

Enhancing Local Governance in Surigao del Norte through Barangay Connect: A total Management Information System for Barangays

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ABSTRACT

Local governance in Surigao del Norte, Philippines, faces significant challenges due to manual information management, resulting in inefficiencies, errors, and time-consuming processes. To address these issues, Barangay Connect, an innovative Management Information System (MIS), was developed to digitize and automate local governance. This system facilitates efficient storage, quick retrieval of demographic data, and real-time monitoring of barangay services, significantly improving decision-making and administrative efficiency. By integrating features such as automated data processing, report generation, and SMS notifications for real-time updates, Barangay Connect enhances community engagement and ensures robust data security. The system's usability and performance were evaluated using the System Usability Scale (SUS), achieving a high usability percentile of 91.28%, indicating excellent user satisfaction and system effectiveness.

Keywords: Local Governance, Management Information System, Digital Transformation, E-Governance, Citizen Engagement, Barangay Connect, Surigao del Norte

INTRODUCTION

The barangays in Surigao del Norte, the smallest political and administrative units in the Philippines, play a crucial role in local governance and service delivery. However, these barangays face significant challenges in effectively fulfilling their responsibilities due to their heavy reliance on manual systems for information management and service provision.

The current manual processes employed by many barangays in Surigao del Norte present significant obstacles. The storage, retrieval, and processing of crucial data, such as resident profiles, business registrations, and incident reports, are heavily dependent on paper-based records and archives. This over-reliance on manual methods limits the accessibility and usability of the data, hindering evidence-based decision-making and hampering the barangays' responsiveness to the evolving needs of their constituents [1].

The recent COVID-19 pandemic has further underscored the critical need for digital transformation in local governance. Accurate and timely data on factors like business closures, unemployment, food insecurity, and infection rates are essential for formulating effective public health policies and allocating resources strategically [2]. However, the manual systems prevalent in Surigao del Norte's barangays have impeded both national and local authorities from responding effectively during this crisis, ultimately impacting the well-being of citizens [3].

This research proposes the implementation of Barangay Connect, a comprehensive Management Information System (MIS) specifically designed for barangays in Surigao del Norte. Barangay Connect aims to bridge the digital divide within local governance. It will function as a one-stop platform, offering functionalities such as resident profile management, streamlining the issuance of barangay clearances and certificates, facilitating business registration and reporting, and enabling efficient management of blotters, settlements, disaster information, and incident reports. Additionally, the system will incorporate SMS capabilities for disseminating critical updates and notifications to residents. By equipping barangays with a user-friendly digital platform, Barangay Connect empowers them to

embrace the principles of digital local governance in the 21st century, fostering greater transparency, efficiency, and ultimately, improved service delivery to citizens.

Project Context

The barangay occupies a vital position within the Philippines' governmental structure. As the nation's smallest political and administrative unit, barangays serve as the "basic political unit" [4]. Section 384 of the Local Government Code of 1991 outlines their core functions, including spearheading government planning and program implementation at the community level [4]. Additionally, barangays serve as a crucial platform for citizen participation and fostering dispute resolution within communities [4].

However, the growing complexity of communities due to factors like digitalization and demographic shifts has placed a strain on barangays' ability to fulfill these crucial functions effectively. Their continued reliance on manual systems for information storage, retrieval, and service delivery creates significant obstacles. The inherent delays and inefficiencies associated with these manual processes hinder barangays' capacity to respond promptly and efficiently to the evolving needs of their constituents [1]. This highlights the urgency for a transition from manual methods to a digital system of governance. This research proposes Barangay Connect; a Management Information System (MIS) specifically designed to address these challenges in Surigao del Norte's barangays. Barangay Connect aspires to bridge the digital divide, empowering barangays to fulfill their critical role in the 21st century.

Table 1: Key Features Comparison

Key Features	Manual System of Service Delivery	Barangay Connects Digitization and Automation of Local Governance
Facilitates the efficient storage, search, and retrieval of information such as demographic data, needs of the people, resources, and vulnerabilities	✗	✓
Enables a quick search of the same information	✗	✓
Processes the prompt retrieval of information (e.g., complete and updated profiles of barangay residents and businesses; disaster zoning; financial collections)	✗	✓
Sustains projects through the up-to-date and advanced automated monitoring of fee collections	✗	✓
Offers real-time monitoring of barangays to check and balance their services and functions.	✗	✓
Ensures hassle-free transactions for residents and businesses through automated data processing especially during peak hours and urgent situations	✗	✓
Aids in the effective and efficient decision-making of barangays through the quick generation of reports and other information	✗	✓
Integrates all reliable, accurate, and timely information for disaster management	✗	✓
Records cases of domestic violence, disputes, and other circumstances involving barangay residents	✗	✓
Offers real-time updates and notifications through SMS regarding barangay updates and disaster information	✗	✓
Ensures strong data security with automatic back-up files	✗	✓
Guides cities and municipalities in creating strategic and potent decisions, managing operations and governance, and facilitating proper formulation and execution of development plans	✗	✓
Facilitates a faster implementation of the National ID System	✗	✓
Allows National Government Agencies (NGAs) to access the main database in real time	✗	✓

Improves the relationship among citizens, businesses and government offices by delivering a satisfactory variety of different ends	✗	✓
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Purpose and Description

The primary purpose of this study is to enhance local governance in Surigao del Norte through the implementation of Barangay Connect, a comprehensive Management Information System (MIS) designed specifically for the barangays in the province.

Barangay Connect aims to bridge the digital divide within local governance by equipping barangays with a user-friendly digital platform. The system will offer a wide range of functionalities, including resident profile management, streamlining the issuance of barangay clearances and certificates, facilitating business registration and reporting, and enabling efficient management of blotters, settlements, disaster information, and incident reports. Additionally, the system will incorporate SMS capabilities for disseminating critical updates and notifications to residents.

