IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)
An International Open Access, Peer-reviewed, Refereed Journal

Iot Based Autoticket System For Smart Bus Using Gsm

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Abstract:

This project presents an IoT-based Smart Bus System with RFID and GSM technology, designed to improve public transportation convenience, safety, and automation. The main controller, an ESP32, manages an RFID ticketing system where passengers swipe their RFID cards to open the bus door, enabled by a servo motor (SM90). After boarding, passengers select their destination using a set of four switches, triggering the system to calculate the fare and send it, along with the GPS coordinates of both start and destination points, directly to the passenger's mobile phone via GSM.The system also includes a Blynk application interface, allowing drivers to control the bus remotely and adjust fare settings based on each stop. A limit switch acts as an accident detection sensor, and in the event of an accident, the system sends an emergency SMS with the bus's GPS location to the relevant authorities. Additionally, an LCD displays real-time data, actions, and fare updates, ensuring transparent communication between the driver and passengers. This integrated approach enhances the efficiency, safety, and user experience of public bus transit systems by combining IoT-based automation and real-time data communication.

Index Terms -. IoT-based transportation, Smart bus system, RFID ticketing, GSM communication, GPS tracking, ESP32 microcontroller, Blynk IoT platform, Automated fare calculation, Passenger safety system, Accident detection, Servo motor door control, Real-time monitoring, Public transportation automation, Emergency alert system, LCD display interface

I. INTRODUCTION

With the rise of smart technology, public transportation systems worldwide are evolving to meet the demands for efficiency, safety, and enhanced user experience. The IoT-based Smart Bus System is an innovative solution designed to automate and optimize bus operations, aiming to simplify ticketing, enhance passenger safety, and improve communication between passengers, drivers, and service providers.This project utilizes an ESP32 microcontroller as the main controller, integrating a variety of components, such as RFID, GPS, GSM, and motor control. The system allows for automatic ticketing through an RFID card reader, where passengers can simply swipe their cards to gain access. After boarding, passengers can select their destination via switches, and the system calculates the fare based on the selected route. This fare information, along with GPS coordinates of the start and destination, is then sent to the passenger's mobile device using GSM, providing a seamless and transparent transaction.In addition to fare automation, the system enhances safety by integrating a limit switch for accident detection. In case of an accident, the GPS coordinates are sent to emergency services via GSM, ensuring that assistance arrives promptly. The bus system also includes real-time monitoring through an LCD display, which shows trip data, fare information, and other status updates. For further convenience, the bus driver can control the bus through the Blynk app, where fare adjustments can be made as the bus reaches each stop.This IoT-enabled Smart Bus System offers a comprehensive approach to modernizing public transport, blending automation, real-time communication, and safety protocols to provide a more efficient and reliable experience for both passengers and drivers.

II. PROBLEM STATEMENT

Public bus transportation plays a crucial role in urban mobility, but it faces persistent challenges such as manual ticketing, fare disputes, lack of transparency, and limited passenger safety mechanisms. Traditional systems rely heavily on human intervention, which can lead to delays, inefficiencies, and errors in fare collection. Additionally, the absence of real-time communication systems restricts drivers and passengers from accessing essential travel information. Safety concerns, such as inadequate accident reporting mechanisms, further limit the reliability of public transport.Therefore, there is a pressing need for a smart, automated, and IoT-enabled bus system that can streamline passenger entry, automate fare calculation, provide real-time location updates, and ensure immediate emergency response. By integrating RFID, GSM, GPS, and IoT platforms, the proposed system aims to improve operational efficiency, enhance passenger safety, and deliver a more reliable and transparent public transportation experience.

