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Ubiquitous Tracking System: A Mobile and Versatile GPS-GSM Solution for Real-Time Vehicle and Asset Monitoring.

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Abstract: **The Universal Tracking System is a cutting-edge technology that utilizes GPS and GSM modules to provide real-time tracking of assets, people, and vehicles. The system is versatile, offering a range of features and applications that cater to various needs, such as location tracking, asset management, and fleet monitoring. The system helps in reducing the chances of things getting lost, stolen, or misplaced by providing accurate and up-to-date location data. It is an affordable, easy-to-use, and reliable solution that can be accessed from anywhere, making it a valuable tool for personal and commercial use. With its wide range of benefits, the Universal Tracking System is an indispensable for anyone who needs to keep track of their assets or loved ones.**

I. Introduction

The GPS technology has become indispensable in our daily lives, so much so that we often use it involuntarily. We like to keep our essential items within our reach most of the time; when they are not mobile, we store them in a safe to keep them safe. However, what would be the scenario for those items that demand continuous monitoring? How can we know the status of an item when it is on the move? The proposed tracking system is designed to perform live tracking of the objects to which it is coupled. It enables us to have continuous monitoring of the item. [1]

In the late 1950s, the military developed the precursor to the current GPS. The Navy was responsible for the first two attempts, and the first satellite-based navigation system was called Transit. It was launched in 1959 and used radio signals and seven low-orbiting polar satellites to determine the locations of the ships. Transit measured distances using the Doppler Effect of radio waves, but it had limited accuracy, was only available in certain areas, and required constant monitoring. In 1964, the Timation system was introduced as the second attempt. It used two space satellites equipped with atomic clocks for more precise two-dimensional positioning.

The organization of rest of the article is as following:
II. Literature Survey
III. System Model
IV. Results and Discussion
V. Conclusion.

II. Literature Survey

Laipac S-911™ Personal Locator: The Laipac S-911™ Personal Locator is a compact device that can track personal safety and assets. It works on a global GSM/GPRS network and can function as an emergency phone with speed dialing for two-way communication. In an emergency, the device can silently call 911 or any other emergency number and reports its location and time stamp using a simulated voice. The device can also send SMS messages to a control center and be monitored in real time over the internet. The small device is 70 x 40 x 20 mm and has a rechargeable lithium-ion battery. An additional map database software is required to track the device in real time over the internet.

Star Finder I: The Automatic Vehicle Location (AVL) system is designed to be compatible with various communication methods, including cell phone modems, digital radios, and satellite modems (ORBCOMM), using CDMA/1X, GSM/SMS, and GPRS. The size of the AVL unit is compact, measuring 15 x 15 x 3.5 cm. The Star Finder AVL software is available to control the AVL system, which can track an unlimited number of vehicles in real-time. This software requires a map database like Microsoft MapPoint to function correctly.

Real Time Bus Track and Location Update System: The public transportation system is crucial to the development of the economy and is an integral part of people's lives. However, this tracking of the systems, monitoring, scheduling, and surveillance services are currently operating manually, which means the information is not easily accessible to the public. To address this issue, the "Real Time Bus Track and Location Update System" project aims at automation of these services by providing real-time tracking of buses. Each bus will have an RFID tag, and RFID readers will be placed at each bus stop. The central regulator of the system is Arduino. The GSM module will send location updates to authorized personnel for continuous monitoring, while GPS is used to track the buses. IoT will provide users

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with information on bus trackers. Data from RFID readers will be processed using Arduino and sent to the cloud, which will act as an interface between the user and the system.

Location Tracking in GPS using Kalman Filter through SMS: The paper "Location Tracking in GPS using Kalman Filter through SMS," presented at IEEE EUROCON in 2009, explains a system in which 1' pixel depict areas suitable for bus travel, while 0' pixels depict other areas. Since there is always some margin of error and noise when measuring the location of the bus, the observations are revised utilizing a weighted average. This approach places greater weight on the estimations with higher accuracy.

