

IMPLEMENTATION OF RFID-BASED AUTOMATED PARKING MANAGEMENT SYSTEM: A FEASIBILITY STUDY

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ABSTRACT

The difficulties of finding a parking spot in any business area are well-known to drivers. Parking tends to put them behind schedule owing to inefficient parking systems, making it much longer due to lost tickets, slow payment procedures, and insufficient parking information. To help lessen the delays caused by these problems, the researchers intend to integrate a technology-based solution in the three important parking procedures — the car entry and exit, the payment mechanism, and the location of parking slots — to significantly reduce the time spent handling these processes, with a particular emphasis on the management system's ability to improve the parking experience. This study, titled Implementation of RFID-based Automated Parking Management System: A Project Feasibility, seeks to determine the feasibility of an RFID-based parking management system at Victory Mall and Market in Tanauan City, Batangas as its initial client. The project consists of two parts: (1) the system itself as the product and (2) the service that it will provide, featured by its cashless, contactless, and paperless transactions, making the overall service effective and efficient. The researchers conclude that the project is attainable, anticipating an initial service capacity of 929,888.07 parking hours with a 5% annual increase that will result in an average gross profit ratio of 68% per year. It is expected to have a three-year payback period for the total investments of its shareholders amounting to PHP 15,000,000.00. The assumed start of operation where the company caters to its first client is in June 2023.

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I. INTRODUCTION

Attributed to the growing urbanization and rising population density in cities, the demand for mobility solutions has escalated. As the standard of living continues to rise, an enormous proportion of individuals and businesses purchase new automobiles. It has boosted the necessity of effective parking lot management systems in an establishment to provide a hassle-free customer experience and prevent squandering money and resources. This circumstance inevitably necessitates enhanced parking lot management systems capable of addressing problems while streamlining operations. In connection, car parking is a significant issue in today's densely populated cities owing to the rising number of individuals who own automobiles each year, damaging the Philippines' parking system [1]. Parking or seeking a parking spot has become as aggravating and frustrating as driving our clogged roads.

Furthermore, the report stated that around 79 million automobiles were sold globally in 2018 [2]. As these vehicles become more prevalent on the road, there is a rising need for parking lots controlled by modern technology. Based on the International Parking and Mobility Institute,

various developments in this market have emerged due to technical improvements and changing customer behavior. The most significant is the rising application of electronics, more dependence on guiding systems, and enhanced access and payment options in the parking industry [3].

In venturing into the automated parking lot systems domain, researchers determined the factors contributing to the need for automated solutions in a survey. Manual ticketing systems consume time resulting in increased expenses and turnaround times. Also, users often lose manual tickets, necessitating a higher penalty. Finding a parking space takes significant time, and being unaware that it is full is frequently challenging and frustrating for consumers. Manual payment upon departing is lengthy and leads to delays. In completing research on automated parking management systems, frequent parking difficulties may be resolved.

The researchers intend to develop the RFID - based parking system to streamline the parking procedure and resolve parking problems. Radio Frequency Identification (RFID) is a technology that belongs to the Automatic Identification and Data Capture (AIDC) category. AIDC techniques recognize things, gather data about them, and

instantly feed that data into electronic systems with little or no human interaction through radio waves. The study [4] revealed that RFID technology applied to Intelligent Transportation Systems (ITS) is essential for monitoring traffic flow and controlling parking systems. RFID permits the saving and retrieval of data wirelessly and automatically. It offers a substantial advance over traditional identification, tracking, and storage of objects. RFID is anticipated to enhance parking lot security and reduce instances of theft and counterfeiting [5]. In addition, [6] assert that RFID is the essential technology for allowing wireless data transfers across networks. Even though this technology has been accessible for quite some time, current standardization and affordability have substantially increased its application. Any industry using RFID tags has observed a significant boost in both performance and efficiency. RFID, which has been used extensively in tracking, monitoring, and parking systems, meets its most extensive and essential application in automation. It is developed using RFID readers, RFID sensors, and RFID controllers. However, according to [7], the high cost of RFID makes it undesirable for certain uses. Radio waves are affected by metal, water, and electromagnetic interference; thus, it is impossible to ensure that every tag will be read every time.

The adoption of RFID technology significantly lowers human labor and error. It is the reason that the RFID - based intelligent parking management system has been presented to address parking management challenges. Furthermore, this study aims to highlight to the consumers that the business's operators are conscious of all aspects of their operations and care about their satisfaction. Since commercial centers and shopping areas require parking lots that are convenient and comfortable for their customers. The systems integrator will assess end-users unique requirements through a survey questionnaire to give a hassle-free solution.

The research focuses on an intelligent parking management system that simplifies the process of tagging a car by recognizing the user and deducting the adequate amount from his account. RFID scanners access the data about the vehicle and its linked account as it approaches the gate barrier at the parking lot's entry. The LCD screen will then present details about the available parking space, and the boom barrier will raise to let the vehicle pass by and choose the most convenient parking place. When the customer wants to depart the parking lot, he will approach the exit gate, where the RFID will be read once again to calculate the amount of time the user spent concerning the cost of parking. This information is provided on the driver's left-side screen and the driver's remaining account balance, and the driver is now permitted to exit the area.

This system enables both parties to monitor and make timely payments easily. It saves time and money by lowering administrative costs and adopting a paperless system, as mandated by Republic Act No. 8792, known as the

Electronic Commerce Act of 2000 [8]. Additionally, ticket clogging concerns that result in cars waiting for ticket handling will be solved. Entrance and exit will occur more promptly, without requiring cars to be delayed.

