

Enhancing Barangay Household Registration with Google Maps

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Abstract: *This study presents the creation of the "Enhancing Barangay Household Registration with Google Maps" system, which aims to enhance the efficiency and accuracy of household registration in the barangay. By incorporating Google Maps technology, the system improves data visualization and analysis for informed decision-making by barangay officials. The project follows Agile software development methodology and object-oriented analysis and design, ensuring a flexible and scalable system architecture. Implementation is done using the Laravel Framework, ensuring a robust and easily maintainable solution. User satisfaction is evaluated using the System Usability Scale (SUS), with positive feedback received on usability. The web-based registration system, integrated with Google Maps, effectively overcomes the limitations of the traditional paper-based approach, streamlining data collection and providing real-time information access.*

Keywords: household services ePortal, object-oriented design, Laravel

I. INTRODUCTION

At the local level in the Philippines, barangays play a crucial role in governance and community development [1]. An essential aspect of efficient barangay administration is the Barangay Household Registration (BHR) system, which systematically collects demographic and geographic data of residents. This process enables local authorities to understand the needs of their constituents and tailor services accordingly. Accurate household data is of utmost importance for effective policymaking, planning, and service delivery at the barangay level. It serves as the foundation for various local government initiatives, encompassing social welfare programs, health services, education, and infrastructure development. Additionally, precise data plays a pivotal role in disaster preparedness and response, facilitating targeted relief efforts during emergencies [2].

Advancements in technology have opened up new possibilities for improving traditional systems, and one such innovation is the integration of Google Maps into barangay household registration. Google Maps, a widely-used web mapping service, provides geolocation, dynamic maps, and route planning capabilities. Leveraging this technology, barangay officials can incorporate geospatial data, enhancing the accuracy, management, and visualization of household information.

However, despite the significance of accurate household data and the potential benefits of Google Maps integration, many barangays in the Philippines still rely on a paper-based registration system. In this approach, household information is manually collected and recorded on physical forms, stored in filing cabinets or folders [1]. While this traditional method has been used for years, it comes with inherent limitations and challenges. The paper-based system is inefficient and prone to errors, as manual data gathering is time-consuming and labor-intensive, leading to delays in data updates and potential backlogs. Additionally, human errors in the manual entry of data, such as misspellings and omissions, compromise the overall data quality.

To overcome these limitations, this project aims to improve the barangay household registration system by designing and developing a web-based BHR integrated with Google Maps technology. By making this transition from a paper-based system to a digital platform, the barangay can streamline data collection, enhance data accuracy, and enable real-time access to information. Leveraging geospatial data from Google Maps, the registration process can be optimized, leading to better-informed governance and improved services for the community.

II. REVIEW OF RELATED STUDIES

Barangay Household Registration (BHR) is an essential component of local governance, responsible for recording demographic and geographic data of residents within a barangay. Traditionally, this registration process has relied on manual, paper-based methods, where barangay officials collect and record household information on physical forms. However, this method has several limitations, including time-consuming data entry, potential errors, and limited data accessibility. Manual data collection and entry lead to delays in updates and potential inaccuracies, hindering effective decision-making and resource allocation within the barangay. Additionally, the physical storage of records restricts data sharing among stakeholders, affecting timely responses during emergencies.

Integrating Google Maps into barangay household registration offers numerous advantages to overcome these limitations. As a widely-used web mapping service, Google Maps provides geolocation, dynamic maps, and route planning capabilities, enabling the inclusion of geospatial data in the registration process [3]. This integration enhances data accuracy, efficiency, and visualization. Geocoding allows precise mapping of household addresses, enabling better spatial planning and targeted service delivery. Real-time access to information through Google Maps facilitates prompt decision-making during emergencies. Furthermore, the visual representation of data on maps aids in identifying patterns for informed policymaking.

Studies by Zhang et al., Ghumman et al., and Adnan et al. explore diverse applications of geospatial technology in local governance. Zhang et al. [4] investigated the integration of GIS and SDSS for urban land use planning, while Ghumman et al. [5] conducted geospatial analysis of air pollution to identify hotspots and assess health risks. Adnan et al. [6] reviewed the use of GIS for monitoring SDGs at the local government level. Additionally, Yu et al. [7] highlighted the use of GIS in urban transportation planning, and Rafiei et al. [8] emphasized the significance of geospatial data infrastructure for supporting e-government services in smart cities.