III. System Model

Flowchart:

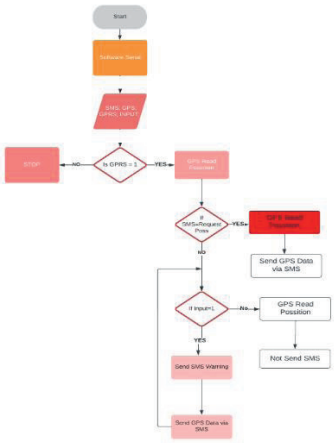


Figure1. Flow chart of universal tracking system

Figure 1 shows the flow of process of the tracking system happening before, after receiving the SMS to the module.

Component specifications:

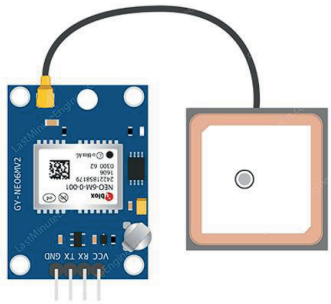
1. **GY-NEO6MV2 GPS Modem:**
   - Power Supply Range: 3 V to 5 V.
   - Model: GY-GPS6MV2.
   - Ceramic antenna.
   - Antenna Size: 25 x 25 mm.
   - Module Size: 25 x 35 mm.
   - Mounting Hole Diameter: 3 mm.
   - Default Baud Rate: 9600 bps.

2. **Arduino board based on ATmega328P:**
   - A 16MHz crystal.
   - A 10K resistor.
   - Two 22pf capacitors
   - A 10uf capacitor.
   - Runs at clock speeds from 1MHz to 20MHz.
   - 32Kb Flash Memory.
   - 2Kb SRAM (Static Random Access Memory).
   - 1Kb EEPROM (Electrically Erasable Read Only Memory).

3. **SIM 900A GSM Module:**
   - Dual-Band 900/1800 Mhz.
   - GPRS multi-slot class 10/8GPRS station class B
   - Compliant to GSM phase2/2+
   - Dimensions: 24*24*3
   - Weight: 3.4g.
   - Supply voltage range: 5v.

A. GPS module:

A radio navigation system determining accurate latitude and longitude coordinates irrespective of the weather conditions. It works on land, air, and sea. The GPS modules are devices that allow your devices or circuits to receive the data of the GPS. It is a subcategory of satellite communication. The GPS provides different wireless services like navigation, positioning, location, and speed with the help of the dedicated GPS receivers and satellites. [1]



GY-NEO6MV2 GPS MODEM

B. Dual SIM band module:

Global system for mobile communication (GSM) is a standard describing the protocols for the second generation (2G) digital cellular network. It is developed by European Telecommunications standards institute. This module is responsible to communicate the location of the system that must be tracked via SMS. [2]

The GSM module uses standard AT (At Tension) commands to communicate with the host device and provides features such as voice and data communication, SMS (Short Message Service), GPRS (General Packet Radio Service), and GPS (Global Positioning System) functionality. It typically requires a SIM (Subscriber Identity Module) card to operate and can be powered by a battery or external power source.

GSM SIM900A Module

C. Arduino module:

Arduino is an open-source electronics platform that provides an easy and affordable way for people to create interactive projects. It consists of both hardware and software components, including microcontroller board and a programming environment that allows users to write code and upload it to the board. [3]

Arduino board based on ATmega328P

The Arduino board is equipped with input and output pins that can be used to connect to various sensors, actuators, and other electronic components. Users can write code to read input data from sensors, process that data algorithms and output control signal to actuators to perform various tasks.

One of the main advantages of Arduino is its accessibility. It is designed to be user friendly, even for those with little or no electronics experience. The programming language used in Arduino is based on C++, but it has a simplified syntax and a set of libraries that make it easier to use for the beginners. Arduino has a wide range of applications, from building robots and drones. It is also widely used in education as it provides a hands-on way for students to learn about electronics, programming, and engineering. It is overall a versatile and accessible platform that empowers individuals and communities to bring their ideas to life through electronics and programming.