By empowering barangays with Barangay Connect, the study seeks to foster greater transparency, efficiency, and improved service delivery to the citizens of Surigao del Norte. The digital platform will enable barangays to embrace the principles of digital local governance in the 21st century, allowing them to respond more effectively to the evolving needs of their constituents.

The study proposes to ground the implementation of Barangay Connect in several theoretical frameworks, including e-governance theory, information management systems (IMS) theory, and citizen engagement theory. These frameworks provide a robust foundation for understanding how technology can enhance government efficiency, transparency, and citizen participation in local governance.

Furthermore, the study will consider the specific context of Surigao del Norte, including the Local Government Code of the Philippines, the digital divide, and the province's unique geographic and resource allocation needs. By tailoring the system's functionalities to this context, the researchers aim to ensure that Barangay Connect effectively addresses the unique challenges and opportunities faced by barangays in Surigao del Norte.

Overall, this study seeks to demonstrate the transformative potential of digital technologies in empowering local governance, with the ultimate goal of improving service delivery, fostering data-driven decision-making, and enhancing citizen engagement in Surigao del Norte's barangays.

OBJECTIVES

The researcher sets the following goals to come up with a working system,

General

To enhance local governance in Surigao del Norte through the implementation of Barangay Connect, a comprehensive Management Information System (MIS) designed specifically for the barangays in the province.

Specific

1. To create a centralized resident and business database for Surigao del Norte barangays, enabling efficient access to information and streamlining service delivery processes.
2. To facilitate informed decision-making by barangay officials through data analysis and reporting, leading to improved program development and project execution.
3. To leverage the system's database and communication features to enhance disaster preparedness, response, and recovery efforts in Surigao del Norte barangays.
4. To improve administrative efficiency by automating workflows and facilitating real-time data sharing between barangays and relevant government agencies.
5. To provide residents with communication channels to access information and engage with barangay officials, fostering transparency and participation.
6. To contribute to a safer environment by enabling efficient tracking of resident information and fostering communication for crime prevention and response
7. Evaluate the application using the system evaluation tool parallel to the ISO 9126 Standards for usability, functionality, and maintainability.

Scope and Limitations

Scope

The scope of this study is focused on the implementation of Barangay Connect, a comprehensive Management Information System (MIS), in the barangays of Surigao del Norte, Philippines. The study aims to address the challenges faced by barangays in the province due to their reliance on manual systems for information storage, retrieval, and service delivery.

The study will encompass the following key aspects:

1. Design and development of the Barangay Connect application software, incorporating features and functionalities tailored to the specific needs and context of Surigao del Norte's barangays.
2. Implementation of a centralized database system to store and manage resident, business, and barangay-level data within the province.
3. Digitization and automation of core barangay processes, such as resident profile management, issuance of barangay clearances and certificates, business registration, and incident reporting.
4. Integration of communication channels, including SMS capabilities, to facilitate the dissemination of critical updates and notifications to barangay residents.
5. Training and capacity building of barangay officials and staff to ensure effective utilization of the Barangay Connect system.
6. Strategies for citizen engagement and communication to promote awareness, access, and participation among residents in the province.

Limitations

The study is subject to the following limitations:

Geographic Scope

The study is focused solely on the barangays within the province of Surigao del Norte. The findings and recommendations may not be directly applicable to barangays in other provinces or regions of the Philippines without further adaptation and contextualization.

Technological Limitations

The effectiveness of the Barangay Connect system is dependent on the availability and reliability of the required technological infrastructure, such as internet connectivity, computing devices, and power supply, within the barangays of Surigao del Norte.

Digital Divide

The study acknowledges the potential challenges posed by the digital divide, where some residents may have limited access to or proficiency with digital technologies. Strategies to address these disparities will need to be incorporated into the implementation plan.

Regulatory Compliance

The design and development of Barangay Connect must adhere to the relevant laws, regulations, and policies governing barangay operations and information management in the Philippines, which may limit the system's flexibility or functionality in certain areas.

Sustainability and Maintenance

The long-term sustainability and maintenance of the Barangay Connect system will depend on the availability of financial resources, technical support, and ongoing capacity building for barangay officials and staff.

Research Project Duration

The implementation of Barangay Connect, the comprehensive Management Information System (MIS) for the barangays in Surigao del Norte, is envisioned as a 12-month project. The study will commence in June and is expected to be completed by May of the following year.

REVIEW OF RELATED SYSTEMS

E-Governance and Digital Transformation in Local Government

The pervasive adoption of digital technologies has significantly reshaped the landscape of public administration and service delivery, ushering in the era of e-governance. E-governance refers to the use of information and communication technologies (ICTs) to improve the efficiency, accessibility, and transparency of government operations and public service provision [5][6]. At the local government level, the implementation of e-governance initiatives holds immense potential to enhance citizen engagement, streamline administrative processes, and foster more responsive and accountable governance [7].

Scholars have underscored the transformative impact of e-governance on local authorities' capacity to address the evolving needs of their constituents. Kolsaker and Lee-Kelley (2008) found that the strategic deployment of digital tools empowers local governments to improve service quality, reduce bureaucratic delays, and increase organizational efficiency. Similarly, Royo et al. (2014) observed that e-government platforms enable local authorities to enhance transparency, facilitate citizen participation, and strengthen the trust between citizens and their elected representatives.

Beyond improved service delivery, digital transformation at the local level can also foster more data-driven and evidence-based policymaking. Puron-Cid (2013) highlighted how the integration of information management systems and analytics capabilities within e-governance frameworks enables local officials to make more informed decisions, allocate resources more effectively, and develop targeted programs to address community needs.

However, the successful implementation of e-governance initiatives at the local level is not without its challenges. Barriers such as limited digital infrastructure, financial constraints, and resistance to organizational change can impede the adoption and sustained use of e-government platforms [11]. Effective change management strategies and capacity-building efforts for local government personnel are crucial to overcome these hurdles and ensure the long-term viability of digital transformation efforts [12].