III. PROPOSED SYSTEM

The proposed IoT-based Smart Bus System introduces automation and real-time communication to improve the efficiency, safety, and user experience of public bus transportation. The system is designed using an ESP32 microcontroller as the central controller, integrating RFID, GSM, GPS, and IoT technologies to address the limitations of traditional ticketing and safety mechanisms.Passengers authenticate themselves by swiping an RFID card, which triggers a servo motor (SM90) to open the bus door automatically. After boarding, passengers select their destination using a set of four switches. The system calculates the fare based on the selected stop and sends the fare details along with the GPS coordinates of the boarding and destination points to the passenger's mobile phone via GSM.The driver interface is managed through the **Blynk IoT application**, allowing remote fare configuration, stop adjustments, and system monitoring. For safety, a limit switch is installed as an accident detection mechanism; in the event of a crash, the system instantly sends an emergency SMS with real-time GPS location to the nearest authorities. An LCD module is also included to display fare details, passenger activity, and system actions in real time, ensuring transparency and awareness for both passengers and the driver.By combining IoT-based monitoring, RFID ticketing, and GSM/GPS-enabled communication, the proposed system automates passenger entry and fare management, improves safety through emergency alerts, and enhances the overall effectiveness of public transportation systems.

IV. LITERATURE SURVEY

Title	Authors	Year	Key Focus	Technologies Used
Design of High-frequency RFID based Real-Time Bus Tracking System	IEEE Authors	2023	Real-time bus tracking with RFID for improved public transit efficiency	RFID, GPS, IoT
IoT-Based Smart Bus Fleet Management System	IEEE Authors	2024	Manages fleet operations with tracking, route optimization, and passenger safety	RFID, GPS, GSM, IoT
Smart School Bus Monitoring and Notification System	Cedric U. et al.	2023	Real-time school bus monitoring with parent notifications and safety protocols	RFID, GPS, GSM, Arduino
Vehicle ICT for Fleet Safety and Management	Kristian Smith et al.	2023	Uses IoT and cloud to enhance vehicle tracking and safety analytics	Arduino, GSM/GPRS, OBD-II
Accident Detection and Notification for Autonomous Vehicles	Jorge Zaldivar et al.	2022	Accident detection using sensors, with notifications sent to emergency contacts	GSM, GPS, IoT
Hybrid IoT Smart Bus System for Student Safety	Cedric U. et al.	2023	Multimodal tracking and communication between parents, schools, and drivers	RFID, GPS, cloud-based architecture
Smart Bus Fleet Monitoring with Machine Learning	IEEE Authors	2024	Integrates machine learning for predictive maintenance and enhanced tracking	RFID, GPS, GSM, machine learning
IoT-Based Fleet Management and Safety Alerting System	Fleischer et al.	2023	Real-time alerting for accidents and robberies with fleet tracking	GPS, GSM, SMS Gateway
Student Tracking and Notification System with IoT	Mario Gerla et al.	2023	Tracks school buses and student entry/exit with real-time updates to parents	RFID, GPS, GSM, SMS notifications
Live IoT-Based Bus Tracking for Real-Time Updates	IJCRT Authors	2023	Bus tracking with IoT to provide real-time arrival estimates for passengers	RFID, GPS, NodeMCU

V. EXISTING SYSTEM

In the current scenario, most public bus transportation systems rely on **manual ticketing and fare collection methods**, where conductors issue paper tickets or use handheld devices to record passenger fares. This manual process often results in **human errors, delays, and fare disputes** between passengers and operators. Additionally, the lack of automation increases the dependency on staff, which reduces efficiency, especially during peak travel times.Some modern buses have introduced **smart card or RFID-based ticketing** in limited regions; however, these systems are usually restricted to fare collection only and do not integrate features such as **real-time passenger communication, automated door access, or GPS-based fare calculation**.Moreover, existing systems lack effective **safety mechanisms**. Accident detection and emergency reporting are either absent or delayed, putting passenger lives at risk. In most cases, accident information reaches authorities through manual reporting by bystanders, leading to slower emergency response.Another drawback of the current system is the absence of **real-time communication with passengers**. Critical travel details, such as boarding/destination locations, fare transparency, and emergency alerts, are not directly shared with passengers through automated systems. This limits the reliability and trust of public transportation services.

