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# Auto Monitoring and Identification of Bus Transport System

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**Abstract**: *The "Auto Monitoring and Identification of Bus Transport" project presents an automated solution for managing bus entry and exit at designated points, with a current focus on college campus transport. The system leverages a combination of barcode scanning, GPS tracking, and wireless data transmission to monitor bus movements. The primary objective is to streamline the process of identifying and tracking buses as they pass through specific gates, ensuring efficient and reliable management of transport services. The project focuses on providing a cost-effective and scalable solution for transport management in educational institutions and other similar environments. It offers the benefits of automated tracking, realtime data transmission, and enhanced security through precise vehicle identification. Though the current application is limited to tracking bus locations at the campus gate, this framework has the potential for expansion into broader real-time vehicle tracking systems. The combination of low-cost hardware and simple implementation makes it an ideal solution for institutions seeking improved transport management systems.*

**Keywords**: Auto Monitoring, GPS Tracking, Wireless Data Transmission

## I. INTRODUCTION

Efficient and automated monitoring of bus transport is critical for enhancing safety, improving logistics, and streamlining operations, particularly in institutional environments such as colleges or schools. The "Auto Monitoring and Identification of Bus Transport" system aims to achieve this by automating the process of bus identification and gate control. The system utilizes barcodes and GPS tracking to capture essential data like vehicle numbers and locations when buses arrive at a designated gate[1][2][13]. This data is then transmitted wirelessly to a mobile device using Bluetooth technology, offering real-time tracking and verification of buses at the point of entry and exit[3][8].

This project is designed to automate and simplify the existing manual processes of bus in-and-out management. In many institutions, bus entry and exit are monitored manually, which is time-consuming, prone to errors, and lacks real-time data access [6]. By integrating a barcode scanning system that identifies the bus and combining it with GPS tracking for location verification at the gate, this system significantly improves accuracy and efficiency.

The hardware used includes an Arduino Uno as the central processing unit, a barcode scanner to read vehicle information, an HC05 Bluetooth module for wireless communication, and two servo motors for controlling an automatic boom barrier gate for bus entry and exit[2][4][7][11]. The demo of this project includes information for four buses, and the primary application is focused on college bus management, where real-time location data at the gate is used to track and log bus movements. This system eliminates the need for manual logging, providing an automated solution for campus security and administration. Its ability to integrate with mobile devices ensures that bus tracking data is instantly available to authorized personnel, making it a practical solution for modernizing bus transport management.

The project has significant potential for expansion beyond college bus management. It can be implemented in larger transportation systems, such as public bus services, schools, and corporate shuttle systems, enhancing security and tracking efficiency[5][12]. Integrating GPS technology and mobile connectivity provides realtime vehicle tracking, allowing better monitoring of arrival and departure times[8]. The system could also be adapted to track multiple entry and exit points across different locations, with centralized data management for fleet control. Expanding the current

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Bluetooth data transfer to cloud storage can improve data accessibility for administrators. Additionally, incorporating features such as passenger counting, fuel consumption tracking, and predictive maintenance based on vehicle history can further enhance its value[14][15]. The project's low-cost, scalable design makes it an ideal solution for small and medium-sized institutions aiming to streamline bus transport monitoring and improve operational efficiency.

Fig.1.The current MSRTC bus transportation system operates without the use of modern smart technology.

## II. LITERATURE SURVEY

Bus transport handling has become so much more relevant nowadays, particularly in schools, colleges, and big organizations. Barcode scanning has been widely used in many systems for vehicle recognition since it is easy to use, affordable, and reliably functional [1][6][13]. Installing a barcode label on every bus makes it very convenient to simply identify vehicles on the gate quickly without having to check manually. To understand where an exact bus is at crucial locations such as entry points, systems tend to employ a GPS module with an Arduino microcontroller [2][7]. It aids in recording the live location of the bus at the correct time, and it becomes simpler to maintain records and enhance security. For wireless data transfer, most projects employ Bluetooth modules such as the HC-05. This module transfers bus information and timing information to nearby mobile devices [3][8]. While Bluetooth operates within a limited range (approximately 10 meters) [10], this is sufficient for shortrange communication, particularly near gate areas. Apart from this, servo motors also control boom barriers. After a bus is confirmed through barcode scanning, the Arduino gives a command to open or close the gate itself [4][11]. This reduces time and minimizes the presence of security personnel at the entry gates. Past research has identified that applications involving Arduino boards with barcode readers are not only inexpensive but are flexible enough to fit into larger systems if the situation calls for it [5][12]. With time, the systems could be enhanced to incorporate features such as cloud data storage and solar-powered systems to be even more handy and environment-friendly [14][15].

