Design and Development of Barangay Health Information System using Google Maps

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Abstract: *The study aimed to design and develop a Barangay Health Information System that integrates Google Maps as a key component. It utilizes rapid application development methodology and object-oriented analysis and design. The system was implemented using Laravel Framework, to create a robust and efficient BHIS. By integrating Google Maps, the BHIS can efficiently geolocate and map health facilities, patient populations, and other relevant data points. This spatial visualization offers a comprehensive view of healthcare dynamics within the barangay, enabling evidence-based decision-making and resource allocation. The evaluation conducted on the app concluded that it is highly effective in terms of usability, relevance, functionality, maintainability, and portability, receiving an overall average rating of 4.52, which is very satisfactory. This underscore the system's potential to significantly enhance health information management and healthcare services delivery at the barangay level, fostering improved health outcomes for the community.*

Keywords: health information system, Google maps, object-oriented design

I. INTRODUCTION

The design and development of a Barangay Health Information System (BHIS) using Google Maps is a critical endeavor that aims to enhance the management and utilization of health-related data at the barangay (village) level in the Philippines. The integration of Google Maps into the BHIS offers significant potential in terms of improving data visualization, accessibility, and analysis, thereby facilitating evidence-based decision-making and resource allocation in healthcare settings [1].

The existing state of the BHIS is often characterized by a paper-based system, where barangay health workers rely on physical paper records to document and manage health information. However, this paper-based approach presents several disadvantages, including data disorganization, limited storage capacity, difficult data retrieval, vulnerability to damage and loss, and challenges in data sharing and collaboration [2].

To address these limitations and improve health information management, the design and development of a BHIS using Google Maps become paramount. By leveraging the capabilities of Google Maps, the BHIS can overcome the challenges associated with a paper-based system and provide a more efficient and effective platform for managing health-related data.

Integrating Google Maps into the BHIS allows for the geolocation and mapping of health facilities, disease outbreaks, patient populations, and other relevant data points. This spatial visualization provides a comprehensive view of the healthcare landscape within a barangay, facilitating a better understanding of healthcare dynamics and supporting evidence-based decision-making. The integration also enhances the accessibility and usability of health data, as Google Maps is widely available and accessible on various devices, ensuring that healthcare providers, administrators, and policymakers can access the BHIS and its mapping functionalities from different locations and platforms [1].

The objective of this study is to design and develop a Barangay Health Information System that integrates Google Maps as a key component. By doing so, the study aims to improve data organization, accessibility, security, and analysis within the BHIS. The ultimate goal is to enhance healthcare management, decision-making, and resource allocation at the barangay level, leading to improved health outcomes for the communities served by the BHIS.

II. BACKGROUND OF THE STUDY

Existing health information systems (HIS) play a crucial role in capturing, managing, and utilizing health-related data. However, they often face limitations that hinder their effectiveness. One common limitation is the lack of interoperability and data integration among different systems, which leads to fragmented and incomplete health information [3]. Additionally, many traditional HIS rely on paper-based or legacy systems, resulting in challenges related to data accessibility, storage capacity, and security [4]. Moreover, these systems may lack user-friendly interfaces and comprehensive functionalities, making it difficult to analyze and utilize the collected data efficiently [5].

Geospatial technology offers valuable advantages and applications in healthcare. It allows for the integration of geographical information with health data, enabling spatial analysis and visualization. Geospatial technology facilitates the identification of disease patterns, health disparities, and the impact of environmental factors on health outcomes [6]. Geospatial tools such as geographic information systems (GIS) enable researchers and policymakers to explore the spatial distribution of diseases, assess the accessibility of healthcare services, and identify areas in need of targeted interventions [7]. Geospatial analysis also supports resource allocation, emergency response planning, and public health surveillance [8].

Google Maps, a widely used mapping platform, has found various applications in healthcare and community programs. It offers user-friendly interfaces, interactive maps, and geolocation capabilities that enhance data visualization and accessibility [9][18][20][21]. Google Maps can be utilized to map health facilities, track disease outbreaks, and monitor health indicators in real-time [10]. It enables the creation of health facility locators, allowing community members to easily locate nearby healthcare services such as clinics, hospitals, and pharmacies [11]. Moreover, Google Maps can support disaster response efforts by providing up-to-date information on evacuation centers, medical facilities, and safe routes during emergencies [12].

