BUS IDENTIFICATION SYSTEM

A PROJECT REPORT

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BONAFIDE CERTIFICATE

Certified that this Report titled "**BUS IDENTIFICATION SYSTEM**" is the bonafide work of **AATHMIHAN S B (210701006), ABINESH R(210701010), ALWYN JOSE L (210701025)** who carried out the work under my supervision. Certified further that to the best of my knowledge the work reported herein does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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ABSTRACT

Public transportation systems often face challenges in efficiently identifying and managing buses, leading to issues such as inaccurate scheduling, and difficulty in passenger communication. Existing bus identification systems may lack precision, real-time tracking capabilities, or cost-effectiveness, hindering the overall effectiveness of the transportation network. There is a need for a reliable and affordable bus identification system that can accurately track buses and provide real-time information to passengers. This project proposes an innovative solution to address the challenges faced by visually impaired individuals in identifying and boarding the correct bus independently. Leveraging IoT technology and RFID tags, the system provides real-time bus identification assistance at bus stops or terminals. Upon the arrival of a bus equipped with an RFID tag, sensors installed at the bus stop detect its presence and trigger the system to announce the bus's unique identifier through a speech synthesis module. This audible announcement enables visually impaired individuals to confidently board the correct bus without the need for external assistance. Through seamless integration with existing bus infrastructure, the proposed solution aims to enhance safety, convenience, and independence for visually impaired users. Success criteria include accurate and reliable bus identification, positive user feedback, and compliance with regulatory requirements.

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LIST OF SYMBOLS

Process

This denotes various process involved in the development of proposed system

This arrow indicates the flow from one process to the another process.

This indicates the Stages in the proposed system

ABBREVIATIONS

1. IoT - Internet of Things
2. SDK - Software Development Kit
3. IDE - Integrated Development Environment
4. CAD - Computer-Aided Design
5. RFID – Radio-Frequency Identification
6. API - Application Programming Interface
7. USB - Universal Serial Bus
8. GPIO - General Purpose Input/Output
9. MCU - Microcontroller Unit
10. IR – Infra-Red

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Public transportation plays a pivotal role in fostering mobility, independence, and social inclusion for individuals of all abilities. However, for visually impaired individuals, navigating public transportation networks poses unique challenges, particularly in identifying and boarding the correct bus independently. This project endeavors to address this issue by developing an innovative IoT-based bus identification system tailored specifically for visually impaired individuals. The primary objective of this project is to design and implement a solution that enables visually impaired individuals to confidently and safely identify and board the correct bus without reliance on external assistance. Leveraging Radio Frequency Identification (RFID) technology and speech synthesis modules, the proposed system offers real-time bus identification assistance at bus stops or terminals. This introduction provides an overview of the project's objectives, significance, and methodology

By detecting the presence of RFID-tagged buses and announcing their unique identifiers audibly, the system empowers visually impaired individuals to navigate public transportation networks with greater autonomy and confidence. This introduction provides an overview of the project's objectives, significance, and methodology. It sets the stage for the subsequent sections of the report, which will delve into the system design, implementation, evaluation, and outcomes. Through this project, we aim to contribute to the advancement of inclusive transportation systems and the empowerment of visually impaired individuals in accessing essential services and opportunities within their communities.

CHAPTER 2

LITERATURE SURVEY

The development of assistive technologies for visually impaired individuals is critical for fostering independence and inclusion in public transportation. Traditional aids like canes and guide dogs, while beneficial, offer limited assistance in complex urban environments. Modern technologies, particularly IoT and RFID, present new opportunities for enhancing accessibility. RFID technology, widely used for automatic identification and tracking, is effective in public transportation for asset tracking and inventory management. Research by Shaikh et al. (2015) and Tavares et al. (2020) demonstrates that RFID-based systems can provide real-time bus identification, reducing reliance on visual cues.

