UGNAY PINSAO: BLOCKCHAIN-POWERED DIGITAL PLATFORM FOR ENHANCING COMMUNICATION AND SERVICES DELIVERY IN BARANGAY PINSAO PROPER

A Capstone Project Presented to the Faculty of the
College of Information Technology and Computer Sciences
University of the Cordilleras

In Partial Fulfillment
of the Requirements for the Degree
BACHELOR OF SCIENCE IN INFORMATION TECHNOLOGY

by
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January 2025

APPROVAL SHEET

This capstone project proposal entitled UGNAY PINSAO: A CENTRALIZED WEBSITE FOR STREAMLINING COMMUNICATION AND SERVICES BETWEEN BARANGAY RESIDENTS AND OFFICIALS prepared and submitted by ORLAND JHAN D. CARTUJANO, MARIA HENYLIE GYANNA N. GONZALES, FRANCESCA YSABEL R. PACO in partial fulfillment of the requirements for the degree BACHELOR OF SCIENCE IN INFORMATION TECHNOLOGY, has been examined and is recommended for acceptance and approval for oral examination

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Chapter 1

INTRODUCTION

Rationale

Blockchain technology, being a decentralized and distributed network, addresses the vulnerabilities of centralized systems by eliminating the need for a central authority while ensuring security, privacy, and accountability. For smart communities, blockchain facilitates the secure management of sensitive data, such as resident databases, by encrypting information and storing it in a distributed ledger accessible only to authorized entities. This ensures data privacy, mitigates single points of failure, and enables real-time interaction. Notably, it safeguards the integrity of resident information, protects personal details like family data and appointments, and streamlines service delivery. For instance, a proposed blockchain-based data trading ecosystem is designed to mitigate risks associated with dishonest buyers or data brokers in Punja India. According to the study entitled "Blockchain in Public Governance for Secure and Transparent Data Management," Aggarwal (2019) emphasized the value of blockchain in enhancing data security and service delivery.

Moreover, blockchain's peer-to-peer network structure enhances cybersecurity by reducing threats of data breaches. Hackers can only access partial, encrypted information rather than entire datasets, thereby preserving data integrity. This makes it easier for local government units, such as barangays, to securely store and manage sensitive information, hold virtual meetings, and post announcements with confidence. In the study entitled "Blockchain Applications for Community-Based Governance," Farhana (2024) highlighted how blockchain reduces cybersecurity threats while improving data accessibility for local governments.

Additionally, blockchain supports transformational government initiatives through ICT applications that enhance efficiency, transparency, and citizen engagement. By incorporating features such as appointment scheduling, real-time feedback, and secure data management, blockchain-driven systems facilitate a citizen-centric approach. This boosts residents’ trust in local governance and ensures efficient delivery of services, thereby transforming public sector operations at the grassroots level. For instance, the Australian government's myGov platform provides citizens with streamlined access to various online

government services, including tax returns and health records, thereby saving time and minimizing the need for in-person interactions (Australian Government, 2022). Similarly, Estonia's e-Residency program enables foreign entrepreneurs to establish and manage businesses entirely online, offering seamless access to the country's digital infrastructure (Estonian Government, 2022). As Katembwe (2023) explained in the study entitled "Citizen-Centric Blockchain Systems for Grassroots Governance," blockchain strengthens public sector efficiency and citizen confidence.

Furthermore, integrating blockchain technology with governance platforms aligns with e-Government objectives by enhancing public service delivery through reduced transaction times and improved transparency. Blockchain's decentralized nature allows efficient and safe sharing of information among stakeholders, fostering coordination between barangay officials and residents. For instance, scheduling appointments, verifying documents, and storing proof of transactions are streamlined, ensuring accountability and transparency. As indicated in a study titled "Decentralized Systems for Inclusive e-Governance,"

Ona (2019) discussed the role of blockchain in fostering an inclusive and efficient digital society.

On a broader level, blockchain not only ensures transparency but also strengthens grassroots governance by simplifying administrative processes. Tasks such as issuing certifications, implementing programs, and providing public services can be efficiently managed through decentralized, real-time accessible storage. According to the study entitled "Empowering Local Governments Through Blockchain Technology," Carpio (2020) asserted that blockchain fosters participatory governance while promoting resilience in local government units.

