University of Batangas
LIPA CITY

T.A.P.C.A.B

Transit Automated Payment for Commuters, Associates, and Businesses

(A Smart Card for Multi-cabs in Lipa City)

A Thesis

Presented to the

College of Information Technology, Entertainment, and Communication (CITEC)

University of Batangas – Lipa City

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In Partial Fulfillment

of the Requirements for the Degree

Bachelor of Science in Information Technology

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Approval Sheet

This thesis entitled "T.A.P.C.A.B -Transit Automated Payment for Commuters, Associates, and Businesses (A smart Card for Multi-cabs in Lipa City)", was prepared and submitted by Juan Gonzales, Renier Infante, and Jamie Endozo, in partial fulfillment for the requirements for the degree of Bachelor of Science in Information Technology has been examined.

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Chapter 1

Introduction

1.1 Project Context

Transportation is an integral component of financial, economic, and societal developments. People are more equipped to benefit from a broader range of economic possibilities when good transportation infrastructure increases mobility and improves living standards. Transportation Management involves enhancing transportation options for recreational travel and reducing automobile traffic congestion. All over the world are experiencing severe transportation problems. We all know that no one likes difficulty in traveling. That much is globally valid. But what does it mean when even as commuters worldwide get less delayed, drivers face a challenge due to traffic congestions. Transportation is a solution to our core mobility issue. Many individuals desire to move at certain times of the day, which is a challenge. The same problem exists in every central metropolitan area in the world.

The growth in circulation intensity in cities is associated with increased accidents and deaths, particularly in poorer countries. Congestion-related delays are primarily due to accidents as people feel less secure on the roads with more traffic.

Nowadays, criminal activities have become more violent and frequent where the criminals are getting bolder in carrying out their activities. Crime rates increased daily, and those crimes were reported widely, including in newspapers and television. Even among passengers, it also happens, especially in public vehicles, which is one of the passengers' fears. The security of the passengers is still not enough even though many security systems have been implemented for it worldwide.

Research on transportation design aspects for public mental health is in its infancy to stop the transmission of contagious diseases. On the other hand, the transportation sector may benefit from information from other urban planning sectors. This study applies the principle of urban planning for good mental health to the transportation sector: future

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research and innovation goals are identified to utilize transportation design for better mental health promotion.

Transportation is essential in the Philippine economy, unifying the island's population and economic sectors. The Philippines' transportation system is composed of road, water, air, and train modes of travel. Public transportation was considered a sustainable, cost-effective, and time-saving mode of transportation. But it is still viewed as a relatively unsafe mode of transportation and unreliable due to frequent delays caused by traffic jams. Also, it is not recovering as efficiently as private automobiles, bicycles, and walking.

Bambang Susantono, Vice President for Knowledge Management and Sustainable Development at the Asian Development Bank, states, "the two major challenges ahead are resolving public transportation capacity to meet safe distance standards and restoring public confidence in public transportation. "In the near term, further work is required to reassure public transportation passengers of their safety and exhibit clean, safe public transportation." Technology, big data, artificial intelligence, digitalization, and automation may help create smarter cities in the long term."

When a country enters the "recovery" phase, additional preventive and precautionary operating procedures and current technologies are very effective. We need to promote contactless payment methods. Public transportation networks and airports benefit from demand management strategies that reduce overcrowding. Non-motorized transportation capacity might be increased as a supplementary approach to absorb the demand for public transportation spillovers.

Cleaning, thermal scanning, tracking, wearing a facemask, and wearing a face shield to the passengers and driver are essential procedures to restore passenger trust in the public transportation sector. There is a need for planning and evaluation to increase preventive measures that may help reduce capacity problems. It is feasible that new travel

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patterns and habits may necessitate the consolidation and streamlining of transportation services. Improved productivity, using tap-to-pay technology is quicker and requires a less workforce. Paying with a payment card using contactless technology saves companies time from running smart cards or counting cash. Studies have shown that companies offering contactless payment facilities provide a smoother and quicker checkout experience, earning loyalty. The provision of a contactless payment option imposes no additional service charges. The contactless payment process is secure and encrypted to prevent hacking. Better transaction security ensures that companies get their funds without contention. In addition, most issuing institutions protect against fraud for contactless payments.

Authorities aim to tighten security procedures at transportation hubs, including ports and long-distance passenger ships throughout the country. Unattended luggage may necessitate security procedures at transportation hubs and institutions. Increased criminal activity, including theft and robbery, would likely occur at transportation hubs around the country. During the Christmas season, significant roadway safety remains an essential worry.

The City of Lipa is a first-class component city in the province of Batangas. The roads in Lipa City are substantial; it has been considered a transportation hub for Batangas and the surrounding areas, particularly the National Capital Region. This scenario has led to the highly urbanized city experiencing traffic congestion due to rapid urbanization and development. Due to a lack of planning for transportation systems to meet the rising demand for transportation services, the travel demand model, which starts with trip generation modeling, must be finished.

Traffic congestion has become a daily struggle in the City of Lipa. Nobody can avoid commuters becoming impatient, road rage, and crowded roads caused by an overabundance of private automobiles. Congestion affects everything, including getting to work, going to school, shopping at malls, getting groceries, and even receiving

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deliveries for customer necessities. A lack of roadways does not simply cause lipa City's excessive traffic. It is also due to various other issues, including the overcrowding of inhabitants, traffic congestion in private cars, and inefficient traffic control management, mainly due to a lack of discipline among drivers, passengers, and individuals in the City of Lipa. They do not observe the traffic rules of the road.

The other problem in Lipa City is that it does not have a good alternative for public transportation because it does not yet have modern technology for public transport and cannot control unregistered vehicles. Unregistered vehicles are illegal public utility vehicles, better known as "Colorum Vehicles," and are also one of the traffic causes in Lipa City; more importantly, it's not fair. For fair drivers working with registered franchises from the Land Transportation Franchising and Regulatory Board (L.T.F.R.B.). Moreover, it is safer to ride a registered vehicle because they have insurance.

Our Bayanihan concept of paying today for public vehicles such as multi-cabs have been disturbing since the Covid 19 pandemic. The inevitable interaction of passengers and drivers endangers every passenger's health, especially the elderly and children. Adding to the concern is the driver's pressure in taking the passenger's fare while driving and calculating the passenger's fee, and of course, it is their job to provide change to the passenger. It is quite stressful because driving is not easy, especially on populated roads. This concept also bothers passengers who want to rest and do not want to interact with fellow passengers or drivers to handle their fares.

The researchers plan to develop software designed specifically for the multi-cab association to lessen the transportation problem in Lipa City. The researchers will develop software that will innovate the payment method of the multi-Cab services. One solution is to enable a convenient electronic fare payment option using Radio Frequency Identification (RFID). It has two components, software, and hardware. It also integrates data generation and retrievals like driver information, vehicle information, passenger's travel history, and balance queries. It provides transport operators with higher efficiency,

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profitability, and convenience. It can increase passenger satisfaction with additional benefits from electronic fare payment using the Radio Frequency Identification Card and Radio Frequency Identification Card Scanner.

Implementing the T.A.P.C.A.B. The payment system can prevent a commuter from bringing bulkier wallets; it also contains the sight of money detection that gets the attention of thieves. It prevents the interaction of each passenger and driver. The drivers will be less distracted, allowing them to focus more on driving safely. It will help avoid spreading the viruses. With T.A.P.C.A.B., the driver and passenger will follow passengers' proper loading and unloading policy. It will also prevent the passenger's failure to pay their fare.

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Objectives of the Study

The study's main objective is to develop an electronic fare payment system for multi-cabs using Radio Frequency Identification for the City of Lipa.

The following are the goals that must be accomplished by this research:

1. To analyze the concepts of Radio Frequency Identification Systems, Website development, and Graphical User Interface using Visual Basic.Net in relation to the development of the T.A.P.C.A.B. Radio Frequency Identification payment system for Multi-cabs in Lipa City.

2. Design and development of the Program (GUI) Application and Website of with the following features:

   a. Distinct level of privileges of the Administrator and Cashier account
   b. Loading and withdrawing balance
   c. Adding, editing, and deleting users
   d. Balance Inquiry for passengers and drivers
   e. Collection of payment from passengers
   f. Store and retrieve records in the database
   g. Export records into excel format

3. Test the application based on the following criteria:

   ISO 9126 SOFTWARE EVALUATION CRITERIA

   The following criteria must be met:

   1. The software should be able to calculate and display accurate data to the users.
   2. The software must be user-friendly and should be able to learn to operate at ease.
   3. The software should be modular so that the developers can easily add new features to the system and may continue to function after modifications.
   4. The software can be installed easily, and it is reliable.
   5. The software utilizes the resources efficiently and responds on time.

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4. To implement the Transit Automated Payment for Commuters, Associates, and Businesses (T.A.P.C.A.B.).

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Significance of the Study

This study shall be beneficial to the following entities:

For the City Government of Lipa

This study will benefit local governments as it will influence their transportation planning and implementation to establish the essential instruments for the growth of public transportation.

For the Land Transportation Franchising Regulatory Board (L.T.F.R.B.)

This study will provide insights to the (L.T.F.R.B.) about implementing cashless transactions to another mode of transportation utilizing multi-cabs.

For the Multi-Cab Association

Implementing T.A.P.C.A.B. will benefit the multi-cab association as it will automate the transactions between drivers and passengers.

For the Multi-Cab Drivers

Cashless fare payments can boost multi-cab transportation income by lowering handling expenses. Furthermore, the funds are instantly ready for use using the card, with sorting time required. Cashless fare payments maintain the fare pricing regulated by the LTFRB.

For the Commuters

This study will be a rapid and seamless payment process that provides a compelling passenger experience, significant operational efficiencies, and improved resource performance. Passengers may pay quickly and easily, eliminating waiting in line to handle cash and change. It can also make multi-cab transportation more appealing and accessible for younger generations while enhancing the city's sustainability.

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For the Future Researchers

To give additional information to other researchers who want to conduct further research in the related field. Future researchers might seek to incorporate more components into the study's model/system or execute it in various cities and locations to show a more detailed knowledge about the adoption and use of smart cards for transportation.

Technical Terms

Colorum Vehicles

Colorum is the slang term for unlicensed public transportation in the nation. The Land Transportation Franchising and Regulatory Board (LFRB) reports that the term colorum was first used in 1973 as part of President Marcos' "anti-colorum" campaign. Typically, a vehicle is unregistered or unlicensed; it is called a colorum. (Finder, 2022)

Contactless Payment

Contactless payment allows users payment without handing or touching money. This technology, also called "tap to pay," enables users to tap their phone or card at an enabled terminal to authorize payment. (Beaver, 2021)

Crippling

Refers to the act of producing serious harm or trouble, as well as rendering someone physically severely injured. (*Merriam-Webster Dictionary*, 2022)

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Database

A database is a well-organized collection of various data types often kept electronically in a computer system. A database management system generally controls a database (DBMS). (*What Is a Database?* 2020)

GUI

GUI, known as "graphical user interface," is a system of interactive visual components for computer software. It displays objects that convey information and represent actions the user can take. User interaction changes items' color, size, or visibility. (GUI, 2021)

Hardware

It is a computer's or a machine's physical components. It contains printed circuit boards, integrated circuits, and other computer electronics to construct computers and other machinery. (*Merriam-Webster Dictionary*, 2022)

RFID

RFID (radio frequency identification) uses electromagnetic or electrostatic coupling in the radio frequency spectrum to identify a product, animal, or person. (Amsler & Shea, 2021)

Software

The software operates computers and performs specific functions—the reverse of computer hardware. Software refers to device-running apps, scripts, and programs. (Turrell et al., 2021)

LTFRB

LTFRB is an official agency of the Philippine government that reports to the Department of Transportation (LTFRB). (*About | LTFRB*, 2020)

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Traffic Congestion

Is a state in the transport sector defined by slower speeds, longer trip durations, and greater vehicular queueing? Congestion is another term for heavy traffic. (*Traffic Congestion and Reliability: Trends and Advanced Strategies for Congestion Mitigation: Chapter 2*, 2022)

Transportation Hubs

A transportation hub is a station where people and goods transfer between various forms and modes of transport. Railway stations, rapid transit stations, bus stops, tram stops, airports, and ferry docks are public transportation hubs. (*Transport Hub*, 2022)

Scope and limitation of the Project

The study covered a topic related to a system for modern transportation where the payment method will use a card called "TapCab." This study focuses on reducing contact with other people, especially these days. With this study, the researchers will develop a cashless payment for only the Multicab drivers and their passengers. TapCab could help improve public transport safety and convenience for drivers and passengers. This study also focuses on improving public transportation with new technology.

The design and development of the program (GUI) Application and Website include the following features: it has a distinct level of administrator and cashier privileges, it can load and withdraw a balance, it can add, delete, and edit users, it has a balance inquiry for passengers and drivers, it can collect payment from passengers, store and retrieve records from the database, and export records to excel. Citizens need to have a valid RFID card linked to TAPCAB; it records the direction of travel. It is easier for passengers who identify as students, people with disabilities, or senior citizens to take advantage of discounts offered due to technological advancements. This system has lower system maintenance costs. Smart cards are also essential components of system security and data transfer.

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Limitations of the application are as follows; There are still noticeable costs, including enabling confirmation areas with stations. The application needs an internet connection to save data in the database. It cannot be loaded using payment merchants**.**

The study only applies to multi-cab drivers in Lipa City Public Market to Pilipinas Kyohritsu, Inc (PKI), and the card is only available to multi-cabs registered with TAPCAB. However, the system's main features will be covered and present the goal of this study.

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Chapter 2

Review of Related Literature and Studies

This chapter contains literature and studies collected and analyzed from online publications, research, and journal resources by researchers who seek this paper as a reference in terms of conducting more reliable studies. This Related Literature and Studies gave the researchers a broader understanding and perspective on the subject under study. The literature review, as a piece of writing, must demonstrate to the viewer what understanding and concepts have been developed prior, as well as establish a statement in favor of the research problem.

2.1 Review of Related Literature

Smart Card

Based on the authors (Arroyo-Arroyo, Van Ryneveld, & Finn, 2021), smartcards were the fundamental technology that enabled the transition from cash and print ticket fare processes to digital, automated fare systems around the world. This all marked an important improvement in inefficiency. Operations could be much faster and clearer for those in charge of the system, limiting the opportunity for wrongdoing. Moreover, they provided significant progress by significantly improving the data available on ridership patterns that could be used to improve the system's overall efficiency.

Dent (2013), For those unfamiliar with smart cards, they are plastic cards with an embedded microchip that can be loaded with data used for phone calls, e-cash payments, and other purposes. Smart cards are currently widely accepted in Europe.

According to (Sreelekshmi S, Shabanam, Preethi Presannan Nair, George, & Sajana Saji, 2021), the smart card is a rapidly growing technology. Smart cards will improve overall security and efficiency, resulting in a cashless environment, data consistency, and student card functionality. Many improvements to the existing situation

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can be made using the versatile smart card's applications. Education is only one sector where smart cards can be used; smart cards can be used in various sectors, and using them improves their functionality, efficiency, and usability.

Bank cards and credentialing applications (such as employee identification badges) require personal information protection, and fast, secure transactions also use contactless smart card technology. These cards use an open standard set by the finance financial services sector or the other standardizations. They are now used as government and corporate identification cards, electronic passports and visas, and monetary payment system cards (credit, debit, prepaid, ATM, and benefits cards). (Smart, 2022)

Smart card data has enormous potential for assisting people in understanding the long-term effects of transportation policies on user behavior. Smart card data could be carefully analyzed to consider aspects of individual commuters' travel behavior. Demonstrated how time-based data was combined with train schedules to estimate how each passenger used the trains between any two origin and destination stations.

In the remark to Green Light for Best Buses, Norman Baker MP, Parliamentary Under-Secretary of State for Transport, stated in March 2012: "This isn't simply about providing more reliable, frequent, and affordable services but making the best use of smartcards and multi-operator ticketing. In the years to come, we want any bus traveler to purchase tickets quickly and conveniently while seamlessly moving from one operator, or mode of transport, to another." (DfT, 2012b)

This recent policy commitment to Smart Ticketing as a core pathway to supporting broader sustainable transportation outputs results from policy measures undertaken by previous governments. The transportation system has been a fundamental goal of prior Labour, Coalition, and Conservative governments dating back to 1997. (Green Light for Better Buses, 2012) Presently, smart cards, as well as other emerging technologies, are receiving billions of dollars in investment. In every case, the important questions are, "Will

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this new technology's entry fail to be accepted?" and "Will the billions of dollars spent on its development achieve the hoped-for return on investment?"

Smart cards being used in transportation are expanding since they provide more flexibility, crime reduction, and speed because users prefer them. The Transport for London Oyster card is a great example, allowing consumers to use public transportation within London without cash, queuing for tickets, or worrying about getting the best deal. Similar systems exist in other areas of the world (e.g., Hong Kong), and there has been participation in using multifunctional smart cards (e.g., credit card plus e-ticket) and mobile phones with contactless card interfaces (NFC) to create these systems much more practical and widely known. (Boland, 2019)

The Muntinlupa Care Card (MCC), the most modern electronic smart card system in the Philippines, will be used to pay for the e-Jeepneys. Citizens who purchase a yearly Muntinlupa Care Card membership for 80 pesos (US$1.60) can use the smart card on e-Jeepneys as well as a variety of other public services. The MCC is the first and only city government benefit card in the Philippines that collects and includes information from its constituents to include more effective service delivery.

"As the leader in using electric Jeepneys in the country, we believe that our model can be replicated in other cities in the Philippines," explains Salvador. "We have set an example that the riding public can accept alternative modes of transport and embrace new ways of riding. Our operations are only on a small scale, but it is still a big leap towards finding a more sustainable transport solution that would have a long-term impact on our environment." Andrews, J. (2017)

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Automated fare collection for Public Transport

D'Souza (2020) stated that automated fare collection had become standard equipment in many metropolises and smart cities' terminals and bus stops. This system, which consists of an automated machine, a ticket verifying machine, and a ticket dispensing machine, is powered by IC chip-equipped non-contact smart cards, making fare collection more precise and secure. The payment system can be of the Contactless smart token or card variety. Since the demand for automation in the fare management system grows, the fare collection organization's strategy has seen rapid growth because the automated payment system will enhance transportation facilities while effectively reducing operating costs. (RUBIANO & DARIDO, 2019)

According to Rajkumar (2020), The automated payment system for public transit is a new invention that saves labor. By implementing these system solutions, problems such as underutilization of the bus fleet are expected to be reduced. As a result of the program's real-time information, commuters and bus terminal administrators will gain. RFID issuing tickets devices can be combined to solve the issues mentioned earlier. This project proposes a more user-friendly, automated ticketing system based on RFID-enabled tickets. This intelligent Embedded System can be integrated into the transportation system, automating fare collection. This system is appropriate for megacities such as Chennai and Bangalore, where many customers use public transportation daily.

