TagSakay: A Low-Cost RFID Tapping System for Monitoring Tricycle Queue Rotations in Davao City

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I - INTRODUCTION

1.0 Project Context

Globally, rapid urbanization is exerting immense pressure on cities, driving the need for more efficient and organized public transportation systems, often leaning towards innovative transportation solutions to manage complex urban mobility challenges [1]. The push for smart cities and digital governance emphasizes solutions that are not only efficient but also transparent and equitable for all stakeholders, including transport operators and commuters, by leveraging information and communication technologies to enhance public value and urban development [2].

In the Philippines, tricycle transport stands as a vital mode of public transportation in numerous local barangays, including Barangay Communal, Davao City. This sector plays a crucial role in last-mile connectivity and local commerce, supporting the daily lives of countless Filipinos. Recognizing its significance, there are national efforts to formalize and protect the interests of tricycle drivers and operators, aiming to ensure their dignified existence and economic advancement through proper regulation and support [3]. Despite its essential role, the current system for managing tricycle queue rotations in many areas, including Barangay Communal, often relies on traditional, manual processes such as chalkboard listings, verbal coordination, or simple memory. These outdated methods are highly prone to human error, miscommunication, and disputes among drivers, leading to inefficiencies and fairness issues in the dispatch system.

As urbanization increases and digital governance continues to gain traction, grassroots-level transport systems require innovations that are affordable, easy to implement, and resilient to infrastructure limitations. The absence of an automated, verifiable queuing mechanism has highlighted the need for a system that can ensure order, transparency, and accountability, especially during peak hours, holidays, or in the presence of multiple routes.

The current queueing system in Barangay Communal specifically depends on informal methods such as chalkboard listings and verbal arrangements among drivers. These manual practices are highly prone to errors, subjective decision-making, and disputes, particularly during rush hours, holidays, or when multiple units arrive simultaneously. Inconsistencies in maintaining the order of arrival often result in arguments among drivers, while barangay personnel lack the tools to validate or audit queue entries effectively. Furthermore, there is no centralized or digital record of queue rotations, making it difficult for local authorities to manage terminal operations, review disputes, or gather insights for planning. This lack of structure undermines fairness, accountability, and operational efficiency.

The TagSakay project addresses these issues by proposing a digital tap-in system using RFID cards. This will enable real-time monitoring of tricycle queue rotations, minimize human error, and provide a visual display and backend dashboard to facilitate transparent queueing practices.

While alternatives like GPS-based tracking or smartphone applications were considered, they introduce higher initial costs, require consistent driver smartphone ownership and data plans, and face challenges with signal reliability in shaded terminal areas. RFID technology, however, offers a robust, low-cost, and user-friendly solution. Its passive nature ensures minimal power consumption, its physical tap provides clear, verifiable timestamps, and its simplicity aligns with the grassroots operational environment, making it the most practical and sustainable choice for ensuring fair turn-taking and reducing conflicts.

1.1 Purpose and Description

The main purpose of the **TagSakay** project is to streamline the tricycle queueing system in Barangay Communal by introducing a digital, RFID-based tap system. This solution seeks to automate the recording of tricycle drivers' rotations, enabling real-time updates on a visual display and generating structured digital records for administrative monitoring.

TagSakay will include a tap station powered by an ESP32 microcontroller, equipped with an RFID reader and display screen, and connected to a cloud-ready backend. The data will be transmitted to a web-based dashboard developed using modern frameworks such as Vue.js and Node.js, with reports stored in a PostgreSQL database.

This low-cost solution is designed to minimize manual intervention, ensure queue fairness, and provide the barangay administration with accurate insights into daily operations. It empowers both drivers and terminal staff by reducing ambiguity, resolving disputes faster, and encouraging transparency through technology.

1.2 Objectives

1.2.1 General Objective

The general objective of this capstone project is to develop a low-cost RFID-based tapping system named "TagSakay" that streamlines the tricycle queue rotation process in Barangay Communal, Davao City, enhancing operational efficiency, accuracy, driver fairness, and administrative transparency through the integration of real-time digital tracking and queue monitoring features.

1.2.2 Specific Objective

1. To design a system that logs driver queue entries using RFID technology, eliminating manual processes such as chalkboard listings and verbal coordination.
2. To enable real-time visual updates of the queue status through a public-facing display, ensuring transparency and accountability in the queuing process.
3. To improve queue processing efficiency during peak hours, holidays, and high-traffic periods through automated queue management and reduced processing time.
4. To automate the generation of daily and weekly reports for route and rotation monitoring, providing centralized digital records and actionable insights for terminal planning and operational optimization.
5. To develop a dashboard that allows barangay staff or transport officers to track tricycle queue data efficiently, enabling effective validation and audit of queue entries.
6. To reduce administrative disputes by maintaining an accurate and transparent queue record, ensuring fairness in driver rotation order and minimizing conflicts.

