MANTECH Publications

Journal of Embedded Systems & Its Applications
Volume 9 Issue 2, July-December 2024

Iot Based Automated Geo Location and Route Optimization System for Campus Transist

Akshay Satish Kumbhar[1], Kedar Pradip Gosavi[1], Pruthviraj Bhagavan Shelar[1], Vinay Vilas Suryawanshi [1], Mahesh Dattatraya Bhambure[2]

Students[1], Assistant Professor[2],

Department of Electronics and Tele-communication Engineering

Adarsh Institute of Technology and Research Centre, Vita, Maharashtra, India

Email: *kedargosavi2003@gmail.com, mdbhambure_ee@aitrc.edu in*

Abstract

Efficient and convenient transportation within large campuses, such as university campuses or corporate parks, is often a challenge. Existing systems may lack real-time tracking, optimized routing, and effective communication, leading to delays and inconvenience for commuters. This project proposes an IoT-based solution for campus transit, utilizing GPS technology for precise vehicle tracking and an intelligent routing algorithm to optimize routes based on real-time factors such as traffic conditions and passenger demand. This will result in reduced waiting times, improved efficiency, and an enhanced computer experience. The system will include GPS modules on vehicles, a wireless communication network, a central server for data processing and route optimization, and a user-friendly interface for commuters to access real-time information.

The Internet of Things (IoT) offers promising solutions for real-time tracking and route optimization in campus transit systems. By integrating GPS modules on vehicles, wireless communication networks, and a central server for data processing, IoT-based systems can provide accurate vehicle location data and enable intelligent routing algorithms. GPS technology is widely used for vehicle tracking due to its accuracy and accessibility. Several studies have explored the use of GPS modules in conjunction with microcontrollers and wireless communication networks to track vehicle locations in real-time. This information can be used to provide commuters with accurate arrival times,

estimated time of arrival (ETA) updates, and real-time bus locations through a user-friendly interface, such as a mobile application or web portal.

Intelligent routing algorithms play a crucial role in optimizing campus transit routes based on dynamic factors such as traffic conditions, passenger demand, and vehicle availability. Algorithms such as Dijkstra's algorithm or search can be implemented to determine the most efficient routes, reducing travel times and minimizing delays. Wireless communication networks, such as Wi-Fi or cellular networks, enable seamless data transmission between vehicles and the central server. The choice of communication technology depends on factors such as campus coverage, bandwidth requirements, and cost considerations.

Keywords: *IoT, GPS, Campus Transit, Route Optimization, Real-time Tracking, Automated Geo-location, Wireless Communication, Central Server, User Interface, Smart Transportation Systems.*

INTRODUCTION

The efficient and convenient transportation of students and staff within large campuses, such as university campuses or corporate parks, is a significant challenge. Traditional campus transit systems often rely on fixed routes and schedules, which can be inflexible and inefficient in responding to dynamic factors such as traffic congestion, passenger demand, and unexpected events. The lack of real-time tracking and communication capabilities can lead to delays, overcrowding, and inconvenience for commuters. To address these challenges, researchers have explored various technologies and approaches to improve the efficiency and convenience of campus transit systems. One promising avenue is the Internet of Things (IoT), which offers the potential for real-time tracking and route optimization. By integrating GPS modules on vehicles, wireless communication networks, and a central server for data processing, IoT-based systems can provide accurate vehicle location data and enable intelligent routing algorithms. Several studies have investigated the use of GPS technology for vehicle tracking in campus environments.

This project aims to leverage these technologies and research findings to develop an IoT-based Automated Geo-location and Route Optimization System for campus transit. The

proposed system will utilize GPS technology for precise real-time tracking of campus transit vehicles, allowing commuters to know the exact location of their ride and estimate arrival times accurately. Furthermore, an intelligent routing algorithm will be implemented to optimize routes based on dynamic factors such as traffic conditions, passenger demand, and vehicle availability. This will ensure that vehicles take the most efficient routes, reducing travel times and minimizing delays.

