BACHELOR OF SCIENCE IN ELECTRONIC AND TELECOMMUNICATION ENGINEERING

GSM Based Smart Bus Ticketing System with Loan Facilities

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February - 2024

Certification of Approval

Title of the undergraduate thesis **" GSM Based Smart Bus Ticketing System with Loan Facilities"** was submitted by **Md Rokibul Fahad khan** (T191037) have met the requirements for the degree of Bachelor of Science (B.Sc.) in **Electronic and Telecommunication Engineering (ETE)** with good acceptance from **International Islamic University Chittagong.**

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Declaration

"We declare that this thesis is the result of our own original research and that all sources used were properly acknowledged and cited in the reference section. This work was never been submitted before for any other academic certification or title. Any aid received throughout the research and preparation of this thesis has been appreciated, although it is only advisory in nature."

FEBRUARY 2024

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ACKNOWLEDGMENT

In the name of Allah, the Universe's Most Gracious and Forgiving Being (SWT). Our first gratitude is to Allah for bestowing upon us strength and knowledge throughout our lifetimes. Our family's love and support mean a lot to us, both monetarily and spiritually. We are appreciative of the insightful remarks, checks, and suggestions made during this research by Engr. Syed Zahidur Rashid, Assistant Professor, Department of ETE, IIUC. His outstanding assistance, as well as his perceptive observations and ideas, made the project successful throughout the experiment and project work. In conclusion, we express our heartfelt gratitude to our educators, companions, and relatives

ABSTRACT

This paper proposes a GSM-based smart metro bus ticketing system with loan facelities that utilizes radio frequency identifier (RFID) technology and a loan system to provide an efficient and reliable ticketing solution for metro bus services. The system comprises four primary components: RFID tag reader, GSM module, loan system, and an LCD display. Additionally, ten push buttons and a keypad are used for selecting the destination location and reloading the balance. The system's flow can be divided into three main stages: ticket purchasing, balance checking, and balance reloading. To purchase a ticket, a passenger selects their desired destination by pressing one of ten push buttons on the system's interface. The RFID tag reader then detects the passenger's RFID card and deducts the appropriate amount from their balance, which is displayed on the LCD display. To check their balance, passengers need to tap their RFID card on the RFID tag reader, which will then display their current balance on the LCD display. If the passenger's balance is insufficient, the system will automatically activate the two-time loan feature, which enables the passenger to use the metro bus service twice more before their balance is deducted. To reload their balance, a passenger uses the keypad to enter the desired recharge amount, which is then deducted from their bank account via the GSM module. The system updates the passenger's balance and displays the new balance on the LCD display.

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LIST OF ABBREVIATIONS

GSM	Global System for Mobile Communication
RFID	Radio Frequency Identification
LCD	Liquid Crystal Display
USB	Universal Serial Bus
IDE	Integrated Development Environment
SIM	Subscriber Identity Module
SMPS	Switched Mode Power Supply
UART	Universal Asynchronous Receiver / Transmitter
ICSP	In-Circuit Serial Programming
PWM	Pulse Width Modulation
I2C	Inter Integrated Circuit
SPI	Serial Peripheral Interface
MOSFET	Metal Oxide Semiconductor Field-Effect Transistor
EEPROM	Electrically Erasable Programmable Read-only Memory
SDA	Serial Data line
SCL	Serial Clock line
MISO	Master in Slap Out
MOSI	Master out slap in
CS	Clip selector
SCk	Serial Clock line
GPS	Global Positioning System
IoT	Internet of Things
SMS	Short Message Service
CPU	Central Processing Unit

CHAPTER 1

INTRODUCTION

1.1 Introduction

The transportation industry has seen significant advancements in the past decade, with the introduction of smart technologies that have revolutionized the way people travel. The use of smart cards for transportation has been widely adopted by many countries around the world. However, there are still several challenges that need to be addressed to ensure efficient and reliable ticketing systems for public transportation [2, 3].

This paper proposes a GSM-based smart metro bus ticketing system that utilizes radio frequency identifier (RFID) technology and a load system to provide an efficient and reliable ticketing solution for metro bus services [6]. The proposed system comprises four primary components: RFID tag reader, GSM module, load system, and an LCD display. Additionally, two push buttons and a keypad are used for selecting the destination location and reloading the balance [1].

The proposed system aims to address some of the challenges faced by traditional ticketing systems. The use of RFID technology ensures fast and convenient transactions, eliminating the need for physical tickets. The load system enables passengers to reload their balance using the keypad, which is deducted from their bank account via the GSM module. This feature ensures that passengers can recharge their balance quickly and efficiently. Additionally, the proposed system incorporates a two-time loan feature that allows passengers to use the metro bus service twice more before their balance is deducted [7].

Furthermore, the proposed system uses a GSM module to send location messages to a central server. This feature ensures that transport authorities can monitor the system's operations and ensure that the service is running smoothly. The LCD display provides passengers with up-to-date information about their balance and other important details related to the metro bus service [14].

Overall, the proposed GSM-based smart metro bus ticketing system with a load system and RFID technology offers an efficient and reliable ticketing solution for metro bus services. The system ensures fast and convenient transactions, efficient balance

reloading, and provides passengers with up-to-date information. The proposed system has the potential to improve the passenger experience and reduce operational costs for metro bus services [9, 10]

The main feature of the Smart Bus System is automated ticket buying, while it has other functions as well. Two units, one for the entry gate and one for the exit gate, are installed in the bus as part of the system. Each unit is used to scan passenger entrance and exit instances when the passengers are wearing RFID (Radio Frequency Identification) tags. The GPS module in each unit is designed to periodically update the bus's location at predetermined intervals, making it possible to record passengers' whereabouts in both situations. The fare amount from the passenger's E-wallet, which can be handled using the S-Bus mobile application, will be deducted by the system after accounting for the distance traveled [16].

Private vehicle is chosen by people instead of public transport. Improved public transport is the need of India. So, to improve public transport is the agenda of Indian government. To integrate and automated these services computing technology plays a important role. People prefer buses because buses are the reliable mode of transport. The paper aim to present such a solution which helps to citizens and promote public transport usage for commuters, as well as reducing operational costs for public transit companies. To integrate the system, we are using two main components 1) E-ticketing 2) Tracking. To avoid traffic problems and to promote for usage of public transport we are proposing such a system. In this system commuters will be able to track the bus with the help of smart phone by scanning the QR (Quick Response) code placed at the bus stop to view estimated arrival time of bus, current location of bus, and bus routes on a map is proposed in this paper [17 ,18].

This study presents an RFID (Radio Frequency Identification Device) label-based computerized transport ticketing system for the Public Transport System. When compared to traditional transportation frameworks, transportation systems with cutting edge innovations like RFID, GSM, and GPS will eventually gain prominence due to their advantageous position of more comfort and more notable life guidelines. The proposed framework employs RFID tags in conjunction with GPS to enhance the accuracy of passenger identification and fare deduction. The fare is automatically calculated based on the distance traveled and the passenger is identified automatically.

RFID systems can take the role of traditional paper-based tickets since they are more accurate and reusable than paper tickets [24].

With regard to the RFID application, it has been widely used for the public ticketing system as well as transit vehicle tracking. Already, it has proven to be an incredible accomplishment in many major cities throughout the world, including London, Helsinki, Shanghai, Istanbul, Moscow, Porto, and many more. For the purpose of systematic operations in the appropriate instances, the system may be used to public bus, train, and subway services [21 ,22]. In the megacity of Dhaka, the traditional public transportation system relies on paper-based bus or train tickets, which ultimately cause disorder among the populace, system failure, corruption, and most importantly, traffic jams that result in significant time wasting. There is no way to get advance notice of the arrival and departure of the transportation, which causes a lot of to address the current issues, the RFID ticketing and tracking systems can be combined. Although a GPS-based system might be created, we suggest using RFID-based tickets instead since they are more affordable, convenient to use, portable, dependable, and long-lasting. Additionally, the tracking system of a running bus is made simple by the high-speed RFID tags and detectors. By simply inputting their present position and destination on the keypad that is affixed to every bus, the public who are carrying RFID-based electronic tickets will have access to all municipal bus services. The comparable credit will be kept in the associated bus account, and the data will be sent straight to the server main database. The passengers will also be informed of the departure time of the final bus of each route via the screen at each bus stop. In addition to saving time, this automated approach will have a more authoritative inspection and lessen confusion and turmoil on the road [27].

In recent years, Beijing, Shanghai and other major cities as examples, the domestic implementation of a large number of museums open to visitors are free of charge. Due to this industry-changing, the traditional ticketing of the domestic museum on management shall improve a higher level, and require a more comprehensive ticketing and visitor management system. RFID technology-based ticketing and visitor management systems museum is emerged. Through this visitor management system, the museum will enable more efficient, more orderly organization. In addition to in meeting the basic ticketing functions, through RFID technology to capture the

audience's visit behavior, statistical analysis, rational and targeted implementation culture value increasing service accord to the characteristics of the museum [25].

1.2 Problem Statement

- The GSM-based smart metro bus ticketing system employs RFID technology and a loan system to streamline ticketing for metro bus services. Its components include an RFID tag reader, a GSM module, a loan system, and an LCD display.
- Passengers can buy tickets by selecting their destination using push buttons. The RFID reader deducts the fare from the balance displayed on the LCD.
- Passengers can check their balance by tapping their RFID card. Balance can be reloaded through the keypad, deducting the chosen amount from their bank account via the GSM module, with the updated balance shown on the LCD.

1.3 Motivation

Despite being a developing nation, we refuse to be technologically backward. Our focus on technological development prioritizes accessibility for the masses. Acknowledging the laborious and frustrating manual process of collecting bus tickets, which hampers traffic flow and annoys drivers, we recognize the urgent need for a nationwide shift. The emphasis lies on adopting more efficient ticket collection methods to avert potential disasters. This necessitates leveraging technology to streamline processes and ensure a smoother, more convenient experience for both commuters and drivers. By addressing these inefficiencies, we not only enhance efficiency but also contribute to the overall modernization of our transportation infrastructure. The commitment is not just to technological progress but to making these advancements inclusive, catering to the diverse needs of our population, and propelling our nation forward in the global landscape.

1.4 Objectives

The project's goals are listed below:

- To develop a program according to the condition of the project.
- To develop an advanced ticketing system.

- To remove the analog or manual systems and develop an easily controllable ticketing system.

1.5 Report Outline

The design and construction of this project have been divided into six chapters. These are the chapters and their contents:

Chapter 1 (Introduction): This chapter offers an overview Introduction, Problem Statement, motivation, Objective, Report outline and the project's goal.

Chapter 2 (Literature Review): This chapter examined earlier research or work that was relevant to the project.

Chapter 3 (Methodology): This chapter contains a detailed discussion of all the project's components. It always explains how the experiments for this project are planned. Block diagrams, flowcharts, algorithms, circuit diagrams, and pin connection projects are all covered in this chapter.

Chapter 4 (Implementation and result): This chapter offers a thorough summary that delves further into the project's details. It evaluates potential future growth paths and highlights the benefits, manner of implementation, and ultimate result of the project.

Chapter 5 (Conclusion): This chapter offers a comprehensive synopsis that explores even more project information. In addition to outlining the benefits the project offers, it takes possible development paths into consideration.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The proposed GSM-based smart metro bus ticketing system with RFID technology, a two-push button interface, and a load system is a solution designed to provide an efficient and reliable ticketing system for metro bus services [1]. The system uses advanced technologies like RFID and GSM to improve the efficiency and reliability of the service while also enhancing the passenger experience. The system features a LCD display that provides passengers with up-to-date information about their balance and other important details related to the metro bus service, as well as a keypad for reloading their balance and a two-time loan feature that allows them to continue using the service even when their balance is insufficient [4].

2.2 An Analysis of Earlier Works

The present research agenda covers a broad spectrum of innovative methods for streamlining the ticketing process in addition to innovative technologies that will be regularly applied. As such, there are a number of novel approaches in the area of Internet of Things-based tariff collection systems, and several others are being researched. In the sections that follow, I'll provide a thorough rundown of the tasks that must be completed.

2.2.1 Rfid Based Automatic Bus Ticketing

This study presents an RFID (Radio Frequency Identification Device)-based computerized transport ticketing system for the Public Transport System. Transport systems including cutting-edge innovations such as RFID, GSM, and GPS are sure to gain prominence eventually due to their advantageous position of greater convenience and more significant life guidelines as compared to traditional transport systems. The suggested framework uses RFID tags in conjunction with GPS to improve the accuracy of both the passenger's and the fare's identification. The fee is automatically withdrawn from the passenger's account based on the distance traveled. Since RFID tickets are reusable and offer more accuracy than traditional paper-based tickets, they are a superior option. This eliminates corruption and missing money in addition to replacing

the current paper-based bus ticketing system. RFID tags are utilized as reusable tickets that deduct the fee according to the user's GPS-measured distance traveled. This approach reduces the number of human mistakes and effort [2].

