RescueLink: A Web Application for Victims and Rescue Agencies

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***Abstract*—Tuguegarao City's emergency response institutions rely on hotlines or cell phone numbers as their primary means of contact during emergencies. However, this method falls short, particularly when victims are far from immediate assistance or unattended. To address this issue, the developers have designed and implemented the RescueLink in Tuguegarao City, providing comprehensive emergency response services for incidents such as accidents, fires, floods, earthquakes, and crimes. The system efficiently manages the storage, retrieval, and archival of user and emergency report information for both managing institutions and users. Leveraging the Evolutionary Prototyping Model, the system utilizes the Laravel framework for front-end and back-end development, along with MySQL for robust database management. Key features of the system include emergency reporting, user and agency notifications, GPS-based victim tracking, and the generation of detailed emergency reports. The system's usability was evaluated through the USE questionnaire, with participants rating it across four dimensions. The results showed that 73% strongly agreed and 22% agreed with the system's usefulness. Furthermore, 71% and 76% of respondents strongly agreed with the ease of use and learning aspects, respectively. In terms of satisfaction, 78% of participants strongly agreed, and 19% agreed with the system's performance. These positive findings indicate that the system is perceived as highly beneficial to Tuguegarao City and its residents.**

Keywords— web development, emergency response, Laravel, MySQL, USE questionnaire

I. INTRODUCTION

The year 2020 witnessed a series of unprecedented challenges, as the COVID-19 pandemic swept across the globe while the Philippines faced the aftermath of natural disasters, including the eruption of Taal volcano and the destructive typhoons Quinta, Rolly, and Ulysses [1]. The Cagayan Valley region, in particular, endured significant hardships when Typhoon Ulysses struck, compounded by the release of water from Magat Dam, resulting in widespread flooding and affecting nearly 300,000 individuals [2]. During this crisis, social media platforms such as Facebook and Twitter played a crucial role as Cagayan netizens initiated the #CagayanNeedsHelp campaign to seek assistance and relief operations, highlighting the potential of social media in enhancing situational awareness for emergency managers [3].

Effective communication between rescue teams and victims is vital in disaster and accident situations, where the unpredictable nature of such events makes communication even more critical. Previous studies have consistently shown that advancements in communication technology contribute to improved disaster management and reduced fatalities [4]. However, emergency response institutions in Tuguegarao City, Philippines, currently rely on outdated methods, such as hotlines or cell phone numbers, to handle emergencies, revealing the urgent need for a modernized emergency response system, especially when victims are geographically distant or unattended.

While advancements in mobile technology have given rise to web applications and mobile apps, the fundamental need for quick and effective emergency tools remains unchanged, particularly in the face of natural calamities [6]. The promptness of the response plays a pivotal role in preventing the escalation of disasters and minimizing casualties, necessitating well-crafted emergency plans at the local government level [7]. Real-time incident reporting is of utmost importance, enabling timely and accurate information dissemination to the relevant agencies, thereby facilitating efficient and effective emergency responses [8].

This research study aims to address the pressing need for an efficient emergency response system in Tuguegarao City, Philippines, particularly in response to the #CagayanNeedsHelp campaign. The developed system utilizes a responsive web-based platform to deliver prompt and reliable end-to-end services to both victims and rescue agencies. It focuses specifically on Region 02 and is managed by dedicated system and agency administrators to ensure smooth operation. Tuguegarao City serves as the pilot implementation site, with plans to expand to other regions across the Philippines. By prioritizing disaster preparedness and resilience-building measures, the system seeks to save lives and safeguard property during emergencies.

II. RELATED WORKS

During emergencies, communication poses significant challenges, highlighting the need for innovative techniques to effectively handle catastrophes. Mobile applications and web apps have emerged as potential solutions to assist in saving lives and improving emergency response [7]. For instance, the Geolocation-based Mobile Emergency Response Application proposes a system where users can request emergency assistance through a mobile app, which transmits their location to a command center for dispatching emergency units [9]. However, the accuracy of user location detection relies on internet connectivity and geographic location, limiting the app's effectiveness in certain scenarios.

To address the lack of proper communication between emergency responders and victims in Nigeria, the Integrated Emergency Management System provides a proactive approach for collaboration among different organizations to prevent, protect, respond, recover, and mitigate incidents [10]. By incorporating features such as registration, emergency selection, and location pages, this Nigerian-specific system aims to decrease the loss of life, property, and environmental harm during emergencies. Similarly, the Emergency Management System enables ad-hoc communications via smartphones during disasters, utilizing GPS for tracking and generating detailed reports [11]. This cost-effective solution improves response time and enhances rescue operations, although the system's reliance on an oral collection of information may cause delays.