Customers may go cashless, streamlining the payment process by calculating the amount of time elapsed. In line with this, it encourages compliance with health requirements such as physical distance by limiting human intervention, lowering traffic bottlenecks, and alleviating parking lot congestion, all of which contribute to the public's protection against the infectious coronavirus disease 2019. (COVID-19). Thus, clients will be more inclined to return to the establishment if they know that the parking management system will operate efficiently, allowing them to maximize their free time.

In conclusion, the researchers intend to implement an RFID - based Automated Parking Management System as an effective approach to addressing prevalent parking issues accomplished by IR sensors that designate each accessible space and RFID technology that enables cashless transactions.

II. RESEARCH METHOD

A. Sources of data

In this study, the researchers collected data through a questionnaire using a Google Form, which served as the primary data source for achieving the research ventures regarding market acceptability as the main objective. The data will be thoroughly processed, categorized, and structured methodically in line with the specific points stated in the statistical tools. Five aspects are the emphasis of the questions. (1) the respondent's profile, (2) parking histories (such as parking visits and hours, ratings on the ticketing and payment system, satisfaction in locating a spot, and type of parking management system experience), (3) parking challenges (including misplaced tickets, difficulty in locating a slot, inadequate parking information, and lengthy payment process), (4) features of proposed service, and (5) consumer acceptability.

Slovin's Formula will be used to identify the optimal sample size for this research study. After determining the population's sample size, researchers will employ Stratified Random Sampling, a technique for classifying the entire population into homogeneous groups.

B. Computation of the sample size to be surveyed

The population involved in this study comprises Tanauan City, Batangas' residents who own vehicles. Researchers will employ Stratified Random Sampling, a technique for classifying the entire population into homogeneous groups and ensuring that the sample size is equally distributed.

Table I, entitled "Tanauan City's Registered Vehicle Owners" represents the total number of registered vehicle owners from 2016 to 2020, which the researchers utilized to determine the sample size of three hundred eighty-two (382) individuals. The selected respondents possess the ability to respond to the survey questions based on their personal experiences and will be informed on the benefits of implementing an RFID-Based Automated Parking Management System.

TABLE I

TANAUAN CITY'S REGISTERED VEHICLE OWNERS	
YEAR	POPULATION
2016	5567
2017	6326
2018	7654
2019	7806
2020	8523

Source: Freedom of Information (FOI) [9]

C. Sample size

Using the population, the company decided to have a 95 percent level of confidence, which meant that they have a 5% margin of error. This study's sample size will be determined using Slovin's Formula. Following the calculations of sample size, researchers will use Stratified Random Sampling to classify populations into homogenous groups to equally dispersed population size.

Slovin's Formula: This tool was used to determine the ideal sample size of the population.

Formula:

$$n = \frac{N}{1 + Ne^2} \tag{1}$$

Where: n = Sample size; N = Population;
e = Margin of error (5%)

$$n = \frac{8523}{1 + 8523(0.05)^2}$$

$$n = 382.07 \approx 382 \text{ respondents}$$

The method of treatment in the collection of data is stratified because the researchers believed that this would result in the generation of unbiased and valuable information for the study. The table below exhibits the strata per barangay of Tanauan City.

D. Research instrument

The survey questionnaire is designed to obtain data on respondents' parking background, challenges, perception of RFID-based Automated Parking Management System along with their acceptability to its implementation.

E. Analysis of research data

This feasibility study describes the research data gathered in a descriptive analysis using the mean, frequency and percentage distribution, and standard deviation to summarize the characteristics of the sample and extract insights from it.

1. Frequency and percentage distribution, mean

Formulas:

Frequency and percentage distribution

$$\frac{\text{Total Respondents per Category}}{\text{Total Respondents}} \tag{2}$$

Mean

$$\frac{\text{Sum of the terms}}{\text{Number of terms}} \tag{3}$$

2. Method of projection

Finding the appropriate projection method is determined in two ways: (1) mathematical computations of standard deviation, wherein the smallest value is the most likely to give a reliable forecast; and (2) visual representation of historical data to analyze the trend and behavior it follows.

Based on the researcher's analysis of the data, the standard deviations obtained indicate that the statistical parabolic curve method is considered to be the most favorable since it yields the lowest standard deviation value. However, assessing the historical data graph, which illustrates that the change in the figure is constant, but the percentage decreases every year, implies that its behavior is inconsistently increasing, and this is indicative of a statistical straight-line. It was emphasized by [10], if the method with the lowest standard deviation proves to be unrealistic, the next smallest standard deviation should be preferred. Thus, the researcher utilized a statistical straight-line approach to forecast demand and supply for the next five years since it yielded the second-lowest standard deviations, and the graph's trend and behavior clearly demonstrate the historical data is inconsistently increasing. This is essential for the researchers to project the demand and supply appropriately.

Demand and supply determined price and quantity. It maximizes the effectiveness of business decisions to make customers happy and sellers profitable.

