DIGITAL BUS PASS SYSTEM

A PROJECT REPORT

Submitted by

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Of

BACHELOR OF ENGINEERING

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VELAMMAL ENGINEERING COLLEGE,
CHENNAI - 66

BONAFIDE CERTIFICATE

Certified that this project report **"DIGITAL BUS PASS SYSTEM"** is the bonafide work of **MADHUMITHA B and SOWMIYA P"** who carried out at the project under my supervision.

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BRANCH : COMPUTER SCIENCE ENGINEERINGE

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2	SOWMIYA P		

This report of project work submitted by the above students in partial fulfillment for the award of Bachelor of Computer science Engineering Degree in Anna University was evaluated and confirmed to be reports of the work done by the above studentsand then assessed.

Submitted for Internal Evaluation held on.....

Internal Examine **External Examiner**

ABSTRACT

The Smart Card Bus Pass project seeks to revolutionize conventional bus passes through the integration of smart card technology. These cards promise to enhance the passenger journey by offering convenience, security, and efficient payment methods. By simplifying boarding procedures and eliminating cash transactions, the system aims to bolster overall operational efficiency. Moreover, the incorporation of smart cards will yield valuable data insights, facilitating the optimization of public transportation routes and schedules. With seamless integration, reduced operational costs, and a transition towards digital transactions, this initiative pledges to modernize and enhance the effectiveness of public transportation systems.

During peak hours, passengers encounter difficulties boarding buses and having their bus passes promptly checked, leading to delays and frustration. This bottleneck arises due to the sheer volume of commuters and the manual process of pass verification, resulting in lengthy queues and overcrowded buses. Passengers often struggle to navigate through crowds, making boarding time-consuming and stressful. Additionally, manual pass verification slows down boarding, exacerbating congestion and increasing travel time for all passengers. These challenges underscore the necessity for an automated, streamlined system to improve boarding experiences and ensure swift pass verification during peak hours.

Nwakanma et al. propose a system that helps passengers to reserve tickets online by providing a web portal, where passengers can login into the web portal and reserve tickets for the journey. This application only focuses on solving the problem of ticket reservation; it is also of no help to passengers who travel on a daily basis.

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Finally, to all those who have supported my academic journey yet whose names are not mentioned here, I am truly grateful and very much appreciate all your contributions. May the ever-good Lord immensely you all!

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION TO PROJECT

Demand for a digital bus pass system is increasing as 85% of respondents prefer digital bus passes for the convenience of quick transactions and reduced queuing times.. This project proposes the implementation of smart card technology to revolutionize traditional bus passes. The Smart Card Bus Pass system aims to enhance computer experience by providing a convenient, secure, and efficient mode of payment. The smart cards will streamline boarding processes, eliminate cash transactions, and offer valuable data for optimizing public transportation efficiency. The project envisions a seamless integration of smart cards, reducing operational costs, promoting digital transactions, and ultimately fostering a more accessible and user-friendly public transit system The implementation of a digital bus pass results in improved convenience, reduced paper usage, streamlined administration, and enhanced tracking capabilities, leading to a more efficient and user-friendly public transportation system.

1.2 LITRATURE REVIEW

Nwakanma et al. [1] propose a system that helps passengers to reserve tickets online by providing a web portal, where passengers can login into the web portal and reserve tickets for the journey. This application only focuses on solving the problem of ticket reservation; it is also of no help to passengers who travel on a daily basis.

Anurag Sharma and Amit Sharma [2] propose a system that aims to provide an effective solution for an interactive web-based bus pass creation system for college students. This system will simply require their personal details with a confidential

pin for authentication purposes, which the student has to buy from the DTC bus depot or college office. The system can be accessed by a student at any time.

Vasanta Sanga et al. [3] propose a system that aims to provide an effective solution for maintaining bus pass information using a database. There are two logins in the system: one for users and one for administrators. The online bus pass generation system is a web application that allows people to obtain bus passes online. Accessing the basic information for authentication and providing a bus pass to a particular person without placing him or her in a queue for a long time.

[4] propose a system where the user can fill out their information, link a bank account, or use wallet services to make a payment. This system offers features like instantaneous delivery of bus tickets and access to user-basic information for authentication. This technology offers the user security choices and verifies whether buses are running along the next route. The application would send the user a message with information such as the time, date, and location that the ticket was being used in a transaction.

The tickets are generated directly on passenger's mobile phones so smart card usage and paper tickets are eliminated. On that account it will make the passenger comfortable to travel with this User-friendly system[5].

CHAPTER 2

PROBLEM STATEMENT

2.1 PURPOSE OF THE PROJECT

During peak hours, passengers face challenges boarding buses and getting their bus passes checked efficiently, leading to delays and frustration. This bottleneck occurs due to the high volume of commuters and the manual process of checking bus passes, resulting in long queues and overcrowded buses. Passengers often struggle to navigate through crowds, making boarding time-consuming and stressful. Additionally, the manual verification of bus passes slows down the boarding process, exacerbating congestion and increasing travel time for everyone. These difficulties highlight the need for an automated, streamlined system to improve the boarding experience and ensure efficient verification of bus passes during peak hours.

2.2 OBJECTIVES

1. To enhance Efficiency
2. To boost Public Transportation Adoption
3. To improve Fleet Management
4. To foster Innovation in Public Transit

CHAPTRE 3

SYSTEM ANALYSIS

3.1 EXISTING SYSTEM

The existing system in the project involves the utilization of paper bus passes, where passengers present physical passes to conductors for validation. Conductors manually mark or tick off the passes to indicate their usage for the day. These paper passes are susceptible to damage, loss, and fraud, and the manual validation process can lead to errors and inefficiencies. The system lacks real-time tracking and digital integration, making it challenging to monitor pass usage and optimize transit services effectively. Overall, the existing system relies on outdated paper-based processes, resulting in environmental, operational, and financial drawbacks.

3.2 DISADVANTAGES

1. Environmental Unsustainability: Paper bus passes contribute to deforestation and waste generation, exacerbating environmental concerns associated with paper production and disposal.

2. Prone to Damage: Paper passes are susceptible to damage from moisture, tearing, or loss, leading to inconvenience for passengers and administrative challenges for transit authorities, such as the need for frequent reissuance.

3. Manual Validation Errors: The manual ticking process for pass validation is prone to errors, including missed ticks or fraudulent usage, potentially resulting in revenue loss for transport operators and undermining the integrity of fare collection systems.

