pAUTOMATIC BUS FARE SYSTEM

A PROJECT REPORT

Submitted by

HARINI PRABA M (2116210701069)
JEFFRIN TANIA B (2116210701093)

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BONAFIDE CERTIFICATE

Certified that this Thesis titled **"AUTOMATIC BUS FARE SYSTEM**" is the bonafide work of "**HARINI PRABA M (2116210701069), JEFFRIN TANIA (2116210701093)"** who carried out the work under my supervision. Certified further that to the best of my knowledge the work reported herein does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

SIGNATURE

Dr . N.DURAIMURUGAN M.E.,Ph.D.,

PROJECT COORDINATOR

Professor

Department of Computer Science and

Engineering Rajalakshmi Engineering

College

Chennai - 602 105

Submitted to Project Viva-Voce Examination held on__

Internal Examiner **External Examine**r

ABSTRACT

Public transportation systems are an essential part of modern urban infrastructure. Millions of people rely on buses as their public transport. However, managing the fare collection process in these systems can be a significant challenge for transportation authorities and operators. To address this challenge the automatic bus fare collection system can be implemented for accurate and efficient way of collecting fares from passengers, reducing the time and cost associated with manual fare collection methods. In this system, GPS technology is used to track the and allows the system to calculate fares based on the distance traveled, ensuring that passengers are charged accurately for their journeys. RFID technology can be used to identify and authenticate passengers, providing seamless and contactless fare collection experience. The objective of an automatic bus fare collecting system using GPS and RFID technology is to improve the efficiency and accuracy of fare collection in public transportation.

ACKNOWLEDGMENT

First, we thank the almighty god for the successful completion of the project. Our sincere thanks to our chairman **Mr. S. Meganathan B.E., F.I.E.,** for his sincere endeavor in educating us in his premier institution. We would like to express our deep gratitude to our beloved Chairperson **Dr. Thangam Meganathan Ph.D.,** for her enthusiastic motivation which inspired us a lot in completing this project and Vice Chairman **Mr. Abhay Shankar Meganathan B.E., M.S.,** for providing us with the requisite infrastructure.

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HARINI PRABA M

JEFFRIN TANIA B

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LIST OF SYMBOLS

1.	GHz	Giga Hertz
2.	KHz	Kilo Hertz

LIST OFABBREVIATIONS

S.NO	NAMES	
1.	ABFC	Automated bus fare collection
2.	CRT	Cathode Ray Tube
3.	DoD	Department of Defence
4.	EPC	Electronic Product Code
5.	GPS	Global Positioning System
6.	HF	High Frequency
7.	LCD	Liquid Crystal Display
8.	LF	Low Frequency
9.	RFID	Radio-Frequency Identification
10.	UHF	Ultra High Frequency

CHAPTER 1

Introduction

Automated bus fare collection (ABFC) systems are used in many urban public transport systems around the world. As the designation suggests, these are typically designed with the specific purpose of automating the ticketing system, easing public transport use for passengers and adding efficiency to revenue collection operations. In addition, ABFC systems are used to enable integrated ticketing across different public transport modes and operators in urban areas. This chapter gives you an introduction about the ABFC system and its real time applications. The main idea behind this project is to collect the fare automatically using the RFID and GPS in a cost-efficient manner. Internet of Things allows objects to sensed and controlled remotely across existing network infrastructure.

1.1 RFID TECHNOLOGY

RFID (Radio Frequency Identification) technology is a form of wireless device that allows for the identification and tracking of objects or living beings using radio waves. It consists of two main components: RFID tags and RFID readers.

RFID tags are small electronic devices that contain a microchip and also an antenna. They can be attached to or embedded in various objects, such as products, animals, or even humans. RFID tags come in different sizes and types, ranging from tiny tags the size of a grain of rice to larger tags used in industrial applications. These tags can be passive, meaning they do not have their own power source and rely on the energy from the RFID reader to function, or active, which have their own power source and can transmit signals without needing an external reader.