III. METHODOLOGY

The development of the Barangay Health Information System (BHIS) utilized an iterative and incremental approach based on rapid application development methodology, integrating object-oriented analysis and design (OOAD) techniques [13][19]. The data collection phase involved gathering information from selected barangays in Surigao City, Philippines. To capture the system requirements, a design use-case diagram was created, followed by the development of a class diagram specifying the necessary classes and objects for the application. This approach aligns with the principles of OOAD, which emphasize designing software using self-contained objects that encapsulate data and methods [14]. The primary goal was to create a scalable, maintainable, and adaptable application capable of accommodating future changes.

In the requirement gathering phase, interviews were conducted with system users to obtain essential information such as system users, use-cases, and objectives. This step ensured a comprehensive understanding of the app's requirements [15].

The subsequent phase encompassed object-oriented analysis, design, and implementation. This involved identifying the objects and classes required to fulfil the app's requirements. Use-case and class diagrams were created to visually represent the app's functionality[14]. The implementation of the app utilized a combination of programming languages and tools, with Laravel serving as the primary framework for app development [22]. During implementation, adherence to the design principles established in the object-oriented analysis and design phase was maintained [16].

To evaluate the system's effectiveness, a group of barangay health workers and medical personnel participated in the evaluation process. Feedback from the participants was collected to identify areas for improvement and enhance the system's functionality and usability. Statistical methods were applied to analyze the data gathered during the evaluation phase, aiding in the assessment of the BHIS's effectiveness [17].

IV. RESULTS AND DISCUSSION

In this research, the researcher conducted interviews with barangay health workers and medical personnel of selected barangays in SurigaoCity, Philippines. The interviews aimed to collect pertinent data to shape the design and development of the barangay health information system, with a focus on their preferences and needs concerning the integration of Google Maps as a crucial component of the system.The gathered data revealed essential factors to

consider for the success of the project. Firstly, it is imperative that the application is user-friendly for the barangay health workers. Moreover, the design should incorporate the combination of geographical information with health data to enable spatial analysis and visualization. This integration seeks to optimize healthcare management, decision-making, and resource allocation at the barangay level, ultimately leading to improved health outcomes for the communities served by the BHIS.
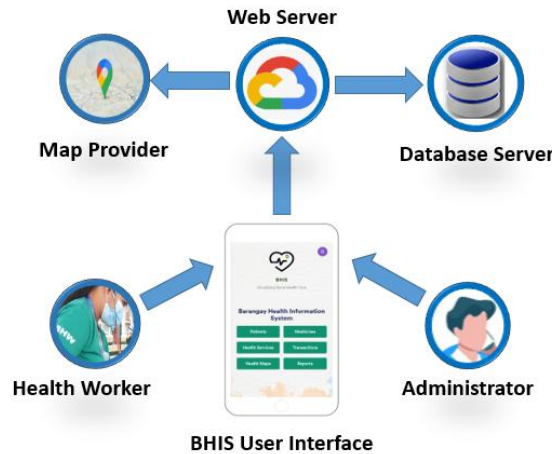

Fig. 1. System diagram

4.1 System Diagram

Figure 1 shows the components of the system. The map provider is a crucial component of the Barangay Health Information System (BHIS) that offers map-related services and functionalities, such as geolocation, mapping, and route planning. It allows the BHIS to integrate geographical information and display maps within the user interface. By incorporating a map provider like Google Maps, the BHIS can display health facility locations, patient addresses, and visualize health-related data spatially, enhancing the system's overall usability and effectiveness. The web server is a software component that hosts the BHIS application and makes it accessible over the internet. It handles requests from BHIS users, processes those requests, and serves the corresponding web pages and data back to the users. The web server ensures that the BHIS is available to authorized users, such as health workers and administrators, and allows them to access the system from various devices with an internet connection. The database server is a critical part of the BHIS that manages and stores all the system's data, including patient records, medicine information, health service details, and transaction logs. It provides a secure and organized storage environment for the BHIS data and enables efficient data retrieval and manipulation. The user interface allows users, including health workers and administrators, to interact with the application. It provides a user-friendly and intuitive interface where users can input data, view information, and perform various tasks, such as managing patient records, updating medicine details, conducting transactions, view health maps and generating reports.

4.2 Design and Development

To ensure that the application achieved its functional requirements, the researcher constructed a use-case diagram and class diagram. These diagrams were designed to encompass the necessary objects and classes required to support the application's functionality effectively. The use-case diagram served as documentation for the system's requirements and provided guidance throughout the development process.