IoT further augments these capabilities by enabling connected systems that deliver timely updates and automated responses. Speech synthesis technology, as highlighted by Alahi et al. (2016), is essential for creating auditory interfaces that offer real-time information through speech, thereby aiding visually impaired users. User-centered design principles are paramount in developing effective assistive technologies. Involving visually impaired users in the design and testing phases ensures the solutions are tailored to their specific needs and preferences, as emphasized by Bansal and Sharma (2019). Despite the promise of RFID and IoT, challenges such as ensuring accurate RFID readings, integrating with existing infrastructure, and addressing privacy concerns remain. Future research should focus on enhancing system robustness, exploring multimodal feedback, and expanding deployment across more routes. Overall, RFID and IoT offer significant potential for creating inclusive, accessible public transportation systems, enhancing the independence and safety of visually impaired individuals.

2.1 EXISTING SYSTEM:

The current state of public transportation systems presents significant challenges for visually impaired individuals in identifying and accessing buses independently. At bus stops and terminals, the primary means of bus identification relies heavily on visual cues such as signage displaying route numbers and destinations. However, these visual indicators often lack sufficient contrast, clarity, or tactile feedback, making them inaccessible to those with visual impairments. Additionally, announcements made over public address systems may be inconsistent, incomprehensible, or entirely absent, further exacerbating the difficulty of identifying buses.

Visually impaired passengers frequently rely on the assistance of fellow travelers or transit personnel to navigate the complexities of bus routes and schedules, resulting in a loss of independence and dignity. While certain assistive technologies exist to aid in wayfinding, such as GPS-enabled smartphone apps or tactile maps, they often fail to provide real-time bus identification information or may be hindered by technological limitations, such as signal interference or inaccuracies in GPS positioning. The existing system is slow by taking time to announce the bus after receiving the signal. Announcements made over public address systems may be inconsistent, incomprehensible, or entirely absent, further exacerbating the difficulty of identifying buses. Moreover, the accessibility of these technologies may be limited by factors such as cost, availability of compatible devices, and digital literacy. Overall, the existing system falls short in meeting the specific needs of visually impaired individuals, highlighting the urgent need for a more comprehensive and inclusive solution to improve accessibility, independence, and safety in public transportation.

CHAPTER 3

PROJECT DESCRIPTION

RFID Tags and Readers

Each bus in the system will be equipped with an RFID tag that contains a unique identifier, which serves as the digital identity of the bus. At bus stops or terminals, RFID readers will be strategically installed to detect the presence of these tags as buses approach. The readers will scan the tags and capture the unique identifier, which will then be used to determine the bus's route and destination. This module is critical for the initial identification process, ensuring that the system accurately recognizes each bus entering the bus stop area. The RFID tags and readers are chosen for their reliability and ability to function without direct line-of-sight, making them ideal for real-world public transportation environments.

IoT Sensors and Connectivity

The IoT sensors form the backbone of the system, interfacing with the RFID readers to collect bus identification data and transmit it to a central server. These sensors are equipped with wireless communication capabilities, allowing them to send data in real-time over a secure network. The connectivity aspect ensures that the information is promptly processed and disseminated, enabling timely updates and responses. This module also includes the integration of data processing algorithms that filter and validate the incoming RFID data, ensuring accuracy and reducing the likelihood of errors. The robust network connectivity is designed to handle high volumes of data and maintain continuous operation, even in busy urban environments.

Speech Synthesis Module

The speech synthesis module is responsible for converting the textual bus identification data into audible announcements. Using advanced text-to-speech (TTS) technology, this module generates clear and natural-sounding speech that communicates essential information such as the bus route, destination, and arrival time. The module is designed to support multiple languages and customizable voice settings to cater to diverse user preferences. By providing real-time auditory feedback, the speech synthesis module ensures that visually impaired individuals receive immediate and comprehensible information, enhancing their ability to navigate the public transportation system independently. This module plays a crucial role in bridging the communication gap and making the system accessible.

User Interface

The user interface (UI) module is designed to be user-friendly and accessible, allowing visually impaired users to customize their experience with the system. The interface includes options for adjusting the volume, selecting preferred languages, and configuring notification settings. It can be accessed through a dedicated mobile application or physical interface devices installed at bus stops. The UI is developed with input from visually impaired users to ensure it meets their needs and is intuitive to use. The design focuses on simplicity, ease of use, and accessibility, incorporating features like voice commands and tactile feedback. This module ensures that users can interact with the system effortlessly, tailoring it to their specific preferences for an optimal experience.