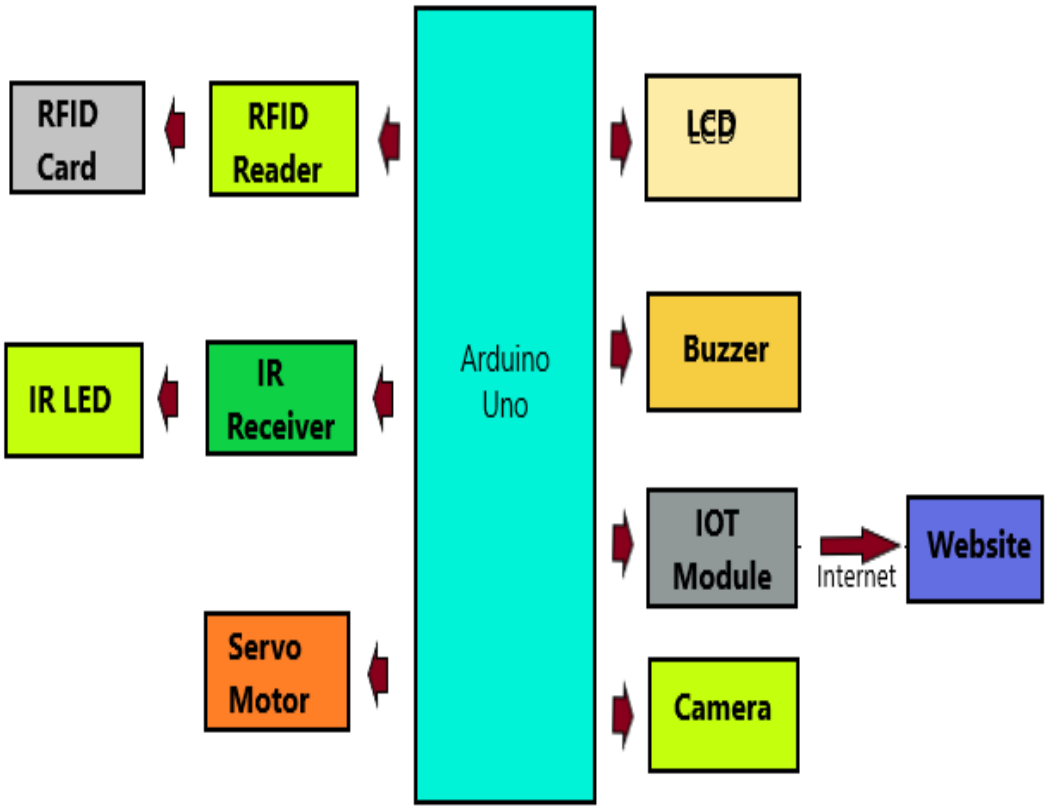

Figure 2.1 System Design and Layout [2]

2.2.2 Implementation of Cashless Bus Ticketing System Using Rfid

An RFID-based ticketing system is superior to a traditional ticketing system. Passengers will wear an RFID tag with a unique ID and connected data because it uses RFID technology. The RFID reader is triggered when a passenger boards the bus. As a result, information is obtained from the database, and an electronic ticket is produced. Data from the RFID tag will be gathered by the RFID reader and sent to the computing device. This computing gadget has a GPS module that tracks and records location, and a GSM module that allows it to access databases. When the passenger exits the vehicle, a computing device determines the fare based on the passenger's distance traveled and deducts the appropriate amount from the account. It encourages cashless transactions, digital India, and paper conservation. IoT technology will be used to create an online

payment system with a keypad of its own, facilitating speedy and secure transactions.

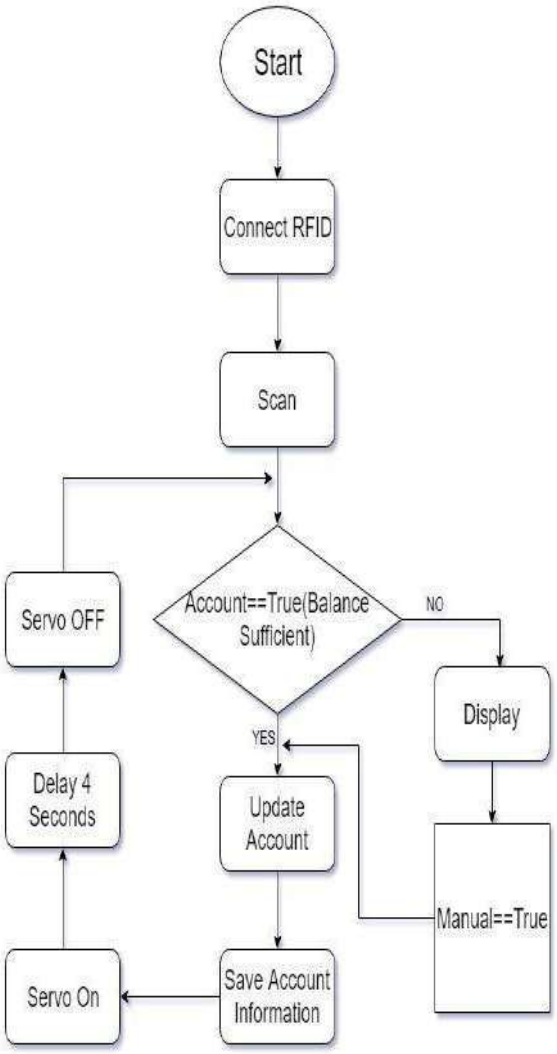

Figure 2.2 Block Schematic for the System [2]

2.2.3 An Automated Tariff Collection System for Bangladesh: An Experimental Approach

Daily tasks are greatly impacted by automation, which ultimately makes things simpler. Every day, more and more vehicles cross the street, which increases the likelihood of traffic jams and the inefficiency of human work. Furthermore, the current time limits of the Bangladeshi manual tariff collection method make this impossible.

Thus, in order to reduce human costs, idle time, and most importantly traffic congestion, the authors of this study suggest an experimental way to operate a system twenty-four hours a day, seven days a week, using a fully automated tariff collecting system with active RFID tags. The technology electronically detects vehicles as they approach the

tariff plaza, and then deducts the correct amount of tariff based on the vehicle's specifications.

A prepaid smartcard cum license card is connected to a centralized database that stores information about every vehicle. You may add money to your account at a recharge booth if it runs low. In addition, each plaza's daily or monthly collected tariff, as well as a vehicle's arrival and departure times, may be seen on the site, and illegal vehicles can be reported there. The number of tariff plazas on the driver's route, the amount needed to pass them, the location of the recharge booth, and the account balance may all be sent to the driver through an Android app.

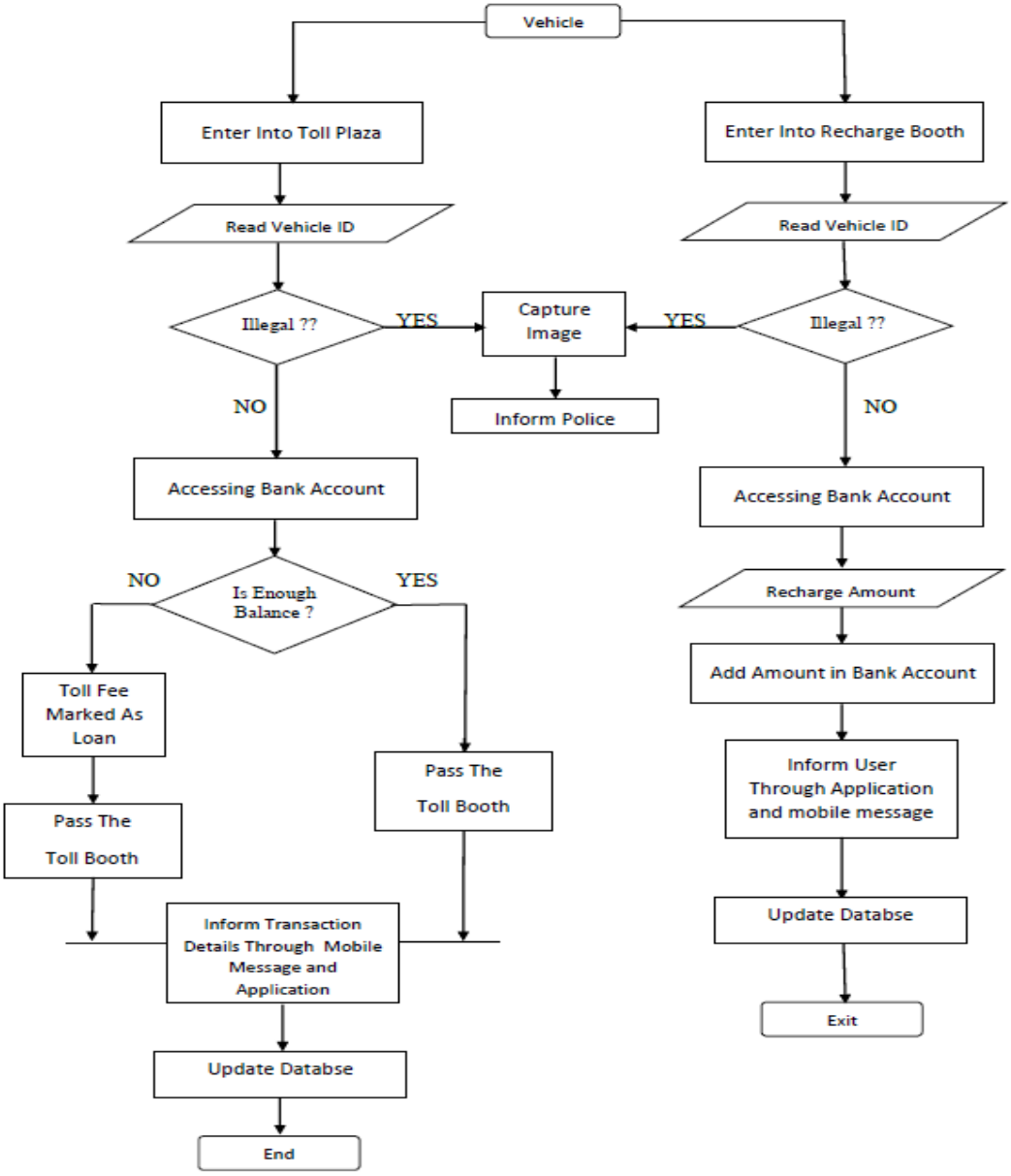

Figure 2.3 The proposed method's work flow [3]

The main city of Bangladesh, Dhaka, is beginning to face severe traffic congestion as a result of ongoing economic expansion and development. People in Dhaka city is becoming quite irritated over this. In addition to making customers wait a very long time for their buses, this also causes the ticketing process to be exceedingly time-consuming. In order digitize our travel experience, this paper suggests a new system that will replace the current paper ticketing system with RFID-based smart cards. Both at the entry and the departure, the smart card is held over the RFID scanner, and the appropriate charge based on the distance traveled is subtracted from the passenger's account. Rotary encoders and Arduino are used for a for the computations [28].

The main feature of the Smart Bus System is automated ticket buying, while it has other functions as well. Two units, one for the entry gate and one for the exit gate, are installed in the bus as part of the system. Each unit is used to scan passenger entrance and exit instances when the passengers are wearing RFID (Radio Frequency Identification) tags. The GPS module in each unit is designed to periodically update the bus's location at predetermined intervals, making it possible to record passengers' whereabouts in both situations. The fare amount from the passenger's E-wallet, which can be handled using the S-Bus mobile application, will be deducted by the system after accounting for the distance traveled [31 ,34].

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important role. People prefer buses because buses are the reliable mode of transport. The paper aim to present such a solution which helps to citizens and promote public transport usage for commuters, as well as reducing operational costs for public transit companies. To integrate the system, we are using two main components 1) E-ticketing 2) Tracking. To avoid traffic problems and to promote for usage of public transport we are proposing such a system. In this system commuters will be able to track the bus with the help of smart phone by scanning the QR (Quick Response) code placed at the bus stop to view estimated arrival time of bus, current location of bus, and bus routes on a map is proposed in this paper [35].

For the academic community, this study introduces a novel application of RFID technology in public transportation, namely Bus Rapid Transit (BRT), for identification and offline intelligent payment systems. A contactless smart card, an identification card, and an e-ticket are used for the authentication process. In order to save a user's identification in particular sectors and offer a classified authentication key for the card, contactless smart cards can be obtained by completing the administrator registration procedure. The Contactless Payment Terminal (CPT), which has already been deployed on the BRT, is where passengers will make their payments. LCD Waveshare 3.5, MFRC522, and Raspberry Pi 3 Model B make up CPT. CPT operates by accessing the data contained in the contactless card rather than requiring server communication during the transaction. At a distance of 1 and 2 cm, the CPT can recognize the data on the contactless card with an optimal range of 100%; at a distance of 3 cm, the percentage dropped to 86.67%. When the distance is 1 cm, the shortest delay time is 0.1 s, and the greatest delay time is 3 cm, which is 2.7 s. A website that an administrator may utilize to register new users, modify user identities, add funds to existing accounts, and view transaction histories is also included in the system's architecture [42].

With regard to the RFID application, it has been widely used for the public ticketing system as well as transit vehicle tracking. Already, it has proven to be an incredible accomplishment in many major cities throughout the world, including London, Helsinki, Shanghai, Istanbul, Moscow, Porto, and many more. For the purpose of systematic operations in the appropriate instances, the system may be used to public bus, train, and subway services. In the megacity of Dhaka, the traditional public transportation system relies on paper-based bus or train tickets, which ultimately cause

disorder among the populace, system failure, corruption, and most importantly, traffic jams that result in significant time wasting. There is no way to get advance notice of the arrival and departure of the transportation, which causes a lot of to address the current issues, the RFID ticketing and tracking systems can be combined. Although a GPS-based system might be created, we suggest using RFID-based tickets instead since they are more affordable, convenient to use, portable, dependable, and long-lasting. Additionally, the tracking system of a running bus is made simple by the high-speed RFID tags and detectors. By simply inputting their present position and destination on the keypad that is affixed to every bus, the public who are carrying RFID-based electronic tickets will have access to all municipal bus services. The comparable credit will be kept in the associated bus account, and the data will be sent straight to the server main database. The passengers will also be informed of the departure time of the final bus of each route via the screen at each bus stop. In addition to saving time, this automated approach will have a more authoritative inspection and lessen confusion and turmoil on the road [44].

RFID-based Ticketing System for public transport. In this, authors have used RFID tags (Tickets) which has the right of entry to any bus service of the city only incoming passenger's current location and passenger destination point on the keyboard attached to each bus. The data is transferred to the server's main database and the equivalent credit will be stored in the corresponding bus account. Also, the display at every bus stop reports the passengers, leaving time of the last bus of any path [46].

These systems provide mobile device ticketing operations by utilizing Global System for Mobile Communications (GSM) technology. I'll give a broad overview based on the typical characteristics and benefits of GSM-based smart ticketing systems up to that time, as my knowledge may be out of date. Recent technological innovations have produced amazing improvements for the general welfare in a number of areas, public transportation being one of them. Thanks to its advantages over traditional bus systems in terms of convenience and quality of life, public bus transit systems utilizing sophisticated technologies such as RFID, GSM, GPS, ZigBee, and RF modules are expected to become more popular soon. The many suggested bus ticketing and informational systems have all been thoroughly reviewed and presented in depth in this

article. Regarding cost, ease of use, user satisfaction, and potential implementation, the study presents an enhanced solution [16].