Fig. 2 shows the design use-case diagram. It shows the main interactions between the users and the BHIS app. The users include the barangay health workers and medical personnel working at the barangay level. They play a crucial role in providing primary healthcare services to the community. Their responsibilities include recording patient data, dispensing medicines, conducting health transactions, viewing health maps and managing health services. The users also include the administrator responsible for overseeing the BHIS system's overall management, configuration, and security. It has access to administrative functions, such as user management, system settings, and data backups. The patients are individuals who receive healthcare services at the barangay health center.
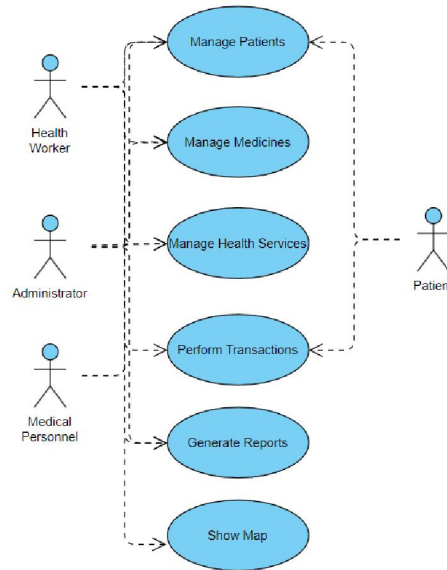
Fig. 2. Use-case diagram

They may interact with the BHIS to access their medical records, and receive health-related information. The Barangay Health Workers and Medical Personnel can visualize health-related data on maps within the BHIS system. The integration of geographical information with health data enables spatial analysis and visualization of various health indicators, facilitating better decision-making and resource allocation.
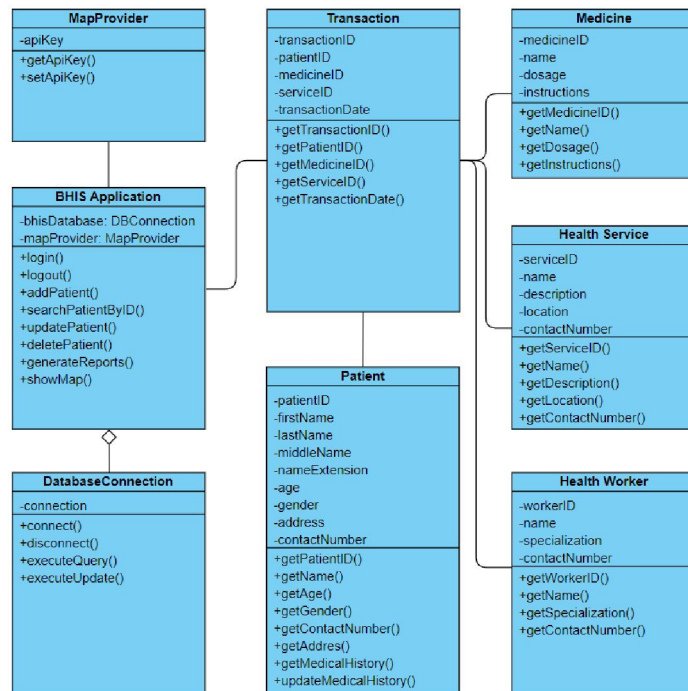

Fig. 1. Class diagram

Fig. 3 shows the class diagram to provide a visual representation of the system's architecture. It gives a high-level overview of the different classes and their relationships in the system. In this class diagram, we have the following classes: BHIS Application, Map Provider, Database Connection, Transaction, Health Service, Patient, Medicine, and Health Worker. The BHIS Application, is the main class of the app, which includes the attributes this Database and map Provider. The Patient class represents individuals who receive healthcare services at the barangay health center. It stores

patient information such as name, age, gender, contact details, and medical history. The Medicine class encapsulates information about medicines available at the barangay health center. It includes attributes such as medicine name, dosage, and instructions. The Health Service class represents various health services offered at the barangay health center. It includes attributes like service name, description, location, and contact number. The Transaction class records interactions between patients, medicines, health services, and health workers. It includes details about the specific healthcare service provided, medicines dispensed, and relevant timestamps. The Barangay Health Worker class represents healthcare professionals and personnel working at the barangay level. Finally, the Map Provider class integrates geographical information services, such as Google Maps, into the BHIS system. It enables spatial analysis and visualization of health-related data on maps.These classes capture the essential entities and functionalities within the BHIS system, allowing for effective data management, user interactions, and healthcare services delivery. The class diagram played an important role in the development of the application using object-oriented programming. The identified class were directly mapped to the classes of objects in the code that were used at the time of construction.

4.3 The Barangay Health Information System with Google Maps

The following gives the important details of the BHIS following the design and development process. As envisioned, the application has been designed with user-friendly interfaces that integrates Google Maps as a key component to improve data organization and visualization.

