

Ticket Purchase System using RFID and Bus Location Tracking System with GPS Tracker

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Abstract: The Ticket Purchase System using RFID and Bus Location Tracking Systems with GPS Tracker is a system that performs ticket bookings and bus location tracking, developed for intercity Malaysia bus operators. The technology employs Radio Frequency Identification (RFID), which allows the cardholder to perform a transaction with RFID card in a contactless payment terminal such as a kiosk. The system aims to help user book bus tickets online and make payments using RFID technology, by scanning RFID card at ticketing kiosks counter. In addition, the implementation of a GPS tracker for the current location of the bus so that users can know where they are while boarding the bus. This project also aimed to establish an expected arrival time for the trip so that they can be aware of the arrival of the bus. The methodology that has been used to develop this system is the System Development Life Cycle (SDLC) Waterfall Model and internet of things (IoT) equipment, for example, Raspberry Pi 3, RFID Scanner Card Module, and GPS Board Module. It has also been tested several times and got satisfactory results. The result of the evaluation of the respondents' opinions about this system is that most respondents, namely 80% user, stated that this system facilitates the purchase of tickets online while 80% respondents think that there is an increase in their bus company's ticket sales by 60% and above compared to before using this system. Hence, our future improvement goal is to integrate NFC in the payment system.

Keywords: Payment, Online Reservation, Maps, Passenger, Intercity, Seat

1. Introduction

A bus is a large vehicle carrying passengers that operates according to a specific itinerary. Express buses are for long journeys that stop only in a few big cities or places to eat. Buses are one of the main options for public transportation services that are the community's choice to go anywhere, especially for travel abroad [1]. However, sometimes customers queue long to buy bus tickets and ask for information [2].

Currently, passengers can buy bus tickets at the booths of various intercity bus service companies around the bus station or on bus ticket business websites for all states in Malaysia. If the purchase is made through the website, the payment options available are the FPX system, credit card, or debit card. FPX is an alternative payment channel that does not require a credit card for consumers to pay for their consumers on e-market locations such as websites and online stores. Any transaction needs electronic authorization to improve the protection of the user account. The debits are automatically deducted from the user's account. Transactions are encrypted using the customer's Personal Identification Number (PIN) online account [3]. Based on **Figure 1**, from the analysis and evaluation survey, respondents stated that usually, if they want to know the current position of the bus, they will try to search for a nearer signboard or open a maps application on the phone or otherwise ask the bus driver.

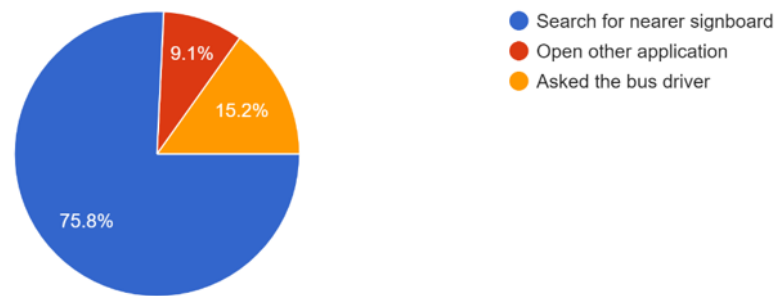


Figure 1: Method to Know Current Location of the Bus

This system, 'Ticket Purchase System using RFID and Bus Location Tracking System with GPS Tracker,' was developed to solve these problems. Therefore, the main objective of this project is to create a ticket booking system using RFID payment types. In addition, to produce GPS bus location. Next is to establish an expected arrival time for the trip. The system is developed for use in every fourteen states in Malaysia.

This project is quite significant to many parties. Firstly, to the individuals and the community, this project helps them prepare to plan their trips more systematically. In addition, consumers get broader exposure to using payment methods by RFID tag/ smart card. Secondly, on behalf of industry and government, they will benefit from developing this system through more efficient management of public transport services. Thirdly, it also will prepare the country for a more advanced era in using new technologies, such as intelligent cities, through the development of RFID on every public transportation across the country for the time to come.