System Integration and Testing

This module focuses on the seamless integration of all system components and rigorous testing to ensure functionality, reliability, and user satisfaction. Integration involves connecting the RFID readers, IoT sensors, and speech synthesis modules with the central server and user interface. Comprehensive testing is conducted in controlled environments and real-world scenarios to validate the system's performance. User feedback is collected to identify any issues and make necessary adjustments. This module ensures that the system operates smoothly under various conditions, maintaining high accuracy and reliability. Continuous monitoring and iterative improvements are part of this module to address any emerging challenges and enhance the system over time.

Deployment and Future Enhancements

The deployment module involves the systematic installation of the system across selected bus routes and terminals, followed by a phased rollout to ensure successful implementation. This includes training transit staff, conducting user orientation sessions, and setting up support infrastructure. Future enhancements will focus on expanding the system to additional routes, incorporating advanced features such as haptic feedback for direct tactile notifications, and integrating with mobile applications for seamless user interaction. Continuous research and development will address potential improvements in system robustness, scalability, and user experience. Collaboration with public transportation authorities and advocacy groups will be crucial for ongoing enhancements and widespread adoption.

3.1 PROPOSED SYSTEM

The proposed system aims to revolutionize bus identification for visually impaired individuals through the integration of IoT technology and RFID tags. By leveraging Radio Frequency Identification (RFID) tags installed on buses and sensors deployed at bus stops or terminals, the system will enable real-time identification and announcement of bus arrivals. Upon the approach of an RFID-tagged bus, sensors will detect its presence and trigger a speech synthesis module to announce the bus's unique identifier audibly. This auditory announcement will provide visually impaired individuals with timely and accurate information, empowering them to independently identify and board the correct bus without reliance on external assistance. Our project uses RFID tag and sensor for signal transmission and it does not contains any database, so it is time optimized. Each RFID tag has a specific route recordings and it will be played when the RFID sensor senses the RFID signal through speaker.

The system will prioritize accessibility features, such as customizable settings and intuitive user interfaces, to cater to the diverse needs and preferences of users. Furthermore, user-centered design principles will guide the development process, ensuring that the system is user-friendly and responsive to the specific challenges faced by visually impaired individuals. Through rigorous testing and evaluation, the proposed system will be refined to optimize accuracy, reliability, and user satisfaction. Ultimately, the implementation of this innovative solution has the potential to enhance accessibility, safety, and independence for visually impaired individuals in public transportation, fostering a more inclusive and equitable urban environment.

REQUIREMENTS:

3.1.1 HARDWARE SPECIFICATION

Arduino Uno Board RFID

RC522 Sensor

RFID Tags

ISD 1820 Voice Module

Breadboard

Jumper Wires

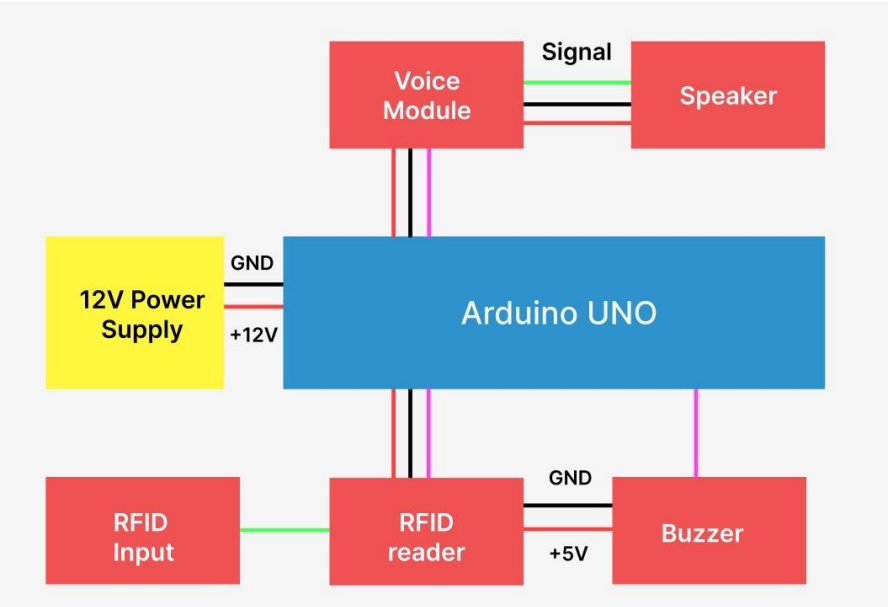
Speaker

3.1.2 SOFTWARE SPECIFICATION

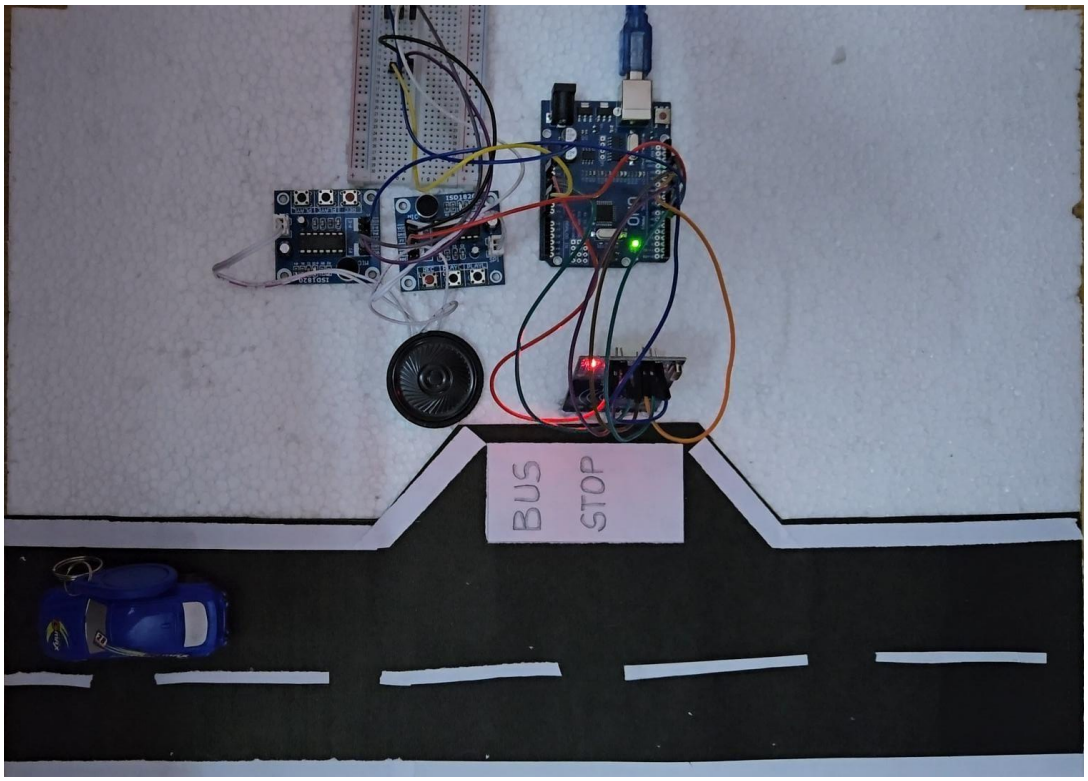
Arduino

IDE C++ (14)

3.2 ARCHITECTURE DIAGRAM



3.3 OUTPUT



DESCRIPTION

The IoT-based bus identification system for visually impaired individuals outputs real-time auditory announcements that specify the bus route as a bus approaches a stop. Each bus is equipped with an RFID tag containing a recording of its specific route information. RFID RC522 sensors are installed at bus stops to detect these tags. When a bus enters the vicinity of a bus stop, the RFID sensor reads the signal from the bus's RFID tag. The sensor then triggers the playback of the pre-recorded route information through the speakers installed at the bus stop. The system's design ensures that visually impaired users can independently identify and board the correct bus without relying on external assistance. This real-time audio output announces the route and destination of the arriving bus, providing visually impaired individuals with clear and immediate information

CHAPTER 4

CONCLUSION AND FUTURE WORK

In conclusion, the development and implementation of the bus identification system using RFID tags represent a significant step towards enhancing accessibility and inclusivity in public transportation for visually impaired individuals. By leveraging IoT technology and RFID tags, the system provides real-time identification and announcement of bus arrivals, empowering visually impaired individuals to navigate public transportation networks independently and with confidence. Through user-centered design and rigorous testing, the system has been refined to optimize accuracy, reliability, and user satisfaction.

