# Empowering Assets and Vehicles with Cutting-Edge ESP32 Real-Time Tracking System

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***Abstract*— In today's fast-paced world, the need for real-time tracking technology has grown more and more significant, particularly for tracking assets and vehicles. The goal of this project is to equip vehicles and assets with a cutting-edge real-time tracking system based on the ESP32. To effectively track and monitor assets or vehicles, the system combines an ESP32 Wi-Fi board, a GPS Neo module, a SIM800 module, and a battery power source. This system is to create a real-time tracking system for cars and assets based on the ESP32. For effective tracking and monitoring, the system comprises an ESP32 Wi-Fi board, GPS Neo module, SIM800 module, and battery power supply. While the GPS Neo module enables precise location, the ESP32 handles wireless communication and processing. Innovative cellular connectivity is made possible for remote monitoring by the inclusion of the SIM800 module. The battery power source ensures continuous operation. This research demonstrates how these elements may be combined to produce a modern tracking system that will be useful for applications in asset management, transportation, and security. Numerous advantages come with the suggested ESP32-based real-time tracking system, including increased security, effective asset management, and improved logistical operations. It makes it possible for people and companies to keep track of the whereabouts and condition of their assets or vehicles instantly, enabling proactive decision-making, resource allocation, and general operational efficiency improvements.**

***Keywords*— *Asset tracking, innovative, research vehicle tracking, ESP32, tracking with IoT monitoring, technology***

## I. INTRDUCTION

An electronic device gathers the data closely and sends it to the internet of wearable things (IoWT) system hourly. Data research shows that function memory allocation has a small impact on performance and it is not easy to implement in reality. The complete safety and control of the fleet are addressed by the vehicle tracking system. It is the process of figuring out where a car is using various technologies, such as global positioning systems (GPS) and other navigation systems that work through ground stations and satellites. While global positioning systems (GPS) comprise the backbone of modern car tracking systems, other forms of automatic vehicle locating technologies are occasionally employed as well. Vehicle tracking systems are installed in cars and offer accurate real-time location data. This data can also be recorded and sent to a computer for future study. Nowadays, this system is widely used by individuals who own expensive automobiles for purposes such as preventing theft and recovering stolen vehicles. It is a vital gadget for tracking cars whenever their owners want to watch them. Through the use of software and the internet, the gathered data can be seen on digital maps. This gadget has state-of-the-art hardware and software features that aid in the online and offline tracking and location of vehicles. The vehicle unit, the fixed-based station, and the database with software system are the three primary components of a tracking system. Hardware components such as an Arduino, GPS, and global system for mobile communication (GSM) modem housed within the target car make up the vehicle unit. A modem, connected to the unit through a GPS antenna, receives signals sent by the satellite. The data is converted by this modem, which subsequently communicates the vehicle's location information via SMS and a mobile app called "VTS." This app is synchronized with the web page and can be shown on digital mapping thanks to a server.

The data center receives and transfers data from the based station over a wireless network system. The software and geographic map at the base station can help find the car. The central station features an integrated web server and provides maps of all cities. The position, or coordinates, of each tourist spot can be found in a database and shown on a screen using Google Maps with the help of software. Constantly because of a number of limitations. The car tracking system integrates a number of features, including tracking a vehicle's position, detecting gas leaks, keeping track of its speed, and identifying accidents. By leveraging the GSM network to send an SMS alert message, it makes sure that owners are instantly alerted of any events [1]. This project develops a low-cost, high-performance car surveillance and security circuit using an Arduino microcontroller. In-depth examinations of the system's minimal power use and immediate GPS tracking capabilities are also included in the research. Modern technologies are included in the architecture, which uses microservices to provide continuous monitoring solutions and thorough journey history analysis [2]. An easy-to-use online dashboard at the base station, real-time position tracking, a freely available GIS platform, and flexibility are all provided by the framework, which combines GPS, GSM, and MCU technologies. A prototype of the suggested technology has been successfully used [3]. The study suggests a real-time tracking system for automobiles that makes use of the GPS satellite navigation system and GPS for precise placement and tracking. The system, which is built as an application, continually updates the user on the state of the car by tracking its motion. For real-time position tracking, the tracking device integrates a GSM modem, Arduino, and GPS [4]. A SIM800 module is attached to the MCU to provide vehicle control and security. Through this technology, the owner may communicate with and operate the car. In the event of stealing, the user can dial an anonymous number within the GSM, which instructs the microcontroller to end the conversation and turn on the GPS to locate the stolen car. Then, the microcontroller sends an SMS with the latitude and longitude information [5].

