Mamamayan: An Android mobile Community-based Emergency Reporting and Notification System

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Abstract

During national, regional, and local catastrophes, reliable public alert and warning systems are critical for saving lives and protecting property. Emergency notifications have become a top issue in both national and local governments these days. This research focuses on designing, developing, and evaluating Mamamayan: An Android mobile Community-based Emergency Reporting and Notification System for Makati City in the Philippines. Mamamayan can be used to report emergencies ranging from fires to typhoon-related incidents, vehicular accidents with casualties, emergency health-related concerns, community-related incidents and concerns, and other occurrences that require an immediate and concrete response from the responsible agencies. The PSSUQ and the ISO 9126 were used to evaluate the system yielding a high acceptance as perceived satisfaction from the evaluators. The PSSUQ usability test yielded a 1.50 overall mean, indicating that the system was highly acceptable in terms of system usefulness, information quality, interface quality, and overall satisfaction. The system effectively captured respondents' perceptions of satisfaction, as evidenced by an overall mean of 4.71 (highly acceptable) on the ISO/IEC 9126 software quality test. The evaluation considered system performance, reliability and availability, efficiency, maintainability, and portability.

Keywords:
Mamamayan, mobile app, emergency reporting, featured-driven, PSSU

1. Introduction

The Philippine archipelago is a cluster of 7,641 islands with almost 300,000 square kilometers (CNN Philippines 2016). Being a country composed of islands and is geologically located near the Pacific Ocean, the Philippines is among one of the world's most disaster-prone countries. The Philippines has endured 274 natural calamities between 1995 to 2015, making it the world's fourth most disaster-prone country and affecting 130 million people, belonging to the top ten (10) countries with the most people affected by disasters (UNISDR 2015). With this current situation of the Philippines being disaster-prone, people must be wary about natural disasters. Natural disasters are events resulting from the natural process of the Earth, which may disrupt a functioning community, and is inevitable (IRFC 2018). Natural disasters are any catastrophic event that is caused by nature. The severity of a disaster is measured in lives lost, economic loss, and the population's ability to rebuild. Events in uninhabited areas are not thought of as disasters; therefore, a flood on an uninhabited island would not count as a disaster. But a surge in a geographic region is termed a natural disaster (Basicplanet 2018).

The Philippines regularly encounters strong typhoons, earthquakes, volcanic eruptions, and other natural disasters. The country is situated on the Pacific ring of fire. It is within the typhoon belt – a large region of the Pacific Ocean where many of Earth's volcanic eruptions and earthquakes occur (Winguard and Brandlin 2013). According to the Philippine Atmospheric, Geophysical, and Astronomical Services Administration (PAGASA), voluminous tropical cyclones make landfall in the Philippine Area of Responsibility (PAR) more than anyplace else on the planet. With an average of 20 tropical storms passing through this region each year, roughly 8 or 9 of them cross the Philippines. The typhoon season peaks from July to October, when approximately 70% of all typhoons form (Pagasa 2020). The National Disaster Risk Reduction and Management Council (NDRRMC), formerly known as the National Disaster

Coordinating Council (NDCC), is the Philippine government agency responsible for a government response. It is under the Office of the Civil Defense (NDRRMC 2020).
NDRRMC is an agency tasked with protecting the welfare of the people during natural calamities and emergencies. They are also responsible for preparing and mitigating the possible effects of natural disasters like typhoons and earthquakes (Bueza 2013). The NDRRMC plans and leads the guiding activities in communication, warning signals, emergency, transportation, evacuation, rescue, engineering, health and rehabilitation, public education, and auxiliary services such as firefighting and the police in the country (NDRRMC 2018). Local government units have their disaster response anchored to the NDRRMC. Makati Disaster Risk Reduction and Management Office (DRRMO) is the City's local disaster response responsible for promoting disaster preparedness among Makatizen (Citynet 2020). Natural disasters are common, such as earthquakes, floods, fires, volcanic eruptions, tsunamis, hurricanes, and other natural events. When it happens, it takes time before information about these disasters gets disseminated over the news and media. Information about these events is crucial for anyone, especially those near or affected. New technology can help us prevent and lessen the casualties once any of these events happen. The number of casualties increases because most people do not know what to do in an adverse event. People who do not know the protocol once an adverse event occurs panic most of the time, giving them the disadvantage of having a high risk of injury rather than evacuating safely. Knowing what to do and where to go is crucial during an adverse event, every second counts. Since most Filipinos own a smartphone nowadays, knowing such information, even simple ones, can be an advantage.

