SMART BUS TRACKER USING IoT

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ABSTRACT - *The primary objective of this paper is to introduce an IoT based live location tracking system for college buses, government buses, and other public transportation vehicles on Google Maps. Additionally, the system aims to provide real-time information about availability of seats in buses, enhancing the comfort and convenience of users. Globally commuters often face challenges due to road congestion caused by lack of information about vehicle locations and available seating. To address this issue, a live location tracking system was developed which can be easily installed in any vehicle, including RTC buses, with government support. The core concept of this tracking system revolves around utilizing the Internet of Things (IoT) to monitor bus movement and identify availability of seats from any location at any time. The tracking system incorporates a Global Positioning System (GPS) device along with an IR Sensor, enabling precise tracking of bus positions on Google Maps and monitoring seat availability through a Node MCU ESP8266 Microcontroller connected to the local network. A unique URL was generated to display the vehicle's location on the map via smartphones.Overall, this tracking system aims to improve the public transportation experience by providing accurate and timely information to commuters, ultimately enhancing their travel convenience and satisfaction.*

KEYWORDS: MICROCONTROLLER, GPS, WiFi MODULE, Node MCU ESP8266, IoT, RTBTSS

A. INTRODUCTION

The Internet of Things (IoT) has emerged as a transformative paradigm, linking everyday objects and devices to the Internet for seamless data collection, exchange and control of Devices. Its impact spans across diverse industries, driving efficiency, automation, and connectivity to new heights. Within the realm of public transportation, IoT has catalysed groundbreaking solutions such as the Real-Time Bus Tracking and Seat Updation System. This innovative system harnesses IoT devices, advanced sensors, and robust mobile connectivity to furnish passengers with accurate, real-time information related to bus schedules, precise bus locations, and available number of seats. By embedding sensors within buses and infrastructure, the system continually monitors passenger occupancy levels, enabling the dynamic updation of seat availability in real time. Passengers can conveniently access this information through user-friendly mobile applications or digital displays strategically positioned at bus stops. This empowers passengers to plan their journeys with precision, reduce waiting times, and ensure a comfortable travel experience. Furthermore, IoT-powered solutions not only enhance passenger experience but also facilitate efficient fleet management for transportation authorities. Real-time data on bus locations and seat availability enables operators to optimize routes, allocate resources effectively, and respond promptly to changing demand patterns. This level of operational insight and control contributes to overall service reliability and cost-effectiveness, making IoT a game-changer in the evolution of modern public transportation systems.

B.LITERATURE REVIEW

The paper titled "Development of an Android-based Real-Time Bus Tracking System" by Mohammad Nazmul Hasan and Md. Sharif Hossen from the Department of Information and Communication Technology at Comilla University, Bangladesh, introduced an Android application specifically tailored for students, providing comprehensive bus information and real-time location tracking via Google Maps. However, its student-centric focus may restrict its broader utility, and its reliance on GPS technology could present challenges in regions with weak signal coverage.

Another study, the "Low-Cost Bus Seating Information System" proposed by A. Murdan, Vicky Bucktowar, V. Oree, and M. Enoch introduced an Internet of Things (IoT)-based solution for monitoring seat availability. However, challenges related to cost and complexity arise due to the installation of microcomputers and IoT modules in each seat, along with potential connectivity issues with GSM services.

Furthermore, "Bus Tracking using RFID Readers" by S. Indhu Priya, M. Rohini, and G. Nivedhitha, PG students at the Department of Computer Science and Engineering at Kumaraguru College of Technology (KCT), Coimbatore, presented a system utilizing RFID tags at bus stops for location tracking. Despite its potential benefits, this method has drawbacks such as susceptibility to tag tampering and the necessity for buses to stop for scanning, which could impact overall operational efficiency.

In contrast, the "Real-Time Bus Monitoring System" developed by Akshay Sonawane, Ankeet Bhanushali, Kushal Gogri, and Milind Khairnar focused on tracking current bus location and estimated time of arrival (ETA) using GPS and GPRS technologies. Despite its real-time tracking capabilities, this system lacked additional features such as seat availability information and detailed route data, relying instead on SMS-based information delivery.

Additionally, the "Bus Tracking Application" proposed by Shubham Jain, Adarsh Trivedi, and Shweta Sharma utilized satellite data processing and Kalman filtering for precise location estimation. However, this method faces challenges and potential inaccuracies in data processing, alongside dependence on GSM services for data transmission.

Lastly, the "Android-Based School Bus Tracking System" developed by Tarneem M. Hamadto, Zakaria A. Adam, and M.H. Elsayed at the Department of Electronics, UMST, Khartoum, Sudan, prioritized student safety but may have limited use beyond school transportation. Its reliance on GSM/GPRS and GPS technologies could encounter difficulties in areas with inadequate network coverage.