The positive feedback and validation received from visually impaired users underscore the system's effectiveness in addressing the challenges faced by this demographic. Moving forward, further efforts are needed to expand the deployment of the system across additional bus routes and terminals, ensuring broader accessibility and coverage. Additionally, ongoing research and development will focus on enhancing the system's capabilities, such as integrating additional sensors for improved localization accuracy, enhancing speech synthesis for multilingual support, and incorporating connectivity with mobile applications for seamless user interaction. Collaboration with stakeholders, including public transportation authorities, technology developers, and advocacy groups, will be essential in driving the continued evolution and adoption of the bus identification system to create more inclusive and equitable transportation systems for all individuals, regardless of ability. Further efforts are needed to expand the deployment of the system across additional bus routes and terminals, ensuring broader accessibility.

APPENDIX

SAMPLE CODE

```
#include <SPI.h>
#include <MFRC522.h>
#include <Arduino.h>

#define RST_PIN  9
#define SS_PIN   10
#define BUS1_PIN 6
#define BUS2_PIN 7

// Define UID values for bus1 and bus2
byte BUS1_UID[] = {0xF3, 0x57, 0x02, 0x0E}; // Bus1 UID
byte BUS2_UID[] = {0xC3, 0x9A, 0x69, 0x13}; // Bus2 UID

MFRC522 mfrc522(SS_PIN, RST_PIN);
MFRC522::MIFARE_Key key;
MFRC522::StatusCode status;

int blockNum = 2;
byte bufferLen = 18;
byte readBlockData[18];

void setup() {
  Serial.begin(9600);
  pinMode(BUS1_PIN, OUTPUT);
  pinMode(BUS2_PIN, OUTPUT);
  SPI.begin();
}

void loop() {
  mfrc522.PCD_Init();

  if (!mfrc522.PICC_IsNewCardPresent()) { return; }

  if (!mfrc522.PICC_ReadCardSerial()) { return; }

  Serial.println();
  Serial.println(F("Reading last data from RFID..."));
  ReadDataFromBlock(blockNum, readBlockData);

  Serial.println();
  Serial.print(F("Last data in RFID:"));
  Serial.print(blockNum);
  Serial.print(F(" --> "));
  Serial.print(String((char*)readBlockData));
  Serial.println();

  // Compare UID with predefined values
  if (compareUID(mfrc522.uid.uidByte, BUS1_UID)) {
    Serial.println("Bus 1 detected");
    digitalWrite(BUS1_PIN, HIGH);
    delay(500);
    digitalWrite(BUS1_PIN, LOW);
```

```
} else if (compareUID(mfrc522.uid.uidByte, BUS2_UID)) {
    Serial.println("Bus 2 detected");
    digitalWrite(BUS2_PIN, HIGH);
    delay(500);
    digitalWrite(BUS2_PIN, LOW);
  }
}

void ReadDataFromBlock(int blockNum, byte readBlockData[]) {
  // Prepare the key for authentication
  for (byte i = 0; i < 6; i++) {
    key.keyByte[i] = 0xFF;
  }

  // Authenticate the desired data block for Read access using Key A
  status = mfrc522.PCD_Authenticate(MFRC522::PICC_CMD_MF_AUTH_KEY_A, blockNum, &key,
&(mfrc522.uid));
  if (status != MFRC522::STATUS_OK){
    Serial.print("Authentication failed for Read: ");
    Serial.println(mfrc522.GetStatusCodeName(status));
    return;
  } else {
    Serial.println("Authentication success");
  }

  // Read data from the Block
  status = mfrc522.MIFARE_Read(blockNum, readBlockData, &bufferLen);
  if (status != MFRC522::STATUS_OK) {
    Serial.print("Reading failed: ");
    Serial.println(mfrc522.GetStatusCodeName(status));
    return;
  } else {
    Serial.println("Block was read successfully");
  }
}

bool compareUID(byte* uid1, byte* uid2) {
  for (int i = 0; i < 4; i++) {
    if (uid1[i] != uid2[i]) {
      return false;
    }
  }
  return true;
}
```

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