1.1 Current Process Flow for Makati EOC

Figure 1 shows Makati's Emergency Operations Center (EOC). It starts with the users/callers asking for assistance from the city emergency hotline. The operator asks for pertinent information related to the reports and validates them. It will then be forwarded to the local government-specific units for response and deployment.

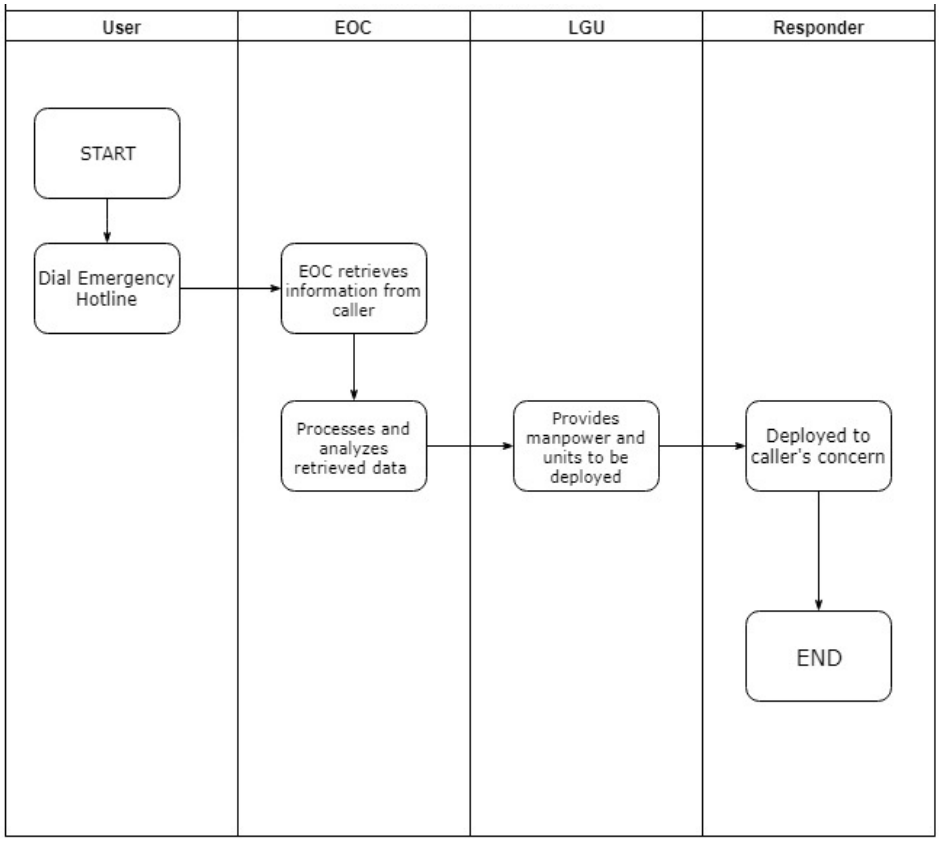

Figure 1. Emergency Operation Center (EOC) Current Process

Rapid information dissemination is possible through the application. The system can also send information to its users and receive data. The notification design focuses only on an earthquake, flood, and fire. The community-based

reporting system can gather information from its users. The reports will be forwarded to the local government unit responsible for deploying the needed resources.

1.2 Objectives of the Study

The research objective is to design and develop MAMAMAYAN: a Mobile Community-based Emergency Reporting and Notification System.
Specifically, other specific intents of the study aims are:

1. To develop a system with the following modules: notification, community-based reporting, evacuation-map assistance, marked-as-safe, local emergency contacts list, and safety tips;
2. To conduct a different level of testing to verify the systems (a) performance, (b) interactivity, (c) visual stability, (d) speed index/load time, (e) responsiveness/ response time, (f) user experience, and (g) compatibility platform support;
3. To evaluate the developed system using the Post-Study System Usability Questionnaire (PSSUQ) and ISO 9126 software quality metrics based on the evaluators' perception.

2. Research Paradigm

Figure 2 depicts the structured concept of this study, which consists of three required components: input, process, and output (IPO with feedback). The IPO model envisions the overall flow of deliverables that will lead to the study's outcomes.