## III. METHODOLOGY

This project focuses on the automation and real-time monitoring of bus transport through barcode scanning[1][6][13], GPS tracking[2][7], and Bluetooth communication[3][8], for efficient gate management. The system aims to streamline bus entry and exit from a designated area (e.g., a college campus) and provide real-time tracking data to a mobile device. System Design and Architecture: The system is designed around an Arduino Uno microcontroller[2][7], which serves as the core processing unit. A barcode scanner is used to identify the bus by scanning a barcode sticker placed on each vehicle[1][6][13]. The system reads the barcode and associates it with pre-stored data (such as bus number and route). GPS data is captured when the bus approaches the gate to log the exact location.

Hardware Setup: Barcode Scanner: Placed at the entrance gate, this scanner reads the barcode affixed to each bus. It sends the vehicle identification number to the Arduino for further processing[6][13]. Arduino Uno: The Arduino controls the overall functionality of the system, processing the scanned data and coordinating the servo motors and Bluetooth module[2][7]. HC-05 Bluetooth Module: This module transmits the scanned bus details and its gate location to a mobile application or a nearby device via Bluetooth. The mobile app receives and displays the bus number and time of entry/exit in realtime[3][8]. Servo Motors: Two servo motors are installed at the gate, one for the entry barrier and one for the exit barrier. These motors receive signals from the Arduino to automatically open and close the boom barrier based on the bus identification[4][11].

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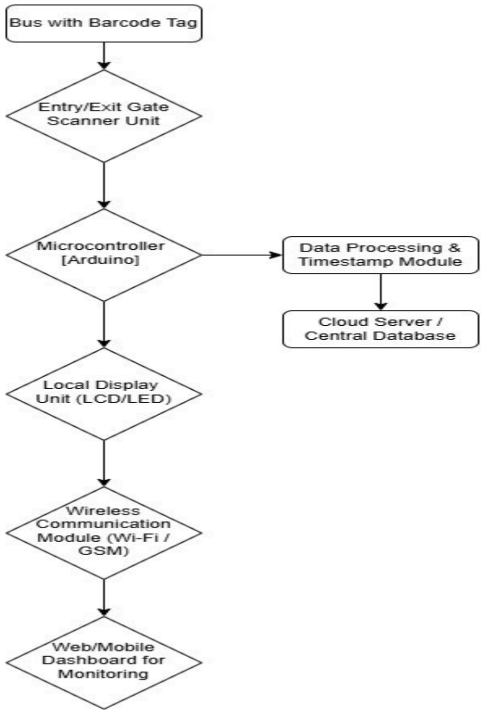


System Operation: When a bus approaches the gate, the following steps take place:

Bus Identification: The barcode scanner reads the bus's unique barcode and sends the data to the Arduino[6][13]. GPS Location Tracking: The system logs the bus's location at the gate (e.g., when entering or exiting) via the GPS module, though real-time tracking is limited to the gate area for this prototype[2][8]. Data Transmission: The HC-05 Bluetooth module transmits the bus ID and entry/exit time to a mobile device, where the information is displayed for monitoring[3][8]. Boom Barrier Control: Based on the identification, the Arduino activates the servo motors to lift the boom barrier, allowing the bus to pass. After a set delay, the barrier automatically closes[4][11]. Demo Setup and Application: For demonstration purposes, data for four buses will be stored in the system. The application is designed for college buses, tracking their entry and exit from the campus. The demo focuses on gate tracking, with future scope for extending real-time tracking to the bus's entire route[14][15]. Testing and Optimization: The system will be tested for accuracy in bus identification and responsiveness of the servo motors. Optimization efforts will focus on reducing latency in barcode scanning and data transmission to ensure smooth operation. This methodology provides an automated, low-cost solution for monitoring bus transport, enhancing security and convenience in areas like college campuses[3][8][5][12].

Software Setup: Barcode Scanner: Function: The barcode scanner reads the unique barcode attached to each bus when it arrives at the gate. It identifies the bus by scanning the vehicle number encoded in the barcode. Process: The scanned barcode data is sent to the Arduino Uno for processing and identification[1][6][13]. Arduino Uno: Function: This is the central microcontroller that processes all the input signals from the barcode scanner, GPS module, and controls the servo motors for the boom barrier. Process: The Arduino receives the barcode data, processes it, and logs it for identification. It also receives GPS data for location tracking and sends this information to the Bluetooth module. Based on the bus ID and system logic, it sends control signals to the Servo Motors to open or close the boom barrier. GPS Module: Function: The GPS module tracks the real-time location of the bus when it is scanned at the gate. Process: The GPS coordinates of the bus are sent to the Arduino Uno, where they are logged and processed. This ensures that the bus's position at the gate is tracked in real time[2][7]. HC-05 Bluetooth Module: Function: The HC-05 Bluetooth module enables wireless communication between the Arduino system and the mobile device. Process: The bus information (ID, GPS location, and timestamp) is transmitted via Bluetooth to the Mobile Device, where it is displayed to the administrator or user monitoring the bus[3][8]. Servo Motors (for Boom Barrier Control): Function: The two

