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Enhancing Campus Connectivity: A Smart Intra-Transit Strategy for Efficient Vehicle Throughput

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ABSTRACT

An advanced vehicle monitoring, and seat availability system is designed to monitor the vehicles from any source location A to destination location B in real time to the passengers. The proposed system would make good use of modern technologies via leveraging ultrasonic sensors, cloud API for example Thing Speak, and in-house Word Press software. The system track's location, speed, and passenger count in real-time. This data fuels optimized scheduling and route planning, maximizing seat occupancy, and boosting overall productivity. A user-friendly dashboard visualizes vehicle activity within designated time slots, empowering faculty, and administrators with data-driven insights for improved resource allocation and scheduling. By comprehensively monitoring location, speed, and passenger count, the system ensures efficient Electric Vehicle operation within the campus confines, ultimately revolutionizing campus transportation and maximizing resource utilization.

Keywords: GPS, Node MCU ESP 8266, IoT Sensors, Dashboard, Vehicle Monitoring, Real-time Tracking, Word Press.

I. INTRODUCTION

In today's transportation landscape, convenience and connectivity coexist with safety and resource optimization concerns. Driver fatigue, vehicle theft, and unforeseen hazards emphasize the need for innovative solutions prioritizing security and efficiency. This paper explores a groundbreaking vehicle monitoring and seat availability system set to transform transportation, promising a paradigm shift in journey navigation. This system surpasses traditional tracking methods, benefiting individuals, families, public transport operators, and school administrators. At its core is proactive monitoring to safeguard lives. Strategically placed sensors capture real-time data on location, speed, and seat occupancy, fueling intelligent algorithms optimizing routes and schedules, and maximizing passenger capacity while minimizing empty vehicle travel. Imagine campuses where students wait less, schools enabling real- time parental monitoring, and transport operators efficiently allocating resources based on demand. Efficiency isn't the sole aim safety is paramount. Integrated ultrasonic sensors accurately detect passenger occupancy, aiding data-driven decision- making for seat allocation and resource planning, reducing overcrowding, and enhancing passenger safety. Temperature and gas leakage sensors provide immediate hazard alerts, further ensuring passenger and vehicle safety. At its core lies a fusion of hardware and software, utilizing the Node MCU 8266 micro-controller for data collection and transmission, processed and visualized on the Thing Speak cloud platform. A Word Press website serves as the user interface, displaying real-time vehicle data. Implementation requires meticulous attention to sensor selection, prioritizing accuracy, low power consumption, and suitability. Data security demands robust encryption and authentication protocols, while reliable network connectivity and efficient data handling ensure uninterrupted transmission. Ultimately, this system transcends technological marvel, embodying a societal imperative. By fostering safety, and efficiency, and empowering stakeholders with real-time data, it sets the stage for safer, more efficient, and sustainable transportation. This vision, coupled with technical precision, has the potential to revolutionize transportation, ensuring every journey is optimized for comfort and efficiency.

II. EASE OF USE

A. System Objectives

Continuously monitor and track the vehicle in real-time using an in-house developed web page, if the seat is vacant, it displays the information on the portal.

Provide real-time data about the vehicle's location and information about the trip.

With a customizable dashboard, we can keep an account of the driver allocation and dispatch with the details of the respective vehicle.

The proposed system would get control with the help of Node MCU ESP 8266 which is placed inside the vehicle. The GPS module of Neo 6M GPS would communicate to the ESP 8266 board. The longitudes and latitudes of the current path received from the GPS Neo 6m module will be sent to the Thing Speak API cloud. According to the data received from the ultrasonic sensor placed on the seat, the cloud interface is updated which further leads to updates in the in-house developed website with access to the live location of the vehicle through the GPS sensor placed inside further being displayed side-by-side on the dashboard on the website. The Node MCU ESP 8266 with all the portability communicates the data from the vehicle to the cloud through a Wi-Fi connection in the vehicle.

B. System Specifications

1) Node MCU ESP 8266
   - Microcontroller: Tensilica 32-bit RISC CPU Xtensa LX106
   - Operating Voltage: 3.3V
   - Input Voltage: 7-12V
   - Digital I/O Pins: 11 (can be used as GPIO, PWM, I2C, etc.
   - Analog Input Pins: 1 (3.2V max input)
   - Flash Memory: 4MB
   - SRAM: 64KB
   - Clock Speed: 80MHz (can be overclocked to 160MHz)
   - Wi-Fi: 802.11 b/g/n (2.4GHz)
   - Integrated TCP/IP protocol stack
   - GPIO, PWM, I2C, SPI, ADC functionalities
2) Ultrasonic Sensor
   - Operating Voltage: 5V DC
   - Operating Current: ¡ 15mA
   - Operating Frequency: 40 kHz
   - Detection Range: 2cm - 400cm (0.78 inches - 157.48 inches)
   - Resolution: 0.3 cm
   - Trigger Input Signal: 10 micro seconds TTL pulse

- Echo Output Signal: Output TTL signal proportional to distance
- Maximum Detection Angle: 15 degrees
- Timing Measurement Accuracy: ±0.3cm.