Citizen Engagement and Participation in Local Governance

Effective local governance is predicated on the active engagement and participation of citizens in the decision-making processes that shape their communities. Citizen engagement refers to the various mechanisms and channels through which residents interact with their local government to voice their concerns, provide input, and collaborate on policy and service delivery initiatives [13][14].

Scholars have emphasized the critical role of citizen engagement in strengthening the legitimacy and responsiveness of local governance. Callahan (2007) found that when citizens are empowered to participate in local decision-making, they develop a stronger sense of ownership and commitment to their community, leading to more effective implementation of government programs and policies. Similarly, Yang and Callahan (2007) observed that citizen engagement enhances the transparency of local government operations, fosters trust between residents and elected officials, and ultimately, improves the overall quality of public services.

Beyond improved service delivery, citizen participation in local governance can also contribute to more equitable and inclusive policymaking. Michels and De Graaf (2010) highlighted how the integration of citizen input into the policy development process can help local authorities identify and address the diverse needs and priorities of their constituents, particularly marginalized or underrepresented groups. This, in turn, can lead to the formulation of policies that are better aligned with the unique socioeconomic and cultural contexts of local communities.

However, the realization of meaningful citizen engagement at the local level is not without its challenges. Barriers such as lack of political will, limited civic awareness, and inequitable access to participation channels can hinder the active involvement of citizens in local governance [18]. Effective strategies to overcome these barriers, such as targeted outreach, capacity-building programs, and the utilization of digital technologies, are crucial for fostering a more inclusive and participatory model of local governance.

Disaster Preparedness and Information Management in Local Government

Effective disaster preparedness and response at the local level are crucial for safeguarding the well-being of communities and minimizing the adverse impacts of emergencies and calamities. A key component of this is the efficient management of information related to disaster risks, vulnerabilities, and mitigation strategies [19][20].

Scholars have emphasized the critical role of local governments in leveraging information and communication technologies (ICTs) to enhance disaster preparedness and response capabilities. Scholl and Patin (2014) found that the strategic adoption of digital tools, such as geographic information systems (GIS) and online data platforms, enables local authorities to gather, analyze, and disseminate crucial information related to hazard mapping, early warning systems, and emergency resource allocation. This, in turn, can lead to more proactive and coordinated disaster risk management at the community level.

Furthermore, the integration of digital information systems can also improve the responsiveness and resilience of local governments during and after disaster events. Wukich and Mergel (2016) observed that the use of social media and mobile applications by local authorities can facilitate real-time communication with residents, promote situational awareness, and streamline the reporting of incidents and damage assessments. This allows for a more efficient and targeted allocation of resources and the delivery of timely assistance to affected communities.

The COVID-19 pandemic has further underscored the importance of robust information management systems in local governance. Qi et al. (2020) highlighted how the availability of comprehensive data on infection rates, business closures, and socioeconomic impacts enabled local authorities to formulate more effective public health policies and allocation of relief resources. Conversely, the lack of centralized and digitized information systems in many localities hindered the ability of governments to respond effectively to the evolving needs of their constituents during the crisis.

In the Philippines, the importance of disaster preparedness and information management at the local level is enshrined in the Disaster Risk Reduction and Management Act of 2010 (Republic Act No. 10121). This legislation mandates the establishment of local disaster risk reduction and management offices, which are tasked with, among other responsibilities, the collection, analysis, and dissemination of disaster-related information [23]. The integration of the Barangay Connect system in Surigao del Norte can further strengthen the capacity of local government units to fulfill these critical functions by providing a centralized platform for data management, analysis, and communication during emergencies and natural disasters.

Management Information Systems (MIS) for Local Governance

The effective implementation of Management Information Systems (MIS) at the local government level has been a subject of increasing scholarly attention. MIS can play a crucial role in enhancing the efficiency, transparency, and responsiveness of municipal and barangay-level administration [24] [6].

Researchers have emphasized the transformative potential of MIS in local governance. Pardo et al. (2012) found that the strategic adoption of digital information systems enables local authorities to streamline administrative processes, improve data management, and facilitate evidence-based decision-making. This, in turn, can lead to better service delivery and more effective allocation of resources to address the needs of local communities.

Furthermore, the integration of MIS can also enhance the transparency and accountability of local governments. Meijer (2015) observed that the use of digital platforms for service requests, citizen feedback, and information dissemination can foster greater public engagement and reduce the potential for corruption or mismanagement of public funds.

In the context of developing countries, the implementation of MIS in local governance has faced various challenges, including limited digital infrastructure, low levels of digital literacy, and insufficient technical capacity among government personnel [27][28]. However, scholars have emphasized the importance of addressing these barriers to ensure equitable access to the benefits of digital governance and promote more inclusive and sustainable development at the local level.

The Philippines, in particular, has made significant strides in recent years to promote the adoption of information and communication technologies (ICTs) in local government units. The Electronic Government Procurement System (EGovProcure) and the Local Government Financial Management Information System (LGFMIS) are examples of national-level initiatives aimed at improving transparency, efficiency, and accountability in local public administration [29][30].

The Barangay Connect system proposed in this research aligns with these broader efforts to digitize local governance in the Philippines. By providing a comprehensive MIS tailored to the specific needs and context of Surigao del Norte's

barangays, the system can contribute to enhancing service delivery, citizen engagement, and data-driven decision-making at the most fundamental level of local government.

Overcoming the Digital Divide in Local Governance

One of the key factors underpinning the need for digital transformation in local governance is the importance of barangays within the Philippines' governmental structure. As the nation's smallest political and administrative unit, barangays serve as the "basic political unit" [4] and play a crucial role in delivering services and facilitating citizen participation.

The Local Government Code of 1991 outlines the core functions of barangays, which include spearheading government planning and program implementation at the community level [4]. Additionally, barangays are mandated to serve as a platform for citizen participation and fostering dispute resolution within communities [4].