4. Lack of Real-time Tracking: Paper-based passes lack real-time tracking capabilities, making it difficult for transit authorities to monitor pass usage patterns,

identify trends, and promptly address issues such as overcrowding or underutilization of services.

5. Limited Digital Integration: The absence of digital integration hampers efforts to modernize public transit systems, hindering the implementation of features such as mobile ticketing, automated fare collection, and data analytics for service optimization and customer engagement.

3.3 PROPOSED SYSTEM

The digital bus pass system utilizes passive RFID cards carried by passengers, which are scanned by RFID readers installed on buses. When a card is scanned, the RFID reader sends the data to an Arduino Uno microcontroller onboard the bus. The Arduino Uno processes the data and forwards it to a GSM module for real-time validation. The GSM module communicates with a central server to verify the pass validity and deduct the fare from the user's account if applicable. Once validated, the system sends a digital ticket to the user's smartphone via SMS message, confirming their successful validation and providing essential journey details. This system offers convenience to passengers, reduces the reliance on paper-based passes, improves operational efficiency, and enables real-time monitoring of passenger activity for transit authorities.

3.3.1 RFID

The RFID RC522 reader is a widely used module for reading RFID (Radio-Frequency Identification) tags. It operates at 13.56 MHz frequency and utilizes SPI communication protocol for interfacing with microcontrollers. The RC522 reader can detect passive RFID tags within its range, typically up to several centimeters, and retrieve unique identification information stored on these tags. Passive RFID tags, lacking a power source of their own, rely on energy from the reader's signal for operation. They are commonly used for inventory tracking, access control, and

identification purposes in various industries due to their low cost and ease of deployment[6]

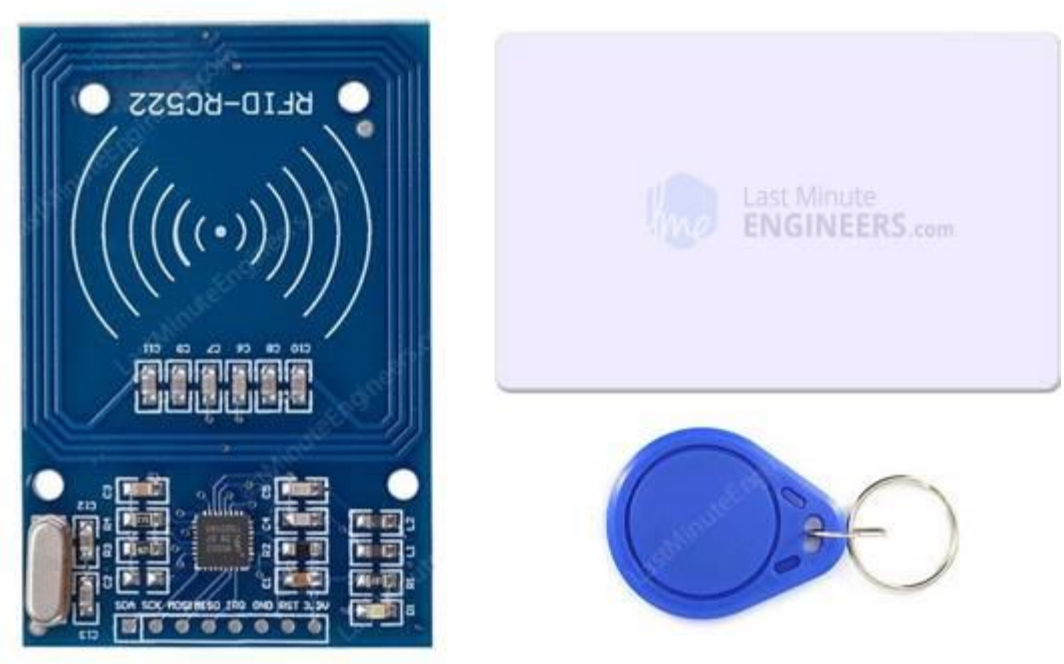


Fig 3.3.1.1 RFID RC522

3.3.2 GSM

GSM 900, operating within the 900 MHz frequency band, is a cellular technology used for voice and data communication. Despite being an older standard, it can still send notifications efficiently. Airtel, a major telecommunications provider, offers 5G SIM cards compatible with modern networks. While GSM 900 does not support 5G data speeds, it can transmit basic notifications and text messages. When paired with an Airtel 5G SIM, GSM 900 enables devices to utilize Airtel's network infrastructure for sending notifications, ensuring reliable communication even in areas where 5G coverage may not be available [7].

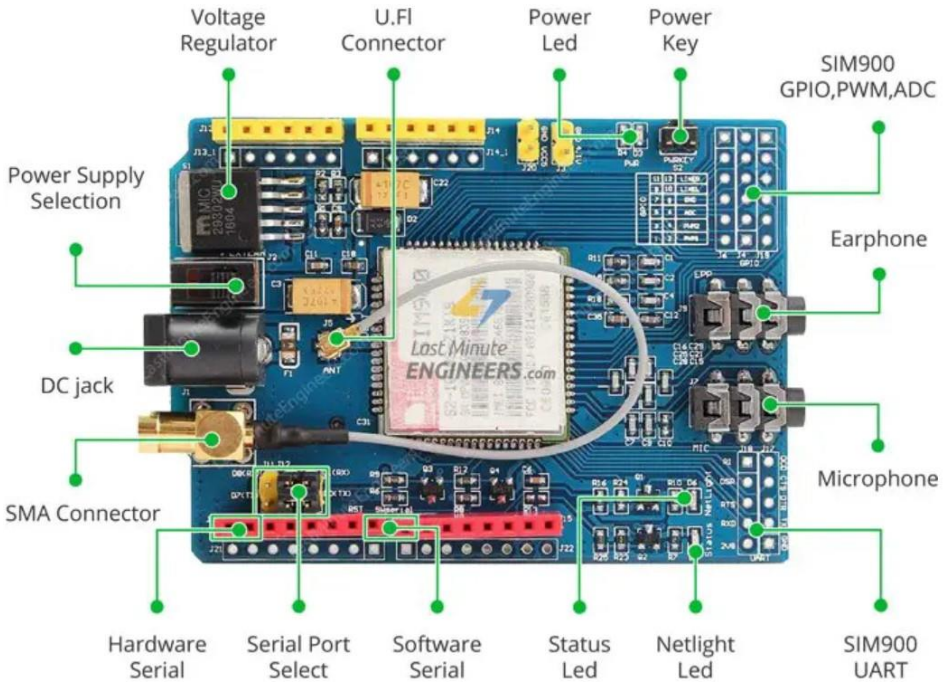


Fig :3.3.2.1 GSM MODULE

3.3.3 AURDINO UNO

The Arduino Uno is a popular microcontroller board widely used in electronics projects and prototyping. It features multiple digital input/output (I/O) pins, typically 14 in total. These digital pins can be individually configured as inputs or outputs, allowing for interfacing with various sensors, actuators, and other devices. Each digital pin can be set to either a HIGH (5V) or LOW (0V) state, making it suitable for simple digital communication and control tasks. Additionally, some of these pins have special functionalities such as PWM (Pulse Width Modulation) for analog output and interrupts for handling time-sensitive events[8]