This study introduces a livestock tracking system intended to deliver the end-user current location and behavior status of vehicles. The system is made up of wirelessly communicating tag, beacon, and base station that nodes. Using the position data that tag nodes acquire from nearby beacon nodes, trilateration is used to locate a single animal. The activity level of the animals is detected using motion sensors inside the tags [6]. Another study's objective was to build and put into practice a car tracking system for theft detection that would locate the vehicle using GPS and GSM technology. The technology uses GSM's General Packet Radio Service (GPRS) to communicate data on the location of the vehicle [7].

## II. Literature Review

In ADAS systems, tracking is crucial for comprehending a changing environment. In this research, a 3D multi-target tracking approach with real-time goals is proposed. It is implemented in a lean manner utilizing object detection. Environment sensing includes object tracking, that allows the vehicle to calculate the trajectories of nearby objects to carry out motion planning [8]. The suggested system takes a novel strategy that combines SURF descriptors for tracking, features in a revised algorithm in an ongoing chain configuration, and background reduction approaches [9]. This project involves connecting these three modules to an Arduino board. The vehicle monitoring system is the result of this fusion. GPS coordinates a vehicle surveillance system, and the operator controls it by SMS, which serves as both a receiver and a transmitter of data [10]. The GPS and GSM is used to track the vehicle [11]. In another paper, the tracking and monitoring system is suggested. Our team is also working on developing a system that will use an Arduino Uno R3, a GSM device, and a GPS device to track the precise and exact position of the car at any given area. The gadget also has a display that shows the user information about the vehicle's present position. Additionally, two programs are used to display the data: Freeboard is used to display the identical data as a publicly accessible map, and ThingSpeak is used to show the trend of the vehicle's route via longitude and latitude charts.

A continuous graphical tracking system for keeping tabs on flying targets is provided. The technique is based on how well the target and surrounding contrast in a grayscale image. Since the background is uniform in videos of flying targets, the decision is made based on contrast between the tracking gate border and a goal inside that rectangle gate [13]. The main contribution of this paper is to reduce the amount of data sent from an embedded system in a vehicle to a cloud server by limiting the amount of GPS data used for vehicle tracking and cutting down on the number of (hypertext transfer protocol) HTTP requests made to a cloud-based server using the transmission through time concept [14]. The built-in device employs GPS and GSM technology, making it one of the most widely used methods for tracking vehicles [15-16]. The GPS with GSM technology utilized by the gadget built within the car is one of the most widely used techniques for vehicle tracking. The device is built into a car and enables real-time position determination and tracking. The car tracking system regularly obtains geographic positions using the GPS module [17-21].

## III. Proposed System

The block diagram shows the important elements and relationships between them. This graphic shows how the system's functionality and data flow.

- Wi-Fi ESP32 Board: The ESP32 Wi-Fi board incorporates a microcontroller with integrated Wi-Fi capabilities and serves as the main controlling component. Its main purpose is to connect several modules seamlessly in order to allow communication between them.
- GPS Neo Module: Attached to the ESP32 board, the GPS module module receives signals from various satellites to precisely determine the asset's or vehicle's real-time GPS coordinates, including latitude and longitude. This GPS data is processed for later usage by the ESP32 device.
- SIM800 Module: The tracking system's cellular communication is made possible by the SIM800 module. By attaching to the ESP32 board, it creates a cellular network connection. This link allows the

system to send crucial information, including the GPS location, to third-party apps like the Blynk 2.0 IoT app.

- Battery Power Supply: A dependable battery power supply is built into the system to guarantee ongoing operation even when the main source of electricity is absent or disturbed. The tracking system's power source supplies the electricity it needs to continue operating properly. Additionally improving mobility and versatility, its integration makes the system appropriate for a range of applications.

- IoT Blynk 2.0 App: The user interaction for tracking and surveillance purposes is provided by the Blynk 2.0 IoT app. Through the cellular network connection, it gets the ESP32 board's real-time GPS position information. The software allows customers to track their assets remotely by displaying the item or vehicle's current location on a map.