Other studies have explored GIS applications for disaster management and resource allocation [9][10] and utilized mobile-based data collection tools in remote areas [11][12]. These studies collectively demonstrate the diverse and essential applications of geospatial technologies in local governance. From land use planning to disaster management and e-government services, GIS and related technologies offer valuable tools for data-driven decision-making and efficient governance at the local level.

The insights and findings from the related studies on geospatial technology applications in local governance offer valuable guidance for enhancing the household registration process in the project "Enhancing Barangay Household Registration with Google Maps." The integration of GIS and SDSS demonstrated by Zhang et al. can be adapted to improve the accuracy and efficiency of data collection and visualization in barangay household registration [4]. By leveraging geospatial data, barangay officials can precisely map household addresses, facilitating better spatial planning and targeted service delivery within the community. Additionally, Ghumman et al.'s study on geospatial analysis of air pollution can provide a framework for incorporating environmental data into the registration system, enabling the identification of specific areas of concern and potential health risks for residents [5]. Adnan et al.'s review on monitoring SDGs using GIS can guide the project in implementing mechanisms to track and evaluate the impact of household registration efforts in achieving sustainable development goals at the local level [6]. By utilizing the knowledge from these studies, the project can create an enhanced web-based Barangay Household Registration (BHR) system, integrating Google Maps technology to elevate data accuracy, streamline the registration process, and enhance governance effectiveness within the barangay.

III. METHODOLOGY

The project "Enhancing Barangay Household Registration with Google Maps" will adopt an Agile software development methodology, which emphasizes a flexible and iterative approach to system development [13]. This methodology encourages collaboration, customer feedback, and incremental progress, allowing the project team to continuously improve and adapt to changing requirements throughout the development process. Fig. 1 shows the block diagram of systems development methodology used in the study.

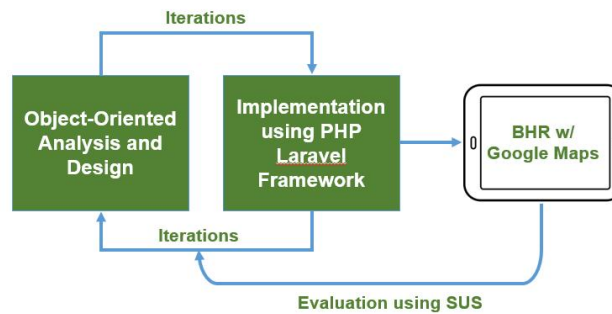


Fig. 1. System development methodology

For conceptualizing and modeling the system's structure and behavior, Object-oriented analysis and design (OOAD) principles will be utilized [14]. OOAD focuses on defining objects, classes, and their relationships, promoting efficient problem-solving and facilitating code reusability. A use-case diagram and class diagram for the system is prepared during this stage [15]. By employing OOAD, the project team can design a scalable and maintainable system architecture for the Barangay Household Registration (BHR) system.

To implement the BHR app, the Laravel Framework will be employed, known for its robustness, scalability, and developer-friendly features in PHP web application development [16][17]. Laravel offers a comprehensive set of tools and libraries that expedite the development process, making the integration of Google Maps technology into the registration system efficient and effective.

To assess the system's usability and user satisfaction, the project will utilize the System Usability Scale (SUS) [18]. SUS is a widely recognized questionnaire-based tool used to evaluate the usability of software systems. By providing a set of standard usability-related statements, users will provide their responses on a 5-point Likert scale, enabling the measurement of the BHR system's overall usability and identifying potential areas for improvement based on user feedback.

The development process will involve multiple iterative cycles, with each cycle resulting in an increment of the BHR system. Regular interactions and communication channels will be established with stakeholders, including barangay officials and end-users, to gather feedback and requirements for each iteration. This iterative approach ensures the continuous evolution of the system based on user input, aligning the BHR system with the specific needs and preferences of the barangay community.

IV. RESULTS AND DISCUSSION

The study on successfully applied Agile software development methodology, facilitating a flexible and iterative approach to system development. Throughout the development process, continuous feedback and collaboration with stakeholders, including barangay officials and end-users, were prioritized, ensuring adaptability to changing requirements and continuous improvement.