3) Neo 6 GPS Sensor
   - Chipset: u-blox NEO-6M
   - Receiver Type: 56-channel GPS L1 C/A code
   - Update Rate: Up to 10 Hz
   - Time to First Fix (TTFF):
   - Cold Start: 26 seconds average
   - Warm Start: 26 seconds average
   - Hot Start: 1 second average
   - Horizontal Position Accuracy:
   - Autonomous: ¡ 2.5 meters
   - SBAS (WAAS, EGNOS, MSAS): 2.0 meters
   - Operating Voltage: 3.3V - 5.0V
   - Operating Current: 45mA (typical)
   - UART Interface: Default baud rate 9600 bps.

III.LITERATURE REVIEW

1. A vehicle tracking system utilizes Arduino, GPS, and GSM to track the vehicle's real-time location and sends data to a database. Information is displayed on digital maps like Google Maps, using XAMPP and Google Maps API for web server functionality and map integration, respectively. Location data is stored in a MySQL database.

2. A GPS and GSM-based vehicle tracking system continuously monitors and reports a vehicle's status using Arduino Uno, GPS receiver, and GSM modules. It's crucial for various applications and demonstrates improved real-time tracking feasibility, global operability, and cost-effectiveness compared to existing solutions.

3. A method using Received Signal Strength Indicator (RSSI) to measure distance collects signal strength samples using NodeMCUs, estimating distance through curve fitting. The paper discusses RSSI's accuracy improvement methods and challenges in wireless sensor networks.

4. A real-time monitoring and control system for Electric Vehicles (EVs) leveraging IoT technology in smart cities for self-parking and State of Charge (SoC) determination. It reviews 5G's impact, BMS efficiency enhancement, and addresses technical challenges in EV energy systems.

5. An IoT-based Public Transport Management System uses wireless sensor networks for self-parking and real-time monitoring in electric vehicles, alongside 5G technology's role and challenges in public transportation efficiency.

6. An ultrasonic sensor for automotive use measures ground distance using optimization techniques for sub-wavelength detection, showing functionality up to 30 m/s speeds.

7. The use of Vehicle-to-Grid (V2G) systems in smart cities focuses on LoRaWAN technology for bidirectional power exchange, optimizing network design in vehicular environments.

8. Blockchain and IoT's significance in car supply chains, integration methods, and automotive blockchain-based applications are discussed, emphasizing better information sharing and traceability in today's business environment.

9. Challenges in clustering in VANETs are addressed with a new clustering algorithm (MSCA) for urban scenarios, considering vehicle mobility and communication disconnections.

10. A sophisticated tracking and monitoring system using Raspberry Pi for fleet management, safety, and asset tracking, integrating GPS, additional sensors, and GSM/GPRS modules for data transmission and remote-control capabilities.

IV. METHODOLOGY

The System, using the power of Internet of Things (IoT) technologies, is precisely configured to revolutionize urban transportation within the university campus. This system, tailored for on-campus perspectives, centers around a centralized control hub arranging a network of strategically placed IoT devices. University buses are outfitted with GPS trackers, environmental sensors, and passenger occupancy monitoring systems, complemented by smart infrastructure at bus stops facilitating real-time data exchange. Leveraging advanced communication technologies such as LTE or 5G, wireless sensor networks enable seamless connectivity between devices, ensuring efficient data transmission.

A. Configuration

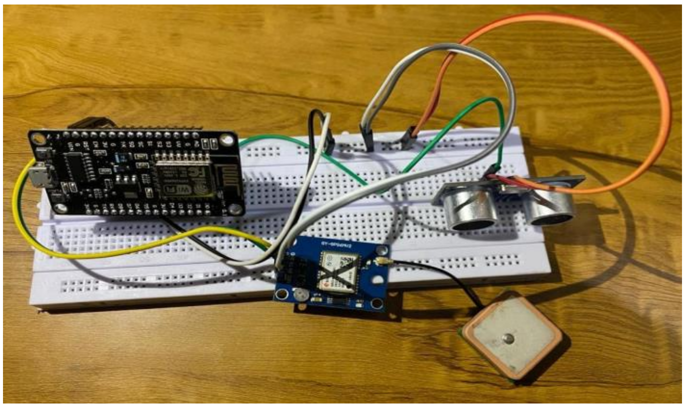

Figure 1. System Setup

The collected data, containing precise location information, and real-time occupancy status, is seamlessly transmitted to a cloud-based storage system. Cloud computing, with its scalable and accessible data processing capabilities, becomes the backbone for the system's efficiency. Real-time and historical data analytics, powered by machine learning algorithms, optimize bus routes, predict demand, and enhance decision- making for university transit authorities.