To sum up, the GPS Neo module sends GPS data to the ESP32 Wi-Fi board, which serves as the system's central control. The SIM800 module enables cellular connectivity so that the Blynk 2.0 IoT app may get GPS position information. The tracking system runs continuously thanks to the battery power source. The user interaction for actual time observing and tracking of assets or vehicles is ultimately provided by the Blynk 2.0 IoT app [22-24].

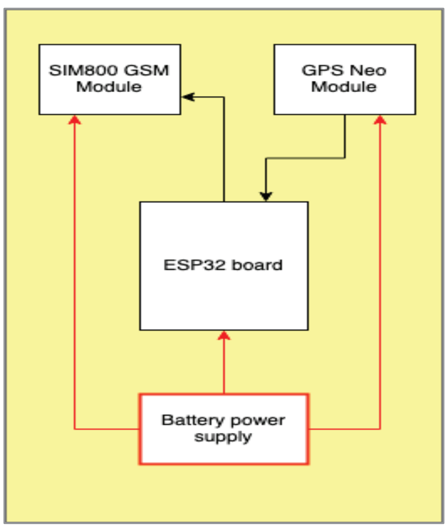


Fig. 1. Flow Diagram of the Proposed Method

## IV. Implementation

The AssetTrack Node's hardware connections are shown in Fig. 1 as follows:

- To supply power to the suggested system, a 5V DC battery has been attached. Through this battery, the SIM800 module and GPS Neo are also powered.

- A serial connection using a 9600 baud rate has been made between the GPS Neo and the ESP32 wifi board. The GPS Neo's Voltage pin is attached to a 5V battery, while its Ground pin is attached to Common Ground. The receiver pin on the ESP32 board is linked to the GPS Neo's transmitter pin.

- The ground pin of the Sim800 module is linked to common ground, and the voltage pin is connected to the battery's 5V DC. The GPIO16 and GPIO17 no pins of the ESP32 wifi board are used to connect the transmitter and reception pins of the Sim800 module, respectively.

The steps of the proposed system as follows:

### *A. Launch the System*

- Turn on all of the hardware parts, such as the ESP32 board, GPS Neo module, SIM800 module, and battery power supply.
- Create the connections between the parts that are required.
- Establish a solid and dependable Wi-Fi connection by configuring the ESP32 Wi-Fi board to link to a Wi-Fi network in order to access the internet.

### *B. Obtain GPS Information*

- Initialize the GPS Neo module for receiving satellite signals.
- Constantly acquire GPS information, such as latitude and longitude geographic coordinates, at predetermined intervals.

### *C. Process GPS Data*

- Obtain the GPS information from the ESP32 Wi-Fi board's GPS Neo module.
- Use any information that is required filtering or preprocessing methods to guarantee the accuracy and dependability of the data.

### *D. Establish Cellular Connection*

- Set the SIM800 module up to connect to the cellular network.
- Join the cellular network that is allocated for data transmission.

### *E. GPS Data Transmission:*

- From the ESP32 Wi-Fi board, send the SIM800 module the GPS data that has been processed.
- Use the cellular connection to send the GPS data to a platform or server outside of your own.
- Establish a connection between the ESP32 Wi-Fi board and the Blynk 2.0 IoT app before updating it.
- Use the established connection to provide the app live GPS data.

### *F. Display Real-time Tracking*

- Allow the Blynk 2.0 IoT app to receive GPS data.

- Show the asset or vehicle's current location in the app's map interface.