In the Philippines, the AppLERT mobile application integrates smartphone capabilities such as GPS, camera, social network connection, and internet access to track, seek help, and warn others of impending danger [12]. While this application can be beneficial in crises, the lack of data or Wi-Fi connectivity on users' smartphones poses a limitation. In Pakistan, the Life Savior integrated emergency response system aims to provide an end-to-end communication solution for timely access to emergency treatment and effective coordination between patients and rescue service providers [13]. By dispatching ambulances efficiently and offering accurate information, this system contributes to reducing response time and improving emergency care.

Furthermore, the iMALERT mobile application enhances emergency response activities by enabling real-time incident reporting in Palayan City, Philippines [14]. The application allows users to report emergencies through photos or videos, which are automatically tagged with GPS coordinates and saved in a web database for evaluation and assessment. However, future improvements should focus on integrating emerging technologies like 5G network technology to enhance interactivity and efficiency in emergency reporting and response.

In Tanauan, Leyte, the Bandilyo App employs various information and communication technologies to monitor disaster risks, provide real-time incident reporting, and facilitate coordination and humanitarian activities [15]. By leveraging specialized applications and secure database systems, this app offers accurate and timely information for DRR operations. Additionally, the Emergency, Tracking, and Anti-theft System for Android Mobiles provides a comprehensive approach for locating stolen phones even when internet connectivity is turned off, employing multiple methods such as GPS, Wi-Fi, GPRS, and network tower connection [16]. This system offers reliable tracking, enabling users to send SMS requests for the device's current position.

The RESCUE Disaster Portal in Ontario City serves as a multi-faceted information portal for citizens and emergency personnel during disasters and emergency response operations [17]. Offering real-time information, such as situation summaries and shelter details, this portal enhances coordination and information dissemination. However, the system heavily relies on internet connectivity, which can pose challenges in areas with limited or disrupted access.

In Malaysia, a web-based support system for flood relief operations has been developed to aid in flood management, data management, and monitoring of the flood situation [18]. Using UML models and ontological representation, this system provides valuable support for flood-related agencies. Additionally, the LifeRescue web portal facilitates search and rescue operations during fire incidents, offering emergency responders access to vital information, including the number and location of victims and sensor data on fire location and progression [19]. By integrating university systems and leveraging indoor localization technologies, this portal expedites the work of firefighters in saving lives and property.

III. Methods

As illustrated in Fig. 1,

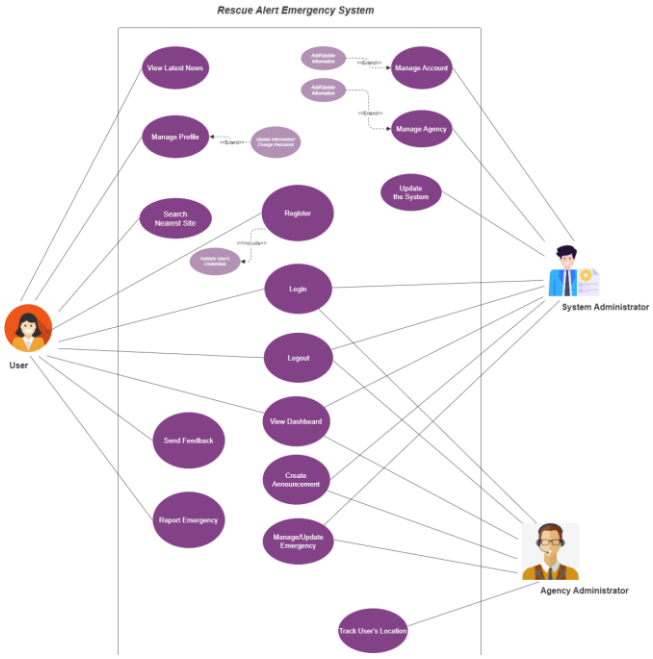

Fig. 1. Use Case Diagram of the System

Fig. 1 illustrates the high-level functions and scope of a system, including user interactions. Users must register and provide personal data before logging in, and their credentials are verified during login. The dashboard allows users, system administrators, and agency administrators to access the system's features. Users can manage their profiles, while the system administrator has the authority to modify user accounts, create new accounts, perform updates, and handle archiving. The system administrator also manages system announcements and oversees the agency. In case of an emergency, users can report the incident, describing the problem and its severity. The report is then sent to the System and Agency Administrator, who can view the user's location and coordinate real-time emergency response with relevant agencies such as the Tuguegarao City Disaster Risk Reduction Management Office,

Bureau of Fire Protection, hospitals, and other rescue agencies. Once the issue is resolved, the System and Agency Administrator can mark the report as resolved.