Formula: Statistical Straight-Line

$$Y = ax + b \tag{4}$$

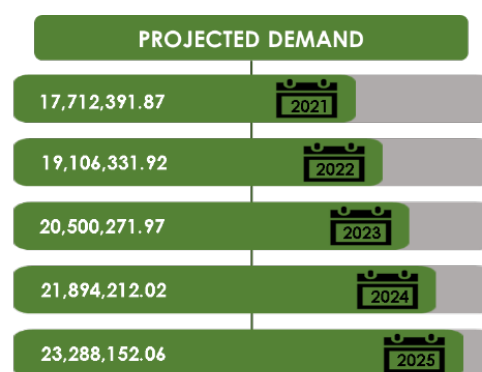


Figure 1 Graph of Projected Demand

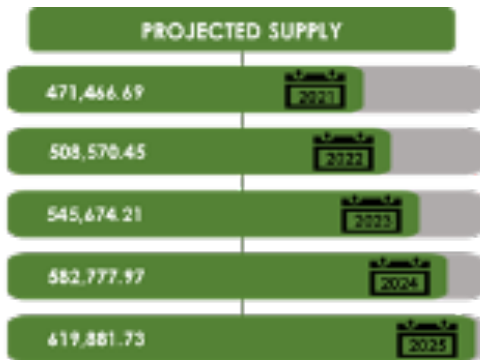


Figure 2 Graph of Projected Supply

In Figures 1 and 2, there's a 97.34 percent of projected demand and supply that is unsatisfied. This suggests that there is significant demand for the next five years that the researchers' suggested automated parking management system seeks to meet. The unsatisfied demand has an increasing average of 7.08% annually.

III. RESULT AND DISCUSSION

A. Marketing aspect

Automated parking management systems are a way of facilitating that unsatisfied demand while also assisting in the resolution of critical parking issues encountered by the clients in terms of car entry and exit, payment mechanisms, and the location of the available parking slots – all are necessary to streamline the parking processes to be able to offer comfortable parking experience. To demonstrate the significant demand and supply, a survey was administered in Tanauan City in a stratified manner. The method of treatment in the collection of data is stratified because the researchers believed that this would result in the generation of unbiased and valuable information for the study.

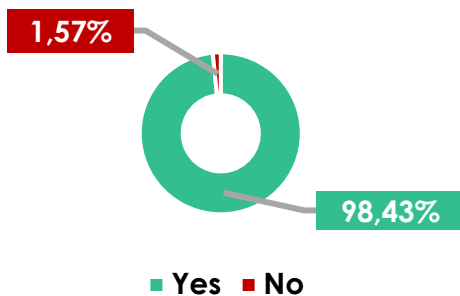


Figure 3 Acceptability on Automated Parking Management System

The Figure 3 above shows, 98.43% accepted the possible implementation of RFID-based Automated Parking Management System. Only 1.57% do not accept the upgrade for traditional parking.

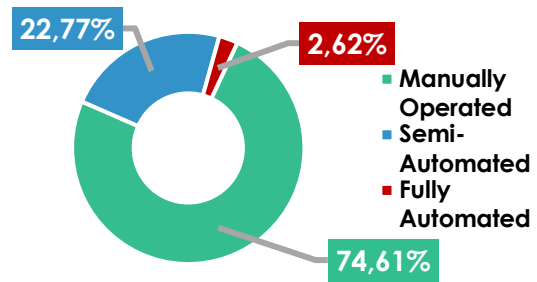


Figure 4 Types of Parking Management System

Based on Figure 4, only 2.62% of respondents are familiar with fully automated parking systems. While almost 75% of 382 respondents are aware of and have personal experience with manually operated parking systems, both in terms of payment and slot location.

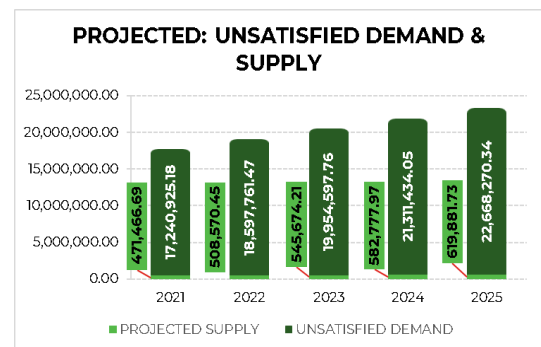


Figure 5 Graph of Projected: Unsatisfied Demand and Supply

The Figure 5 above indicates that 97.34 percent of predicted demand is unsatisfied. This suggests that there is significant demand for the next five years that the researchers suggested automated parking management system seeks to meet. The unsatisfied demand has an increasing average of 7.08% annually.

It was claimed by [11] that car parks are a significant cost to society, as are parking conflicts. Such issues are frequently defined in terms of both supply and demand; too few spaces are available, and facilities are inefficiently used and should be better managed.

The table II below used a statistical straight line to determine the projected demand for parking hours-visits over the next five years since the data gathered by the researcher reflected its trend of inconsistently increasing.

In addition, the unsatisfied demand illustrated in Figure 5 is used to calculate the service capacity under the assumption that, as an introduction company, the desired service rate must be set at 5 percent, growing at a rate of 0.10 percent per year while accounting for the yearly parking hours-visits.

This culminates in calculating the market share for the subsequent five years by dividing the service capacity by the projected demand. In which the market share demonstrates an annual growth rate of 10%. While the average annual increase in predicted sales is 18.18 percent, the projected market share of the firm gives the resources necessary to influence the company's income and sales.

TABLE II
MARKET SHARE

YEAR	PROJECTED DEMAND	SERVICE CAPACITY	MARKET SHARE
2021	17,712,391.87	-	-
2022	19,106,331.92	929,888.07	4.87%
2023	20,500,271.97	1,017,684.49	4.96%
2024	21,894,212.02	1,108,194.57	5.06%
2025	23,288,152.06	1,201,418.33	5.16%
2026	24,682,092.11	1,297,355.76	5.26%

*The year 2021 is part of the organization's preparatory stages as suggested by the project schedule.