Figure 2. Dashboard

Passenger applications and administrative dashboards, designed with the on-campus user in mind, provide real-time transit information. This empowers students and faculty with accurate and timely information regarding vehicle locations, occupancy status, and route planning. Security measures, including encrypted communication protocols and privacy considerations, are meticulously implemented to safeguard the integrity and confidentiality of the data.

By focusing on the university perspective, this configuration not only transforms intra-campus transit but also lays the foundation for a sustainable and technologically advanced campus environment, ultimately contributing to improved mobility and enhanced quality of life within the university community.

B. Preliminary Setup

Utilizing Ultrasonic and GPS Sensors:

Ultrasonic sensors are utilized to gauge seat occupancy within the vehicle. These sensors function by emitting ultrasonic waves and measuring the time it takes for these waves to bounce back, thereby determining whether a seat is occupied or vacant. GPS sensors are employed to collect and provide the vehicle's precise geolocation data.

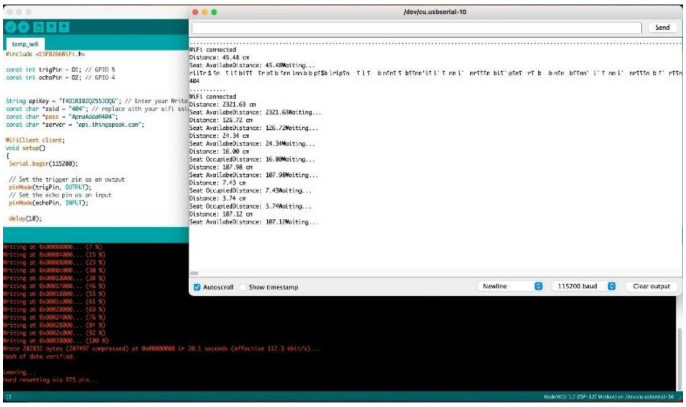

Figure 3. Data from Ultrasonic Sensor

C. Data Storage in the Cloud via Node MCU 8266:

The Node MCU 8266 is equipped with a built-in Wi-Fi module, which is leveraged to establish an internet connection. Data collected from the ultrasonic and GPS sensors is transmitted to the cloud for storage and subsequent processing.

Analysis and Integration with Thingspeak Cloud API: The project encompasses the analysis and processing of sensor data within the cloud environment. Thingspeak, a cloud based IoT platform, is employed to manage and analyze incoming data. Integration with the Thingspeak API facilitates seamless communication with the cloud platform.

D. Data Transfer to Users through a Webpage:

A user-friendly web interface is developed to display real-time seat occupancy information to faculty members and other users. The webpage is hosted on the Thingspeak server. Data collected from the vehicle sensors is continually transmitted to the webpage for display, enabling users to access the number of vacant seats within the vehicle.

E. Seat Occupancy Updates:

The system defines a threshold value for ultrasonic sensor data. When ultrasonic sensor readings surpass this threshold, indicating a seat is occupied, the webpage is updated accordingly.

F. Project Workflow:

Ultrasonic and GPS sensors gather data from the vehicle and transmit it to the Node MCU 8266. The Node MCU 8266 uses its integrated Wi-Fi module to send this data to the cloud. The cloud, powered by Thingspeak, processes, and stores the data for subsequent analysis. The web interface retrieves the processed data from the cloud and displays it in real time for users. When the seat occupancy status changes (crossing the defined threshold), the webpage updates users accordingly.

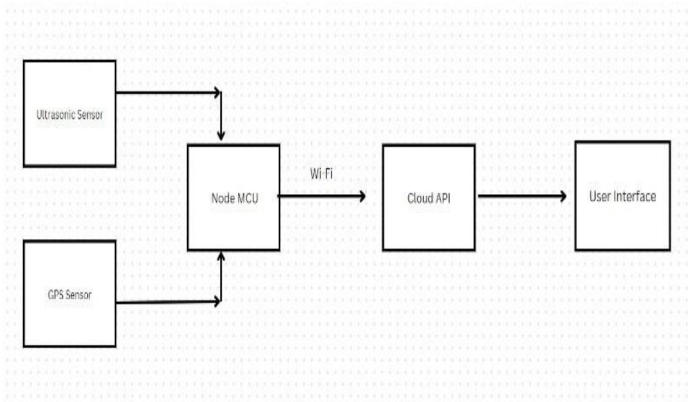

Figure 4. Project Flow

V. COMPARISON

In today's situation, for customers to be acquainted with the information about travel plans and its availability they either have to get in touch with the service provider directly or visit stations to find out if a seat is available, as the information provided may be out of date or completely unavailable. This methodical technique may irritate and cause delays. On the other hand, our system aims to deliver precise and current information by utilizing technologies such as integrated booking systems, ultrasonic sensors, and GPS. Through the website travellers can obtain this information, enabling them to effectively plan their travels and make educated decisions. By giving them the ability to allocate resources optimally and even boost revenue through features like dynamic pricing or advanced booking, this technology also helps operators.