However, the growing complexity of communities due to factors like digitalization and demographic shifts has placed a strain on barangays' ability to fulfill these crucial functions effectively. Their continued reliance on manual systems for information storage, retrieval, and service delivery creates significant obstacles [1]. The inherent delays and inefficiencies associated with these manual processes hinder barangays' capacity to respond promptly and efficiently to the evolving needs of their constituents.

This highlights the urgent need for a transition from manual methods to a digital system of governance, as emphasized by Heeks (2010) in his work on the transformative impact of digital technology on the public sector. Barangay Connect, as a Management Information System (MIS) designed specifically for barangays in Surigao del Norte, aims to bridge this digital divide and empower barangays to fulfill their critical role in the 21st century.

By leveraging digital tools and automating key processes, Barangay Connect can help barangays enhance service delivery, improve efficiency, and ultimately, better serve their constituents [31]. This aligns with the principles of e-governance, which examines how technology can enhance government transparency, accountability, and citizen engagement.

Furthermore, the implementation of Barangay Connect in Surigao del Norte should consider the specific legal and contextual factors relevant to the province, as emphasized by Walsham and Sahay (2006) in their work on information systems research in developing countries. This includes compliance with the Local Government Code of the Philippines (RA 7160) and strategies to address the digital divide and ensure inclusive access for all residents.

Barangay Governance and the Local Government Code of the Philippines

The barangay occupies a vital position within the Philippines' governmental structure. As the nation's smallest political and administrative unit, barangays serve as the "basic political unit" (Department of Interior and Local Government Philippines [DILG Philippines], 1991). Section 384 of the Local Government Code of 1991 outlines their core functions, including spearheading government planning and program implementation at the community level [4]. Additionally, barangays serve as a crucial platform for citizen participation and fostering dispute resolution within communities [4].

However, the growing complexity of communities due to factors like digitalization and demographic shifts has placed a strain on barangays' ability to fulfill these crucial functions effectively. Their continued reliance on manual systems for information storage, retrieval, and service delivery creates significant obstacles [1]. The inherent delays and inefficiencies associated with these manual processes hinder barangays' capacity to respond promptly and efficiently to the evolving needs of their constituents.

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Furthermore, the implementation of digital governance solutions in barangays should consider the specific legal and contextual factors relevant to the Philippines. This includes compliance with the Local Government Code of the Philippines (RA 7160) and strategies to address the digital divide and ensure inclusive access for all residents [28].

By leveraging the insights from existing literature, the proposed Barangay Connect system in Surigao del Norte can be strategically designed to capitalize on the benefits of e-governance while addressing the unique challenges and contextual considerations of the local government landscape in the Philippines

TECHNICAL BACKGROUND

Development Tools

Software Development Tools

Laravel

A PHP web application framework used for the development of the Barangay Connect application software

Ionic Framework

A framework for building mobile apps using web technologies (HTML5, CSS, and JavaScript)

HTML5

The latest version of the Hypertext Markup Language, used for structuring the content of the Barangay Connect system

PHP

A server-side scripting language used in the development of the Barangay Connect application

JavaScript

A programming language used for adding interactivity and dynamic behavior to the Barangay Connect system

CSS

Cascading Style Sheets, used for styling the visual presentation of the Barangay Connect interface

AJAX

Asynchronous JavaScript and XML, used for creating interactive web applications that can update content without requiring a full-page refresh.

Bootstrap

A popular front-end framework for developing responsive, mobile-first websites and applications.

Database Management System

Database Management System (DBMS) will use to store and manage the barangay data securely.

Development Tools

Integrated Development Environments (IDEs) - Used for efficient software development and testing of the Barangay Connect application.

Cloud Computing Platform

If opting for a cloud-based deployment, researcher will use of a cloud computing platform to host the Barangay Connect system.

Data Security Software

Encryption tools and access controls to ensure strong data security for the Barangay Connect system.

System Monitoring Tools

Tools used for performance optimization and monitoring of the Barangay Connect system.

These development tools will enable the effective implementation and deployment of the Barangay Connect system to enhance local governance in Surigao del Norte.

Conceptual Framework

The study adopted the Input-Process-Output (IPO) model as a functional and conceptual framework for the implementation of the Barangay Connect system. The IPO model serves as a schematic representation that categorizes the various inputs, outputs, and processing steps involved in transforming the interrelated variables within the system.

Figure 1. The framework of Barangay Connect

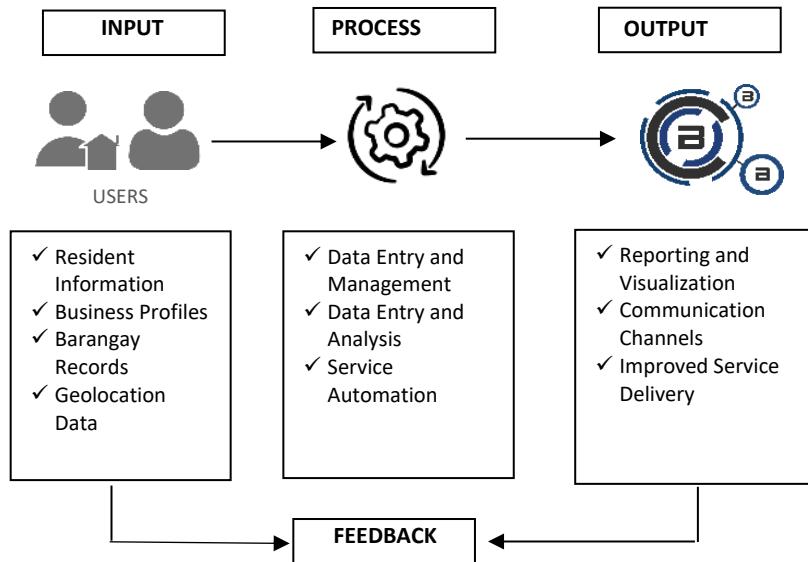


Figure 1 delineates the key input data that the Barangay Connect system will leverage, such as resident information, business profiles, barangay records, and geolocation data, all tailored to the specific context of Surigao del Norte. These inputs are then subjected to a series of core processes, including data entry, data processing, and service automation, designed to efficiently manage and extract valuable insights from the gathered information.