FIG :3.3.3.1 AURDINO UNO

3.3.4 AURDINO IDE

The Arduino Integrated Development Environment (IDE) is a software platform designed for programming Arduino microcontroller boards. It provides a user-friendly interface for writing, compiling, and uploading code to Arduino devices. With a simple and intuitive editor, programmers can write sketches (programs) using the Arduino programming language, which is based on C/C++. The IDE includes a vast library of pre-written code examples and functions, making it easy for beginners to get started with electronics projects. Furthermore, it supports various Arduino board models and offers tools for debugging and serial communication, making it an essential tool for both hobbyists and professionals alike.[9]

3.4 ADVANTAGES:

The digital bus pass system offers several advantages over traditional paper-based systems:

1. Convenience: Users benefit from the ease of carrying a single RFID card compared to paper passes, reducing the risk of loss or damage.

2. Efficiency: The automated RFID scanning and data processing streamline the boarding process, reducing boarding times and improving overall bus service efficiency.

3. Real-time Validation: Real-time validation through GSM technology ensures that only valid passes are accepted, reducing the risk of fraudulent usage and revenue loss.

4. Environmental Sustainability: By eliminating the need for paper passes, the system reduces paper waste, contributing to environmental sustainability efforts.

5. Enhanced Security: RFID technology provides a secure and tamper-resistant method of pass validation, minimizing the risk of counterfeit passes or unauthorized use.

CHAPTER 4

SYSTEM SPECIFICATION

4.1 REQUIREMENTS:

4.1.1 HARDWARE:

1. Microcontroller: Arduino or Raspberry Pi for controlling and processing data.

2. RFID/NFC Module: RFID or NFC card reader module for pass scanning.

3. GSM Module: GSM module for sending SMS notifications.

4. LIGHTS AND BUZZERS to indicate the card is scanned or not.

5. mobile phone for reciving notification

6. Power Supply: Battery or bus power source, depending on the project requirements.

4.1.2 SOFTWARE:

1. AURDINO IDE

4.2 KEY FEATURES

1. Digital Pass System: Implement a digital pass system to replace traditional paper passes, allowing passengers to use electronic passes stored on their smartphones or smart cards for convenient and environmentally sustainable fare collection.

2. Real-time Tracking: Integrate GPS technology and backend systems to enable real-time tracking of buses and pass usage, providing transit authorities with valuable data to monitor service performance, optimize routes, and improve operational efficiency.

3. Mobile Ticketing: Develop a mobile ticketing app that allows passengers to purchase and validate tickets directly from their smartphones, reducing reliance on physical passes and streamlining the ticketing process for both passengers and operators.

4. Automated Fare Collection: Introduce automated fare collection systems onboard buses, such as contactless payment terminals or fare gates, to improve fare collection accuracy, reduce manual errors, and enhance passenger convenience.

5. Data Analytics: Utilize data analytics tools to analyze pass usage patterns, passenger demographics, and service demand, enabling transit authorities to make informed decisions regarding service planning, resource allocation, and customer engagement strategies.

6. Fraud Detection Mechanisms: Implement robust fraud detection mechanisms, such as biometric authentication or machine learning algorithms, to prevent unauthorized usage of digital passes and minimize revenue leakage due to fraudulent activities.

7. Integration with Existing Systems: Ensure seamless integration with existing transit infrastructure, including ticketing machines, fare collection gates, and backend databases, to facilitate a smooth transition to the new digital system without disrupting ongoing operations.

8. User-Friendly Interface: Design intuitive and user-friendly interfaces for both passengers and transit staff, making it easy to purchase, validate, and manage digital passes, as well as access real-time information about bus schedules, routes, and service updates.

9. Security and Privacy Measures: Implement robust security measures, such as encryption, authentication protocols, and data privacy policies, to safeguard

passengers' personal information and ensure the integrity of the digital pass system against cybersecurity threats.

10. Stakeholder Engagement: Engage with stakeholders, including passengers, transit operators, government agencies, and technology vendors, throughout the project lifecycle to gather feedback, address concerns, and foster collaboration in driving the successful implementation of the modernization initiative.

