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GPS Tracking System Using Raspberry Pi Zero Wireless

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Abstract: ***In response to the growing need for advanced personal security measures, this project introduces a cutting-edge "GPS Tracking System Using Raspberry Pi Zero Wireless." Leveraging the compact and versatile Raspberry Pi Zero W along with a NEO-6M GPS Module, the system facilitates real-time location tracking for enhanced personal security. The implementation process includes the installation of Raspbian, setup of the Raspberry Pi Zero W, and the connection of the GPS module using serial communication. A Python script, utilizing the gpsd library, processes GPS data, allowing users to save location information locally or transmit it to a server for real-time tracking. Optional integration with internet platforms such as Ubidots or Firebase enables continuous, remote monitoring. The project emphasizes user-friendly deployment, consideration of enclosure options for environmental protection, and implementation of power management strategies to optimize system longevity. This Real-Time GPS Tracking System serves as a contemporary solution, providing individuals with accessible and efficient technology to reinforce their personal security measures.***

Keywords: IoT (Internet of Things), Raspberry pi kit, GPS (Global Positioning System), NEO-6M GPS Module, GSM (Global System for Mobile Communications).

I. INTRODUCTION

In the ever-evolving landscape of personal security and location-based technologies, the concept of trilateration has emerged as a powerful and foundational principle.

This project embarks on the development of a sophisticated Real-Time GPS Tracking System using Raspberry Pi Zero Wireless, strategically integrating trilateration to achieve precise and instantaneous location tracking. Trilateration, a method based on triangulating distances from multiple known points, serves as the structural backbone for this system, ensuring accuracy and reliability in determining the device's position.

The convergence of the Raspberry Pi Zero W and the NEO-6M GPS Module provides a versatile platform for implementing trilateration, offering a cost-effective and accessible solution for personal security. Historically, the intricacies and costs associated with precise positioning systems limited their widespread adoption. However, the democratization of technology through platforms like Raspberry Pi has paved the way for transformative applications.

This project not only introduces a novel Real-Time GPS Tracking System but also underscores the transformative potential of trilateration in creating precise and user-friendly solutions. The subsequent exploration of the project's implementation details delves into the intricacies of the trilateration-based structure, shedding light on its pivotal role in meeting the evolving demands of individuals seeking advanced yet accessible security measures in an interconnected world.

II. LITERATURE SURVEY

A. Vehile Tracking System

Arduino IoT platform and a web-based system were used to construct a vehicle tracking system that allows car owners to track the whereabouts of their vehicles.

Through SMS or the web-based system, the user can keep track of the whereabouts of the vehicle. The Global Positioning System (GPS) module, the Arduino UNO R3 microcontroller, and the Global System for Mobile Communications (GSM) module for the Internet of Things platform make up the system. More precisely, the primary controller that manages and communicates with GPS and GSM modules is the Arduino UNO R3 microcontroller. The GPS module is in charge of obtaining the location from the satellite in the form of latitude and longitude. Users can view the current location of the vehicle on Google Maps with the assistance of the web-based technology.

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B. Real Time Vehicular Tracking System Using Raspberry Pi 3

The Vehicle System makes use of Raspberry Pi 3 to send data about a vehicle, such as its position via a GPS module and its identity to a monitoring station and mobile device in response to a specific event recorded in a program or a query from a monitoring station. and instantly transmits this data to a police station or hospital. These data are shown on a tracking webpage by the monitoring station, which can be mounted in vehicles, motorcycles, and boats. There are numerous uses for the system.

C. Child Security Enhancement System Using Raspberry Pi 3 And Amazon Elasticsearch Service

Using Amazon Elastic Search, this system will keep an eye on the child all the time and give the parent real-time data. With the use of an Android application, parents can monitor their child's real-time movements and assist in assessing their health. The cloud server used by the system is an Amazon Web Services EC2 instance called t2.micro. The Amazon Cloud's Elastic search service is a managed search solution for setting up, managing, and using elastic search clusters. A gadget called a pulse sensor is used to measure a person's heart rate. Students, athletes, and artists who wish to track their real-time heart rate data will find this device valuable.