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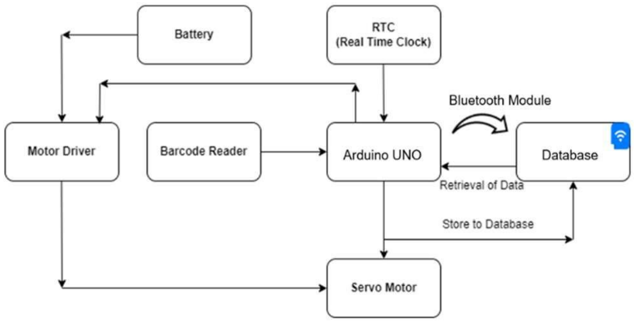
servo motors control the opening and closing of the boom barrier. Process: Based on the input from the Arduino Uno, the servo motors lift the boom barrier when a bus is successfully identified. Once the bus passes, the motors lower the barrier back to its closed position[4][11]. Mobile Device: Function: The mobile device receives and displays the real-time data (bus ID, GPS location, and entry/exit time) from the system via Bluetooth. Process: The administrator can monitor the bus movements and entry/exit logs using a Bluetooth terminal or a custom mobile application. Power Supply: Function: The power supply provides the necessary electrical power to all components, including the Arduino Uno, barcode scanner, Bluetooth module, GPS module, and servo motors. Process: It ensures all components operate smoothly throughout the system's working cycle.

**System Operation Flow**

Bus Arrival: When a bus arrives at the gate, the barcode scanner reads its barcode, sending the vehicle number to the Arduino for processing[6][13]. Identification & GPS Tracking: The Arduino identifies the bus and simultaneously logs its GPS location from the GPS module[2][8]. Bluetooth Communication: The bus details are transmitted to the administrator's mobile device via Bluetooth for real-time monitoring[3][8]. Boom Barrier Control: Based on the bus identification, the Arduino sends signals to the servo motors to open the boom barrier, allowing the bus to pass. Once the bus clears the gate, the barrier automatically closes[4][11].




**Software Working**

System Initialization: The software begins by initializing the Arduino Uno, barcode scanner, GPS module, Bluetooth module (HC-05), and servo motors. The required libraries for barcode scanning, GPS tracking, and Bluetooth communication are loaded in the Arduino Integrated Development Environment (IDE). The servo motors are set to their initial position, ensuring the boom barrier gate is closed[2][3][7][8]. Barcode Scanning: When a bus approaches the gate, the barcode scanner reads the barcode on the bus, which contains its unique identification number. The scanned data (bus ID) is processed by the Arduino and logged into the system. This step ensures the bus is identified correctly[1][6][13]. GPS Location Tracking: Simultaneously, the GPS module checks the location of the bus when it arrives at the gate. This helps track the bus in realtime at the entry/exit point. The GPS coordinates are recorded along with the bus ID and time of entry/exit, creating a log for monitoring purposes[2][8]. Data Transmission via Bluetooth: Once the barcode is scanned and GPS data is captured, the information (bus ID, GPS location, time) is sent to a mobile device through the HC-05 Bluetooth module. On the mobile device, a custom mobile application (or a Bluetooth terminal app) receives the data for realtime monitoring and management by the administrator or security personnel [3][8]. Automated Boom Barrier Control: After confirming the bus ID, the Arduino sends a signal to the servo motors to lift the boom barrier, allowing the bus to pass. After a preset time, delay or when the bus fully passes through, the servo motors return the boom barrier to the closed position[4][11].

Data Logging: All data (bus ID, GPS coordinates, and timestamp) is stored in the Arduino memory (or transmitted to a connected system) for future reference. This data can be accessed or downloaded later for performance evaluation, security purposes, or operational tracking[2][5]. Error Handling and Alerts: The software is designed to handle errors, such as barcode scanning failure or GPS signal issues, by alerting the user on the mobile device through Bluetooth. If the system fails to identify the bus or any malfunction occurs, it will notify the user, and the boom barrier will remain

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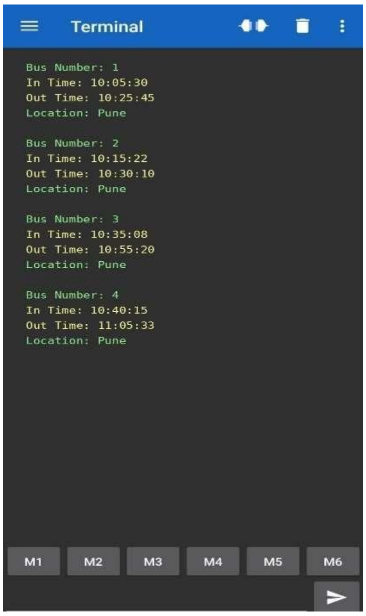
closed for security reasons[3][8]. Shutdown Process: At the end of the operation or when manually stopped, the system stores the current data, resets the boom barrier, and safely turns off components like the barcode scanner and Bluetooth module to conserve power. This software process ensures efficient monitoring, accurate bus identification, and secure control of the boom barrier with seamless communication between hardware components and the mobile application.