QR codes are a means of tracking a bus. Through the use of their smart device, commuters may scan the QR code displayed at each bus stop to obtain the bus time schedule. The algorithm is used to estimate bus routes, which are shown on a mobile device using the Google Maps program. For us to view the bus map, we need to know the latitude and longitude. The GPS receiver that is installed in the bus provides the values. Google uses AJAX (Asynchronous JavaScript and XML) and REST (Representational State Transfer) APIs to assist us show the map pictures. When compared to physical components, the amount of information sent by QR codes is far smaller. The bus's location was accessed via smartphones. Smart phones were installed inside the buses, and they utilize their built-in GPS to determine the bus's location. From there, they use their networks to relay the coordinates to the lighting server. All of the information about the bus source, destination, stops in between, distance traveled, and trip duration is stored on the server. The coordinates are continually sent from the smartphone to the server, which calculates the delay between the previous and next coordinates. Data requests can be sent by the customer via an application or SMS (Short Message Service [47].

Every city in the globe has seen a significant reduction in extreme traffic congestion thanks in large part to the computerized traffic management system. It's the simplest way to control high traffic. It makes its own decisions thanks to M2M technology. Using wireless and mesh networks, machine-to-machine (Lora) communication technology connects, monitors, and controls real-world objects remotely. in Because of this, there are several updated m2m-based traffic signal light control system solutions available, and more are being researched. These are thorough labor analyses [22].

India, buses are a vital part of the public transportation system. Every day, 10–15 million people utilize public transportation buses in big cities like Delhi and Mumbai. Public transportation must keep up with technological advancements in the age of Digital India, a government of India program, and the Cashless Economy. A clever and dependable system is nevertheless required, even if the public transportation buses have been offering services that are generally adequate. The passengers' main issues include

excessive wait times at bus stops, unpaid balances, and failing to provide other passengers a seat [49].

The megacity of Dhaka, Bangladesh, has a paper-based public transportation ticketing system that leads to serious system malfunctions, nasty public arguments, corruption, and most importantly, traffic jams. This article proposes an RFID-based ticketing system that is considerably more user-friendly and automated, along with a credit transaction process. Through an automated server that is updated each time a passenger travels using an RFID-based ticket, the whole system primarily serves to promote uniformity between different bus agencies, resulting in consistent access for passengers on daily journeys [25].

With regard to the RFID application, it has been widely used for the public ticketing system as well as transit vehicle tracking. Already, it has proven to be an incredible accomplishment in many major cities throughout the world, including London, Helsinki, Shanghai, Istanbul, Moscow, Porto, and many more. For the purpose of systematic operations in the appropriate instances, the system may be used to public bus, train, and subway services. In the megacity of Dhaka, the traditional public transportation system relies on paper-based bus or train tickets, which ultimately cause disorder among the populace, system failure, corruption, and most importantly, traffic jams that result in significant time wasting. There is no way to get advance notice of the arrival and departure of the transportation, which causes a lot of To address the current issues, the RFID ticketing and tracking systems can be combined. Although a GPS-based system might be created, we suggest using RFID-based tickets instead since they are more affordable, convenient to use, portable, dependable, and long-lasting. Additionally, the tracking system of a running bus is made simple by the high-speed RFID tags and detectors. By simply inputting their present position and destination on the keypad that is affixed to every bus, the public who are carrying RFID-based electronic tickets will have access to all municipal bus services. The comparable credit will be kept in the associated bus account, and the data will be sent straight to the server main database. The passengers will also be informed of the departure time of the final bus of each route via the screen at each bus stop. In addition to saving time, this automated approach will have a more authoritative inspection and lessen confusion and turmoil on the road [28].

There is nothing better than an RFID-based ticketing system over a conventional one. As it employs RFID technology, each passenger will have an RFID tag with a unique ID and linked data. Passengers board the bus and activate the RFID reader. An electronic ticket is created as a consequence of information being pulled from the database. After being captured by the RFID reader, data from the RFID tag will be transmitted to the computer. With the help of a GSM module that enables database access, this computer device features a GPS module that tracks and records position. RFID-based Ticketing System for public transport. In this, authors have used RFID tags (Tickets) which has the right of entry to any bus service of the city only incoming passenger's current location and passenger destination point on the keyboard attached to each bus [29].

Buses are a vital part of the numerous convenient public transit options available to customers in India. Approximately thirty minutes are spent by a typical city dweller each day equivalent to eight hours per week waiting for a bus to arrive. Buses now consume a lot more energy, which has led to a sharp rise in pollution from petroleum use. absence of appropriate bus transit information, such as schedule, navigation, and seat availability. the habit of utilizing paper tickets, which contributes to deforestation and harms the environment, as well as the lack of adequate amenities in bus stations, such seating and lighting. Ultimately, we hope to make commuters' journeys calmer and more paperless by implementing our suggested solution, which will enable improved bus management through IoT-based E-ticketing, route scheduling, and bus monitoring. People in Dhaka city is becoming quite irritated over this. In addition to making customers wait a very long time for their buses, this also causes the ticketing process to be exceedingly time-consuming. In order digitize our travel experience, this paper suggests a new system that will replace the current paper ticketing system with RFID-based smart cards. Both at the entry and the departure, the smart card is held over the RFID scanner, and the appropriate charge based on the distance traveled is subtracted from the passenger's account. Rotary encoders and Arduino are used for a for the computations [30].

As the title "An Automated Tariff Collection System for Bangladesh: An Experimental Approach" implies, the study looks at the creation and testing of an automated system for Bangladeshi tariff collection. The phrase "experimental approach" suggests that the

study may include real-world trials or testing to assess the suggested automated tariff collecting system's viability, efficacy, and any drawbacks. The research's unique setting of Bangladesh's tariff collecting systems is shown by its emphasis on the nation. In order to shed light on the possible advantages and difficulties of automating tariff collection in the Bangladeshi context, the paper is expected to address the design, execution, and outcomes of the experimental approach. The paper "An Automated Tariff Collection System for Bangladesh: An Experimental Approach" likely explores the design, implementation, and testing of an automated system for collecting tariffs in Bangladesh. The term "experimental approach" suggests practical trials to assess the feasibility and effectiveness of the proposed system. The focus is on introducing automation to the tariff collection process in the specific context of Bangladesh. The paper may discuss the methodology, results, and implications of the experimental approach, aiming to provide insights into the potential benefits and challenges of automating tariff collection in the country [31].

Individuals prefer to use private vehicles over public transportation. India requires better public transportation. Therefore, the Indian government's goal is to enhance public transportation. Computing technology is essential to the automation and integration of these services. Buses are the most dependable form of transportation; hence people choose them. The purpose of this article is to propose a solution that benefits commuters, assists residents, and lowers operating costs for public transportation providers. We are employing two key components to integrate the system. First, electronic tickets 2. Monitoring. We are suggesting such a system to prevent traffic issues and to encourage the use of public transportation. With this technique, passengers will be able to follow the bus using them. This study proposes to use a smartphone to scan a QR (Quick Response) code at the bus stop to examine the bus's current location, projected arrival time, and bus routes on a map [32].

Recent years have seen the domestic implementation of a huge number of free-to-enter museums in key cities, such as Beijing, Shanghai, and others. The domestic museum's conventional ticketing system has to be improved to a higher level and requires a more comprehensive visitor management system due to the industry changes. Museum ticketing and visitor management systems built on RFID technology have evolved. The museum will be able to organize itself more effectively and neatly thanks to this visitor

control system. In addition to fulfilling the requirements for basic ticketing, RFID technology is used to record audience visitation patterns, do statistical analysis, and implement culture value-adding services that are reasonable and tailored to the museum's unique features [74].

RFID technology has been extensively employed in the public ticketing system and transit vehicle tracking. In several global metropolises, such as London, Helsinki, Shanghai, Istanbul, Moscow, Porto, and many more, it has already shown to be an amazing achievement. The system may be deployed to public bus, rail, and subway services in order to facilitate systematic operations under the proper circumstances. The old public transport system in the megacity of Dhaka is based on paper tickets for buses or trains, which ultimately lead to chaos among the people, malfunctions in the system, corruption, and most significantly, traffic bottlenecks that waste a lot of time There is no way to be informed in advance when the conveyance will arrive or depart, which results in a lot of It is possible to integrate the RFID tracking and ticketing systems to solve the existing problems. While a GPS-based system may be developed, RFID-based tickets are recommended instead since they are less expensive, easier to use, portable, durable, and dependable. Furthermore, the high-speed RFID tags and detectors simplify the bus tracking system. All municipal bus services will be accessible to members of the public holding RFID-based electronic tickets by simply entering their destination and current location on the keypad attached to each busDirect data transmission to the server main database will result in the similar credit being retained in the related bus account. Along with this, the screens at each bus stop will notify passengers of the final bus on each route's departure time. This automated technique will save time, reduce confusion and disturbance on the road, and have a more authoritative inspection [27].

Extreme traffic congestion has significantly decreased in every city on the planet, mostly due to computerized traffic control systems. The easiest approach to manage heavy traffic is to do this.M2M technology allows it to make judgments on its own. Remotely connecting, monitoring, and controlling physical items is possible with machine-to-machine (Lora) communication technology over wireless and mesh networks. in This has led to the availability of many updated m2m-based traffic signal light control system systems, with more being investigated [77].

Within India's public transit system, busses play a crucial role. Large cities such as Delhi and Mumbai see 10–15 million people using public transit buses every day. The government of India's Digital India program and the Cashless Economy require public transit to stay up with technology improvements. Public transit buses have been providing generally satisfactory services; nonetheless, a more intelligent and reliable system is still needed. Long wait periods at bus stops, outstanding debts, and neglecting to provide other passengers a seat are the passengers' primary complaints [36].

The Public transit System's computerized transit ticketing system, which uses RFID (Radio Frequency Identification Device) labels, is shown in this paper. Modern transportation frameworks, such as those including RFID, GSM, and GPS, will gradually become more popular compared to more traditional ones due to their benefits in terms of comfort and significant living guidelines. The suggested architecture uses GPS and RFID tags to improve the precision of passenger identification and fare deduction. The passenger is automatically recognized, and the fare is computed depending on the distance traveled. Since RFID technologies are more accurate and reusable than paper tickets, they can replace traditional paper-based tickets [38].

This study presents an RFID (Radio Frequency Identification Device) label-based computerized transport ticketing system for the Public Transport System. When compared to traditional transportation frameworks, transportation systems with cutting edge innovations like RFID, GSM, and GPS will eventually gain prominence due to their advantageous position of more comfort and more notable life guidelines. The proposed framework employs RFID tags in conjunction with GPS to enhance the accuracy of passenger identification and fare deduction. The fare is automatically calculated based on the distance traveled and the passenger is identified automatically. RFID systems can take the role of traditional paper-based tickets since they are more accurate and reusable than paper tickets. In addition to preventing corruption and missing money, this replaces the current paper-based bus ticketing system. Reusable RFID tags are being used as tickets, with the fee being subtracted based on the user's GPS distance traveled. Human mistake and effort are reduced by this approach [37].

A wide range of problems, including extreme traffic congestion, declining air quality, an increase in traffic accidents, and an explosive rise in the number of private

automobiles, are being faced by cities as their populations grow. Public transportation's share is declining concurrently. The dearth of trustworthy public transportation options is the cause. The Internet of Things, or IoT, is becoming a reality with the advancement of information technology. The public transportation system can benefit from the integration of communication, control, and information processing through the use of IoT. In order to give end users access to information like bus number, arrival time, and passenger count, this study addresses the integration of IoT in public transportation systems. The efficient prototype approach that was created gathers data at the vehicle terminal, updates it online and sends it to a server where the user may view it while they wait. RFID, GPS, and a controller with an integrated Wi-Fi module are important technologies utilized in the proposed work. The suggested system's prototype model has been created and tested [34].

Nowadays, individuals find it very difficult to examine a vehicle's license, insurance, and RC book. It prolongs fuel absorption time, causes traffic annoyance, and creates traffic jams in the toll gate system. At the moment, the automatic toll accumulation system is incredibly successful. This article is about the use of the Global System for Mobile Communications (GSM) module and Radio Frequency Identification (RFID) for Automated Toll collection and Check-Post system. Passive radio frequency guiding enables successful recognition. Information about the car, such as its unique ID, is kept in an RFID tag that is affixed to the vehicle as part of this initiative. When every specification is successfully observed by a computer, it can be stored on a data bank for periodic gaps in time and date. Individual users secure their car's unique ID. The tax amount is determined from the account balance by using an RFID and GSM module, and the tag is scanned by the reader when the vehicle crosses the Toll Plaza. The ATmega328 Arduino controller has to be connected to a GSM network in order for a user to be able to send an SMS or place a call, operate the system, and prevent car theft [38].

Traffic grows as the proportion of private automobiles rises. The city's congestion rises proportionately as well. Public transportation is not preferred by most people. People prefer to drive their own cars over using public transportation. India has to improve its public transportation system. The Indian government therefore has improving public transportation on its priority. Computing technology is essential for the automation and

integration of these services. Buses are the dependable form of transportation, which is why people choose them. This article aims to provide a strategy that benefits residents, encourages commuters to use public transportation, and lowers operating expenses for public transportation providers. We are employing two primary components to integrate the system. 1. E-ticketing; 2. Monitoring. We are advocating for the use of public transportation and preventing traffic issues by putting out this method. Through the use of a smartphone and a QR (Quick Response) code that is posted at the bus stop, commuters will be able to monitor the bus and display its projected arrival time, present location, and routes on a map, all of which are suggested in this article. A smartphone is used to check the bus's availability. GPS (Global Positioning System) and Google Maps technologies are utilized for display and navigation [42].

CHAPTER 3

HARDWARE COMPONENTS

3.1 Introduction

Without its constituent parts, an activity cannot be effectively finished. Making the proper component selections is a challenging and crucial process. The materials that will be used in the building of our project will be discussed in this section. Attempts will be made to describe the hardware in this part, covering its design, function, features such as block diagrams.