RFID readers are devices that use radio frequency signals to communicate with the RFID tags. They send out radio waves that energize the RFID tags within their range, allowing the tags to respond with their stored information. The RFID reader then captures and interprets the response, which may include data such as a unique identifier, product details, or location information. RFID readers can be handheld, fixed, or integrated into other devices, such as smartphones or gate systems.

RFID technology has many applications across various industries. One of the most common uses of RFID is in supply chain management, where it enables efficient tracking and tracing of goods during transportation and warehousing. It helps streamline inventory management, reduce theft, and improve overall logistics operations. In retail, RFID is used for inventory control, loss prevention, and enhancing the customer experience through technologies like self-checkout and smart shelves that automatically restock items.

RFID technology also finds applications in healthcare, where it can be used for patient identification, medication tracking, and asset management. In agriculture, RFID is used for livestock tracking, crop management, and food safety. It is also used in access control systems for secure entry into buildings, parking lots, and events.

One of the significant advantages of RFID technology is its ability to automate the processes and provide real-time visibility into the movement and status of objects. It can improve operational efficiency, reduce human error, and enhance security. However, there are also concerns about privacy and security with the Use of RFID, as the technology can potentially enable tracking and profiling of individuals without their consent.

In conclusion, RFID technology is a powerful tool for identifying and tracking objects or living beings using radio waves. It has a wide range of applications across various industries, offering benefits such as improved efficiency, enhanced security, and better customer experiences. As technology continues to evolve, RFID is expected to play an increasingly important role in many aspects of our daily lives.

1.1.1 HISTORY OF RFID

The history of RFID (Radio Frequency Identification) dates back to the early 20th century, with the development of wireless communication technologies. The concept of using radio waves to remotely identify objects or living beings was first proposed in the 1940s and 1950s, but it was not until the 1960s that practical RFID systems began to emerge. The earliest RFID systems were large and expensive, used primarily in military and industrial applications. They were based on technologies such as radar and were used for purposes such as tracking military aircraft and monitoring railroad cars. These early systems used large transponders, which were bulky and required direct line of sight between the reader and the transponder.

In the 1970s, with advances in microelectronics and the development of integrated circuits, RFID technology became more compact and affordable. This led to the commercialization of RFID for various applications, such as toll collection, access control, and livestock tracking. In the 1980s, the adoption of RFID expanded further with the introduction of passive RFID tags, which do not require their own power source and can be made smaller and cheaper.

The 1990s marked a significant milestone in the history of RFID with the development of the Electronic Product Code (EPC) by the Auto-ID Center at the

Massachusetts Institute of Technology (MIT). The EPC is a unique identifier that can be attached to products, allowing for individual item-level tracking in supply chains. This paved the way for the use of RFID in retail and other industries, as it provided a standardized way of uniquely identifying and tracking products throughout the supply chain.

1.1.2 TYPES OF RFID

RFID (Radio Frequency Identification) technology is classified into several types based on various factors, such as the operating frequency, the power source of the RFID tags, the read range, and the application requirements. The main types of RFID are:

Low-Frequency (LF) RFID: LF RFID operates at a frequency range of 125 kHz to 134 kHz. It has a short read range of up to 10 cm and is commonly used for applications such as access control, animal tracking, and asset management. LF RFID tags are usually passive and do not require their own power source, as they are powered by the electromagnetic field generated by the RFID reader.

High-Frequency (HF) RFID: HF RFID operates at a frequency range of 13.56 MHz. It has a short to medium read range of up to 1 meter and is widely used in applications

such as contactless payment systems, electronic passports, and library book tracking. HF RFID tags can be either passive or active, with passive tags being more common.

Ultra-High-Frequency (UHF) RFID: UHF RFID operates at a frequency range of 860 MHz to 960 MHz. It has a longer read range of up to several meters and is commonly used in applications such as supply chain management, inventory tracking, and retail logistics. UHF RFID tags can be either passive or active, with passive tags being more prevalent due to their lower cost and smaller form factor.

