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Design Of Smart Cities

Smart Bus Ticketing System

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Abstract:-

Public transit is essential for many, yet the current ticketing process is cumbersome. Our team has developed an intelligent bus ticketing system that integrates RFID technology to associate passengers' RFID tags with their personal and financial data. At the bus entrance, RFID scanners assess fares using GPS data and debit the amount from the tags. The system can be customized to permit a limited negative balance; surpassing this, triggers a full trip fare charge, indicated by a red LED signal upon entry. In case of loss or theft, passengers can invalidate their tags through Aadhar authentication. This innovative approach to bus ticketing serves passengers and operators, while also promoting environmental sustainability by reducing paper usage.

Introduction:-

In India, where the pulse of urban life is sustained by the flow of its citizens, the provision of effective public transit is crucial. Yet, the prevailing bus ticketing infrastructure is marked by delays and inefficiencies. Research indicates that daily, approximately 25 million individuals rely on bus services, which are currently insufficient in number. This document delineates an innovative Smart Bus Ticketing System employing RFID and GPS technologies to refine the ticketing operations and augment the overall efficacy of the transport network. This system incorporates RFID tags to encapsulate passenger identification and financial details. These tags undergo scanning via RFID readers positioned at the ingress and egress of buses, thereby updating the commuter's positional data and fiscal balance. For additional functionality, RFID Readers can be equipped with LED indicators that reflect the balance status—red signaling deficit, blue indicating low funds, and green denoting sufficient balance. Additionally, conductors are furnished with mobile readers to ensure comprehensive scanning, if in case the bus service system doesn't permit us for a conductor-free bus. Upon exiting, the system may be configured to compute the fare based on the journey's length, ascertained through GPS, and accordingly adjusts the balance on the tags. This method allows for charging based on the precise distance travelled, guaranteeing both equity and precision. It also deters fare evasion and simplifies passenger management for conductors. Furthermore, this system contributes to ecological conservation by obviating the need for physical tickets.

The system is replete with features that bolster user convenience. Patrons can replenish their tags digitally, circumventing the inconvenience of manual top-ups. It also encompasses security measures to safeguard users against theft; in instances of tag misplacement or theft, users can deactivate their tags via an online interface, preventing unauthorized access. This Smart Bus Ticketing System represents a progressive stride in bus ticketing, poised to benefit commuters and operators alike, and catalyze a transformation in India's public transport paradigm.

Motivation:-

The development of the Smart Bus Ticketing System is driven by a commitment to resolve the pressing challenges faced by India's public transportation sector. The system is designed to alleviate the issue of overcrowding on buses by introducing a more streamlined ticketing process, which could lead to a better regulation of passenger flow and an increase in service frequency. It also aims to curb fare evasion by automating the fare collection process, ensuring that revenue is accurately collected and allocated for the enhancement of transit services.

The transition from cash payments to RFID technology simplifies transactions, speeding up the process while reducing the risks associated with cash handling, such as theft and loss. This new

system also enhances the efficiency of conductors, freeing them from the manual task of fare collection so they can better focus on passenger safety and service quality.

Furthermore, the Smart Bus Ticketing System demonstrates a commitment to environmental sustainability by eliminating the need for paper tickets, thereby reducing waste and promoting a greener mode of operation. Overall, this report introduces a transformative approach to bus ticketing, one that not only improves the efficiency and convenience of public transportation but also aligns with the broader objectives of sustainability and equitable access to transit services across India.

Novelty:-

An automated fare collection system integrating passenger identity and payment information with RFID tags, introduces a groundbreaking approach to transportation efficiency and passenger convenience. The system makes it easier for customers to pay for their rides while at the same time streamlining fare collection and improving traveler’s experience by merging passengers' names and payment details with RFID tags. At the same time, by placing readers at the entrance and exit points of different stations, accurate figures will always be obtained as it does not require manual ticketing plus it allows fast deduction of payments made through these smart cards. Moreover, the system's innovative implementation charges maximum fare only when passengers fail to tag in, incentivizing compliance and fairness. The inclusion of real-time balance fare display on LCD screens further enhances transparency and convenience for passengers.