3.2 List of Components

The parts listed below are the ones utilized in this project.

1. Arduino Mega
2. LM2596 Module
3. SIM800l
4. Switch Mode Power Supply
5. Push button
6. RFID Reader
7. RFID Card
8. 20*4 Display
9. I2C Module
10. Buzzer Module
11. Keypad
12. IBA
13. Wires

3.3 Arduino Mega

A microcontroller board, the Arduino Mega uses an ATmega2560-based microprocessor. It has a crystal oscillator running at 16 MHz, 54 digital I/O pins (14 of which are PWM outputs), 16 analog I/O pins, 4 UARTs (hardware serial ports), a reset button, a USB connection, a power connector, an ICSP header, and a power connector. Additionally, it has a power connector. The Arduino Mega has a significantly larger number of digital and analog I/O pins compared to other Arduino boards. This makes it suitable for projects that require a large number of sensors, actuators.

3.3.1 The Arduino Mega components

The parts of the Arduino Board may be separated into two categories.

1. Hardware

2. Programs

3.3.2 Hardware

There are several parts that make up the Arduino Development Board, and each one is necessary for the board to work as intended. Among the crucial elements needed for it to operate are the following:

- **Microcontroller** This part of the development board serves as a minicomputer and is able to both receive and send information as well as orders to the many peripheral devices that are connected to it. It is the board's "heart." Every board utilizes a different microprocessor, each of which has its own unique set of specifications.

- **External power supply** This power source offers a constant voltage between 9 and 12 volts, which is sufficient for the Arduino development board to function.

- **USB Plug** One of the most important ports on the circuit board we have here is this jack. It is used to upload (burn) a program onto the microcontroller by connecting it to a computer using a USB connection. In addition to this, it has a regulated power source of 5V that may be used to power the Arduino board in the event that the External Power Supply is not available.

- **Internal Programmer** The built-in USB port on the microcontroller allows the created software code to be sent to the device without the requirement for an external programmer.

- **Reset Button** Pressing this button on the board will cause the Arduino microcontroller to reset.

- **Analog Pins** It has a few analog input pins labeled A0 through A7 (typical). Analog signals may be sent to and received from these jacks. Additionally, the number of analog pins might differ across different circuit boards.

- **Digital I/O Pins** Additionally, multiple pins for digital input (2–16) are offered (usually). These terminals should be used for sending and receiving all digital data. There could be variations in the quantity of digital pins on various boards.

➢ **Power & Ground Pins** The development board has pins that supply the device with ground, 3.3 volts, and 5 volts.

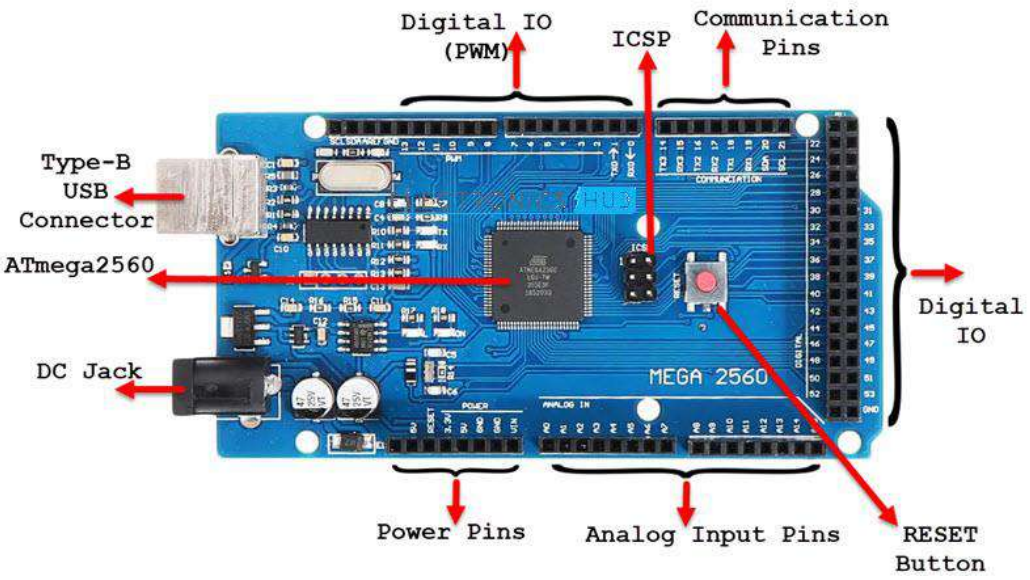

Figure 3.1 An Arduino Mega 2560 Labeled Diagram [13]

3.3.3 Software

Arduino software is referred to as a "sketch" during development. The Arduino IDE was used to create these sketches for an Arduino. This IDE has the following capabilities.:

- **Arduino Programming Language:** The Arduino programming language, which is a condensed form of C++, is used to program the Arduino mera.
- **Sketches:** Arduino programs are called "sketches." A sketch typically consists of two main functions:
  - ✓ setup () and
  - ✓ loop ()
- **Message Area** It looks for and identifies any issues it discovers while trying to save or export code.
- **Text** Error messages, completion messages, and other text data produced by the Arduino environment are shown on the console.
- **Console Toolbar This toolbar offers the following options:** Open, Save, Serial Monitor, and Open/Upload/Verify.

  Development Board and Serial Port are located in the lower right corner of the window" suggests that in the IDE's graphical user interface (GUI), there's likely a section or a panel dedicated to displaying information or controls related to the

development board and serial port. This section might provide options for selecting the connected development board and choosing the appropriate serial port for communication. It's a common layout in IDEs for microcontroller programming, offering easy access to crucial settings.

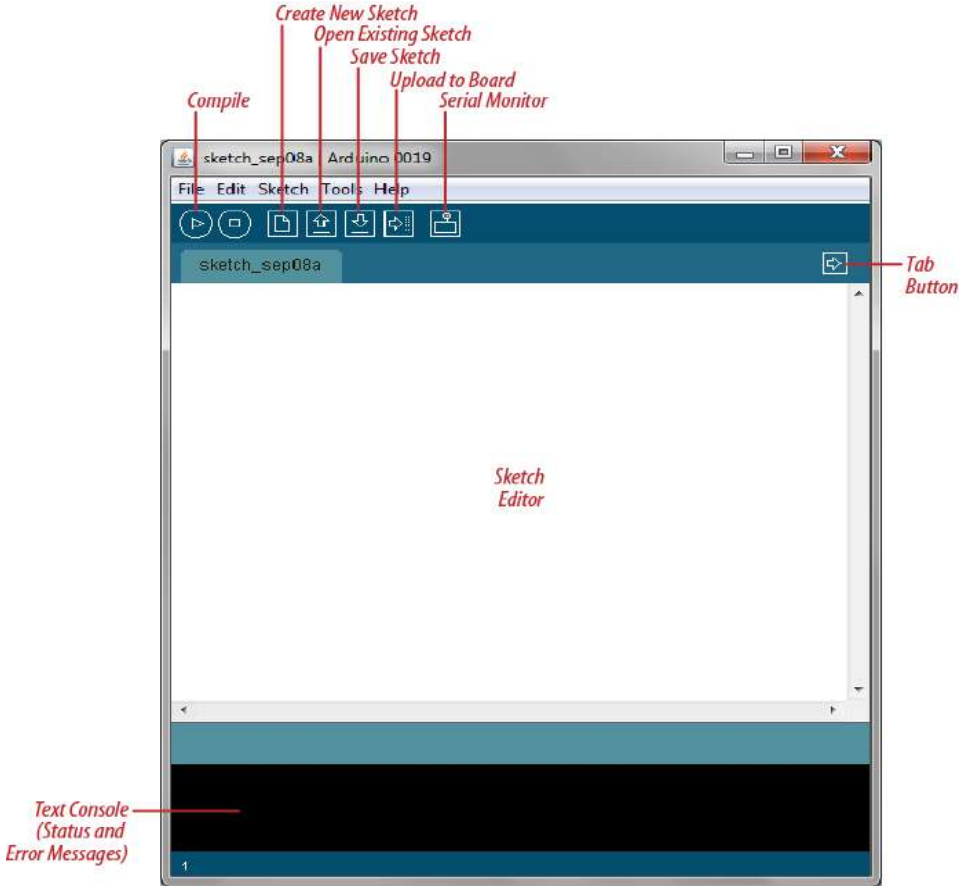

Figure 3.2 An Arduino IDE Labeled Diagram [13]

3.3.4 Characteristics of the Arduino IDE

- ✓ The project file or project drawings are saved with the file extension.ino.
- ✓ This IDE supports features like cut, copy, and paste.
- ✓ The most fundamental component, or skeleton, of any Arduino code will contain two functions.
- ✓ By hitting the Ctrl + F keys on the keyboard, you may also find a certain word and replace it with another.

3.3.5 Basics of Arduino Programming

Using the Arduino software development kit (IDE), we will now discuss how to write

an Arduino sketch. Two elements are constant in any drawing

i. void setup ()
ii. void loop ()

3.3.6 void setup ()

This is the very first thing that is executed when an Arduino is turned up. During the lifetime of the program, this function receives a single invocation.

Every input and output pin in our project is initialized in the setup method. Here's how it ought to appear as an illustration

```
void setup()
  {
    pinMode(pin, INPUT);
    pinMode(pin, OUTPUT);
  }
```

The pin in this case represents the pin's identifying number. Indicates whether the pin is an input or output.

```
void setup()
  {
     Serial.begin(9600);
  }
```

In addition, the Serial Monitor's setup is included here. Data transfered serially to a peripheral device may be seen with the help of a serial monitor. All variables used in a program must be declared on a line above the "void setup ()" procedure.

3.3.7 void loop()

Here we have the Sketch's second most important feature. Contrary to the code written in the setup function, this code is meant to be executed repeatedly. A void loop may look like this:

```
void loop()
  {
    digitalWrite(pin, HIGH);
  }
```

To set the logic high or low on a digital pin, a program needs a Write function. If pin Mode() was used to set the pin as an output, the pin's voltage will be set to the proper value: It's HIGH at 5V (or 3.3V for 3.3V boards) and LOW at 0V (ground).

Similarly, if the drawing has to be delayed, there's another function that slows down the program:

```
delay(1000);   //delay for a second
```

3.4 LM2596 Module

A DC-to-DC power converter called a buck converter, sometimes referred to as a step-down converter, lowers input voltage while keeping output voltage constant (load).The LM2596 is a step-down (buck) switching regulator that can drive a 3-A load while maintaining excellent line and load control in a DC power supply. There is an adjustable output option, and fixed 3.3 V, 5 V, and 12 V versions. The 150kHz switching frequency of the LM2596 series allows for smaller filter components than are achievable with lower frequency switching regulators

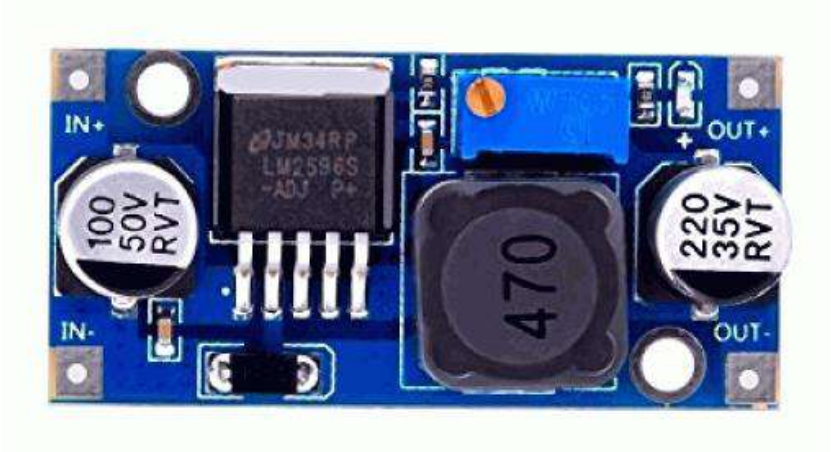

Figure 3.3 LM2596 Module [33]

3.4.1 LM2596 Module Features

The LM2596 is a versatile voltage regulator module with several features that make it popular for a wide range of electronic applications. Here are the key features of the LM2596 module:

1. Input voltage:3-40V
2. Output voltage:1.5-35V(Adjustable)

3. Output current: Rated current is 2A, maximum 3A(Additional heat sink is required)
4. Module Properties: non-isolated constant voltage module
5. Rectification: non-synchronous rectification
6. Short circuit protection: current limiting, since the recovery
7. Switching Frequency: 150KHz

3.4.2 LM2596 IC Pin Diagram

Below figure represents the pin diagram of LM2596 Module IC:

Figure 3.4 Diagram of LM2596 IC Pins [34]

TABLE I PIN DESCRIPTION OF LM2596 MODULE IC

Pin Number	Pin Name	Description
1	V-IN	The input voltage has to be controlled
2	V-OUT	Resigned from controllable output voltage
3	Ground	Attached to the system ground
4	Feedback	Uses output voltage feedback and a divider network to set the output voltage.
5	ON/OFF	Ground the enable pin so that it can function normally.

3.4.4 The LM2596 IC Module's Operating Principle

1. DC 3.2V40V input voltage range (the input voltage must be more than 1.5V higher than the voltage to be output.)
2. Output Voltage Range: DC 1.25V35V continuous adjustable voltage with

excellent efficiency (up to 92%); output current up to 3A. Obtain a power supply (3-40v), ensure that the power indicator light is on, and that the module is operational.

3. Turn the blue potentiometer knob to your liking (generally clockwise rotation makes boost and turning counter-clockwise makes step-down). Using a multi meter, measure the output voltage to acquire the desired voltage.

The LM2596 IC module employs a step-down switching regulator, converting higher input voltages to stable, lower output voltages efficiently. It utilizes controlled switching, feedback regulation, and output filtering to achieve reliable voltage conversion in electronic circuits.

3.5 SIM800l GSM module

A GSM module with a serial interface is called the SIM800L. It is capable of making and receiving phone calls as well as text messaging. It can also receive FM broadcasts and establish an internet connection. The serial UART interface may be used to link the SIM800L to a microcontroller; in the example below, the SIM800L is connected to an Arduino.