The following section discusses the related studies on the RFID technology and tracking system with GPS trackers. Then, Section Three examines the methodology used in this study, while Section Four focuses on the result and analysis, followed by the conclusion in Section Five.

2. Literature Review

The Online Bus Ticket Booking System is a web -based application that allows visitors to check bus ticket availability, buy bus tickets and pay for bus tickets online [4]. The system is set up for all home or office users after gaining access from the administrator. Therefore, the online bus ticket booking system is helpful for both passengers and transportation companies [5]. The online bus booking system offers a bus transportation system, accommodations for reserved seats, and a variety of inquiries that need to be answered right away. Users of this system are able to utilise it to make bookings online for any aspect of their business. Users do not need to install this platform; they can use it immediately on their website.

2.1 The Advantages of This Platform

There are several online bus booking platforms in use nowadays for the convenience of the users. Among them are redBus, AbhiBus, MakeMyTRip, MyBusTicket and many more online bus booking platforms in Malaysia. When comparing the platforms, we create and with existing platforms, we find some of the advantages that our platforms gain. Among the advantages and differences of the existing online bus booking platform and ‘Ticket Bus Booking System using RFID and Bus Location System with GPS Tracker’.

2.1.1 Using RFID Payment Type Via Smart Card

When purchasing bus tickets, customers must deal with a number of issues, one of which is the lengthy line outside the ticket office. However, the situation in the Malaysian bus transport business has radically changed with the introduction of payment methods that employ RFID. Cash, tokens, and passes can all be replaced with smart cards, often known as touch and go cards. A memory or microprocessor that is integrated into a computerised chip known as a smart card is referred to as a smart card [6]. One benefit of using it is that it speeds up the payment process. For instance, if a customer purchases a ticket at the counter, they must wait in line for a very long time because there are several steps involved in the payment process, such as entering personal information and paying with cash. Customers can avoid long lines by paying at the kiosk because they do not need to enter their personal information to utilise the kiosk. Additionally, utilising the kiosk is safer because the customer only needs to scan, and we are able to detect consumer data thanks to the user id number. So, with payments using RFID it's faster because it's touch and go.

2.1.2 Generate a GPS Bus Location

Formerly existing platform that allows passengers to find their location after boarding the bus. Customers may now locate the bus before boarding it by using ‘Ticket Bus Booking System using RFID and Bus Location System with GPS Tracker’. As a result, even if the consumer is not yet aboard the bus, they can occasionally know where the bus is now located.

2.2 The Disadvantages of This Platform

The lack of a line of sight between the transmitter and receiver, which results in the GPS signal being attenuated, makes GPS tracking devices, which can detect in all weather conditions, unsuitable for tracking bus whereabouts at underground bus stops [4].

2.3 GPS Tracking Bus in Public Transportation

The GPS is a system for calculating the position from signals sent by a satellite network to determine the status accurately, and it can pick the strong signals [7]. The GPS and GSM-based system may offer all the essential bus tracking characteristics. Our suggested technology can locate the bus. Once the information has been uploaded to the server, commuters can access it via a web-based application over the internet. The bus is able to be followed in real time, every day of the week. So, GPS trackers offer a comprehensive bus tracking and security solution. This system provides high expansibility, minimal operating costs, and a wide range of capabilities [8].

2.4 RFID in Public Transportation

The term Internet of Thing refer to any item connected to the internet up to information exchange and communication as well as radio frequency identification (RFID), infrared sensors, global positioning system, laser scanner and other information sensing devices, according to the agreed-upon protocol in order to achieve intelligent network identification, location, tracking and management [9]. RFID technology automates data collecting, minimizing human and labour mistakes dramatically. The RFID reader is a mobile or stationary device that connects to a network. Switching on the tag sends a

wave back to the antenna, which is translated into data. Since, RFID technology has three main function that is tagging, addressing, and sensing, it has the unique ability everyone and everything in real life using methods in virtual reality networks [10]. Besides, with the introduction of RFID based ticketing, this advancement of the booking system became a lot more user friendly, automated method of ticketing as well as credit transaction [11].