This paper is aimed to overcome the challenges faced by authors in literature and provide an flexible solution.

C. METHODOLOGY

The prototype designed for this work is as follows

A. System Block Diagram

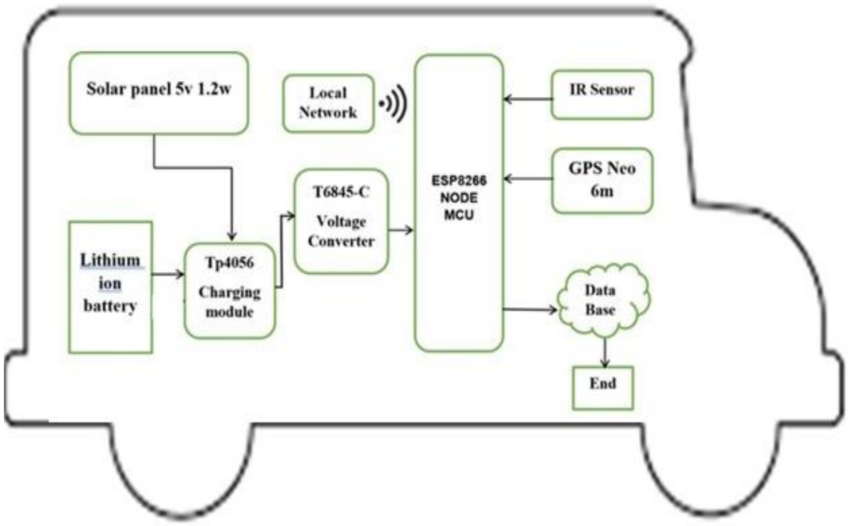

Figure 1 Block Diagram

The vehicle is equipped with a GPS module and a Node MCU ESP8266 microcontroller connected to the local network. The GPS module continuously provides geographic coordinates of the vehicle's location. The Node MCU ESP8266 microcontroller receives the GPS data and transmits it to the Heroku cloud database. The Arduino cloud database stores the location data and updates it whenever new data is received. The location data is then accessed by the user through a smartphone or other device. The Google Maps library is used to display the vehicle's location on the map. The system allows for real-time tracking of the vehicle's movement and provides flexibility for travel planning.

B. Workflow Description

The Workflow Description is shown below

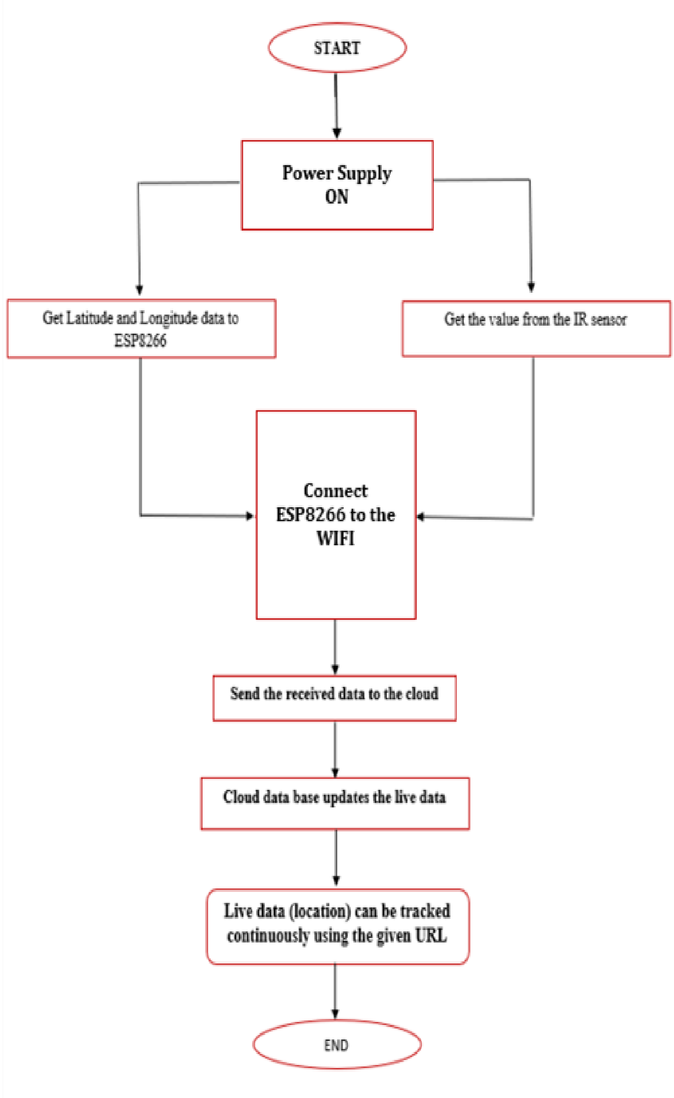

Figure 2 Workflow Diagram

The system is activated at the conference venue, with the ESP8266 module powering up along with connected sensors. Geographical coordinates are obtained by the ESP8266 using a GPS module or API for real-time location tracking. Sensor data including temperature, occupancy, and sound levels is collected periodically by the ESP8266, which is then transmitted within the conference area. This data is sent to the cloud via the ESP8266 using MQTT or HTTP protocols, securely transmitting over the internet. Processed data is updated on a live dashboard accessible to attendees and organizers through a web interface or mobile app for effective monitoring and management. The system undergoes thorough testing to ensure accuracy, reliability, and responsiveness throughout the event. Any issues or optimizations needed are promptly addressed to maintain seamless operation