Whereas blockchain technology provides an excellent foundation for modernizing governance systems globally, its potential in the Philippine context is highly significant. Barangays—the smallest administrative units in the country—play a crucial role in local governance, yet they face systemic inefficiencies due to a hybrid reliance on traditional and digital methods. For instance, many barangays, including those managed by Kapitan Raymund Laxamana and the kagawads, struggle with delays and inefficiencies in document processing, event communication, and community engagement. Residents frequently arrive at

barangay halls with incomplete requirements, causing delays in processing permits and certifications. Similarly, officials face challenges in automating data processing, leading to inaccurate demographic reports and hampering decision-making.

In addition, low awareness of waste segregation schedules, insufficient community participation in local events, and inadequate disaster preparedness further strain barangay governance. These challenges impact both officials and residents, often leaving the latter dissatisfied and the former overwhelmed. According to the study entitled "Community Empowerment through Blockchain-Driven Solutions," Carpio (2020) linked such inefficiencies to a lack of integrated digital solutions in grassroots governance.

Addressing these issues aligns with the UN Sustainable Development Goals, particularly Goal 16.6, which advocates for effective governance, and Goal 11.3, which promotes inclusive and sustainable urbanization through participatory planning. Additionally, Goal 9.1 is widely recognized as one of the major goals of any e-government effort. With shrinking budgets and the high cost of new technologies, government IT managers are optimizing the use

of existing resources and leveraging the opportunities brought about by new technologies. Thus, introducing a centralized blockchain-based platform for barangay management becomes imperative. Such a platform can streamline processes, enhance inclusiveness, and foster community participation, ultimately strengthening local governance structures. Without addressing these inefficiencies, barangay officials risk further disengagement from residents and a weakened governance framework, which threatens the sustainability and resilience of barangay communities.

Project Objectives

The main objective of this study is to design and develop a blockchain-powered website for enhancing communication and service delivery between barangay residents and officials. Specifically, it will aim to answer the following;

1. to identify the information requirements of the proposed system;

2. to determine to architectural framework of the proposed system;

3. to identify the features of the proposed system; and

4. to measure the extent of usability of the proposed system.

Proposed Solutions

Emerging IT technologies like blockchain offer transformative solutions to modernize communication and data management in Barangay Pinsao Proper, addressing inefficiencies rooted in traditional practices. Existing digital systems in e-governance, such as the Unified Barangay E-Services System and e-Barangay, highlight the significant benefits of integrating digital tools into local governance. The Unified Barangay E-Services System, for instance, leverages augmented analytics to enable data-driven decisions, streamline service accessibility, and reduce response times. In barangay Batasan Hill a system was developed with the goal of improving the efficiency and accessibility of government services for the community. It can identify which services are most frequently used by residents or identify areas where there may be a need for additional resources or support. (Pastoril, 2023).

Similarly, the e-Barangay platform improves administrative efficiency by centralizing local statistics and automating routine processes. For instance, The Aguada Barangay in Isabela City developed a system that allows

barangay officials and residents to properly manage and handle their daily operations and transactions. (Carpio, 2020). These solutions underscore the potential of digital platforms to enhance governance but also highlight the opportunity for further innovation, such as the adoption of blockchain technology, to address current limitations effectively.

Blockchain technology, characterized by its decentralized, immutable, and transparent data management capabilities, directly tackles challenges like inefficient communication and data inaccuracies. (Albadi, 2023) emphasize how blockchain ensures data security and integrity through encryption, decentralized storage, and tamper-proof mechanisms. This technology also supports by securely distributing announcements and updates, preventing unauthorized modifications. Furthermore, smart contracts—a key feature of blockchain—can enhance efficiency by automating repetitive tasks, such as processing permit applications and managing resident data according to the research of (Hakimi, 2024). These capabilities align with Barangay Pinsao Proper’s objectives to streamline operations and use reliable data for socioeconomic decision-making. Blockchain also promotes trust and

accountability by creating immutable logs of data transactions, ensuring transparency and enhancing public confidence in barangay processes. This case study analyzes blockchain-based e-government solutions in countries like Estonia, Germany, and the UAE, focusing on emerging areas such as e-health, e-migration, e-municipality, and e-military. These examples highlight the potential of blockchain and distributed technologies in automating government services. By improving internal and external information processes, e-government aims to enhance service delivery to citizens and businesses through increased use of information and communication technologies (Kassen, 2022). Integrating blockchain with existing digital tools provides Barangay Pinsao Proper with a secure and efficient governance framework. Blockchain-enabled platforms can modernize communication by delivering timely, tamper-proof updates to residents, while officials can utilize blockchain’s data integrity to inform decision-making. This integration also supports long-term socioeconomic planning through accurate community profiling and resource allocation. Research indicates that blockchain has revolutionized e-governance globally by enhancing security, transparency, and efficiency(Farhana, 2024). For Barangay