1.3 Scope and Limitations

Scope:

This project is limited to the implementation of a single RFID-based tap-in station designed specifically for the CATICOMODA Route A-29-A tricycle terminal in Barangay Communal. It will accommodate up to 40 registered tricycle drivers, each of whom will be issued an RFID card. The system will include one active portable tap station, a display screen to show real-time queue positions, and a web-based administrative interface to generate reports and monitor activity. The system will be deployed under a canopy-type terminal with a power solution that may include power banks or solar kits, and it will rely on Wi-Fi or mobile data for connectivity.

Limitations:

However, the system is dependent on the availability of a stable power source and internet connection. In the absence of connectivity, real-time synchronization and report generation will be unavailable until reconnection occurs. Moreover, the RFID system assumes that drivers will consistently comply with the tap-in procedure. The system does not support automatic tap-out logging and lost or damaged RFID cards may require manual intervention. Features such as multi-language support, GPS tracking, and automated facial recognition are not included in this version. Additionally, the system is primarily designed for tricycle queue monitoring and does not address other transport management concerns, such as fare tracking or passenger volume. While the current iteration focuses on RFID due to its specific advantages for this pilot, the project acknowledges the dynamic nature of technology and remains open to integrating or evolving towards other solutions (e.g., vision-based systems for automatic vehicle identification) in future phases based on performance, cost-effectiveness, and community feedback. Future iterations envision shifting the primary user to passengers, enabling cashless fare transactions via RFID cards or integrated QR codes.

II - REVIEW OF RELATED LITERATURE AND STUDIES

2.1 Review of Related Literature

Studies from the Philippines provide valuable insights into the local transportation landscape and the applicability of technology-driven solutions for public conveyances like tricycles and jeepneys.

2.1.1: A NodeMCU-Based Contactless Fare Management System for Tricycle Commuters

The implementation of RFID technology in Philippine public transportation has shown promising results through the work of Calis and Aba Jr. [4], who developed an RFID-based contactless fare management system specifically for tricycle commuters in Negros Oriental, Philippines. Their comprehensive research involved testing with a tricycle driver, ten passengers, and an engineer, utilizing an Arduino/NodeMCU RFID system to modernize payment processes and reduce dependency on cash handling. The findings demonstrated that the system was both feasible and reliable, resulting in smoother fare transactions and overwhelmingly positive feedback from users. This research directly supports TagSakay's focus on tricycle queue management by validating the potential for RFID technology in small-scale public transport applications.

2.1.2: Queuing Management System for Lingayen Jeepney Terminal

Building upon the success of contactless systems, Borje et al. [5] addressed the broader challenge of queue management through their research on a queuing management system for Lingayen Jeepney Terminal in Dagupan City, Philippines. Using Scrum methodology and various data collection tools, they developed a web-based system aimed at improving ticketing, record-keeping, and queuing processes for jeepney drivers and terminal staff. While their solution primarily focused on web-based queue order management rather than physical queue enforcement, the positive user feedback on system performance underscores the critical need for effective queue management tools in the local transport sector and validates the concept of visual displays for queue management systems.

2.1.3: Jeepney Queuing and Tracking System (JEEPQTS)

Expanding the scope of technological solutions, Sotto [6] explored a Jeepney Queuing and Tracking System (JEEPQTS) across various routes in the Philippines. This innovative SMS-based platform enabled drivers and commuters to communicate availability and transportation needs through text messaging, with a centralized system providing real-time updates to all participants. Although the system demonstrated improvements in matching efficiency and reduced idle time for drivers, it did not address physical queue order management directly. This limitation reveals a significant gap in real-time, on-ground queue enforcement that TagSakay aims to fill through its comprehensive approach to physical queue management.

2.1.4: Internet of Things-Based Revenue Collection System for Tricycle Vehicle Operators

The integration of Internet of Things (IoT) technology in public transportation has been demonstrated by Maduka et al. [7], who developed an "Internet of Things-Based Revenue Collection System for Tricycle Vehicle Operators" in Akwa Ibom State, Nigeria. Their comprehensive system utilized Android applications and microcontroller circuits, specifically aimed at reducing revenue leakages in tricycle operations. While broader in scope than queue management alone, this research highlights how digital systems can effectively manage and collect revenue from tricycle drivers, demonstrating the potential for comprehensive technological solutions in similar public transport contexts and supporting TagSakay's integrated approach to transportation management.

2.2 Review of Related Systems

International studies and system implementations offer a broader perspective on RFID and IoT applications in transport, addressing various aspects from fare collection to smart logistics, and demonstrating solutions that can be supportive of TagSakay's goals.