The automated fare collection system is widely used in public transportation. AFC systems are now being used in Russia's major cities. Based on the information gathered, the variables of a passenger's trip can be determined in the non-cash payment. (Alexsandr Fadeev, Sami Alhusseini, & E.N. Belova, 2018)

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Transportation

As a concept and a field study by Preston (2020), public transportation is constantly changing. Public transportation has progressed from descriptive accounts to quantitative analytical approaches. Lately, these advancements have been supplemented by a much more qualitative approach advised by the latest mobilities paradigm, which also views public transportation as a sociocultural practice. Providing efficient and effective public transportation is essential to the effective transition of transportation and land use within localities. (Pojani & Stead, 2015) The tourist industry is essential to public transportation, yet tourism can also help support public transportation services. (Hall et al., 2017).

Incorporating an off-optimality measure to improve the precision of recognizing hidden short activities differentiates the proposed technique from established studies in the literature. Off-optimality, in specific, is insisted to be an effective option for identifying exchanges within passenger pathways in transport networks with overall topologies. Brisbane's transportation system explains the significance of implementing off-optimality in transfer identification. (Nassir et al., 2015)

Established to oversee public transportation systems is regarded as one of the best practices among these measures since this can reduce overall car reliance, ease traffic congestion, and improve air quality. (Ma & Wang, 2014)

Kaplan, Mayara Moraes Monteiro, Anderson, Nielsen, & Santos (2017) conducted a study to understand the relationship between travel information. According to them, public transportation is an essential service whose value is becoming more widely known. It does, in fact, significantly reduce traffic jams, air pollution, and energy and oil usage. Nevertheless, managing the public regular transit system is a challenging task, especially in today's world of urban growth and corresponding population increase, particularly in developing countries. As a result, to overcome the challenge, public transport systems must consider adopting tools and using existing data. Indeed, several studies have shown that acquiring reliable information and data is critical for properly operating public transportation information systems.

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Public transportation has become a significant mode of transportation, particularly when it comes to lowering personal motorized vehicles and promoting sustainable development while helping the environment, noise, etc. In the last few centuries, the use of public transportation information has developed and strengthened its position. The accessibility of data from different sources, combined with advances in analysis and predictive strategies, has resulted in a greater focus on using user data to help the public transportation system. (Billones et al., 2021)

Smart transportation is popular in Thailand and the Philippines, where governments would like improved transportation to reduce traveling time. It will be far safer and more cost-effective than traditional public transport systems.

According to the Philippine News Agency, the government of Manila has also announced that it will implement an intelligent transportation system to alleviate transportation problems. It will be the same system for managing Seoul's traffic flow and is known as the Transport Operation & Information Service (TOPIS).

The system includes data from multiple traffic management facilities, such as the bus management system, transport card system, and many others. Real-time data is sent to public facility employees who operate buses, subway trains, and parking lots, among other things.

Innovative services for various traffic and transportation administration have been made available by intelligent transportation systems. It improves communication among users, allowing them to be better careful in producing safe, comfortable, and more innovative use of transportation networks. (Liu, 2017)

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Metro Manila's public transit industry is currently disorganized. Even though the LTFRB designated particular stops for buses and jeepneys, people do not adhere to them and instead stop whenever a commuter wishes to board or exit the vehicle. This practice of loading and unloading everywhere has been recognized as one of the leading causes of traffic network problems, particularly on major highways such as the EDSA. The government should strictly impose road laws to resolve this bad behavior by drivers and commuters. (Chelcie NARBONETA & Kardi TEKNOMO, 2016)

According to Rafor & Escober (2017), the Philippines should use smart data systems for public transportation. As a result, the Intelligent Information System for Philippine Public Transportation should be applied as part of a planned way to improve the public transportation industry.

Phillips (2022) stated that public transportation commuters in the Philippines will then top up their Beep prepaid contactless fare payments card with an NFC-enabled smartphone. To use the service, cardholders must first upload funds from their preferred payment card to the most recent version of the Beep card app and tap the Beep card on their mobile device to transfer the funds to their physical Beep card.

Commuters can also convert the reward points they earn from receipts into funds that could be added to their physical card via NFC or even mobile QR tickets used on specific transportation systems.

The provider of the contactless payment system Beep Card is part of the company's plans to expand its company's operations even outside Metro Manila next year, according to AF Payments Inc. president and CEO Peter Maher.

"We are looking at jeepney co-ops in Bukidnon, Iloilo, and Cebu. These projects will come up, and they all have to follow the franchising guidelines. We are one of the viable suppliers of fare collection systems. So, we expect that we will be given a chance

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to pitch to provide services," Maher said in its year-end press briefing in Makati City on Tuesday. (Aerol John Pateña, 2018)

Advantages of using smart cards in public transportation

Personal travel patterns are analyzed using smart card data and specific transportation tools. The advantage of using smart card data is it can display the start time, end time, and direction of travel. The management team can predict the movement of vehicles and create a decent timetable based on the frequency of multiple places. However, because smart card data can only show traffic data for specific modes of transportation, data flexibility is limited. (Karami & Kashef, 2020)

From an economic perspective, cash turnover is unfavorable because it is time-consuming & involves direct costs for each organization. The expense of money revenue is approximately 1.5 percent of GDP. Digital payments, on the other hand,

strengthen the economy while promoting access to financial services. (Thomas et al., 2013)

The gradual substitution of cash for cashless payments is a visible trend worldwide. The industry often prompts it on its own, and nationwide legal constraints on using money (Passas, 2018; Shamraev, 2019). The proportion of non-cash payments varies across countries.

Going cashless does have significant advantages during the current pandemic. Individuals can lower the risk of diseases caused by minimizing cash handling and direct interaction. Nevertheless, once everyone looks at the big picture, there are many other benefits.

Although there are numerous advantages to adopting a digital payment system, there still are noticeable costs involved with that, including enabling confirmation areas with stations, other equipment, and the back-end system to handle and monitor

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payments. Luckily, we live in a time when these alternatives are more convenient and, as a result, less pricey to maintain than in the past. (Marchbank, 2022)

Safety is one of the significant advantages of smart cards. It is used in applications worldwide in which information is safe and secure is extremely important. (Smart, 2022)

Radio Frequency Identification

The benefits of RFID solutions have been acknowledged by developing countries' traffic and transportation sectors. RFID-based technologies are expected to be widely used to strengthen transportation safe and secure environments, raise transportation system efficiency, save money, and create a better world. Furthermore, smart card-based fare payment offers convenience for commuters while increasing productivity for transportation service providers. According to expertise, successful execution may take several years and prevalent problems. (Samadi, 2013)

The researchers proposed an idea for a study in a smart ticketing system, which combines RFID and the system's drivers and passengers, will benefit from GPS technology. Whenever a passenger exits the bus, the bus fare between the opening and closing points is calculated and subtracted from the balance of passengers. (Chowdhury, Bala, Addy, Giri, & Chaudhuri, 2016)

This study presents an automated, dependable, clear, and user-friendly system for PTS ticketing. Computed the fare via the internet, the fare is precise and leaves no confusion. A transit database was developed and accessed through the internet using a USB modem.

It is presented as a low-cost, efficient plan that uses RFID and IoT technology. This is consistent with advanced countries such as the United States, England, Germany, and Japan, in which RFID and IoT technologies are commonly used in traffic control. Due to

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high expenses, no automated transportation management system is applied in India. Keeping this in mind, we proposed a low-cost plan. (IJESRT Journal, 2016)

K.S. developed an automatic bus ticketing system. Vairavel [4] addressed fare collection using RFID, an infrared sensor, a u-slot sensor, and a motor to gather up location traveled and fare payment from a smart card. The use of RFID cards and infrared sensors is essential in most existing systems. (Vairavel, Jayashree, & Manimekalai, 2017)

Transportation card

Transportation cards are another vital source of patient mobility. Even though we were unable to locate a reliable source of data, it's impressively safe to assume that a large percentage of Koreans use a public transit card, if it's a physical card, a chip embedded in a credit card, or an app on a smartphone, because this payment provides significant fare discounts. As a result, local authorities and transportation agencies access data on people's mobility via public transit card payment. The South Korean transportation card mandates both touch-in and touch-out in other countries, so all these records contain useful origin-destination information. (Sonn et al., 2020)

2.2 Review of Related Studies

The "Cashless Society" is rapidly evolving and quickly becoming a popular research topic. The factors being investigated are needed to define the driving factors behind the implementation of a cashless society. For so many years, it was claimed that using cash was gradually declining with the transition to a cashless transaction proceeds, which is described as "an environment in which money is spent without being physically carried from one person to the other" (Ejoh et al., 2014)

Paper money, as well as other traditional payment options, are being phased out. Paper money is gradually being switched out in favor of a number of leading electronic payment systems that have already developed as a result of the data processing

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transformation. E-payment systems become more popular as e-commerce grows in popularity. Filipino customers actively appreciate the advantages of a cashless society via electronic payments, as they're more confident enough to make financial choices with their hands in their pockets. (Cahiles-Magkilat, 2020)

Smart cards are connected to a wide range of industries, including banking, telecommunications, transportation, home/office access control, health care, and E-passports. Cardholders have ordinarily been obliged to bring a smart card for each system.

(Bouffard, 2014) Smart cards are commonly used for data authentication, storage, and processing (crypto-processor). There are two types of smart cards. On the one hand, closed platforms do not allow the installation of applications other than those that the manufacturer has pre-installed on the card. On the other hand, open platforms allow for the installation of multiple applications even after the card has been insured. This platform is either articulated around a public specification (for example, Java Card smart cards) or it is not (cards that embed a virtual .Net machine, for example). (Bouffard, 2014)

On a national and international level, smart cards are also being used for human identification. Citizen cards, driver's licenses, and patient card schemes are rising. A credit card-sized plastic card with an embedded microchip is called a smart card. This smart card can be loaded with information, used for phone calls, electronic cash payments, and other applications, and then periodically refreshed for more use. Users may be able to use a smart card to do the following things right now or soon: Dial a connection on a mobile phone and be charged per call.

People discovered new and innovative ways to use smart cards and other chip-based cards as they developed, including charge cards for credit purchases and record-keeping in place of paper. In the United States, S. Consumers have been using chip cards for everything from visiting libraries to purchasing groceries to going to the movies, firmly integrating them into our daily lives. Several U.S. States are developing chip card

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programs for various political applications, including the Department of Motor Vehicles and Electronic Benefit Transfers (EBTs).

Smart card systems have proven more reliable than machine-readable cards, such as magnetic stripes and barcodes. Numerous studies show improved card read life and reader life, resulting in significantly lower system maintenance costs. Smart cards are also essential components of system security and data transfer across virtually any type of network.

Smart cards can be used as electronic key rings, allowing the bearer to access information and physical locations without an internet connection. They are encryption devices that will enable the user to encrypt and decrypt data without relying on an unknown, and thus potentially untrustworthy, appliance such as ATMs. Smart cards are highly versatile in providing authentication at various bearer levels and their counterpart. Finally, because smart cards can provide both parties with details about the user, they are valuable devices for customizing products and services. (Smart Card, 2016)

Because a rail transit framework with smart cards is already in use in the Philippines, envisioning the use of a smart card system in public bus transportation could potentially be applied. With a positive response from commuters to adopt smart card consumption (73 percent) and advertise cashless payment (72 percent), it would have been more practical for students/PWD/senior citizen passengers to take advantage of discounts with the advances in technology (71 percent). Furthermore, given the presence of foreign participants in this study, their responses to the questions may have been influenced by their good experience with smart cards in their home country. (Cendana, 2018)

Public transportation operators in various countries have implemented appropriate solutions for their business context. For example, Japanese public transportation companies have implemented numerous IC card solutions to promote their businesses and provide better services. However, large corporations with enormous capital give all of the answers due to budget cuts for attempting to implement e-money. Afghanistan's

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public transportation system is vastly different from that of other countries. Personal operators perform one or two buses in a region to offer public transportation.

Because of this, implementing a new solution in Afghanistan is impossible. As a result, the problems are becoming more severe by the day. To address transportation issues for Kabul residents, a new project must be adopted using currently offered technologies such as smart cards. (Hassani & Ito, 2016)

Public transport agencies widely use automated Fare Collection (AFC) systems worldwide. The initial target with these is to automatically collect the accurate fare when travelers register their card in a smartcard reader. The action of registering the card can also be referred to as "tapping," hence the term "tap-in" data. However, the system has potential benefits expanding beyond a user-friendly, efficient and accurate fare collection system. With systematic, automatic, and continuous registration of trips, operators and other stakeholders can retrieve detailed and quantitative travel data at a meager cost. Pelletier et al. (2011)

According to the study of (Faroqi et al., 2018) based on the high level of detail in the AFC datasets, there is still significant potential to develop diverse applications across the public transportation network. User-centric applications, such as friend (fellow traveler) recommendation systems, can be designed. These have both social and transportation advantages. They can also be used to create appropriate routes with few turns or even to control traffic lights.

According to Li et al. (2015), Automated fare collection systems are increasing. Mode of payment for urban transportation that is widely used. There is also an ongoing source of data to assist planners and researchers. Furthermore, to get a better overview of transit users' behaviors.

The benefit of using smart card data is that it can reveal an individual's spatial-temporal activity pattern as a regular timeline of activity areas and time duration. Mining

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activity patterns from smart card data are critical for estimating travel purposes accurately. (Ma, Wu, Wang, Chen, & Liu, 2013)

Furthermore, smart card transactions simplify the transportation department to generate reliable financial statements. Smart card automated payment systems are among the most interesting ITS existing technologies to transportation policymakers. (Pau, 2014)

The main reason for building a Grand Terminal is to address congestion caused by population growth, increased vehicle numbers, and the terminal's preceding site. In Batangas City, it requires development in the transportation sector. The impacts of the Grand Terminal created a good possibility.

For the transportation industry, as tourist numbers in Batangas City rise to further improve the operation of the Grand Terminal for Batangas City, its individuals, and tourists, proper management, amenities, and services are needed to improve.

The terminal has a beneficial impact on the ease of access, indicating its high level of concern for the convenience and availability of the community while using the terminal. The use of protective measures ensured commuters' safety. Tourists occasionally encounter issues well within the terminal's location. (Jennia et al., 2013)

According to Bustillo et al. (2017), Whereas public transportation operators throughout advanced countries have already adopted new technologies through their fare collection systems, the Philippines is another country that has yet to implement technology that improves its public transportation services. With the success of innovative card services in other countries, envisioning their use in the Philippines may be feasible by collaborating with various areas like transportation operators, banking sectors, government units, and commuter participation.

According to Sharaby and Shiftan, one of the important parts of interconnected public transit has always been fare and ticketing implementation, which must meet two requirements: no additional cost for transfer fees, as well as all modes and services using

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the same technology platform. Fare and ticketing interconnection can impact the travel journey but also will affect the use of public transportation. The studies showed that implementing a fare system can boost the courage to use roads that include transfers in an advanced city situation.

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Synthesis

The prior conceptual and researched literature and studies, both directly and indirectly related to the current study, provided additional better understanding of the nature and scope of the study, as that is the TAPCAB System.

Public transportation is essential to developing countries and drives a significant impact on one's economy. According to Preston (2020), public transportation, as a concept and a field study, is constantly changing along with time; from descriptive accounts to quantitative analytical approaches, public transportation has evolved. These advances have recently been augmented by a more qualitative methodology following the most recent mobility paradigm and further changing the landscape of public transportation; it is indeed seen as a sociocultural practice. Utilization of smart data systems on public transportation as a norm should be highly considered in the Philippines. According to our survey *add percentage of satisfactory results ng survey nyo yung nag aagree sa paggamit ng tap card*. Intelligent information systems for public transportation will be a great improvement in the industry (Rafor & Escober, 2017).

Established to oversee public transportation systems is regarded as one of the best practices among these measures since this can reduce overall car reliance, ease traffic congestion, and improve air quality. Smart transportation is primarily popular in Thailand and the Philippines, where governments would like improved transportation to reduce traveling time. According to the Philippine News Agency, the government of Manila has also announced that it will implement an intelligent transportation system to alleviate transportation problems. Innovative services for various traffic and transportation administration have been made available by intelligent transportation systems. Phillips stated that public transportation commuters in the Philippines will then top up their Beep prepaid contactless fare payments card with an NFC-enabled smartphone. The provider of the contactless payment system Beep Card is part of the company's plans to expand

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its company's operations even outside Metro Manila next year of 2019, according to AF Payments Inc.

Smart cards are one of portable technological advancements that enabled the transition from cash and printed ticket fares to digital and automated fare systems globally; this undoubtedly made a significant improvement on process efficiency. Operations were faster and eliminated risks of human error. Moreover, they provided improvement of accessible data on ridership patterns and more rooms for improvement on the system's overall efficiency. The use of smart cards in the transportation sector is exponentially increasing since it provides flexibility, efficient and faster transactions and is highly likely to reduce crimes. The Transport for London Oyster Card is a noticeable example, allowing its users to use public transportation, within the city of London, cashless, avoidance of ticket queuing and availing of best promos and deals. Similar systems exist in other areas of the world (e.g., Hong Kong), and there has been participation in using multifunctional smart cards (e.g., credit card plus e-ticket) and mobile phones with contactless card interfaces (NFC) to create these systems much more practical and widely known. (Boland, 2019).

Ejoh et al., (2014) stated that the "Cashless Society" is constantly advancing and gaining popularity as a topic of interest. The factors under investigation are required to determine the motivators behind the development of a cashless economy.

According to Rajkumar (2020), an automated payment system for public transit is a new invention that saves up labor costs and load. This process of innovation solves problems such as underutilization of the bus fleet, imbalance fare system and additional labor for drivers of public utility vehicles. As a result of this improved process, real-time data, commuters' profiles and bus terminal administrators can be easily monitored. According to the study of (Faroqi et al., 2018) based on the high level of detail in the AFC datasets, there is still significant potential to develop diverse applications across the public transportation network. User-centric applications, such as *friend* (fellow traveler) recommendation systems, can be designed. These have both social and transportation

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advantages. They can also be used to create appropriate routes with few turns or even to control traffic lights.

The related literature and studies have an important relationship with the current study in that they both explain the same system, privileges, and other details that could assist the researchers in developing a new system. Similarly, this system will be used to improve information accessibility.