Microwave Frequency RFID: Microwave frequency RFID operates at frequencies above 1 GHz, typically around 2.45 GHz. It is used in specialized applications, such as industrial automation and vehicle identification, where longer read ranges and higher data transfer rates are required.

Passive RFID: Passive RFID tags do not have their own power source and rely on the energy from the RFID reader to operate. They are typically smaller, less expensive, and have a shorter read range compared to active RFID tags. Passive RFID tags are commonly used in applications such as supply chain management, inventory tracking, and access control.

1.2 GPS TECHNOLOGY

GPS (Global Positioning System) technology is a satellite-based navigation system that allows users to determine precise location, velocity, and time information anywhere on or near the Earth's surface. GPS was developed and is operated by the United States Department of Defense, but it is widely used by civilians for various applications, ranging from navigation and tracking to surveying and location-based services.

The history of GPS can be traced back to the 1960s when the U.S. Department of Defense initiated the development of a navigation system that could provide precise positioning information for military purposes. The system became operational in the 1970s with limited access for civilian use, and it has since gone through several upgrades and improvements to become the global navigation system we know today.

1.2.1 GPS HISTORY

In the 1970s, the U.S. DoD launched the first prototype of the modern GPS system, known as the Navstar GPS. Navstar GPS was designed to provide global positioning and timing information for military applications. It initially had limited access for civilian use, with the primary focus on military applications, such as navigation for aircraft, ships, and missiles.

Over the years, GPS has gone through several upgrades and improvements to enhance its accuracy, reliability, and availability. In the 1980s and 1990s, the U.S. DoD launched additional GPS satellites and made the system more accessible for civilian use. In 2000, President Bill Clinton ordered the discontinuation of the selective availability (SA) feature, which intentionally degraded the accuracy of GPS signals for civilian users, making GPS more accurate and reliable for civilian applications.

1.2.2 GPS TYPES

There are several different types of GPS (Global Positioning System) devices that are used for various purposes. Here are some of the common types of GPS devices:

1. Handheld GPS devices: These are portable GPS devices that are designed to be carried by hand and used for outdoor activities such as hiking, camping, and geocaching. Handheld GPS devices typically have a small screen, buttons or touchscreens for input, and built-in maps, waypoints, and tracking features.
2. Vehicle-based GPS devices: These are GPS devices that are installed in vehicles, such as cars, trucks, boats, and motorcycles. Vehicle-based GPS devices are typically larger than handheld devices and are designed to be mounted on the dashboard or windshield of the vehicle. They often come with

additional features such as voice-guided turn-by-turn directions, real-time traffic information, and points of interest (POI) databases.

3. Wearable GPS devices: These are GPS devices that are designed to be worn on the body, such as smartwatches, fitness trackers, and sports watches. Wearable GPS devices are often used for fitness and outdoor activities, providing location tracking, distance, and speed measurements, and other related data.

1.2.3 VOICE RECOGNITION

Welcome to the Automatic Bus Fare System, a revolutionary IoT project designed to streamline the process of fare collection and enhance the commuting experience for passengers. In this system, we incorporate voice recognition technology to facilitate seamless fare payment, ensuring efficiency and convenience for both passengers and transit authorities.

To initiate the fare payment process, simply speak clearly and concisely the following command: "Pay fare." The system will then prompt you to confirm the payment amount. You can confirm by stating "Yes" or "No" accordingly. If you encounter any issues or require assistance, feel free to ask for help by saying

Upon confirmation of the payment amount, the system will deduct the corresponding fare from your registered payment method. You will receive a verbal confirmation of the successful transaction along with your updated balance, if applicable.

In the event of an error or discrepancy, such as an unrecognized command or payment failure, the system will prompt you to repeat the action or seek assistance from the onboard staff.

Rest assured, your payment information and personal data are safeguarded through advanced encryption and authentication protocols. Voice recognition adds an extra layer of security by ensuring that only authorized users can access and utilize the fare payment functionality.

