WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

GPS Tracker

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ABSTRACT :

The increasing need for real-time location tracking in today's fast-paced world has made GPS technology a vital component across various sectors, including logistics, personal safety, and asset management. As urbanization and mobility rise, so do the concerns related to theft, loss of valuable assets, and inefficient resource management. Traditional tracking solutions often fall short in terms of affordability, flexibility, and user-friendliness, leaving a gap in the market for a more accessible and efficient system. This project aims to develop a GPS tracking system utilizing the SIMCOM SIM7070G module combined with an STM32, addressing these critical needs while providing a reliable solution for users. The objective of this project is multifaceted, focusing on the creation of a real-time location tracking system that is both cost-effective and easy to use. By harnessing the capabilities of the SIM7070G, which integrates GPS and GSM functionalities, the project will enable seamless data transmission over mobile networks. This integration allows users to monitor the location of their vehicles or personal assets in real time, thereby enhancing security and operational efficiency. Additionally, the ESP microcontroller will serve as the central processing unit, managing data collection and communication, ultimately creating a lightweight and energy-efficient tracking solution.

Keywords: - GPS Tracker, STM32 Microcontroller, SIMCOM SIM7070G

Introduction:

In many urban areas worldwide, bike theft has become a prevalent and growing problem. Bikes, being an affordable and eco-friendly mode of transportation, are widely used, especially in densely populated cities. However, their portability and lack of built-in security features make them attractive targets for thieves. Studies show that bike theft rates are rising year over year, with many stolen bikes never being recovered. This issue affects individuals, students, commuters, and even businesses that rely on bikes for delivery or transportation. The existing security measures, such as traditional locks or physical barriers, are often insufficient to prevent theft, as thieves can easily bypass these methods using simple tools. In addition, the lack of real-time tracking and location monitoring makes it nearly impossible to trace a stolen bike once it's taken. This creates a sense of vulnerability among bike owners, leading to financial losses and decreased trust in bike security systems.

Therefore is the need for an effective, real-time solution to secure bikes and recover stolen vehicles. Bike owners require an affordable and reliable way to track the location of their bikes, receive timely alerts of unauthorized movement, and have an efficient method to aid in the recovery of stolen bikes. This major project aims to address this problem by developing a GPS-based bike tracking system, offering a modern and proactive solution to combat bike theft.

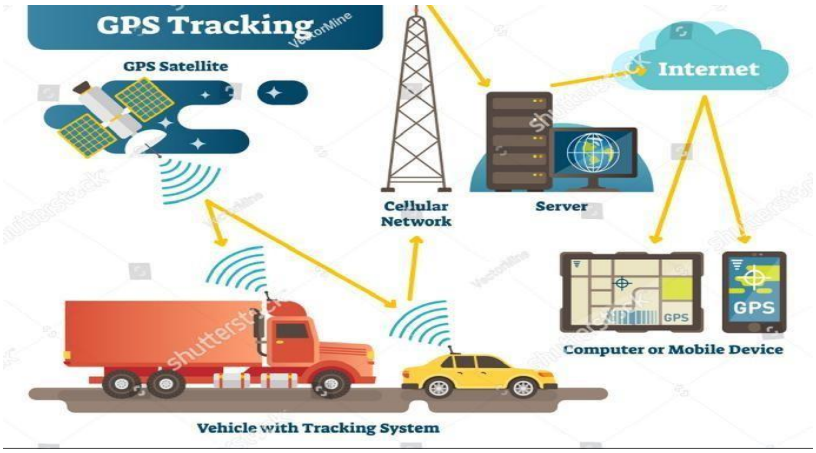


Figure 1.1 GPS Tracker system

Define User based problem

A common user-based problem with GPS trackers revolves around the balance of privacy and functionality. Users often struggle with the feeling of being constantly monitored, whether by family members, employers, or even themselves, leading to anxiety and distrust. This is exacerbated by unclear data usage policies, potential for misuse of location data, and the lack of transparent control over tracking parameters. Consequently, users seek a system that provides accurate location information when needed, while offering robust privacy safeguards and customizable settings to ensure they feel secure and in control of their personal data.