2.2.1: Bus Fare Collection System Using RFID and GPS

Zaman et al. [8] developed a comprehensive "Bus Fare Collection System Using RFID and GPS" in Dhaka, Bangladesh, creating an Automatic Fare Collection (AFC) system that aimed to streamline ticketing by replacing paper tickets, reducing processing time, and avoiding fare disputes. The system automatically calculated and deducted fares based on travel distance while recording passenger locations for operational analysis. Despite demonstrating improvements in fare collection and offering discounted fares to users, the system revealed important limitations including inability to handle new users and GPS accuracy issues in indoor environments. This research directly supports TagSakay's concept of automated tracking highlighting the critical importance of offline capabilities for outdoor queue monitoring, given the identified GPS limitations.

2.2.2: Automated Public Transport Fare Collection System Using RFID

In Mumbai, India, Joshi et al. [9] demonstrated an "Automated Public Transport Fare Collection System Using RFID" using a Raspberry Pi-based prototype. Their system successfully streamlined payment processes and reduced human contact while integrating RFID technology for simplified commuting experiences. Additionally, the system generated valuable operational data for transport authorities, reinforcing the efficiency of RFID in fare collection and demonstrating its capacity to provide comprehensive admin-side reporting capabilities that can inform operational decisions.

2.2.3: Design of Smart Bus Fare Collection System Using RFID

Ramani et al. [10] designed a "Smart Bus Fare Collection System Using RFID" in Visakhapatnam, India, creating a comprehensive prototype built with Arduino UNO, RFID reader, GSM module, and LCD display components. Their implementation featured integrated software for fare deduction via microcontroller, highlighting the effectiveness of hardware-software integrated solutions for automated fare collection. This research demonstrates how different hardware components can be successfully integrated to create a functional automated fare collection system.

2.2.4: RFID-Based Bus Tracking System

Omkar Aher et al. [11] proposed an "RFID-Based Bus Tracking System" in Pune, India, featuring an innovative architecture that used RFID tags on buses and readers at stops connected via IoT infrastructure. The system aimed to provide real-time bus location information and estimated time of arrival (ETA) data to passengers and operators. Their findings suggested improved transit efficiency and optimized scheduling capabilities for transport operators. While focused on vehicle tracking rather than queue management, the use of RFID at fixed points for data collection is highly relevant to TagSakay's approach to monitoring queue rotations and driver positions.

2.2.5: Conductor-less Bus Ticketing System Using RFID Technology

Agarwal et al. [12] developed a "Conductor-less Bus Ticketing System Using RFID Technology" in India, creating an Arduino-based contactless fare system that demonstrated significant time and cost savings for operators through automatic ticket generation and fare deduction processes. This research emphasizes the operational benefits and increased security provided by automated systems, demonstrating how technology can reduce labor costs while improving service reliability and reducing opportunities for revenue leakage.

2.2.6: Hospital Queue Wait Time Prediction

Mishra et al. [13] proposed a multi-stage queue model using RFID tag-sensors for hospital queue wait time prediction in Navi Mumbai, India. Their IoT queue-management system aimed to reduce patient anxiety and improve hospital efficiency through better queue management and wait time estimation. Although implemented in healthcare rather than transportation, the application of RFID for real-time queue monitoring and data collection is directly analogous to TagSakay's goals for physical queue management, demonstrating the versatility of RFID technology across different domains.

2.2.7: Smart Ticketing for Academic Campus Shuttle Transportation System Based on RFID

Abayomi-Alli et al. [14] implemented a "Smart Ticketing for Academic Campus Shuttle Transportation System Based on RFID" in Ota, Nigeria, creating a simple, low-cost system that utilized RFID student cards to effectively eliminate paper tickets and revenue leakage. The successful implementation of this cost-effective RFID solution on a campus shuttle system provides a scalable model for TagSakay, particularly demonstrating the feasibility of deployment in resource-constrained environments where cost-effectiveness is a primary concern.

2.2.8: Integrated Ticketing System for Public Transport Using RFID Technology

Senthazhai et al. [15] proposed an "Integrated Ticketing System for Public Transport Using RFID Technology" in Tamil Nadu, India, utilizing a unified "Smart Master Card" that integrated RFID and IoT technologies for multi-modal transit applications. This comprehensive system aimed to eliminate manual fare collection, reduce operational costs, and improve efficiency through centralized payment management across multiple transport modes. The research highlights the potential for broader integration and centralized management of transport data, supporting TagSakay's vision for comprehensive transportation management.