4.3 BLOCK DIAGRAM

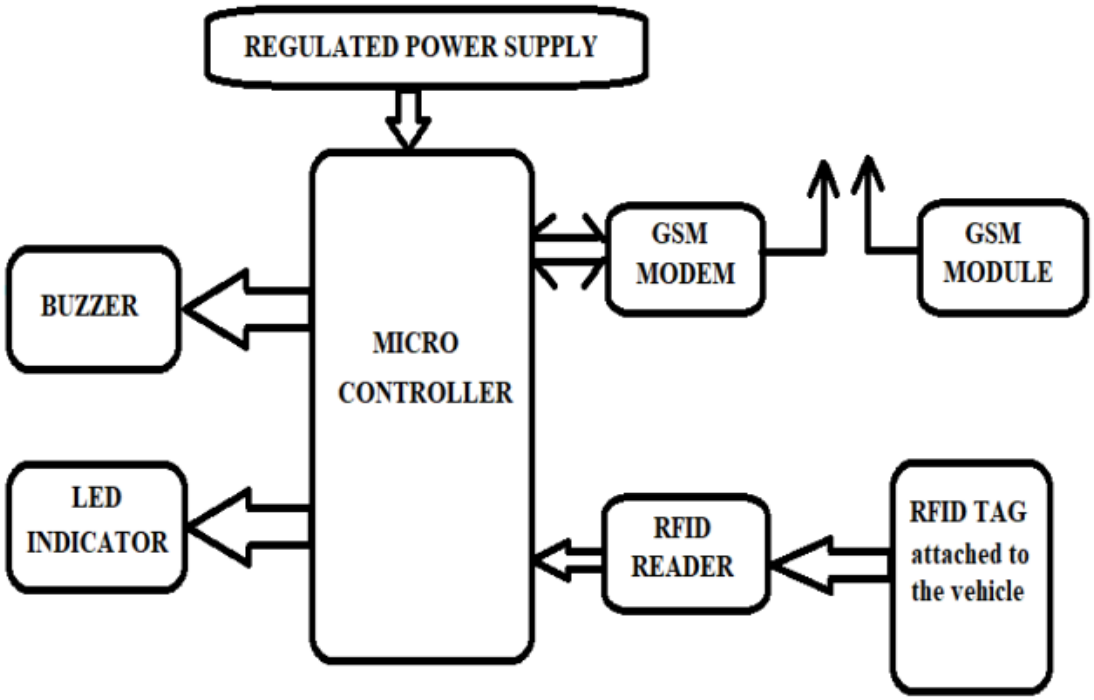


Fig 4.3.1 BLOCK DIAGRAM

4.5 WORK FLOW

The workflow of the project begins with the Arduino Uno, GSM 900A module, and RFID reader being powered by an external power supply. When the system is turned on, the RFID reader scans a card placed within its vicinity. The scanned data is then transmitted to the Arduino Uno, which processes the information received from the RFID reader. Upon successful processing, the Arduino triggers the GSM 900A module to send a notification via SMS to a predefined phone number, indicating that the card has been scanned. Additionally, the Arduino activates the buzzer and LED lights to provide visual and auditory feedback, indicating that the scanning process is complete. The resistor integrated into the circuit ensures proper signal conditioning and indicates that the card has been successfully scanned. Throughout this workflow, the components work in tandem: the RFID reader captures data, the Arduino processes it, and the GSM module facilitates communication to send notifications, while the buzzer and LED lights provide immediate feedback to the user. Overall, this streamlined process ensures efficient card scanning and notification delivery in real-time, enhancing the functionality and usability of the system.

4.6 WORKING EXPLANATION

The incorporation of LED lights, messages, and a buzzer ensures real-time communication, keeping commuters informed about bus schedules and important updates. It enhances user convenience and also generates valuable data for optimizing public transportation efficiency. The system's remote management capabilities empower administrators to monitor and manage the entire infrastructure efficiently, minimizing the need for on-site interventions