The researchers want to implement and develop a new system that is convenient and reliable to the commuters. According to Li et al., (2015) Automated fare collection systems are increasing and cashless modes of payment for urban transportation are widely used. There is also a sufficient source of data on networks that may assist planners and researchers in developing innovations for public transportation and for other research purposes.

Chapter 3

Research Methodology

This chapter presented the research design, the data gathering procedure, the technical background, the hardware, and the software requirements used to develop the proposed system.

3.1 Research Design

The type of research used for the project is descriptive quantitative research. Descriptive quantitative research seeks to describe the status of identified variables. It provides systematic information about a phenomenon. Systematic collection of information requires careful selection of the units studied and measuring each variable. Descriptive research aims to generalize the result and can work with larger sample sizes. This research method is relevant to the study as the researchers have collected information using the survey research method and interviews conducted. With the gathered information, the application would garner the needed information to work successfully.

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3.1.1 Research Method

Software Development Life Cycle (SDLC)

AGILE Model

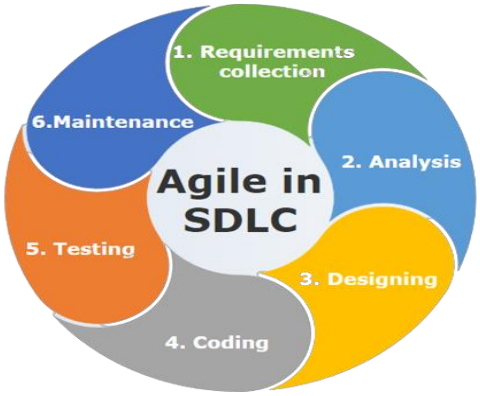

Figure 3.1 Agile Model

Agile SDLC is an integration of iterative and incremental processes models, which includes adaptability and customer satisfaction by utilizing rapid delivery of a functional software product. Agile methodology divides the product into small incremental builds that are products of iteration. Each iteration spans from one to three weeks, depending on the software load that is developed. Every iteration comprises cross-functional teams working together on various phases like Planning, Requirements Analysis, Design, Coding, Unit Testing, Acceptance Testing, and Maintenance.

Phase 1: Planning

The researchers will go through the data collection needed for the development of the TAPCAB system. Interviews and surveys will be conducted as this will determine if the TAPCAB system is feasible for the implementation in Lipa City using multi cabs as a mode of transportation. In this phase, an initial list of features will be created as the basis for the next phase.

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Phase 2: Requirements Analysis

The researchers will analyze the gathered data and will validate if the data is applicable for the development of the TAPCAB system. In this phase,

Phase 3: Design

The researchers will gather to design a User Interface for the software, it is vital that the features are necessary to the system's purpose. Database schematics are also initially designed for the system's storage.

Phase 4: Coding

The researchers will begin to program the software by integrating all the data collected and designs that have been initially printed. It is possible that potential bugs and problems may arise in this phase.

Phase 5: Unit Testing and Acceptance Testing

The researchers will undergo testing, troubleshooting, and documentation of the TAPCAB system as preparedness for the deployment of the software to the client.

Phase 6: Maintenance

The researchers will maintain the product at its functional state as bugs will appear in the future. If major issues arise, the researchers can restart the development cycle in order to solve the issues.

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3.3 Data Gathering Instrument

The researchers will utilize a survey instrument to obtain data from respondents through a questionnaire using Google Form. A survey should not collect information on contentious matters such as unlawful behavior and sensitive information. The researchers used a survey questionnaire as their data collection instrument since it enabled them to collect valuable insights from commuters about their commuting experiences.

The researchers will provide a letter to the respondents stating the rationale of the survey, and the respondents will provide the necessary information. The researchers will conduct the study and gather the data by coordinating with the Multicab Vice President, Multi-Cab drivers, and commuters in Lipa City. Respondents will receive ample time to complete the survey to ensure the reliability and accuracy of the data.

The Researchers will only acknowledge the respondent's data, and other valid sources cited. The data gathering will only focus on the respondents who are the vice president of the multi-cab association, multi-cab drivers, and commuters.

3.4 Data-Gathering Procedure

After the researcher-made survey was validated by the adviser, the interview letter was obtained from the thesis adviser for us to interview the vice president and drivers of the multi-cab association for the official route and pricing of the fares.

The researchers delivered the instrument through links using Google forms. The researchers informed respondents on how to fill out the surveys. The surveys were retrieved the day they were submitted and analyzed.

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3.5 Technical Background

This study helps multi-cab passengers in Lipa City automate their payment method, so they no longer have to reach for their wallets in their bags or pockets, leaving them exposed to theft and the drivers focused on computing for change while driving which may lead to accidents. The system is expected to be more beneficial for information gathering by implementing cashless transactions using Radio Frequency Identification. With this, the flow of transactions would be more accessible for the users. This study was conducted to make Lipa citizens adapt to the emerging technology of today's generation.

Cashless payment methods are becoming more popular these days because of benefits like convenience, security, rewards, and discounts to passengers. Adding to the crisis caused by the COVID pandemic, the cashless payment option becomes the ideal solution to minimize the threat of transmission to the public.

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3.6 Hardware and Software Requirements

Hardware	Description
Desktop or Laptop	· 1.8 GHz or faster 64-bit processor; Quad-core or better recommended. ARM processors are not supported. · Minimum of 4 GB of RAM · **Hard disk space:** Minimum of 850 MB up to 210 GB of available space, depending on features installed; typical installations require 20-50 GB of free space.
Mobile Phone	· Android Marshmallow or Later Version for Chrome browsing.
RFID USB Scanner (125kHz) / RFID SMART CARD (125kHz)	· Radio Frequency Identification Reader (RFID) is a plug-and-play device that collects specific information from an RFID card or tag. This technology relies on radio waves to transmit and receive data between a card and a reader. The RFID reader sends a signal directly to an RFID card, and the card sends back the data-carrying signal.
7-inch 1024 x 600 HDMI Screen LCD Touch Screen	The screen functions as a traditional monitor screen but has a digitizer that enables a touch screen feature for the product. It supports multiple platforms that have an HDMI output. Manual configuration is required when operating on an operating system that does not support Generic Support drivers like Linux systems.

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Software	Description
Microsoft Visual Studio 2022 (VB.NET/ PHP)	· The Visual Studio IDE is a software program made by Microsoft to provide the software developers with an interface to write and edit their code. It functionally offers code editing, debugging, and building code structures for web applications, web services, and mobile applications.
. NetFramework 4.8 Runtime	- Processor: 1 GHz / RAM: 512 MB / Minimum disk space: (32-64 bit) 4.5 GB
Visual Studio Code IDE	- CPU 1.6 GHz or faster processor / RAM :1 GB / Windows 8.0, 8.1 and 10, 11 (32-bit and 64-bit) / Linux (Debian): Ubuntu Desktop 16.04, Debian
Freesqldatabase.com (MySQL/phpMyAdmin Hosting Platform)	- Free SQL Database is a hosting platform that provides secure and reliable service for developing or running prototype or production-level website databases and services. The platform is compatible with MySQL, PHP 7.0, Linux, and cPanel.
Ph.000webhost.com (Website Hosting Platform)	- 000webhost is a free hosting service for website prototyping compatible with PHP and WordPress.

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Chapter 4

Analysis and Presentation of Data

This chapter of the study will show the analysis and presentation of the gathered data for the development of the T.A.P.C.A.B System.

Conceptual Framework

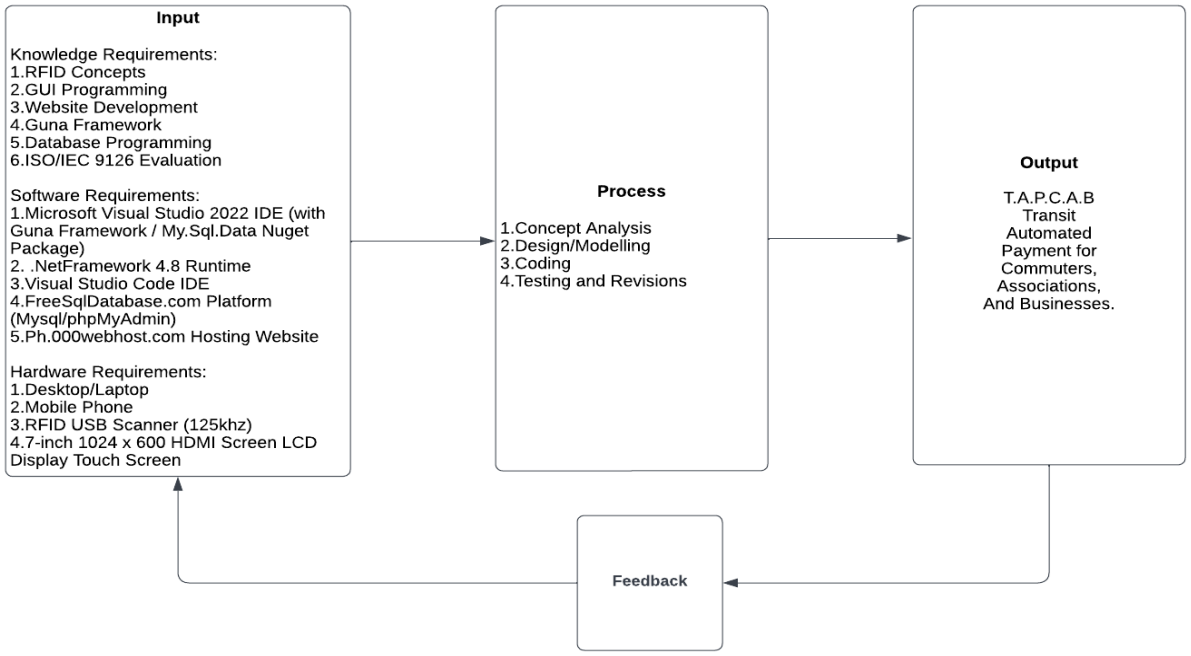

Figure 4.1 Conceptual Framework

Figure 4.1 shows the Conceptual Framework Diagram of how the application and website are developed, starting from the attainment of knowledge requirements. This will be vital to the development since the concepts of the following requirements will be integrated to create a prototype. Software and hardware requirements will determine the needed materials to create the desired output. The process will undergo concept analysis, designing, and modeling of the system, coding system, and testing it for probable revisions. After the process, the output will then again be evaluated in case bugs are identified in the system.

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Flowcharts

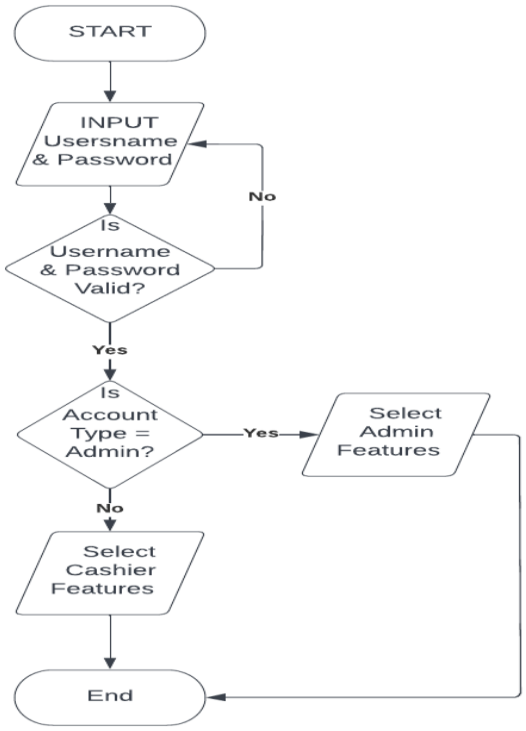

Figure 4.2 TAPCAB Main UI Flowchart

Figure 4.2 shows the Main UI flowchart of the system. It starts with prompting the user to enter the username and password and if the account is for the administrator, then the process will proceed with the administrator-level features. If the account is for employees, then the process will proceed to the employee-level features.

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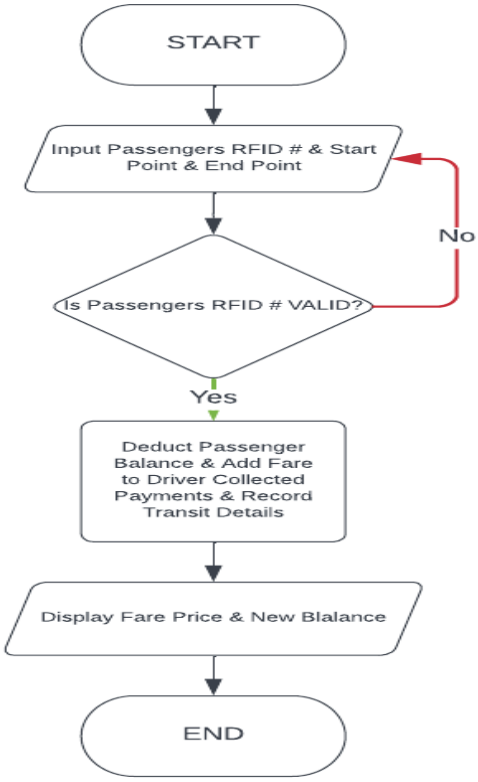

Figure 4.3 TapCab Fare Collection System Flowchart

Figure 4.3 shows the TapCab fare collection process. It begins by prompting the user to enter the passenger's RFID number, starting point, and ending point. If the entered data are valid, the flow will proceed to the deduction of the passenger's balance, add the fare collected to the driver's account, and store the passenger transit details in the database. After that, the system will show the user output of fare pricing and the new balance of the passenger account.

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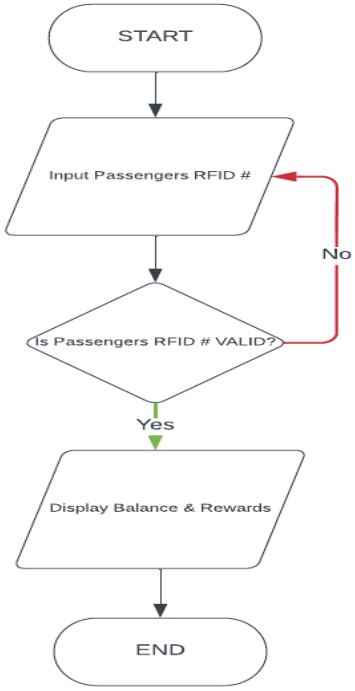

Figure 4.4 Passenger Balance Inquiry Website

Figure 4.4 shows the Passenger Balance Inquiry process. It begins by prompting the user to enter the passenger's RFID number. If the passenger's RFID number is validated from the database, then it will display the passenger's balance and rewards to the user.

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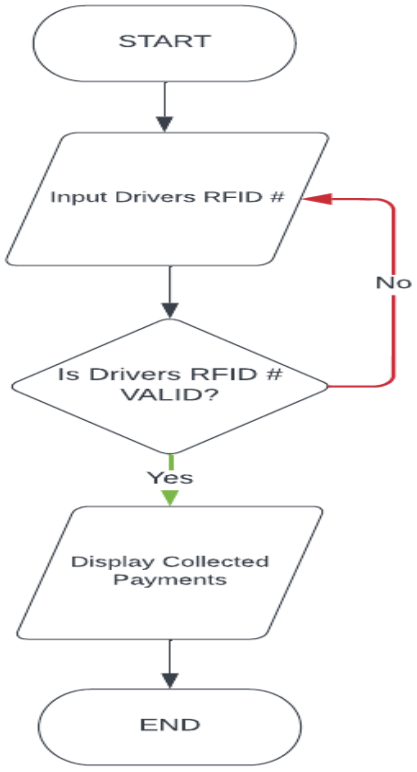

Figure 4.5 Driver Balance Inquiry Website

Figure 4.5 shows the Driver Balance Inquiry process. It begins by prompting the user to enter the driver's RFID number. If the driver's RFID number is valid, then it will display the driver's balance and rewards to the user.

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Data Flow Diagrams

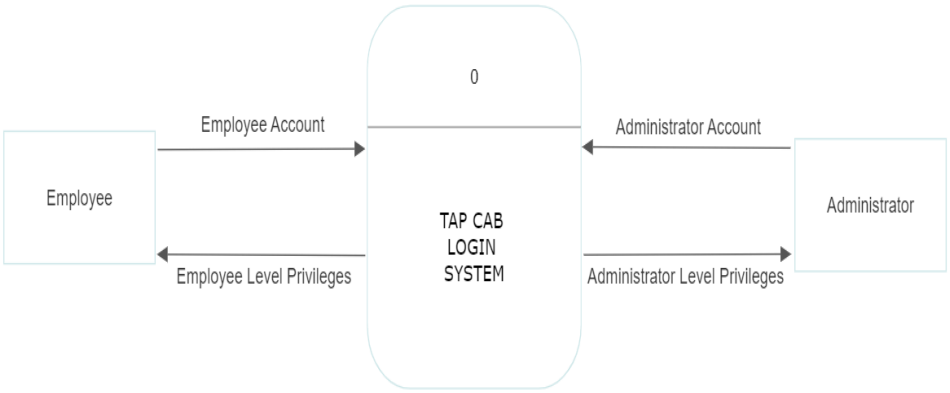

Figure 4.6 Level 0: TABCAB Login Page

Figure 6.6 shows the Login Page of the TABCAB system. Validation will occur by entering the employee or admin account, if the account is valid then either employee or administrative level privileges will be granted for the user depending what type of account is being used.

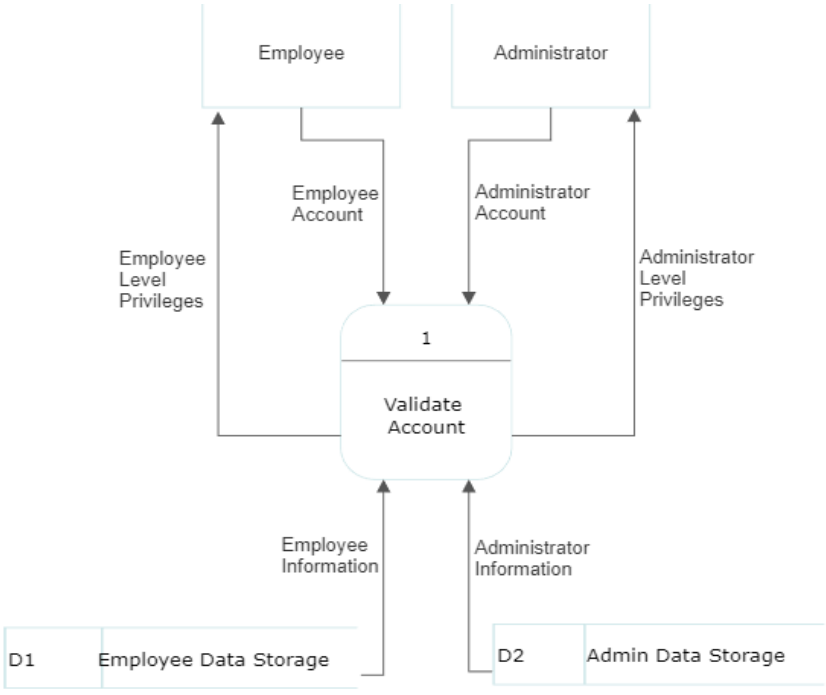

Figure 4.7 Level 1: TAPCAB Login Page

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Figure 4.7 Level 1 of TAPCAB Login Page broken down into sub-processes where you can see there are validation of the account of either the employee or the administrator. When the employee or the administrator logs in, their data will be fetched and validated to their respective data storage to grant access for the user.