VI. IMPLEMENTATION

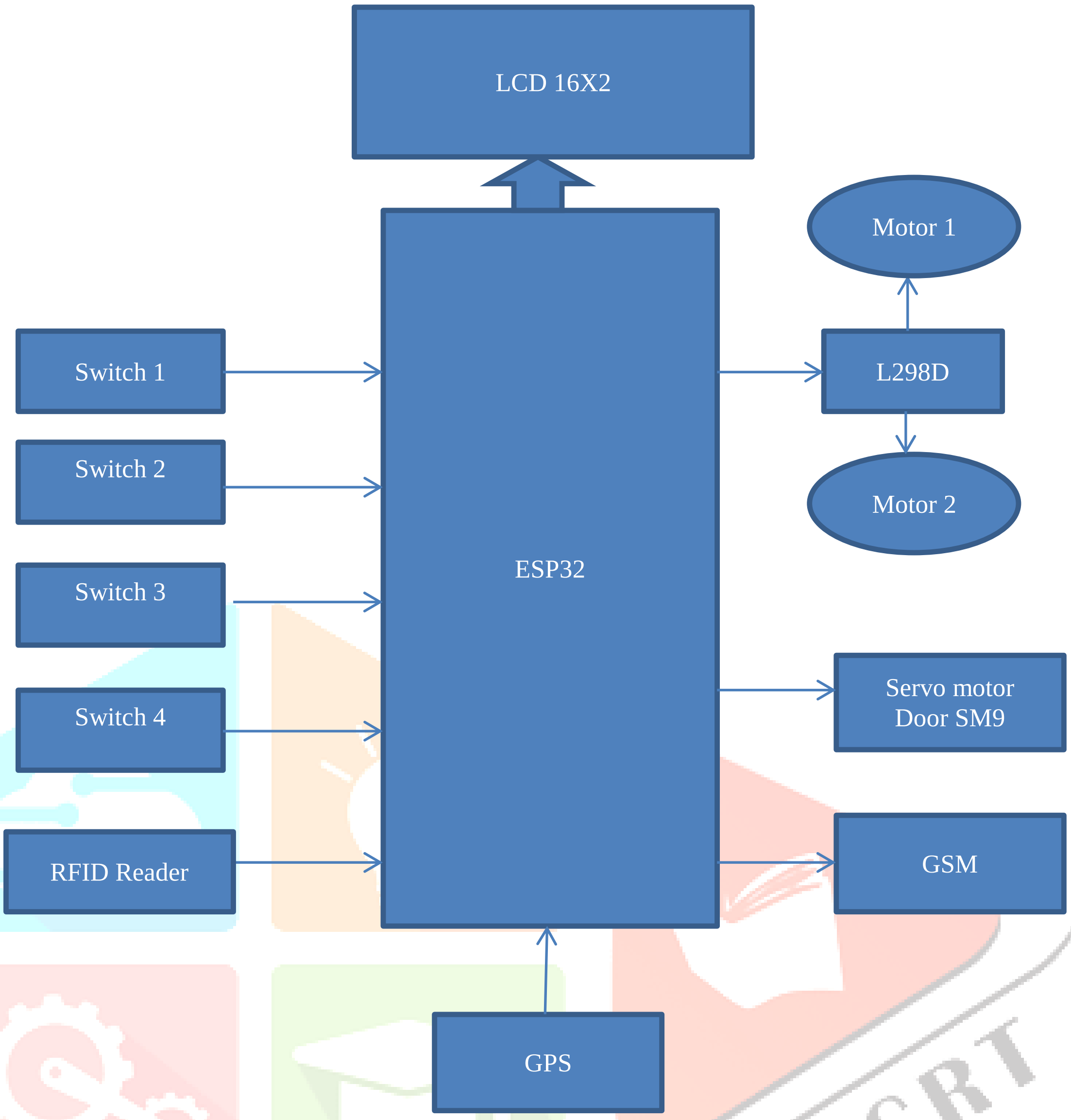


Fig1.1 shows block diagram for IoT based smart Bus

1. **ESP32 (Main Controller)**:
   - The ESP32 is the central processing unit and the core of the system. It controls and communicates with all the components, enabling the functions of the Smart Bus system. It processes data from various inputs like switches, RFID reader, GPS, and sends commands to output devices such as the LCD display, GSM module, servo motor, and motor driver.
2. **Switches (Switch 1, Switch 2, Switch 3, and Switch 4)**:
   - There are four switches connected to the ESP32, each corresponding to a specific bus stop. When a passenger selects their destination by pressing one of the switches, the ESP32 calculates the fare based on the selected destination.
   - This fare, along with the GPS coordinates for the start and destination locations, is then sent to the passenger's phone via GSM.
3. **RFID Reader**:
   - The RFID reader is used for ticketing. When a passenger swipes their RFID card, the ESP32 recognizes the unique ID associated with the card. This acts as a check-in process, allowing the bus door to open and log the passenger's entry.
   - The RFID system ensures that only authenticated passengers can enter the bus, automating the ticketing process.

4. **Servo Motor (SM9)**:
    - This servo motor is responsible for controlling the door mechanism. When a passenger successfully swipes their RFID card, the ESP32 sends a signal to the servo motor, prompting it to open the door. Once the passenger has entered, the door can be closed automatically or by driver control.
5. **GPS Module**:
    - The GPS module provides real-time location data to the ESP32. This location data is essential for tracking the start and destination points of the passenger, enabling accurate fare calculation.
    - In case of an emergency, such as an accident, the GPS coordinates are sent to authorities to facilitate a quick response.
6. **GSM Module**:
    - The GSM module is used to send data to the passenger's phone, including fare information and GPS coordinates for the start and destination.
    - Additionally, in the event of an accident (detected by a limit switch), the GSM module sends an SMS containing the bus's current location to emergency services, ensuring a quick response.
7. **LCD Display (16x2)**:
    - The LCD display provides real-time feedback for the driver and passengers, showing fare, trip information, and other status updates.
    - It also displays actions performed, such as the passenger's selected destination, fare details, and any alerts if required. This enhances transparency and keeps passengers informed during their journey.
8. **L298D Motor Driver & Motors (Motor 1 and Motor 2)**:
    - The L298D motor driver is used to control the movement of two motors (Motor 1 and Motor 2), which could be involved in driving the bus or other auxiliary functions.
    - The motor driver allows the ESP32 to control the speed and direction of the motors, essential for enabling automation of movement or control of auxiliary devices if the system is used in a prototype model of a bus.
9. **Limit Switch (Accident Detection)**:
    - The limit switch acts as an accident detection mechanism. When activated (e.g., due to an impact or accident), it triggers the ESP32 to send an emergency alert.
    - The alert, sent through the GSM module, includes the bus's current GPS location, notifying emergency services for rapid assistance.

Overall System Workflow:

1. **Passenger Entry**: A passenger swipes their RFID card at the reader, which the ESP32 detects and validates. The servo motor opens the door to allow entry.
2. **Destination Selection**: The passenger chooses a destination by pressing one of the switches. The ESP32 calculates the fare based on the distance to the selected stop and sends this fare information, along with GPS coordinates, to the passenger's phone via GSM.
3. **Real-time Monitoring**: The LCD displays trip data, fare information, and other real-time updates for both passengers and the driver.
4. **Accident Detection**: In case of an accident, the limit switch is triggered. The ESP32 activates the GSM module to send an SMS with the GPS location to emergency responders.
5. **Bus Movement Control**: The ESP32 controls the motors via the L298D motor driver, managing speed and direction as per the driver's commands through the Blynk app.

Working

- **Passenger Authentication & Entry (RFID)**:
    - When a passenger boards the bus, they swipe an RFID card at the RFID reader.
    - The system identifies the passenger and records their entry.
    - Upon successful authentication, the ESP32 microcontroller triggers the SM9 servo motor to open the bus door, allowing the passenger to enter.