3. Materials and Methods

3.1 Materials

The Raspberry Pi 3 (**Figure 2 (a)**) is a main tool for this project development. It turned on the Micro SD card and GPS Module connected to it, to read and store data about the project such as the latitude and longitude of location in the particular state and make programming in Python language.

The RFID card is purposely gathered the passengers' information on the RFID USB reader by scanning their id number to be displayed at the kiosk screen (**Figure 2 (b)**).

The Micro SD Card (**Figure 2 (c)**) served as the initial storage location for the operating system and files where the Raspberry Pi does not come with internal storage. The Class 10 type has been chosen as it is the fastest and most suitable class for operating high performance of input and output on screen.

The female-to-female jumper wire (**Figure 2 (d)**) is used to connect the GPS Module to the Raspberry Pi for transferring location data to be read and displayed on the Raspberry Pi screen.

The Global Positioning System (GPS) module (**Figure 2 (e)**) is directly received satellite data via dedicated RF frequencies. This module aimed to track the particular location of the state that included in this bus location tracking, by determining the location and position longitude as well as latitude then transferred the data to the Raspberry Pi through the jumper wire, to be read and displayed what the bus current location.

The USB card reader (**Figure 2 (f)**) is an external device utilized to read, copy and backup data from Micro SD Card adapter. It allowed to easily shared information from a Micro SD card by reading and writing data as well as access to SD card files.

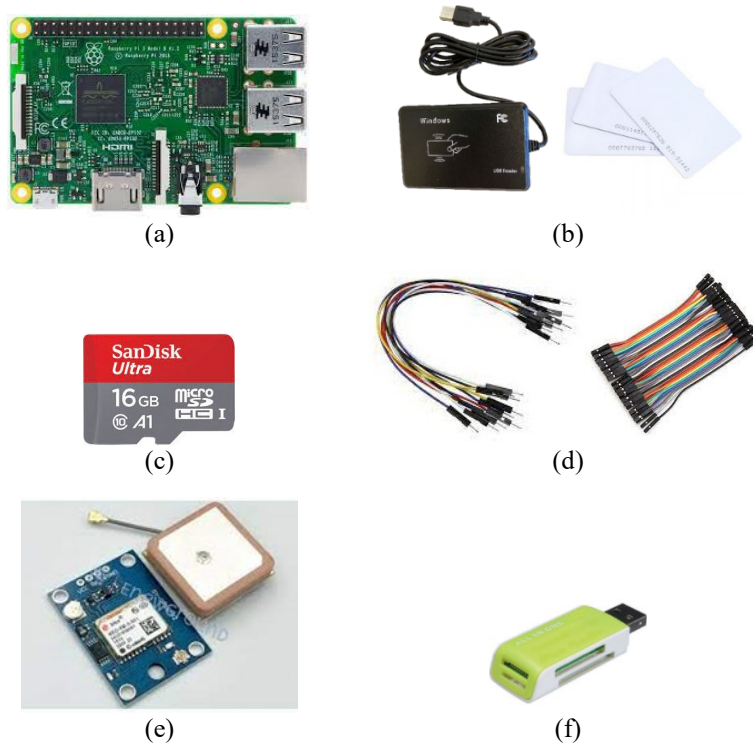


Figure 2: Materials, (a) Raspberry Pi 3, (b) RFID Card Scanner Module, (c) Micro SD Card Class 10, (d) Female-to-Female Jumper Wire, (e) GPS Module, (f) USB Card Reader

3.2 Methods

First and foremost, in this project, the Software Development Life Cycle will be used as a method in developing the 'Ticket Purchase System using RFID and Bus Location Tracking System with GPS Tracker'. The Systems Development Life Cycle (SDLC) Waterfall Model is a phrase used to describe the numerous stages involved in the development of an IT project, from concept to construction. The approach is separated into six stages, each with its own set of processes. **Figure 3** below are the processes included in the methodology we used for the system development.