The output section of the IPO diagram showcases the desired deliverables of the Barangay Connect system, encompassing data-driven reports, communication channels, and enhanced service delivery to citizens. These outputs directly address the objectives of improving local governance, empowering data-driven decision-making, and fostering greater citizen engagement within the barangays of Surigao del Norte.

By adopting this IPO model as a conceptual framework, the study ensures that the Barangay Connect system is built upon a comprehensive and relevant data foundation, while also streamlining the data processes to transform inputs into impactful outputs. This model serves as a valuable tool to align stakeholders, guide the system's design and development, and ensure the overall alignment between the system's capabilities and the specific requirements of Surigao del Norte's barangays.

System Features

Dashboard

The Dashboard serves as the default view of the system. It is also used as an information management tool to organize and present information that is easy to read, search, and access. It is customized to meet the specific needs of the barangay.

Resident profiles and databases

Display and manage barangay resident information, which include the following:

- Update list of residents
- Search resident information and records based on chosen parameters
- View and update resident information and records
- View resident identity
- View certificate issuance history

- View payment history
- Generate household information
- Generate resident mapping
- Search database of resident's affiliation
- Facilitate mass migration of data

Biometric scanning

The system is integrated with a biometric fingerprint scanner that collects fingerprint specimens of residents. It allows a person to be identified and authenticated based on a set of recognizable and verifiable data, which are unique to each person. The system could be scaled up, utilizing other types of biometric scanning such as iris recognition.

QR code generation

A quick and error-free method generated as a unique matrix barcode to identify and verify profiles. It provides data that are useful for future government activities and protocols.

Business profiles

Organizes information on businesses at the barangay level. It is essentially a repository of current business activities and related information.

- List of Businesses
- Search Businesses
- Register New Business
- View Business Records
- Contact Person
- Logo/Photo
- Edit Business Records
- Delete Business Records
- Payment History
- Business Mapping

Barangay directory

Display and manage barangay profile.

- Barangay profile in terms of:
 - Physical information
 - Political information
 - Fiscal information
 - Economic information
 - Social information
- List of previous and current officials
- Barangay functionaries and organizations/programs
- List of institutions and public markets within the barangay
- List of economic and natural resources

Inventory management

Inventory management module to oversee, monitor, and maintain a stockpile of resources for an uninterrupted service delivery to the barangay. This includes both facilities and properties.

Voters management

A systemized module where all voters within the barangay are listed for any purposes.

Collections and payments

View resident and business fees, and process payments.

- Date of payment
- Payment number
- Payor
 - Resident

- Business
- Payment for (purpose of payment)
- Total amount collected

Blotter records

Easier access to barangay blotters and police blotters, and reports that are accessible for concerned citizens for future use.

- List of Blotter Records
- Search/Filter Blotter Records
 - Blotter Type
 - Date committed
 - Date Reported
 - Place of incident
 - Photos
- View Blotter Records
- Blotter Details
- Narrative Report
- List of Persons Involved
 - Complainant
 - Victim
 - Witness
 - Suspect

Settlement schedules

This feature facilitates the management of settlement records.

- Set settlement schedules
- Show list of scheduled settlement
- Search settlements
- Issue a settlement document

Document issuance

Generates, issues, and prints certificates and other documents issued by the barangay.

- Barangay Clearance
- Certificate of residency
- Summon
- Download certificate templates
- Generate and print a certificate

ID print facility

National ID card issues are handled with simplicity and security.

- Design Secure ID Cards
- Capture Signature and Fingerprint
- Fast enrollment with the aid of resident's information from the database

Emergency and disaster management

Identifies disaster-prone areas through mapping, and facilitates the conduct of Damage and Needs Assessment (DANA). It also generates timely reports of incidents such as fire, flood, earthquake, which include the following:

- Incident type
- Date and time of occurrence
- Specific location (address)
- Uploaded images and videos of the incident
- Description

Watchlist

This module lists monitored individuals that require close surveillance related to:

- Drugs
- Terrorism
- Crime
- COVID PUI, PUM, and Positive
- etc.

Events information

Displays upcoming events in the barangay. This feature is essential in ensuring active participation of residents in important events and activities of the barangay by keeping them notified and/or updated.

SMS management

Mobile devices are vastly used by most residents. With this feature, it is more convenient to reach out to all residents on barangay updates. It can also send personalized greetings on special occasions and holidays. It will help the barangay officials connect the residents and businesses and ensure their involvement.

Population override

Capturing large amounts of data/profiles is not possible for days or weeks. The system provides accurate information depending on what is encoded. With this special feature, the total population can be adjusted to temporary values closer to the total population of the barangay for reporting purposes only.

Area management

Manages and displays all the zones and clusters under the barangay. It also shows the geographical location of a certain area through mapping.

Reporting

Generates timely information from the system. It also assists the barangay in the analysis and decision making for a timely response by capturing the data needed by the management. Data includes;

- Resident and business summaries,
- Blotters,
- Fees and payments accounting,
- Disaster-related analysis, and others.

System settings and user management

This module provides administrative controls over the Barangay Connect system, allowing authorized users to:

- Manage user accounts: Create, delete, and configure access permissions for barangay officials and staff to use the system.
- Control system configurations: Edit the name and values of various system settings and parameters.
- Secure the system: Ensure the integrity and confidentiality of data by implementing robust access controls and user authentication.

The user management feature is crucial for maintaining the security and integrity of the Barangay Connect system. It allows the barangay administration to control who has access to the system and what functionalities they can perform, preventing unauthorized access or misuse of sensitive information.