2.2.9: Fare Transfer in Public Transport Using RFID

Singh et al. [16] designed an "RFID tap-to-pay machine for auto rickshaws and buses" in India, achieving remarkable cashless transactions within two seconds of card presentation. This efficient system instantly transferred fare amounts to the driver's account, emphasizing faster transaction processing and the convenience of cashless systems for both passengers and operators. These aspects of rapid processing and immediate fund transfer can be extended to automated data collection and record-keeping for TagSakay, bolstering fair practice when it comes to transparency

2.2.10: A Review of Passenger Counting in Public Transport: Concepts with Solution Proposal

Radovan et al. [17] conducted "A Review of Passenger Counting in Public Transport: Concepts with Solution Proposal," providing a comprehensive international literature review of passenger counting methods and technologies. They noted that RFID technology offers fast, contactless passenger counting capabilities but requires every passenger to carry a tag and may miss fare evaders who bypass the system. This review highlights both the significant advantages and inherent limitations of RFID for counting and monitoring applications, informing TagSakay's development regarding potential challenges in tag management and verification processes to prevent system misuse.

2.2.11: Ticket Generating and Bus Crowd Controlling Smart Bus Stop System Using IoT

Priya et al. [18] proposed a "Ticket Generating and Bus Crowd Controlling Smart Bus Stop System Using IoT" in Tamil Nadu, India, using RFID cards, Arduino, and GSM modules to create a comprehensive passenger management system. This innovative system automatically generated tickets via RFID tags and notified passengers via SMS, effectively reducing bus crowding and improving passenger flow management. The concept of using RFID for automated ticketing and crowd control is highly relevant to queue management applications and supports TagSakay's objectives for automated queue processing.

2.2.12: Automatic Bus Fare Collection System (undergraduate project report)

Donnel J et al. [19] presented an "Automatic Bus Fare Collection System" as an undergraduate project in India, creating an Arduino UNO-based fare machine with an RFID card top-up portal. Their system demonstrated how RFID systems can eliminate the need for cash transactions and facilitate online recharging capabilities for users. This research indicates the feasibility of comprehensive RFID-based payment solutions that can be integrated into broader transportation management systems, supporting TagSakay's vision for automated operations.

2.2.13: AUTOMATED CROWD MANAGEMENT IN PUBLIC TRANSPORT

Jadhav et al. [20] demonstrated an "Automated Crowd Management in Public Transport" system in Bengaluru, India, using RFID smart-cards, ARM controllers, NodeMCU, and IR sensors to create a comprehensive passenger management solution. Their embedded system provided real-time seat monitoring and automated fare/messaging capabilities, showing an efficient crowd-management solution that significantly reduces human error in transport management. This research aligns with TagSakay's efforts to minimize manual processes and improve operational efficiency through automation.

2.2.14: Design and Implementation of a Low-Cost Universal RFID Wireless Logistics Terminal in the Process of Logistics Traceability

Yu et al. [21] designed and implemented a "Low-Cost Universal RFID Wireless Logistics Terminal" in China, creating an RFID terminal integrated with LoRa, RJ45, and Wi-Fi connectivity options. Their system achieved high accuracy and real-time logistics traceability across different communication protocols. While applied in logistics rather than transportation, this research emphasizes the reliability and real-time capabilities of RFID in tracking applications, which is directly relevant to TagSakay's data collection requirements and demonstrates the potential for multi-protocol connectivity.

2.2.15: Smart Trolley with Automatic Billing System using RFID

Dangat et al. [22] developed a "Smart Trolley with Automatic Billing System using RFID" in Pune, India, creating a prototype that successfully automated item scanning and real-time billing processes, significantly reducing checkout time and improving shopping efficiency. This demonstrates RFID's broader application in real-time data capture and automated processes across various domains. Though not specifically for transportation, this system shows how RFID technology can improve process efficiency and reduce manual work, supporting the principles underlying TagSakay's automated approach to queue management.

Research Gap

Despite the range of studies and systems reviewed, several key gaps remain unaddressed, particularly in the context of small-scale, community-level transportation like that in Barangay Communal. Most existing systems did not specifically focus on ensuring fair turn-taking among tricycle drivers, which is a crucial aspect in maintaining order and avoiding disputes in local terminals. Additionally, there is a noticeable absence of real-time visual displays that show the current queue order—an essential feature for transparency and efficient driver coordination.

Many of the existing solutions were also designed for more resource-rich settings and did not consider the constraints of low-cost environments. These include areas with limited access to stable electricity, internet connectivity, or advanced infrastructure—conditions commonly found in rural and barangay-level terminals. Lastly, a significant gap was the lack of deployment and testing within actual local communities, which limits the practical validation of these systems in real-world scenarios. This highlights the need for solutions like TagSakay that are not only technically sound but also tailored for and tested within grassroots settings.