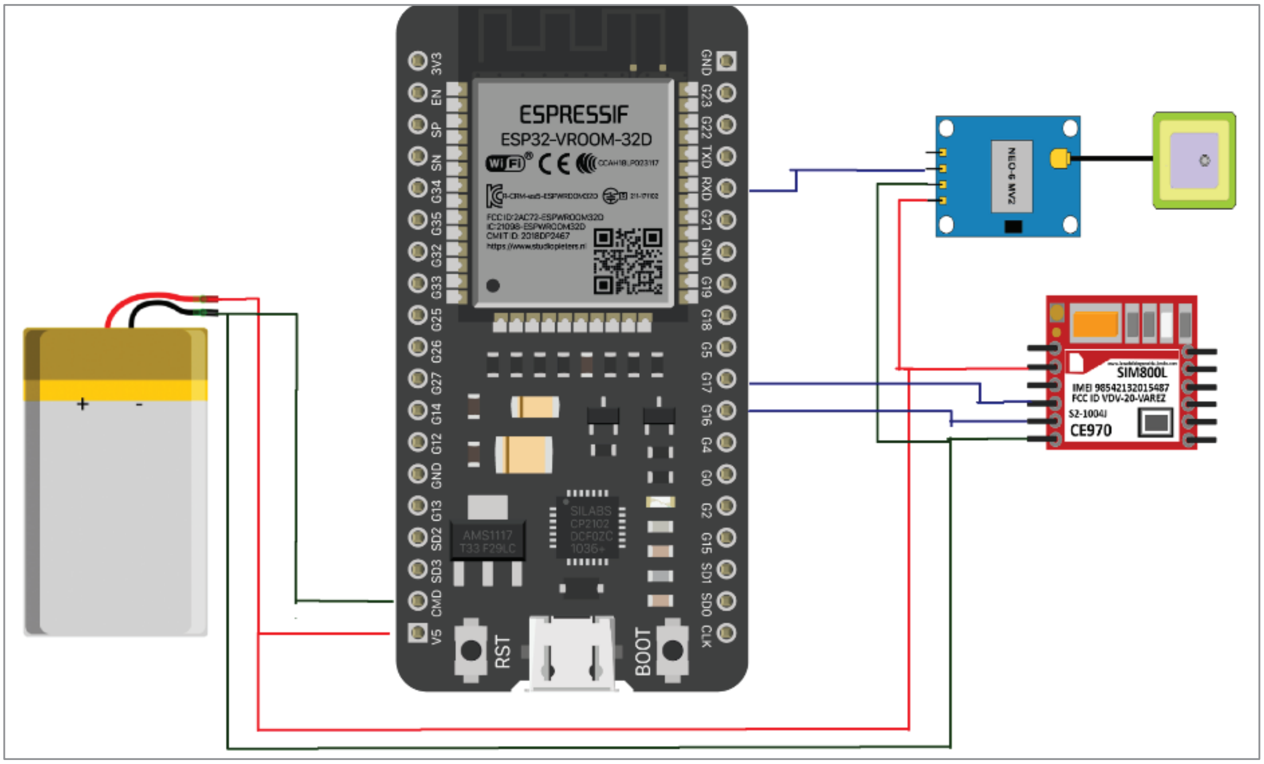


Fig. 2. Connection diagram of AssetTrack Node

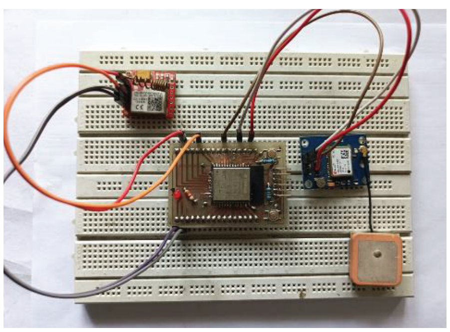

Fig. 3. AssetTrack Node

## V. Results and Discussion

The ESP32 real-time tracking system, which includes the following parts: the IoT Blynk 2.0 app, the GPS Neo module, the ESP32 Wi-Fi board, the SIM800 module, the battery power supply, and the wire connection, is detailed and discussed in this section. To prevent theft, the suggested vehicle tracking system uses a PVC box concealed in a car's trunk to house an ESP32 Wi-Fi board. The circuit for this system is shown in Fig. 2. The vehicle's position can be retrieved by means of the GPS Neo module. The data will be transmitted to the IoT Blynk 2.0 app via the SIM800 module, and the position will be shown on the freeboard website after exporting it from the app.

The ESP32 software needs to read the GPS values and display them in the Serial Monitor before it can send the latitude and longitude to the IoT Blynk 2.0 app. The data that have been exhibited in the serial monitor, as shown in Figure 3, are identical to the values that will be uploaded to the Blynk 2.0 app. These numbers are refreshed every five seconds.