The module can read messages and make and receive calls. It can also understand AT commands, which may be used to verify signal strength, acquire the SIM card number, check the network connection, and check the condition of the battery.

Figure 3.5 SIM800l [35]

3.5.1 SIM800l Pin Diagram

The pin diagram for is shown in the image below of SIM800L

Figure 3.6 SIM800l Diagram of Pins [35]

3.5.2 SIM800l Specifications & Features

SIM800L is a miniature cellular module which allows for GPRS transmission, sending and receiving SMS and making and receiving voice calls. Low cost and small footprint and quad band frequency support make this module perfect solution for any project that require long range connectivity. After connecting power module boots up, searches for cellular network and login automatically.

- External antenna attachment pin
- Operating Voltage: 5V
- Input Voltage: 5V
- Reset pin, pull low for 100ms to perform hard reset
- Serial data input
- Serial data output
- Module ground reference
- Speaker differential output
- Microphone differential input
- Serial data terminal ready pin, pull high to enable sleep mode
- Interrupt output, active low
- USB-TTL based on CP2102 is included onboard, Enabling Plug n Play

3.6 Switch-Mode Power Supply

Electronic equipment frequently employs what is referred referred to as a switcher, switching regulator, switched power supply, or switched-mode power supply (SMPS) for effective electrical power conversion.

Figure 3.7 An adjustable switched-mode power supply for laboratory use [36]

3.6.1 Theory of Switch Mode Power Supply Operation

- Stage of Input Rectifier
- Stage of Inverters
- The output rectifier and voltage converter
- Rules and laws

3.6.2 Stage of the Input Rectifier

The initial step in a switched-mode power supply's operation, if necessary, is ac-dc conversion (SMPS). This is called "correction." This need not be done when utilizing a DC input SMPS. By inserting a switch that may be operated manually or automatically, certain power supplies enable the rectifier circuit to be utilized as a voltage doubler. Hence, it may be powered by common 115- or 230-volt outlets. The rectifier's voltage of unregulated direct current is sent into a large filter capacitor. Short bursts of grid power are drawn by this rectifier circuit through the usage of AC voltage peaks. The high frequency of these brief, powerful energy bursts results in a low power factor. Many contemporary SMPSs have a specialized power factor correction (PFC) circuit to adjust power factor. This circuit converts the input current into an incoming alternating current (AC) sinusoidal function.

Since most active PFC power supplies are "auto-ranging," human adjustment is not necessary for them to accept input voltages between 100 VAC and 250 VAC. A DC source can frequently power an SMPS intended for AC input since the DC would pass through the rectifier unchanged. If the power supply is rated for 115 VAC but does not include a voltage selection switch, the needed DC voltage is 163 VDC (115 * 2). However, this type of application may be detrimental to the rectifier stage since only half of the rectifier's diodes are being used for the whole load. This might cause these parts to fail early and overheat.

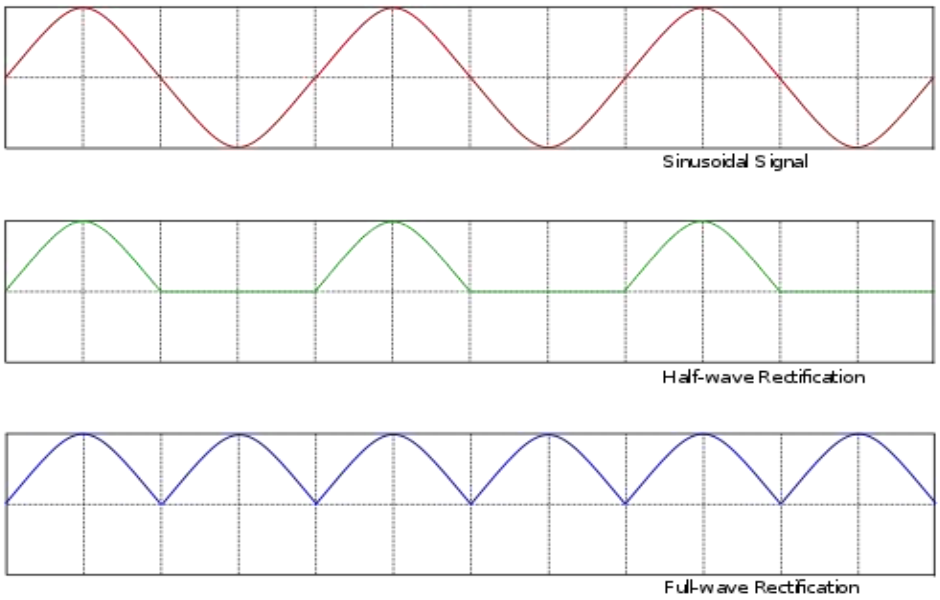

Figure 3.8 AC, Half-wave and Full-wave rectified signals [34]

3.6.3 Stage of Inverter

To convert DC from the input or rectifier stage to AC, the inverter stage employs a power oscillator and a small output transformer with few windings. Frequencies in the tens or hundreds of kilohertz range are often used by it. People are unable to hear the frequency since it is often higher than 20 kHz. A high gain MOSFET amplifier that operates in many stages activates the switch. MOSFET transistors can withstand large current levels even if they have a low on-resistance.

3.6.4 The Voltage Converter & the Output Rectifier

When a high-frequency transformer separates the input from the output, as is often the case with mains power supplies, it powers its principal windings with reversed alternating current. This modifies the voltage to produce the desired result of the

secondary winding. This task is performed by the output transformer in the block diagram. Transformers require the alternating current to be rectified in order to produce a direct current. Commonly, ordinary silicon diodes are employed at output voltages greater than around 10 volts. Schottky diodes can operate low-loss at higher frequencies because of their quick recovery periods and low forward voltage drop, which makes them popular choices for rectifier components at lower voltages. Compared to Schottky diodes, MOSFETs have smaller voltage dips between their conducting states, which allows them to be employed as synchronous rectifiers at even lower output voltages. Inductors and capacitors can be used to filter a rectifier's output in order to lessen ripple. Lower capacitance and inductance are required by components in order to support greater changing the frequency.

3.6.5 Rules and law

The voltage at the output of the circuit is measured and contrasted with a reference value. The controller may be physically isolated from the DC output by an isolation mechanism, depending on the design details and required level of safety. These opto-couplers, which are used in switching supplies, precisely control the output voltage of devices like PCs, TVs, and VCRs. A regulator that is open-loop lacks feedback. Instead, they only make the assumption that the output is accurate when a constant voltage is provided to the transformer's or inductor's input. Compensation circuitry is used in regulated systems to take the transformer or coil impedance into account. Monopolar designs account for magnetic hysteresis in the core, much more so than dipole designs do. An inactive power source is provided for standby as the feedback circuit needs electricity to produce energy.

3.6.6 A Switch-Mode Power Supply Block Diagram

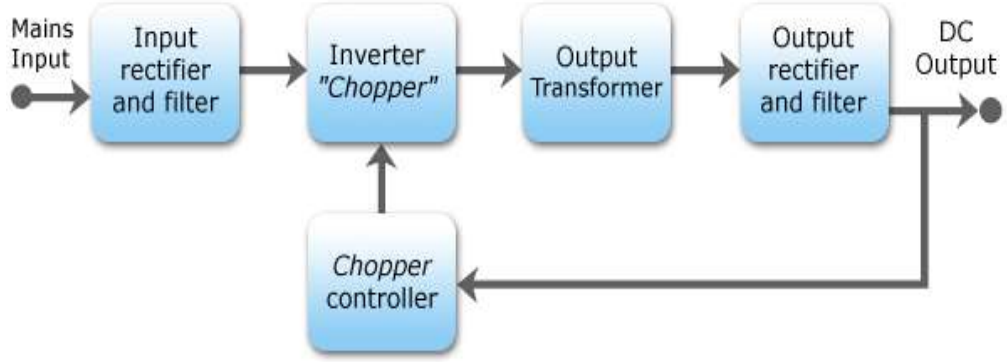

Figure 3.9 Block diagram of an AC/DC SMPS that runs on the mains and regulates output voltage [35]

3.7 Push Button

Push button switches can be classified as being normally open (NO) or normally closed (NC). Normally open (“OFF” position) switches complete the circuit when actuated, while normally closed (“ON” position) switches break the circuit when actuated. Within this classification, the functionality of push button switches can further be defined in terms of the switching circuit they utilize.

Figure 3.10 Push Button [47]

3.8 RFID Reader

A radio frequency identification reader (RFID reader) is an electronic device used to read data stored in RFID tags attached to things. Information is sent through radio waves from the tag to the reader.

Users who are already comfortable with bar codes will have no trouble adapting to RFID. The RFID tag doesn't have to be in direct line of sight with the reader to be scanned. The standard RFID reader has a reading range of 3 to 300 feet, thus the RFID tag must be within that range to be read. Quickly scanning a huge number of things is possible using RFID technology, and a single item may be detected even if it is surrounded by many others. Moreover, RFID technology enhances data capture accuracy and speed, as multiple tags can be read simultaneously. This capability significantly reduces the time and labor required for inventory counting and asset tracking tasks. Additionally, RFID tags can store more data than traditional barcodes, enabling comprehensive item information to be accessed quickly and reliably. RFID technology offers a versatile and efficient solution for a wide range of applications, including retail, logistics, healthcare, and manufacturing, enabling organizations to

streamline operations, improve inventory accuracy, and enhance overall productivity.

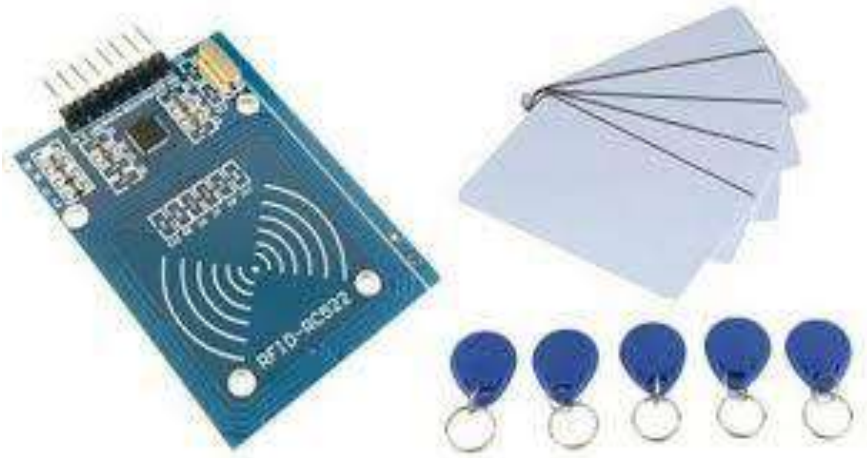

Figure 3.11 RFID Reader [42]

3.8.1 How does a RFID Reader work?

A scanning antenna, a transceiver, and a transponder are the three essential parts of an RFID system. An RFID reader or interrogator is the result of combining a scanning antenna with a transceiver. RFID readers may be either permanently installed or easily moved. Readers for radio frequency identification (RFID) tags may be either portable or fixed devices that connect to networks. The tag may be triggered by the device's radio waves. When the antenna is activated, the tag transmits a signal that is decoded into information.

This is a result of the transponder being present in the RFID tag. A number of variables, including the RFID frequency being used, the read sensitivity of the tag and reader, and the existence of other RFID tags or readers, might impact an RFID tag's read range. The reading range of tags with a bigger power source is greater.

3.8.2 Types of RFID Systems

One might choose from a low-frequency (LF), high-frequency (HF), or ultra-high-frequency (UHF) RFID system (UHF). The usage of RFID with microwaves is also possible. In terms of frequency, there is a huge variance across nations and areas.

1. Low-frequency RFID systems: These typically operate at a frequency of 125 KHz but can operate at 30 or 500 KHz. Distances of transmission for LF RFID are limited, typically being between Not quite six feet, but a few inches.

2. Systems using high-frequency RFID: The most popular of these operates at 13.56 MHz, however its frequency ranges from 3 to 30 MHz. As a rule of thumb, one can expect a variation of several feet, from a few inches.
3. UHF RFID systems: These can be read from at least 25 feet away and have a frequency range of 300 MHz to 960 MHz, with a typical frequency of 433 MHz.
4. Microwave RFID systems: These can be read up to 30 feet away at a distance of 2.45 GHz.

3.9 RFID Card

Radio-frequency identification (RFID) technology is embedded in an RFID card. This allows a single credit card to communicate with a terminal wirelessly, rather than through the magnetic strip. If you have a credit card equipped with radio frequency identification technology, all you have to do is tap it or wave it in front of a card reader or ATM. RFID cards are seen in Fig. 3.11.

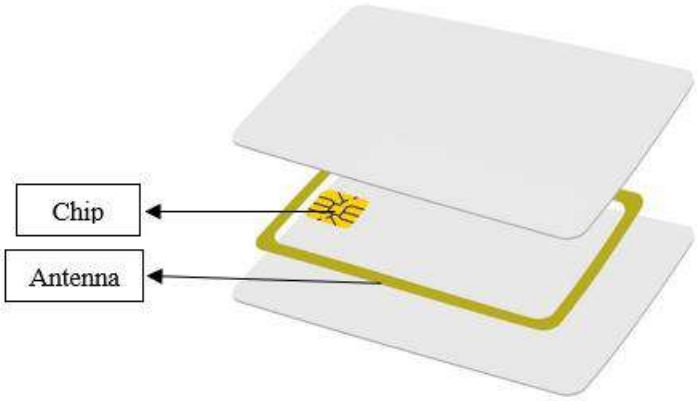

Figure 3.12 RFID Card Structure [42]

3.9.1 RFID Card Types

The main components of RFID tags are the substrate, antenna, and integrated circuit (IC). The tag's unique identifying information is stored in the tag's radio frequency identification (RFID) inlay.

RFID cards basically come in two varieties. Here are a couple such examples:

1. **Active RFID** Active RFID tags are usually powered by a battery.
2. **Passive RFID** The electromagnetic wave in the tag's antenna from the reading antenna powers the current that powers the passive RFID tag.

