IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 5, April 2024

Smart College Bus Transportation System Using IoT

Dr. S. A. Shaikh[1], Mr. S. T. Pokharkar[2], Mr. Heramb Shirgaokar[3], Miss. Sakshi Lande[4], Miss. Nikita Sonawane[5]
Guide, Department of Electronics Engineering[1]
Students, Department of Electronics Engineering[2,3,4,5]
Pravara Rural Engineering College, Loni, Maharashtra, India

Abstract: *This project enhances the college bus experience through a mobile application that leverages the power of IoT. Students and staff can ditch the guesswork about bus arrival times with the app's real-time GPS bus tracking feature. This translates to less time spent waiting and more flexibility in planning commutes. Furthermore, the system prioritizes student safety through RFID technology. RFID tags track student entries and exits, keeping parents and the college informed of their whereabouts. This combined approach of real-time bus tracking and student monitoring offers a comprehensive solution that improves efficiency, affordability, and overall safety for college bus transportation. The system's scalability paves the way for future expansion to encompass all college buses, creating a centralized tracking network.*

Keywords: RFID, Servo motor, GPS

I. INTRODUCTION

This project tackles student commuting woes at colleges by implementing a smart bus system built on IoT tech. To address overcrowding and ensure students get a seat, the system utilizes RFID cards that act as student IDs. These cards are scanned upon boarding, guaranteeing access only to authorized riders. Furthermore, GPS trackers installed on the buses provide real-time location updates. This not only benefits the college administration by keeping them informed of the bus's progress, but also empowers them to proactively communicate any delays to students, parents, and faculty. The system goes a step further by incorporating GSM modules, which establish seamless communication between bus drivers, the college, and a central monitoring unit. This ensures everyone stays informed and critical information is disseminated quickly. Overall, this project offers a comprehensive solution that improves efficiency, communication, and student safety in college bus transportation.

II. LITERATURE REVIEW AND OBJECTIVE

A. Objective

- Design and implement a smart college bus transportation system using IoT.
- Develop a software application to collect, analyze, and visualize the data from the buses.
- Develop a mobile app for the system to allow students and staff to track the location of buses and receive arrival alerts on their smartphones.
- Test and deploy the system at our university.

B. Literature Review

Researchers have been looking into ways to improve public bus systems using technology. One common approach is to use GPS to track the location of buses in real-time. This allows riders to see where the bus is and when it is expected to arrive. In addition to location tracking, some systems also use RFID tags to track how many people are on the bus. This information can be used to provide riders with information about crowdedness and help them decide whether to wait for the next bus. Other systems go even further and include sensors to monitor things like temperature inside the bus. This information can be used to ensure the safety and comfort of riders. Overall, these studies show that there are a number of promising technologies that can be used to improve public bus systems.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 5, April 2024

T. A. Salih et al. [1] proposed system is based on Internet of Things (IoT) technology and utilizes various components such as GPS modules, microcontrollers with built-in Wi-Fi modules (ESP32), and mobile user interfaces by the Blynk IoT platform

P. Singhal et al. [2] explores how IoT can improve public transport in a research paper. They discuss how technologies like RFID and GPS can track buses, manage ridership, and improve communication during delays, ultimately creating a smarter and more efficient system.

V. Pawar et al. [3] proposes system uses GPS and RFID tags for location tracking and GSM GPRS for communication of information to users.

R. Dange et al. [4] proposes a system in which the WiFi-sensing is used in other research work for bus live tracking and arrival time prediction. The system leverages WiFi data available to bus riders and can integrate with GPS or Cell-ID based location systems. It has applications for bus arrival time prediction, traffic map generation, and navigation in subway environments.

A. J. Kadam et al. [5] explores system uses GPS (Global Positioning System) data and dynamic traffic information for the prediction of bus arrival time.

R. S. Krishnan et al. [6] proposed a system in which temperature monitoring is done using an IR temperature sensor, which checks the temperature of the students during the screening process.

R. C. Jisha et al. [7] explored system is designed to perform all desired operations in real-time and broadcast live results to users.

P. S. Saarikaet al.[8] proposed a system in which data is collected from various sensors on the vehicle and transmitted to the central data center for storage and further analysis.

A. M. Sanam et al. [9] proposes system utilizes IoT technologies to provide real-time monitoring, tracking, and alerts about the children's whereabouts, condition, and safety while on the school bus.