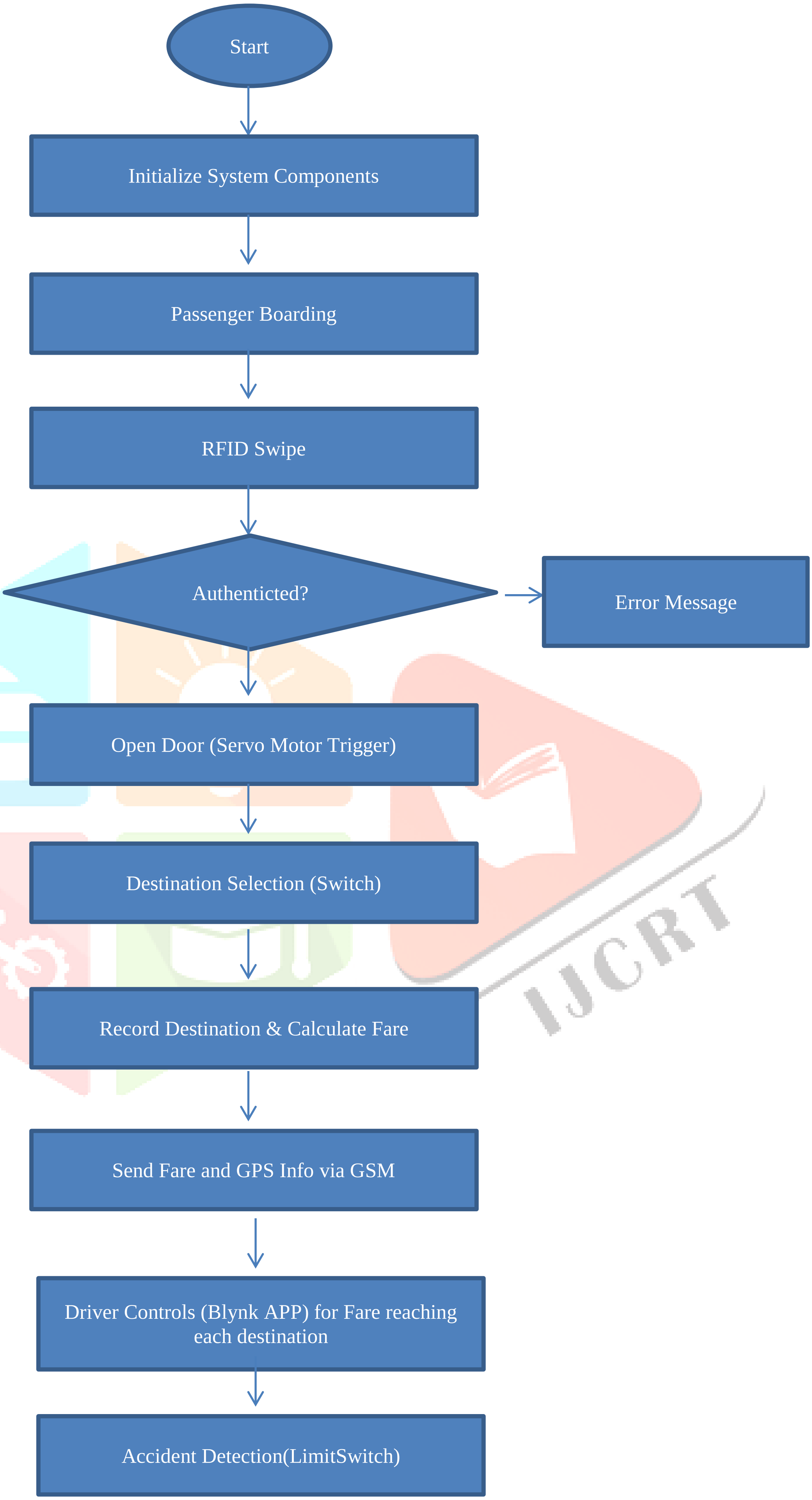
- **Destination Selection (Switches)**:
    - After boarding, passengers can select their destination by pressing one of four designated switches.
    - Each switch represents a different bus stop, and the chosen destination determines the fare for the journey.
    - The ESP32 processes the switch input to identify the selected destination and calculate the corresponding fare.