Supporting Theories and Tools:

- **RFID Technology:** Helps identify drivers through cards and scanners.
- **ESP32-S3:** Small, low-powered but affordable microcontrollers used in many DIY electronics and smart systems.
- **Vue.js and Node.js:** Web development tools used to create dashboards and real-time interfaces.
- **PostgreSQL:** A reliable database used in many systems to safely store data.
- **Internet of Things (IoT):** The concept of connecting devices to share and collect data, is used in many modern automation projects.

III - TECHNICAL BACKGROUND

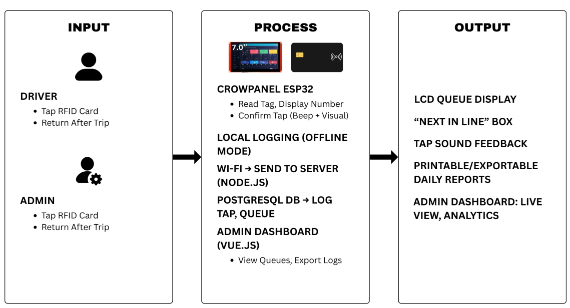

Figure 1.0 Conceptual Framework

System Overview

The TagSakay system is designed to improve the way tricycle queues are managed in Barangay Communal, Davao City, by replacing manual processes with a low-cost, automated RFID-based solution. The system provides a reliable and transparent way to track driver turns, reduce disputes, and support local transport officers in managing terminal operations more efficiently. Its architecture is divided into three main components: Input, Process, and Output, each working together to transform RFID taps into real-time queue data and administrative reports.

Input

The system starts when tricycle drivers tap their RFID cards on the tap station upon arriving at the terminal. Each card is assigned to a specific driver and acts as a digital signature to mark their presence in the queue. A manual keypad is also included, allowing the terminal administrator to override the system if a card is lost, a tap is missed, or if the queue needs adjustment. These two input methods help ensure accurate and flexible recording of queue entries.

Process

Once a driver taps their card, the CrowPanel ESP32-S3 reads the RFID tag and immediately displays the driver's number on the terminal screen. It also plays a confirmation beep for audio feedback. If the internet is temporarily unavailable, the data is stored locally in memory. When connected, the data is sent via Wi-Fi or mobile hotspot to a Node.js server, which handles the processing and saves the information into a PostgreSQL database. The system also powers a Vue.js-based web dashboard, where staff can view live queue activity, generate logs, and access real-time statistics. This flow ensures that both live and historical data are accurate, consistent, and easy to manage.

Output

The final part of the system delivers real-time and historical queue information through various interfaces. A live queue display on the terminal shows the current list of drivers, including those who have tapped in and who is next in line. Audio feedback confirms each tap to drivers without needing to look at the screen. On the staff side, the admin dashboard provides access to detailed reports, tap logs, and system controls. These outputs make it easy to monitor activity, resolve disputes, and ensure fairness in driver rotations.

IV - METHODOLOGY/PROJECT DESIGN

4.1 Research Method

This study employs a developmental research methodology with field testing and evaluation components to design, develop, and implement the TagSakay RFID-based tapping system for monitoring tricycle queue rotations in Barangay Communal, Davao City. The developmental approach is appropriate for this capstone project as it focuses on creating a novel technological solution that addresses specific transportation management challenges while contributing to the existing body of knowledge in IoT-based public transportation systems and community-level digital governance.

The research methodology integrates both quantitative and qualitative approaches to ensure comprehensive evaluation of the system's technical performance, operational efficiency, and community acceptance. The quantitative component involves systematic testing of RFID reading accuracy, data transmission reliability, queue processing speed, and system uptime metrics. The qualitative component encompasses user feedback collection from tricycle drivers, usability assessment by terminal administrators, and stakeholder evaluation of the system's effectiveness in reducing queue disputes and improving operational transparency in real-world community transportation scenarios.

4.2 Tools, Programming Languages, Platforms, and Devices

4.2.1 CrowPanel 7.0" ESP32-S3 Display

The CrowPanel is a 7.0-inch RGB TFT LCD touchscreen integrated with an ESP32-S3-WROOM-1 microcontroller, designed for rapid HMI development. It supports display and control in a single board, featuring built-in USB-C power, GPIO headers, and support for LVGL (Light and Versatile Graphics Library).

The researchers chose the CrowPanel due to its large visual display, native ESP32 processing capabilities, built-in speaker support, and direct GPIO pin access. These features made it ideal for showing live queue rotations, capturing RFID taps, and running all front-end logic locally at the terminal without needing external microcontrollers or displays.

4.2.2 PN532 RFID Reader

The PN532 is a widely used NFC module that supports ISO14443 Type A/B cards and communicates via I2C, UART, or SPI. It was selected for its compatibility with ESP32, ease of integration, and wide availability in the local market.