The following are essential data to accommodate:

- Employee information
- Administrator information

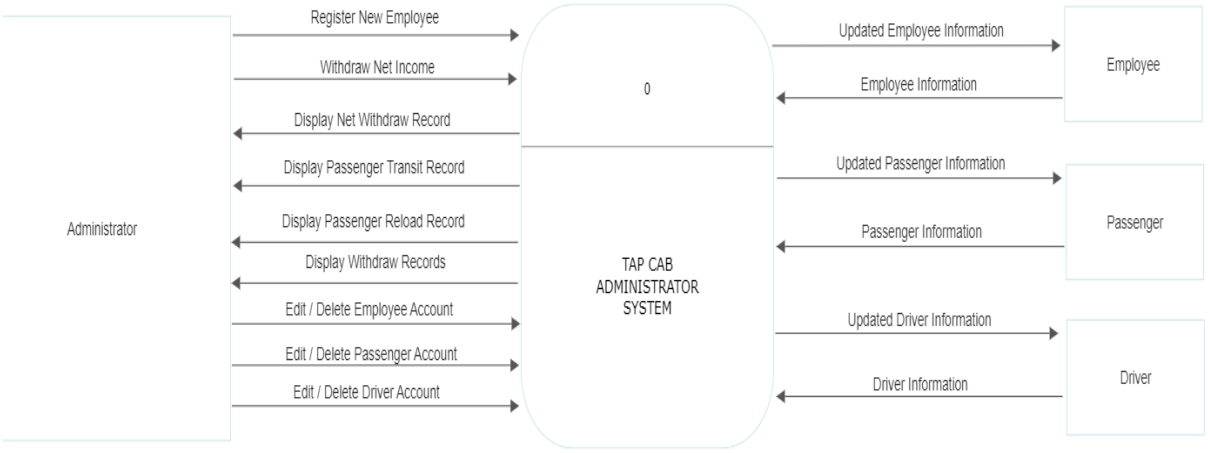

Figure 4.8 Level 0: Administrator Account System

Figure 4.8 shows the process in the TAPCAB Administrator system. It comprises with different features like register new employee, admin withdraw net income, display net withdraw record, display passenger transit record, display passenger reload record, display withdraw record, edit, and delete employee, passenger, and driver account.

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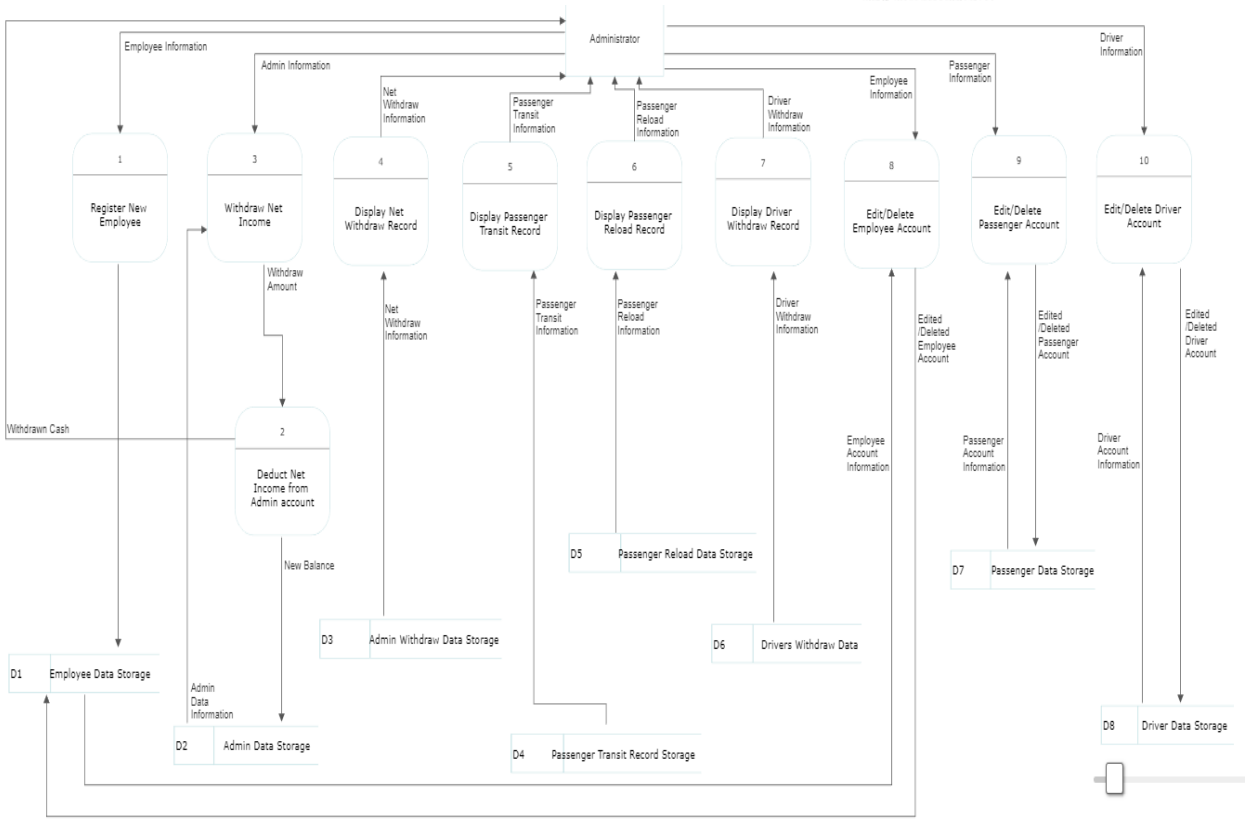

Figure 4.9 Level 1: Administrator Account System

Figure 4.9 shows the content of TAPCAB Administrator Account System DFD level 1 is a multiple process node broken down into sub-processes. At this level, the system displayed further processing information depending on the feature that the user has selected. And the user who can use the system are only the administrator.

The following are essential data to accommodate:

- Employee information
- Admin information
- Passenger Information
- Driver information

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TAPCAB Employee Cashier System

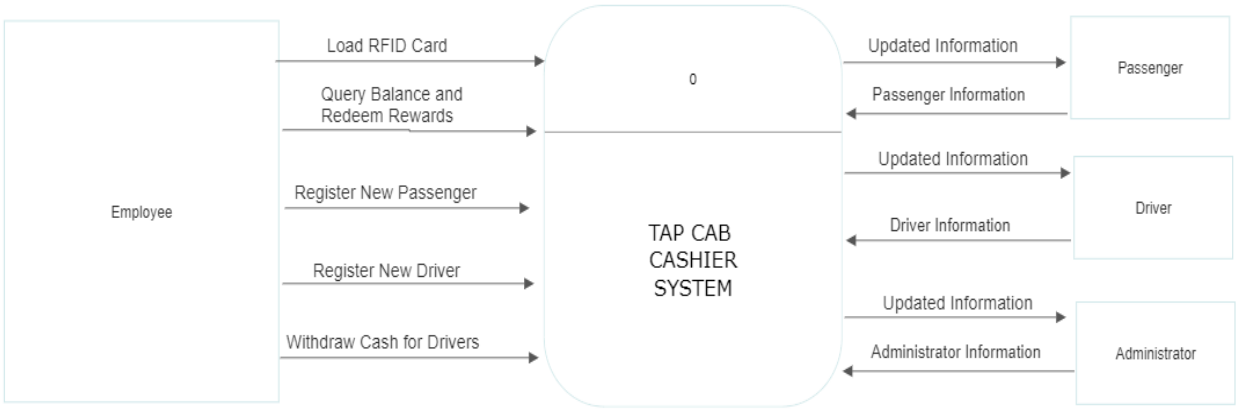

Figure 4.10 Level 0: TAPCAB Cashier System

This diagram shows the Cashier system of the TABCAB system. It comprises with different features such as loading the RFID card, balance inquiry and redeem of rewards, registration of new passenger, registration of new driver, cash withdraw for drivers.

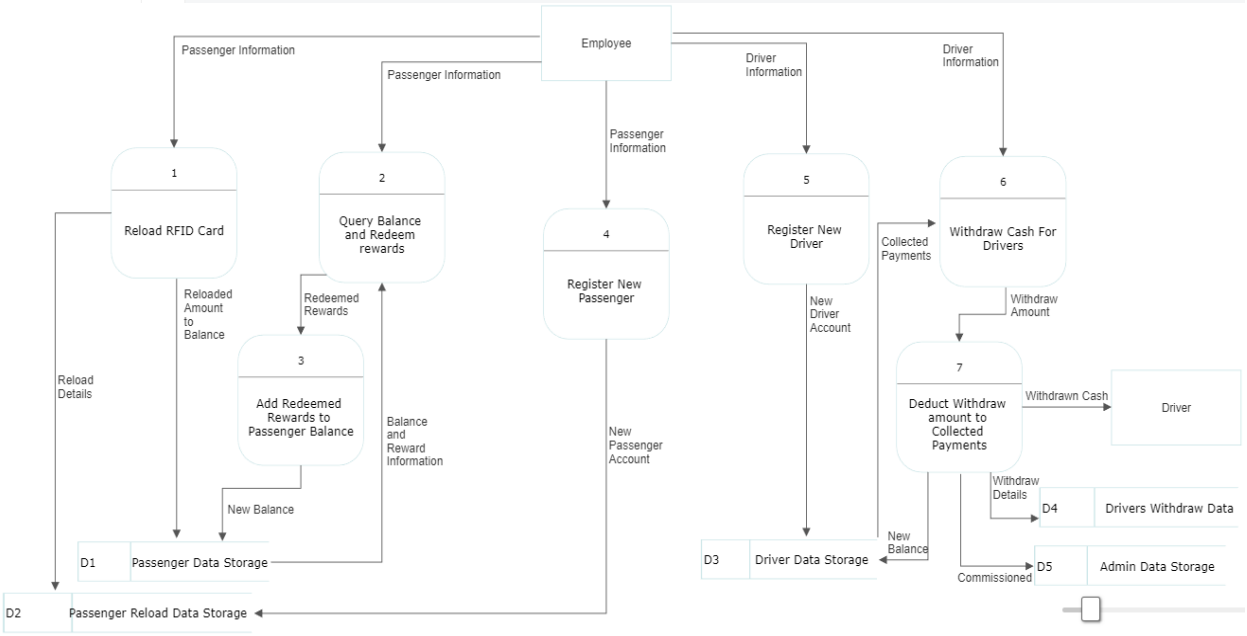

Figure 4.11 Level 1: TAPCAB Cashier System

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Figure 4.11 shows the content of TAPCAB Cashier system DFD level 1 is a multiple process node broken down into sub-processes. At this level, the system displayed further processing information about the features of the cashier system. And the user who can use the system are only the employees.

The following are essential data to accommodate:

- Passenger information
- Driver information

TAPCAB Fare Collection System

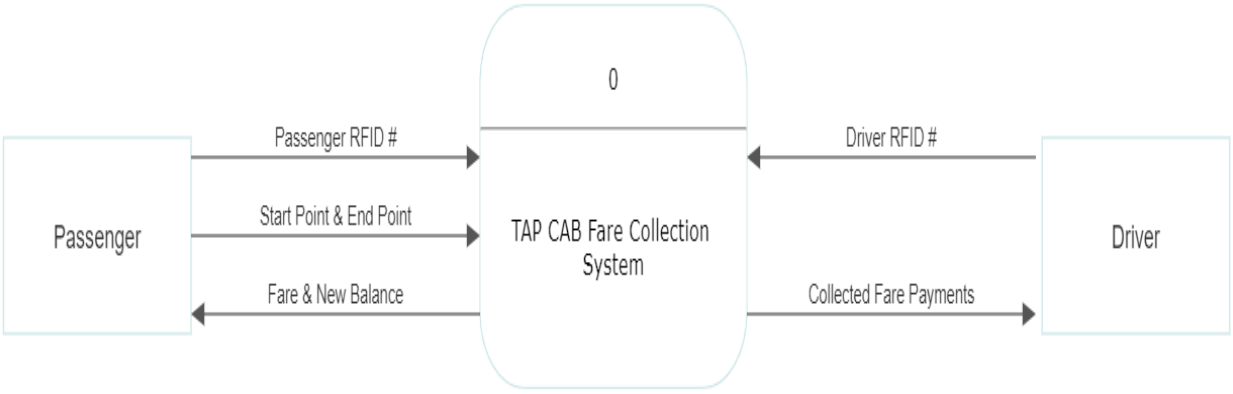

Figure 4.12 Level 0: TAPCAB Fare Collection System

Figure 4.12 shows the Fare Collection System of the TABCAB system. To use fare collection system, the user must prompt their passenger RFID number to the scanner and enter the starting and ending point for the system to calculate the fare amount to be deducted to the balance of the passenger and add fare amount to the driver's collected payment.

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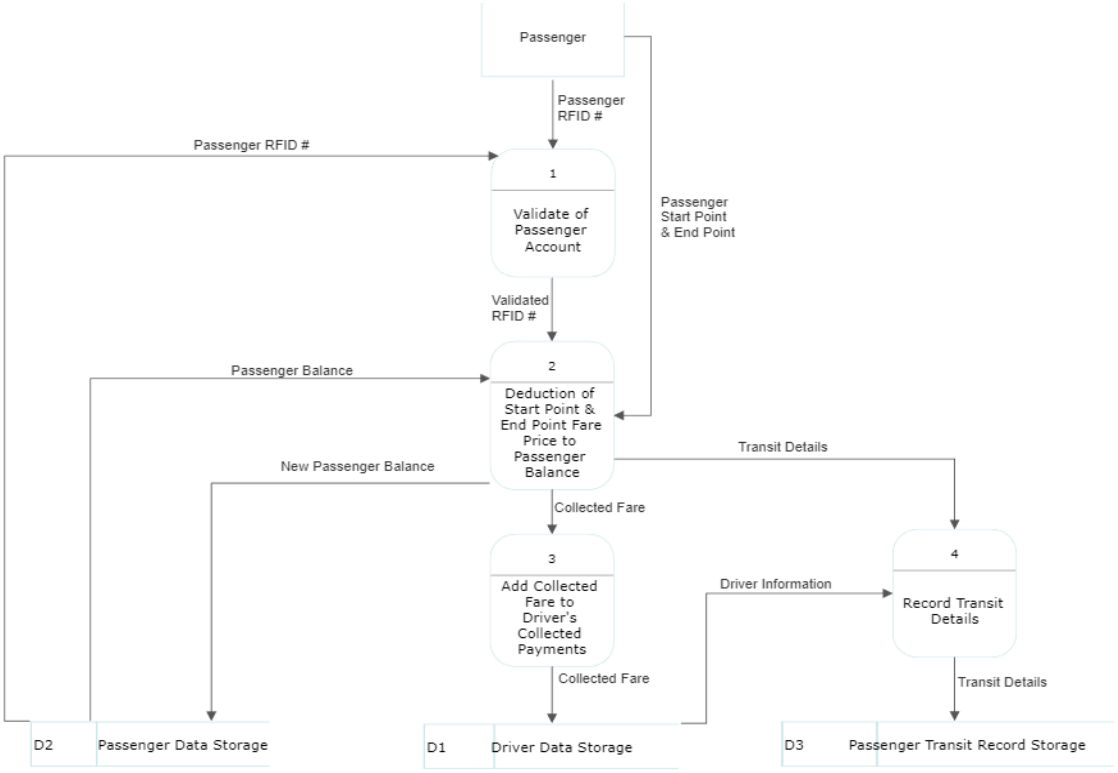

Figure 4.13 Level 1: TAPCAB Fare Collection System

Figure 4.13 shows the content of TAPCAB Fare Collection System DFD level 1 is a single process node broken down into sub-processes. At this level, the system displayed further fare collection processes.

The following are essential data to accommodate:

- Transit details
- Passenger Information
- Driver information

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Balance Inquiry for Passengers and Drivers

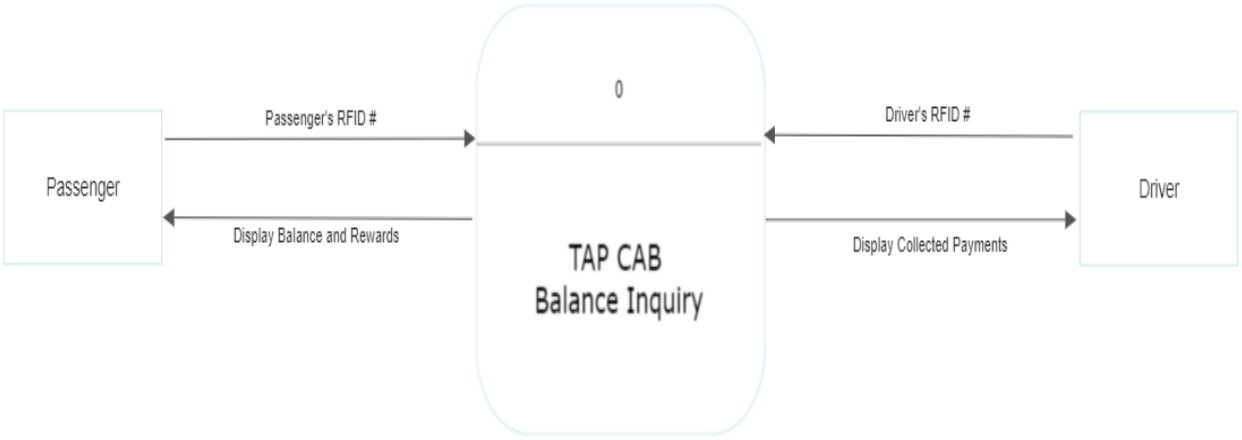

Figure 4.14 Level 0: Balance Inquiry for Passengers and Drivers

Figure 4.14 shows the Balance Inquiry for Passengers and Driver.