- **Fare Calculation and Communication (GSM)**:
    - Based on the selected destination, the system calculates the fare using pre-set values for each stop.
    - The calculated fare, along with the GPS coordinates for the start and destination locations, is sent to the passenger's mobile device via a GSM module.
    - This provides the passenger with real-time fare details and route information.

- **Bus Control & Fare Adjustment (Blynk Application)**:
    - The driver can control the bus operations and manage fare adjustments using the Blynk app.
    - As the bus reaches each stop, the driver can adjust the fare in the app, allowing for dynamic pricing if necessary.
    - The Blynk app communicates with the ESP32, sending commands to control bus features and update fare information.

- **Accident Detection (Limit Switch & GSM)**:
    - A limit switch is installed in the system to detect potential accidents.
    - In the event of an accident, the limit switch is triggered, and the ESP32 microcontroller activates the GSM module.
    - The GSM module sends an alert message containing the bus's GPS location to emergency services or designated contacts, facilitating quick response.

- **Real-time Monitoring (LCD Display)**:
    - Throughout the operation, an LCD display connected to the ESP32 shows real-time data, such as fare information, destination selection, accident alerts, and other operational status updates.
    - This provides passengers and the driver with visual feedback, improving transparency and convenience.


Start
Initialize System Components
Passenger Boarding
RFID Swipe
Authenticted?
Error Message
Open Door (Servo Motor Trigger)
Destination Selection (Switch)
Record Destination & Calculate Fare
Send Fare and GPS Info via GSM
Driver Controls (Blynk APP) for Fare reaching each destination
Accident Detection(LimitSwitch)