## IV. RESULT

Efficient Bus Identification: The system successfully automates the identification of buses through barcode scanning, eliminating the need for manual logging and enhancing accuracy.Real-Time Location Monitoring: With the integration of GPS modules, the system effectively tracks the bus's real-time location when entering and exiting the gate, ensuring precise data logging.Automated Boom Barrier Operation: The implementation of servo motors allows for automatic opening and closing of the boom barrier based on bus identification, improving operational efficiency at entry points.Bluetooth Data Transmission: The HC-05 Bluetooth module enables wireless transmission of bus data to mobile devices, providing a convenient and low-cost solution for monitoring bus movements.Enhanced Security and Management: The system offers improved security by accurately recording bus entry and exit times, which can be particularly useful in managing college or institutional transport systems.Cost-Effective and Scalable Solution: The use of affordable components such as Arduino Uno, barcode scanners, and Bluetooth modules ensures a low-cost system that can be scaled for larger transportation networks.Improved User Convenience: The automation of bus tracking and boom barrier control reduces human intervention, leading to smoother operations and more convenient management of transport systems.

Here is a Snapshot of output:




## V. ADVANTAGES

- Increased Efficiency: Automating the process of bus identification and gate control reduces manual labour, allowing buses to enter and exit faster while ensuring accurate logging of vehicle data.
- Enhanced Security: By capturing bus information using barcode scanning and GPS, the system improves security by keeping track of each bus entering or leaving the premises, preventing unauthorized access.
- Real-time Data Transfer: With Bluetooth technology, the system provides real-time transmission of bus location and identification data to mobile devices, ensuring timely updates for better management.

- Cost-effective: Utilizing affordable hardware such as Arduino, barcode scanners, and Bluetooth modules makes the system economically viable for institutions, reducing operational costs compared to more complex systems.
- Scalability and Flexibility: The system is scalable, allowing it to be adapted to larger transport networks or different applications, such as public bus management or vehicle access control in gated communities

## VI. CONCLUSION

The "Auto Monitoring and Identification of Bus Transport" project aims to provide an efficient, low-cost solution for managing and monitoring bus transportation, with a focus on automated entry and exit systems. Using a combination of barcode scanning, GPS location tracking, and Bluetooth communication, this system enables real-time monitoring of buses, with data transmitted to mobile devices for immediate access.

The project's expected conclusion is that the integration of these technologies Arduino Uno, barcode scanners, Bluetooth modules (HC-05), and servo motors will significantly improve the accuracy and efficiency of bus identification at gate points. The automation of the Boom Barrier Gate using servo motors will reduce manual intervention and enhance security by ensuring that only authorized vehicles enter and exit the premises. Real-time location tracking at the gate ensures that vehicle movements are logged precisely, aiding in efficient transport management for institutions like colleges. The system's ease of use, scalability, and low cost make it an ideal solution for not only educational institutions but also larger transport networks, gated communities, and industrial complexes. The implementation of Bluetooth and GPS technologies ensures a balance between affordability and functionality, enabling effective data transmission and tracking. This project is expected to pave the way for more advanced, automated transport systems that improve safety, reduce human error, and enhance operational efficiency. Ultimately, it offers a sustainable and adaptable solution for transport monitoring in various applications.

## VII. FUTURE SCOPE

The future scope of this system includes several enhancements that can improve its applicability and functionality. One potential improvement is integrating advanced technologies like GPS-based real-time tracking for continuous monitoring of bus locations, which would extend beyond the gate. By incorporating IoT-based cloud data storage, the system could provide centralized access to transport data, making it useful for large-scale implementations in public transportation or corporate fleets.

Another possibility is enhancing the security and accuracy of vehicle identification by integrating RFID or biometric systems alongside barcode scanning. Moreover, expanding the system to handle traffic management, student attendance, and even predictive maintenance for buses could add significant value. Finally, using solar-powered components and low-power communication protocols like LoRa could make the system more sustainable and energy-efficient, particularly in resource-constrained environments. These future advancements can make the system more versatile, scalable, and effective in smart transport applications.

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