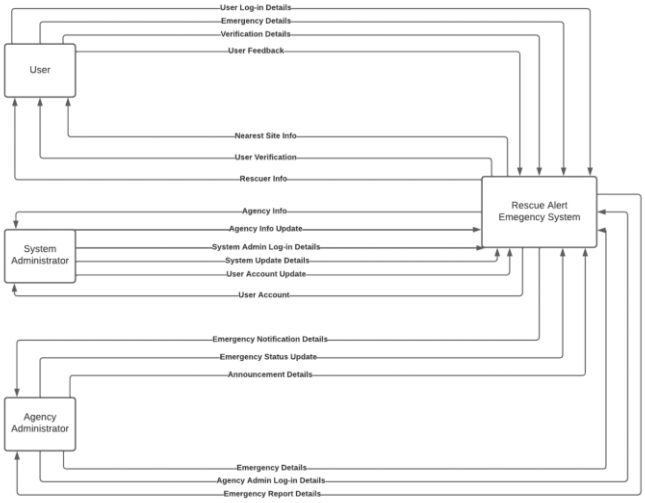

Fig. 2. Dataflow Diagram of the System

Fig. 2 provides an overview of the data inflows and outflows within the Rescue Alert Emergency System, highlighting the sources and destinations of data as well as their storage locations. To access the system, users are required to register and complete the verification process via email. Once verified, users can utilize the system's services. In case of an emergency, users can submit emergency details through the application, which triggers the system to provide information on nearby rescue agencies and appropriate rescuers. After receiving assistance, users can provide feedback. All user data, including emergency details and feedback, are stored in the system's database and shared with the relevant agency rescue centers. The Agency Administrator, who logs into the system, is responsible for managing emergencies, receiving notifications, and posting emergency announcements. Additionally, the Agency Administrator can update emergency information, notify registered users, and generate emergency reports using the available data. Similarly, the System Administrator is required to log in for system management, including account and role updates, as well as hotline information maintenance.

Fig. 3 represents the various components that contribute to the system's functionality, including hardware platforms, network connectivity, services, and software components. Users can access the system through a web browser, enabling them to report emergencies, with the command center receiving the reports and tracking the user's location via GPS. The front end provides the interface for users and administrators to interact with the system, while the web server processes and manages HTTP/HTTPS requests and responses. Web services facilitate secure communication between clients while protecting sensitive information and are supported by a database server for data storage. The development process involved creating interface design prototypes using Figma, implementing essential functionalities and features using the Laravel framework [20] for front-end and back-end development, and refining the prototypes based on feedback from the Tuguegarao City Command Center and experts. The process model allowed users and clients to evaluate and refine the prototypes, focusing on critical features like reporting emergencies until the working model was deemed satisfactory.

Fig. 3. System Architecture

Usability, defined as the effectiveness of users in accomplishing specific objectives with a product, was evaluated using the revised five-point scale USE questionnaire [21]. The system's user interface was rated by a panel of IT experts, IT practitioners from the University of Saint Louis, Tuguegarao residents, and Tuguegarao City Command Center staff. The evaluation involved an online meeting and demonstration of the system's main feature for most participants, while the Command Center staff evaluated the system on-site. Feedback and recommendations were collected using Google Forms and analyzed using Google Sheets and ChartExpo. The administrator's Web-based system was deployed at the Tuguegarao City Command Center, while the user's Web-based system was made accessible to residents and bystanders online. Routine maintenance is performed to ensure system availability and prevent failures. The implementation will start in Tuguegarao City and may expand to other regions in the Philippines.