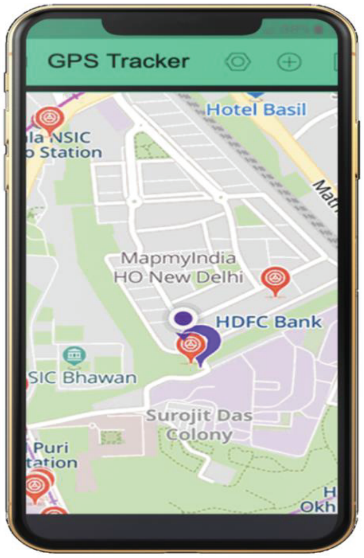


Fig. 4. The live tracking through the AssetTrack Node can be seen in to the New Blynk2.0 IoT mobile App Dashboard

TABLE I. QUALITATIVE ANALYSIS WITH OTHER METHODS

| Ref. | Method | Accuracy | Reliability | Power Consumption |
|---|---|---|---|---|
| Dhanalakshmi et al. [1] | IVMT-IoT-Arduino | Moderate | ✓ | High |
| Anand et al. [2] | GPSTE-RTOS-SA | High | ✓ | Moderate |
| M. A. Sufiyan [10] | VSS-ESP32 | High | ✓ | High |
| Taha et al. [7] | AES-WMB | Moderate | ✓ | Moderate |
| Mahmood et al. [4] | GPS-GSM-Arduino | High | ✓ | High |
| Proposed | | High | ✓ | Low |

Thus, when the GPS module transmits updated readings, the latitude and longitude values will change if the vehicle is in motion. The location values shown on the LCD screen are constantly changing to reflect the most recent data received from the GPS module. User can also view the precise location in Google Maps, as depicted by the red marker in Figure 4. See how the suggested approach stacks up against current gold standards like IVMT-IoT-Arduino, GPSTE-RTOS-SA, VSS-ESP32, AES-WMB, and GPS-GSM-Arduino in Table 1. In terms of accuracy, IVMT-IoT-Arduino and AES-WMB shows moderate, however all other comparative methods including proposed method shows higher accuracy. In addition, in terms of reliability, all the comparative methods have better reliability performance. Similarly, we also computed all comparative methods based on power consumption, IVMT-IoT-Arduino, VSS-ESP32, GPS-GSM-Arduino shows high power consumption during operation. However, GPSTE-RTOS-SA and AES-WMB shows moderate power consumption. However, when compared to all other methods, our method consumes less power which is suitable for applications [25-26].

## VI. CONCLUSION

In this study, the article proposes an advanced tracking system utilizing the ESP32 Wi-Fi board, GPS Neo module, SIM800 module, and a battery power source. These components may be integrated to track and monitor assets and vehicles in real-time, offering insightful information and improving security and productivity across a range of applications. The ESP32 Wi-Fi board serves as the system's central controller, enabling efficient interaction between the modules. The SIM800 module provides cellular connectivity so that the GPS data may be sent to external platforms, while the GPS Neo module precisely identifies the real-time GPS locations. The system is ideal for a variety of situations and circumstances thanks to the battery power source, which guarantees continuous functioning. Through a user-friendly interface, customers may constantly monitor and track assets or vehicles thanks to the project's successful incorporation with the Blynk 2.0 IoT app. The software shows the real-time GPS position on a map, enabling organizations and people to make well-informed decisions and improve logistics and asset management processes. Several advantages of the proposed tracking system include increased security, better asset management, and improved logistics. Applications like managing a fleet, supply monitoring, as well as personal surveillance of assets, gain additional avenues for development. In the end, we understand how to use an ESP32 Wi-Fi board, a GPS Neo module, a SIM800 module and a battery power source to construct a state-of-the-art real-time tracking system. The system's capabilities may be expanded, and it can be further customized to meet certain use cases and needs. Overall, the study presents the capabilities of the combined hardware parts and proves that it is feasible to equip vehicles and assets with state-of-the-art real-time tracking technology. The created solution shows potential for a range of businesses and people looking for trustworthy and effective monitoring and recording solutions. The system's accuracy, precision, and reliability were examined by positioning it in different geographical areas with varying satellite accessibility. One of its shortcomings is that the system's reliability steadily reduced when the GPS was moved from an outside, isolated location to an outdoor, urban region to an indoor, maybe even a parking lot. We suggest that in future projects, we look at the communication protocol and how precise and accurate it is when the vehicles are driven faster.

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