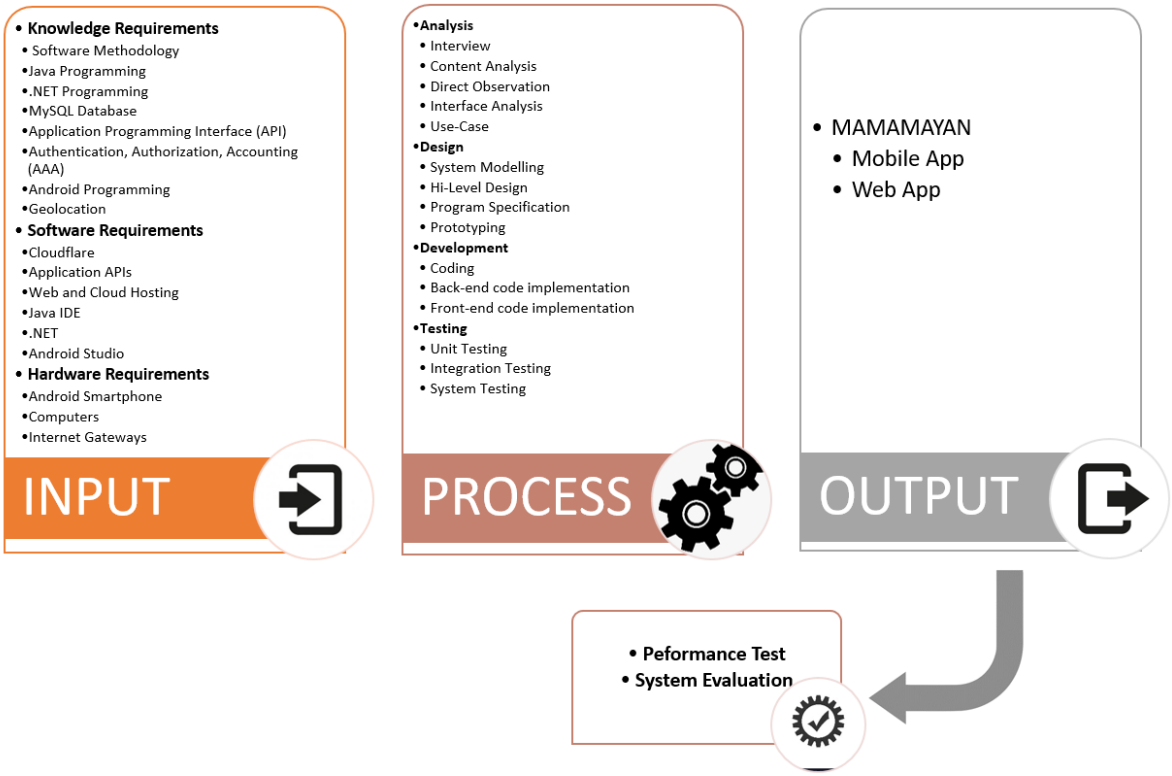

Figure 2. Conceptual Framework Model

Research input comes from examining knowledge requirements, software requirements, and hardware requirements. Software methodology, android mobile programming, web programming, MySQL database, APIs, hardware interface, authentication, authorization, accounting concepts, and software optimization are among the knowledge required for the study. Content Delivery Network API, cloud web services, android studio, java IDE, and ASP are among the software needs. An Android phone, a computer, an internet connection, and gateways are all required pieces of hardware.

The deliverables from the input phase were used in the next phase, the process phase. This process phase's components include software analysis, design, development, and testing. Agile's Feature-Driven Development (FDD) is the

software design and development methodology used. FDD is customer-centric, iterative, and incremental, intending to deliver tangible software results often and efficiently. FDD in Agile encourages status reporting at all levels, which helps track progress and results.

3. Concept of Operation

In the development of the system, it showcased the different APIs and android libraries used in creating the design. Java was the primary programming language used to develop the mobile application and the website, while Firebase was used as a database for the system. Figure 3 shows the general system architecture of Mamamayan. Users utilize the mobile app to send data to the web services where the monitoring software application shares data.