IV. Results and Discussion

In response to the challenges of communication during emergencies, there is a growing demand for innovative techniques to effectively prepare for and manage disasters. Mobile applications and Web Apps have emerged as potential solutions for saving lives in dangerous situations [6]. The developed system incorporates three roles: the user, system administrator, and agency administrator, with a user-friendly interface designed to enhance usability for all users. Each role has specific access to the system's features and functionalities. The dashboard, depicted in Figure 4, serves as an executive intranet, organizing information based on user interests and incorporating performance indicators to ensure effective and efficient functionality aligned with user needs [22] [23]. The

user's dashboard includes features such as a report emergency button, hotline information, date and time, and details of other users' reported activity, all presented in a vertically positioned navigation pane for a seamless and consistent user experience [24]. Effective dashboards have proven to enhance processes, communication, and situational awareness, thereby significantly improving emergency care services.

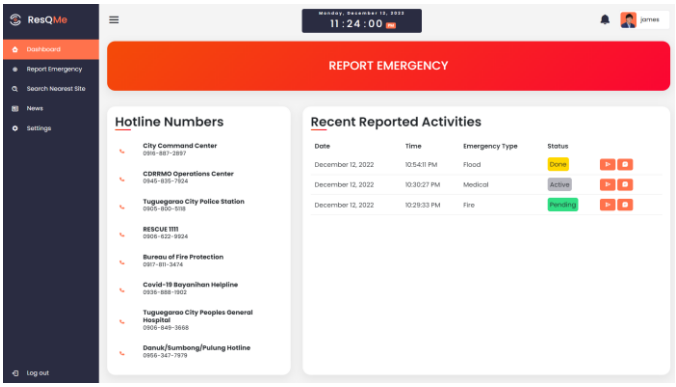

Fig. 4. User Dashboard

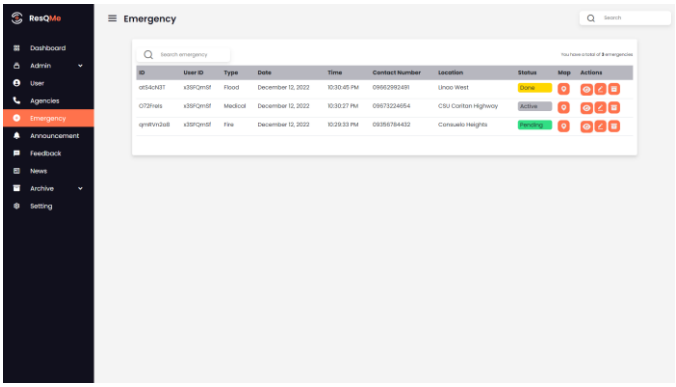

Fig. 5. Admin Dashboard

Performance dashboards serve as a valuable management tool for measuring progress and performance toward business goals [25]. The system's dashboard provides administrators with the ability to monitor various aspects of their activities, extracting useful information and statistics [26]. It presents data such as the total number of emergencies, users, agencies, and announcements, as well as visualizations of reported emergencies categorized in various ways. Real-time situational analysis and access to information are essential for effective emergency response, enabling first responders to assess needs and resource availability [19]. The Emergency Management Module, as depicted in Figure 5, allows agency administrators and system administrators to receive and address residents' reports and help requests. User-provided GPS positions and cellphone numbers help prevent fraudulent or prank reports, as the provided information is shared with the appropriate authorities. By verifying the authenticity of reported emergencies through media evidence and GPS positions, administrators can classify the emergency status as active, pending, or resolved, ensuring the legitimacy of requests [27]. Given the era of Big Data, tools and platforms that facilitate selective data collection, filtering, processing, and retrieval are essential to obtain and utilize valuable information [28].

Fig. 6. The Usefulness of the System

Fig. 7. Ease of Use

The survey results obtained from the panel of IT experts, IT practitioners, Tuguegaraoeños, and Tuguegarao City Command Center staff were analyzed using Google Sheets and ChartExpo to present the findings straightforwardly. The survey aimed to measure participants' attitudes, opinions, and perceptions regarding the developed system. By assigning numbers to intangible aspects, the data analysis process facilitated the interpretation of the survey results.