This reader serves as the main mechanism for tricycle drivers to "tap in" their rotation. Each tap logs their presence and queues them digitally. The researchers configured the module in I2C mode for fewer wiring requirements and reliable communication.

4.2.3 4x4 Matrix Keypad

The keypad was chosen due to its low cost, easy GPIO mapping, and compatibility with standard Arduino and ESP32 libraries. It provides redundancy and control during times when RFID taps may fail or need manual adjustment.

4.2.4 Integrated Speaker (SPK Port)

The speaker connected via the dedicated SPK port on the CrowPanel provides real-time audio feedback. It plays short tones or beeps to confirm RFID taps, queue updates, or errors like invalid cards.

Audio alerts improve usability and awareness in a noisy terminal environment and ensure drivers receive confirmation without needing to check the screen.

4.2.5 Power Bank (5V/3A)

A high-capacity USB-C power bank was chosen to power the entire system due to the absence of a stable power source at the terminal. It supplies 5V power to the CrowPanel and all peripherals reliably.

The portability and charging capability of the power bank make it a practical solution for barangay-level deployments in open-air terminals or areas with intermittent electricity.

4.2.6 Vue.js

Vue.js is a progressive JavaScript framework for building modern user interfaces. The research team selected Vue.js for the administrative dashboard due to its reactive data-binding system, lightweight architecture, and seamless integration with APIs and charting libraries.

Vue.js powers the TagSakay dashboard, allowing admins and superadmins to view real-time queue data, generate reports, and manage terminal activity efficiently.

4.2.7 Node.js + Express.js

Node.js is a server-side JavaScript runtime that allows fast and scalable network applications, while Express.js is a minimalist web application framework built on Node.

The backend of TagSakay uses Node.js and Express to handle REST API requests, manage incoming RFID data from the terminal, process reports, and maintain communication between the database and the web dashboard. This stack was selected for its performance, flexibility, and community support.

4.2.8 PostgreSQL

PostgreSQL is a powerful open-source relational database known for its reliability and feature set. It stores tap records, driver profiles, queue data, and report logs.

The researchers selected PostgreSQL because of its ability to handle structured data, support for timestamps and relational keys, and seamless integration with Node.js applications.

4.2.9 LVGL (Light and Versatile Graphics Library)

LVGL is a graphics library for embedded systems used to create smooth and interactive UIs on low-resource devices like the ESP32. It was used to design the CrowPanel’s tab-in display interface with queue columns, edit buttons, and “Next in Line” indicators.

4.2.10 Visual Studio Code

Visual Studio Code (VS Code) served as the primary Integrated Development Environment (IDE) for the development of the TagSakay system. VS Code is a lightweight yet powerful source code editor developed by Microsoft, offering built-in support for JavaScript, Node.js, and other web technologies essential to TagSakay’s architecture. The IDE features IntelliSense code completion, integrated Git version control, and advanced debugging tools, which would allow developers to streamline backend development in Node.js and real-time frontend updates using Vue.js.

VS Code’s extension marketplace was leveraged to install essential plugins, including Prettier for code formatting, ESLint for JavaScript linting, and PlatformIO for embedded system development. Terminal integration within the IDE enabled direct communication with ESP32 hardware, allowing seamless testing, deployment, and monitoring of RFID functions and serial outputs. These capabilities made VS Code a versatile environment for both hardware interfacing and software development components of TagSakay.

4.2.11 Figma

Figma was utilized as the primary platform for user interface (UI) and user experience (UX) design throughout the development of the TagSakay system. Figma is a collaborative, browser-based design tool widely used for wireframing, prototyping, and layout design. It enabled the team to visually draft the queue display screens, admin dashboard, and mobile-responsive interfaces based on real-world usage scenarios in Barangay Communal.

The collaborative nature of Figma allowed direct stakeholder involvement—including feedback from tricycle drivers, barangay staff, and association leaders—during the design stage. This ensured that the interface was intuitive, readable in outdoor terminal settings, and aligned with the actual workflow of the terminal. Components were organized into a design system to maintain consistent visual identity across all screens. Figma’s seamless export features also simplified asset integration into the Vue.js development workflow, reducing frontend development time and ensuring visual fidelity between design and implementation.

4.3 Project Development Lifecycle

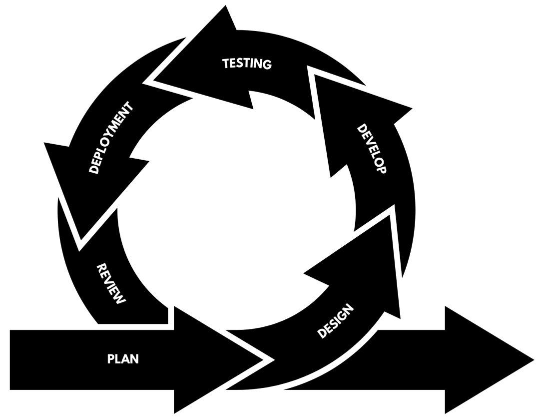

Figure 1.1 Modified Agile Development Cycle

This project follows the Modified Agile methodology to ensure flexible development while accommodating both hardware constraints and evolving stakeholder needs. Modified Agile allows the researchers to gradually build each component of the system—such as RFID tapping, queue rotation display, and the web dashboard—while incorporating frequent feedback from tricycle drivers, the association president, and barangay officials.