VI.RESULT

The research paper discusses a new system for monitoring vehicles and seat availability, which has the potential to greatly improve transportation. This system combines convenience, connectivity, and safety features to make traveling safer and more efficient. Through thorough testing, it was shown that the system can effectively address common challenges in transportation. The system uses special sensors placed strategically in vehicles to monitor various factors like location, speed, and whether seats are occupied. This information is then used by smart algorithms to plan better routes and schedules, reducing the risks associated with tired drivers and unexpected dangers. The sensors can accurately detect if seats are occupied, helping in making decisions about where passengers can sit and how resources can be used more efficiently. Overall, this new system promises to revolutionize transportation by making it safer and more efficient. It does this by using advanced technology to monitor vehicles in real-time and make smart decisions to improve the travel experience for everyone.

VII. CONCLUSION

The proposed system plays an important role in real-time tracking and monitoring of vehicles and provides a statistical view through the designed dashboard. Whenever there is a vacant seat available in the vehicle, the proposed system provides the current location and the precise data of the vacant seat. Hence, these benefits invigilate the vehicle. In the future, we will work on the implementation of artificial intelligence and machine learning models to further derive a pattern and manage the fleet of vehicles more efficiently.

VIII. REFERENCES

[1] Khin, June Oo, Nyein. (2018). Real-Time Vehicle Tracking System Using Arduino, GPS, GSMand Web-Based Technologies. International Journal of Science and Engineering Applications. 7. 433-436. 10.7753/IJSEA0711.1006

[2] D. Pham, M. Drieberg and C. C. Nguyen, "Development of vehicle tracking system using GPSandGSMmo- dem,"2013IEEEConferenceonOpenSystems(ICOS),Kuching, Malaysia, 2013, pp. 89-94, doi: 10.1109/ICOS.2013.6735054

[3] S. Barai, D. Biswas and B. Sau, "Estimate distance measure- ment using NodeMCU ESP8266 based on RSSI technique," 2017 IEEE Conference on Antenna Measurements Appli- cations (CAMA), Tsukuba, Japan, 2017, pp. 170-173, doi: 10.1109/CAMA.2017.8273392.

[4] F. Mohammadi and R. Rashidzadeh, "An Overview of IoT- Enabled Monitoring and Control Systems for Electric Vehicles," in IEEE Instrumentation Measurement Magazine, vol. 24, no. 3, pp. 91-97, May 2021, doi: 10.1109/MIM.2021.9436092.

[5] A. Lushi, D. Daas and M. Nadeem, "IoT-Based Public Transport Management System," 2022 IEEE Global Con- ference on Artificial Intelligence and Internet of Things (GCAIoT), Alamein New City, Egypt, 2022, pp. 69-75, doi: 10.1109/GCAIoT57150.2022.10019029

[6] A. Carullo and M. Parvis, "An ultrasonic sensor for dis- tance measurement in automotive applications," in IEEE Sen- sors Journal, vol. 1, no. 2, pp. 143-, Aug 2001, doi: 10.1109/JSEN.2001.936931.

[7] H. Klaina et al., "Aggregator to Electric Vehicle LoRaWAN Based Communication Analysis in Vehicle-to-Grid Systems in Smart Cities," in IEEE Access, vol. 8, pp. 124688-124701, 2020, doi: 10.1109/ACCESS.2020.3007597.

[8] Reimers, Tim Leber, Felix Lechner, Ulrike. (2019). Integration of Blockchain and Internet of Things in a Car Supply Chain. 146-151. 10.1109/DAPPCON.2019.00028.

[9] Ren, Mengying Khoukhi, Lyes Labiod, Houda Zhang, Jun V‘eque, V´eronique. (2016). A newmobility-based clus- tering algorithm for Vehicular Ad Hoc Networks (VANETs). 10.1109/NOMS.2016.7502988.

[10] H. Singh, V. Pallagani, V. Khandelwal and U. Venkanna, "IoT based smart home automation system using sensor node," 2018 4th International Conference on Recent Advances in Information Technology (RAIT), Dhanbad, India, 2018, pp. 10.1109/RAIT.2018.8389037.