3.9.2 Working Principle of RFID Cards

A number of contactless smart cards use RFID, the technology behind RFID. A RFID smart card's integrated chip is where its data is kept. The integrated circuit incorporates its own microprocessor or equivalent intelligence and memory. There's an antenna built inside the plastic card's main body. Radio frequency identification induction technology is used to both power and communicate between the card and the reader. The RFID technology used in this instance has a range of less than 4 inches. This is why you need to maintain the card near the reader at all times. Both the card and the reader include antennae that enable them to exchange data wirelessly. When the card comes in touch with the reader's electromagnetic field, the chip within is activated. When the card is used with a reader, the chip begins a procedure for exchanging data through radio waves.

When the card is near the reader, the following events occur

1. Wireless energy transfer powers the card's integrated chip;
2. Reader and card exchange clock signals;
3. Reader and card exchange data;
4. Card exchanges data with reader.

3.10 20*4 Lcd Display

A 20x4 LCD means it can display 20 characters per line and there are 4 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. This is standard HD44780 controller LCD.

3.10.1 Features of Lcd Display 20*4

- These are some features of 20 x 4 LCD modules that are described here in detail.
- The most important feature of this module is that it can display 80 characters at a time.
- The cursor of this module has 5x8 (40) dots.
- This module already assembled the controller of RW1063.
- This module operates on the plus five volts input supply and can also work on the plus three volts.
- The plus 3-volt pinout can also be used for the negative supply.
- The duty cycle of this module is one by sixteen (1/16).

- The light-emitting diode of this module can get supply from the pinout one, pinout two, pinout fifteen, pinout sixteen, or pinout A and K.

3.10.2 20*4 Lcd Display Pinout

The pin diagram for a standard 20x4 LCD display module, often based on the HD44780 controller, is as follows:

- **VSS (Pin 1):** Ground (0V).
- **VDD (Pin 2):** Power supply for the LCD, usually connected to +5V.
- **VO (Pin 3):** Contrast adjustment. Connect to a potentiometer for manual contrast adjustment.
- **RS (Pin 4):** Register Select. It determines whether the data being sent is a command or character data.
- **RW (Pin 5):** Read/Write. It is used to select between reading and writing modes. In many applications, it is connected to ground for write-only operation.
- **E (Pin 6):** Enable. Falling edge triggered to latch data.
- **D0 to D7 (Pins 7 to 14):** Data bus. These are the 8 data lines for communication in 8-bit mode. In 4-bit mode, typically only D4 to D7 are used.
- **LED+ (Pin 15):** Anode for the LED backlight, if present.
- **LED- (Pin 16):** Cathode for the LED backlight, if present.

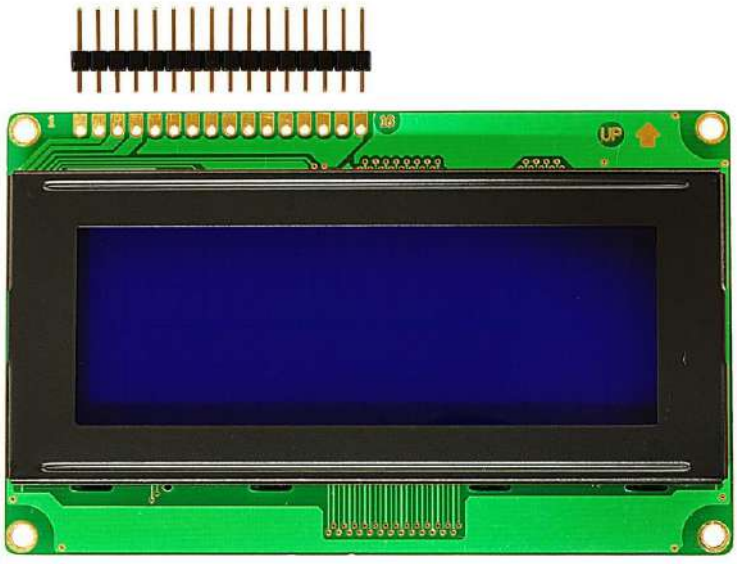

Figure 3.13 16*2 LCD Display Pinout Diagram [39]

3.11 I2C (Inter-Integrated Circuit) Module

A device that uses the I2C protocol to enable communication between a microcontroller and other peripherals, like sensors, displays, or other integrated circuits, is known as an I2C module. Because it only requires two wires to transmit data between devices the SCL, or serial clock, and the SDA, or serial data—this communication protocol is widely used.

An I2C module is frequently used for LCD displays in order to streamline the wiring and minimize the number of pins needed to link the LCD screen to a microcontroller. When working with a microcontroller's limited number of GPIO pins, this is extremely helpful.

3.11.1 I2C Module Features and Specification

A few of the I2C Serial Interface Adapter Module's features and specifications are covered in this section:

- Working Voltage: DC 5 volts
- I2C management with PCF8574
- able to fit Eight modules onto a single I2C bus
- I2C Address: 0X20~0X27 (you can use the onboard jumper pins to change the address yourself; it was originally 0X20).

Figure 3.14 20*4 LCD Display Pinout Diagram [37]

3.11.2 I2C Module Pin Diagram

Several pins on the module are available for using the I2C protocol for interaction with the MCU or CPU. The pin name, type, and functions are displayed in the table below:

TABLE II PIN DESCRIPTION OF I2C MODULE

Pin Name	Pin Type	Pin Description
GND (Ground)	Power	This pin connection to the Arduino GND pin
VCC	5V DC Power	This pin connection to the Arduino 5V pin
SDA	I2C Data	This pin connection to the Arduino pin 13
SCL	I2C Clock	This pin connection to the Arduino pin 14

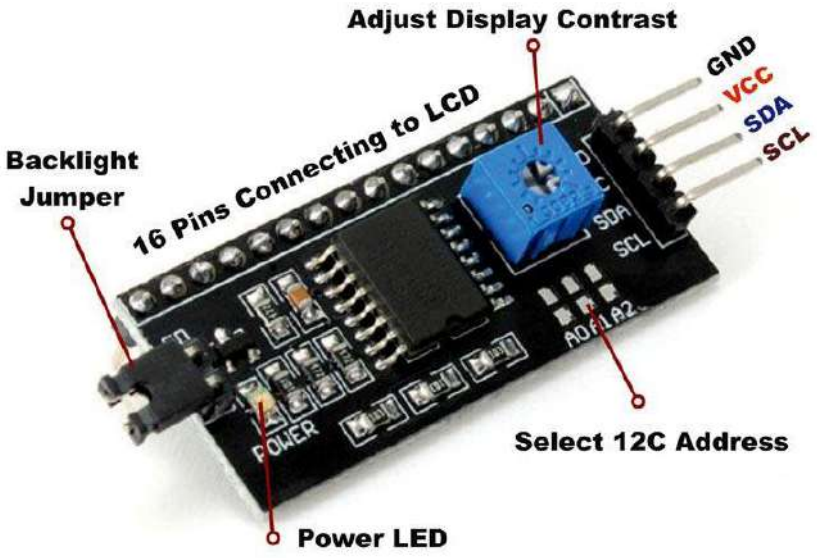

Figure 3.15 I2C Serial Interface Adapter Module Pin Diagram [37]

3.12 Keypad

Keypads are a fantastic tool for enabling user interaction with your project. They let you operate games and robots, traverse menus, and input passwords. In this post, I'll be using a 4X4 matrix membrane keypad, however 3X4 matrix keypad code and wiring schematics are also available. Since membrane style keypads are thin and feature an

adhesive backing that allows them to be adhered to most flat surfaces, I prefer them. If you prefer that look, you may also obtain keypads in the telephone form with thicker buttons. The Arduino may even be used with keypads that have been rescued from outdated phones.

3.12.1 How Keypads Work

A keypad has buttons organized in columns and rows. 4 rows and 3 columns make up a 3X4 keypad, whereas 4 rows and 4 columns make up a 4X4 keypad: A membrane switch is located beneath every key. Underneath the pad, a conductive trace connects every switch in a row to the other switches in the row. A conductive trace connects each switch's one side to every other switch in the column in the same manner for every switch in the column. A 4X4 keypad has 8 pins total—one for each row and column that are brought out to a single position. Button pressing shuts the switch that separates the row from column traces, enabling current to go between row and column pins.

The arrangement of the rows and columns is depicted in the schematic of a 4X4 keypad.

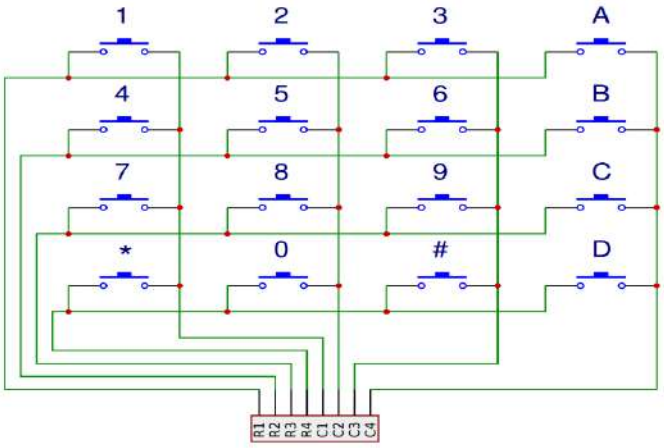

Figure.3.16 4X4 keypad [44]

3.12.2 Connect the Keypad to The Arduino

The majority of membrane keypads will have this pin configuration. The 4x4 keypad and Arduino are very easy to connect to. Attach digital pins 4, 5, 6, and 7 on the Arduino Mega to the keypad's four columns, and digital pins 8, 9, 10, and 11 to the keypad's four rows. This can be accomplished by utilizing headers or connectors to establish the connections, or by soldering wires to the keypad.

Connecting a 4x4 membrane keypad to an Arduino Mega is straightforward and can be accomplished with ease. The typical pin configuration of membrane keypads simplifies the wiring processes. By following these steps, you can establish the necessary connections between the keypad and the Arduino Mega:

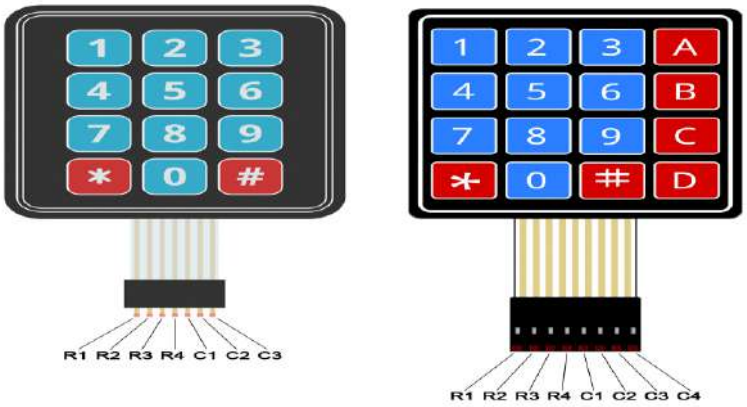

Figure 3.17 3X4 or 4X4 keypad [45]

3.13 Buzzer Module

A digital transducer with built-in DC power supply, the Active Buzzer Module is widely used in digital electronics projects for alert sound, including timers, alarms, digital toys, digital cameras, printers, copiers, and computers. An electrical signal supplied to a passive buzzer causes it to emit sound. Being devoid of an internal oscillator that might produce sound on its own is why it is dubbed passive. Its ability to emit sound instead depends on an external signal from a microcontroller, such as an Arduino. Comprising of extra circuitry to facilitate its usage with Arduino, the passive buzzer module is a compact electrical component.

Figure 3.18 Buzzer Module [46]

3.13.1 Working Principle

The passive buzzer module operates on the basis of the piezoelectric effect. The buzzer vibrates at a certain frequency due to a piezoelectric crystal within that receives an electrical signal. Human-audible sound waves are produced by this vibration. The buzzer's sound frequency is determined by the electrical signal frequency that is applied to it. The pitch of the buzzer's sound may be altered by adjusting the signal's frequency.

3.14 Block Diagram

The project's block diagram is complete. The device used is an Arduino ATmega2560 Mega. The Arduino Mega 2560 is a microcontroller board that utilizes the ATmega2560. It has an ICSP header, a reset button, 54 digital I/O pins (15 of which are PWM outputs), a USB port, a power connector, a crystal oscillator running at 16 MHz, and a reset button. Below is a block schematic of the complete project:

The necessary block diagram is shown in Fig 4.1. In this case, the ATmega2560 CPU is used. Three distinct memory regions are available to the ATmega2560 for storing code: 256 KB of flash memory (of which 8 KB is used for the bootloader), 8 KB of SRAM, and 4 KB of EEPROM (which may be read and written using the EEPROM library). The I/O, CPU, and power supply are the three primary components of an Arduino. Three distinct components comprise the block diagram shown in Fig. 4.1: input, Arduino Mega, and output.