Savitha S. C et al. [10] proposes system aims to improve the efficiency of the bus system and address challenges such as traffic, delays, and dispatching incidents. It allows users to view bus details, bus numbers, and bus routes online, ensuring that they arrive at the bus stop on time. The system also includes features such as alerting the driver when a user is close to the bus stop and providing estimated arrival times.

III. MATERIALS AND METHODS

To develop the smart college bus system, we will follow a five-step process. First, we'll gather requirements from students, staff, and bus operators to understand their needs and desired functionalities. Then, we'll design the system architecture including hardware selection (GPS, RFID reader, GSM module, etc.) and software development for data collection, analysis, visualization, and mobile app functionality. In the implementation phase, we'll install the chosen sensors on buses, configure data transmission, and develop the software application for the central server and mobile app. Finally, after thorough testing to ensure everything functions as intended, we'll deploy the system at the university and provide ongoing maintenance and support.

Our system contains following steps:

- Develop a bus pass validation system.
- Develop a system to track the real-time location of bus the bus faculty.
- Create an SOS button to alert the agencies in case of emergency.
- Send message to the passengers in case of change in arrival / departure time.
- Block the passengers who uses bus faculty without valid pass.

A. Existing work

The area of smart bus systems describes how such systems use GPS technology to track bus locations and provide real-time information to passengers through mobile applications. Additionally, it highlights the use of RFID technology for passenger identification and boarding location tracking.

B. Proposed Work

In The proposed IoT-based college bus management system *operates* through a meticulously orchestrated combination of advanced technologies, ensuring seamless functionality and addressing the challenges faced by students during their

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 5, April 2024

bus commute. Upon receipt of an RFID card, students initiate their journey by tapping the card on the designated RFID reader within the bus. The RFID reader instantaneously validates the card, allowing access exclusively to students possessing valid passes. Simultaneously, the RFID reader triggers the system, meticulously logging the student's entry data. This real-time information is transmitted to the central server, establishing a comprehensive database for monitoring and analysis. While the bus is in transit, GPS sensors continuously track its precise location. This real-time geospatial data is transmitted via GSM modules to the central server, offering up-to-the-minute insights into the bus's movement.

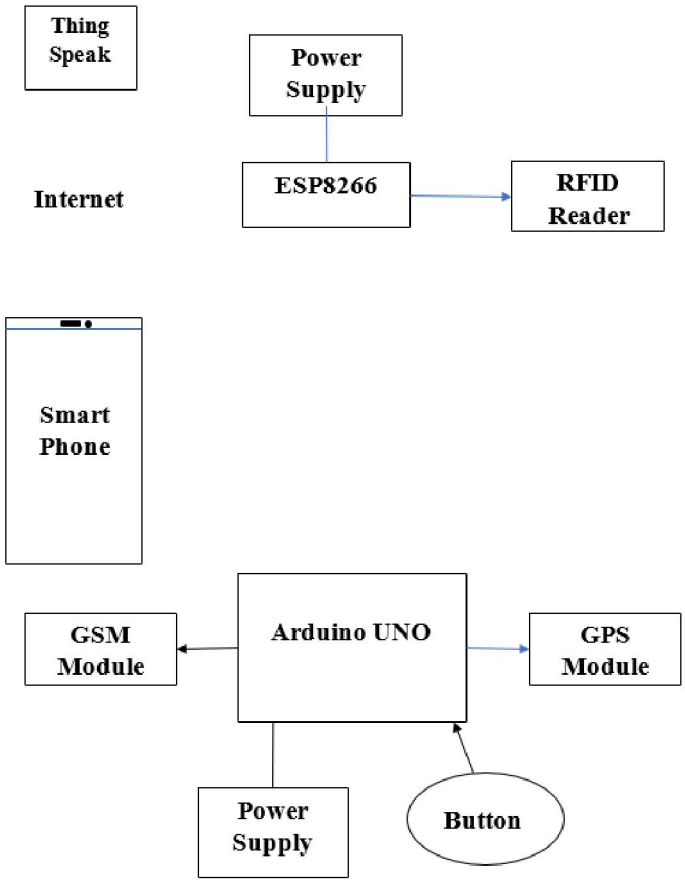


Fig (a). System Architecture

This smart college bus transportation system leverages the Internet of Things (IoT) to create a more efficient and safer transportation experience for students. Onboard sensors like GPS and RFID readers act as the system's eyes and ears, constantly collecting data about the bus's location and ridership. This data is then processed by a mini-computer on the bus and transmitted securely to a cloud server via WiFi, with cellular connectivity acting as a backup if needed. At the cloud server, the collected information is transformed into actionable insights. Bus location data is used to optimize routes and track the bus's progress in real-time. RFID data, meanwhile, can be used to track student ridership patterns, potentially enabling faster boarding times through efficient passenger identification. This processed data is then made accessible to users through a mobile application. Students and parents can leverage the app to track the exact location of their bus, eliminating the anxiety of long waits at bus stops. College administrators can also utilize the system to monitor ridership trends, identify areas for improvement, and optimize bus routes for better efficiency. Overall, this IoT-powered system offers a significant upgrade to traditional college bus transportation, promoting safety, convenience, and improved operational efficiency.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 5, April 2024