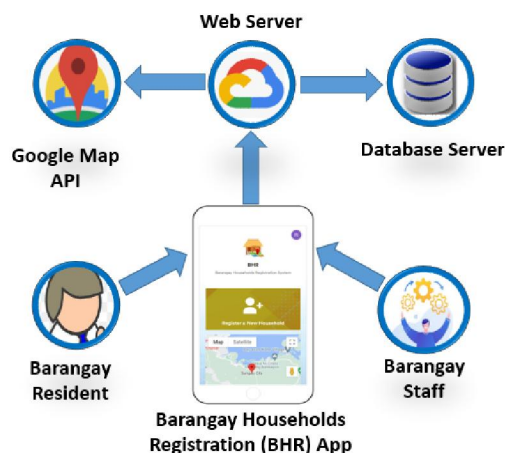


Fig. 2. System diagram

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4.1 System Diagram

Fig. 2 shows the system architecture. At its core is the Barangay Households Registration App, serving as a web-based interface for both barangay residents and staff. The app enables barangay residents, to be facilitated by barangay staff, to register their households by providing essential information such as address, location, household head and details of household members. Meanwhile, barangay staff can utilize the app to manage and update household data, view registered households on the map, and generate reports based on the collected information. The system relies on a Web Server to host and serve the Barangay Households Registration App to users. The web server handles incoming user requests, processes them, and delivers appropriate responses, facilitating smooth communication and interactions. Data storage is handled by the Database Server, which stores all relevant information about barangay households and their members. This includes household IDs, addresses, household members' details, and geographic coordinates (latitude and longitude). The database server ensures data integrity, security, and reliability, allowing the app to efficiently manage and access household data. To enhance the accuracy and visualization of household data, the system integrates the "Google Maps API." This API provides geolocation, dynamic maps, and route planning capabilities within the app. By leveraging the Google Maps API, the system can display registered households on the map with markers, providing a visual representation of their locations. This feature aids in better planning and service delivery for the barangay.

4.2 Design and Development

Object-oriented analysis and design (OOAD) were effectively utilized in conceptualizing and modeling the system's structure and behavior. OOAD principles, such as defining objects, classes, and their relationships, enabled efficient problem-solving and promoted code reusability, resulting in a scalable and maintainable system architecture. Use-case and class diagrams were developed to provide a clear representation of the system's functionalities and interactions.

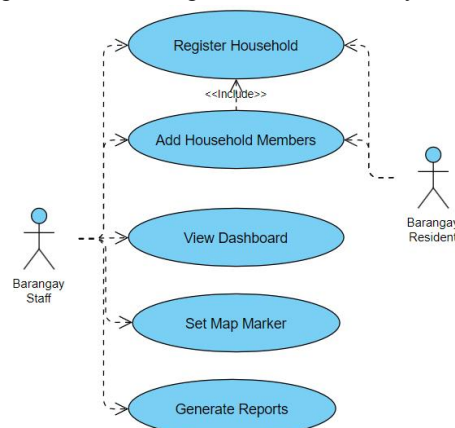


Fig. 3. Use-case diagram

Fig. 3 shows the use-case diagram for the system illustrating the use-cases along with their corresponding actors. The Barangay Resident actor engages in the Register Household and Add Household Members use-cases, enabling them to register their households and add information about household members. Conversely, the Barangay Staff actor interacts with the View Dashboard, Add Map Marker, and Generate Reports use cases. The View Dashboard use case allows barangay staff to access a comprehensive overview of registered households and relevant statistics for efficient management. By utilizing the Add Map Marker use case, staff can plot registered households' locations on the map, enhancing data visualization. Additionally, the Generate Reports use case empowers barangay staff to generate reports based on the collected household data and statistics, facilitating informed decision-making and strategic planning. The use-case diagram visually represents these interactions, illustrating how the system accommodates both barangay residents and staff in managing household registration, data visualization, and generating valuable insights for improved barangay services.

Fig. 4 shows the design diagram for the "Enhancing Barangay Household Registration with Google Maps" system comprising the three primary classes: Household, Members, and Map Marker. The Household class represents individual households within the barangay and contains relevant attributes such as household ID, address, and other

essential information specific to each household. Meanwhile, the Household Members class represents the members residing in each household and stores their details, including member ID, name, age, gender, and other relevant data. The Map Marker class is responsible for visualizing household locations on the map. It includes attributes such as geographic coordinates (latitude and longitude), which precisely determine the position of each household on the map.