D. LTE Based Vehicle Tracking System And Anti-Theft System Using Raspberry Pi Microcontroller

A efficient anti-theft management system for cars has been developed with the use of LTE Release 8 and a Raspberry Pi microcontroller. The GPS system is operated by a Raspberry Pi, a GSM/GPRS SIM900A Module, a GPS Module, a Pi Camera, a Relay, a fuel pump fuse, power supply, and other crucial equipment blocks. When the car is turned on, a power supply of 5V from the battery goes to the Raspberry Pi, and a power supply of 12V goes to the internal relay of the car. The secret number of the GSM module, which is hidden inside the car, is only known by authorized staff. When a car is stolen, the owner calls the GSM. The Raspberry Pi then rejects the call and SMSs the location and photo of the vehicle.

E. Innovative Real-Time Vehicle Monitoring And Tracking System Based On Raspberry Pi 3

The GPS tracking system is used to control theft problems and to know the location of the vehicle when an accident occurs. The advanced vehicle monitoring and tracking uses a Raspberry Pi3, GSM, GPS, an IR sensor, a smoke sensor, a Web page, and converters. GPS will give the longitude and latitude values to the Raspberry Pi3, and then it will send the SMS of the vehicle location to that particular person by using GSM. Sensors are used to detect the accident.

F. School Bus Monitoring System Using Raspberry Pi

The automatic tracking and monitoring that this system offers is beneficial for school buses, their owners, and the safety of the kids. It also comes with two keys and a panic switch. The system makes use of a Pi camera, a Hall effect sensor, and radio frequency identification (RFID). RFID technology is used to identify people who have an RFID tag inserted in instead of manually scanning. The tag does not have to be in the reader's direct line of sight to function; RFID is one way to accomplish automatic identification and data capture. Additionally, RFID cards are utilized for entity identification.

G. Advantages

1) The reviewed tracking systems offer versatile solutions for vehicle tracking, child security, and school bus monitoring, catering to various user needs.
2) Real-time monitoring capabilities in the systems enhance user awareness, allowing prompt responses to location changes or security concerns.
3) Integration with cloud services, such as Amazon Elastic Search, provides continuous and scalable monitoring with access to real-time data.
4) Systems like the LTE-based anti-theft solution incorporate advanced security features, such as rejecting unauthorized calls and discreetly sending location information.
5) Automated tracking in school bus monitoring and accident detection in the innovative vehicle monitoring system contribute to enhanced safety.
6) Integration of technologies like GPS, GSM, cameras, and sensors provides comprehensive solutions addressing various aspects of tracking.
7) User-friendly interfaces, such as web-based systems and Google Maps integration, simplify tracking for end-users.

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H. Dis-Advantages

1) Implementation of advanced tracking systems may incur higher costs, potentially impacting affordability for some users.
2) Regular maintenance may be necessary for complex systems, potentially leading to increased operational costs.
3) Implementing and maintaining certain systems, such as LTE-based tracking, may require technical expertise.
4) Systems relying on cloud services may face issues related to internet connectivity and data privacy.
5) Integrating multiple sensors and technologies, as seen in the innovative vehicle monitoring system, may pose challenges.
6) Some systems, like the vehicle tracking system using Arduino IoT, may lack certain advanced features found in more sophisticated solutions.
7) More advanced hardware in systems like real-time vehicular tracking using the Raspberry Pi 3 may lead to increased power consumption and cost.

III. PROBLEMS IDENTIFIED

An analysis of the existing literature on GPS tracking systems highlights several key challenges that need consideration. Firstly, the cost and affordability concern is prominent, with advanced platforms like the Raspberry Pi 3 or LTE-based systems potentially increasing hardware expenses. This financial aspect could pose a barrier to widespread adoption. Power consumption emerges as a significant challenge, particularly when compared to the energy-efficient Raspberry Pi Zero Wireless, as more advanced platforms may compromise the system's longevity in scenarios with limited power sources. Size constraints become a critical consideration, impacting the system's adaptability in space-sensitive applications when incorporating larger microcontrollers or additional components. Integration complexities are evident due to the intricate designs of advanced systems, necessitating additional efforts to ensure seamless communication and functionality. Scalability poses challenges, as the simplicity of the Raspberry Pi Zero Wireless contrasts with issues related to hardware expansion and resource management when adopting more advanced platforms. Connectivity options, sensor compatibility, and overall system complexity contribute to the comprehensive set of challenges identified in the literature analysis of GPS tracking systems.