Problem Definition

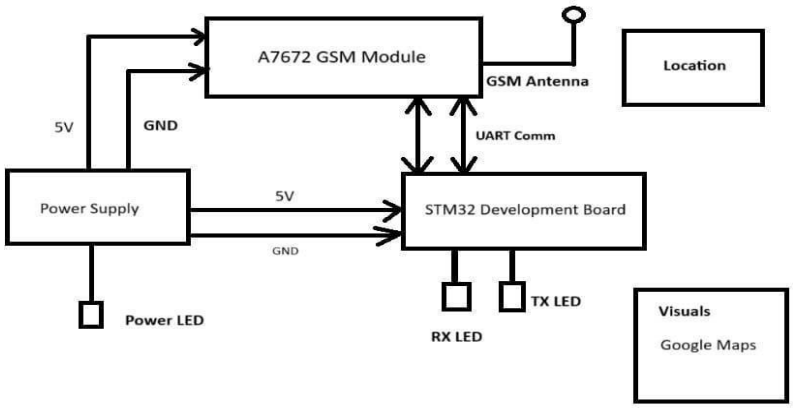
A GPS tracker can significantly reduce bike theft by providing real-time location updates to the bike owner. If the bike is stolen, the GPS tracker allows the owner or law enforcement to accurately trace its location. This technology enables quick recovery of stolen bikes, reducing the time the thief has to relocate or dismantle the bike. Furthermore, knowing that a bike is equipped with a tracker could deter potential thieves from attempting to steal it in the first place. In summary, integrating GPS technology into bikes offers a practical and efficient solution to address the rising concern of bike theft, increasing the chances of recovery and enhancing overall security.

Literature survey :

Bike theft is a well-documented issue in both urban and suburban areas across the globe. With rising urbanization and the increasing popularity of bicycles as an eco-friendly mode of transport, the number of bike thefts has also grown. Several studies and reports highlight the scale of the problem, its impact on bike owners, and existing solutions. Prevalence of Bike Theft: According to a report by the National Bike Registry (NBR), millions of bicycles are stolen annually worldwide. In major cities like London, New York, and Paris, bike thefts have become a routine problem, with only a fraction of stolen bikes being recovered. Statistics from the U.S. National Crime Victimization Survey (NCVS) indicate that over 1.5 million bicycles are stolen each year in the United States alone, resulting in millions of dollars in losses. Similarly, in India, a 2021 report showed an alarming increase in bike thefts in metropolitan cities like Delhi, Mumbai, and Bengaluru. Existing Security Measures: Traditional anti-theft measures primarily include physical locks such as U-locks, chain locks, and cable locks. While these solutions provide some level of protection, they are often vulnerable to cutting tools or theft in public spaces where bikes are left unattended for long periods. Research by the University of California (2018) found that the average time for a thief to break a common b i k lock was just under 30 seconds, rendering locks inadequate as a Technological Solutions: In recent years, GPS-based bike tracking systems have emerged as a potential solution to the problem of bike theft. GPS trackers offer real-time location tracking, allowing bike owners to monitor their bike's movement and receive alerts if unauthorized movement occurs. A study conducted by the European Cyclists' Federation (2019) found that GPS trackers significantly increase the chances of recovering a stolen bike. Several commercial GPS-based tracking systems, such as "Logical" for bicycles and "Tracker
," have been developed, but they often come with high costs and complex installation procedures. Furthermore, these systems sometimes rely on battery- powered devices that may have limited battery life, making them less reliable in the long term.