With voice recognition technology integrated into the Automatic Bus Fare System, commuting becomes not only more efficient but also more accessible and user-friendly.

CHAPTER 2

LITERATURE SURVEY

1. TITLE : Design and Implementation of Automatic Bus Fare Collection System using Smart Card Technology
   AUTHOR : R. Karthikeyan, et al.
   YEAR 2017
   This study presents the design and implementation of an ABFCS using smart card technology, including system architecture, fare collection process, and security features.

2. TITLE : Evaluation of Automatic Fare Collection System in Public Bus as a Case Study
   AUTHOR: M. Gamarra, et al.
   YEAR 2019
   This research evaluates the implementation of an ABFCS in public bus transport, analysing its impact on fare collection efficiency, revenue management, and passenger satisfaction.

3. TITLE :Technological Innovations in Automatic Fare Collection Systems for Public Transport
   AUTHOR: A. Manaktala, et al.
   YEAR 2018
   This literature review provides an overview of various technological innovations in ABFCS, including smart cards, contactless payment methods, mobile applications, and their benefits and challenges.

4. TITLE : Challenges and Opportunities of Automatic Fare Collection Systems: A Review
   AUTHOR: P. Lenka, et al.
   YEAR 2020

This review paper discusses the challenges and opportunities of ABFCS, including implementation costs, technology selection, equity and accessibility, and privacy and security concerns.

5. TITLE : An RFID-based Automatic Fare Collection System for Public Transportation.
AUTHOR: M. Ghosh, et al.
YEAR 2016
This paper proposes an RFID-based ABFCS for public transportation, including the design of RFID-based smart cards, fare collection process, and system evaluation.

6. TITLE : Mobile Ticketing in Public Transport: A Literature Review.
AUTHOR: C. Schroeder, et al.
YEAR 2018
This literature review focuses on mobile ticketing as a technology solution for ABFCS, including mobile applications, mobile wallets, and their benefits, challenges, and user acceptance.

7. TITLE : Enhancing Efficiency of Bus Fare Collection using Contactless Smart Card Technology.
AUTHOR: S. Yaseen, et al.
YEAR 2015
This research presents a contactless smart card-based ABFCS for bus fare collection, including system architecture, fare validation process, and security measures.

8. TITLE : A Review on the Impact of Automatic Fare Collection System on Public Transportation.
AUTHOR: R.Purushothaman, et al.
YEAR 2017
This review article provides an overview of the impact of ABFCS on public transportation, including fare collection efficiency, revenue management, passenger satisfaction, and environmental sustainability.

9. TITLE : Design and Implementation of a Cloud-based Automatic Fare Collection System for Public Transportation.
AUTHOR : A. Anand, et al.
YEAR 2018
This paper presents a cloud-based ABFCS that utilizes cloud computing technology for fare collection, including system architecture, ticketing process, and system evaluation.

10. TITLE : Integration of Automatic Fare Collection System with Internet of Things for Public Transportation.
AUTHOR: M. Subramani, et al.
YEAR 2019
This research proposes the integration of ABFCS with Internet of Things (IoT) technology for improved fare collection and data analytics, including system architecture, IoT-enabled smart cards, and system evaluation.

CHAPTER 3

EXISTING SYSTEM

In general way, every bus is controlled by a conductor. The conductor will collect money from each passenger and issue tickets. Initially, printed papers or tokens are used as tickets. Nowadays, handheld machines are used to print tickets. This system has many disadvantages. The passenger have to carry the ticket till the reaching their stopping, the conductor should ensure that everyone has got the ticket, the time taken for ticketing is comparatively more and more amount of paper is needed to print the Ticket. For example, if a passenger wishes to travel by bus. He must carry money with them. Then conductor will collect the money and he will give ticket. This must be repeated for all passengers. This will take more time and waste of human resource as well as energy. The data relate to an AFC system that integrates with an automatic vehicle location system records a transaction for each passenger boarding a bus, containing attributes regarding the route, the vehicle, and the travel card used, along with the time and the location where the journey began. Some of these are recorded for the purpose of allowing on board ticket inspection but additionally enable innovative spatial validation features introduced by the methodology.