D. System assembly:

GPS Module: The information related to the location (latitude and longitudinal coordinates) of the subject that must be tracked is gathered with the help of the satellite. [1]

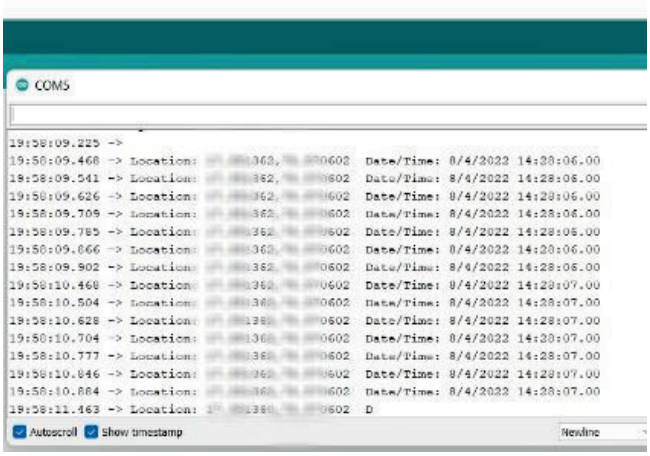


Figure 2. Tracked coordinates by GPS module.

The GPS tracker here is responsible for updating the information related to location, date, and time for about 6 times a second. The output of the GPS functioning is shown as in figure 2.

GSM module: The location of the subject that must be tracked is sent via SMS with the help of GSM module. This module waits for a coded trigger message and sends the programmed SMS. [2]

Some AT commands used for sending and receiving SMS using GSM SIM900A module are:

- To set module in SMS text mode: AT+CMGF = 1
- To send a SMS: AT + CMGS = "<recipient phone number>"

These commands are merely illustrative, and their precise syntax may differ based on the firmware version of your SIM900A module.

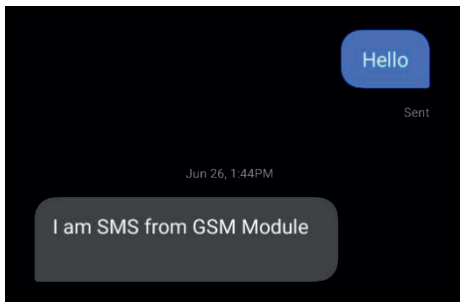


Figure 3. SMS response of GSM module.

Figure 3 shows the response SMS received from the GSM module when a trigger text is sent.

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Arduino module: Arduino coordinates the action of the GPS and GSM modules. The system which runs on battery is deployed along with the subject that must be tracked. The GSM module waits for a coded triggered SMS from the user. The SMS when received is then validated by the Arduino module and then Arduino module access the latitude and longitudinal coordinates which is tracked by the GPS module.

The Arduino module validates the trigger SMS and append the latitude and longitudinal coordinates to the link, https://www.google.com/maps/?q= . The link generated after appending the latitude and longitudinal coordinates enables the user to access the location of the system using google maps app or through chrome.

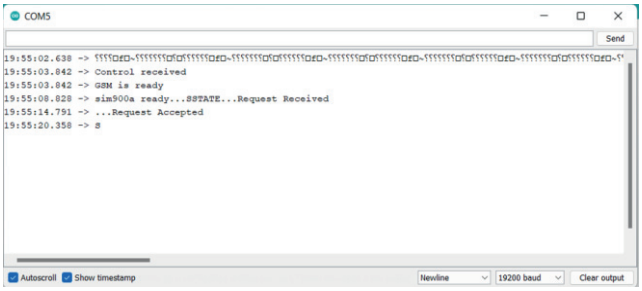

Figure 4. Terminal result when GPS and GSM are programmed.

An Arduino UNO is used with the GPRS+GPS(SIM900A) shield to send GPS coordinates to a mobile with an SMS and through HTTP when the module is called, and your number is correct.

When the person sends a message to the module and if the phone number is correct, the GPS obtains longitude and latitude, sends you an SMS with the position and sends the GPS data to the mobile in the form of a URL.

Load the next sketch into your Arduino and then assemble the GPRS+GPS shield with the antennas and the sim card installed. Remember, you must configure your APN, login, and password. If you don't do this, the GPRS+GPS cannot connect to the GPRS network. Also, you must set the URL with the IP address of the specific mobile. When the GPS fixes the GPS satellites, the GPRS+GPS shield will connect to the network, and it will send the GPS data through the Internet to the mobile in the form of a URL. After the arrival of URL., Search that URL in google then the details such as latitudes, longitudes, and position of the baggage by using this tracker.