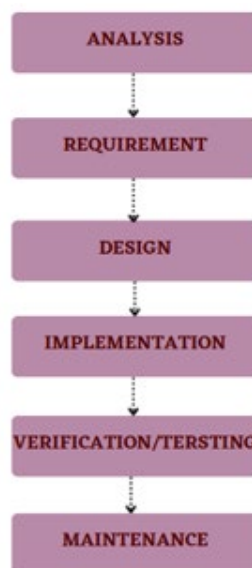


Figure 3: Waterfall Model

3.2.1 Analysis

This stage started with a comprehensive understanding of the system's requirements and processing, such as outlining the product's functionality, performance standards, and security site. We brainstormed ideas for the overall flow of the booking and tracking system. After consulting with our supervisor, the idea would include hardware and software listings that would be used for development. In addition, an initialization and identification for the system's needs, flow, scope, and function are included, such as analysing what the system requires, such as helpful software and hardware, such as a GPS Module and its programming. Analysed the flow, scope, and function to determine who the booking and tracking system would be useful for. Planned how the system will move from one page to another and provide customers with a user-friendly function. During this phase, we held a meeting to discuss the entire system before moving on to the next phase of planning.

3.2.2 Requirement

Moving on to the requirement phase, we understood what needs to be designed, as well as the function, purpose, and specification of the advanced system. First and foremost, we designed user, admin, and vendor interfaces to see how the flow would work. Because of the good design, it also facilitates interaction between the user and our website. It not only focuses on the aesthetics of a website, but also on its responsiveness, efficiency, and accessibility, distinguishing our system's website from other bus ticket booking websites. The hardware and software that we examined were also part of the requirement. As project supporters, we purchased a variety of hardware. GPS Module, Raspberry Pi 3, Jumper Wire, Memory Card, and RFID Module are among the hardware components. The software included the installation of the Raspberry Pi Operating System, VNC Viewer to control the Raspberry Pi, and other coding platforms. This requirement's description includes the system's features that specify what its requirement is, so we can gather details about it to see how it works and if it needs to be improved in the future. We also conduct research and gather information from websites such as YouTube and Journal. Based on the research, this aimed to provide a clear understanding and clarification for developing the system and preparing it for future maintenance. We anticipated that the booking and tracking system will operate smoothly with the presence of the hardware and software. This is because all of the required hardware and software are critical to the system's operation. We must ensure that the payment using an e-wallet and RFID works smoothly for the customer who pays at the kiosk. The main goal of this development system is also stated, which is to track the current location of the bus using GPS. The tracking system using GPS is to assist customers or users when they take a specific bus for a destination they want to go, with several hardware required to be used along in our project. They can use the GPS in the map that we will provide in the system to track the bus's current location so that they know when and where they will arrive. As a result, our system can produce the expected output with the requirements that come with a system that can benefit customers who use our ticket booking and location tracking system.

3.2.3 Design

During the design phase of this system, design for databases, design for interface pages for different users, and design for input and output identifiers involved in system operation were all implemented. An appropriate interface is required to create an efficient and customer-friendly approach, according to a specific type of user. As a result, the interface designs that have been created are:

- a. The user interface is designed.
- b. The admin interface is designed.
- c. The bus company manager's interface design.

The password security system for each type of user on the login interface has been designed to ensure that only the relevant users can access certain parts of the system. On the login interface page, users must enter two types of information: email and password. Furthermore, users who have forgotten

their account password can reset it by clicking 'Click here.' The user will then be redirected to another page and asked to enter the email address they registered with in order to set a new password via email. To confirm the setting of the new password, the user must enter it twice. By pressing 'Register,' new users can create a new account and gain access to the system. This system has three types of users: customers, administrators, and bus managers. Following that, they will be directed to their respective interface page.

3.2.4 Implementation

This project is themed on web systems and applications. Therefore, for designing the development, the Bracket application is used. It is to write coding for the system on the website and the application on the mobile phone. For database development, MySQL database is used. In addition, one of the main objectives of this system is to support the method of ticket payment by RFID. Therefore, two hardware are used, namely Raspberry Pi and Arduino RFID. Furthermore, this system can track the buses in their current position. Like the implementation of RFID payments, it also requires hardware to make it work, namely the NEO-6M GPS modules, combined with some software to produce a bus tracker to enable it to be seen on a map.