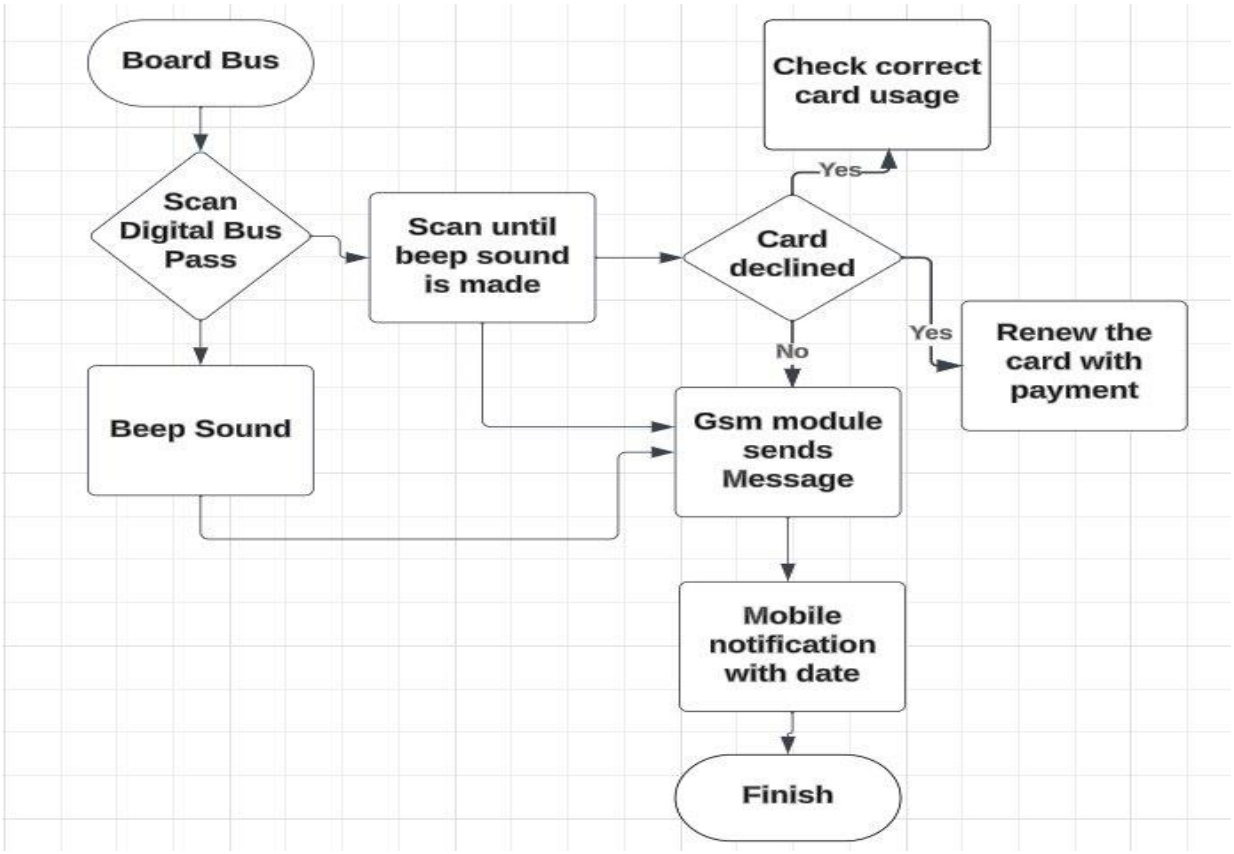


Fig 4.6.1: WORKING FLOW DIAGRAM

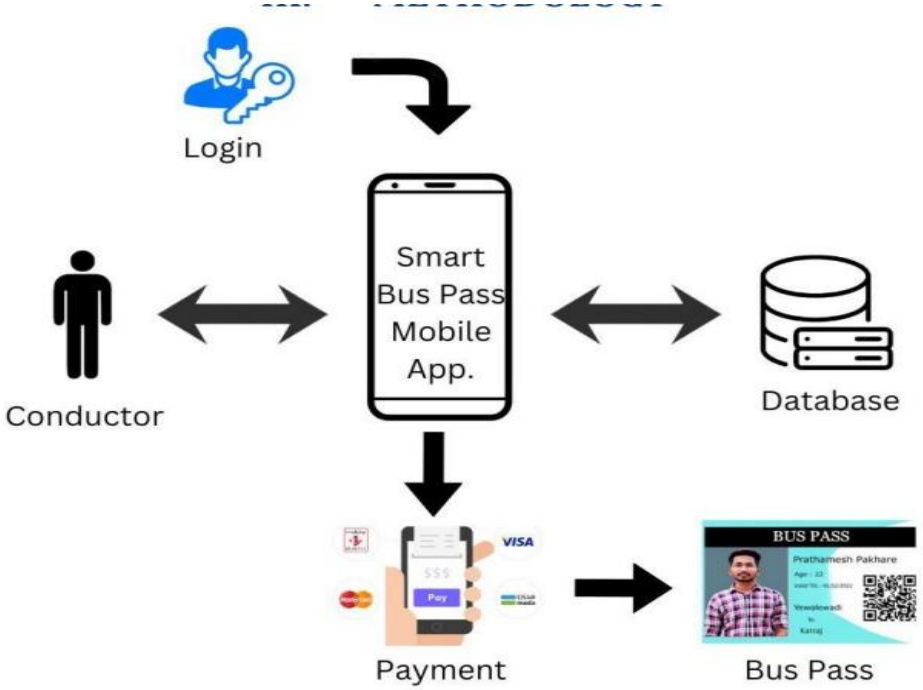


Fig 4.6.2: WORKING

4.7 TEST CASES

CASE 1:

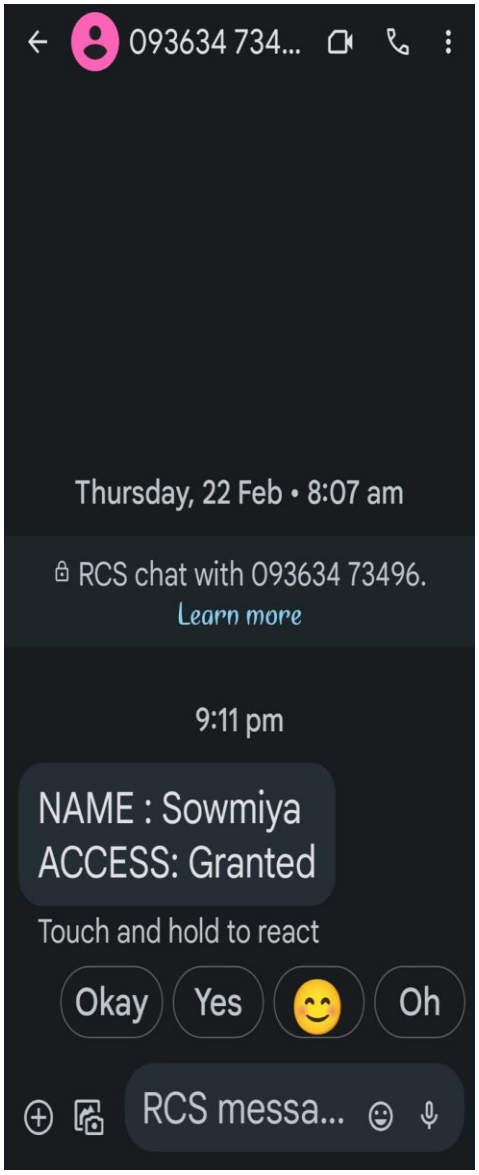


Fig 4.7.1 access granted

card scanned and is valid

CASE 2:

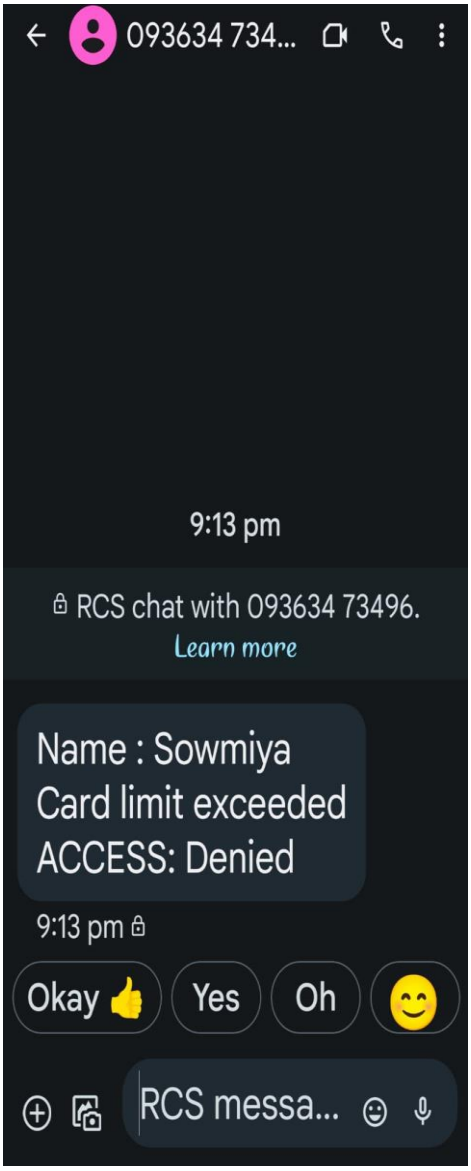


Fig 4.7.2. Card scanned but card

limit exceeded more than 2

CASE 3:

FINAL OUTPUT

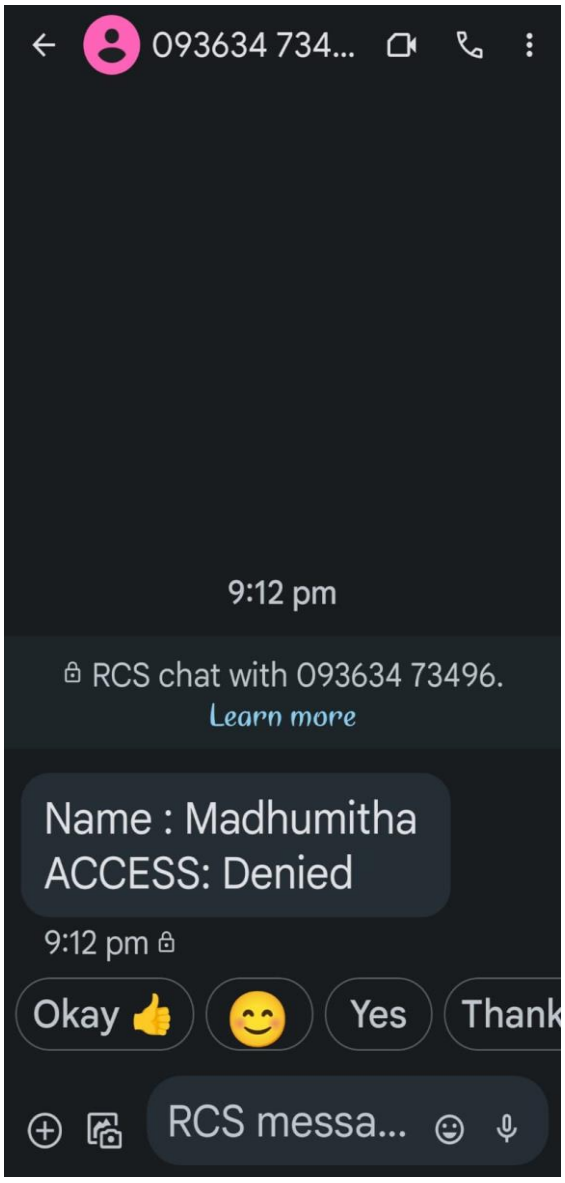


Fig 4.7.3 access denied
card scanned and is invalid

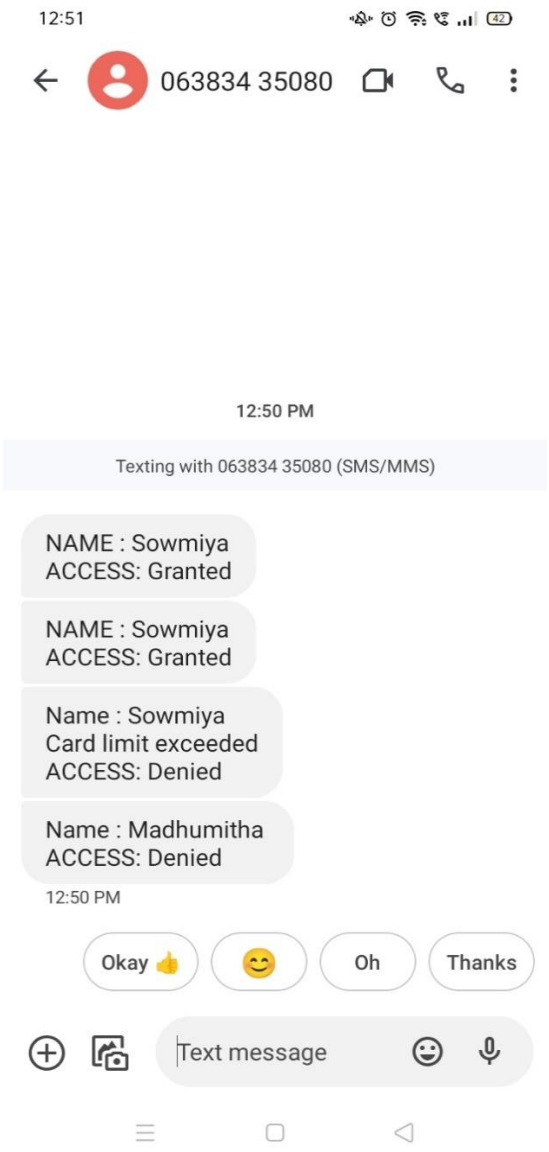


Fig 4.7.4

4.8 WORKING HARDWARE

Fig 4.8.1: ON STATE

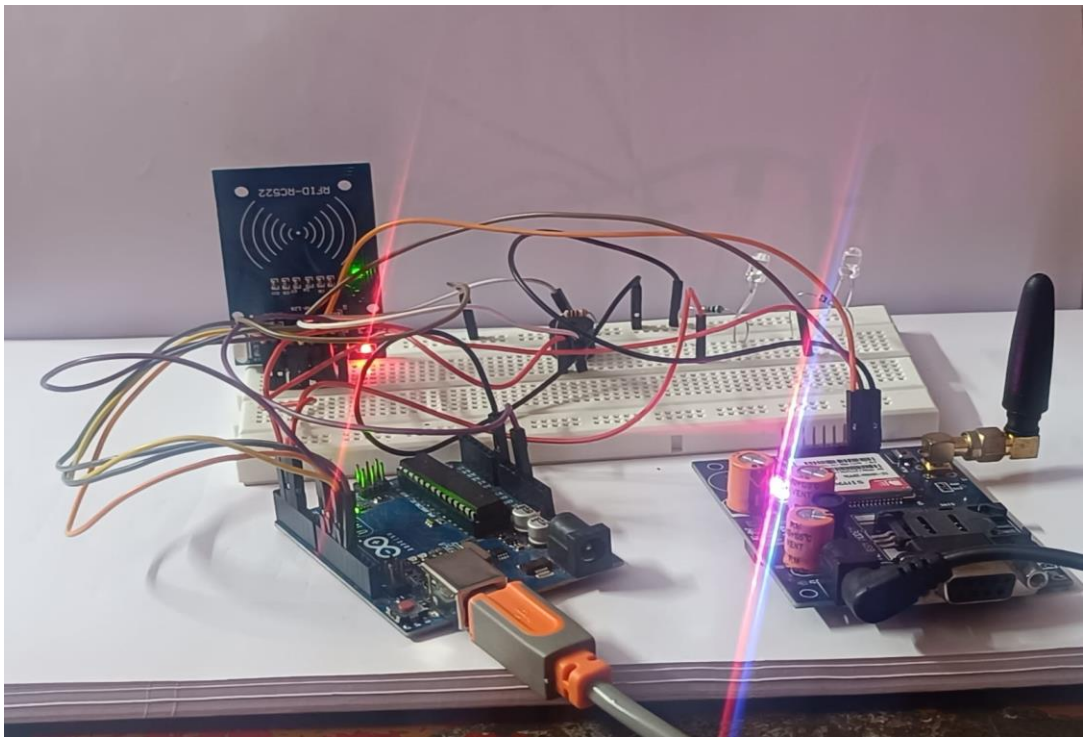


Fig 4.8.2: ACCESS GRANTED

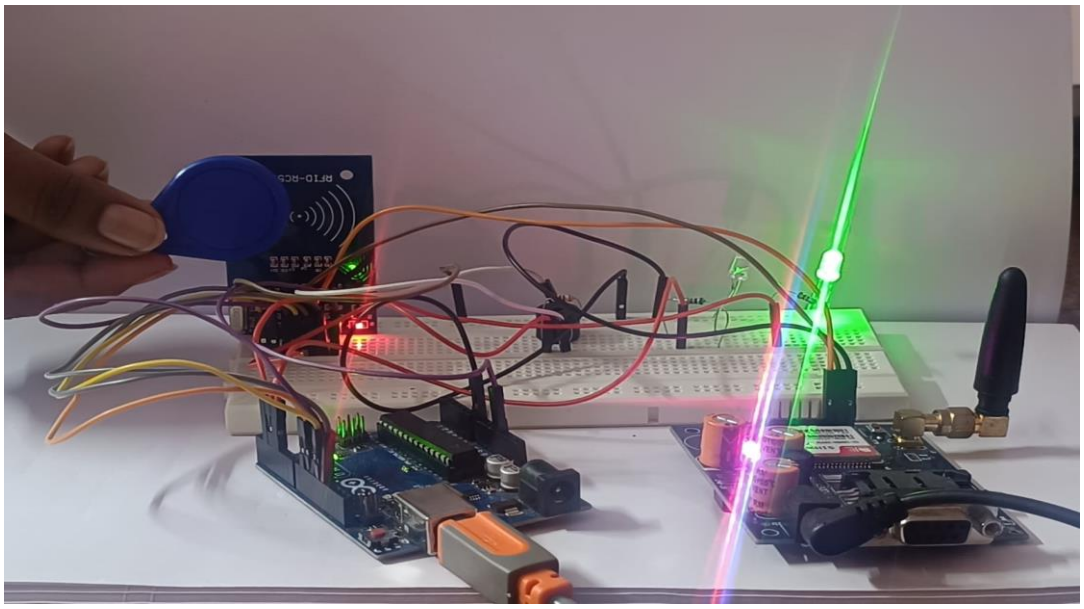
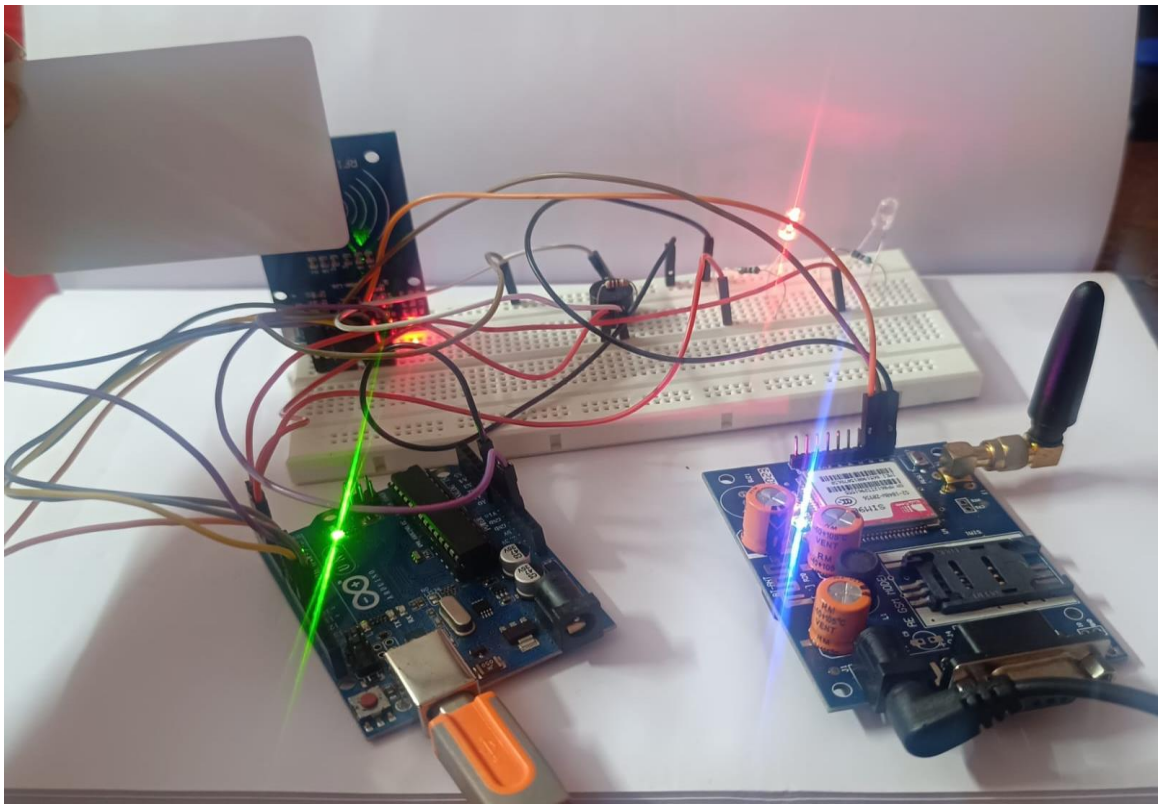


Fig 4.8.3: ACCESS DENIED



CHAPETR 5

CONCLUSION AND FUTURE WORKS

5.1 CONCLUSION

The implementation of the digital bus pass card system in urban India could have a transformative impact on public welfare. Firstly, it would significantly improve accessibility to transportation for urban residents, many of whom rely on buses as their primary mode of travel. By streamlining the boarding process with RFID technology, the system reduces waiting times and enhances overall efficiency, making commuting more convenient for individuals during peak hours. The ability to recharge passes remotely ensures continued access to transportation services, even in areas with limited infrastructure. This initiative not only fosters economic growth by facilitating easier access to markets and employment opportunities. The workflow involves an intelligent fleet management system, scheduling optimization, and resource allocation. The system's remote management capabilities empower administrators to monitor and manage the entire infrastructure efficiently.

5.2 FUTURE WORKS

In the realm of digital bus pass scanner systems utilizing RFID, Arduino, and GSM technology, several avenues for future development and enhancement exist. One potential direction involves integrating advanced data analytics capabilities to gather insights on passenger usage patterns, peak travel times, and popular routes. This data could be leveraged to optimize bus scheduling, improve resource allocation, and enhance overall transit efficiency. Furthermore, enhancing the user interface and experience through mobile applications could streamline the process

of purchasing, managing, and using digital bus passes. Implementing real-time tracking and notification features could also provide passengers with up-to-date information on bus arrival times, delays, and route changes, enhancing convenience and reducing waiting times. Additionally, exploring the integration of contactless payment methods and biometric authentication could offer added convenience and security for passengers. Overall, continued innovation in these areas holds the potential to transform digital bus pass systems into more efficient, user-friendly, and technologically advanced solutions for modern urban transit networks.