Additionally, the system's ample data analysis abilities can offer valuable insights into passenger behavior, enabling data-informed decisions to optimize services and allocate resources. Most importantly, the system prioritizes passenger safety through sophisticated encryption measures and detailed security protocols, ensuring a high level of protection for personal and financial data throughout the transaction process. In essence, your project embodies the ideals of seamless transactions, data-driven optimization, and passenger security, setting a new standard for cashless, secure fare collection in transportation systems.

Block Diagram:-

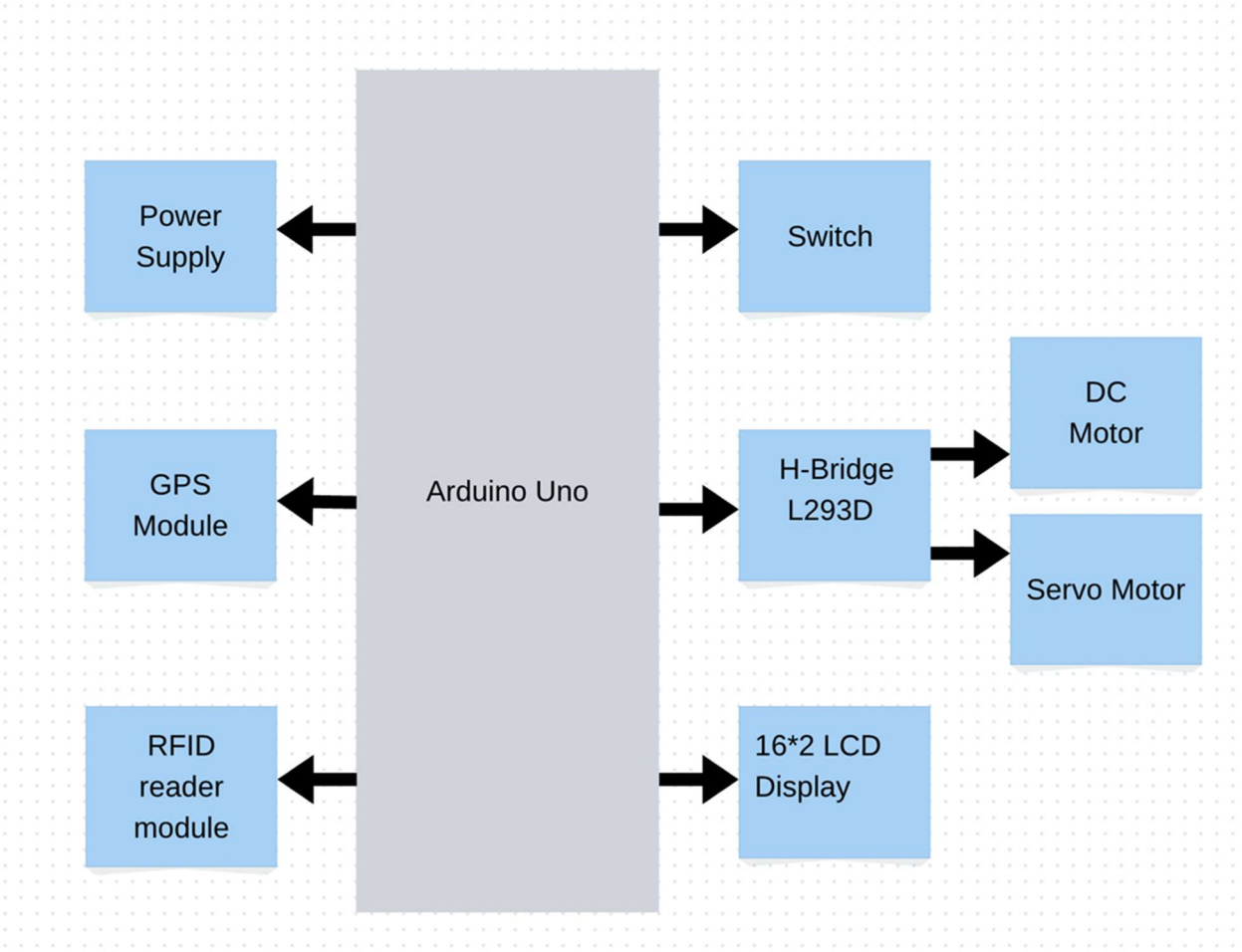


Figure 1. This picture depicts the overall block diagram

Components:-

1) **RFID Tag and Reader-** A RFID reader is a tool that reads radio frequency identification tags. It uses wireless communication with these tags in order to extract certain data carried in them thus allowing such applications as inventory control, security systems as well as tracking.
2) **Neo 6m GPS Module-** A GPS module is an up to date device that utilizes signals from satellites in order to find its own location, altitude relative to earth or any other planet, as well as time spent in movement. It gives precise direction finding data which can be used in different fields like guidance systems, cartography or position finding.
3) **L293D Motor Driver IC-** A popular integrated circuit used to control the direction and speed of DC motors is the L293D which serves as a link between microcontrollers and motors, thus making it a perfect choice for efficient motor control in robotics, automation and other electronic projects.

4) **DC Motor-** A DC motor runs on direct current (DC) power, it is providing electrical energy to mechanical motion and is hence used in robotics, industrial machinery, and automotive systems.