IV. PROPOSED SYSTEM

The proposed GPS tracking system integrates both hardware and software components to achieve accurate and reliable location tracking based on trilateration principles, utilizing the Raspberry Pi Zero Wireless as the central processing unit. The system's hardware includes strategically positioned GPS modules designed to receive signals from the extensive U.S. satellite constellation, ensuring comprehensive global coverage. These modules work in tandem with the Raspberry Pi Zero Wireless, which acts as the core controller, managing data processing, communication, and control functions. A reliable power supply, encompassing rechargeable batteries, power banks, or direct power connections, ensures uninterrupted system operation. An additional protective enclosure shields the hardware components from environmental factors, promoting system durability.

On the software side, the system relies on the Raspbian operating system to provide a stable platform for software implementation. Custom-developed or existing trilateration algorithms, executed through Python scripting, process the GPS data to precisely determine the location of the tracked object. The system interfaces with the GPS modules through the GPS Daemon (gpsd), collecting raw satellite data for further processing. Data logging and storage mechanisms facilitate the recording and analysis of location data, with options for local storage on the Raspberry Pi or transmission to a cloud-based solution. Additionally, a user interface, whether graphical or web-based, allows for real-time tracking and visualization of location data. Communication protocols such as Wi-Fi or cellular networks enable the transmission of location data, supporting real-time tracking capabilities.

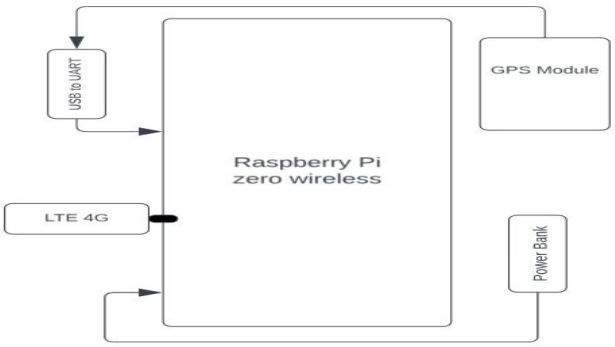


Fig. 1.Block Diagram

Fig 1, represents the schematic flow of process in the GPS tracking system.

The integration and deployment process involves careful assembly, configuration, and strategic placement of components, with regular maintenance protocols established to ensure sustained accuracy and reliability.

Overall, the proposed system offers a versatile and efficient solution for applications demanding precise location tracking, such as fleet management, asset tracking, and personal security. By capitalizing on the inherent strengths of trilateration and the Raspberry Pi Zero Wireless, the system addresses identified challenges, providing an optimal balance between accuracy, simplicity, and cost-effectiveness. This GPS tracking system stands as a promising technology for diverse real-world applications, demonstrating the potential for enhanced location-based services and ensuring the efficient monitoring of assets or individuals.

V. CONCLUSION

In conclusion, the analysis of the aforementioned papers on GPS tracking systems using various platforms, including Raspberry Pi, highlights both the advancements and challenges in the current landscape. Existing systems demonstrate a range of applications, from vehicle tracking and anti-theft solutions to child security enhancement and school bus monitoring. However, common challenges include limited real-time tracking capabilities, complex interfaces, and considerations related to cost, mobility, and stability, especially when utilizing 2G GSM networks.

To address these challenges, a comprehensive GPS tracking system is proposed, leveraging the capabilities of Raspberry Pi Zero W. The system aims to provide efficient real-time tracking, user-friendly interfaces, and optimized mobility, all within a cost-effective framework. Considering the potential instability of 2G GSM networks, the proposed system will navigate these challenges through a forward-looking approach that considers evolving communication technologies.