The calculation of market share takes consumer choice for the provided product or service into consideration. Primarily, a larger market share brings in more revenues, less work required to sell more, and a strong barrier to entry for potential competitors. In Table II, these attributes indicate that the company's market entrance is competitive [12].

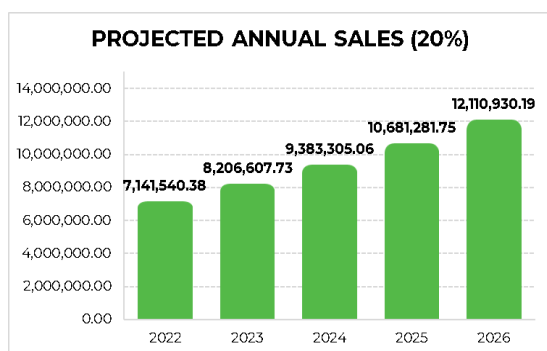


Figure 6 Graph of Projected Annual Sales

The Figure 6 above depicts projected sales growth over the next five years, with an average annual growth of 14.12 percent in projected sales, based on its estimated market share, which provides the resources necessary to affect revenue and sales.

B. Technical aspect

This aspect encompasses the process, capacity, and design of the plant, including the location, layout, and requirements for the building and structural components with its raw materials and suppliers. It entails assessing the entire cost of the project and specifying the primary components of capital costs. I-Wise PH offers EZ Park, a parking management system that uses RFID to automate parking lot entrance and exit gates and classify available parking spaces, reducing traffic congestion and time spent looking for parking. It was shown in the study [13] that the initiative of an Intelligent Transportation System (ITS) links

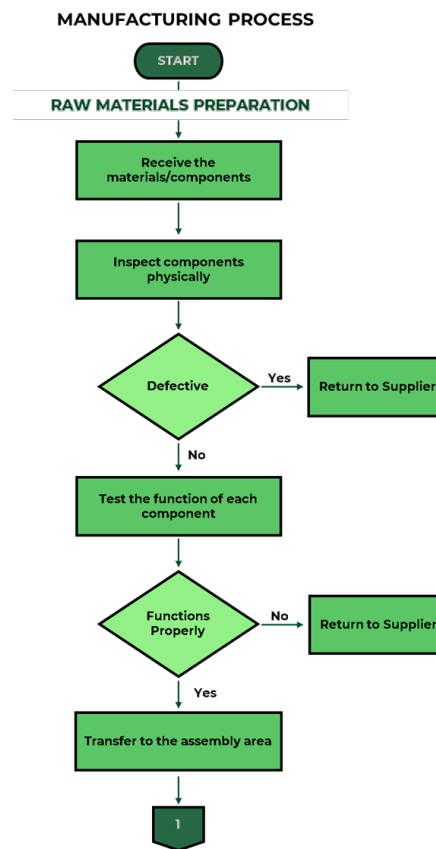
to smart technology, such as RFID technology, to boost drivers' and customers' comfort and convenience while simultaneously increasing the standard of living. Thus, I-Wise PH produces, develops, and designs products that use RFID technology.

Inspired by the country's expressways, this system will feature automated gate barriers with RFID tags for cashless and contactless fee collection, and infrared sensors to inform drivers of parking space availability. In order for the mechanical aspects of the system to work properly, programming technology must be included, as it is the product's core component. Additionally, hardware components such as a radio frequency identification reader, an infrared sensor, a liquid crystal display screen, Arduino Mega, Servo Motor, and a boom/gate barrier are required for setting up the system. The RFID automated parking management system is developed in the following manner: preparation of raw materials, programming and coding, hardware assembly, software and hardware integration, deployment, and preventive maintenance. It will take 120 days to complete this manufacturing process.

1) Project process

The project process encompasses the product's manufacturing phases and the service process that this product delivers to its customers. This part will be accompanied with process flow chart, a description of the processes and a detailed process flow charts based on operators' analysis point of perspective.

I. Manufacturing process



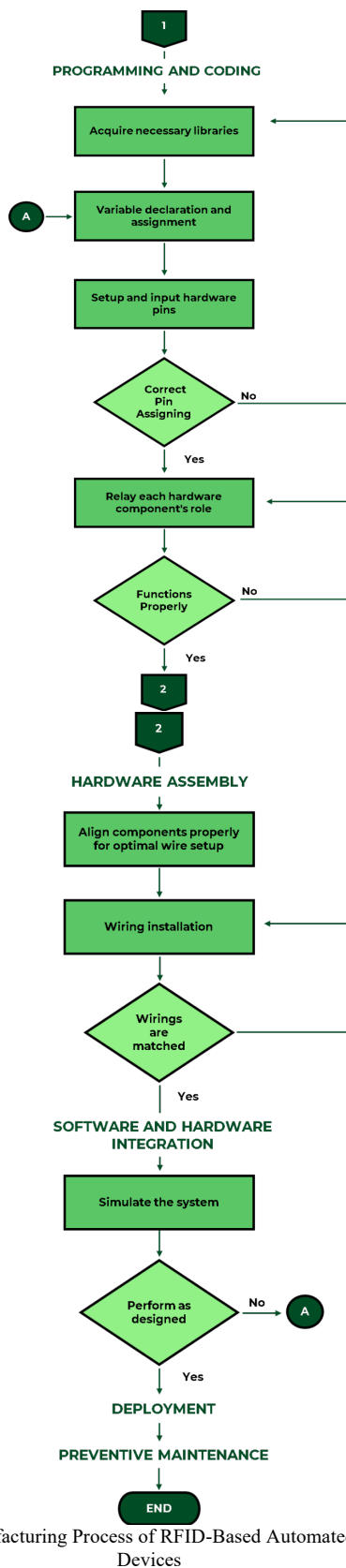


Figure 7 Manufacturing Process of RFID-Based Automated Parking Devices

The Figure 7 above shows the RFID automated parking management system is developed in the following manner:

- 1) Raw Materials Preparation
 - a) Receive the materials/components.
 - b) Do a physical inspection of components.
 - c) Test and verify the workability of each component.
 - d) Transfer to the storage area and/or assembly area.
- 2) Raw Materials Preparation
 - a) Receive the materials/components.
 - b) Do a physical inspection of components.
 - c) Test and verify the workability of each component.
 - d) Transfer to the storage area and/or assembly area.
- 3) Programming and Coding
 - a) Acquire necessary libraries (pre-written code to a certain model of component) to create dependencies.
 - b) Variable declaration and assignment of each component to the microcontroller.
 - c) Set up and input the hardware components pins.
 - d) Relay the role of each hardware component.
 - e) Establish functions of the following:
 - e.1 LCD – displaying the availability of slots, RFID balance, minimum parking fee.
 - e.2 IR sensors – detecting the cars in entry and exit, and slots. Moreover, it iterates the car's duration to calculate parking time in a database.
 - e.3 RFID Scanner – checking and deducting balance.
 - e.4 Servo Motor – facilitating automatic boom barrier response.
- 4) Hardware Assembly
 - a) Establish proper placement of components for optimal wiring setup.
 - b) Wiring installation.
- 5) Software and Hardware Integration
 - a) Simulate the system
- 6) Deployment
- 7) Preventive Maintenance

II. Service process

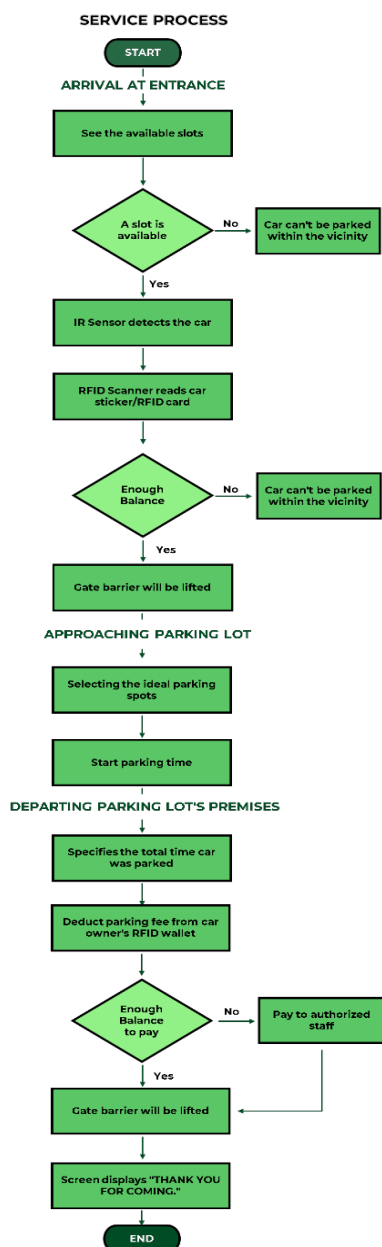


Figure 8 Service Mechanism of RFID-Based Automated Parking Devices

The Figure 8 above is the parking system in operation at the point of entry and exit.

- 1) Arrival of a Car at the Entrance
 - a) See the available slots on the screen.
 - b) The IR sensor detects the presence of the car.
 - c) RFID scanner either detect the vehicle's sticker or can be tapped using RFID card.
 - d) The gate barrier will be lifted.
- 2) A Car Approaching the Parking Lot Perimeter
 - a) Selecting the best available parking spaces based on the information displayed on the entry screen.

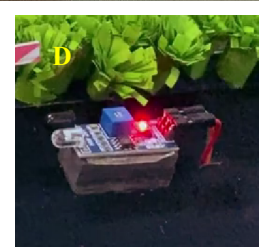
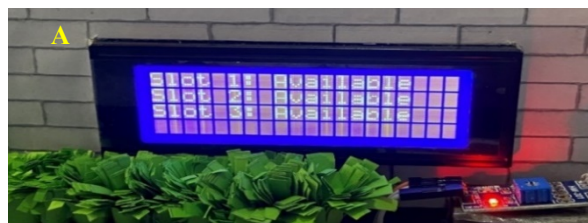
- b) Once the car is parked in the optimal spot, the IR sensor begins iterating the car's duration to compute parking time.

- 3) A Car Departing the Parking Lot's Premises
 - a) The IR sensor identifies the car's RFID tags and instantly shows the total time the car was in the vicinity and the amount owing by the vehicle owner on the screen.
 - b) RFID scanner either detect the vehicle's sticker or can be tapped using RFID card to deduct the specified amount from the RFID wallet of the car owner.
 - c) The gate barrier will be lifted.
 - d) On the screen, there will be a sign that states, "Thank you for coming."

2) Project model

This section will showcase the project's elements through its prototype model; each of these elements play a big role to construct the EZ Park Parking System. Additionally, the prototype model will help visualize the appearance of the actual project to be done in the future. Below are the elements that compose the EZ Park Parking System.