The existing system of bus fare collection in India has some potential disadvantages. One such disadvantage is the need to handle and manage physical cash, which can

be time-consuming, labor-intensive, and prone to theft or counterfeit currency. This can impact the accuracy of fare collection and pose security concerns. Additionally, cash-based systems may lack transparency and accountability, as there may be limited or no electronic record of fare collection, leading to difficulties in tracking revenue and detecting potential fraud. Cash-based systems may also cause inconvenience for passengers who need to carry exact change or wait for change, resulting in delays and longer boarding times. Moreover, some existing systems may only accept cash as the mode of payment, which can be inconvenient for passengers who prefer digital payment methods. Furthermore, lack of integration and interoperability between different fare collection systems used by different bus operators or transportation authorities can create complexity and inconvenience for passengers who need to use multiple bus services or modes of transportation. Efforts are being made to address these challenges by adopting modern fare collection technologies that offer greater efficiency, transparency, and convenience for both passengers and operators.

CHAPTER 4

PROPOSED METHODOLOGY

4.1. RFID Based Automatic Bus Ticketing:

In Recent advancements in various technologies have made remarkable developments in various fields for public welfare and public transport is one such area. In near a future public transport bus system with advanced technologies like Radio Frequency Identification Device (RFID), and RF modules will gain spotlight due to their advantage of higher convenience and greater life standards as compared to the conventional bus systems. The study brings out improved solution in terms of cost, convenience, user satisfaction and future implementation.

This implementation is aimed at a real time usage of Automatic Fare Collection system and does not compromise on the security. It guarantees us that the proposed project is simple, efficient and cost effective.

RFID has been an emerging technology in recent years. RFID consists of two components, RFID Tag and RFID Reader. RFID Tag contains information such as name, address and mobile number. RFID reader reads the above information from the RFID Tag. IR sensor is used to count the number of persons entering into the bus. Internet of Things define the concept of network devices to sense and collect

data from the world around us, and then share that data across the Internet where it can be processed and utilized for various interesting Purposes.

GPS is the latest technology used in various fields such as navigation, tracking and also in some of surveillance applications. Here we are going to use this GPS to calculate the distance travelled by the passenger. GPS module can configured to generate the latitude and longitude of the current position of the bus. The position of the bus can be monitored continuously using this GPS module. Smart cards can provide identification, authentication, data storage and application processing. These smart cards can be used as passenger identifications. Every passenger carries a smart card. The smart card has the information such as user identification number, available balance and status register. These smart cards should be capable of recharging, so that the passenger can use it again and again. Combining GPS technology and smart cards we can design a complete bus ticketing system. Ticketing system without human resource-Conductor is implemented using RFID tag which is rechargeable one.

4.2. HARDWARE AND SOFTWARE TOOLS:

A. Microcontroller: Arduino is an open source, computer hardware and Software Company and a user community that designs and manufactures microcontroller kits

for building digital devices and interactive objects that can sense and control objects in the physical world. It consists of a physical programmable circuit board and an integrated development environment which Is run on the computer and is used to write and upload computer code to the physical board. In this project, Arduino is used for interacting with the GPS and the GSM module.

B. RFID reader: A RFID reader is a device which is used to interrogate an RFID tag. It reads the unique number from the RFID cards and sends it to the microcontroller.

C. RFID card: This is one of the most important part of the project. RFID cards are used for applications as access control in security system, cashless payment etc.

D. GPS Module: The Global Positioning System (GPS) is a radio navigation system that determines precise and accurate location, velocity, and time regardless of weather conditions. Additionally, GPS works on land, air, and sea.

E. Power Supply: This unit will supply the various voltage requirements of each unit. This will be consists of transformer, rectifier, filter and regulator. The rectifier used here will be Bridge Rectifier. It will convert 230VAC into desired 5V/12V DC.