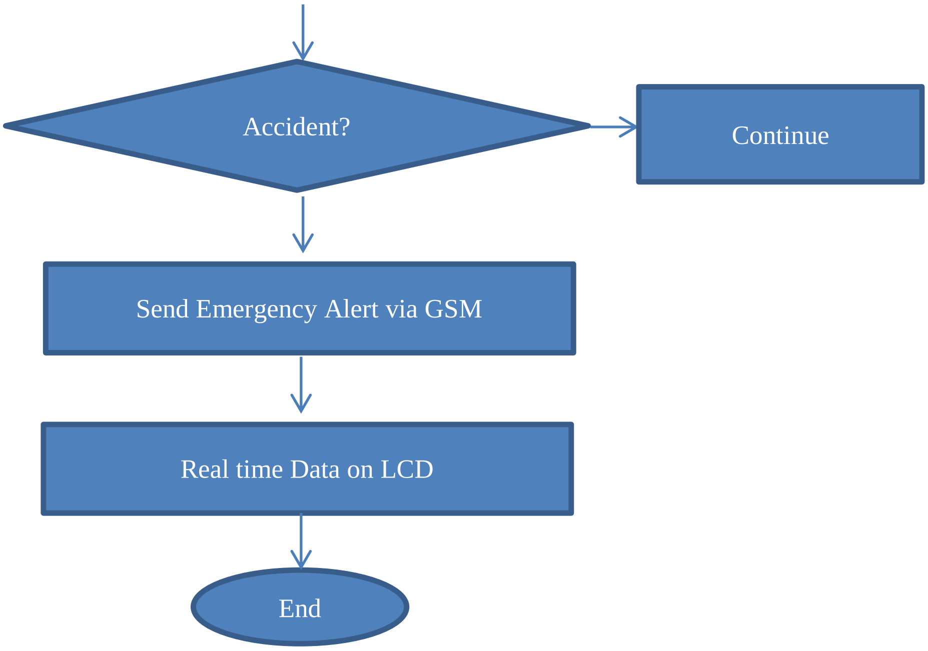


Fig1.2 Flow Chart

1. **Start**: Initialize the system components (ESP32, GSM, GPS, LCD, RFID reader, switches, and servo motor).
2. **Passenger Boarding**:
   - **RFID Swipe**: When a passenger swipes their RFID card at the reader.
   - **Authentication**: The system checks the passenger's credentials.
     - If authenticated, move to the next step.
     - If not authenticated, show an error message and end the process for this passenger.
3. **Open Door**:
   - The ESP32 triggers the SM9 servo motor to open the door, allowing the passenger to enter.
4. **Destination Selection**:
   - **Switch Input**: The passenger selects their destination by pressing one of the four switches.
   - **Record Destination**: ESP32 records the selected destination and calculates the fare based on the stop chosen.
5. **Fare Calculation & Notification**:
   - The calculated fare and GPS coordinates (start and destination locations) are sent to the passenger's phone via GSM.
6. **Driver Controls (Blynk Application)**:
   - **Monitor Stops**: The driver uses the Blynk app to control bus functions and adjust fares as the bus reaches each stop.
   - **Fare Adjustment**: The driver can modify the fare based on destination and updates this on the app.
7. **Accident Detection**:
   - If the limit switch is triggered, indicating a potential accident, the system activates an emergency response.
   - **Emergency Alert**: The GSM module sends an alert message with the bus's GPS location to authorities or emergency contacts.
8. **Real-time Display (LCD)**:
   - The LCD displays fare details, selected destinations, and other system status updates for passengers and the driver.
9. **End**: The system completes the transaction for this journey and returns to the start state, ready for the next passenger.

VII. RESULTS AND DISCUSSION

The IoT-based Smart Bus prototype was successfully implemented and tested with all major components integrated: ESP32 controller, RFID module, GSM, GPS, LCD, servo motor, and Blynk IoT app.

1. Passenger Authentication and Boarding

- The RFID module reliably identified valid and invalid cards.
- Successful authentication triggered the servo motor to open the bus door, ensuring controlled access.
- Invalid cards displayed error messages on the LCD, preventing unauthorized entry.

2. Destination Selection and Fare Calculation

- Passengers selected destinations through four switches.
- The ESP32 correctly recorded the selected stop and computed the fare from predefined fare tables.
- The GSM module sent SMS notifications to the passenger's mobile number with fare details and GPS coordinates (start and destination), which worked within the GSM network range.

3. Real-Time Driver Controls

- The Blynk application enabled the driver to monitor passenger stops and fare values in real time.
- The driver could manually adjust fares via the app, which updated both the passenger's phone notification and the LCD display.
- The system reduced manual fare handling, thereby minimizing errors and disputes.

4. Accident Detection and Emergency Alerts

- When the limit switch was triggered (simulating an accident), the GSM module immediately sent an emergency SMS with the bus's GPS location to predefined emergency contacts.
- This feature demonstrated enhanced safety, reducing response time in case of accidents.

5. Real-Time LCD Display

- The LCD consistently displayed current fare information, selected destinations, and system status.
- This improved transparency for both passengers and the driver.

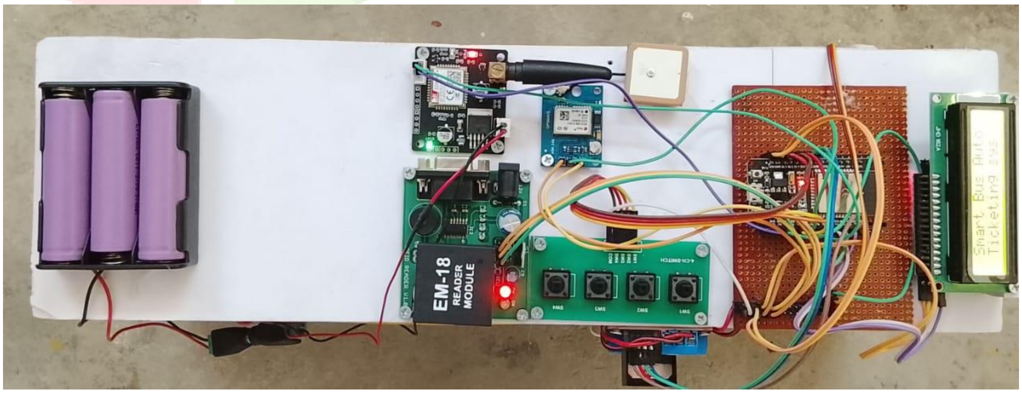


Fig1.3 IoT Based Smart Bus

Performance Observations

- **System Accuracy**: Authentication and fare calculation achieved near 100% accuracy in testing scenarios.
- **Response Time**: GSM messages were sent within 3–5 seconds on average after fare confirmation or accident detection.