Pinsao Proper, adopting blockchain technology presents a significant opportunity to lead in digital transformation within local governance, establishing a scalable and innovative model for other communities to emulate.

Chapter 2

DESIGN THINKING

This chapter discusses the design thinking process, and the phases the researchers have undertaken to identify and validate the problem and solution based on the user feedback.

Design Thinking

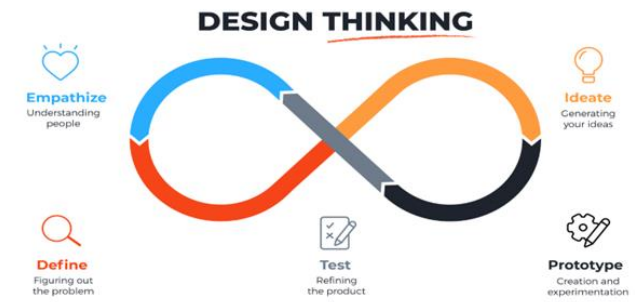
Design thinking is a structured approach to problem-solving that emphasizes understanding user needs and developing innovative solutions. For the Ugnay Pinsao project, the process began with empathizing with the barangay officials and residents, leading to a problem challenge statement. The next stages, Define, Ideate, Prototype, and Test, allowed the researchers to build a solution tailored to the needs of Barangay Pinsao Proper.

Figure 1 illustrates the design thinking framework applied in Barangay Pinsao Proper to address challenges in resource allocation and service delivery. By creating a centralized digital platform, the process aimed to transition from manual to digital data systems, enhance efficiency in scheduling and communication, and empower barangay officials with accurate data for informed

decision-making, ultimately fostering greater community engagement and socioeconomic improvement.

Figure 1

Design Thinking



Empathize. During the empathize phase, the researchers aimed to comprehend the experiences, needs, and challenges faced by Barangay Pinsao Proper in managing resident data and addressing inefficiencies in communication and document processing. They employed methods such as interviews, current practice analysis, and the 5 Why Analysis as shown in Figure 2 to uncover the root causes of these issues. Key findings revealed that traditional methods, including bulletin boards and word-of-mouth communication, were insufficient for effective information dissemination. Additionally, manual data handling processes contributed to delays in delivering services.

To address these issues, the researchers engaged in several activities and delivered actionable outputs. These

included mapping the barangays' existing workflow to identify inefficiencies, conducted surveys to capture insights from residents and officials, and brainstormed features for a centralized digital platform. The 5 Why Analysis was instrumental in pinpointing how outdated systems affected stakeholders, shaping the design of solutions such as real-time announcement systems, automated data handling, and user-friendly digital tools. These efforts aimed to enhance service efficiency, streamline communication, and improve resident engagement.

Figure 2

5-Why Analysis

Why 1	Why 2	Why 3	Why 4	Why 5	Root Causes	Solutions
Residents are not immediately notified about updates regarding barangay matters or recent events within the area.	Residents do not receive notices in a timely manner.	The current communication methods are manual and inefficient.	The barangay relies on traditional methods like bulletin boards and word-of-mouth.	The barangay lacks access to digital tools for better communication.	Lack of initiative, and awareness to invest in digital communication tools, which leads to reliance on inefficient manual methods and delays in notifying residents about important barangay matters.	Create a centralized platform for information sharing and communication .
Traditional information sharing methods are ineffective.	Bulletin boards and word of mouth have limited reach.	Not all residents visit the barangay and messages don't reach everyone.	The barangay hall is quite far and causes an inconvenience to the residents.	Residents are busy and physical bulletin are limited compared to modern methods of relaying information.	Lack of investment in digital communication systems, which forces reliance on outdated methods like bulletin boards and word-of-mouth, resulting in limited reach and inconvenience for residents.	Create an application that enables the residents to be notified on all the barangay's Upcoming events, meetings, and programs.
The current methods used rely on manual input of data.	The barangay lacks access to digital tools.	No prior initiative or awareness of how technology could improve updates for residents.	There is no centralized system for the barangay.	Implementing such systems requires expertise.	Lack of investment in digital infrastructure and training for barangay officials, leading to reliance on outdated document processing methods.	Create an AI-powered messaging system that is comprehensive and convenient for the residents and officials of Pinsao Proper.