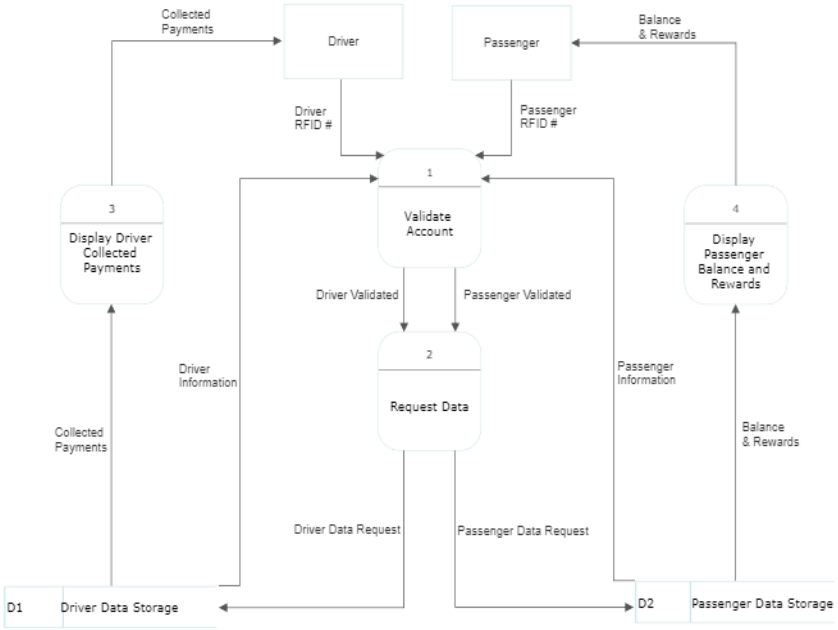

Figure 4.15 Level 1: Balance Inquiry for Passengers and Drivers

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Figure 4.15 shows the content of TAPCAB Balance Inquiry for Passengers and Drivers System DFD level 1 i broken down into sub-processes. In this level, it has a validation and request of data on their respective data storage. And the users who can use the system are passengers and drivers.

The following are essential data to accommodate:

- Passenger information
- Driver information

Entity Relationship Diagram

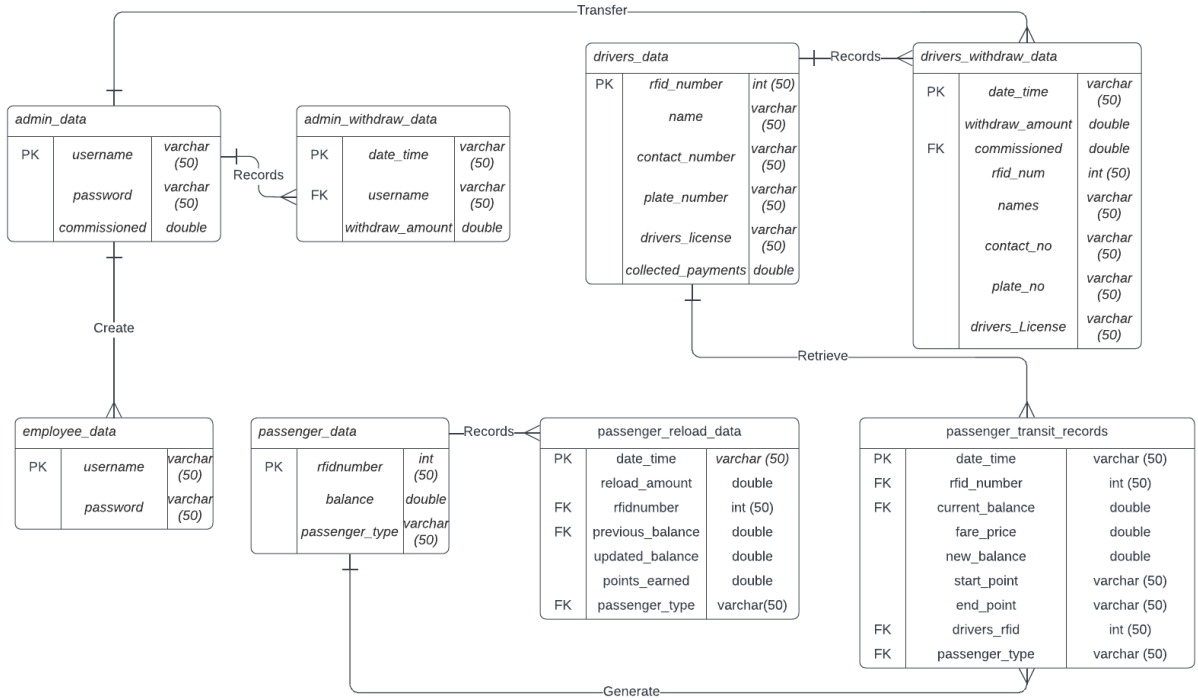

Figure 4.16 TAPCAB Entity Relationship Diagram

Figure 4.16 shows the different types of entities and their relationships. It represents the database relationships of the TAPCAB system.

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Test Results: Passenger Survey

The following were undertaken during the Passenger Survey:

1. Presented the system to the respondents from Lipa City commuters.
2. Demonstrated and explained the functionalities of the system to the respondents.
3. Asked the respondents to use GForms for the survey.
4. Distributed the surveys to the respondents' using links. In compliance with the data privacy act, the respondents were not asked for sensitive information and their answers were treated confidentially.
5. Tabulated and computed the data that had been collected using appropriate statistical procedures.
6. Interpreted the results for the equivalent descriptive rating.

Part 1: Respondent's Demographics

In this survey there are 88 respondents who are using multi-cab as their mode of transportation. This includes different groups, non-residents, and residents of Lipa.

Numerical Rating	Interpretation
5	Strongly Agree
4	Agree
3	Neither Agree or Disagree
2	Disagree
1	Strongly Disagree

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Age	All Respondents	All %
16 to 20	20	23%
21 to 25	54	61%
26 to 34	10	11%
39 to 51	4	5%

Table 1: Age of the respondents

As seen on table 1, the age of the respondents is presented. Majority of them are 21 to 25 years old commuters.

Gender	All Respondents	All %
Female	44	50%
Male	44	50%

Table 2: Gender of the respondents

As seen in table 2, the gender of the respondents is presented. Both male and female are equal in percentages.

Occupation	All Respondents	All %
Student	59	67%
Employed	21	24%
Unemployed	1	1%
Self-employed	7	8%

Table 3: Occupation of the respondents

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As seen in table 3, the Occupation of the respondents is presented. Most of the respondents are students rating at 67%.

Do you own a Vehicle?	All Respondents	All %
Yes	56	63.6%
No	32	36.4%

Table 4: Ownership of vehicle

As seen in table 4, the ownership of the vehicle of the respondents is presented. 63.6% of respondents owned their personal vehicle, while 36.4% of the respondents didn't have their own vehicle.

How often do you commute?	All Respondents	All %
Everyday	22	25%
2-3 times a week	37	42%
Once a week	15	17%
Once a month	14	16%

Table 5: Frequencies of commuting

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Part II: Level of census in Commuters Who use Multicab Section

Questions	5	4	3	2	1	% Of 5	% Of 4	% Of 3	% Of 2	% Of 1
Do Multicab Transportations help you when commuting?	50	29	7	1	1	57%	33%	8%	1%	1%
I feel secure when taking out my wallet inside the multi-cab.	20	19	24	23	2	23%	22%	27%	26%	2%
It is convenient for me to ask my payment to be passed by the other commuters to the driver.	27	24	14	22	1	31%	27%	16%	25%	1%
I am hesitant to ask for my change from the driver when they tend to forget it.	26	25	11	10	16	31%	28%	13%	11%	18%
I am fully aware of my surroundings inside the multi-cab.	41	27	15	5	0	46.6%	30.7%	17%	5.7%	0%
I try to avoid sitting near the driver's seat to avoid interaction with another passenger and driver inside the multi-cab.	40	22	20	6	0	45.5%	25%	22.7%	6.8%	0%
I feel conscious when the other passengers don't notice me when I reach my fare going to the driver.	34	33	16	5	0	39%	38%	18%	6%	0%
I am conscious about my safety when the driver is driving while counting fares and retaliating?	28	44	11	5	0	31.8%	50%	12.5%	5.7%	0%
I am worried about the risks of passing the fare of your fellow commuters which might lead to the transmission of COVID19.	46	34	5	1	2	52%	39%	6%	1%	2%

Table 6: Level of Census in Commuters Who use Multicab

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Table 6 shows the commuter's experience when using the multi-cab transportation, it rates that the protocols in the multi-cab association should change for commuters to have a better commuting experience

Part 3: Implementation of TABCAB to Public Transport (Multi-Cab Association)

Questions	Yes	No	% Of Yes	% Of No
I have knowledge of what is Intelligent Transportation System	64	24	72.73%	27.27%
Do you want to experience a new smart technology for transportation?	82	6	93.18%	6.82%
Would you like your transportation to be smarter or more connected?	86	2	97.73%	2.27%
Have you tried paying your fare using a smart card?	44	44	50%	50%
Are you willing to use a smart card for paying the fare in Multicab?	84	4	95.45%	4.55%
Are you willing to buy a Smart Card (Tab Cab Card) in the future?	83	5	94.32%	5.68%
I believe that the "all-in-one card" fare system is more convenient for Public Transportation.	83	5	94.32%	5.68%
Do you think that the services to the citizens will get better if smart technology is widely implemented under a smart city concept?	83	5	94.32%	5.68%
I believe that using the TAPCAB card should be accepted in the modernization program of the city.	85	3	96.59%	3.41%
I believe that TAP CAB will be helpful for every passenger	82	6	93.18%	6.82%
I believe that it will be more convenient to use daily.	84	4	95.45%	4.55%
Tap cab will directly collect the fare for you, would this be a benefit to you?	82	6	93.18%	6.82%

Table 7: Implementation of TABCAB to Public Transport

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Table 7 shows the commuter's insights into the TAPCAB system as an alternative payment method for multi-cabs.

Questions	5	4	3	2	1	% Of 5	% Of 4	% Of 3	% Of 2	% Of 1
Using card payment is better for our health compared to paying in cash	37	33	15	1	2	42%	38%	17%	1%	2%
Using card payment is more commuter-friendly for senior citizens and PWD compared to paying in cash	49	21	13	3	2	56%	24%	15%	3%	2%
Using card payment is more systematic in terms of getting its passengers.	39	36	10	1	2	44.3%	40.9%	11.4%	1.1%	2.3%

Table 7.1: Implementation of TABCAB to Public Transport

Table 7.1 shows the comparison of traditional payment methods and cashless methods.

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Questions	5	4	3	2	1	% Of 5	% Of 4	% Of 3	% Of 2	% Of 1
Would you recommend other commuters use the TAPCAB RFID Payment system as their primary payment option?	48	23	8	0	9	55%	26%	9%	0%	10%
Are the questions asked necessary for the development of the TAPCAB RFID System?	45	23	11	2	7	51%	26%	13%	2%	8%
How would you rate your survey experience today?	47	23	9	2	7	53.41 %	26.14 %	10.23 %	2.27%	7.95%

Table 7.2: Implementation of TABCAB to Public Transport

In table 7.2 the majority rated 5 with all the questions in this table. The percentage of the respondents who would recommend the other commuters to use the TAPCAB RFID Payment system as their primary payment option is 55%. The respondents that agree that it is necessary for the development of the TAPCAB RFID System is 51%.

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Survey Test Results: ISO/IEC 9126 Evaluation

The following were undertaken during the ISO/IEC 9126 Evaluation:

1. Presented the system to the respondents as a basis for evaluating the system.
2. Demonstrated and explained the functionalities of the system to the respondents.
3. Asked the respondents to use Google Forms for the survey.
4. Distributed the survey to the respondents' using links. In compliance with the data privacy act, the respondents were not asked for sensitive information or to provide their names in the surveys, and their answers were treated confidentially.
5. Tabulated and computed the data that had been collected using appropriate statistical procedures.
6. Interpreted the results for the equivalent descriptive rating.

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In this survey there are 52 respondents who provided data for the software evaluation.

Numerical Rating	Interpretation
5	Excellent
4	Very Good
3	Good
2	Fair
1	Poor

The formula in computing weighted mean is as follows:

Where: $\bar{x}$ = weighted mean

x = frequency

w = weight

$$\bar{X} = \frac{\sum(w \cdot x)}{\sum w}$$

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Overall Evaluation of TAPCAB: Transit Automated Payment for Commuters, Associates, and Businesses

CRITERIA	RATING					Weighted Mean	Interpretation
A. Functionality	**1**	**2**	**3**	**4**	**5**		
1. Suitability. The software performs the tasks required.	1	1	5	20	25	4.29	Excellent
2. Accurateness. The result is as expected.	0	4	1	23	24	4.29	Excellent
3. Interoperability. The system interacts with other systems.	0	3	4	23	33	4.23	Very Good
4. Security. The software prevents unauthorized access.	7	14	3	10	18	3.35	Good
B. Usability							
1. Understandability. The software is easy to use.	1	2	4	14	31	4.38	Excellent
2. Learnability. The system is easily learned.	0	3	4	16	29	4.37	Excellent
3. Operability. The system is used without much effort.	1	3	18	11	19	3.85	Very Good

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4. Attractiveness. The GUI interface looks good.	1	5	14	17	15	3.77	Very Good
C. Reliability							
1. Maturity. Most of the faults in the software have been eliminated over time	1	1	4	22	24	4.29	Excellent
2. Fault Tolerance. The software handles errors.	1	2	16	21	12	3.79	Very Good
3. Recoverability. Software resumes working and restores lost data	0	14	7	14	17	3.65	Very Good
D. Efficiency							
1. Time Behavior. The system responds quickly.	1	1	2	23	25	4.35	Excellent
2. Resource Utilization. The system utilizes resources efficiently.	1	0	3	21	27	4.40	Excellent
E. Portability							
1. Adaptability. The software can be moved to other environments.	5	17	7	4	19	3.29	Good
2. Installability. The software is installed easily.	1	3	4	15	29	4.38	Excellent

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3. Conformance. The software complies with portability standards.	1	1	4	20	26	4.33	Excellent
4. Replaceability. The software is easily replaced with other software.	9	12	7	7	17	3.21	Good
F. Maintainability							
1. Analyzability. Faults are easily diagnosed.	1	0	5	18	28	4.39	Excellent
2. Changeability. The software is easily modified.	0	2	4	19	27	4.37	Excellent
3. Stability. The software continues to function if changes are made.	1	1	4	18	28	4.37	Excellent
4. Testability. The software is tested easily.	0	1	4	19	28	4.42	Excellent
Overall Mean						**4.08**	**Very Good**

Table 8: Evaluation Results

Table 8 presents the summary of the evaluation results. The system attained an overall mean of 4.08 which is equivalent to a very good rating. This indicates that the system complies with the ISO 9126 software quality standards.

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Figure 4.17 TAPCAB Login Page UI

Screenshot 1 shows the TAPCAB software's user interface. It comprises having its own official logo, username input, and password input. It has an option to switch between employee or administrator level.

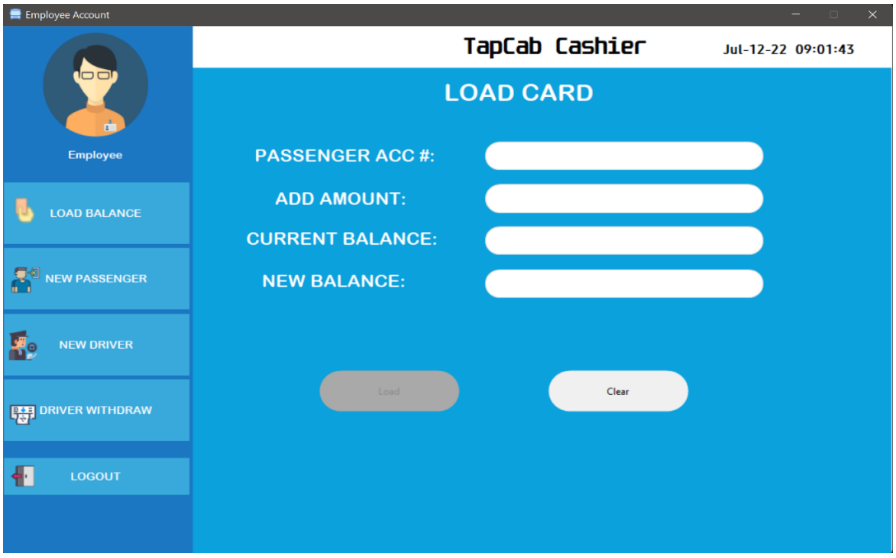

Figure 4.18 TAPCAB Cashier Loading Feature

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Screenshot 2 shows the cashier has the capability to reload the passenger's RFID card.

Figure 4.19 TAPCAB Cashier Passenger Registration Feature

Screenshot 3 shows the requirements to have a passenger account.

Figure 4.20 TAPCAB Cashier Driver Registration Feature

Screenshot 4 shows the data requirements to accomplish to have a driver account.

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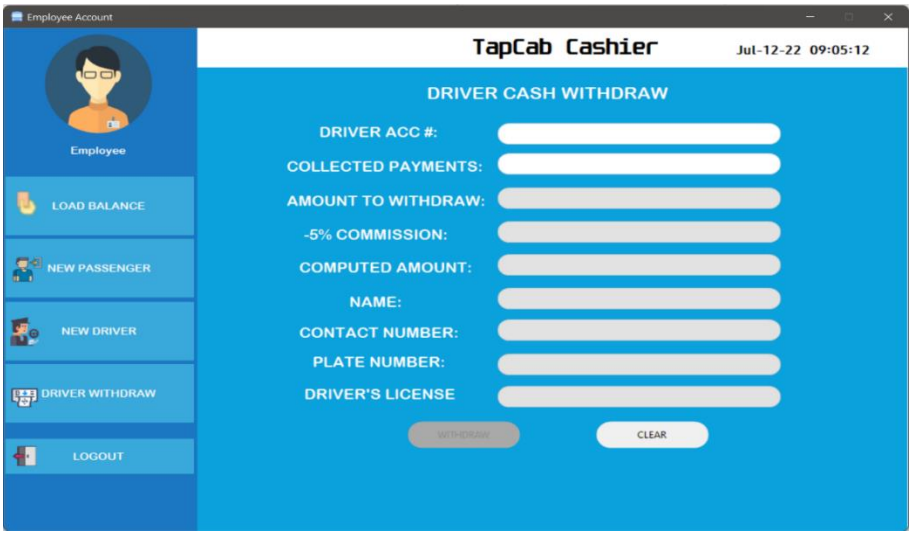

Figure 4.21 TAPCAB Cashier Driver Cash Withdrawal Feature

Screenshot 5 shows the driver withdrawal process.