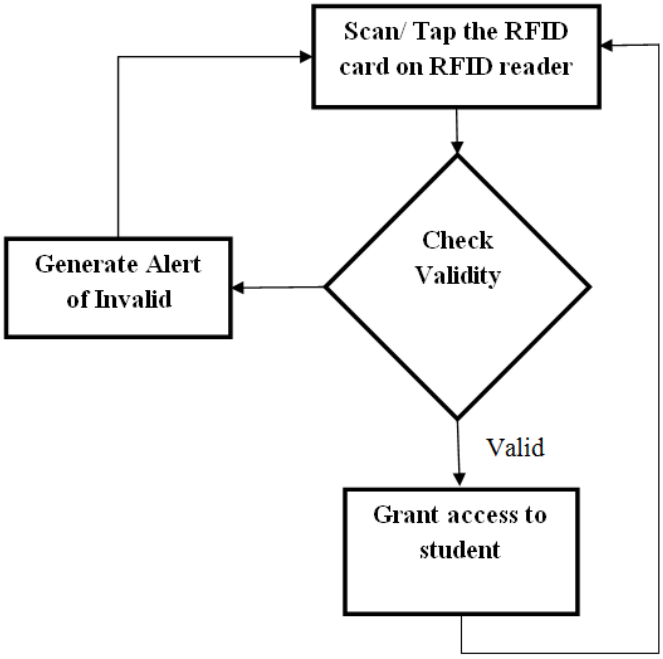


Fig. (b) Flow chart for RFID

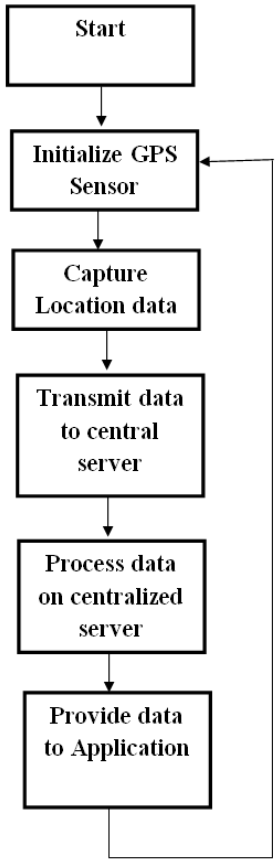


Fig. (c) Flowchart for GPS Tracking

DOI: 10.48175/IJARSCT-17563

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 5, April 2024

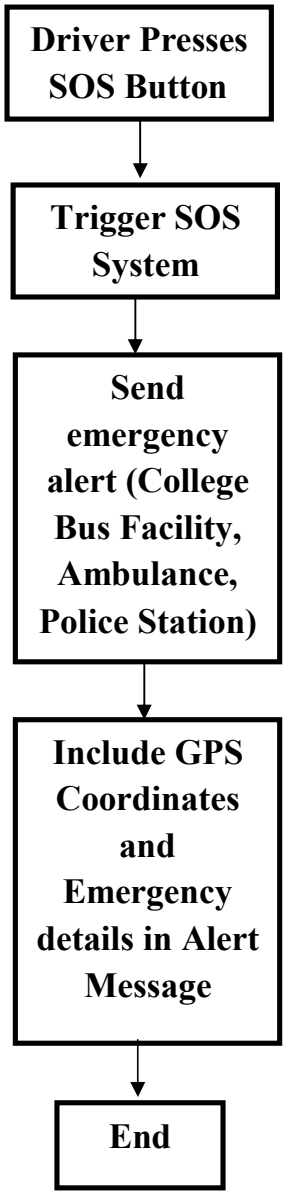


Fig. (d) Emergency Alert System

C. Algorithm

a. RFID Tracker

1. Essential libraries for WiFi, ThingSpeak, SPI, and RFID communication are included.
2. Pins for LED and RFID reader, along with variables for WiFi credentials, ThingSpeak details, and RFID data storage, are defined.
3. Initializes serial communication, sets LED pin as output, connects to WiFi, initializes ThingSpeak and SPI for RFID communication.
4. loop

Continuously checks for new RFID cards.

