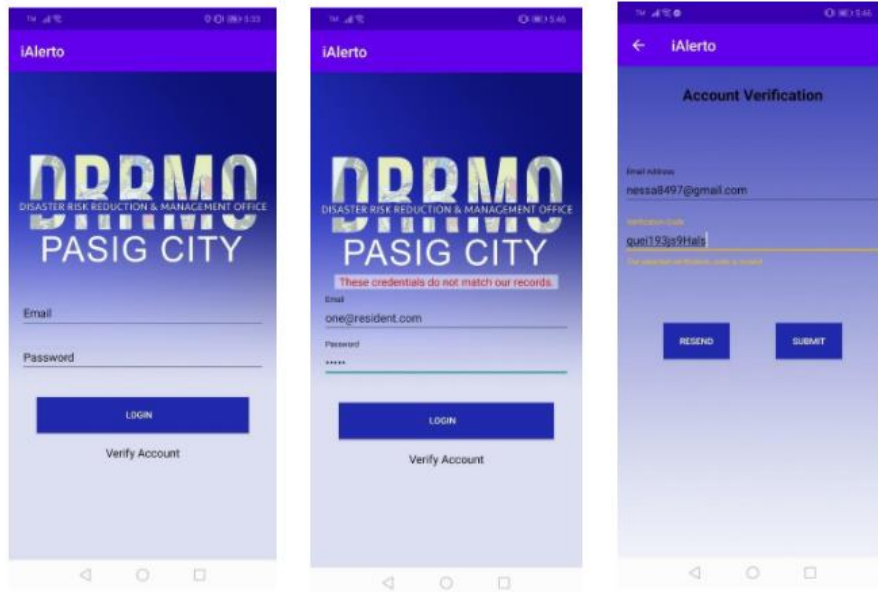


Figure 11. Login Module - Mobile Application

Figure 11 shows the mobile application's Login Module both for the resident's and rescue team's accounts. This ensures that only authorized users can access the system.

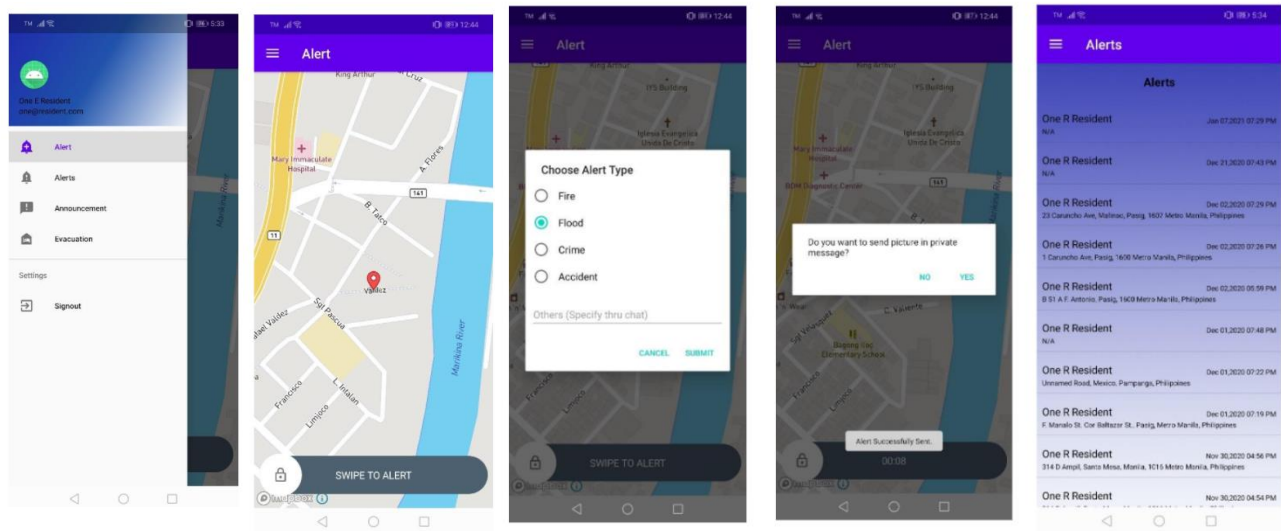


Figure 12. Alert - Resident's Mobile Application

Figure 12 shows the Alert Module for the resident’s account. This module allows users to send alerts and pin the location of the incident using Google Maps. In sending an alert, the system has pre-defined alert types to choose from and may send incident photos. Thus, the user can send an emergency report in just a few clicks. Also, the user can view the alert history.