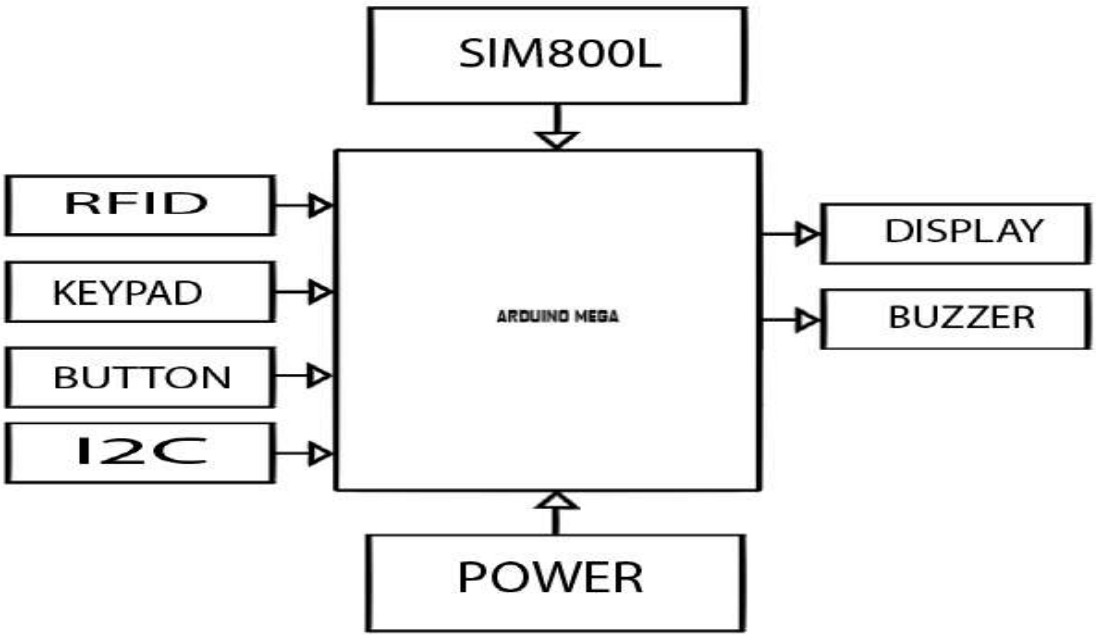

Figure 3.19 Project Block Diagram

The Arduino Mega receives data from the SIM800L, RFID rc522, keypad, PUSH button, and IR-U Turn. It can be seen that we are providing power to the Arduino Mega through the power supply block. The Arduino Mega functions as the main connector for all of the sensors and electrical parts in this setup. Here, the Arduino Mega's input voltage range is 7 to 12 volts.

Input voltage is sent to the Arduino Mega whenever a sensor makes a detection. Then, we'll use the sensor data to inform an output. The 16x2 LCD display, buzzer, and servo motor are the electrical components that will be used to provide the output. After a vehicle's RFID tag has been properly connected to an RFID reader, the LCD screen will display the vehicle's details, including the tariff, the amount of the deduction, and any other relevant data. The car's buzzer will sound if the account balance is insufficient. In both the opening and closing phases, the servo motor will be useful. The Arduino Cable, which is typically a USB Type A to USB Type B cable, will be used to transfer the program to the board. For the purpose of programming the ATmega2560, we hook up the USB Type A cable to the computer and the USB Type B cable to the Arduino Mega.

The construction of the system itself is the first stage of system development. The diagram makes it evident how each component works together flawlessly. As a result, we have created a process flow diagram that shows how the project is going as shown in Figure 4.2.

Below, we elaborate on the functioning of the flowchart.

- The first step is to start the program's algorithm.
- To guarantee correct RFID card verification, a software simulation will be conducted after this.
- In the event that the previous phase's matching of the RFID card with the program proved to be accurate, there will be a transition to the following step of the procedure. In this instance,
- After that, the system will function in line with the state of the program. If the balance is less than $20, the algorithm will route it to the lending system. The process stops if the owner of the car chooses not to obtain a loan; otherwise, the car must do a U-turn and the algorithm repeats itself. When the tariff is deducted and there is still a balance more than 500
- The anticipated outcome will arise from this

3.15 Flow Chart

Below is discussion of how the flow chart operates

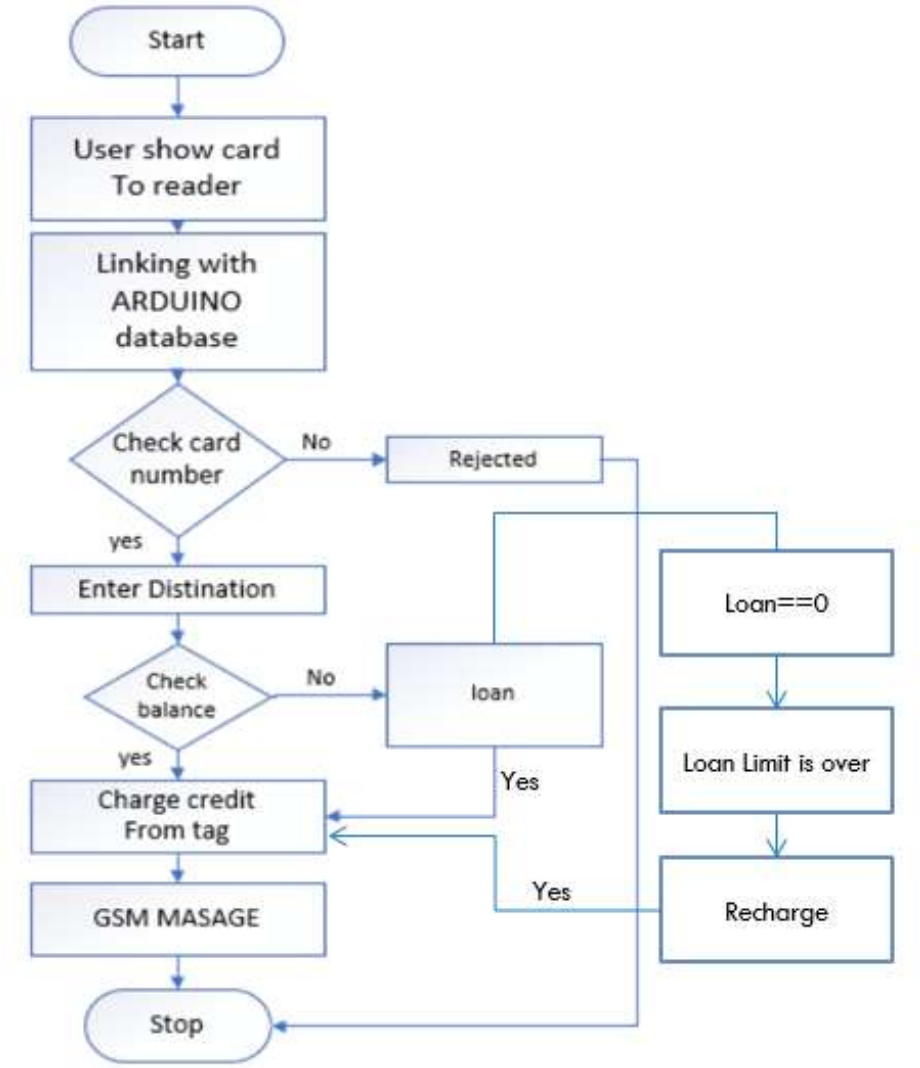

Figure 3.20 This project's flow chart.

3.16 Algorithm

Step 1: Start

Step 2: Set up variables and obtain input from the user

- Declare variables:
- card Number: String
- registered Passenger: array of String (contains registered passenger numbers)
- registered Passenger Count: integer (number of registered Passenger)
- user Balance: integer

- loan Amount: integer

- Obtain the user's card number input.

Step 3: Verify whether the card number corresponds to any recorded passenger.

- Set is Registered Passenger = false

- Go over each registered passenger number in the array of registered passengers one at a time:

- If card Number matches the current registered Passenger number:

- Set is Registered Passenger = true

- Break out of the loop

Step 4: procedure depending on the user's balance or loan amount and card number

- If the statement "is Registered Passenger" is accurate:

-Verify if the user's balance is adequate.:

- In the event when user Balance >= 60 (sufficient balance assumed);

- Check if loan Amount is sufficient (assumed sufficient loan = 30):

- If loan Amount >= 30:

- Print "welcome massage."

- Else:

- Print "Loan amount is insufficient. Need to recharge."

- Else:

- Print "Card number doesn't match any registered vehicles. Vehicle must U-turn."

- GSM massage:

Step 5: End

3.17 Circuit Diagram

Proteus software was used to create the circuit diagram for this project. Below is a comprehensive pin-to-pin connection diagram for the circuit:

3.17.1 Project pin connection

Every part of this system is linked to the ATmega2560 CPU. Pins 23 and 23 of the ATmega2560 are linked to GSM pins D2 and D3, in that order. The 16*2 display module has a total of 16 pins that may be used in different situations. We were using I2C, so even though the display says there are four pins, we really only need four. The VCC and Ground pins are linked to the 5V power supply and ground, respectively. The

microcontroller's pins 20 and 21 are linked to SDA and SCL, respectively. The SDA and SCL pins are referred to as the I2C pins when utilized for serial communication. The gadget is powered and grounded via pin 3 of the ATmega2560, the buzzer's ground, and the buzzer's output. The 5v and Ground connections are linked to the VCC and Ground pins of the IR Gate module. The signal or output pin of the IR gate is linked to pin 46 of the microcontroller. Again, pin 47 of the microcontroller is linked to the signal pin of the IR sensor, and the VCC and Ground connections remain the same. For the gate, we utilized a servo motor, and we linked pin 2 of the ATmega2560 to its signal pin. The RFID module has eight pins, but we only require seven of them. The pins for each are SDA, SCK, MOSI, MISO, RS, VCC, and Ground. connected to pins 48, 52, 51, 50, and 49 on the microcontroller, as well as to the ground and 3.3V power supply. We utilized a 3.3V power source because the RFID Module called for it.We utilized a 7-pin 4x3 keypad, where pins 32, 34, and 36 of the microcontrollers were attached to the first three column pins, while pins 38, 40, 42, and 44 of the ATmega2560 were connected to the final four row pins.

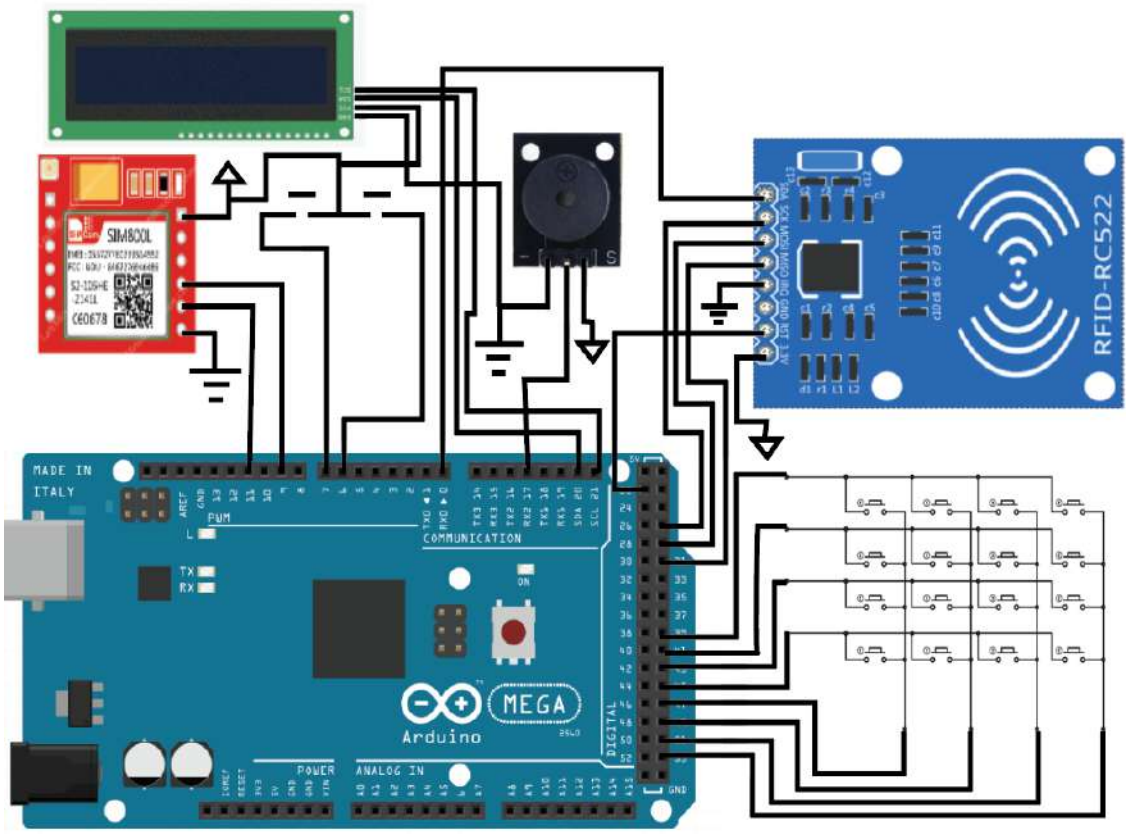

Figure 3.21 Proteus Software circuit diagram for "GSM based smart bus ticketing system with loan facilities"

CHAPTER 4
IMPLEMENTATION AND RESULT

4.1 Introduction

This project aims to create a list of recommendations for an automated toll collecting system. For this project, Arduino was used to write the code. We have created an automated tolling system that makes use of RFID tags, as well as an improved debt management system.

4.2 Application

Each piece of hardware for the system is contained on a single wooden board. Several sensors and actuators, such as an RFID reader, servo motor, 20*4 LCD, and infrared sensor, are connected to the Arduino. Every component is connected to the Arduino board via connectors. Connectors are also used for various connections.

4.2.1 Complete Overview

Proteus software was used to plan out our whole project, and a circuit diagram was created to show how each component was connected to the others. For this project, we utilized an RFID reader, a keypad, an LCD, a push button, cables, and a GSM module. In Fig. 4.1, the entire system is schematically represented.