5) **Servo Motor-** A servo motor is a type of motor that provides precise control of angular or linear position. It consists of a motor coupled with a feedback mechanism, allowing for accurate positioning and speed control. Servo motors are commonly used in robotics, remote-controlled vehicles, and industrial automation.
6) **SPST Switch-** The Single-Pole, Single-Throw (SPST) Switch serves as a fundamental electrical component, offering simple on/off functionality with a single circuit connection. Its straightforward design and reliable operation make it ideal for controlling power flow in various electronic applications, providing users with a convenient and intuitive way to activate or deactivate devices with ease.
7) **LCD Display with I2C Module -** The LCD Display with I2C Module combines the functionality of a standard LCD screen with the simplicity of I2C communication, enabling seamless integration into projects with limited space or complex wiring requirements. This integration streamlines communication between devices, allowing for easy control and manipulation of display content in a compact and efficient manner.

Hardware Implementation:-

The 5V and the Ground pin from the Arduino are electrically interfaced to the Vcc and the Ground lines on the breadboard. From this Vcc line on the breadboard, power is supplied to the Vcc and Power pins of L293D motor driver IC as well as the Servo Motor and the I2C module, which is soldered to our 16X2 LCD. Similarly, the components are grounded through their corresponding Ground pins.

The SDA (Serial Data) and the SCL (Serial Clock) pins of the Arduino are connected to the I2C module. An SPST switch is used whose one terminal is connected to the Vcc line and the other terminal is connected to the 2nd pin (Input1) of the L293D IC. The 3rd pin (Output1) of the IC is connected to one terminal of a DC motor and its other terminal is grounded. From the 2nd pin of the IC, a connection is given to pin D7 which acts as an input pin. The Signal line of the Servo Motor is connected to the D2 (Digital I/O pin) which will act as an output pin here. The connections of the hardware model are shown :