Define. The define phase synthesized the insights gathered during the empathize stage to identify the core problem in Barangay Pinsao Proper. This phase involved analyzing patterns, themes, and pain points to clearly articulate the specific needs and goals that the design solution should address. Researchers identified inefficiencies in data management, delays in document processing, and limited communication between barangay officials and residents as key issues. These insights clarified the project scope, which focuses on creating a streamlined, user-friendly platform to improve administrative efficiency and enhance community engagement.

In response to these challenges, the researchers undertook the task of designing and developing a platform with features that include efficient data filtering, such as categorizing residents by gender, age, occupation, and other relevant attributes. This system enables barangay officials to retrieve accurate information for decision-making, implement targeted programs, and generate socioeconomic insights. By improving data accessibility and organization, the platform ensures smoother workflows, timely document processing, and stronger connectivity between the barangay and its residents.

Ideate. During the Ideate phase, the researchers brainstormed a variety of ideas and potential solutions to address the core problem identified in Barangay Pinsao Proper. This stage involved the creation of the Business Model Canvas (BMC), a visual framework to present the key components of the project's business model.

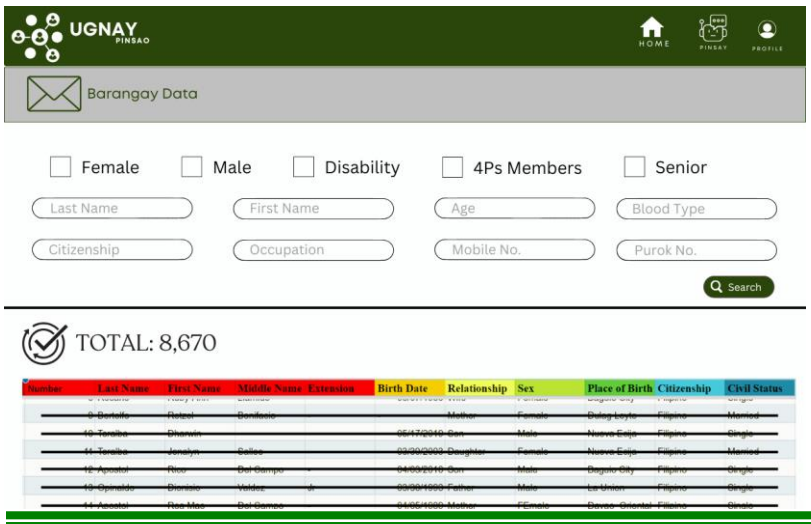
The BMC outlined the project's key partners, including barangay officials of Pinsao Proper, local government units, SK officials, a dedicated application development team, and cloud service providers. The project's essential features were also defined, focusing on improving barangay operations through an advanced resident data filtering system, automated scheduling for document requests, an accessible repository of forms for barangay papers, and a centralized announcement platform. Additionally, revenue streams were identified, which included website advertisements, government funding, and sponsorships from local organizations. These components collectively aimed to position Ugnay Pinsao as a comprehensive digital solution to enhance barangay services and communication.

Prototype. In the Prototype phase, the researchers focused on developing a preliminary model of the website to explore its feasibility and gather valuable user feedback.

This stage began with the creation of low-fidelity prototypes using Canva, which provided a basic visual framework for the website's layout and structure. These initial prototypes helped the researchers identify design priorities and potential areas for improvement. The process then advanced to high-fidelity prototypes created in Figma, showcasing detailed and interactive features of the platform. These prototypes were essential in simulating the actual functionality of the website, offering insights into its usability and design effectiveness. By validating these prototypes with potential users, the researchers gained crucial input to refine their plans and ensure that the final product would meet the needs of the barangay and its residents.