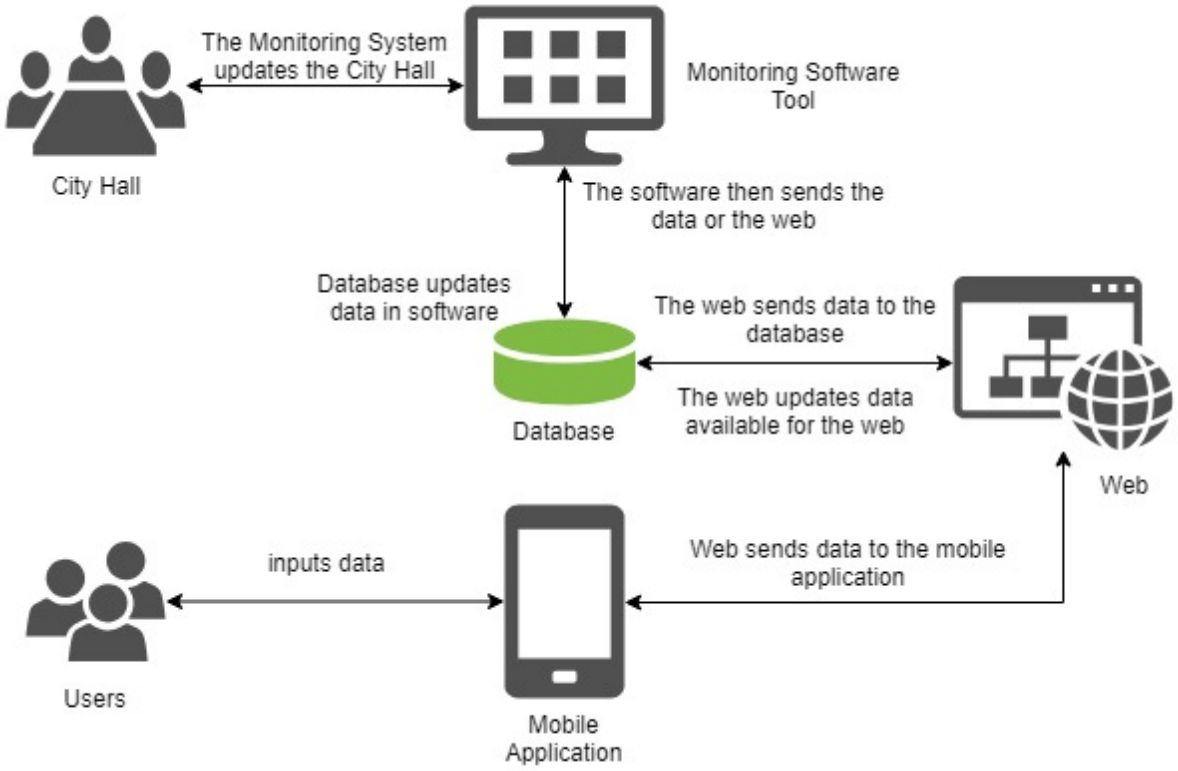

Figure 3. System Architecture

This system architecture begins with the user interacting with the android mobile applications. User inputs will then be forwarded to the web, which has direct access to the system database. The monitoring software notifies the city authorities of the concerns that require immediate action. The monitoring team at the command center will then forward the regards to the respected city departments for resolutions and possible actions.

4. The System – Mamamayan App

Mamamayan Web Application

The Mamamayan web app, as shown in Figure 4, is an application deployed on Makati Command Center. It is primarily used for monitoring reports coming from the site. Once logged in, an end-user has access to the system functionality offered by the Mamamayan app. Mamamayan can be used to disclose emergencies tend to range from fires to typhoon-related incidents, vehicular accidents, emergency health-related concerns, community-related incidents and concerns, and other occurrences that necessitate an immediate and concrete response from the appropriate agencies.

The geolocation features of smartphones are integrated into the application, allowing the dispatcher to pinpoint the exact position of the caller.