I. Elements that compose the EZ park parking system



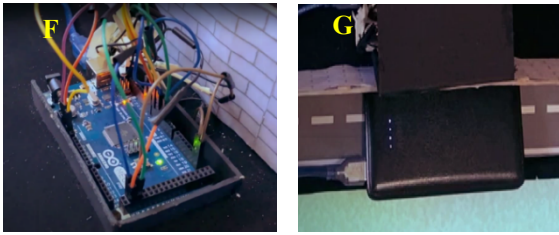


Figure 9 Elements of EZ Park Parking System: (A) LCD Screen, (B) RFID Technology, (C) RFID Tag, (D) IR Sensors, (E) Servo Motor, (F) Arduino Mega, and (G) Power Bank/Power Supply

The elements of EZ Park parking system can be shown in the Figure 9. Starting with the prototype's LCD screen is used to display real-time information about available and occupied parking spaces. Additionally, it displays the customer's RFID balance before to allowing access to the parking lot. On the prototype, RFID technology is utilized for the customers' payment mechanism, just as it is in the actual project. As outlined, if the customer lacked the necessary balance, they would be unable to pass over the barrier and access the parking lot. Before the customer passes through another barrier at the parking lot's departure point, the system will automatically deduct the amount used from their RFID balance. The Servo Motor was employed to simulate the motion of a boom barrier's 90-degree rotation and, with the assistance of certain DIY art, was used as a boom barrier prototype. Infrared (IR) sensors are electrical devices that detect and quantify infrared radiation in the context. It was conducted to identify which parking spaces in the lot were occupied and which were vacant. The Arduino Mega is a microcontroller board that functions as the system's brain. It is here where the program is uploaded and where each wire connecting the entire system is installed. The power bank acts as the system's power supply, providing the Arduino Mega with the power it requires to operate, therefore enabling the other system components to operate as well.

II. Project prototype perspectives



Figure 10 Different Perspectives of the Prototype: (A) Top View, (B) Front View, (C) Back View, (D) Perspective (1), and (E) Perspective (2)

The project prototype was created to demonstrate the possibility of deploying an RFID-based Automated Parking Management System in a smaller scale as presented in the Figure 10 above to prove that it is achievable and attainable in reality. Researchers are encouraged to pursue this study

in a certain manner as [14] proved that the development of a prototype system detects vehicles through the use of proximity sensors. This parking system facilitate the process of finding available parking and serve as a tool for tracking transportation trends.

C. Financial aspect

The capital needed by the company will be provided by the shareholders; each will contribute the amount of PHP 2,500,000.00. The payback period to regain the invested capital is 3 years. The company has an Accounting Rate of Return of 41.60% and an average Income Increase Rate of 270.17%, due to the yearly increase of accepted number of projects. As time goes by, I-Wise PH will be known in the parking industry in which it can leads to generate more clients that will adopt the system. This means that the company will gain a continuous increase of sales on its revenue based on its accepted project.

The financial ratios for the next five years are the following: net income, cash flow, current ratio, gross margin ratio, return on asset, return on sales, and debt ratio, all indicating good figures for the business performance in the face of competition and unfavorable economic conditions.

As illustrated in the Table III below, the company's net income increased year after year as it acquired more clients. On average, it obtains three clients each year, from whom it earns revenue in two ways: (1) rental income and (2) a 20% parking commission, resulting in a positive cash flow from operating operations less expenses incurred.

Current ratio numbers suggest that the company can cover its current liabilities, which is backed up by the debt ratio, which indicates a strong capital basis due to the company being financed mostly via shareholder capital rather than borrowings. Gross margin ratio, return on asset, and return on sales all demonstrate the organization's financial health in terms of long-term net income. As a result, it is likely to attract further investors.

TABLE III
SUMMARY OF FINANCIAL RATIOS

YEAR	2022	2023	2024	2025	2026
NET INCOME	-3,140,826	1,119,770	13,143,784	26,279,356	37,477,073
CASH FLOW	-2,955,395	-2,978,769	7,543,831	21,090,550	33,319,773
CURRENT RATIO	135.57	31.06	96.62	235.41	425.86
GROSS MARGIN RATIO	—	70.05%	66.66%	67.70%	68.12%
RETURN ON ASSET	-26.45%	8.56%	50.20%	50.13%	41.71%
RETURN ON SALES	—	15.51%	53.34%	60.09%	62.46%

1) Initial capital requirements

Loan financiers find it difficult to loan businesspersons who are only starting. Thus, the Table IV below shows the primary source of financing is the capital invested by the shareholders. The six shareholders acquire an equal number of stocks amounting to ₱ 2,500,000.00. Outstanding Shares were valued at ₱ 10.00 per share.

TABLE IV
SOURCES OF FINANCING

SOURCES OF FINANCING			
List of Shareholders		Invested Amount	# Of Shares
Dichoso, Win Lester S.	₱	2,500,000.00	250,000.00
Erlano, Shaina P.		2,500,000.00	250,000.00
Gonzaga, Marianne		2,500,000.00	250,000.00
Guevarra, Katreen K.		2,500,000.00	250,000.00
Lasam, Shaira Grace S.		2,500,000.00	250,000.00
Ronquillo, Nicole Lyka E.		2,500,000.00	250,000.00