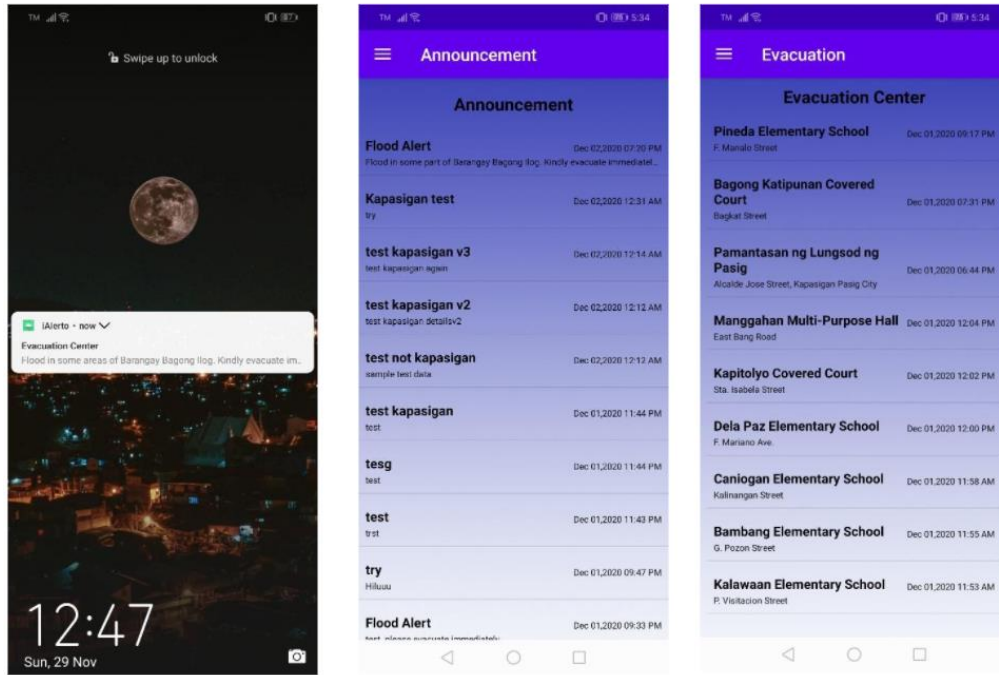


Figure 13. Announcements – Resident’s Mobile Application

Figure 13 shows how the user received an announcement before, during, and after a disaster. Users are being guided to the evacuation center that they should go to during an evacuation. On the other hand, once the resident sends the alert or incident report to the PCDRMMO, it will be received by the rescue team. The report contains the name of the respondent, the resident’s address, contact number, and alert type as shown in Figure 14. It has a responsive and chats command button. If the rescue team clicks respond, then it displays the exact location of the incident and directions via Google Maps. Also, it has a chat support feature where users can communicate with the respondent and receive photos of the incident.

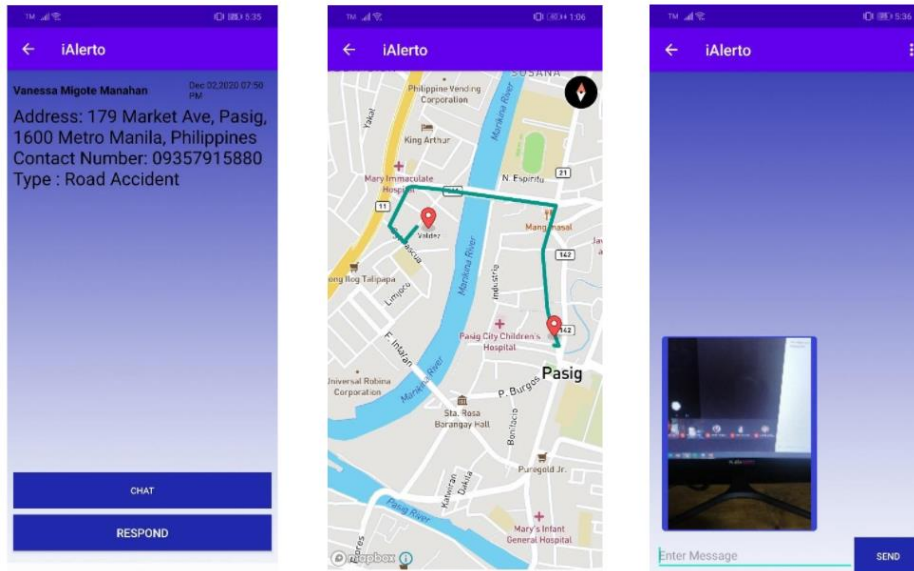


Figure 14. Alert – Rescue Team Mobile Application

Software Evaluation Results

The respondents agree that the system features were met in terms of suitability, accuracy, and compliance, and strongly agree in terms of interoperability and security. Thus, the overall system proves to be functional as perceived by the respondents as manifested by the mean rating of 4.48 as shown in Table 3.

Table 3. System’s Functionality Evaluation Results

Functionality	Mean Grade	Verbal Interpretation
Suitability	4.29	Agree
Accurateness	4.36	Agree
Interoperability	4.64	Strongly Agree
Compliance	4.51	Agree
Security	4.60	Strongly Agree
TOTAL	4.48	Agree

CONCLUSION

This study concludes that the web and mobile registration systems of residents ensure that all incident reports are legitimate as authorized users can gain access to the system. It also provides a better understanding of the residents' demographics and quick identification

of residents using fingerprint biometrics that can be used before, during, and after a disaster. Furthermore, the design of the developed multi-platform applications was found feasible to improve the incident or emergency reporting of the residents in Pasig through the use of a mobile app, and the disaster response was also enhanced through the use of GPS, instant messaging, and the announcement feature of the system. Finally, the system proves to be functionally acceptable as perceived by the respondents, which implies that the design framework of the study can be feasibly implemented.

RECOMMENDATIONS

This study recommends allowing residents with no Internet connection to receive announcements from PCDRRMO before, during, or after a disaster, an SMS module must be integrated into the system. Furthermore, the study recommends integrating a survey response feature that will solicit feedback from people by sending them a multiple-choice survey to perform wellness checks during critical events and to verify the safety of the people.

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