F.LCD: A liquid crystal display or LCD draws its definition from its name itself.It is a combination of two states of matter, the solid and the liquid. LCD uses a liquid crystal to produce a visible image. Liquid crystal displays are super-thin technology display screens that are generally used in laptop computer screens, TVs, cell phones,

and portable video games. LCD's technologies allow displays to be much thinner when compared to a Cathode Ray Tube (CRT) technology.

4.3. BLOCK DIAGRAM

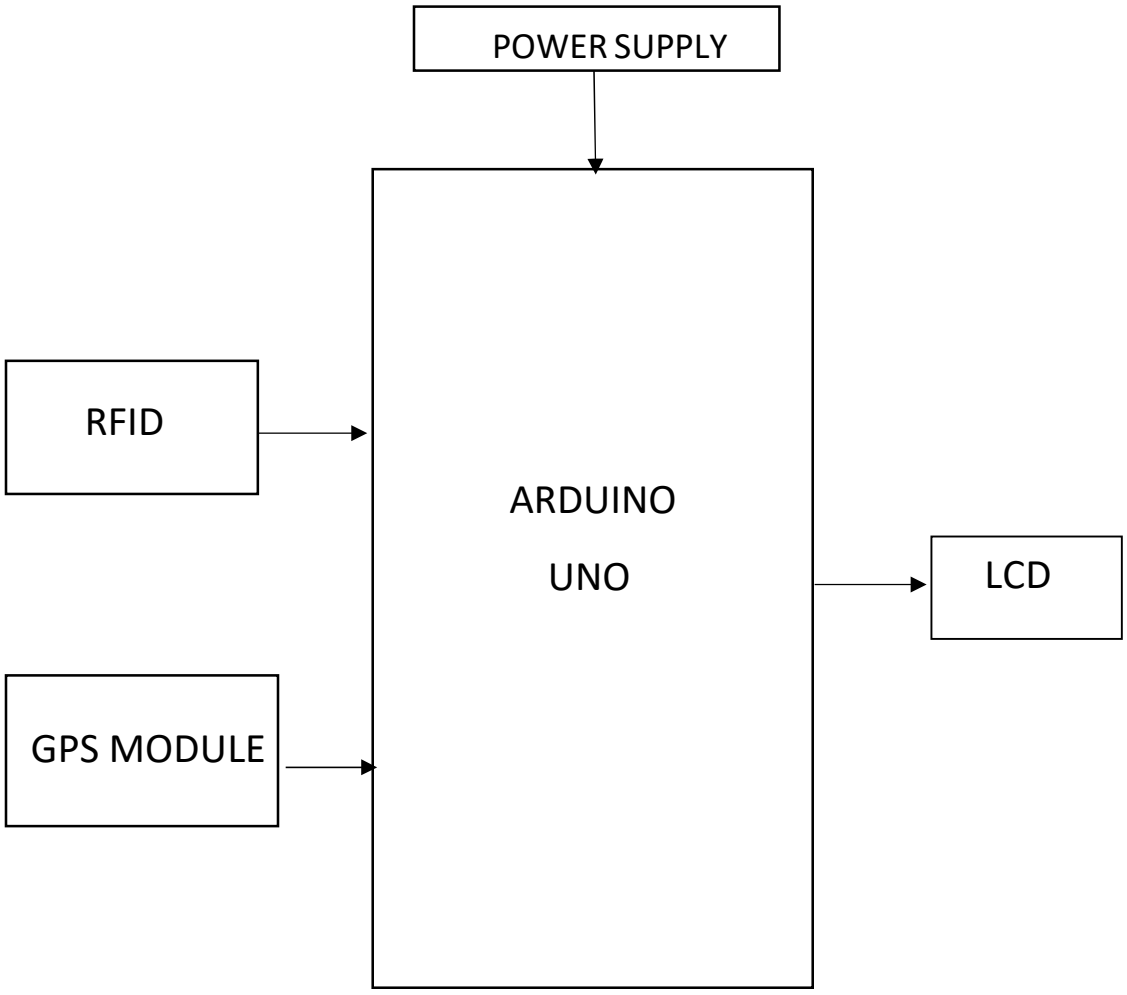