Reads card UID, checks type, and compares with previous UID.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 5, April 2024

Reads data from ThingSpeak channel and field.
Compares RFID data with ThingSpeak data.
Controls LED based on verification outcome.

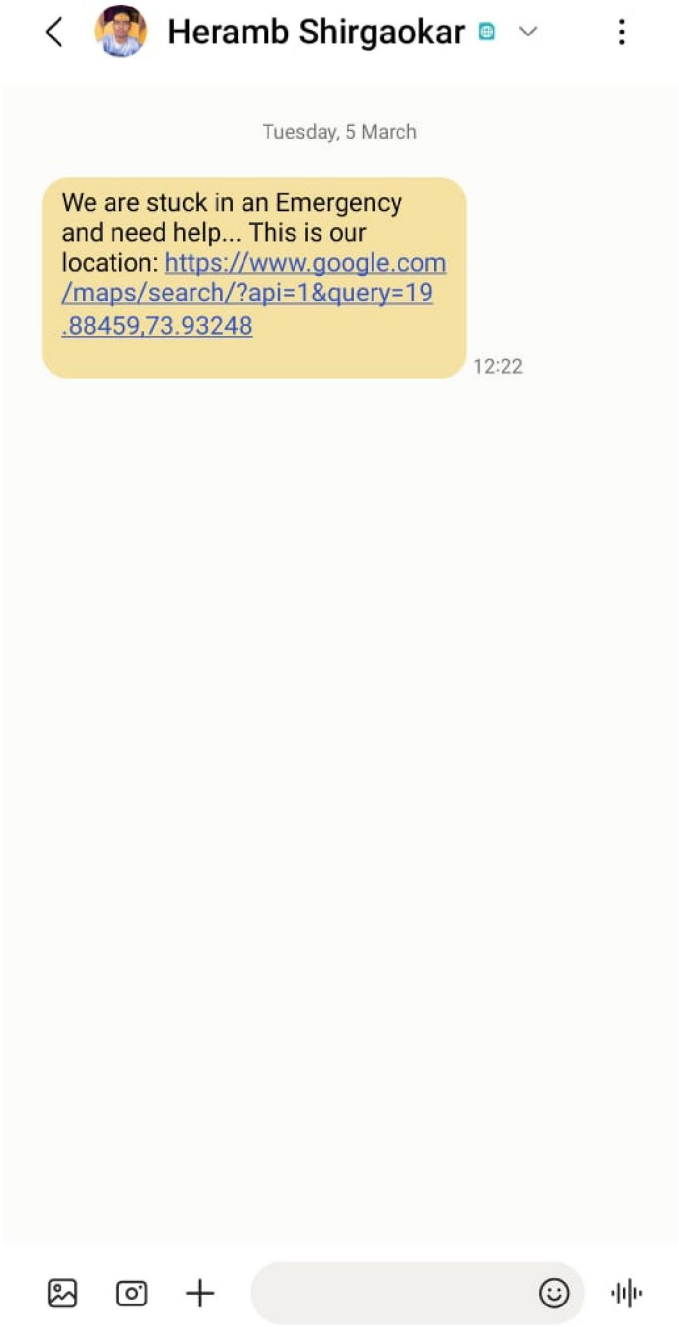
b. GPS and GSM

Include necessary libraries such as TinyGPS++, SoftwareSerial, and AltSoftSerial.
Define pins for GSM and GPS module communication, as well as variables for storing GPS data and SMS recipient numbers.
Initialize serial communication with the Arduino IDE and modules.
Send AT commands to initialize the GSM module for SMS messaging.
Loop
Check for available data from both serial ports (Arduino IDE and GSM module).
Read GPS data periodically and print latitude and longitude to the serial monitor.
Retrieve GPS data and format it.
Send formatted GPS data to a server or display on the serial monitor.
Check button state for emergency SMS sending.
If the button is pressed, send emergency SMS messages to predefined recipient numbers with the current GPS location.
sendMessage`: Sends SMS messages using the GSM module to predefined phone numbers.
updateSerial`: Updates serial communication between Arduino IDE and GSM module.
Checks the state of a button connected to the Arduino.
If the button is pressed, initiates emergency SMS sending to predefined recipients with current GPS location.