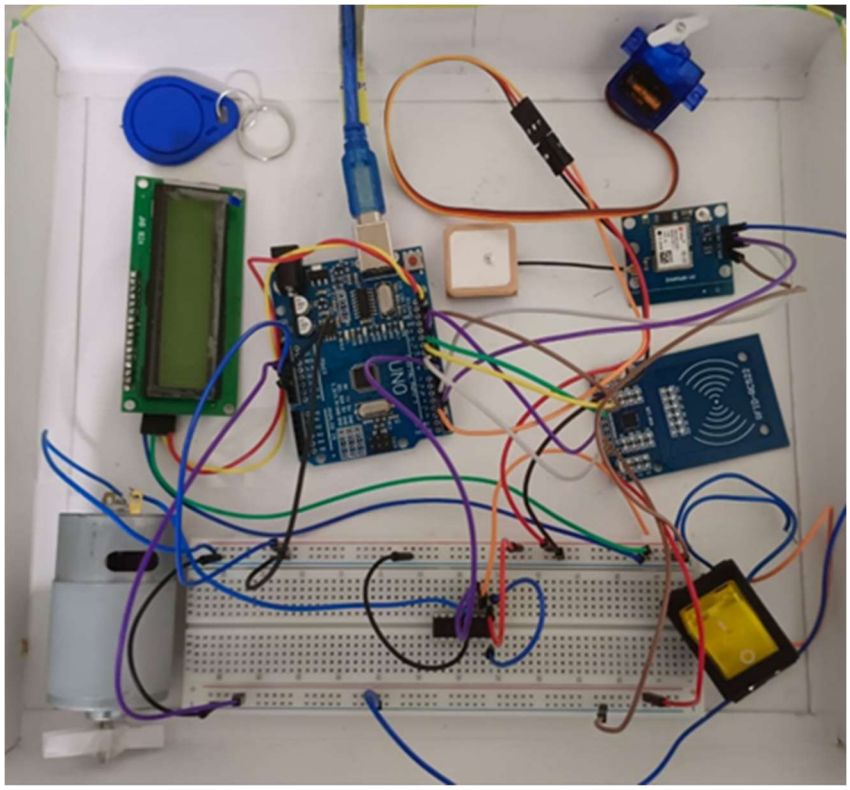


Figure 2. Hardware model with all circuit connections

When the switch is turned on (indicating bus begins motion), the DC motor starts rotating (representing the wheels of the bus) and the Servo Motor rotates 90 degrees (to indicate that bus doors are closed).

When the switch is turned off (indicating bus coming to a stop), the DC motor stops rotating, and the Servo Motor rotates back to its original position (to indicate that bus doors are open)

We expect an RFID scan here by the user to scan their RFID cards while they enter or exit the bus and accordingly the available balance in their cards will be displayed on the LCD. The same is expressed in the form of a flow chart