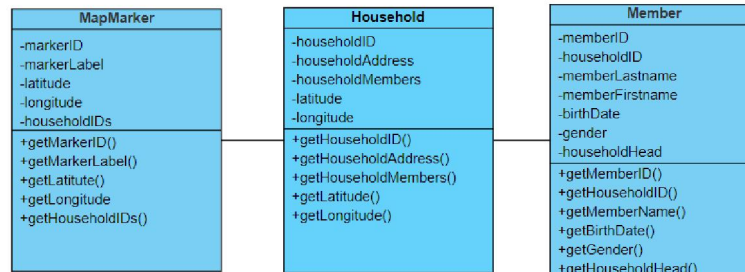


Fig. 4. Class diagram

The relationships between the classes are as follows: The Household class has a one-to-many relationship with the Household Members class, meaning that one household can have multiple household members, but each member belongs to only one household. Additionally, the Household class has a one-to-one relationship with the Map Marker class, signifying that each household is associated with one map marker, enabling accurate spatial representation on the map. The class diagram provides a clear and organized representation of the system's key classes and their relationships. It illustrates how household and household member data are structured and associated with their corresponding map markers, facilitating efficient management and visualization within the system.

4.3 The Barangay Households Registration (BHR) with Google Map App

For implementation, the Laravel Framework, a robust and developer-friendly PHP web application framework, was utilized. Its scalability and efficiency allowed for the seamless integration of Google Maps technology into the registration process, enhancing the accuracy and management of household information. The following provides important details about the implemented Barangay Household Registration with Google Map application.

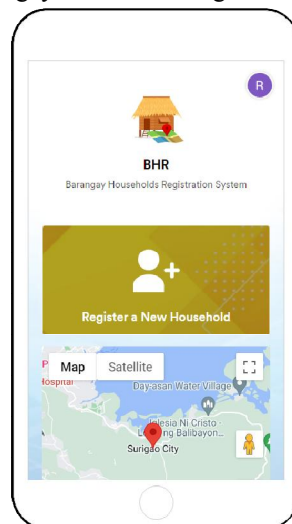


Fig. 5. BHR App home page

The homepage of the BHRapp is shown in Fig. 5. The homepage offers a user-friendly interface with key features to facilitate household registration and data management within the barangay. It prominently includes a link labeled Register a New Household, guiding barangay staff to initiate the household registration process. Clicking on this link leads users to a form where they can input essential household details. The homepage also features an interactive map displaying markers for registered households in the barangay. This map allows users to zoom in and out and explore different areas of the barangay. Each marker represents a registered household, offering a

visual representation of their geographic distribution. The homepage also provides a link for the barangay staff with access to the dashboard.

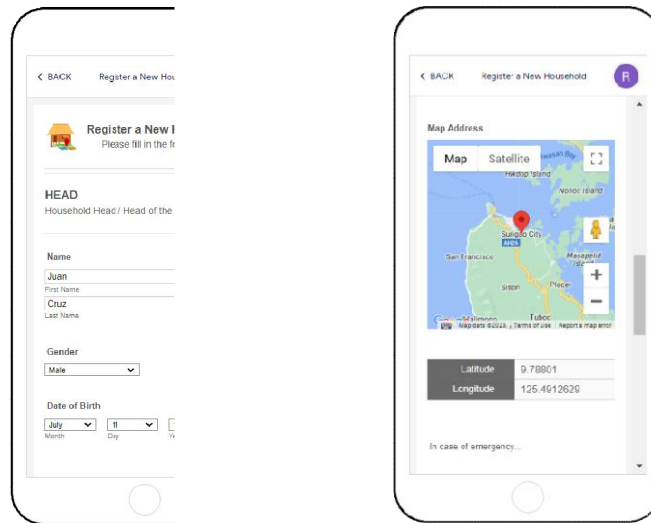


Fig. 6. Household registration page

The Register a New Household form is shown in Fig. 6. The app is designed to gather comprehensive information about newly registering households. It offers a user-friendly layout, capturing essential details of the household head and household members. The form includes fields for the household head's full name, contact information, date of birth, gender, and other relevant attributes. Additionally, users can input information about all household members, such as their names, relationships to the household head, ages, genders, and any other pertinent data. The form also integrates geolocation functionality, allowing users to precisely mark the household's address on the map. This can be achieved either through the device's location services or by manually entering the geographic coordinates (latitude and longitude) corresponding to the household's location. By accurately visualizing the household's position on the map, the BHR app facilitates better data representation and assists in effective spatial planning for barangay services.