Figure 3

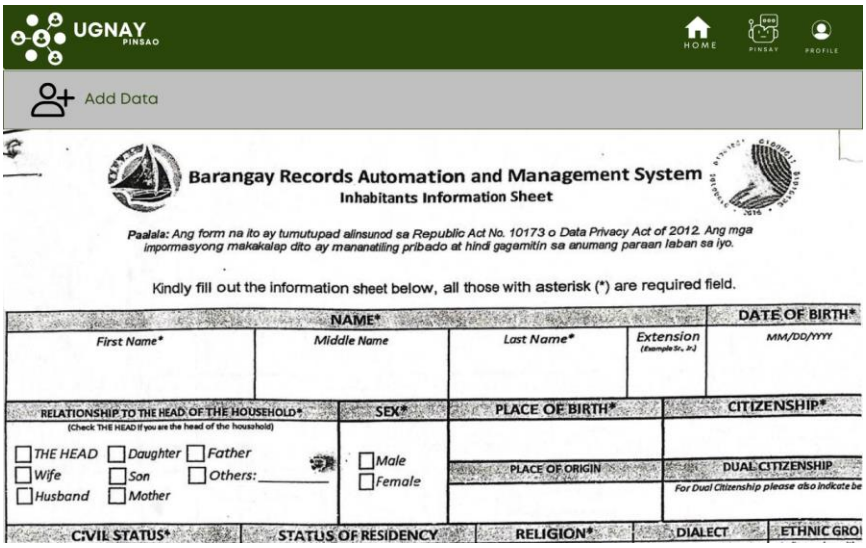
Barangay Data Page



The Barangay Data page will allow barangay officials to access and filter resident information based on various categories such as gender, disability, 4Ps membership, senior status, age, occupation, blood type, and more. It will display the total number of residents at the top of the page, providing a quick overview of the population data. A search bar with filtering options will enable users to retrieve specific data efficiently. Additionally, the list of residents, including their names, age, and more will be presented in a tabular format below the search section, ensuring streamlined navigation and accessibility.

Figure 4

Add Data Page

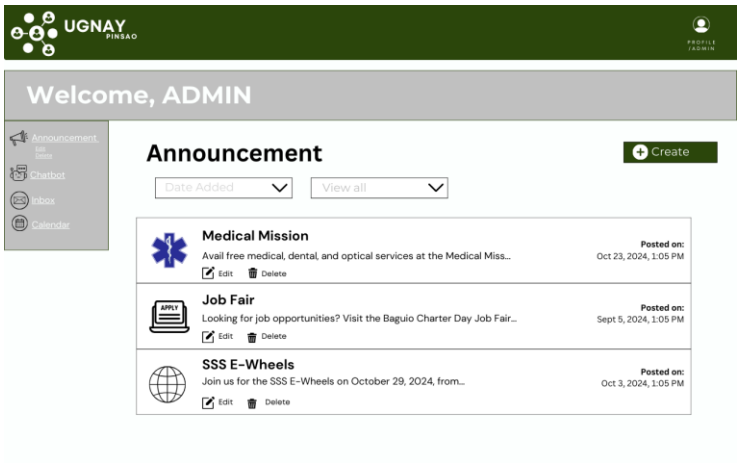


This page enables users, including barangay residents and officials, to efficiently manage and update records

through the Barangay Records Automation and Management System. It features an intuitive interface for adding new data about residents, ensuring all required fields are completed for accurate record-keeping. The platform supports the organization and storage of essential community information, aligned with data privacy laws. The "Add Data" option allows users to seamlessly contribute or update relevant data for the barangay's database, fostering transparency and streamlined management.