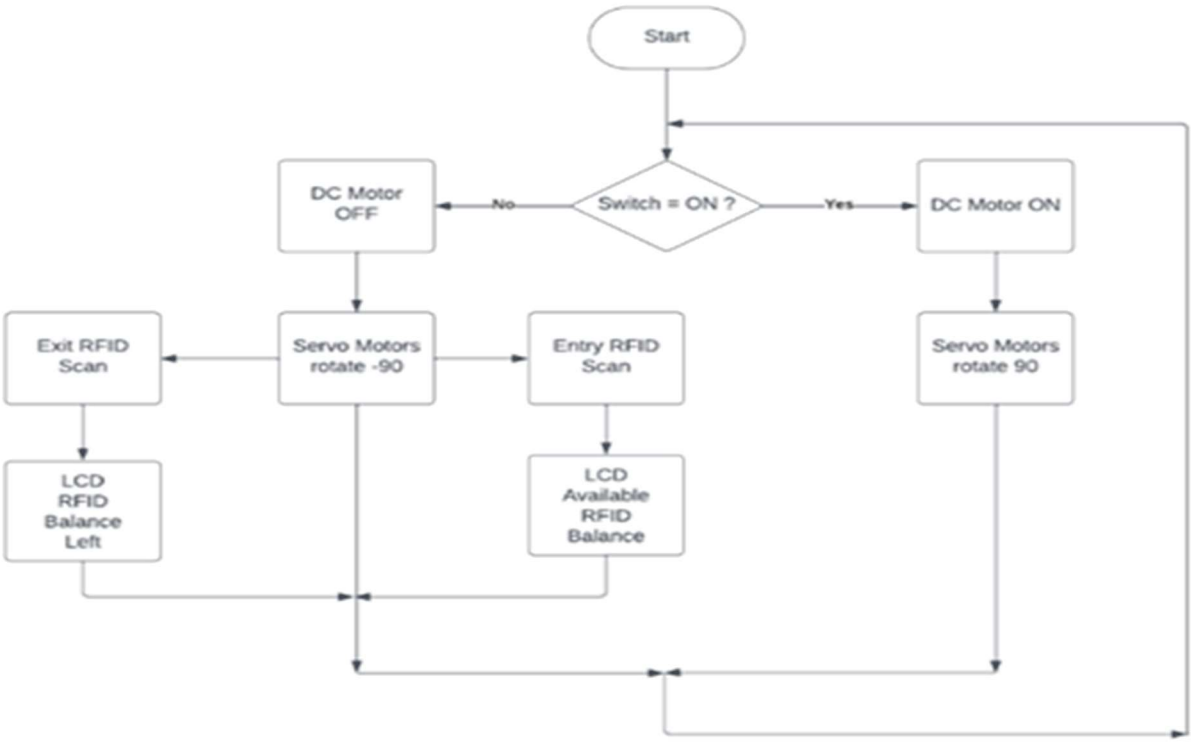


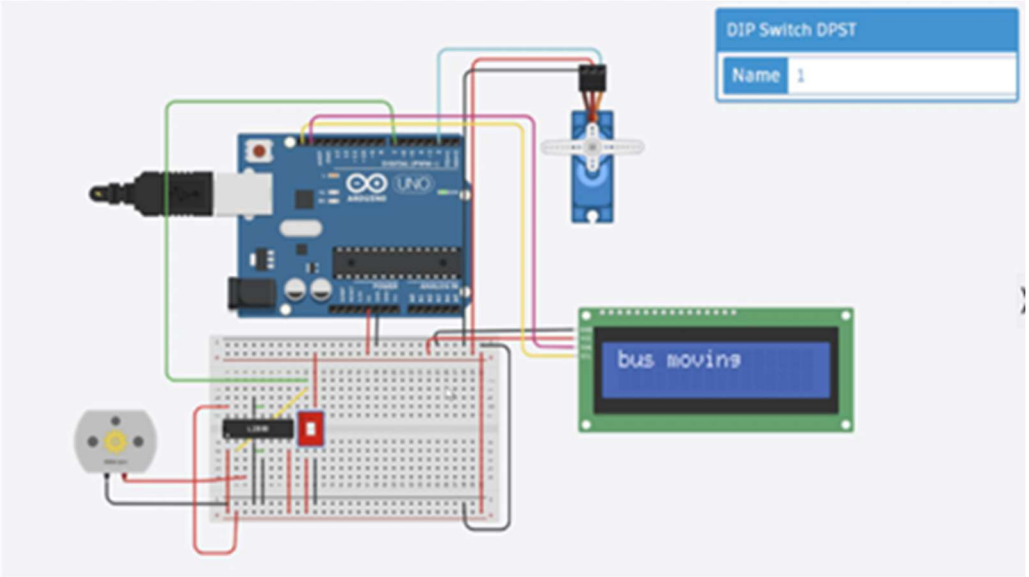
Figure 3. Flowchart representing the hardware working of the project