IV. RESULTS AND DISCUSSION

```
22:21:40.325 -> ..
22:21:40.850 -> Connected.
22:21:40.882 -> Setup Complete.
22:21:45.692 -> A new card has been detected.
22:21:45.692 ->
22:21:45.734 ->
22:21:45.734 -> Dear HS_Production, Here is your RFID card Number115799723
22:21:45.764 ->
22:21:46.553 -> The RFID Card Number on your Server is: 115799723
22:21:46.589 -> 115799723
22:21:46.589 -> Welcome... Mr. HS_Production
22:21:50.796 -> A new card has been detected.
22:21:50.796 ->
22:21:50.834 ->
22:21:50.834 -> Dear HS_Production, Here is your RFID card Number1157997231869684191
22:21:50.869 ->
22:21:51.632 -> The RFID Card Number on your Server is: 115799723
22:21:51.663 -> 1157997231869684191
22:21:51.697 -> Invalid Card... Please Pay Bus Fees...
```

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 5, April 2024



V. CONCLUSION

Our IoT-based solution offers a transformative approach to the challenges encountered in the college bus service. By integrating RFID, GPS, GSM, and an SOS system, we've ensured students' access to seats, provided real-time arrival alerts, and enhanced safety measures. The project's success lies in its ability to streamline communication, optimize routes, and swiftly respond to emergencies. Moving forward, this innovative system not only resolves current issues but also sets a precedent for efficient, secure, and passenger-focused transportation services, showcasing the potential of IoT technology in revolutionizing student commuting experiences.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 5, April 2024

VI. ACKNOWLEDGEMENTS

I thank Dr. S. A. Shaikh, Prof of B.E Electronics Engineering, PREC, Loni, for her continuous support and encouragement for completing this research paper and also thanks to PREC Electronics department for the continuous support.

REFERENCES

[1] T. A. Salih and N. K. Younis, "Designing an Intelligent Real-Time Public Transportation Monitoring System Based on IoT," OALib, vol. 08, no. 10, pp. 1–14, 2021, doi:10.4236/oalib.1107985.

[2] P. Singhal, "A review on smart public transport system based on IOT," Asian Journal of Research in Social Sciences and Humanities, vol. 11, no. 10, pp. 312–317, 2021, doi:10.5958/2249-7315.2021.00108.8.

[3] V. Pawar and N. P. Bhosale, "Internet-of-Things Based Smart Local Bus Transport Management System," 2018 Second International Conference on Electronics, Communication and Aerospace Technology (ICECA), Mar. 2018, doi: 10.1109/iceca.2018.8474728.

[4] A. J. Kadam, V. Patil, K. Kaith, D. Patil, and Sham, "Developing a Smart Bus for Smart City using IOT Technology," 2018 Second International Conference on Electronics, Communication and Aerospace Technology (ICECA), Mar. 2018, doi: 10.1109/iceca.2018.8474819.

[5] R. S. Krishnan, A. Kannan, G. Manikandan, S. S. KB, V. K. Sankar, and K. L. Narayanan,"Secured College Bus Management System using IoT for Covid-19 Pandemic Situation," 2021 Third International Conference on Intelligent Communication Technologies and Virtual Mobile Networks (ICICV), Feb. 2021, doi: 10.1109/icicv50876.2021.9388378.

[6] R. C. Jisha, A. Jyothindranath, and L. S. Kumary, "Iot based school bus tracking and arrival time prediction," 2017 International Conference on Advances in Computing, Communications and Informatics (ICACCI), Sep. 2017, doi: 10.1109/icacci.2017.8125890.

[7] P. S. Saarika, K. Sandhya, and T. Sudha, "Smart transportation system using IoT," 2017 International Conference On Smart Technologies For Smart Nation (SmartTechCon),Aug.2017,doi:10.1109/smarttechcon.2017.8358540.

[8] A. M. Sanam and S. D. Sawant, "Safety system for school children transportation," 2016 International Conference on Inventive Computation Technologies (ICICT), Aug. 2016, doi:10.1109/inventive.2016.7823227.

[9] R. Dange, "Prediction Of Bus Arrival Time Using Global Positioning System(GPS),"International Journal for Research in Applied Science and Engineering Technology, vol. V, no.VIII,pp.1850-1856,Aug.2017,doi:10.22214/ijraset.2017.8264.

[10] L. Kang, S. Poslad, W. Wang, X. Li, Y. Zhang, and C. Wang, "A Public Transport Bus as a Flexible Mobile Smart Environment Sensing Platform for IoT," 2016 12th International Conference on Intelligent Environments (IE), Sep. 2016, doi: 10.1109/ie.2016.10.