Mobile App Features

Collecting resident and business profiles would entail a great amount of work that cannot be achieved overnight. Our system provides a solution that allows the profiling of the barangay and its residents without the need for the residents to leave their homes and spend much resources. Since mobile phones have become affordable, the barangay can minimize the cost of investing in profiling equipment.

By incorporating this mobile application, the barangay and its officials will be able to fully maximize the functionality of the Barangay Connect system, thereby promoting efficiency in collecting resident and business information.

Resident profiling

Resident profiling through a mobile app can capture all important information such as:

- Name

- Address
- Contact information
- Date of birth
- Education and employment history
- Family and relationship
- And all other necessary information

Data synchronization

All information collected through the mobile app can be integrated into the system's database with just one click.

Fingerprint scanning

The mobile app is integrated with a biometric fingerprint scanner when collecting fingerprint specimens from residents.

Resident photo

Since mobile smartphones are built with cameras, attaching a resident photo can be done instantly. The profile photo is an important feature for the easy identification of residents.

User friendly interface

The app is designed with a balance between functionality and aesthetics. It is developed without compromising any of the two major factors in order to create a great user experience.

Secure

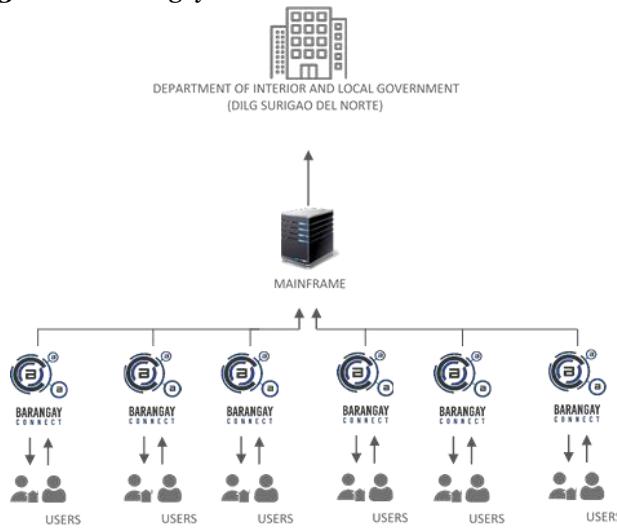
The app is equipped with full maximum security to protect the confidentiality and privacy of resident information.

Technical Specifications

Digital Architecture

The digital architecture of Barangay Connect is designed to seamlessly integrate various components and data sources to create a comprehensive and scalable system. The core components and their interactions are depicted in the following technical architecture diagram (Figure 2):

Figure 2. Barangay Connect Technical Architecture Diagram



The system is built on a web-based platform, accessible through both desktop and mobile devices. At the core of the architecture is the Barangay Connect application, developed using a Laravel, Ionic, HTML5, PHP, JavaScript, CSS, AJAX, and Bootstrap technology stack. This combination of technologies aligns well with the requirements and constraints of barangays in Surigao del Norte, as it allows for the creation of a responsive, user-friendly, and scalable system that can be easily deployed and maintained.

The application is integrated with a secure database management system (DBMS), which serves as the central repository for all barangay-related data, including resident profiles, business registrations, incident reports, and disaster information. This database is designed to handle the increasing data demands of barangays as the system is adopted across Surigao del Norte.

To facilitate seamless data exchange and integration, Barangay Connect is designed to interface with external systems, such as the Department of Interior and Local Government (DILG) mainframe and National Government Agencies (NGAs). This integration allows for the sharing of crucial information, such as voter data and national ID records, improving the efficiency of local governance and the implementation of national initiatives.

The system also incorporates a mobile application, developed using Ionic, which enables barangay officials to capture and update data in the field, reducing the burden of manual data entry and improving the accuracy of information. The mobile app is designed to synchronize data with the central Barangay Connect database, ensuring that all information is centralized and accessible through the web-based platform.

Scalability and Performance Considerations

Barangay Connect places a strong emphasis on data security and privacy to protect the sensitive information of residents and businesses. The system incorporates the following security measures:

1. *Encryption:* All data stored within the Barangay Connect database is encrypted using industry-standard algorithms to ensure the confidentiality of information.
2. *Access Controls:* The system implements role-based access controls, allowing barangay officials and staff to access only the information and functionalities relevant to their roles and responsibilities. This reduces the risk of unauthorized access and data breaches.
3. *Secure Communication:* The system utilizes SSL/TLS protocols to encrypt all communication between the web application, mobile app, and external systems, ensuring the integrity of data transmitted over the network.
4. *Backup and Disaster Recovery:* Barangay Connect employs regular data backups and disaster recovery measures to safeguard against data loss and ensure the availability of information in the event of system failures or natural disasters.
5. *Audit Trails:* The system maintains detailed audit logs of all user activities, transactions, and system events, enabling the tracing of actions and facilitating compliance with regulatory requirements.
6. *Biometric Authentication:* The integration of biometric fingerprint scanning in the mobile app and web application enhances the security of user authentication, reducing the risk of unauthorized access.

Performance Optimization

To ensure optimal performance and responsiveness of Barangay Connect, the system incorporates the following measures:

1. *Caching Mechanisms:* The application leverages caching techniques, such as in-memory caching and content delivery networks (CDNs), to reduce the load on the database and improve the responsiveness of frequently accessed data.
2. *Database Optimization:* The database schema and queries are designed to minimize data retrieval times, ensuring efficient data processing and reporting capabilities.
3. *Asynchronous Processing:* The system utilizes asynchronous processing for resource-intensive tasks, such as generating comprehensive reports, to maintain a responsive user experience even during periods of high activity.
4. *Load Balancing:* The cloud-based deployment model allows for the implementation of load balancing mechanisms, distributing the workload across multiple server instances to handle increased user traffic and data processing demands.
5. *Monitoring and Optimization:* The system is equipped with comprehensive monitoring tools that track key performance indicators, such as response times, server utilization, and error rates. This enables the identification and resolution of performance bottlenecks, ensuring the continued optimization of Barangay Connect.