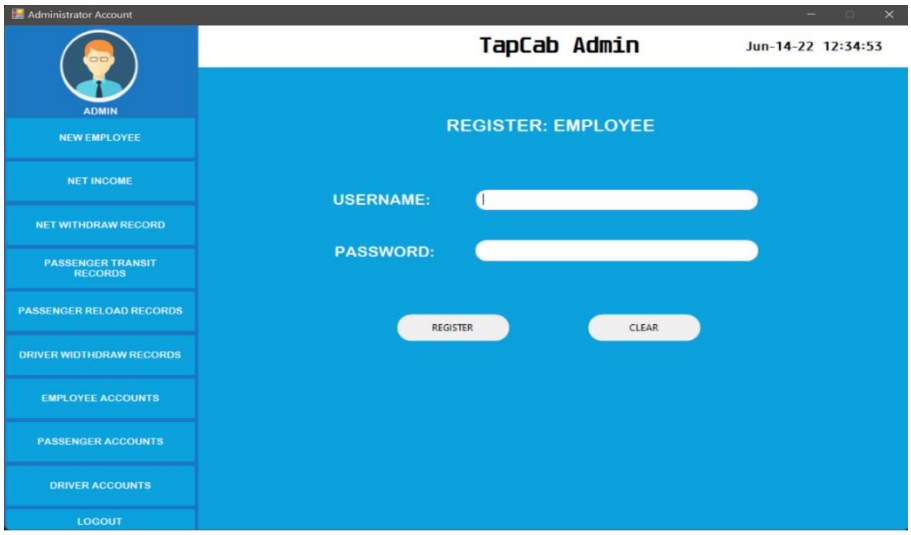

Figure 4.22 TAPCAB Administrator Employee Account Registration Feature

Screenshot 6 shows the creation of the employee account to access the cashier privileges.

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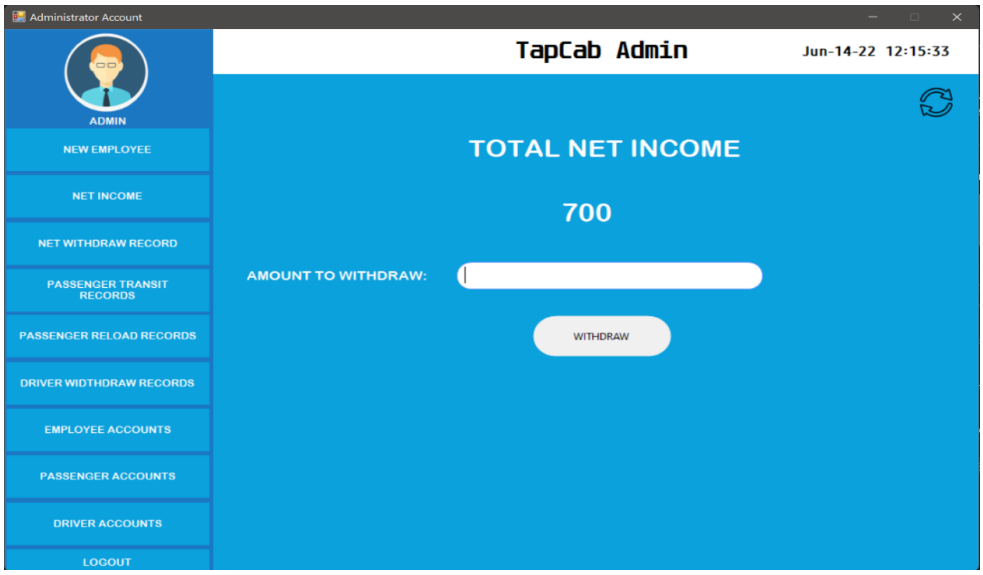

Figure 4.23 TAPCAB Administrator Net Income Withdraw Feature

Screenshot 7 shows the administrator's net income withdrawal process.

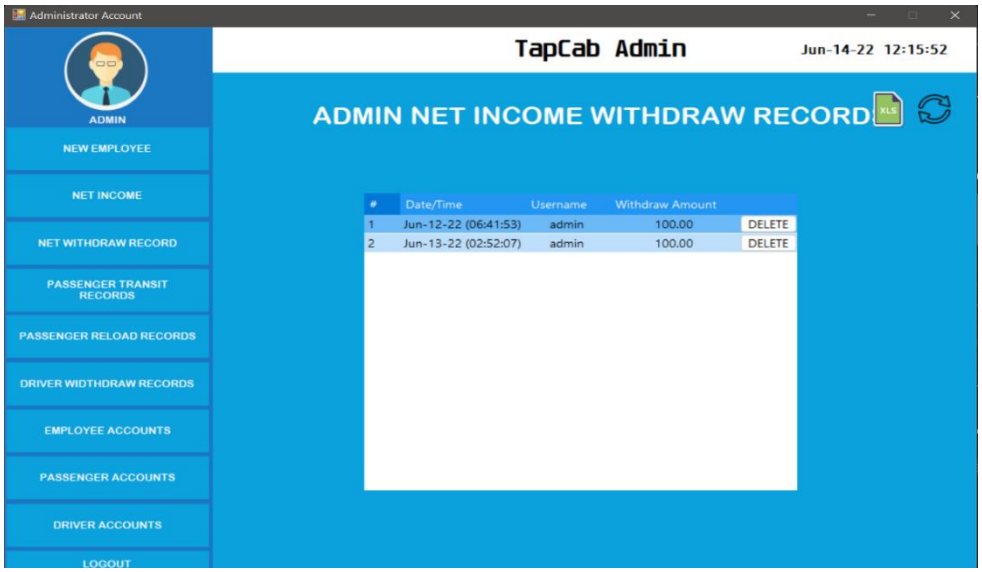

Figure 4.24 TAPCAB Administrator Net Income Records Feature

Screenshot 8 shows the administrators net income withdrawal records.

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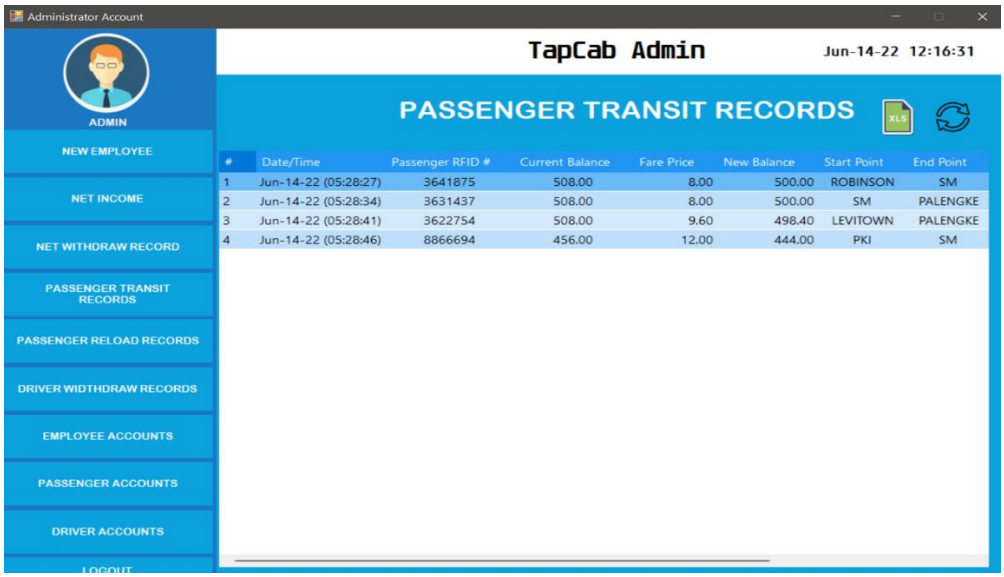

Figure 4.25 TAPCAB Administrator Passenger Transit Records Feature

Screenshot 9 shows the administrator's passenger transit records.

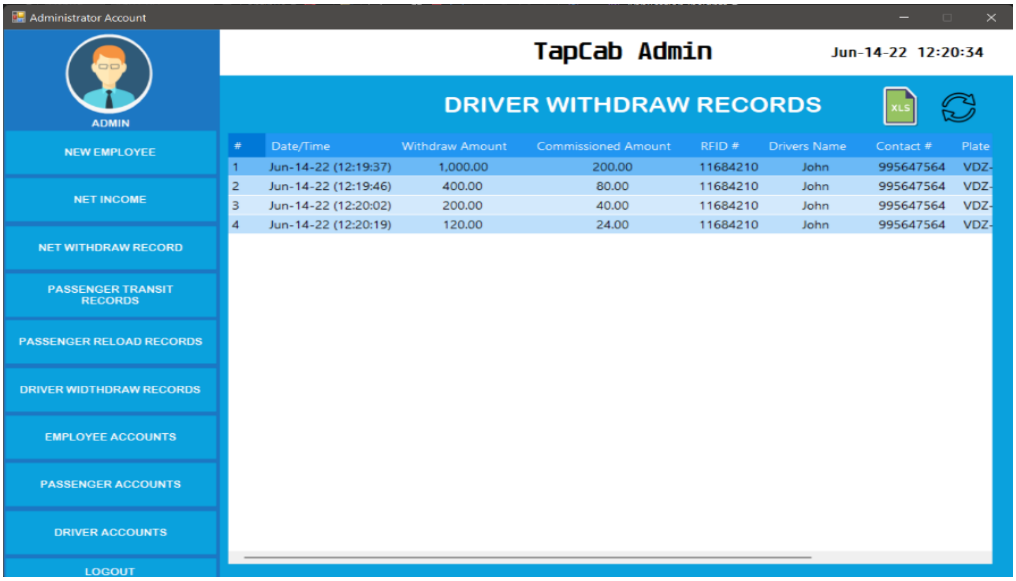

Figure 4.26 TAPCAB Administrator Passenger Reload Records Feature

Screenshot 10 shows the administrator passenger reload records.

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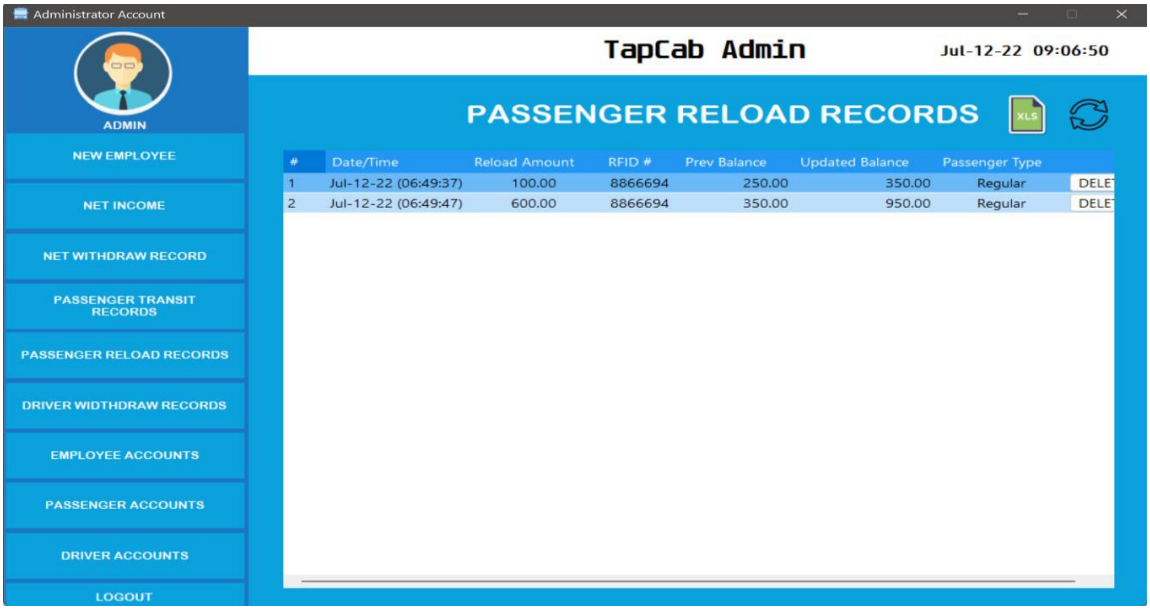

Figure 4.27 TAPCAB Administrator Withdrawal Records Feature

Screenshot 11 shows the administrator withdrawing records.

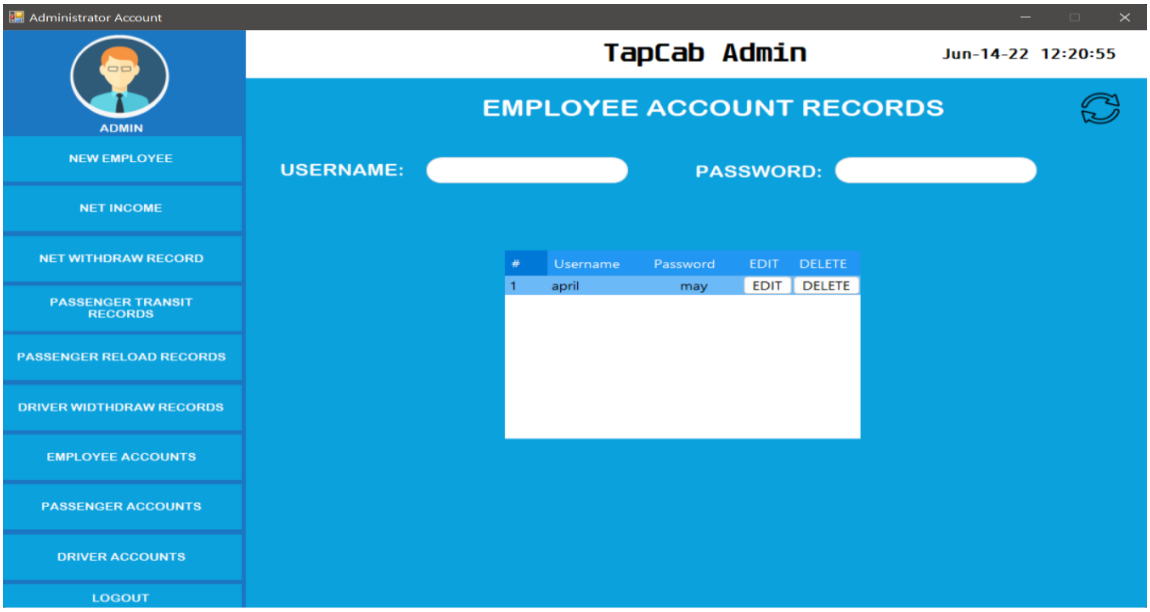

Figure 4.28 TAPCAB Administrator Employee Account Settings

Screenshot 12 shows the option to modify the employee accounts and shows the employee records.

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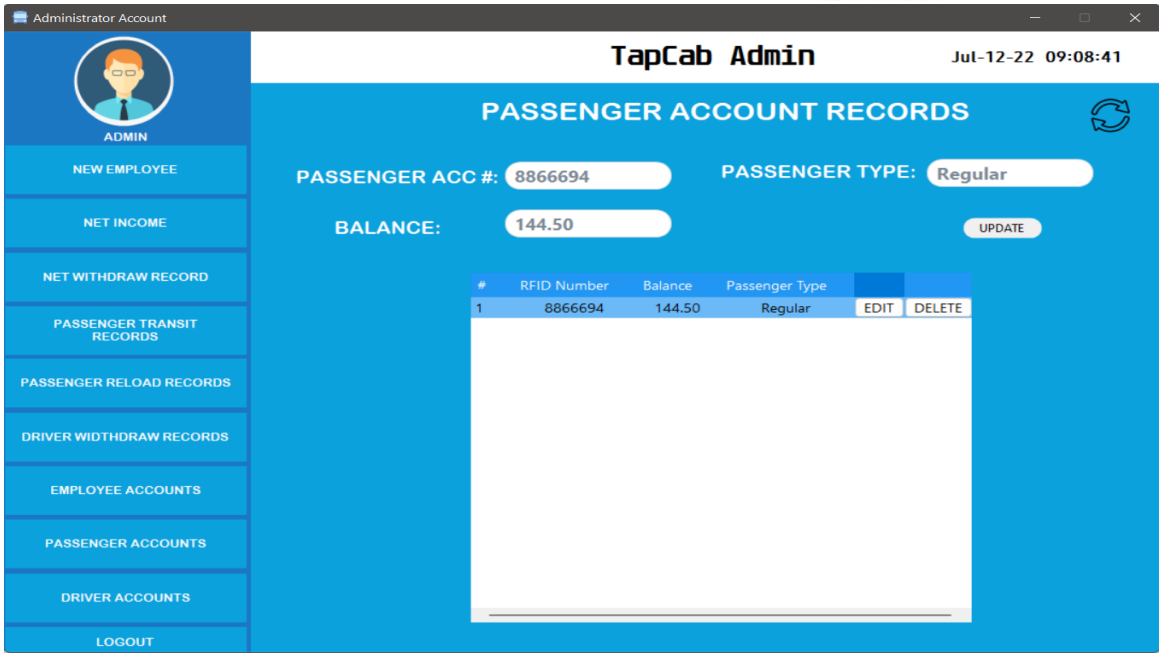

Figure 4.29 TAPCAB Administrator Passenger Account Settings

Screenshot 13 shows the option to modify the passenger accounts and shows the passenger records.

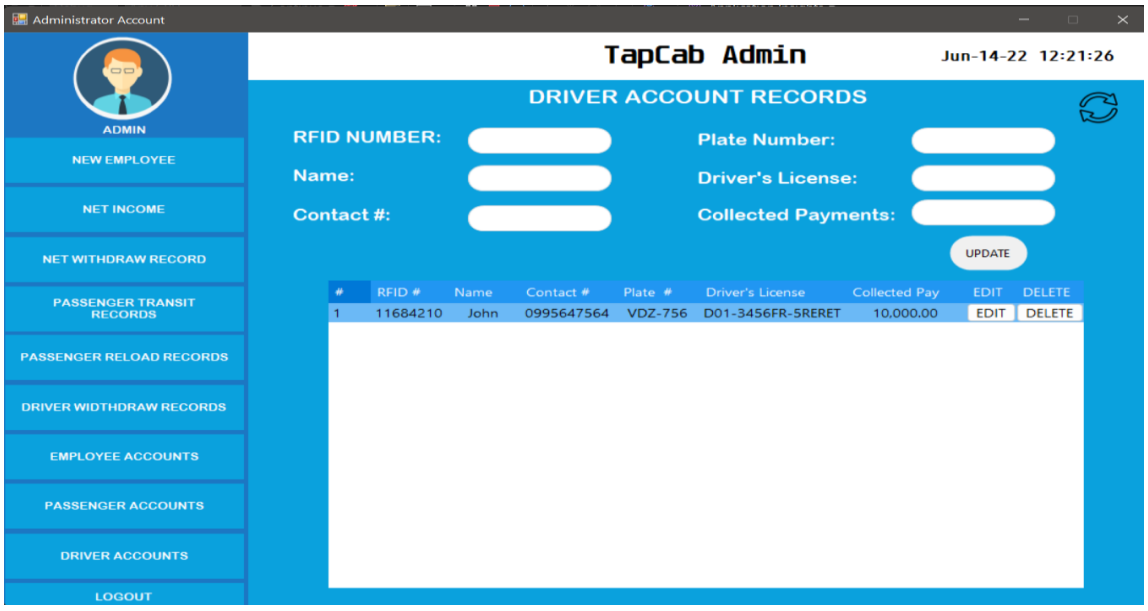

Figure 4.30 TAPCAB Administrator Driver Account Settings

Screenshot 14 shows the option to modify the driver accounts and shows the driver records.