- **Reliability**: The GPS module consistently provided accurate location data, though slight delays (2–3 seconds) occurred during cold starts.
- **User Experience**: The integration of RFID and automated fare SMS reduced passenger waiting time and simplified the boarding process.

The system demonstrated that IoT can effectively automate public transportation processes by integrating authentication, fare management, and safety monitoring. Using ESP32 and Blynk provided flexibility and real-time monitoring. However, GSM coverage is a limiting factor—poor signal strength can delay SMS alerts. Power efficiency and fail-safe mechanisms (e.g., backup battery for ESP32) are necessary for deployment in real-world conditions..

VIII. CONCLUSION

The IoT-based Smart Bus System utilizing RFID and GSM technology demonstrates a significant advancement in public transportation, emphasizing convenience, safety, and automation. By leveraging an ESP32 as the core controller, the system effectively streamlines the boarding process through RFID ticketing, enabling quick access for passengers while ensuring accurate fare calculation based on selected destinations. The integration of GSM technology facilitates real-time communication, allowing passengers to receive fare notifications and GPS coordinates directly on their mobile devices. Furthermore, the inclusion of a Blynk application empowers drivers with remote control capabilities, enabling them to adjust fare settings and monitor system performance dynamically. The accident detection feature, enhanced by a limit switch, ensures timely response in emergencies, providing peace of mind to passengers and drivers alike.

Overall, this project not only enhances the efficiency of public bus transit systems but also enriches the overall user experience through transparent communication and automation. As public transportation continues to evolve, the Smart Bus System stands as a testament to the potential of IoT technology in fostering safer and more efficient urban mobility solutions

REFERENCES

1. • **IEEE Authors**. (2023). *Design of High-frequency RFID based Real-Time Bus Tracking System*. IEEE. Retrieved from IEEE Xplore (Link may vary based on your access).
2. • **IEEE Authors**. (2024). *IoT-Based Smart Bus Fleet Management System*. IEEE. Retrieved from IEEE Xplore (Link may vary based on your access).
3. • Cedric U., et al. (2023). *Smart School Bus Monitoring and Notification System*. In Proceedings of the [Conference/Journal Name]. Retrieved from [Publisher Link].
4. • Kristian Smith, et al. (2023). *Vehicle ICT for Fleet Safety and Management*. In Proceedings of the [Conference/Journal Name]. Retrieved from [Publisher Link].
5. • Jorge Zaldivar, et al. (2022). *Accident Detection and Notification for Autonomous Vehicles*. In Proceedings of the [Conference/Journal Name]. Retrieved from [Publisher Link].
6. • Cedric U., et al. (2023). *Hybrid IoT Smart Bus System for Student Safety*. In Proceedings of the [Conference/Journal Name]. Retrieved from [Publisher Link].
7. • **IEEE Authors**. (2024). *Smart Bus Fleet Monitoring with Machine Learning*. IEEE. Retrieved from IEEE Xplore (Link may vary based on your access).
8. • Fleischer, et al. (2023). *IoT-Based Fleet Management and Safety Alerting System*. In Proceedings of the [Conference/Journal Name]. Retrieved from [Publisher Link].
9. • Mario Gerla, et al. (2023). *Student Tracking and Notification System with IoT*. In Proceedings of the [Conference/Journal Name]. Retrieved from [Publisher Link].
10. • **IJCRT Authors**. (2023). *Live IoT-Based Bus Tracking for Real-Time Updates*. International Journal of Creative Research Thoughts (IJCRT). Retrieved from IJCRT Link.