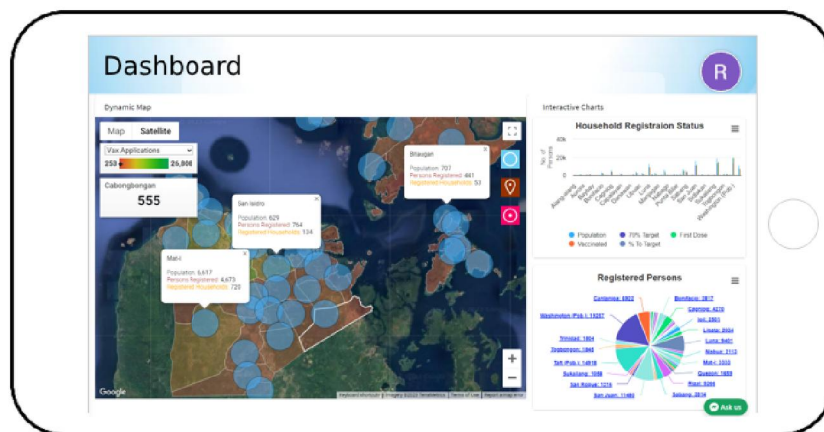


Fig. 7. Household registration page

Fig. 7 shows the Dashboard page in the Barangay Household Registration (BHR) app. It presents a comprehensive and visually appealing overview of household registration data within the barangay. It incorporates dynamic elements that facilitate user interaction and data exploration. A dynamic map takes center stage, featuring markers representing registered households across the barangay. Each marker is accompanied by relevant icons and pop-ups displaying essential household information when clicked. These icons may signify the household's status or eligibility for barangay services, while the pop-ups offer detailed data, including the household head's name, address, and the number of household members. This enhances data visualization and understanding. The page also provides interactive charts provide valuable insights into the barangay's household registration status. These charts depict the total number of

registered households over time, the distribution of registered households in different areas or zones within the barangay, and any registration trends or patterns. Users can interact with the charts by hovering over data points or clicking on specific elements to access more detailed information and explore different aspects of household registration. Adjacent to the household registration charts is the registered persons chart illustrating the number and demographics of registered individuals in the barangay. These charts portray the age distribution, gender ratio, and other characteristics of the registered residents. Users can interact with these charts to gain deeper insights into the registered population's composition and identify significant trends.

4.4 System Evaluation

The System Usability Scale (SUS) was used to evaluate the usability and user satisfaction of the system. Users were asked to rate 10 usability-related statements on a 5-point Likert scale. The average SUS score obtained was 80.5 out of 100, indicating a favorable level of usability and placing the system in the "Good" usability category. Users particularly appreciated the system's ease of use, with the statement "I found the system to be easy to use" receiving the highest average score of 4.6 out of 5. Additionally, users expressed a positive inclination to frequently use the system if available, as indicated by an average score of 4.4 out of 5 for the statement "I would use this system frequently if it were available." However, there were some suggestions for improvement, with a slightly lower score of 3.8 out of 5 for the statement "I thought the system was unnecessarily complex." This indicates a potential area for streamlining certain functionalities to enhance user experience. Overall, the SUS results indicate that the system's usability and user satisfaction are commendable, with scope for further enhancements to provide an even more satisfactory user experience.

V. CONCLUSION

In conclusion, the study "Enhancing Barangay Household Registration with Google Maps" has successfully developed a user-friendly system that greatly improves the household registration process in the barangay. By integrating Google Maps technology, the system enhances data visualization and analysis for better decision-making by barangay officials. The adoption of Agile software development methodology and object-oriented analysis and design ensures a flexible and scalable system architecture. The implementation using the Laravel Framework guarantees robustness and ease of maintenance. The evaluation using the System Usability Scale (SUS) indicates positive user feedback, demonstrating good usability and user satisfaction. The app's web-based registration system with Google Maps integration effectively overcomes the limitations of the traditional paper-based approach. It streamlines data collection, enhances accuracy, and provides real-time access to information, benefiting governance at the local level. With dynamic maps, interactive charts, and a user-friendly dashboard, the system empowers barangay residents and staff with valuable insights for efficient household management. The use of the app contributes to advancing local governance and service delivery in the barangay. By providing modern and efficient tools, the system enables better decision-making, resource allocation, and disaster preparedness. Ultimately, the improved household registration system leads to enhanced services, more effective governance, and an overall improved quality of life for the barangay residents.

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