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Telephone Numbers: +63 43 757 5277
Website: www.ub.edu.ph

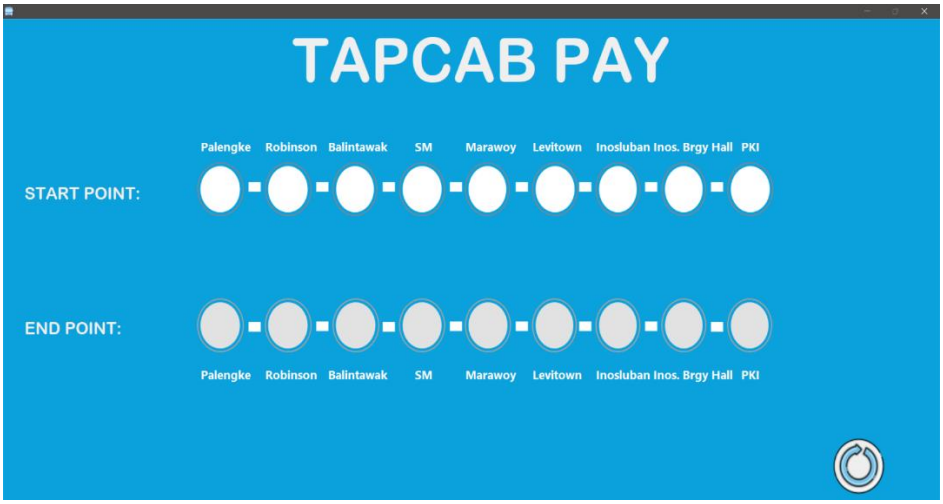

Figure 4.31 TAPCAB Multicab Fare Collection System Software UI

Screenshot 15 shows the TAPCAB Multi-Cab Fare Collection System. It comprises the starting point and the end point of the trip. After the selection of the starting and ending point, the user must tap their card on the RFID reader for the system to determine if the card has a discount or not. Upon the tapping of the card, the fare price and new balance will be displayed in the lower-left corner of the screen. If the user made a mistake in selecting the starting or ending point, the user may click the reset button at the lower right corner of the UI.

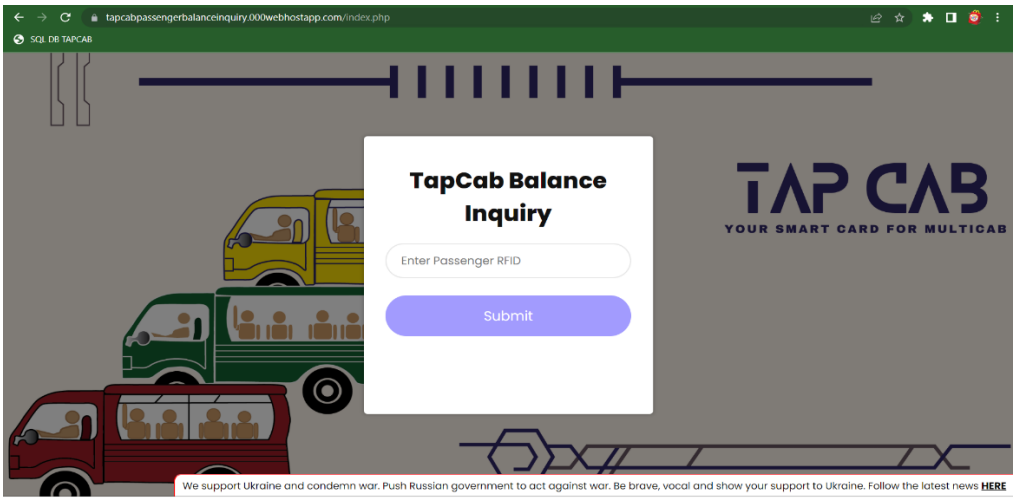

Figure 4.32 TAPCAB Balance Inquiry Website for Passengers

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Screenshot 16 shows the TABCAB Balance Inquiry website for passengers. To use it, the user must input a valid passenger's RFID number in order to query the balance for the user.

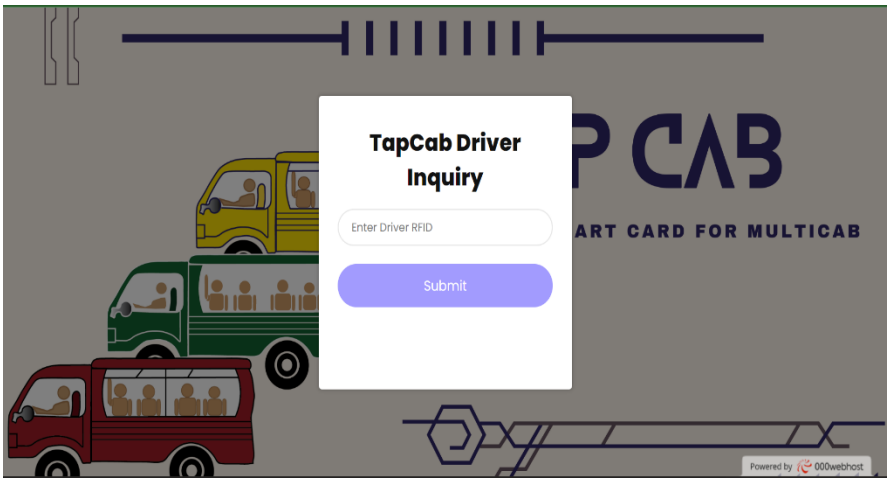

Figure 4.33 TAPCAB Balance Inquiry Website for Drivers

Screenshot 17 shows the TABCAB Balance Inquiry website for drivers. To use it, the user must input a valid driver's RFID number to query the collected payment information for the user.

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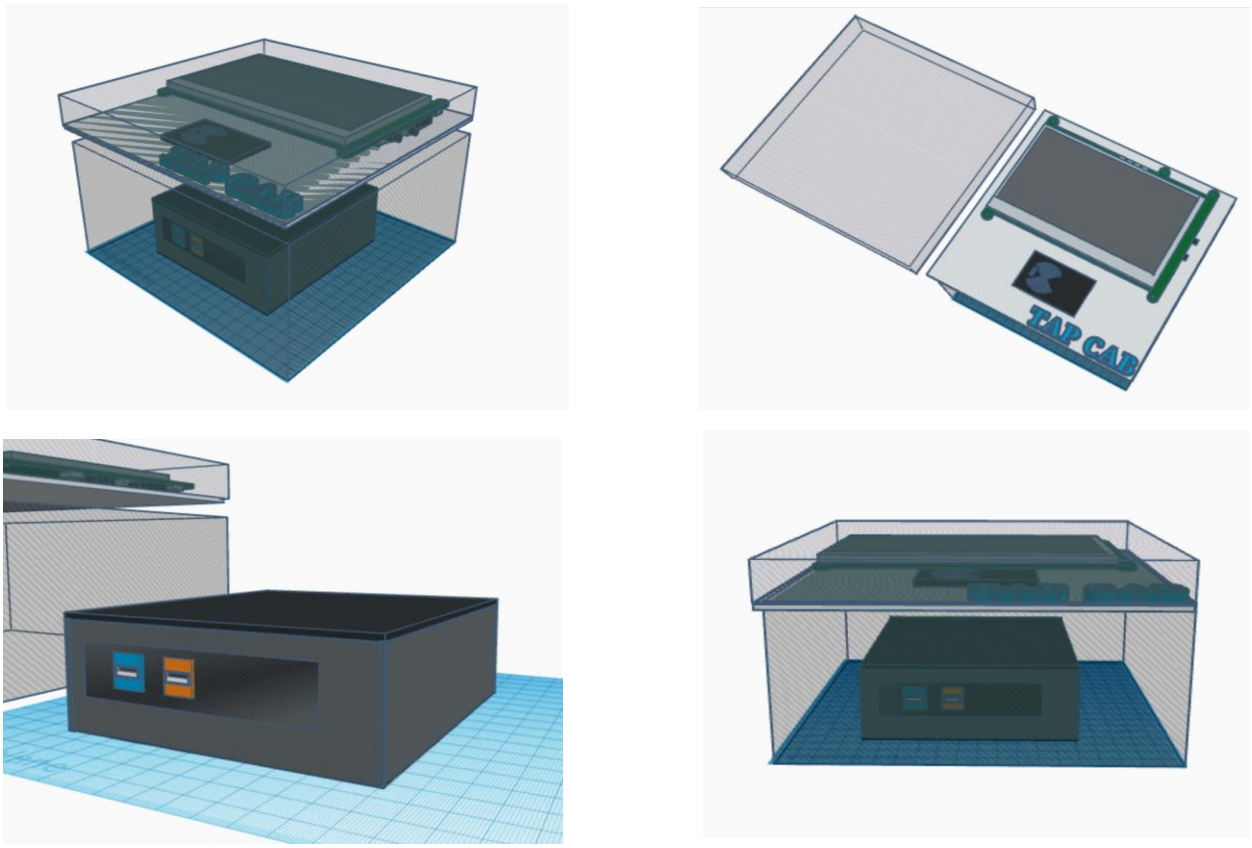

Figure 4.34 Proposed 3D Model of the TapCab Fare Collection System Hardware Prototype

Model 1 Shows the TAPCAB fare collection system hardware prototype with a 7-inch touchscreen, RFID scanner, NUC computer, and its water-proof acrylic enclosure.

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Figure 4.35 3D Model of the TAPCAB Fare Collection System Hardware

Model 2 Shows the TAPCAB Fare Collection System mounted to the right corner of the multi-cab.

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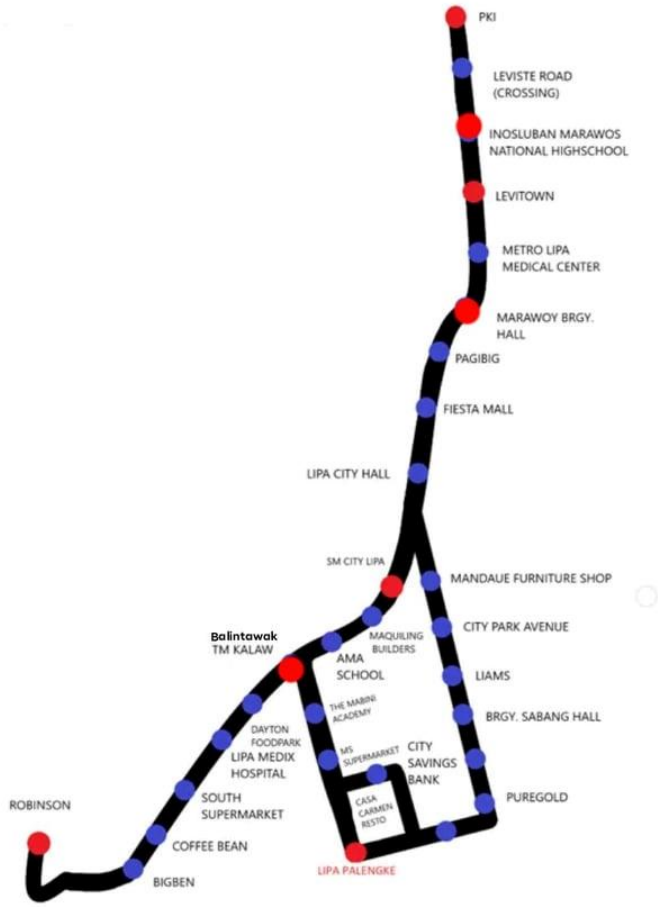

Figure 4.36 TAPCAB MAP ROUTE

Figure 5 shows TAPCAB multi-cab routes. The red dots indicate the presence of the TAPCAB registration and loading booth.

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Start Point	End Point	Kilometer	Fare Price Regular	S/E/D Fare Price
Lipa City Public Market	Robinsons Place Lipa	1.0 KM	11.00	8.80
Lipa City Public Market	SM City Lipa	1.2 KM	11.00	8.80
Lipa City Public Market	Marawoy, Lipa City	3.7 KM	11.00	8.80
Lipa City Public Market	Levitown, Lipa City	3.9 KM	11.00	8.80
Lipa City Public Market	Inosluban, Lipa City	4.4 KM	11.00	8.80
Lipa City Public Market	Inosluban Barangay Hall	5.3 KM	12.50	10.00
Lipa City Public Market	PKI	5.9 KM	12.50	10.00
Robinsons Place Lipa	SM City Lipa	2.2 KM	11.00	8.80
Robinsons Place Lipa	Marawoy, Lipa City	3.8 KM	11.00	8.80
Robinsons Place Lipa	Levitown, Lipa City	4.0 KM	11.00	8.80
Robinsons Place Lipa	Inosluban, Lipa City	4.3 KM	11.00	8.80
Robinsons Place Lipa	Inosluban Barangay Hall	5.3 KM	12.50	10.00

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Robinsons Place Lipa	PKI	6.1 KM	14.00	11.20
Balintawak, Lipa City	Inosluban Barangay Hall	4.6 KM	11.00	8.80
Balintawak, Lipa City	PKI	5.4 KM	12.50	10.00
SM City Lipa	Lipa City Public Market	1.2 KM	11.00	8.80
SM City Lipa	Marawoy, Lipa City	1.3 KM	11.00	8.80
SM City Lipa	Robinsons Place Lipa	2.2 KM	11.00	8.80
SM City Lipa	Levitown, Lipa City	2.2 KM	11.00	8.80
SM City Lipa	Inosluban, Lipa City	2.5 KM	11.00	8.80
SM City Lipa	Inosluban Barangay Hall	3.5 KM	11.00	8.80
SM City Lipa	PKI	4.2 KM	11.00	8.80
Marawoy, Lipa City	SM City Lipa	1.3 KM	11.00	8.80
Marawoy, Lipa City	Lipa City Public Market	3.7 KM	11.00	8.80
Marawoy, Lipa City	Robinsons Place Lipa	3.8 KM	11.00	8.80
Levitown, Lipa City	SM City Lipa	3.9 KM	11.00	8.80

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Levitown, Lipa City	Lipa City Public Market	2.2 KM	11.00	8.80
Levitown, Lipa City	Robinsons Place Lipa	3.9 KM	11.00	8.80
Inosluban, Lipa City	SM City Lipa	2.5 KM	11.00	8.80
Inosluban, Lipa City	Robinsons Place Lipa	4.3 KM	11.00	8.80
Inosluban, Lipa City	Lipa City Public Market	4.4 KM	11.00	8.80
Inosluban Barangay Hall	SM City Lipa	3.5 KM	11.00	8.80
Inosluban Barangay Hall	Balintawak, Lipa City	4.6 KM	11.00	8.80
Inosluban Barangay Hall	Lipa City Public Market	5.3 KM	12.50	10.00
Inosluban Barangay Hall	Robinsons Place Lipa	5.3 KM	12.50	10.00
PKI	Levitown, Lipa City	2.3 KM	11.00	8.80
PKI	SM City Lipa	4.2 KM	11.00	8.80
PKI	Balintawak, Lipa City	5.4 KM	12.50	10.00
PKI	Lipa City Public Market	5.9 KM	12.50	10.00
PKI	Robinsons Place Lipa	6.1 KM	14.00	11.20

Table 9 TAPCAB Route Pricing

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Table 9 shows the TAPCAB route pricing along lipa city with and without discount also the kilometers per destination.

Figure 4.37 TAPCAB Card Design

Model 3 shows the TAPCAB card designs for drivers, PWD, regular, senior, and students. Driver card collects the payments from the passengers. Regular indicates standard fare. Senior, student and PWD provide a 20% discount.

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CHAPTER 5

Conclusion and Recommendation

This section contains the summary of the study, conclusions, and recommendations regarding the research entitled T.A.P.C.A.B. (Transit Automated Payment for Commuters, Associates, and Businesses), a smart card for multi-cabs in Lipa City. This study presents the research results and will state recommendations for future researchers.

This research paper has achieved its main objectives through the whole development of the system using the Agile Methodology. The data that was collected and analyzed during the research study from the other research study, assessment of relevant articles, survey responses from multi-cab commuters, phone interviews with officers of the multi-cab association, and exploration of the routes and terminals in the Lipa City area where public transportation innovation can be potentially implemented in the near future.

After completing the research project "T.A.P.C.A.B. (Transit Automated Payment for Commuters, Associates, and Businesses)" and considering its goals and testing and assessment results, the researchers reached the following conclusions:

1. Using Microsoft Visual Studio 2022 (VB.NET), Freesqldatabase.com (MySQL/phpMyAdmin Hosting Platform), and Ph.000webhost.com (Website Hosting Platform). a T.A.P.C.A.B. (Transit Automated Payment for Commuters, Associates, and Businesses) The application thrived.
2. The conceptual framework, flowchart, context diagram, and data flow diagram have successfully been used to design and develop Program (G.U.I.) Application and Website with the following features:
    a. Administrators and Cashiers have different levels of access.
    b. It can Manage users by adding, changing, and deleting.
    c. Store records in the database.
    d. Balance loading and withdrawal.

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e. Passenger/driver balance inquiry.
f. Obtain payment from passengers.
g. Able to redeem reward points.
h. Export records into excel format.

3. The application successfully met the required functionality.
   a. The software is able to calculate and display accurate data to the users.
   b. The software is simple to use and can be quickly mastered.
   c. The software is modular so that the developers can easily add new features to the system and continue to function after modifications.
   d. The software is installed easily and is reliable.
   e. The software utilizes the resources efficiently and responds on time.
4. The application can fully implement the Transit Automated Payment for Commuters, Associates, and Businesses (T.A.P.C.A.B.).