Geofencing and Alerts: Geofencing, the creation of virtual boundaries for a bike, is another technological advancement that enhances bike security. Research from the University of Tokyo (2020) showed that integrating geofencing with GPS tracking significantly improves the chances of detecting theft in its early stages. If a bike crosses the predefined boundary, the system sends an immediate alert to the owner. This real-time notification, combined with accurate GPS location data, allows users to act swiftly. Challenges and Gaps: Despite advancements, several challenges remain in creating a reliable and cost-effective GPS-based tracking system. One of the primary concerns is the high cost of existing solutions, which limits their accessibility for the average bike owner. Many tracking systems require monthly subscription fees for data usage, which can be a barrier. Additionally, concerns about the durability of trackers in outdoor environments, the potential for tracker tampering, and the ease of installation remain unsolved in some systems. A review of the literature indicates that while GPS-based solutions show promise, there is still a gap in providing an affordable, user-friendly, and tamper-proof bike tracking system for the general public. Furthermore, current systems often do not address the ease of installation or long battery life, which can be a deterrent for non-technical users.

Block digram :



This block diagram represents a system for obtaining and visualizing location data using an STM32 development board and an A7672 GSM module. The system is powered by a regulated 5V power supply, which provides energy to both the GSM module and the STM32 board. A power LED indicates the status of the power supply. The A7672 GSM module, equipped with a GSM antenna, handles cellular communication to determine location data. It communicates with the STM32 development board via a UART (serial communication) interface. The STM32 board processes the received location data and is equipped with TX and RX LEDs to indicate data transmission and reception activities. The location information obtained from the GSM module can be visualized on platforms like Google Maps. This setup is commonly used in GPS tracking or location-based systems for monitoring and displaying real- time positional data.

This block diagram represents a system integrating a GSM and GPS-based tracking solution, powered by a battery and controlled by an STM32 microcontroller.

- **Battery Charging Unit:**

Provides power to the rechargeable battery and ensures it remains charged for long-term use.

- **Battery Supply:**

Supplies a stable 5V output to the components, including the STM32 Development Board and the A7672 GSM module.

- **STM32 Development Board:**

Acts as the system controller, handling communication with the GSM module via UART to send and receive data. It also processes location information.

- **A7672 GSM Module:**

Responsible for communication with the GSM network. It transmits location data and enables messaging/tracking functionalities.

- **Power LED & TX/RX LED Indicators:**
- The Power LED shows that the system is powered.
- The TX/RX LEDs indicate UART communication activity between the STM32 and the GSM module.

- **Visualization:**
- Messaging Tracking: Sends and receives SMS for tracking updates.
- MAPS Last Location: Visualizes the last known GPS location, potentially in a mapping interface.
- The system is designed for real-time tracking and communication, with efficient power management for portability.

Hardware Description :

3.1 STM32 microcontroller.

Figure 3.1 STM32 microcontroller.

The STM32 Blue Pill serves as the central microcontroller in GSM/GPS projects, offering a robust platform to interface with communication modules like the SIMCom A7672. Its primary role is to process data from the GSM module, send AT commands for controlling GSM/GPS functionality, and handle communication protocols efficiently. With its compact design, the Blue Pill enables the development of portable and low-cost embedded systems. The board's capability to process and relay real-time GPS data and GSM-based communication makes it ideal for applications such as vehicle tracking, IoT systems, and emergency alert systems.

Specifications:

- **Microcontroller**: STM32F103C8T6, based on the ARM Cortex-M3 architecture.
- **Clock Speed**: 72 MHz, providing fast data processing and multitasking capabilities.
- **Memory**: 64 KB flash for program storage (sometimes unofficially 128 KB) and 20 KB SRAM for runtime operations

3.2 A7672 GSM Module

An electric meter is a device used to measure the amount of electrical energy consumed by a residence, business, or industrial facility. It records electricity usage in kilowatt-hours (kWh) and helps utility companies bill consumers accurately. Traditional electromechanical meters use a rotating disk to measure power consumption, while modern digital and smart meters provide real-time data and remote monitoring capabilities. Smart meters, equipped with communication technologies, enable automated readings, detect anomalies, and support energy management systems. Electric meters play a crucial role in efficient energy distribution, ensuring accurate billing, and preventing electricity theft.