5.3 APPLICATIONS

1. Paperless and Eco-Friendly
2. Contactless Transactions
3. Reduced Boarding Time
4. Efficient Bus Boarding
5. Accurate Passenger Data

APPENDIX

```
#include <SPI.h>
#include <MFRC522.h>
#include <SoftwareSerial.h>
#include <EEPROM.h>
#define RST_PIN         9
#define SS_PIN          10
MFRC522 mfrc522(SS_PIN, RST_PIN);
byte accessUID[4] = {0x13, 0x4C, 0x10, 0xF5};
int GreenPin = 2;
int RedPin = 3;
int buzzerPin = 4;
int accessLimit = 70;  // Number of accesses allowed per day
SoftwareSerial mySerial(9, 10);  // RX, TX for GSM module
unsigned long lastAccessMillis = 0;
const long dayInterval = 86400000;  // One day in milliseconds
void setup() {
  pinMode(GreenPin, OUTPUT);
  pinMode(RedPin, OUTPUT);
  pinMode(buzzerPin, OUTPUT);
  digitalWrite(RedPin, LOW);
  digitalWrite(GreenPin, LOW);
  Serial.begin(9600);
  while (!Serial);
  SPI.begin();
  mfrc522.PCD_Init();
```

```
  delay(4);
  mfrc522.PCD_DumpVersionToSerial();
  Serial.println(F("Scan PICC to see UID, SAK, type, and data blocks..."));
  mySerial.begin(9600);
  delay(100);
  if (EEPROM.read(0) == 255) {
    EEPROM.write(0, 0);
  }
  digitalWrite(GreenPin, LOW);
  digitalWrite(RedPin, LOW);
}
void sendSMS(String message) {
  mySerial.println("AT+CMGF=1");
  delay(1000);
  mySerial.println("AT+CMGS=\"+919688113385\"\r");
  delay(1000);
  mySerial.println(message);
  delay(100);
  mySerial.println((char)26);
  delay(1000);
}
void updateAccessCount() {
  int accessCount = EEPROM.read(0);  // Read access count from EEPROM
  if (millis() - lastAccessMillis >= dayInterval) {
    accessCount = 0;  // Reset the access count for the new day
    lastAccessMillis = millis();  // Update lastAccessMillis
```

```
  }
  accessCount++;  // Increment the access count
  EEPROM.write(0, accessCount);  // Write the updated access count to EEPROM
}
bool isCardValid() {
  int accessCount = EEPROM.read(0);  // Read access count from EEPROM
  return accessCount < accessLimit;
}
void accessGrantedAction() {
  Serial.println("Access Granted");
  if (isCardValid()) {
    updateAccessCount();  // Update the access count in EEPROM
    digitalWrite(GreenPin, HIGH);
    tone(buzzerPin, 1000, 200);
    sendSMS("Name:Sowmiya \n Access:Granted \n ");
  } else {
    Serial.println("Card limit exceeded - Access Denied");
    accessDeniedAction();  // Implement access denied action
  }
  digitalWrite(GreenPin, LOW);
  digitalWrite(RedPin, LOW);
}
void accessDeniedAction() {
  Serial.println("Access Denied");
  digitalWrite(RedPin, HIGH);
  digitalWrite(buzzerPin, HIGH);
```

```
  tone(buzzerPin, 800, 1000);
  delay(1000);
  digitalWrite(RedPin, LOW);
  noTone(buzzerPin);
  sendSMS("Access Denied");
  digitalWrite(GreenPin, LOW);
  digitalWrite(RedPin, LOW);
}
 void loop() {
  delay(500);
  digitalWrite(GreenPin, LOW);
  digitalWrite(RedPin, LOW);
  if (!mfrc522.PICC_IsNewCardPresent()) {
    return;
  }
  if (!mfrc522.PICC_ReadCardSerial()) {
    return;
  }
  if (mfrc522.uid.uidByte[0] == accessUID[0] && mfrc522.uid.uidByte[1] ==
accessUID[1] && mfrc522.uid.uidByte[2] == accessUID[2] &&
mfrc522.uid.uidByte[3] == accessUID[3]) {
    accessGrantedAction();
  } else {
    accessDeniedAction();
  }
  mfrc522.PICC_HaltA();
}
```

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[8] AURDINO UNO https://docs.arduino.cc/software/ide-v2/tutorials/ide-v2-board-manager/#avr

[9] AURDINO IDE https://www.arduino.cc/en/software

VIDEO LINK:

https://drive.google.com/file/d/1kv300_JoVtb7fb5ZelXXXkCWk2vLI0ku/view?usp=drivesdk

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INSTITUTION'S INNOVATION COUNCIL

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

NCAIF'24

CERTIFICATE OF PARTICIPATION

This is to certify that ~~Dr./Mr.~~/Ms. MADHUMITHA B

of VELAMMAL ENGINEERING COLLEGE has presented a

poster titled DIGITAL BUSPASS USING IOT

in the

9th National Conference on Artificial Intelligence Frontiers: Shaping the Future of Technology held on 12th March, 2024.

ICTACADEMY

HOD-CSE

Dr. B. MURUGESHWARI

Principal

Dr. S. SATISH KUMAR

VELAMMAL ENGINEERING COLLEGE

AN AUTONOMOUS INSTITUTION

INSTITUTION'S INNOVATION COUNCIL

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

NCAIF'24

CERTIFICATE OF PARTICIPATION

This is to certify that ~~Dr./Mr./~~Ms. SOWMIYA P

of VELAMMAL ENGINEERING COLLEGE has presented a

poster titled DIGITAL BUSPASS USING IOT

in the

9th National Conference on Artificial Intelligence Frontiers: Shaping the Future of Technology held on 12th March, 2024.

ICTACADEMY

HOD-CSE

Dr. B. MURUGESHWARI

Principal

Dr. S. SATISH KUMAR

PROGRAM OUTCOMES

PO No.	Graduate Attribute	Program Outcomes (POs)
PO1	**Engineering knowledge**	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.
PO2	**Problem analysis**	Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions**	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex Problems**	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage**	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling to complex engineering activities, with an understanding of the limitations.
PO6	**The engineer and society**	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and Sustainability**	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics**	Apply ethical principles and common to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work**	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication**	Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as, being able to comprehend and withe effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11	**Project management and finance**	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning**	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Mapping of Program outcomes with the Mini-Project

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
3	3	3	3	3	3	3	3	3	3	3	3

PROGRAM SPECIFIC OUTCOMES

PSO No.	Program Specific Outcomes
PSO1	To analyse, design and develop computing solutions by applying foundational concepts of computer science and engineering.
PSO2	To apply software engineering principles and practices for developing quality software for scientific and business applications.
PSO3	To adapt to emerging Information and Communication Technologies (ICT) to innovate ideas and solutions to existing/novel problems.

PSO1	PSO2	PSO3
3	3	3

Signature of Guide