Figure 4.1.Block diagram

4.4. FLOW CHART

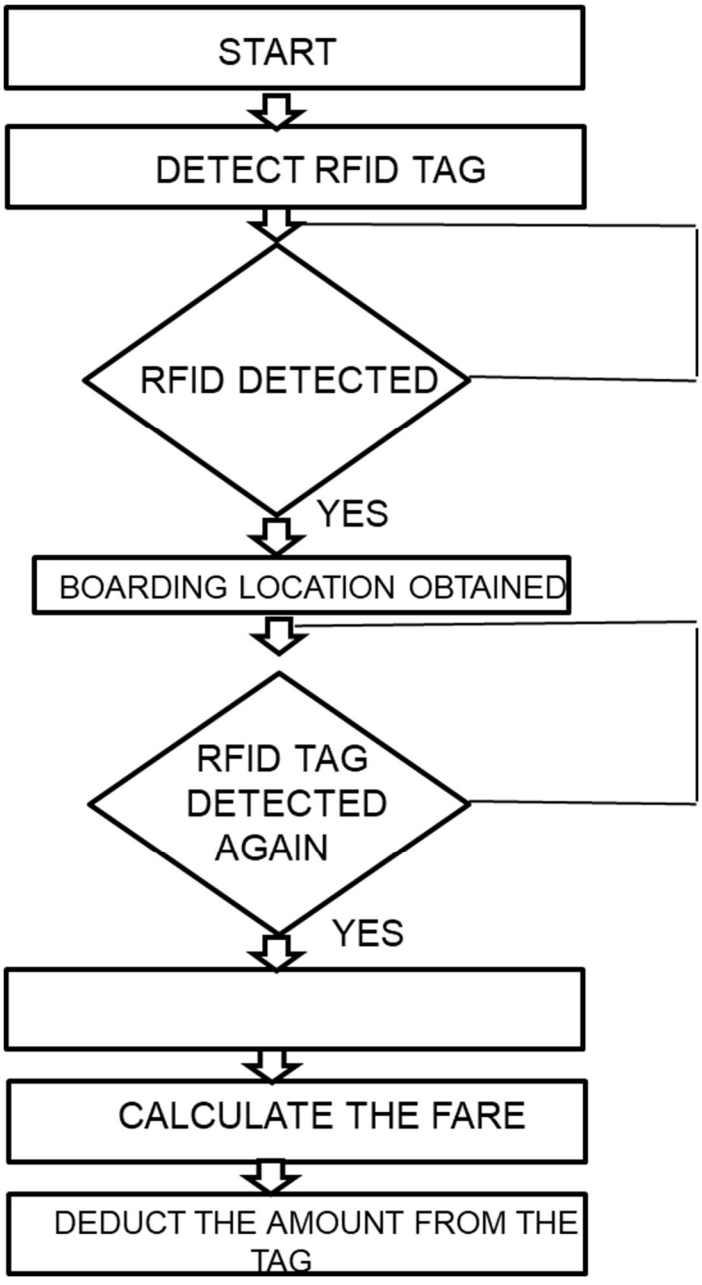

Figure 4.2.Flow chart

CHAPTER 5
RESULTS AND DISCUSSION

An automatic bus fare collection system using GPS and RFID works by utilizing two technologies: Global Positioning System (GPS) and Radio Frequency Identification (RFID).

GPS technology is used to track the location of the bus and determine the fare based on the distance travelled by the passenger. RFID technology is used to identify the passenger and deduct the fare from their account.