3.2.5 Verification or Testing

The testing phase of the waterfall methodology is where we can focus on investigation. During the testing phase, we find out whether our code and programming work accordingly and while it is not possible to solve all failures we might find during the testing phase, it is possible to use the result from this phase to reduce the number of errors within the software program. Before testing can begin, we developed a test plan. The test plan includes the types of testing we all will be using, resources for testing, how the software will be tested, who should be the testers during each phase and instructions for each tester user to test the software. There are several types of testing during the test phase, including quality assurance testing (QA), system integration testing (SIT), and user acceptance testing (UAT). Quality assurance (QA) is a method of systematically assessing whether a product or service fulfils certain standards (QA). Quality assurance creates and maintains a set of criteria for designing or manufacturing reliable products. System Integration Testing (SIT) is the overall testing of a system that is made up of several subsystems. SIT's major goal is to make sure that all software module dependencies are working properly, and that data integrity is maintained between different modules in the system. User Acceptance Testing (UAT), often known as beta or end-user testing, is the process of a user or customer evaluating software to see if it is acceptable. Once the functional, system, and regression testing have been completed, this is the final stage of testing.

3.2.6 Deployment and Maintenance

A project manager assigned to deliver a software application to an insurance company is in charge of the maintenance phase. The product is deployed to the insurance company after the coding and implementation phases of the waterfall are completed. Now that the insurance company has the software and it is functioning properly, the Maintenance team meets with the insurance company to provide instructions for the software's maintenance and upkeep. One of the most important phases of a product or software is the maintenance phase. Some changes may be required to improve performance. These modifications occur as a result of customer requests or defects discovered while using the product or software. After the product is completed, the waterfall maintenance phase begins. These modifications occur as a result of customer requests or defects discovered while using the product or software. The waterfall maintenance phase occurs after the product is fully operational. Software maintenance can include software upgrades, repairs, and fixes if the software breaks. Software applications are frequently required to be upgraded or integrated with new systems deployed by the customer. Additional software testing or version upgrades are frequently required. During the maintenance phase, errors or defects

may occur, necessitating repairs during additional software testing. The performance of the software is also monitored during the maintenance phase.

4. Results and Discussion

4.1 Results

An analysis and evaluation survey were conducted by the various type of people and the bus operator. **Table 2** below shows the results regarding the Ticket Purchase System using RFID and Bus Location Tracking System with GPS Tracker evaluation test based on the 33 respondents answered.

Table 2: Analysis Question

Questions	Answer
Age	A total of 26 out of 33 respondents ranged from 20 to 39 years old. While a total of 4 people were aged 40 to 59 years old, two were aged 13 to 19 years old, and the rest were respondents aged 60 to 79 years.
Gender	51.5% of the respondents were female, and 48.5% were male.
Do you always use the website to buy bus tickets?	Only one respondent stated that he had never bought a bus ticket on the website out of 33 people who responded.
Are you used to using RFID payment to make payment before this?	81.8% of the total respondents answered that they had never used RFID payment to make payment before this, while 18.2% responded that they had used it before.
Is it easy to use RFID payment on this system?	19 respondents said that RFID payment on this system is straightforward to use by giving a scale of 5, while 12 people gave feedback on its ease of use on a scale of 4 and the rest on a scale of 3. And no one states the scale of convenience to use this method of payment at intervals 1 and 2.
Usually if you want to track the location during the trip, which method do you use?	75.8% of respondents stated that they usually search the nearer signboard to track their location during the trip, while 9.1% used the open the other application method, and the rest by asking the bus driver.
Does this system make it easier to buy tickets?	Twenty-nine respondents gave a scale of 5 for the level of this system provided the facility to buy tickets, three people shared a group of 4, and one gave a scale of 3. And none of the respondents said it is complicated to buy tickets using this system on a scale of 1 and 2.
Does this system make it easy to know the current location of the bus?	Only 9.1% answered maybe they feel easy with this system to know the current location of the bus, while the rest stated yes. And no one answered no.
Choose your bus company.	Each 12 bus operators stated that their bus companies are Express Perdana and Aero system Travel, while another nine respondents said Sani United Berhad.
Has the number of ticket purchases for your company increased?	90.9% of the respondents stated that ticket purchase sales for their bus company increased, while the rest answered 9.1%. However, no respondent thought it did not increase at all.