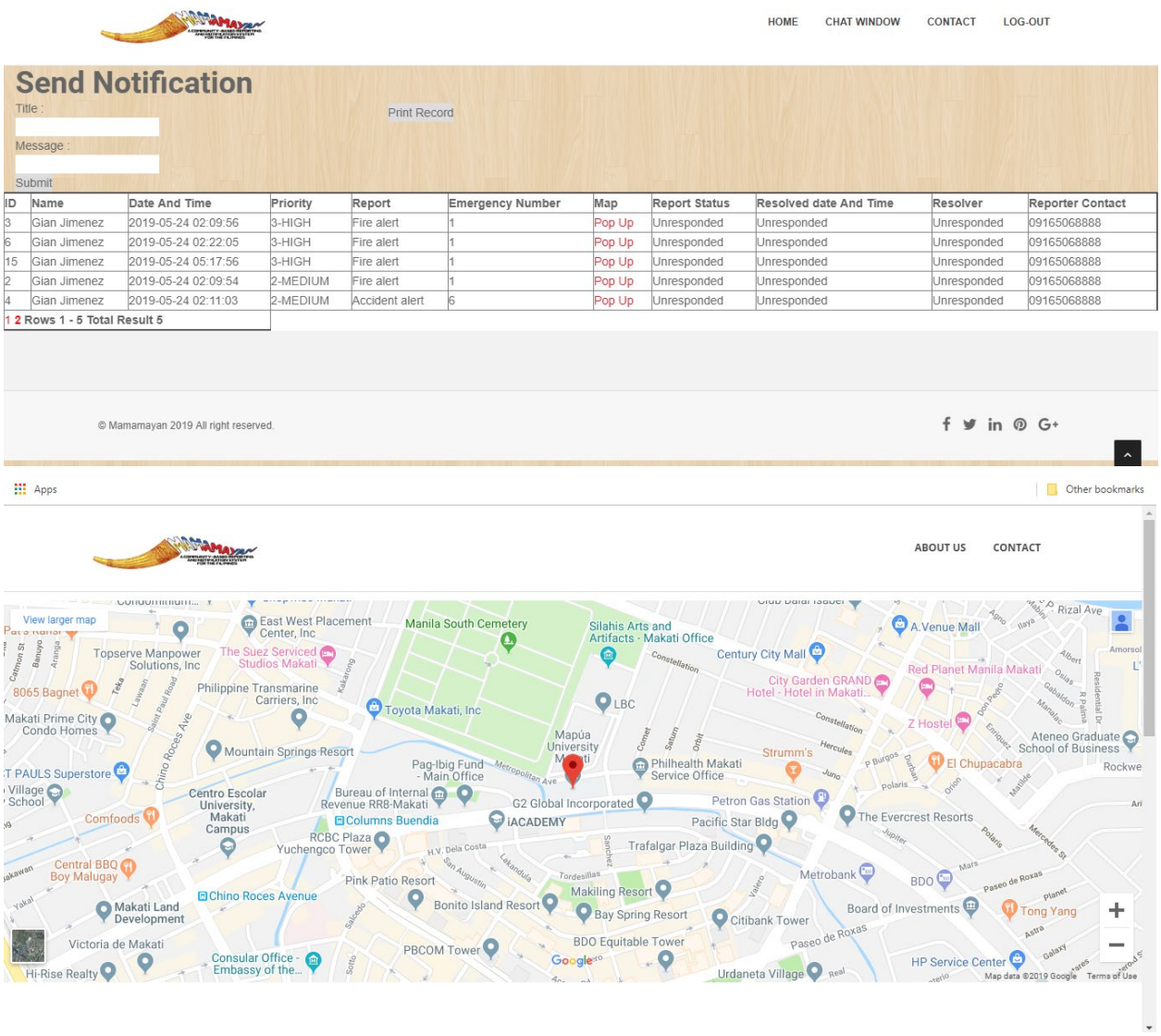

Figure 4. MAMAMAYAN Chat function for website

Mamamayan Mobile Application

The Mamayan mobile app, as shown in Figure 5, is an android based application for mobile Makatizen users. It is designed for android smartphones, tablets, and other similar platforms. The mobile app needs to be installed on android devices. Features available on the web application version of the systems is also available on the mobile app.