Under this approach, the researchers follow a continuous cycle of planning, designing, developing, testing, and refining. Each phase focuses on one functional component, and improvements are made based on feedback before proceeding to the next. Unlike pure Agile, this method considers the physical realities of hardware testing, limited resources, and power limitations at the tricycle terminal, making it more adaptive and practical for real-world field deployment.

The researchers chose Modified Agile because it supports real-time adjustments and validation from actual users on-site. The iterative process helps ensure that each functionality of the TagSakay system—whether for tapping, displaying, or reporting—aligns with the community’s needs and expectations.

Through consistent collaboration with stakeholders and consultants, the system is developed smoothly and is more likely to be accepted, functional, and sustainable at the barangay level.

4.4 Target Users and Participants

The primary target user group for the TagSakay system is the tricycle driver community and administrative personnel operating under the CATICOMODA Route A-29-A terminal in Barangay Communal, Davao City. These individuals are the key stakeholders who will utilize the system for real-time queue logging, transport coordination, and operational monitoring. By focusing on a specific community with clear transport needs, TagSakay aims to deliver a solution that is practical, locally relevant, and aligned with grassroots mobility improvement goals.

Primary users include:

- **Registered Tricycle Drivers** who serve as the main participants in the system. Each driver will receive a unique RFID card that they must tap upon arrival at the terminal. These taps serve as digital records of queue position, helping drivers ensure their rightful turn in the rotation while minimizing disputes and confusion in high-traffic hours.
- **Administrative Officers and Barangay Staff** who access the backend dashboard to generate reports, audit trip records, and ensure system integrity. They play a critical role in using historical queue data for planning, transparency, and evaluating terminal performance.

The system's focus on the CATICOMODA terminal in Barangay Communal enables user-centered development that directly addresses the operational needs and challenges faced by this transport sector. This localized approach ensures relevance, encourages stakeholder buy-in, and supports smoother implementation and iteration.

V - PROPOSED SYSTEM

Project Overview

The TagSakay system is created to make the tricycle queueing process in Barangay Communal easier, fairer, and more organized. Right now, many terminals still rely on chalkboards, notebooks, or memory to track which driver goes next. This often causes confusion and disagreements among drivers.

To solve this, TagSakay uses RFID cards to help drivers "tap in" when they arrive at the terminal. The system then updates the queue automatically and shows who's next on a screen that everyone can see. This removes the guesswork and reduces arguments. At the same time, barangay staff can use a computer dashboard to check who tapped, create reports, and make sure everything is running smoothly.

What makes TagSakay special is that it's **low-cost, easy to use,** and works even in areas with limited power or internet. It's designed for small communities that want to modernize without needing expensive technology. With this system, drivers get a fair turn, staff get accurate records, and everyone benefits from a more organized setup.

Prototype - Figma

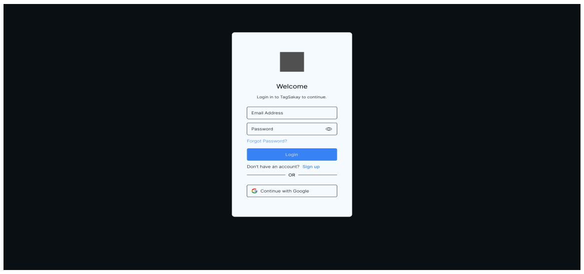

Figure 1.2 Login Interface (User & Admin)