METHODS

Stakeholder Engagement and Needs Assessment

Conduct in-depth interviews and workshops with key stakeholders, including:

- Barangay officials and staff
- Representatives from the Department of the Interior and Local Government (DILG)
- Community leaders and residents

- ✓ Understand the existing challenges, pain points, and specific requirements of barangays in Surigao del Norte.
- ✓ Identify opportunities for digital transformation and the desired outcomes of the Barangay Connect system.
- ✓ Gather feedback and incorporate stakeholder insights into the system design.

Collaborative System Design

Establish a cross-functional project team, including:

- Business analysts to translate stakeholder requirements into system specifications.
- Software architects to design the technical architecture and integration points
- User experience (UX) designers to ensure intuitive and accessible interfaces
- Change management experts to facilitate the organizational transition
- ✓ Adopt a user-centric design approach, involving barangay officials and residents throughout the design process.
- ✓ Leverage design thinking methodologies, such as prototyping and usability testing, to validate and refine the system features.
- ✓ Ensure the system design aligns with the Local Government Code of the Philippines and other relevant regulations.

Agile Software Development

- ✓ Employ an agile software development methodology, such as Scrum or Kanban, to enable iterative development and continuous feedback.
- ✓ Divide the system development into manageable sprints or iterations, each focused on delivering specific functionalities.
- ✓ Collaborate closely with barangay stakeholders to gather feedback and incorporate changes during the development process.
- ✓ Implement robust quality assurance practices, including automated testing and regular user acceptance testing (UAT).
- ✓ Streamline the deployment process through the use of continuous integration and delivery (CI/CD) tools.

Data Migration and Integration

- ✓ Conduct a comprehensive assessment of the existing data sources and formats used by barangays.
- ✓ Develop a data migration strategy to convert manual records into a digital format compatible with the Barangay Connect system.
- ✓ Design data exchange protocols and APIs to enable seamless integration with other government systems, such as the National ID System.
- ✓ Implement data quality control measures to ensure the accuracy and consistency of migrated data.

Capacity Building and Change Management

- ✓ Develop comprehensive training programs for barangay officials and staff, covering system functionalities, data management, and user support.
- ✓ Deliver hands-on training sessions in a phased approach, starting with pilot barangays and expanding to all barangays in Surigao del Norte.
- ✓ Provide ongoing technical support and troubleshooting assistance to address user concerns and ensure smooth system adoption.
- ✓ Engage with community leaders and residents to promote awareness and acceptance of the Barangay Connect system.
- ✓ Establish feedback mechanisms and continuous improvement processes to incorporate user suggestions and address evolving needs.

Phased Deployment and Monitoring

- ✓ *Implement the Barangay Connect system in a phased approach, starting with pilot barangays before a full-scale rollout.*
- ✓ *Continuously monitor system performance, user adoption, and data quality, and address any issues or bottlenecks.*
- ✓ *Analyze usage patterns and feedback to identify areas for system optimization and enhancement.*
- ✓ *Regularly review and update the system's security measures, backup protocols, and disaster recovery plans.*

Sustainability and Scalability

- ✓ Develop a comprehensive governance model to ensure the long-term sustainability of the Barangay Connect system.
- ✓ Establish clear roles, responsibilities, and decision-making processes for system management and maintenance.
- ✓ Explore opportunities for integration with other government initiatives and platforms to leverage synergies and maximize the system's impact.
- ✓ Assess the scalability of the system architecture to accommodate future growth and expansion across the province or even nationwide.

Evaluation Methods and Tools

The System Usability Scale (SUS) was employed to evaluate the usability of the Barangay Connect system. SUS is a reliable and cost-effective tool for assessing the usability of interactive systems, comprising ten statements rated on a five-point scale from Strongly Disagree to Strongly Agree. The questionnaire was distributed to 40 respondents to measure their perceptions of the system's usability. Data analysis involved frequency counts and percentage distributions, followed by tallying, analysis, and interpretation using SUS.

Statistical Treatment

The following formulas were used to analyze the data and calculate the mean for each item:

$$1. \Sigma(fx)=X_1(F_1)+X_2(F_2)+\dots+X_n(F_n)\backslash$$

Where:

- f = Frequency
- x = Respondents

$$2. \text{Mean}(M)=\Sigma(fx)N$$

Where:

- N = Total number of respondents
- M = Represents the total numerical value of the squared mean

Scoring and Interpreting SUS Results

SUS provides a single score representing the overall usability of the system. Scores for individual items are not significant on their own. To calculate the SUS score, total the score contributions from each item. Each item's score contribution ranges from 1 to 5. For odd-numbered items, the score contribution is the scale position minus 1. For even-numbered items, the contribution is 5 minus the scale position. Multiply the sum of the scores by 2.5 to get the total SUS score, which ranges from 0 to 100. A SUS score above 79 indicates higher than average usability, while scores below 79 are considered lower than average. Normalizing the scores generates a percentile rank for better interpretation.

RESULTS AND DISCUSSIONS

The results and discussions for the project "Enhancing Local Governance in Surigao del Norte through Barangay Connect: A Total Management Information System for Barangays" are based on comprehensive in-depth interviews conducted with barangay officials, staff, and other key stakeholders. These interviews provided critical insights into the current practices, challenges, and expectations, which informed the development and implementation of

Barangay Connect. The researcher evaluated the application's performance and usability according to established assessment instruments using the System Usability Scale (SUS) and the guide questions for the in-depth interview technique.