Figure 4.1 Smart Ticketing Architecture

Figure 4.2 Metro bus Ticketing system

Figure 4.3 Punch to UID Card from Close Distance

Figure 4.4 Invalid card and Unauthorized UID Card

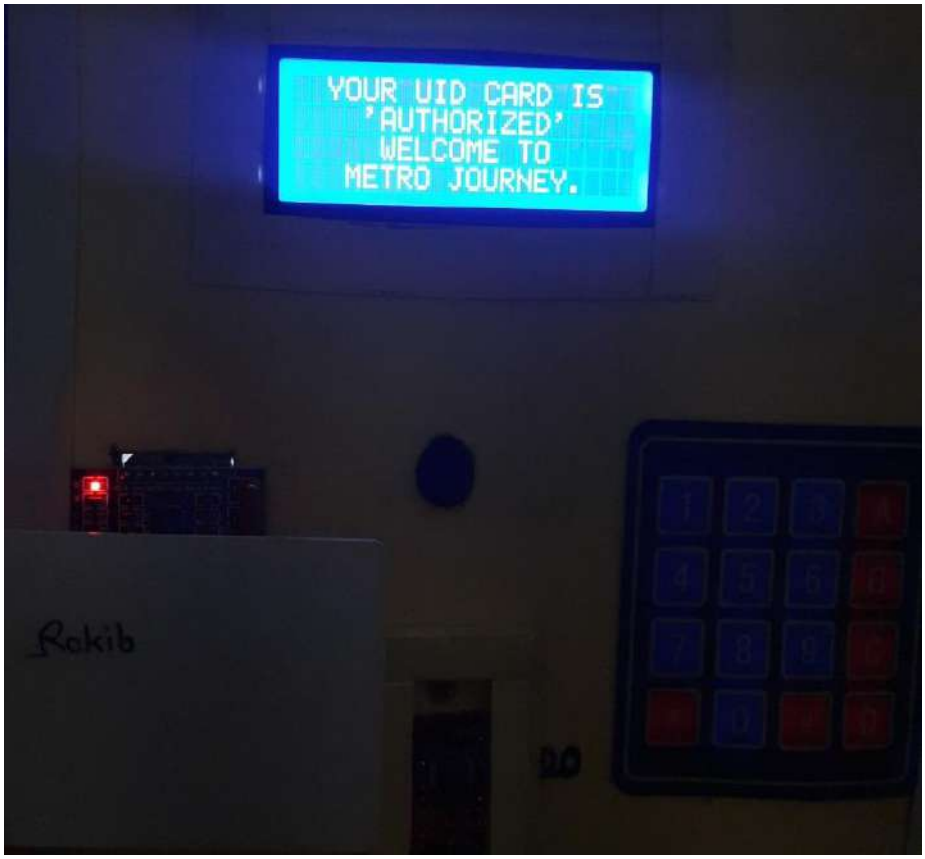

Figure 4.5 Authorized UID Card Using to Metro bus system

Figure 4.6 Result into RFID Card Punch

Figure 4.7 Choosing to Destination Entry by using push button

Figure 4.8 Select Destination Entry by using push button

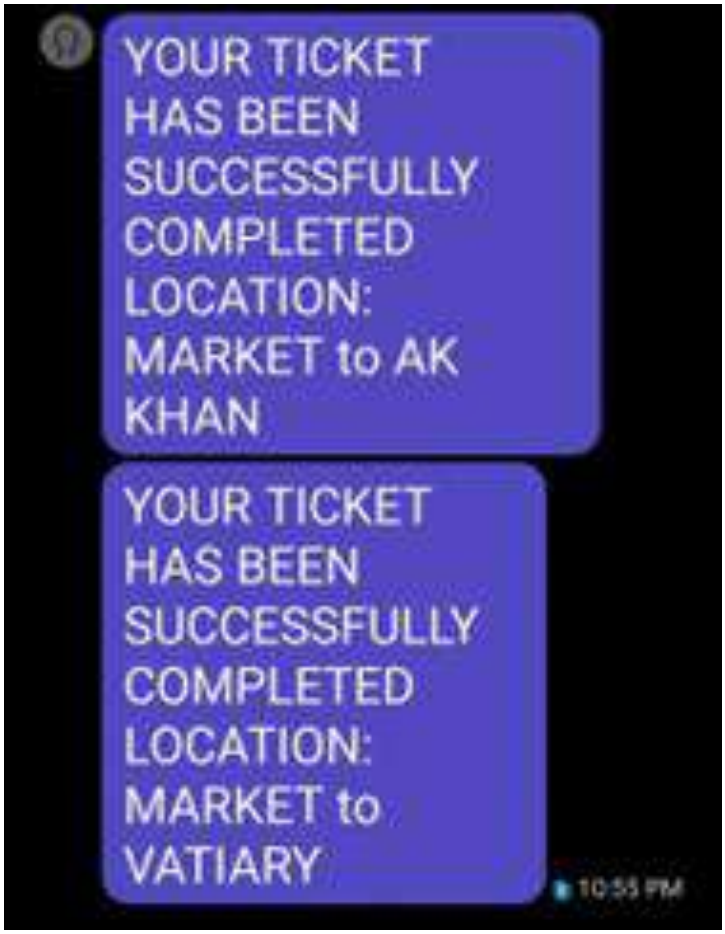

Figure 4.9 Purchase Ticket Message Customer Number

Figure 4.10 Successfully Completed location and remaining balance

Figure 4.11 Balance nil or insufficient balance

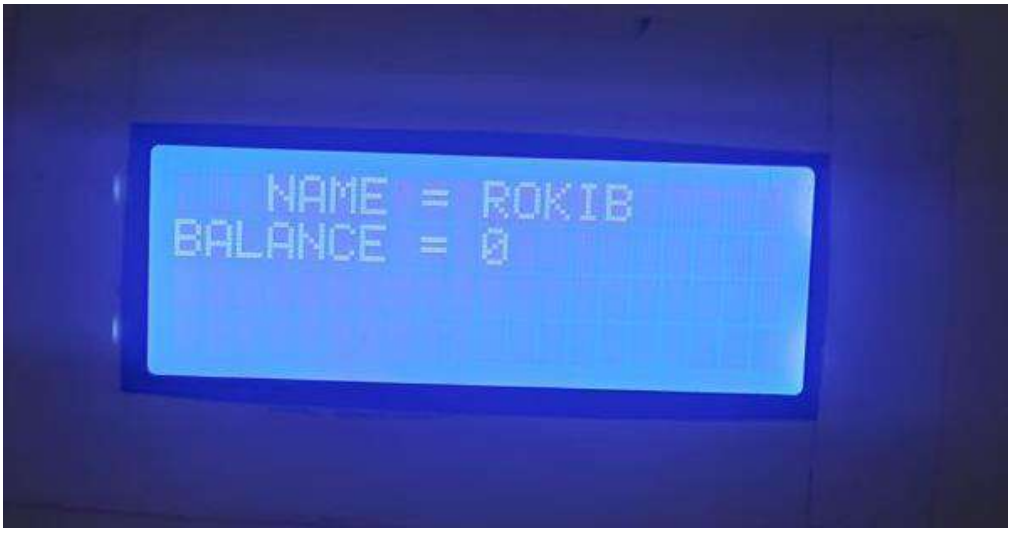

Figure 4.12 Insufficient balance

Figure 4.13 Activation into Loan

Figure 4.14 Loan After Remaining Balance

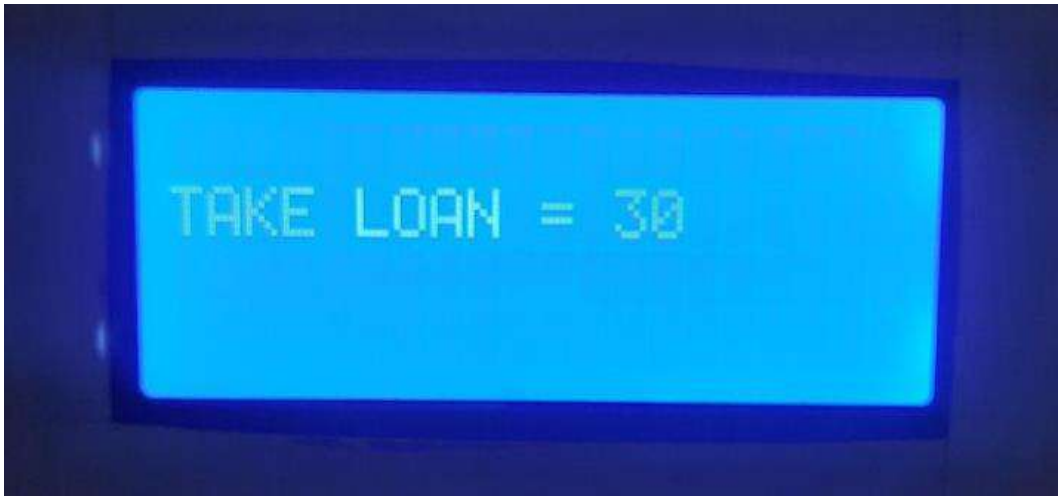

Figure 4.15 Already taken loan

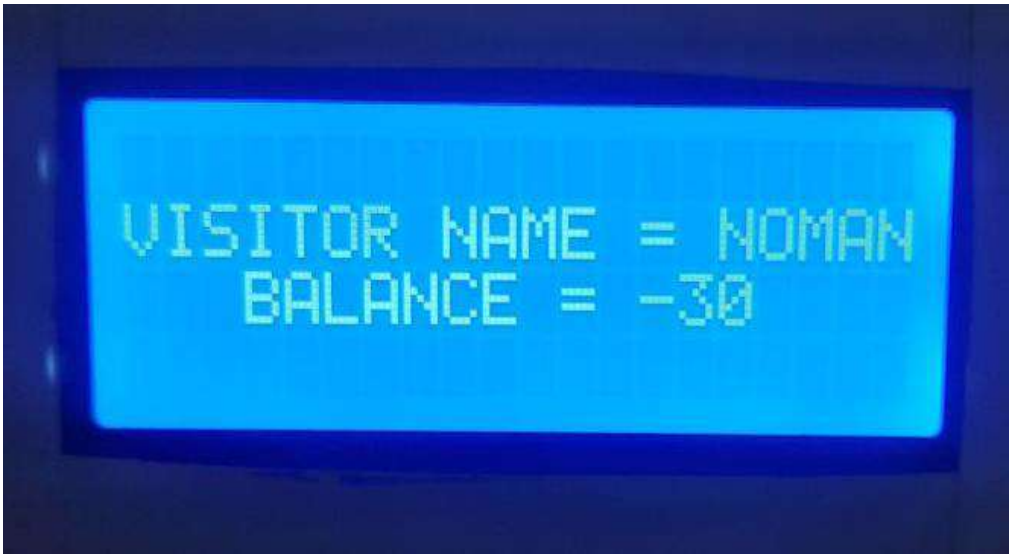

Figure 4.16 Other RFID Card Punch

Figure 4.17 Loan limited over

Figure 4.18 Entry to Recharge Amount

Figure 4.19 After Recharge new balance by using keypad

4.3 System performance.

First, we need to use a programming cable to download the software from PC-Arduino. After that, energy will be provided to run the software. the push button for position detection assistance. and the GSM module sends a message of confirmation. Subsequently, The data contained in the RFID tags will be scanned by the RFID reader, and the system will provide an output that is determined by the owner's balance. The process will be easier to comprehend overall thanks to the utilization of video.

4.4 Project Results and Demonstration

I. System sart
II. Wait for card
III. Message for valid card

IV. passenger status
V. Wai for location selection
VI. Balance status
VII. Loan Statu

4.5 Total cost of the project

Our project will cost a little of money because it is usually used in industrial settings. This project will cost you 4500 takas. We might save costs by selling or discarding some of the less necessary equipment. But as a result, the project's production will suffer.

TABLE III DISPLAYS THE PROJECT'S TOTAL BUDGET

Component Name	**Quantity**	**Price (BDT)**
Arduino Mega	1	2130/-
LM2596 Module	2	250/-
SIM800L	1	470/-
Switch Mode Power Supply	1	380/-
Push button	10	40/-
RFID Reader	1	220/-
RFID Card	3	80/-
20*4 Display	1	350/-
I2C Module	1	100/-
Buzzer module	2	80/-
Keypad	1	100/-
Wires	1	100/-
IBA	1	200/-
Total		**4500/-**

4.6 Cost Comparison

This project is a "GSM based smart bus ticketing system with loan facilities," with an estimated cost of BDT 4500, based on our analysis. Compared to similar ideas published in reputable journals and magazines, it is less expensive. The key idea here is the use of RFID tags and a location-aware GSM massaging system. An estimated BDT 20,000 will be spent on the "Automatic Ticketing System Using Ruspberry Pi". Two of this project's main components are an RFID-based system for autonomous ticketing and another for detecting stolen passengers. The project will come with a total cost of about BDT 12,000, according to the findings of the study paper "IOT Based Ticketing System Using RFID."

CHAPTER 5

CONCLUSION

5.1 Introduction

The project report is now complete. This chapter will cover the project's completion. We will also talk about the advantages, applications, and future directions of the project.

5.2 Conclusion

In conclusion, the proposed GSM-based smart metro bus ticketing system with a loan system using Radio Frequency Identifier (RFID) offers a convenient, efficient, and secure solution for the ticketing process of the metro bus service. The system uses GSM technology to provide real-time information to passengers regarding the availability and arrival of buses, and an RFID-based smart card system for contactless and secure ticketing. The loan system incorporated in the proposed system offers an innovative approach to make travel more affordable for low-income passengers, and the system also provides real-time tracking and monitoring of the metro bus fleet, allowing for optimized scheduling and efficient use of resources. Overall, the proposed system offers several benefits over traditional metro bus ticketing systems, such as reduced boarding time, improved passenger experience, increased operational efficiency, and better fleet management.

5.3 Applications

The following list of real-world uses for our project

- Automatic system for ticketing with RFID.
- Send confirmation message of passenger.
- A system for advancing loans if there is no balance.
- recharge system in case the balance isn't right.

5.4 Advantages

Some of the benefits of our project are listed below.

- Because it's automated, you don't need a separate person to control it. Just set

the program to Arduino.

- It can improve how well traffic control works.
- Worth the money.

5.5 Limitation of the System

Everything in our universe is subject to certain limitations. In light of that, this initiative is subject to a number of limitations, which are described below.

- Because it is a simple project, its use in the corporate sector is limited. In the industry, more sophisticated versions of the components are utilized.

5.6 Future Research Scope

This project may undergo certain modifications in the future; they are mentioned below.

- The proposed system can be expanded to include other modes of public transportation, such as trains and buses. This would provide a seamless and integrated ticketing experience for passengers across different transportation systems.
- Incorporating a real-time passenger counting system into the proposed system would provide valuable data to transportation authorities to better understand passenger demand and optimize routes and schedules accordingly. substantial returns on investment. Next, we'll go further into these benefits.
- The proposed system can be integrated with popular mobile payment systems such as Google Pay, Apple Pay, and others. This would further improve the convenience of the ticketing process for passengers.
- The loan system incorporated in the proposed system can be further enhanced by implementing additional features such as automated loan approval, online loan applications, and repayment tracking.

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