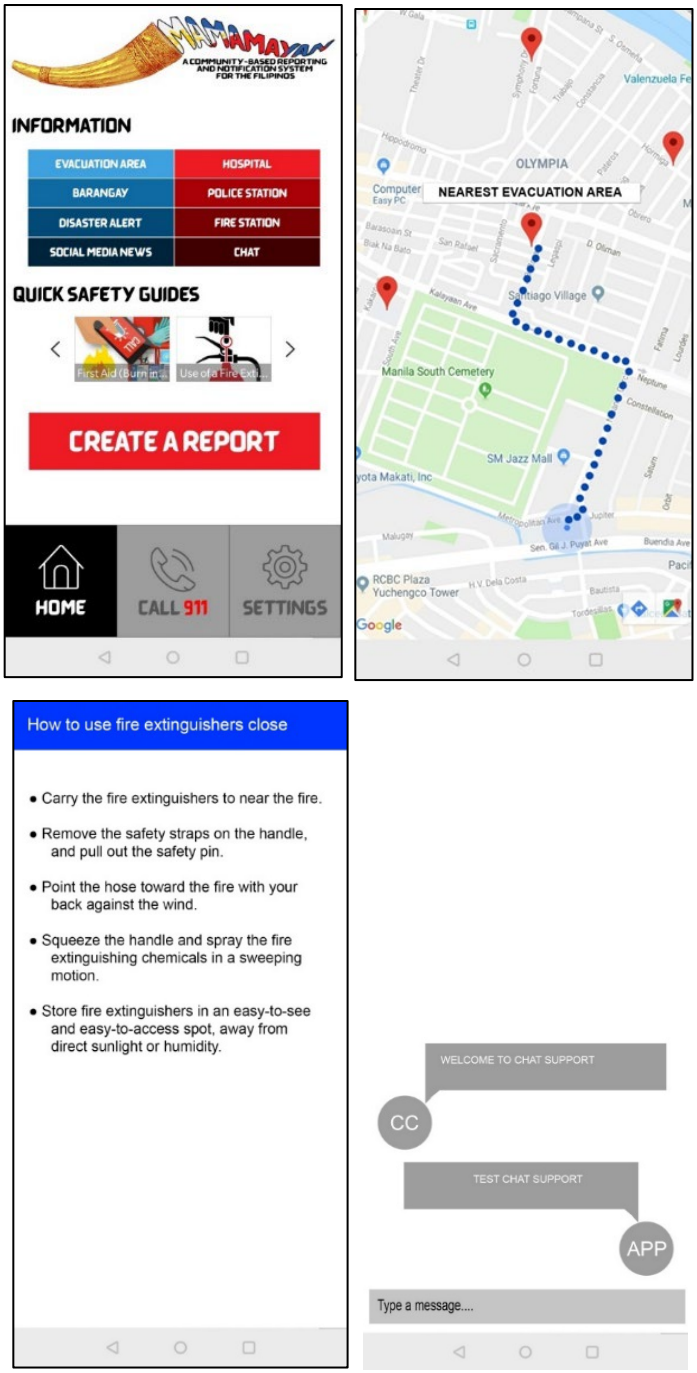

Figure 5. MAMAMAYAN Mobile App

5. Results and Discussion

MAMAMAYAN was developed with national disasters in mind but expanded to include other emergencies such as traffic accidents and crime. With the help of MAMAMAYAN, the citizens would now be able to report incidents that happen around them and be well informed when calamities such as typhoons and earthquakes occur. What to do, where to go, and what's currently happening in the area would all be available in MAMAMAYAN's mobile

application. The local government can now easily track and record the ongoing incidents around their site and assist the incidents reported by the citizens faster.

Based on the users' evaluation, the proponents may conclude that MAMAMAYAN is beneficial for the local government units (LGUs). Moreover, since the LGUs themselves are the ones who register their information into the web application, MAMAMAYAN can provide accurate, reliable, and up-to-date information to its mobile users.

5.1 WebPageTest by Catchpoint

MAMAMAYAN WebPageTest performance results were tabulated in Table 1 with the recommended versus the measured value. It was tested using Singapore as the test location as it is the nearest server. Test settings use default values with connection set to Cable 5/1 Mpbs 28ms RTT, default browser dimensions at 1366x768, 9 test to run, and repeat view at First View and Repeat View. The results on the given table were averaged, as the WebPageTest results provide the first view time and the repeat view time.

Table 1. MAFIS measured value in WebPageTest

Measurement	Recommended Value	Measured Value	Remarks
First Byte	Less than 250ms	0.22 s	Fast
Start Render	Less than 2.5s	0.55 s	Fast
First Contentful Paint (FCP)	0 – 2.5s	1.94 s	Fast
Speed Index (SI)	0 – 4.3s	0.84 s	Fast
Largest Contentful Paint (LCP)	0 – 2.5s	1.85 s	Fast
Cumulative Layout Shift (CLS)	Less than 0.1	0	Fast
Total Blocking Time (TBT)	Less than 300ms	0.04 s	Fast
Document Complete Time	Less than 5s	0.67 s	Fast
Fully Loaded Time	Less than 2s	0.80 s	Fast

The First View row shows what a first-time visitor to the website will see when using a browser with its cache and cookies cleaned off. The Repeat View row is a test run just after the First View test, with nothing removed. The browser window is closed after the First View test, and a new browser is opened to run the Repeat View test. The Repeat View test simulates what users would see if they returned to a page after the first visit.