Recommendation

Upon completion of the development of the Transit Automated Payment for Commuters, Associations, and Businesses (T.A.P.C.A.B), the researchers evaluated that there are recommendations that needed to be considered:

1. To attain foreign and local investors to establish partnerships with companies that will benefit from Transit Automated Payment for Commuters, Associations, and Businesses (T.A.P.C.A.B).
2. To fully implement the Transit Automated Payment for Commuters, Associations, and Businesses (T.A.P.C.A.B) to other modes of transportation like buses, jeeps, vans, and tricycles as a mode of payment.

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APPENDICES

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Survey Questionnaire Template

T.A.P.C.A.B

(Transit Automated Payment for Commuters, Associates, and Businesses)
(Passenger Survey Questionnaire)

Rationale

Good day!

The research entitled "TAP CAB (Use of Card payment for Multicab transportation within Lipa City)" is being conducted by the Information Technologies students from the University of Batangas Lipa Campus.

Considering this, the researchers would highly acknowledge your kind consideration. This questionnaire will ascertain the use of card payment for multicab transportation within Lipa City and used for educational purposes only, your participation is highly needed. The respondents will be anonymous, and the researchers will ensure the confidentiality of the responses. There are no right or wrong answers because all answers will be accepted respectably.

Note: Respondents are required to answer all questions.

Information Technologies Researchers

Endozo, Jamie

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Part 1: Respondent's Profile

The respondents will be anonymous, and the researchers will ensure the confidentiality of the responses. There are no right or wrong answers because all answers will be accepted respectably.

Direction: Please write down the answer on the questions below and put a check mark on the space provided that corresponds to your answer.

Name: _____

Age: _____

Gender: _____

What is your current work set-up?

- ○ Student
- ○ Employed
- ○ Unemployed
- ○ Self-Employed

Do you own a vehicle?

- ○ Yes
- No

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How often do you commute?

- Everyday
- 2-3 times a week
- Once a week
- Once a month

Part II: Level of Agreement in Commuters Who use Multicab Section

Direction: Consider the indicators under each area by reflecting on the level of agreement of effective communication in the restaurants. Please refer to the scale below and place a check under the appropriate column that represents your perception.

5 – Strongly Agree

4 – Agree

3 - Neither Agree nor Disagree

2 – Disagree

1 – Strongly Disagree

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Questions	5	4	3	2	1
Do Multicab Transportations help you when commuting?					
I feel secure when taking out my wallet inside the multicab.					
It is convenient for me to ask my payment to be passed by the other commuters to the driver.					
I am hesitant to ask for my change from the driver when they tend to forget it.					
I am fully aware of my surroundings inside the multicab.					
I try to avoid sitting near the driver's seat to avoid interaction with another passenger and driver inside the multicab.					
I feel conscious when the other passengers don't notice me when I reach my fare going to the driver.					
I am conscious about my safety when the driver is driving while counting fares and retaliating?					
I am worried about the risks of passing the fare of your fellow commuters which might lead to the transmission of COVID19.					

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Part 3: Implementation of TABCAB to public transport (Multi-Cab Association)

TAPCAB (Transit Automated Payment for Commuters, Associates, and Businesses)

In view of the rising number of private vehicles and different types of public transit, multicab continue to be the most cost-effective means of transportation in Lipa City. In addition, while creating a greater revenue yield, considerations surrounding the driver's environment, particularly in terms of safety and user compatibility, are addressed.

The researchers have chosen a specific device that provides a solution to a problem. It will operate the new payment method. However, this discontinues the "Bayanihan" concept of passing the payment, changing from one passenger to another to pay the driver. It also eliminates one of the arguments raised in social media when the Anti-Distracted Driving Act was enforced in June 2017: jeepney drivers are often distracted behind the wheel as they drive the vehicle and receive the payment, calculate the change and pass it to the passengers. This will make the driver more focused on driving instead of collecting the passengers' payment.

This study will be a rapid and seamless payment process that provides a compelling passenger experience, significant operational efficiencies, and improved resource performance. Passengers may pay quickly and easily, eliminating the need to wait in line to handle cash and change. It can also help the passengers make public transportation more appealing and easier for younger generations while enhancing your city's sustainability. Better operational efficiency, adopting tap-to-pay technology is faster with lesser workforce requirements.

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Questions	Yes	No
I have knowledge of what is Intelligent Transportation System		
Do you want to experience a new smart technology for transportation?		
Would you like your transportation to be smarter or more connected?		
Have you tried paying your fare using a smart card?		
Are you willing to use a smart card for paying the fare in Multicab?		
Are you willing to buy a Smart Card (Tab Cab Card) in the future?		
I believe that the “all-in-one card” fare system is more convenient for Public Transportation.		
Do you think that the services to the citizen will get better if smart technology is widely implemented under a smart city concept?		
I believe that using the TAPCAB card should be accepted in the modernization program of the city.		
I believe that TAP CAB will be helpful for every passenger		
I believe that it will be more convenient to use in a daily basis.		
Tap cab will directly collect the fare for you, would this be a benefit to you?		

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Questions	5	4	3	2	1
Using card payment is better for our health compared to paying in cash					
Using card payment is more commuter-friendly for senior citizens and PWD compared to paying in cash					
Using card payment is more systematic in terms of getting its passengers.					

Part V: Survey Evaluation

Questions	5	4	3	2	1
Would you recommend other commuters use the TAPCAB RFID Payment system as their primary payment option?					
How would you rate your survey experience today?					
Are the questions asked necessary for the development of the TAPCAB RFID System?					

Comments / Suggestions: _____

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Interview Letter

University of Batangas
LIPA CITY

May 8, 2022

Hon. Rowel Luay
Vice President of Multi-Cab Associations in Lipa City
Lipa City

Greetings!

We, the fourth-year students of the Bachelor of Science in Information Technology program at the University of Batangas Lipa City Campus, are now conducting research on **"TAP CAB (A SMART CARD FOR MULTI-CABS IN LIPA CITY)"** In line of this, we respectfully seek an interview to discuss our study and improve upon the current payment system of the multi-cab association. With your genuine responses, this interview will be very beneficial in obtaining information that will significantly improve the quality of this study.

Rest assured that any information provided to us will be utilized only for the purpose of this study and kept confidential at all times.

We appreciate your time and looking forward to hearing from you.

Jamie Nicole T. Endozo
Renier M. Infante
Juan Antonio C. Gonzales
Researchers

Noted by:

Mr. Russel G. Reyes
CAPSTONE Adviser

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ABSTRACT

TITLE: Transit Automated Payment for Commuters, Associates, and Businesses (A Smart Card for Multi-cabs in Lipa City)

RESEARCHERS: Endozo, Jamie Nicole T.

Gonzales, Juan Antonio C.

Infante, Renier M.

DEGREE: Bachelor of Science in Information Technology

SCHOOL: University of Batangas – Lipa City

TYPE OF DOCUMENT: Thesis

ACADEMIC YEAR: 2021 – 2022

Information technology plays a vital role in the development of smart cards. Smart Cards are secure portable storage devices used for several app security-related ones involving access to the system's database either online or offline. For the future of smart cards to prosper, it is important to consider several aspects and factors, especially those resulting due to the rapid advancement in information and communication technology. The contactless TAPCAB card is easier to use, more technologically advanced, and more reliable and efficient than the conventional way of payment, in accordance with the findings.

The TAPCAB has the following features to aid the multi-cab association like having distinct level of privileges of the administrator and cashier account, loading and withdrawing balance, adding, editing, and deleting users, balance Inquiry for passengers

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and drivers, collection of payment from passengers, store and retrieve records in the database and export records into excel format.

T.A.P.C.A.B: Transit Automated Payment for Commuters, Associates, and Businesses (A Smart Card for Multi-cabs in Lipa City) designed to be used by commuters for payment convenience. The study used Agile methodology to achieve the initial hardware and software prototype. The aim of this study is to create and develop software designed specifically for the multi-cab association to innovate the multi-cab transportation payment method in Lipa City.

The structure of the system was designed using a conceptual framework, system flowchart, entity-relationship diagram, and data flow diagram. This application and website were developed using VB.NET, PHP, CSS, MYSQL, and Guna Framework. The study concluded using surveys and interviews that the T.A.P.C.A.B: Transit Automated Payment for Commuters, Associates, and Businesses can be possibly implemented in Lipa City for multi-cabs as an alternative method of payment.

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SUBMITTED BY:

Gonzales, Juan Antonio C.

THESIS ADVISER:

Russel Reyes

Faculty, College of Information Technology, Entertainment and Communication

APPROVED BY:

Dr. Mayling Ilagan-Capuno

Dean, College of Information Technology, Entertainment and Communication

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SUBMITTED BY:

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CURRICULUM VITAE

Name: Jamie Nicole T. Endozo
Address: Brgy. Calingatan, Mataasnakahoy, Batangas
Contact no.: 09972520803
E-mail Add: jamiendozo@gmail.com

OBJECTIVES:

Driven student leveraging studies in Information Technology seeks real-world experience as IT Intern. Offers strong interpersonal and task prioritization skills. Coming with the ability to learn and acquire extensive knowledge and experience while effectively performing my duties in an organization.

EDUCATIONAL BACKGROUND

TERTIARY : University of Batangas (Lipa Campus)
(Lipa City, Batangas)
(2018 - to present)

SECONDARY: La Purisima Concepcion Academy
(Brgy. 2, Mataasnakahoy, Batangas)
(2012 - 2018)

PRIMARY : La Purisima Concepcion Academy
(Brgy. 2, Mataasnakahoy, Batangas)
(I2006 - 2012)

TRAINING AND SEMINARS ATTENDED:

- Privacy and Cybersecurity, October 2021 Y4IT - 19th Youth Congress in Information Technology (Privacy and Cybersecurity)
- Career Development, October 2021 Y4IT - 19th Youth Congress in Information Technology (Career Development)

PERSONAL INFORMATION:

DATE OF BIRTH	: August 03, 1999
PLACE OF BIRTH	: Brgy. Bontog, Mataasnakahoy, Batangas
AGE	: 22
CITIZENSHIP	: Filipino
CIVIL STATUS	: Single
GENDER	: Female
RELIGION	: Roman Catholic
FATHER'S NAME	: Roderick Endozo
OCCUPATION	: Clerk of Court
MOTHER'S NAME	: Maureen Endozo
OCCUPATION	: Preschool Teacher
HEIGHT	: 152 cm
WEIGHT	: 40kg
PERSON TO CONTACT	: Maureen Endozo (09776221189)

INCASE OF EMERGENCY
CHARACTER REFERENCES

Russel Reyes

IT instructor

University of Batangas

RUSSEL.REYES@UB.EDU.PH

KIELLY CHRIZZA MAE

College Professor

University of Batangas

KIELLYCHRIZZAMAE.TOJINO@UB.EDU.PH

MAYLING CAPUNO

College Dean

University of Batangas

MAYLING.ILAGAN@UB.EDU.PH

CONFORME:

By signing below, I hereby certify that the above-mentioned information is true and correct to the best of my knowledge and belief. I voluntarily waive any and all rights I may have to privacy and/or confidentiality pertaining to the above-mentioned purposes insofar as the information is released solely to the authorized persons in accordance thereto.

Jamie Nicole Endozo

(NAME OF STUDENT)

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Telephone Numbers: +63 43 757 5277
Website: www.ub.edu.ph

CURRICULUM VITAE

Name: Juan Antonio C. Gonzales
Address: 107 Granada Street, San Antonio Heights, Santo Tomas Bats.
Contact no.: 09190040886
E-mail Add: juanantoniogonzales47@gmail.com

OBJECTIVES:
To be a part of a company that would enhance my knowledge and skills to cope with today's modern technological advancements. To serve the company with integrity and enthusiasm to contribute to the company's success.

EDUCATIONAL BACKGROUND

TERTIARY:	UNIVERSITY OF BATANGAS LIPA Leviste Hwy, Lipa, Batangas 2018 - 2022
SENIOR HIGHSCHOOL:	ASIA PACIFIC COLLEGE Magallanes, Makati Philippines 2016 - 2018
EXTENSION (Grade 9-10):	LPU LAGUNA Km. 54 Pan-Ph Hwy, Calamba, Laguna 2014 - 2016
PRIMARY/SECONDARY:	DE LA SALLE LIPA 1962 J.P.Laurel National Hwy,Batangas 2005 – 2014

TRAININGS/CERTIFICATIONS/OJTs ATTENDED:

CERTIFICATION: Active Learning PH COMPTIA A+ Certificate of Training / Attendance
Certification Duration: September 6 - 10, 2021
Training Director: Gavin C. Lim Contact: (+63) 919-079-522
Website:https://activelearning.ph/courses/511-comptia-a-certification-training-philippines/

CERTIFICATION: CCNAv7: Enterprise Networking, Security, and Automation Online Class Certification Date: September 6, 2021
Approved by: Laura Quintanna
VP/General Manager, Cisco Networking Systems

CERTIFICATION: CCNA Cyber security Operations Online Class Certification Date: June 23, 2021
Approved by: Laura Quintanna
VP/General Manager, Cisco Networking Systems

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CERTIFICATION: JAVA PROGRAMMING (J2SE)
Location: 2nd Flr. UPY Bldg. Sen Gil Puyat Ave. Palanan Makati City, Duration: July 8, 2018 - August 26, 2018.
Certification #: 56PH1U8Q
Link To Verify: http://www.cnctc.edu.ph/verify.php

OJT:
OJT PC ASSEMBLY, Hardware, and Software Troubleshooting/ Repair and Data Recovery, Windows 2008 Server Active Directory Infrastructure Administration
Location: 2nd Flr. UPY Bldg. Sen Gil Puyat Ave. Palanan Makati City Company: Computer Networking Career and Training Center (CNCTC) Duration: May 11 - May 15, 2015
Contact Name: Rosario A. Reglos
Contact Number: (632)889-60-42 / (632)889-60-43

CERTIFICATION: PC LAN/WAN SETUP, CABLING, WIRELESS SETUP. TCP/IP AND WINDOWS 2008 SERVER ACTIVE DIRECTORY ADMIN
Location: 2nd Flr. UPY Bldg. Sen Gil Puyat Ave. Palanan Makati City Duration: May 4, 2015 - May 8, 2015
Certification #: 8XB30LGI
Link To Verify: http://www.cnctc.edu.ph/verify.php

CERTIFICATION: PC ASSEMBLY, Hardware, and Software Troubleshooting/ Repair and Data Recovery
Location: 2nd Flr. UPY Bldg. Sen Gil Puyat Ave. Palanan Makati City Duration: April 22, 2013 - April 26, 2013
Certification #: T6R762U8
Link To Verify: http://www.cnctc.edu.ph/verify.php

PERSONAL INFORMATION:

DATE OF BIRTH	:	April 7, 1999
PLACE OF BIRTH	:	San Jose Batangas
AGE	:	22
CITIZENSHIP	:	FILIPINO
CIVIL STATUS	:	Single
GENDER	:	Male
RELIGION	:	Catholic
FATHER'S NAME	:	Roberto Gonzales
OCCUPATION	:	Electrical Engineer
MOTHER'S NAME	:	Rowena Gonzales
OCCUPATION	:	Business Woman
HEIGHT	:	5'10
WEIGHT	:	80kg

PERSON TO CONTACT

Address: Governor Feliciano Leviste Road, Lipa City 4217, Batangas, Philippines
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Website: www.ub.edu.ph

INCASE OF EMERGENCY: Rowena Gonzales 09254793418

CHARACTER REFERENCES

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KIELLY CHRIZZA MAE
College Professor University of Batangas
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MAYLING CAPUNO
Dean
University of Batangas
MAYLING.ILAGAN@UB.EDU.PH

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Juan Antonio C. Gonzales
(NAME OF STUDENT)

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CURRICULUM VITAE

Name: Renier M. Infante

Address: 67 Interior Rizal Street, Brgy. 3, Lipa City, Bats.

Contact no.: 0975 614 2033

E-mail Add: renierinfante@gmail.com

OBJECTIVES:

As an on -the-job trainee I would like to acquire a challenging position that I can apply and expand my skills and knowledge where it can contribute to achieve the goal of the organization.

WORK EXPERIENCE:

Ava's Kitchen
Service Crew
Kap.Simeon Luz St, Lipa City, Batangas
2015-2016

Brgy. 3 Barangay Hall
SK Councilor
Interior Rizal Street Barangay Tres, Lipa City, Batangas
2018-2022

Computer Set and Computer Parts buy and sell
Barangay Tres, Lipa City, Batangas
2019-2020

CCTV Systems Installation Services
Installation service of CCTV cameras
Maintenance of CCTV systems
Barangay Tres, Lipa City, Batangas
2020-2021

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EDUCATIONAL BACKGROUND

TERTIARY: University of Batangas, Lipa City
Maraouy-Balete Road Balintawak, Lipa, Batangas
2018-2022

SECONDARY: The Mabini Academy
Balintawak, Lipa, Batangas
2011-2018

PRIMARY: Padre Valerio Malabanan Memorial School
Barangay 1, 4217 Lipa, Batangas
2005-2011

AFFILIATION:

Sangguniang Kabataan ng Barangay Tres - 03, Lipa City

Councilor

2018-2022

ACHIEVEMENTS:

Dean's lister
University of Batangas, Lipa Campus
2018-2019

Dean's lister
University of Batangas Lipa Campus
2019-2020

Dean's lister
University of Batangas Lipa Campus
2020-2021

TRAININGS AND SEMINARS ATTENDED:

Y4iT 2021 - The 19th Youth Congress on Information Technology
Via Zoom
October 12-14, 2021
CCNAv7: Enterprise Networking, Security, and Automation
Cisco Networking Academy

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6 Sep 2021
CCNA Cybersecurity Operations
Cisco Networking Academy
23 Jun 2021

RESOLUSYON-NUMBER-192019-SK-CALIRAYA-TEAM-BUILDING
Caliraya Resort and Hotel, Laguna
August 9-11, 2019
Y4iT 2018 - The 16th Youth Congress on Information Technology

UP Diliman, Quezon City
September 24 to 26, 2018

SK Mandatory Training
First Asia Institute of Technology and Humanities
May 22, 2018
February 28 – March 1, 2019

Creotec Philippines, Inc.
Human Resource dept.
Parc, Lima Residence Building National Highway Purok 3 Bugtong na Pulo, Lipa City, Batangas
Jan-Feb 2018

PERSONAL INFORMATION:

DATE OF BIRTH	:	March 25, 1998
PLACE OF BIRTH	:	Lipa City, Batangas
AGE	:	23 years old
CITIZENSHIP	:	Filipino
CIVIL STATUS	:	Single
GENDER	:	Male
RELIGION	:	Roman Catholic
FATHER'S NAME	:	Roderick M. Infante
OCCUPATION	:	Dog breeder
MOTHER'S NAME	:	Lorenza M. Infante

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