2) Project cost

I-WISE PH, INC. PROJECT COST			
Acquisition of Property Plant and Equipment			
Land	₱	600,250	
Building		4,935,700	
Machineries and Equipment-Production		24,381	
Office Machineries and General Equipment		616,202	6,176,533
Pre-Operating Expenses			
Organizational Cost		22,108	
Other Pre-Operating Expenses		49,347	71,455
Working Capital			
<i>Manufacturing Cost (1 Project)</i>			
Direct Materials	₱	343,427	
Direct Labor		998,643	
Indirect Labor		141,595	
Electricity Expense		30,789	
Internet Expense		7,450	
Freight Charges		81,395	1,603,301
<i>Operating Expense (1 year of Operation)</i>			
Office Supplies		5,966	
Cleaning Supplies		5,609	
Medical Supplies		6,253	
Advertising Expense		33,300	
Telecommunications Expense		29,880	
Transportation Expense		16,537	
Electricity Expense		427,654	
Water Expense		20,428	
Insurance Expense		29,678	
Waste Disposal Expense		18,000	
Taxes and Licenses		4,935	
Salaries Expense		5,109,758	
Government Contribution		786,262	
Employee Benefits		425,813	6,920,076
Project Cost			14,771,367
Contingency			228,632
Total Project Cost			₱ 15,000,000

Figure 11 Project Cost

The investment cost for executing the project operations, which is necessary for a corporation to leverage the capital provided by its shareholders will be PHP 15,000,000.00. This is the budget that requires the corporation to use financial sources as capital. This includes the cost of a contingency plan which is necessary for the Company to return quickly as possible after unforeseen events.

Project cost in Figure 11, displayed the total funds needed to complete the Implementation of RFID based-Automated Parking Management System amounted to PHP 14,771,367.41 with a contingency fund of PHP 228,632.59

in a total of PHP 15,000,000.00, which was divided between the acquisition of equipment, pre-operating expenses, and the working capital required.

3) Financial analysis

This section will highlight the key decision factors that investors should consider before determining whether or not to proceed with the project. The Accounting Rate of Return and the Payback Period will be included in the computation.

3.1) Accounting rate of return

The accounting rate of return is the projected percentage rate of return on an investment or asset in comparison to the cost of initial investment. The I-WISE PH has an accounting rate of return of 41.6%, a useful capital budgeting metric to determine the investment's profitability.

If the accounting rate of return is equal or greater than the required return of rate (usually coming from investors – hurdle rate), the project is likely to be accepted and invested on.

TABLE V
ACCOUNTING RATE OF RETURN

Year	Net Income
2022	(3,140,825.53)
2023	1,277,850.50
2024	13,656,489.22
2025	27,202,702.67
2026	38,751,014.77
Total Income: 5 years	77,747,231.62
Average Net Income	6,478,935.97
Accounting Rate of Return	Average Net Income
	Investment
	6,478,936
	15,000,000
	43.19%

3.2) Payback period

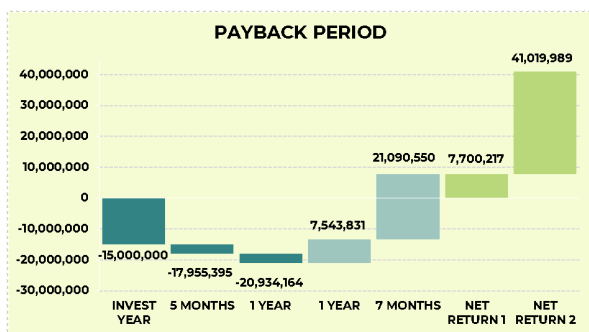


Figure 12 Payback Period

The payback period, as seen on Figure 12, is the time required to recover the cost of an investment or for an investor to reach breakeven. The I-WISE PH has a three-year payback term. A good indicator for a big business to attract more investors in the implementation of an RFID-based Automated Parking Management System.

D. Socio-economic feasibility

Socio-economic feasibility discusses the benefits of the company and how it affects the economy, employment, environment, households, government, and corporate responsibility. The I-Wise PH is not only concerned about its profit but also about its effect on the people and condition of society. The project directly benefits its employees and their families. Indirectly, increased employment opportunities and boosted the economy. This increased demand may enhance production, resulting in more jobs and income for others in society, and more tax revenue for the government. This implies an increase in job opportunities for the general population, wherein they can be part of the manpower of the company. Through this, the unemployment rate in the country will be reduced.

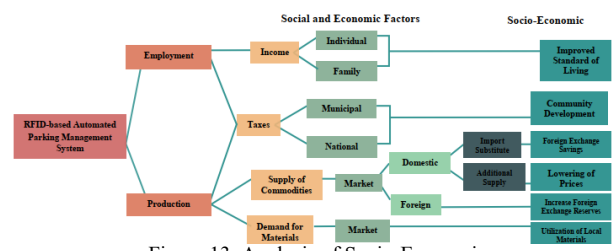


Figure 13. Analysis of Socio-Economic

In the “Analysis of Socio-Economic” as shown in Figure 13, I-Wise PH is foreseeable to generate income that could be taxable, which is subject to Income Tax and Business Tax, which will be remitted to the government. Which will be utilized to sustain the activities of the locals for the benefit of the community. The project's industrial output benefits the industry's supply position in several ways such as increasing the return visits in the mall establishment, propelling an increase in sales potential. I-Wise PH recognizes the project's introduction since it reduces supply limitations which leads to lower prices. In an overcrowded sector, the project may result in better product quality and/or cheaper prices, especially if it is highly competitive in terms of both quality and price. Increasing demand for raw materials and other industrial inputs. This fosters more raw material and service production, improving industrial linkages

E. Management aspect

The management aspect entails restating the purpose of this project feasibility which is to create an RFID-based automated parking management system that would both streamline the process and address parking concerns, the company's vision, mission, core values, general qualifications for various functions, and quality policy which shows how the I – Wise PH enhances and improves itself in providing customers with high-quality service to achieve competitive advantages and effectiveness, and continuous growth and development.