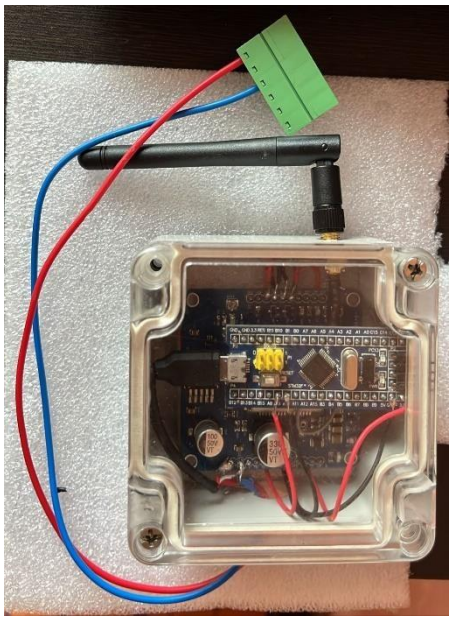
Figure 3.2 A7672 GSM Module

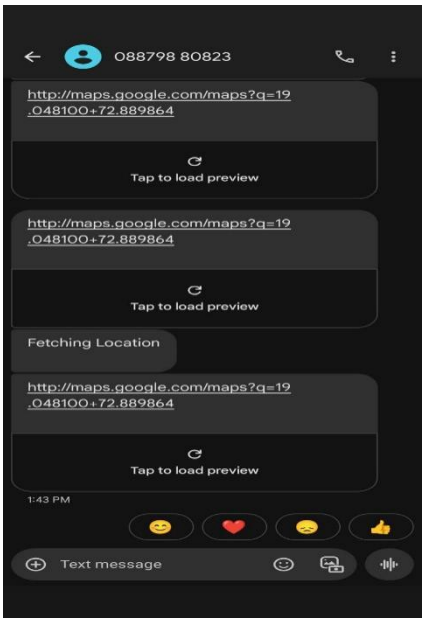
- **Power Supply:** The A7672 development board is also powered by the same 5V battery source.
- **UART Communication:** TX and RX pins of the A7672 module are connected to the respective UART pins on the STM32 board. Thisallows the STM32 to send AT commands to the GSM module and receive responses or data such as GPS coordinates

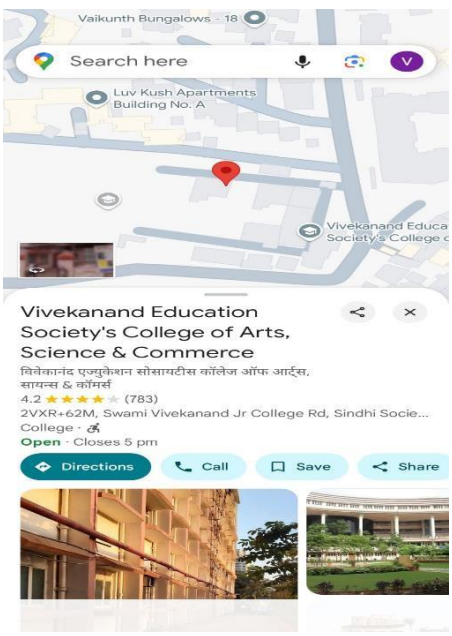
3. Future Directions:

- Advanced Smart Metering
- Regulatory and Legal Innovations
- Cybersecurity & Blockchain
- Policy & Regulatory Improvements
- AI & Machine Learning Integration.

Output:







Result:

We successfully track this Location using GPS Traking module.

Conclusion:

GPS trackers are powerful tools that provide real-time location tracking, improving navigation, security, and fleet management. They offer significant benefits in personal safety, vehicle tracking, and logistics. However, they also come with drawbacks, such as privacy concerns, battery drain, and signal limitations. While GPS technology continues to evolve, users should balance its advantages with potential risks and ensure ethical and legal use for optimal benefits.

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