IV. Result and Discussion

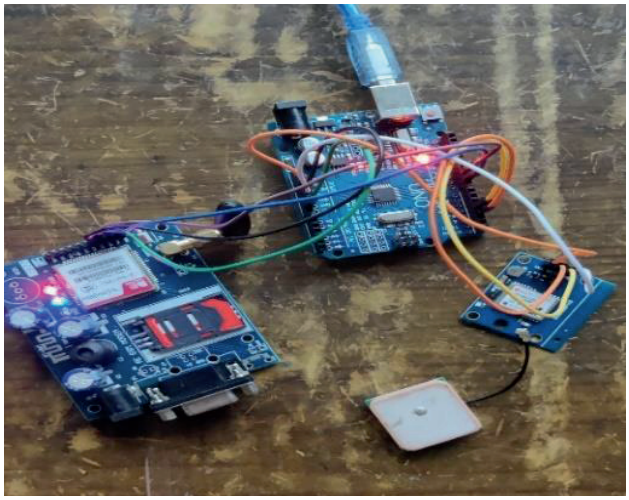

Figure 5. Components integration.

Figure 5 shows the system integration after assembly of components. The GSM and GPS modules will draw power from Arduino and are coordinated in the Arduino module. The Arduino module draws power from the secondary battery source. The code is dumped into the microcontroller from the Arduino software available in open source.

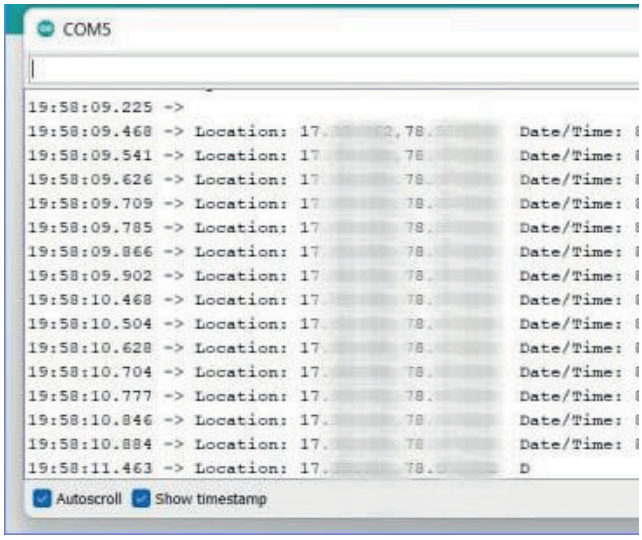

Figure 6. Terminal output.

Figure 6 shows the COMM port data which is been received when trigger message is received and acknowledge the location sent via SMS.

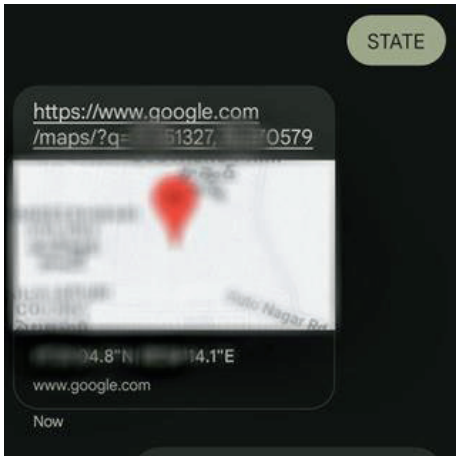

Figure 7. Final output SMS request and response.

Figure 7 shows the final output where the SMS, "STATE" which is said to be the coded text is sent to the module which contains SIM in GSM module. It reads the text and validates with pre-defined code and verifies the phone number and code and then access the location using GPS module and then append the coordinates to the link and send the appended text via SMS using GSM module.

V. Conclusions

In conclusion, the GPS and GSM-based tracking system has multiple benefits. It offers superior security compared to other systems and can be accessed from remote areas. The system helps prevent vehicle theft, and its installation is straightforward. Additionally, it is more dependable and cost-effective than other alternatives.

The utilization of GPS and GSM technologies enable the system to track vehicles in real-time and provides the latest details regarding ongoing trips. This technology can be utilized for real-time traffic surveillance and serves as a valuable resource for obtaining real-time information, monitoring congestion, and evaluating the performance of the systems.

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