I – Wise PH operates as a corporation. This was developed to insulate shareholders from personal liability. It ensures that its owners are not personally liable for the debts of the company. Thus, integrating the company in the process of establishing legitimacy by demonstrating the firm's sustainability, which is more appealing to investors and stakeholders.

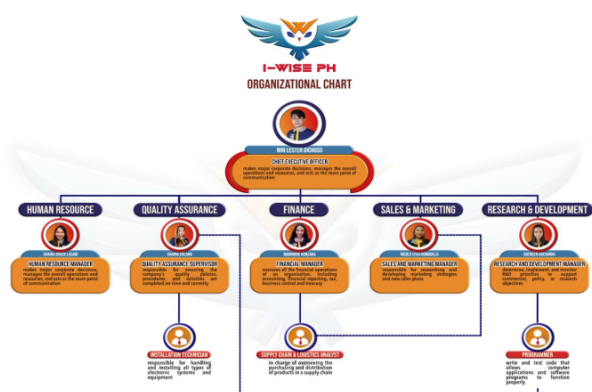


Figure 14 I – Wise PH Organizational Chart

The organizational chart of I – Wise PH in Figure 14, emphasizes the arrangement of teams and departments, the duties and responsibilities of each individual, the reporting links across the entire organization, and the number of human capitals needed in performing the business, to attain optimum effectiveness of its organizational setup.

The flow of authority is represented by the solid line indicating that a position has direct authority over its subordinates, whereas the dashed line denotes the secondary authority so that functions are smoothly delivered as to the communication and collaboration of the personnel

Hiring skilled employees is necessary for ensuring the company's maximum production. Therefore, to assure the employment of skilled individuals, certain standards for each officer's educational achievement and training are defined and established. Each executive's specific roles and responsibilities are defined in the management aspect guaranteeing workload balance and harmony. In addition, the great job performance of the employees is rewarded with gross income and bonuses, recruitment and training programs, compensation, and fringe benefits to boost morale and job satisfaction among the officers and personnel. However, individuals will be hired only if they meet specific criteria set forth by the management to secure the company's long-term success. Both the company and its employees will gain from these skills. The company has set skills to be regarded as qualified for their positions. It also states the project schedule of the company where various actions were undertaken during the planning stage and up to the project's operation are depicted in a Gantt Chart, along with their duration and relationship to one another.

IV. CONCLUSION

This study developed a product system that incorporates the RFID system currently used on the country's toll gates to ensure that technology is used creatively and innovatively. As mandated by the Republic Act No. 8792, it reduces operating costs and implements a paperless system. The primary purpose of this system is to identify the user and debit the proper amount of money from their account.

The researchers concentrated on streamlining the parking process and resolving parking issues while saving clients time and energy when looking for a parking space and facilitating cashless transactions, which will be required under the national initiative to further protect the public from contagious coronavirus disease 2019 (COVID-19), as it promotes compliance with health protocols such as physical distance by limiting human involvement and eliminating traffic jams.

This research found a demand for 98.43 percent consumer acceptance and a supply of just over 2.62 percent customer awareness for fully automated parking systems. It revealed that 97.34 percent of forecasted demand would remain unsatisfied, indicating an average yearly growth rate of 7.08 percent, with market share increasing at a rate of 0.10 percent annually. Thus, I-Wise PH may earn a maximum of PHP 7,141,540.38 per year from their 20% service parking commission at Victory Mall and Market for the first year. In 2023 and beyond, the anticipated average sales value is PHP 9,504,733.02 with an average annual increase in projected sales of 14.12 percent. This exemplifies that this venture will be profitable in the long run.

The overall funding required to execute the RFID-based Automated Parking Management System was PHP 14,771,367.41, which included a contingency fund of PHP 228,635.59, for a total of PHP 15,000,000.00, which was distributed between equipment procurement and working capital requirements. The company's capital requirements will be met by the shareholders, who will each invest PHP 2,500,000.00. It will lead to a three-year payback period to recover the investment capital. Due to the annual growth in the acceptable number of projects, the firm has an accounting rate of return of 41.60 percent and an average income increase rate of 270.17 percent. As I-Wise PH becomes more well-known in the parking market, more clients will adopt and use this system. As an outcome of the project's acceptance, the company's revenue will increase in the next few years.

The findings demonstrate that I-Wise PH is concerned with more than its bottom line when it comes to the welfare of people and society. This initiative significantly benefits employees and their families, hence strengthening the economy. Greater demand may also increase output, resulting in more employment and income for the general populace and more tax revenue for the government as a whole.

A corporation is the legal type of company organization used by I-Wise PH. In protecting the owners from personal liability, the business chose this structure, which is the most formal and provides the strongest management framework. As an outcome, establishing a corporate entity establishes the firm's long-term sustainability, making it more attractive to creditors and investors.

Parking services have become more efficient as a result of technological advances. This research showed how RFID-based parking management and performance might be enhanced. Maintenance, recycling, and appropriate product replacement are all part of a system intended to meet client demands cost-effectively and reduce environmental impact. Implementing the system focuses on the management system's ability to enhance parking by addressing car entry and exit, payment, and space discovery.

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ATTACHMENT

Execution of Prototype:

<https://bit.ly/RFID-BASEDAUTOMATEDPARKINGMANAGEMENTSYSTEM>