C. Implementation

IoT-based live location tracking system includes integrating high-quality GPS devices (Neo 6M GPS Module) and IR sensors into each vehicle, along with utilizing the Node MCU ESP8266 microcontroller for data connectivity and processing. The development involves creating algorithms for real-time vehicle tracking using GPS data and monitoring seat availability through the IR sensors. Integration with the Google Maps API allows for a user-friendly interface where commuters can access live bus locations and seat availability information via unique URLs generated for each vehicle. Deployment and testing procedures ensure seamless network connectivity and compliance with government regulations

The mobile app for the IoT-based live location tracking system was developed using Kotlin, a modern programming language for Android app development. Using Kotlin for developing the system described above offers numerous advantages. Kotlin's concise syntax and interoperability with Java simplify code development and integration with existing libraries. Its support for coroutines enables efficient asynchronous programming, crucial for handling IoT device configurations and data processing concurrently. Kotlin's type and null safety features enhance code reliability, while functional programming support and static typing improve code modularity and robustness. Additionally, Kotlin's tooling support, including IDE features and reactiveprogramming capabilities, boosts developer productivity and facilitates the creation of a more efficient and maintainable IoT system overall.

The app provides a user-friendly interface for commuters to access real-time bus location information and seat availability status. It leverages the Google Maps API to display the live location of buses on a map interface, allowing users to track their desired buses easily. Additionally, the app incorporates features to register complaints or provide feedback regarding their experience with the tracking system or the public transportation services.

D.ANALYSIS AND RESULT

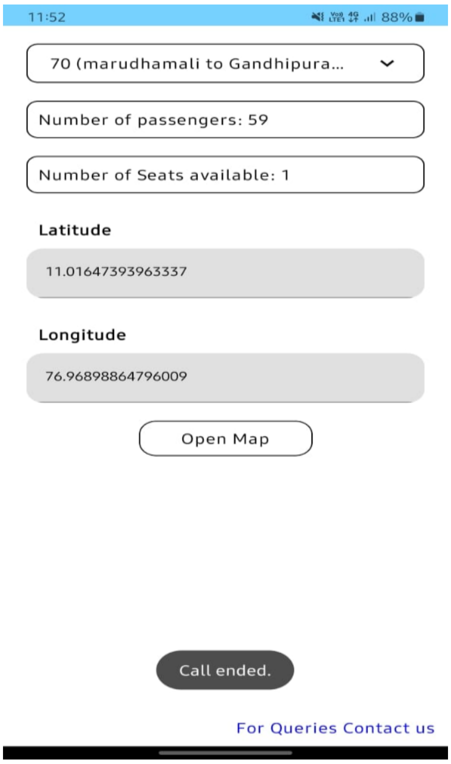

Figure 3 Mobile Application

The overview of the Mobile Application setup is portrayed in the Fig. 3 which is capable of inferring about the Seat Vacancy and the Passenger count with interface of Navigating Map Facility also with the latitude and longitude of the Bus. This Application includes a Query Module which helps the users to provide feedback or register complaints to the Concerned.

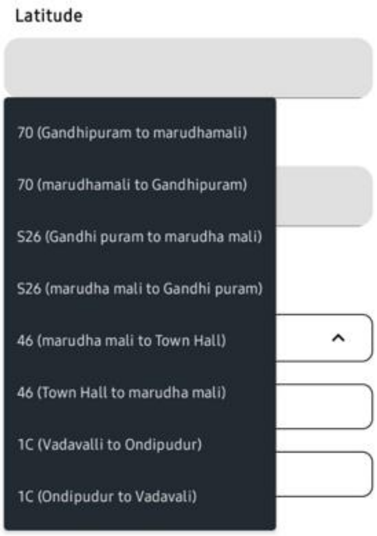

Figure 4 Preloaded Dataset

The data on identical buses running over certain cities are preloaded to the Database and the Responsive Mobile Application queries on the required Bus Number. Fig. 4 depicts the preloaded dataset overview.