MATERIALS & METHODS

System and Architecture: The proposed system will integrate IoT devices, wireless communication, a central server, and a user interface to provide real-time tracking and route optimization for campus transit. The system architecture consists of the following key components: IoT Devices: GPS modules will be installed on campus transit vehicles to collect real-time location data. These modules will use satellite signals to determine the precise latitude and longitude of the vehicle, providing accurate location information.

Communication Network: A wireless communication network, such as Wi-Fi or cellular, will transmit data between the vehicles and the central server. The choice of network will depend on factors such as campus coverage, bandwidth requirements, and cost. GPS modules can be used for communication, as they are a widely accepted standard for digital cellular communication.

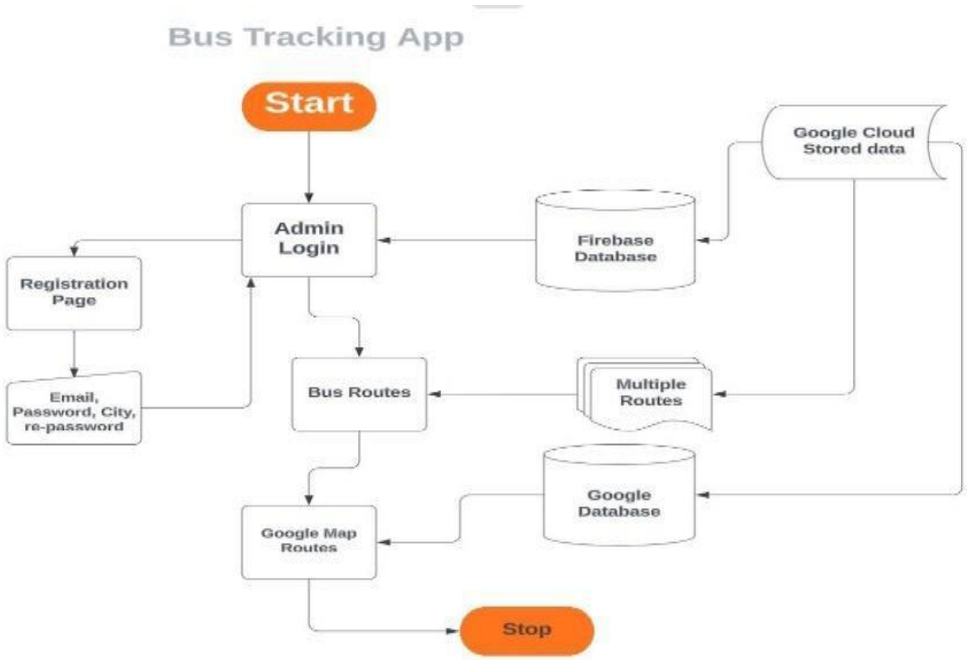

Figure: 1 Flowchart

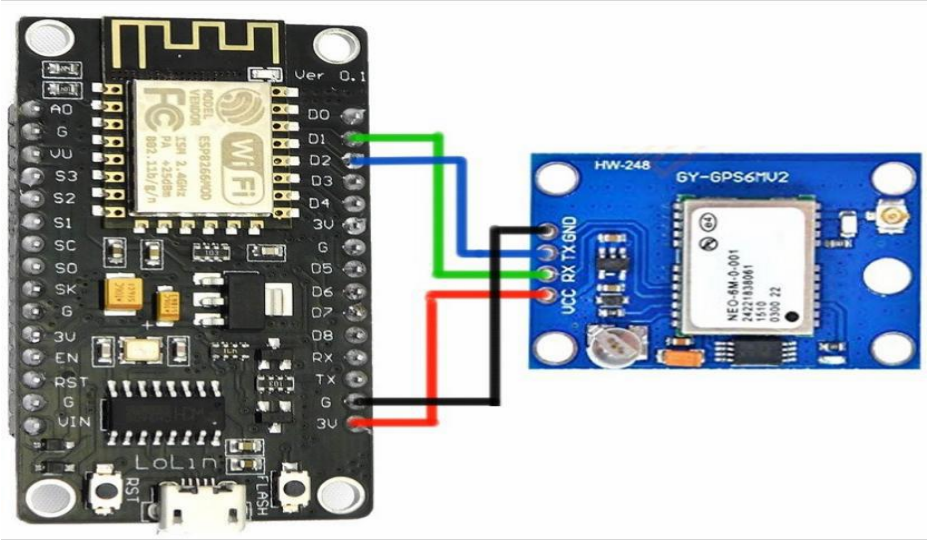

Figure: 2 Connectivity of Modules

ROUTING ALGORITHM

The system will employ an intelligent routing algorithm to determine the most efficient routes for campus transit vehicles. The algorithm will consider various factors, including: Real-time traffic conditions: The algorithm will use real-time traffic data to avoid congested areas and minimize travel times. Passenger demand and preferred destinations: The algorithm will consider the number of passengers waiting at each stop and their preferred destinations to optimize routes and minimize passenger wait times. Vehicle availability and capacity: The algorithm will ensure that routes are assigned to available vehicles with sufficient capacity to accommodate passengers.

HARDWARE

Neon 6M GPS Module: The Neon 6M GPS module is a high-accuracy GPS receiver that captures real-time positioning data, including latitude, longitude, altitude, and speed. It has a fast refresh rate of up to 5Hz, ideal for applications needing frequent updates, such as vehicle tracking. The module communicates over serial at 9600 baud and is compatible with 3.3V–5V power sources, making it easy to interface with microcontrollers. It outputs data in NMEA format, which includes detailed GPS information used for real-time location tracking.

Node MCU ESP8266 Wi-Fi Module: The Node MCU ESP8266 is a Wi-Fi-enabled microcontroller that can send data to the cloud or remote servers, making it suitable for IoT applications. It operates on 3.3V power, has multiple GPIO pins, and can be programmed

