# Real-Time Automobile Tracking System Using ESP8266 & NEO-M8N

## Introduction

This project explains the development of a Real-Time Automobile Tracking System using an ESP8266 microcontroller and a NEO■M8N GPS receiver. The system collects coordinate, speed, altitude, and timing data and uploads it to Firebase Realtime Database for live monitoring.

## Hardware Components

• ESP8266 NodeMCU – Enables Wi-Fi connectivity and acts as the processing unit.
• NEO-M8N GPS Module – High-accuracy GNSS receiver supporting GPS, GLONASS, and Galileo.
• Power Supply – Stable 5V input for GPS and USB/3.3V for ESP8266.

## Software Tools & Libraries

• Arduino IDE – Used for code development and uploading.
• TinyGPS++ – Parses NMEA GPS data.
• Firebase ESP8266 Client – Manages secure cloud communication.
• Firebase Realtime Database – Stores structured JSON-based GPS logs.

## System Architecture

The GPS module sends NMEA signals to the ESP8266. TinyGPS++ decodes the data, converts them into readable values, and the ESP8266 uploads them as JSON objects to Firebase at fixed intervals.

## Code Flow Explanation

1. Wi-Fi Connection: ESP8266 connects to the specified SSID.
2. Firebase Initialization: Database host and authentication token configured.
3. GPS Data Reading: NMEA sentences decoded to extract location parameters.
4. Data Validation: Ensures data is fresh and accurate.
5. Cloud Upload: JSON objects sent to Firebase every second.

## Technical Terms Explained

• GPS Fix – GPS successfully determines location using satellites.
• HDOP – Represents horizontal accuracy; lower value means higher precision.
• Baud Rate – Serial communication speed.
• NMEA Sentences – Standardized GPS output format.
• JSON – Lightweight structured data format.
• Realtime Database – Cloud database with instant data sync.

## Results & Observations

• Achieved 1–3 meter accuracy outdoors.
• Speed and altitude readings updated reliably.
• Stable Firebase logging after incorporating reconnection logic.
• Capable of 24×7 continuous tracking.

## Applications

• Vehicle monitoring
• School bus tracking
• Fleet management
• Anti-theft systems
• Route history analysis

## Conclusion

This project demonstrates a complete IoT-based tracking system that integrates cloud, GPS, and microcontroller technologies. It provides accurate real-time monitoring and serves as a strong foundation for advanced applications such as geofencing, emergency alerts, and mobile app-based tracking.