Fig. 4. Class diagram

Fig. 4 illustrates the home screen of the application. As a result, the app's interfaces were designed to offer an intuitive experience for barangay health workers. The home screen presents accessible links to various pages, including transactions, health services, patient management, and medicine management. Additionally, there is a link to access health services maps and real-time reports, providing valuable insights about barangay health services. The goal of these interface designs is to streamline the user's navigation and facilitate efficient access to essential functionalities of the application.

In Fig. 5, the health services map is presented, illustrating the different locations within the locality where health services have been offered. The map serves the purpose of organizing crucial data spatially, facilitating decision-making and resource allocation at the barangay level. By visually displaying the distribution of health services, this map aids in making informed decisions and effectively managing resources to cater to the healthcare needs of the community.
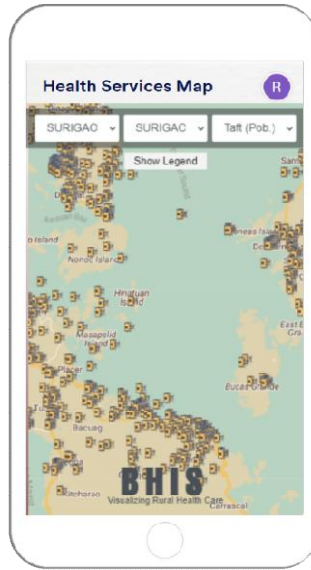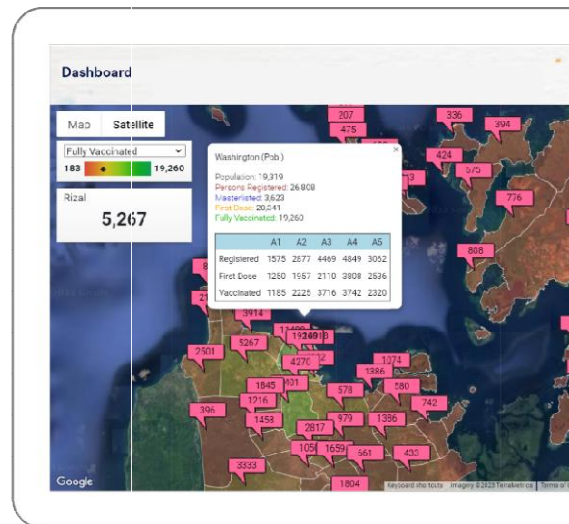
Fig. 5. Health services map

Fig. 6. Dashboard

The enhancement of health information management is achieved through the creation and implementation of a BHIS utilizing Google Maps, as depicted in the system's dashboard in Fig. 6. Leveraging Google Maps' capabilities, the BHIS effectively addresses the drawbacks of a paper-based system and offers a more streamlined and powerful solution for health-related data management. The integration of Google Maps enables geolocation and mapping of health facilities, disease outbreaks, patient populations, and other pertinent data points, leading to a comprehensive grasp of healthcare dynamics and enabling informed decision-making based on concrete evidence. This approach substantially improves the efficiency and effectiveness of health information management within the system.

4.4 System Evaluation

The evaluation of the Barangay Health Information System (BHIS) focused on evaluating its usability, relevance, functionality, maintainability, and portability. In terms of usability, the BHIS obtained a rating of 4.5 out of 5.0, signifying an intuitive user interface and seamless navigation. The relevance evaluation yielded a rating of 4.6 out of 5.0, highlighting the BHIS's strong alignment with specific healthcare needs at the barangay level. For functionality, the system's comprehensive range of features, earneda rating of 4.5 out of 5.0. The system excelled in managing patient records, health services, medicines, and transactions, offering a valuable resource for streamlined healthcare

management. Regarding maintainability evaluation yielded a rating of 4.6 out of 5.0, showcasing the system's ease of maintenance and scalability for future updates and enhancements. On portability, the BHIS received a rating of 4.4 out of 5.0, indicating its capability to operate across various devices. With an overall average rating of 4.52 out of 5.0, these positive ratings underscore the system's potential to significantly enhance health information management and healthcare services delivery at the barangay level, fostering improved health outcomes for the community.

V. CONCLUSION

In conclusion, developing the app using rapid application development methodology and object-oriented analysis and design techniques can result in more scalable, maintainable, and adaptable app. The system was implemented using the Laravel framework integrating Google maps to provide a more efficient and effective platform for managing health-related data. The evaluation conducted on the app concluded that it is highly effective in terms of usability, relevance, functionality, maintainability, and portability, receiving an overall average rating of 4.52, which is very satisfactory. This underscore the system's potential to significantly enhance health information management and healthcare services delivery at the barangay level, fostering improved health outcomes for the community.

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