Figure 5

Centralized Community Announcement Management Page

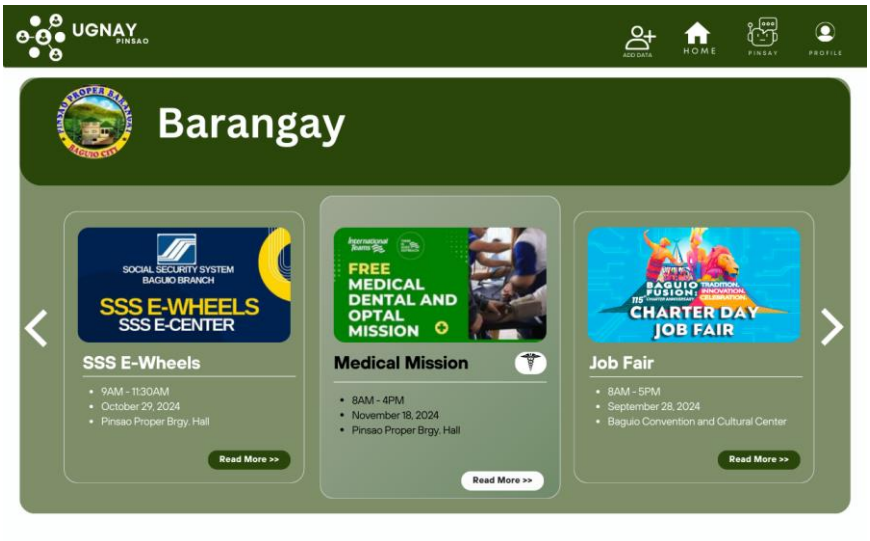


This page provided a centralized and comprehensive platform for barangay officials to effectively manage community announcements. Admins had complete control over the announcement lifecycle, with the ability to create, edit, and delete announcements as needed. This functionality

empowered the admins to keep residents informed about important local events, programs, and services in a timely and organized manner. Additionally, this centralized hub allowed admins to efficiently disseminate critical information, fostering open communication and transparency within the barangay.

Figure 6

Resident Announcement Viewing Page



Residents could easily access and view all announcements through this user-friendly platform. The announcements were conveniently categorized, allowing residents to quickly find relevant information. This streamlined approach facilitated seamless communication and engagement between the barangay administration and the community. The simple and intuitive interface made the page

accessible for all residents. Additionally, the "Create" button gave admins the flexibility to post new updates regularly, ensuring the community remained well-informed and engaged with ongoing activities and developments within the barangay. This fostered transparency and accountability, as residents could stay up-to-date with the latest happenings in their local community.

Test. During the test phase, the researchers gathered and evaluated feedback from the residents and officials of Barangay Pinsao Proper. Usability tests were conducted to assess the effectiveness, usability, and relevance of the Ugnay Pinsao platform. Respondents were provided with a prototype of the website to explore its functionalities before answering a feedback form. The test phase focused on the platform’s core features, such as the resident data filtering system, announcement board, appointment scheduling, and accessible forms. The feedback form included sections for respondents to share their observations, highlight issues, and provide suggestions for improvement. Additionally, space was provided for further questions or detailed comments, which the researchers reviewed and addressed in subsequent design iterations. This process ensured that the platform met the needs and expectations of its users while identifying opportunities for enhancement.

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APPENDICES

Appendix A

Communication Letter

UNIVERSITY of the CORDILLERAS
BAGUIO CITY

December 5, 2024 11-9-24

Mr. Raymund Laxamana
Barangay Captain
Pinsao Proper
Baguio City

Dear Mr. Laxamana:

In partial fulfillment of the requirements for the degree Bachelor of Science in Information Technology, graduating students are required to undertake a study that involves the development of an information system. This undertaking is intended to expose students to actual practices in systems development.

In line with the above, the undersigned wishes to request approval from your office to study your existing **Barangay Records Automation and Management System**. Should this request be approved, data-gathering activities will be conducted at a time deemed most convenient for you. All data gathered will be used strictly for academic purposes only and will be treated with utmost confidentiality.

Further, an acceptance test shall be conducted to validate that the developed system conforms to the given requirements.

Look forward to a positive response.

Sincerely yours,

Orland Jhan D. Cartujano
Project Leader

Noted:

Melinda A. Beninsig
Adviser

Jeffrey S. Ingosan
Academic Dean, CITCS

Appendix B

Documentation

Appendix C

Invitation Letter

UNIVERSITY OF THE CORDILLERAS
College of Information Technology and Computer Science

November 16, 2024

To: Ms. Anna Rhodora M. Quitaleg

Dear Ma'am:

May I request you to serve as adviser for ORLAND JHAN CARTUJANO, MARIA HENYLIE GYANNA GONZALES, and FRANCESCA YSABEL PACO, candidates for the degree BACHELOR OF SCIENCE IN INFORMATION TECHNOLOGY. The title of their capstone project proposal is UGNAY PINSAO: A CENTRALIZED WEBSITE FOR STREAMLINING COMMUNICATION AND SERVICES BETWEEN BARANGAY RESIDENTS AND OFFICIALS.