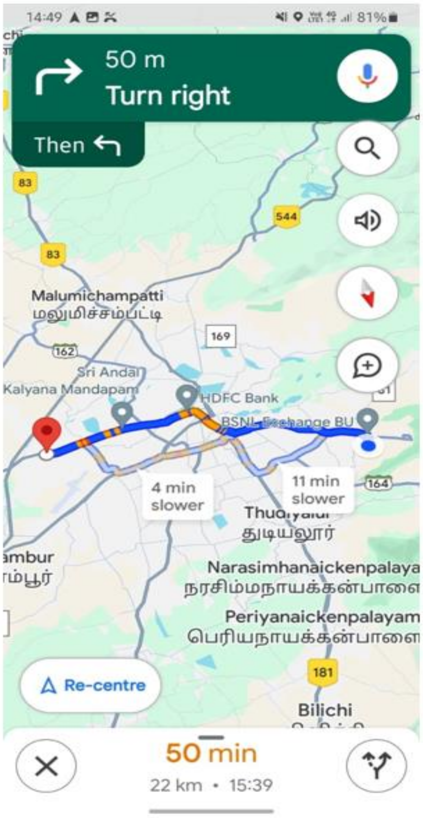

Figure 5 Google Map Interface

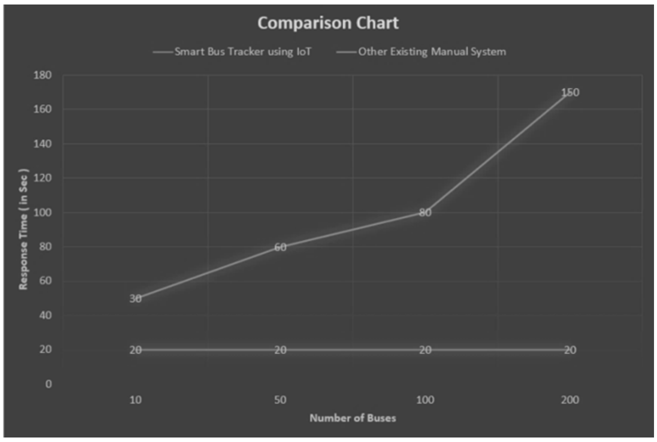

Figure 6 Comparison Chart

The proposed system consistently maintains a constant response time even with an increasing number of buses, showcasing its scalability and efficiency. In contrast, the existing system exhibits a linear increase in response time as the number of buses grows. This comparison chart unequivocally favours the proposed system as the ideal solution, highlighting its ability to handle larger quantities seamlessly and deliver optimal performance regardless of the workload.

D. CONCLUSION

The appropriate design for the Tracking system in optimized space is currently being sought in the process. The proposed RTBTSS is being aimed at accommodating all the needed facilities in a compact manner. In parallel, the selection of microcontroller and sensors has been taken care of. The proposed design will provide a solution in terms of cost-effectiveness and updated technology form for all kinds of Tracking Systems. This proposed system improves upon previous tracking systems by optimizing space utilization, ensuring compatibility of microcontrollers and sensors, and offering a cost-effective solution with advanced technology integration. Unlike previous works, which often faced issues with bulky setups, outdated components, cost overruns, and limited integration capabilities, the RTBTSS addresses these defects to provide a streamlined and efficient tracking system.

E.References

[1] M. N. Hasan and M. Sharif Hossen, "Development of An Android Based Real Time Bus Tracking System," 2019 1st International Conference on Advances in Science, Engineering and Robotics Technology (ICASERT), Dhaka, Bangladesh, 2019, pp. 1-5, doi: 10.1109/ICASERT.2019.8934621.

[2] S. Indhu Priya, M. Rohini, G. Nivedhitha, "Bus Tracking using RFID Readers" March 2016 | IJIRT | Volume 2 Issue 10 | ISSN: 2349-6002

[3] Murdan, Anshu Prakash, Vicky Bucktowar, Vishwamitra Oree and Marcus P. Enoch. "Low-cost bus seating information technology system." IET Intelligent Transport Systems (2020): n. pag.

[4] Akshay Sonawane, Ankeet Bhanushali, Kushal Gogri, Milind Khairnar "Real-Time Bus Monitoring System" June 2020International Journal of Engineering Research and V9(06) DOI:10.17577/IJERTV9IS060545

[5] S. Jain, A. Trivedi and S. Sharma, "Application Based Bus Tracking System," 2019 International Conference on Machine Learning, Big Data, Cloud and Parallel Computing (COMITCon), Faridabad, India, 2019, pp. 152-154, doi: 10.1109/COMITCon.2019.8862254.

[6] T. M. Hamadto, Z. A. Adam and M. H. Elsayed, "An Android Application of School Bus Tracker Based on RFID Technology," 2020 International Conference on Computer, Control, Electrical, and Electronics Engineering (ICCCEEE), Khartoum, Sudan, 2021, pp. 1-4, doi: 10.1109/ICCCEEE49695.2021.9429629.