Figure 1.3 User Homepage

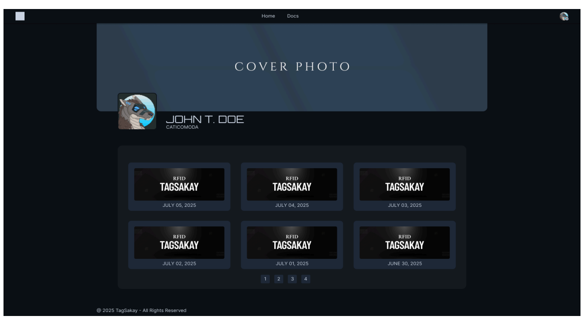

Figure 1.4 User Profile Screen

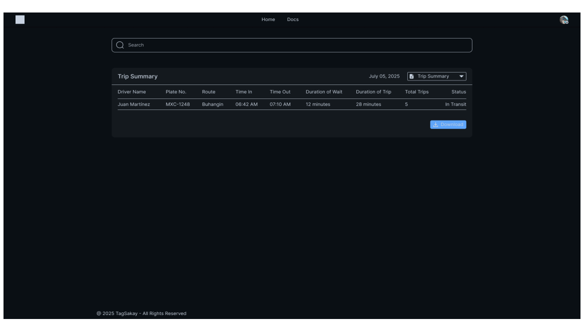

Figure 1.5 User Report View

Figure 1.6 Admin Dashboard Overview

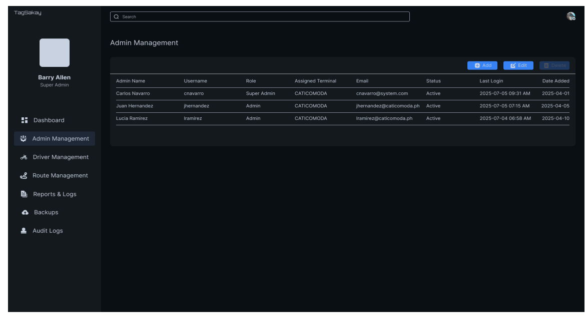

Figure 1.7 Admin Management Interface

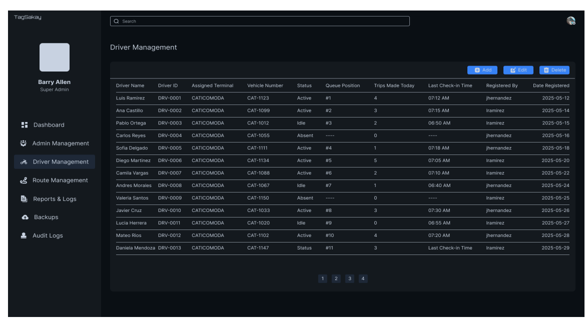

Figure 1.8 Driver Management Page

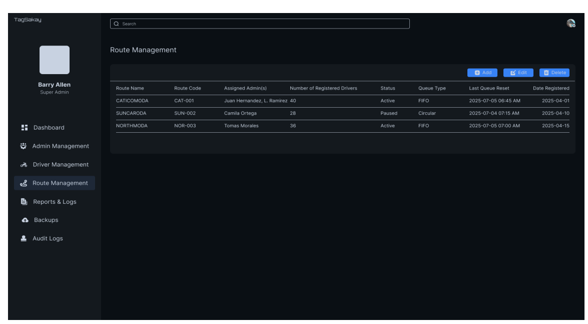

Figure 1.9 Route Management Interface

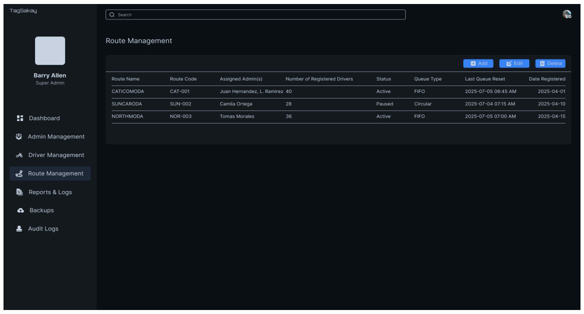

Figure 1.10 Reports and Logs Viewer

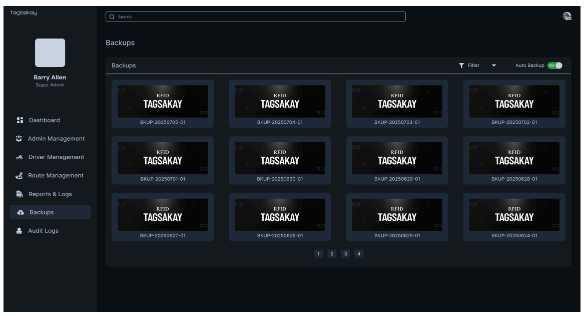

Figure 1.11 System Backups Interface

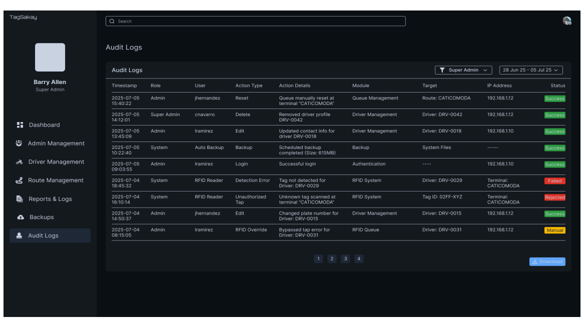

Figure 1.12 Audit Logs Page

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