The Time To First Byte (abbreviated as TTFB) is the time it takes for the browser to get the first byte of the base page from the start of the initial navigation (after following redirects). The period when the user started traveling to the website and when the first byte of the server response came is known as the First Byte time. The majority of this time is referred to as "back-end time." It refers to how long the server took to construct the page for the user. It brings to receive the first byte to be less than 250 milliseconds. The first byte was measured at 0.22 seconds or 220ms which is less than the recommended value.

The Start Render time is measured from the beginning of the initial navigation until the first non-white content is painted to the browser display. The first time something was displayed on the screen was the Start Render time. The user had been staring at a blank page up until this moment. This does not always indicate that the user viewed the page content; it could simply be a background color, but it is the user's first sign that something is going on. The start renders time should not be longer than 2.5 seconds. Start to render registered a 0.55 second which is less than the ideal value at 2.5s.

The first continuous paint was measured at 1.94 seconds, which is less than the desired value of 2.5 seconds. The Speed Index is a computed indicator that indicates how quickly the page rendered the visible content to the user (lower is better). At 0.84 seconds, the speed index was also better than the optimal value. The largest contentful paint at 1.85 seconds which is within the recommended value. Cumulative layout shift has a recorded measured value of 0, less than 0.1 base value. The total blocking time is 0.04 seconds or 40ms which is smaller than the benchmark of 300ms. Document complete and fully loaded time were measured at a better value than the recommended value. All of these parameters were marked Fast and therefore acceptable.

5.2 Post-Study System Usability Questionnaires (PSSUQ) Results

The PSSUQ was used to measure the usability of MAMAMAYAN. The MAMAMAYAN Overall system usability evaluation is summarized in Table 2. The respondents perceived MAMAMAYAN as highly acceptable as its system usefulness (SYSUSE), information quality (INFOQUAL), and interface quality (INTERQUAL) yields a weighted mean of 1.55, 1.37, and 1.49, respectively. The overall satisfaction perceived by the respondents was achieved at 1.59. The PSSUQ overall mean registered at 1.47, which is highly acceptable.

Table 2. MAMAMAYAN Evaluation with PSSUQ

PSSUQ Overall Category	Weighted Mean	Verbal Interpretation
System Usefulness (SYSUSE)	1.55	Highly Acceptable
Information Quality (INFOQUAL)	1.37	Highly Acceptable
Interface Quality (INTERQUAL)	1.49	Highly Acceptable
Overall, I am satisfied with this system	1.59	Highly Acceptable
PSSUQ Overall Mean	**1.50**	Highly Acceptable

5.3 ISO/IEC 9126 Software Quality Evaluation Results

Table 3 summarizes the MAMAMAYAN evaluation results. The respondents professed that MAMAMAYAN is highly acceptable as it registered a weighted mean of 5.0 for functionality, 4.41 for reliability and availability, 4.75 for efficiency, 4.72 for maintainability, and 4.65 for portability. The overall software quality evaluation was rated at 4.71, which means the system is highly acceptable.

Table 3. MAMAMAYAN Evaluation with PSSUQ

Software Evaluation Characteristics	Weighted Mean	Verbal Interpretation
Functionality	5.00	Highly Acceptable
Reliability and Availability	4.41	Highly Acceptable
Efficiency	4.75	Highly Acceptable
Maintainability	4.72	Highly Acceptable
Portability	4.65	Highly Acceptable
Overall Mean	4.71	Highly Acceptable

6. Conclusion

The developed system has successfully implemented MAMAMAYAN, the mobile Community-based Emergency Reporting and Notification System. The functional test garnered a 100% accomplishment rate, which means that the functional requirements set were positively met.

The usability test using the PSSUQ with a 1.50 overall mean showed that the system was highly acceptable based on system usefulness, information quality, interface quality, and overall satisfaction. Achieving an overall mean of 4.71 (highly satisfactory) on the ISO/IEC 9126 software quality test indicates that the system effectively captured respondents' perception of satisfaction. System performance, reliability and availability, efficiency, maintainability, and portability were all considered in the evaluation.

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Biographies

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