using the Arduino IDE or Lua. The Node MCU reads the GPS data from the Neon 6M, processes it, and transmits it over Wi-Fi to a server or Firebase, allowing the data to be accessed by an Android app.

SOFTWARE

Programming Languages: Programming languages such as Kotlin or Java will be used to develop the mobile application and the server-side software. Kotlin is a modern programming language that is particularly well-suited for Android development, while Java is a widely used language for server-side applications.

Cloud Platform: A cloud platform, such as Google Cloud Platform or Amazon Web Services, may be used to host the central server and provide scalable computing resources. Cloud platforms offer advantages in terms of scalability, reliability, and cost-effectiveness, making them suitable for hosting the system's backend infrastructure.

Android Studio: Android Studio will be used as the integrated development environment (IDE) for developing the mobile application. Android Studio provides a comprehensive set of tools and features for Android app development, including a code editor, debugger, and emulator.

Firebase Database: Firebase, a cloud-based platform, may be used to store and manage the system's data, including real-time vehicle locations, passenger information, and route data. Firebase offers a real-time database that enables efficient data synchronization across multiple clients, making it suitable for applications that require real-time updates.

CONCLUSION

This project aims to develop an IoT-based Automated Geo-location and Route Optimization System for campus transit, offering a comprehensive solution for efficient and convenient transportation within a campus environment. The proposed system has the potential to significantly improve the overall commuter experience, optimize resource utilization, and contribute to a more sustainable campus.

REFERENCES

1. Li, M., Chen, Z., & Zhang, Y. (2023). IoT-Based Intelligent Transportation System for Smart Cities: A Comprehensive Review. IEEE Internet of Things Journal, 10(10), 8748-8771.
2. Ghose, A., & Pradhan, S. (2023). A Survey on Deep Learning Techniques for Smart Transportation Systems. IEEE Transactions on Intelligent Transportation Systems, 24(6), 5554-5572.
3. Ning, Z., Zhang, X., & Liang, X. (2022). A Survey on the Security and Privacy Issues of IoT-Based Smart Transportation Systems. IEEE Transactions on Vehicular Technology, 71(11), 12044-12060
4. Binyamin, A. A. (2022). A Cloud-Based Bus Tracking System Based on Internet-of-Things Technology. In 2022 IEEE 7th International Conference on Smart Instrumentation, Measurement and Applications (ICSIMA) (pp. 1-6). IEEE.