State the percentage of total increase in ticket sales of your company after using this system.

Six out of 33 people think the percentage of the total increase in ticket sales for their company after using this system increased by 100% and 60%. In addition, ten people thought the percentage increase was 80% and 40%, while one said the growth for their company was only 20%.

The respondents concluded that the Ticket Purchase System using RFID and Bus Location Tracking System with GPS Tracker provides many benefits and improvements to the existing system. By using this system, the use of public services for express buses becomes more orderly and guarantees double customer satisfaction. In addition, the findings found that all respondents gave positive feedback for this system.

3.2 Discussion

Most people in this country have never used RFID-type payment before. It is not a strange thing because the fact is that this country is still new to the use of this technology. However, we figure out that this does not affect user satisfaction regarding the ease of using RFID payment on this system.

Then, there are a few standard methods previously used to find out the current location of a bus. Reliance on signboards shows a habit for most passengers. However, the technique requires a high level of sensitivity to be aware of the presence of signboards along the way. As most know, maintaining sensitivity consistency over time is pretty challenging.

Besides, many respondents responded that this system has made it easier for them to know the current location of the bus without the need to search the signboard, open other applications, or ask the bus driver anymore. Next, on **Figure 4**, most bus operators feel their ticket sales have increased compared to before using this system. However, only a tiny number stated there might be an increase in their bus ticket sales. Thus, it can be concluded that customer satisfaction also increases the enjoyment of bus operators using this system.

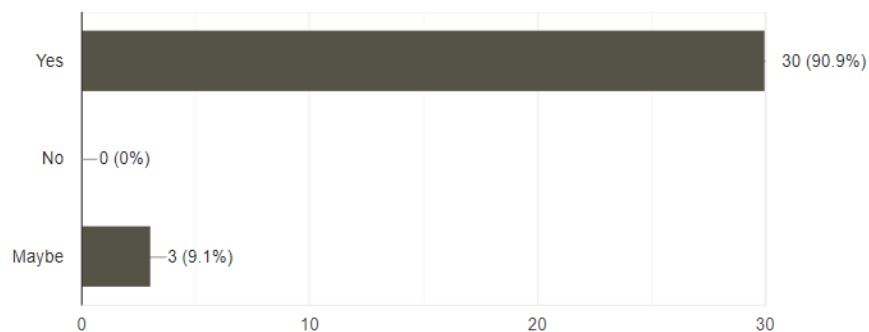


Figure 4: Opinion on the Increase in Ticket Purchases

5. Conclusion

Because purchasing tickets in the offline era presents a number of challenges to both passengers and bus operators. As a result, we are able to offer booking services and information to the users of this application without any constraints on office or labour hours thanks to the online ticket booking system that our firm designed. It is made for use by enterprises to manage internal business operations, lower human error, and address issues present in earlier systems. It not only enables consumers to purchase tickets at any time from any location with an internet connection. Customers may also quickly find out where the bus they are boarding is right now. because GPS and the internet are used to calculate distances and fares. A GPS device is integrated within the bus to determine its present location, and the network's GPRS service sends the bus's coordinates. Thus, by creating this system, we intend to assist

numerous users of this public service, whether they are accustomed to it or are just beginning to utilise it. We believe it can improve transformation for the transportation industry, which is frequently undervalued due to flaws in its organisational structure. However, we also think that by implementing RFID on all national public transportation for the foreseeable future, the nation will be better equipped to utilise new technologies, such as smart cities.

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