By integrating the insights from the literature survey and addressing the identified limitations, the proposed GPS tracking system aims to offer a versatile, reliable, and accessible solution for diverse tracking applications. This approach aligns with the broader trends in IoT and contributes to the ongoing evolution of GPS tracking systems.

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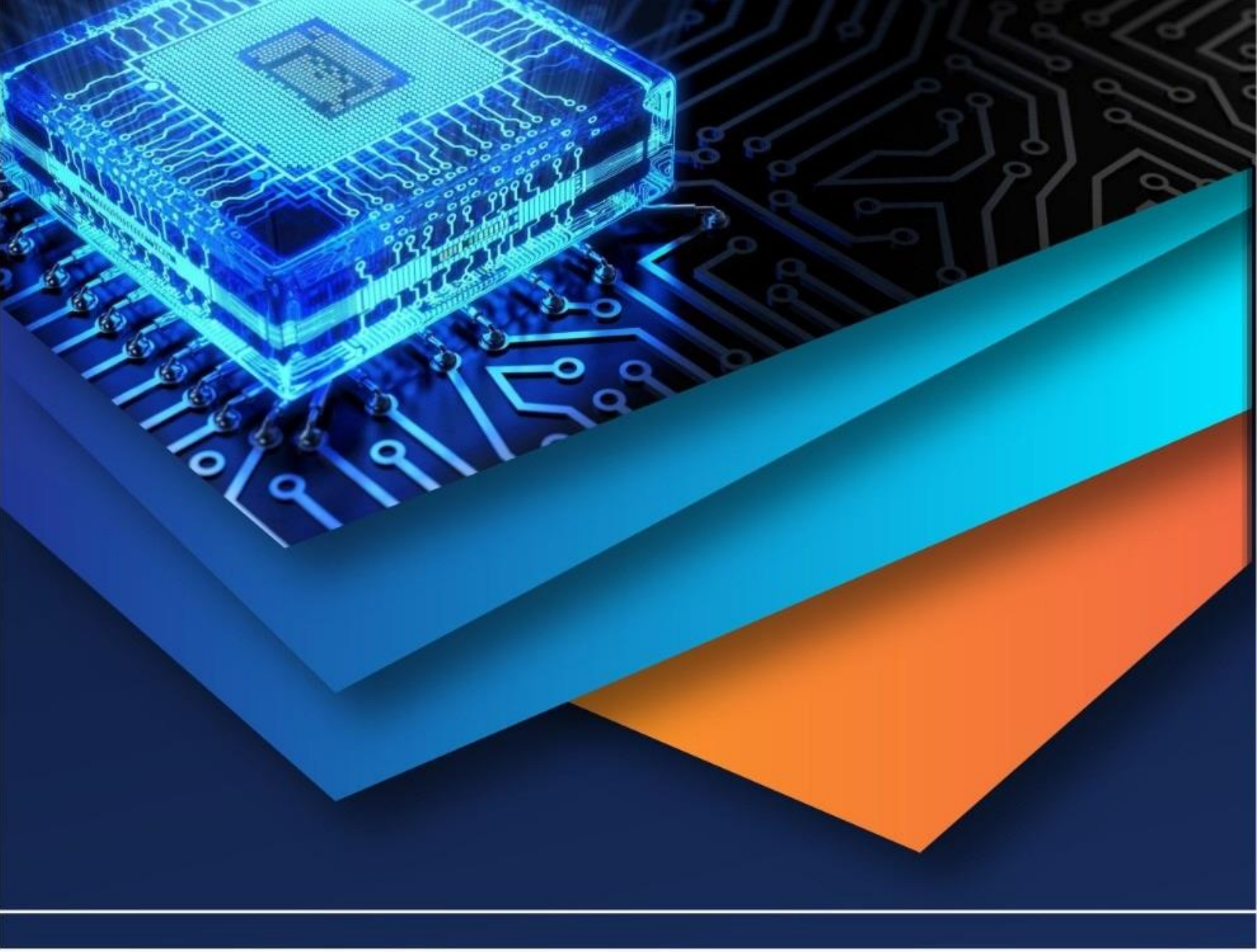
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