WORKING PRINCIPLE:

1. RFID tags are installed on the passenger's smart card, which contains their account information and the fare amount.

2. When the passenger boards the bus, they tap their smart card on an RFID reader located at the entrance of the bus.

3. The RFID reader sends the information to a central system, which deducts the fare amount from the passenger's account.

4. As the bus travels along its route, the GPS system tracks its location and calculates the distance travelled by the passenger.

5. The central system calculates the fare based on the distance travelled and updates the passenger's account.

6. When the passenger reaches their destination, they tap their smart card on another RFID reader located at the exit of the bus.

7. The RFID reader sends the information to the central system, which updates the passenger's account and deducts the final fare amount.

8. The passenger can then view their account balance and transaction history using a mobile app or a website.

Overall, the automatic bus fare collection system using GPS and RFID provides a convenient and efficient way for passengers to pay their fare, while also enabling bus operators to collect accurate fare data and improve their revenue management.

5.1. HARDWARE IMPLEMENTATION:

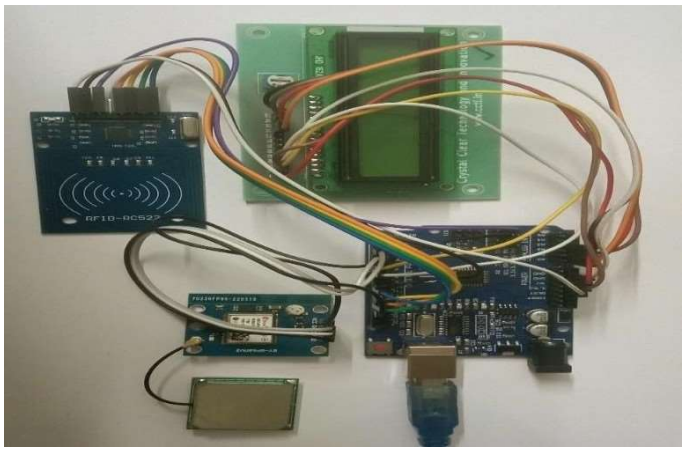

Figure 5.1.Hardware Setup

5.2. EXPERIMENTAL RESULTS:

There have been several experimental results reported for automatic bus fare collection systems using GPS and RFID. Here are a few examples:

1. RFID reader is set up on the bus. When the passenger enters into the bus the person Shows his RFID tag and the device reads it.
2. At first the passenger count will be zero. After detecting RFID tag from the user, the device fetches the information of the user and displays the balance amount of the user in the lcd.
3. Then the GPS module gets the longtitude and latitude of the user's location and displays it.
4. The passenger count is incremented if more passengers gets into the bus. After the destination location is arrived the passenger uses his tag again for the travelled amount.
5. The total distance is calculated and the amount is deducted from the passenger's account. This increases efficiency and overcomes the disadvantage of the traditional ticketing system.

5.3. SIMULATION RESULTS:

Figure 5.2.RFID Device

The key benefits of the working principle of an automatic bus fare collection system using GPS and RFID can be summarized in two points:

Improved Efficiency: The system reduces passenger waiting times, increases fare collection accuracy, and collects valuable data for revenue management and route planning.

Increased Revenue: The system can increase fare revenue for bus operators by accurately calculating fares based on distance travelled and reducing cash handling costs.

CHAPTER 6

CONCLUSION

The manual fare collection system has many issues which are overcome by our proposed system. Automated fare collection system for public transport using GPS is an innovative idea which reduces man power. The manual fare collection system has many issues which are overcome by our proposed system. Automated fare collection system for public transport is an innovative idea which reduces man power. It is believed that by implementation of these system problems such as underutilization of buses fleet will be reduced.

So both passenger and bus station administrators will benefit from the system as Real time information are provided. The ticketing systems using RFID can be merged to solve the above mentioned problems. This project actually suggests a much more public friendly, automated system of ticketing with the use of RFID based tickets. This smart Embedded System can be implemented in the transport system, which will perform the fare collection automatically. This system is suitable for megacities like Chennai and Bangalore where a large no of customers avail public transport system daily.

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