Table 3: Summary of Responses from Guide Questions for the In-Depth Interview

Topic	Responses and Challenges	Discussion
Information Management Practices	Predominantly manual, relying on paper-based records.	The reliance on manual information management systems has proven inefficient and prone to errors. Transitioning to Barangay Connect is expected to mitigate these challenges by providing a digital platform for efficient data management.
Main Challenges	Difficulty in accessing specific records, risks of data loss, and time-consuming processes.	Ensuring data integrity and reducing the time required to access information are critical benefits of transitioning to a digital platform like Barangay Connect.
Pain Points and Frustrations	Lengthy retrieval times, frequent errors in manual entries, and substantial physical storage needs.	Digitizing records and automating processes will significantly reduce management time, minimize errors, and eliminate the need for physical storage space.
Communication with Residents	Public postings, community meetings, and manual distribution of information.	The integration of SMS capabilities will enable direct and efficient communication with residents, enhancing community engagement by providing timely updates and important information directly to residents' mobile devices.
Improved Decision-Making	Improved data access could enhance decision-making in areas such as disaster response and public health initiatives.	Real-time, accurate data access will facilitate timely and informed decisions, particularly during emergencies, thereby improving the responsiveness and effectiveness of barangay operations.
Desired Features in a Digital System	Automated data processing, real-time reporting, and user-friendly interfaces.	Barangay Connect incorporates these features, meeting the specific needs of barangay officials.
Vision for Barangay Connect	Significant improvements in efficiency and responsiveness.	This vision aligns with Barangay Connect's objectives to streamline processes and enhance governance effectiveness.
Concerns about New Systems	Initial cost, potential technical difficulties, and the need for comprehensive training.	The implementation plan includes training and technical support to address these concerns. A phased rollout approach will help manage costs and ensure a smooth transition.
User-Friendliness and Accessibility	Ensuring the system is user-friendly and accessible to all users.	User-centric design principles ensure that Barangay Connect is intuitive and easy to use.
Training and Support Needs	Comprehensive training and ongoing technical support are essential.	Detailed training programs and continuous support are included to equip staff with necessary skills.
Data Storage and Retrieval	Data is currently stored manually, which makes retrieval cumbersome and prone to errors.	The digital storage and retrieval system in Barangay Connect will streamline these processes, ensuring quick and error-free access to data.
Effective Service Delivery	Better data access and improved communication would enable	The real-time data access and enhanced communication features of Barangay Connect are

	more effective decision-making and service delivery.	expected to significantly improve service delivery and decision-making processes.
Functionality Integration	Need for integrating various functions into a single system for improved efficiency.	Barangay Connect's design includes integration of multiple functionalities to ensure comprehensive management capabilities.
Administrative Processes	Current administrative processes are time-consuming and often redundant.	The automation of administrative processes through Barangay Connect is anticipated to reduce redundancy and save time, improving overall efficiency.
Community Engagement	Current engagement with the community is limited and often inefficient.	Enhanced communication features of Barangay Connect, such as SMS alerts, are designed to improve community engagement and ensure timely dissemination of information.
Security and Data Integrity	Concerns about the security and integrity of manually stored data.	The digital system of Barangay Connect is designed with robust security measures to protect data integrity and ensure secure access.
Support for Decision-Making	Decision-making is often hampered by lack of timely access to accurate data.	Real-time data access and comprehensive reporting features of Barangay Connect will support more informed and timely decision-making by barangay officials.
User Training and Capacity Building	Officials and staff require extensive training to effectively utilize the new system.	The implementation plan for Barangay Connect includes comprehensive training programs and ongoing technical support to ensure effective utilization of the system by all users.

Test Conducted Results

The following table summarizes the results based on various tests conducted by users on the Barangay Connect system:

Table 4: Test Conducted Results

Testing Categories	Results	Remarks
Functionality Testing	Operational	Excellent
Usability Testing	Operational	Excellent
Interface Testing	Operational	Excellent
Compatibility Testing	Operational	Excellent
Performance Testing	Operational	Excellent
Security Testing	Operational	Excellent
Communication Features Testing	Operational	Excellent
Data Management Features Testing	Operational	Increase server capacity especially when the database is large
Disaster Response Features Testing	Operational	Excellent
Citizen Engagement Features Testing	Operational	Excellent. However, improve user training for maximum utilization

Evaluation Result

The table below gives the result of the perception of the usability of the Barangay Connect system, with a 91.28% usability percentile. Compared to the adjectival rating, the usability percentile of the system is excellent.

Table 5: Evaluation Result

Usability of the System	f (5)	f (4)	f (3)	f (2)	f (1)	Σfx	Mean	Converted Responses
I think I would like to use this system often	36	2	2	0	0	194	4.31	3.31

I found the system unnecessarily complicated.	0	2	1	5	32	53	1.18	3.82
I thought the system was user-friendly	38	1	1	0	0	197	4.38	1.38
I need the help of admin support to operate the system.	0	1	2	7	30	54	1.20	3.80
The different functions of this system were well integrated.	32	8	0	0	0	192	4.27	3.27
There is too much inconsistency in this system.	0	0	2	1	37	45	1.00	4.00
Most people would learn to use the system very quickly.	38	1	0	1	0	196	4.36	3.36
The system was very cumbersome to use.	0	0	2	1	37	45	1.00	4.00
I felt very confident using the system.	35	2	2	1	0	191	4.24	3.24
I needed to learn a lot of things before I could get going with this system.	0	0	2	4	34	48	1.07	3.93
Usability Percentile								91.28%

RECOMMENDATIONS

1. Comprehensive Training Programs: Implement extensive training sessions for barangay officials and staff to ensure proficiency in using the new system.
2. Phased Implementation: Roll out the system in phases to manage the transition smoothly and address any issues that arise during the initial stages.
3. Continuous Support: Provide ongoing technical support and troubleshooting assistance to ensure sustained effective use of the system.
4. Community Engagement: Engage with the community to promote awareness and encourage participation in using the digital platform.
5. Feedback Mechanisms: Establish channels for users to provide feedback and continuously improve the system based on user experiences and suggestions.

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