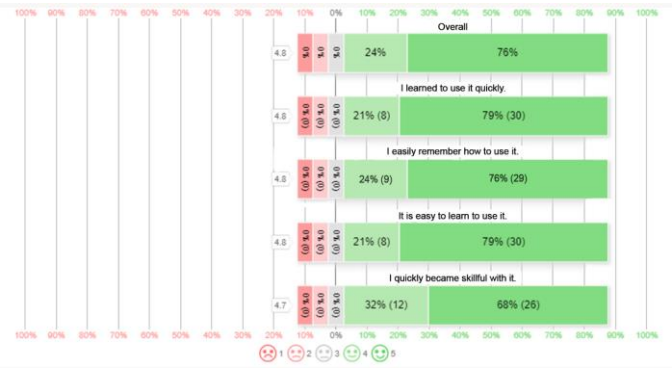

Fig. 8. Ease of Learning

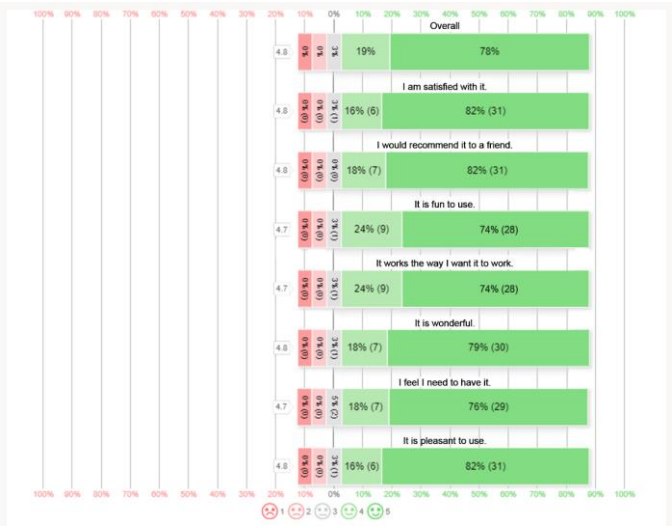

Fig. 9. Satisfaction

In Fig. 6, which represents the Dimension of Usefulness, the survey included eight questions related to the system's usefulness. The analysis revealed that 73 percent of respondents strongly agreed with the system's usefulness, particularly emphasizing its main feature. Additionally, 22 percent of participants agreed, while 5 percent had a neutral stance. These findings indicate a positive perception among the participants regarding the system's practicality and relevance in addressing the needs of Tuguegarao City.

Fig. 7 displays the Dimension of Ease of Use, which consisted of eleven questions aimed at assessing participants' opinions on the system's usability. The analysis indicated that 71 percent of respondents strongly agreed that the system is easy to use, demonstrating a high level of user-friendliness. Furthermore, 26 percent of participants agreed, while only 3 percent had a neutral view. These results suggest that the system's interface and functionalities were well-designed and intuitive, making it accessible to users in Tuguegarao City.

The Dimension of Ease of Learning, depicted in Fig. 8, focused on participants' perceptions of the system's learnability. The survey included five questions addressing this aspect. The data analysis revealed that 76 percent of respondents strongly agreed that users can quickly learn the system. In contrast, 24 percent agreed, indicating a positive perception of the system's ease of learning. These results highlight the effectiveness of the system's design and the availability of resources that support users in acquiring the necessary knowledge and skills to operate it.

Fig. 9 represents the last dimension, Satisfaction, which encompasses seven questions aimed at capturing participants' overall satisfaction with the system. The analysis indicated that a significant majority of respondents, 78 percent, strongly agreed with the system, expressing a high level of satisfaction. Additionally, 19 percent of participants agreed with the system's performance, while only 3 percent had a neutral stance. These findings suggest that the system effectively met the expectations and requirements of the users, resulting in a high degree of satisfaction among the participants.

V. Conclusion

The system developed in this study has demonstrated its capability to efficiently and effectively manage emergencies in Tuguegarao City. By leveraging the functionalities of smartphones, such as GPS, camera, and Internet connectivity, the system enables users to seek emergency assistance, report incidents, and notify the appropriate authorities. The interactive and user-friendly interface enhances usability and promotes timely and accurate communication between users, rescue agencies, and local government units. The system's implementation has the potential to reduce the number of emergency casualties and improve disaster preparedness and resilience-building measures in the city.

Several recommendations can be made to further enhance the usability and functionality of the Rescue Alert Emergency System. First, developers should consider creating an interactive video demonstration of the system's operation to provide easy guidance for users, particularly the senior population. This visual aid can help users understand and navigate the system more effectively. Second, the inclusion of status recency for users in the system's archiving process would be beneficial. This feature would provide a historical record of user activities and contribute to data analysis and future improvements. Furthermore, it is recommended to develop and disseminate the system's graphical user interface (GUI) to all barangays in Tuguegarao City, ensuring widespread access and utilization of the system's capabilities

throughout the community. Lastly, the results and findings of this project can serve as a valuable benchmark for academics and developers who are interested in developing similar emergency response systems, encouraging further research and innovation in this field.

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