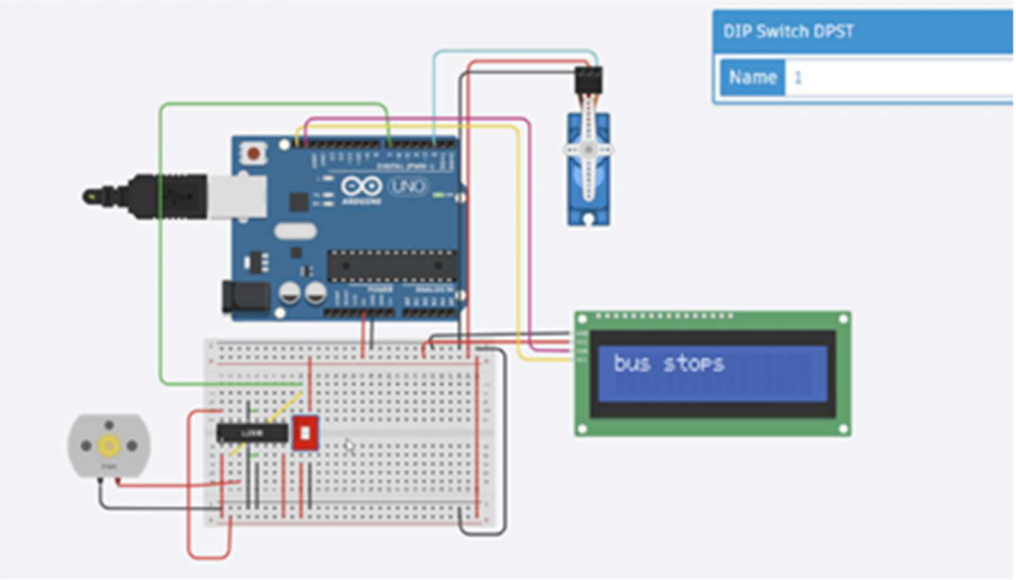
Software Implementation:-

In the software implementation of the project, simulation is conducted using **TinkerCad**, an online platform for electronics prototyping. Within the simulation environment, a virtual device represented by a servo motor replicates the functionality of a bus door. When the door is opened, we assume that an RFID tag is scanned, capturing passenger identity and fare details.

Subsequently, a virtual button is pressed to close the door, initiating the operation of a motor to simulate the bus's movement. This dynamic interaction is visually represented on an LED display, providing real-time feedback to users. The LED display serves as a centralized interface, presenting information on fare transactions, passenger boarding, and the status of the bus (running or stopped).

Through this comprehensive visualization, users can monitor and track all relevant activities within the system, ensuring seamless operation and effective management of transportation services.





Figures . Software simulated results

Future Scope:-

The envisioned advancements for the Smart Bus Ticketing System are set to elevate the public transportation experience through a series of strategic enhancements. The introduction of advanced LED indicators will provide passengers with immediate, color-coded feedback on their fare status, facilitating a smoother boarding process. The integration of Aadhar will bolster the

system’s security, ensuring that each RFID tag is securely linked to its owner’s unique identity, thereby reducing fraud and unauthorized use.

A comprehensive web application is also in the pipeline, designed to serve as a centralized platform for account management, including the creation of accounts, recharging of RFID tags, and reporting of lost or stolen cards. This digital solution will streamline user interactions with the ticketing system, making it more accessible and user-friendly.

Looking ahead, the system will incorporate a real-time analytics dashboard for operators, providing valuable insights into passenger flow and travel patterns, which will inform service improvements and route optimization. The ambition to create a unified transit card through multi-modal integration will further simplify travel, allowing passengers to seamlessly transition between different forms of public transport.

In alignment with global sustainability efforts, the project will explore the use of eco-friendly materials for RFID tags and the adoption of solar-powered RFID readers, significantly reducing the environmental impact of the transportation network. Additionally, the introduction of customer loyalty programs will reward frequent travelers, incentivizing the use of public transportation and fostering a culture of loyalty among commuters.

These forward-looking enhancements are aimed at not just refining the operational aspects of the bus ticketing system but also at contributing to a more sustainable, efficient, and user-centric public transportation ecosystem in India.

Result:-

The video linked provides a detailed demonstration of the project's functionalities, showcasing the seamless integration of components such as bus movement simulation, RFID scanning, and data display on the LCD. Each RFID tag responds uniquely to the reader's scan, and the LCD accurately reflects the corresponding data. While the integration of the GPS module for distance calculation remains pending, the current system demonstrates enhanced efficiency compared to traditional methods, aligning with sustainability goals.

https://youtu.be/FbJ4J6DU5N8?si=ntkK8egRd-WWQZ2J

Conclusion:-

As per the present status, the movement of bus and the opening and closing of the door whenever a passenger tries to enter or exit, is implemented. The RFID tags are loaded with data and are programmed to respond when scanned on the RFID reader. Upon this the appropriate message is displayed on the LCD. The GPS module to calculate the distance is yet to be integrated. This transaction method has proved to be faster than the usual conductor-based system and helps in achieving sustainable development goals.