Their pre-defense is scheduled on _____, _____ at the CITCS Consultation Room.

Thank you and God bless.

Sincerely,
11/16/2024
Melinda A. Beninsig
Teacher-in-Charge

==========

REPLY SLIP

_____ I am willing to be: ___✓___ adviser of their capstone project proposal

_____ chairman of their capstone project defense

_____ member of their capstone project defense

_____ Sorry, I cannot accept the invitation.

Reason: _____

_____

For meetings, I am free: _____
(Pls. indicate date and time)

SIGNATURE OVER PRINTED NAME

UNIVERSITY OF THE CORDILLERAS
College of Information Technology and Computer Science

November 16, 2024

To: Ms. Christine T. Gonzales

Dear Ma'am:

May I request you to serve as chairperson of the panel for ORLAND JHAN CARTUJANO, MARIA HENYLIE GYANNA GONZALES, and FRANCESCA YSABEL PACO, candidates for the degree BACHELOR OF SCIENCE IN INFORMATION TECHNOLOGY. The title of their capstone project proposal is UGNAY PINSAO: A CENTRALIZED WEBSITE FOR STREAMLINING COMMUNICATION AND SERVICES BETWEEN BARANGAY RESIDENTS AND OFFICIALS.

Their pre-defense is scheduled on _____, _____ at the CITCS Consultation Room.

Thank you and God bless.

Sincerely,

Melinda A. Beninsig
Teacher-in-Charge

==========

REPLY SLIP

__✓__ I am willing to be: _____ adviser of their capstone project proposal

__✓__ chairman of their capstone project defense

_____ member of their capstone project defense

_____ Sorry, I cannot accept the invitation.

Reason: _____

_____

For meetings, I am free: _____
(Pls. indicate date and time)

Christine T. Gonzales
SIGNATURE OVER PRINTED NAME

UNIVERSITY OF THE CORDILLERAS
College of Information Technology and Computer Science

November 16, 2024

To: Mr. Genesis Fidel A. Tamondong

Dear Sir:

May I request you to serve as panel member for ORLAND JHAN CARTUJANO, MARIA HENYLIE GYANNA GONZALES, and FRANCESCA YSABEL PACO, candidates for the degree BACHELOR OF SCIENCE IN INFORMATION TECHNOLOGY. The title of their capstone project proposal is UGNAY PINSAO: A CENTRALIZED WEBSITE FOR STREAMLINING COMMUNICATION AND SERVICES BETWEEN BARANGAY RESIDENTS AND OFFICIALS.

Their pre-defense is scheduled on _____, _____ at the CITCS Consultation Room.

Thank you and God bless.

Sincerely,
11/22/2024
Melinda A. Beninsig
Teacher-in-Charge

==========

REPLY SLIP

__/__ I am willing to be:
_____ adviser of their capstone project proposal
_____ chairman of their capstone project defense
__/__ member of their capstone project defense

_____ Sorry, I cannot accept the invitation.

Reason: _____

For meetings, I am free: _____
(Pls. indicate date and time)

FIDEL TAMONDONG
SIGNATURE OVER PRINTED NAME

Appendix D

Business Model Canvas

Business Model Canvas	Designed for:	Designed by:	Date:	Version:
	CIT6 - 3H	Cartujano, Orla Gonzales, Gyan Paco, Francesc	10/02/202	

Key Partners	Key Activities	Value Propositio	Customer Relationships	Customer Segments
Barangay Officials of Pinsao Local government units SK Officials	Application development and maintenance Content management and updates Community outreach Response and communication Data collection and analysis	Timely Updates Communication engagement Automated garbage disposal schedules and reminders Socioeconomic data analysis	User support and assistance Community engagement Regular notifications	Barangay Residents Barangay Officials SK Officials Barangay Visitors
	Key Resources Application development team Content moderator Partnership with barangay Cloud infrastracture		**Channel** Website Social media integration	

Cost Structure	Revenue Streams
Development and maintenance cost Marketing and promoting expenses Infrastructures and server maintenance Data Storage and security	Website Advertisements Government Funding