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SmartGuard: GPS-Based Anti-Theft System with Remote Engine Shutdown and Real-Time Monitoring via IoT

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ABSTRACT: This article presents an Intelligent Vehicle Security system that utilizes Internet of Things (IoT) technology for remote monitoring and GPS-based theft detection in response to the increasing danger of vehicle theft. Because it is hardwired into the vehicle's engine, the system may identify attempts at unauthorized entry that go beyond the initial key press. When it finds a vehicle, it immediately notifies the owner by text message with the exact location of the vehicle, including its latitude and longitude. In addition, the device allows the owner to immobilize the car by remotely turning off the engine using a cell phone. Wi-Fi module activation and GPS monitoring dynamically decide the length for which the vehicle's movement is restricted. This all-encompassing method efficiently enhances vehicle security and deters theft by combining real-time tracking with remote control capabilities and preventive actions. The increasing frequency of vehicle theft highlights the critical requirement for fresh approaches. In light of this need, the present study presents a VAT monitoring system that combines GPS and a DC motor through GSM communication. Using ESP 8266, a wireless module, in conjunction with GPS and GSM connection, the system precisely locates the car. Regardless of the weather, the device's dependable tracking is guaranteed by using GPS, a satellite-based navigation technology, which delivers continuous real-time latitude and longitude coordinates. By combining these state-of-the-art technologies, this initiative offers a strong and efficient way to fight car theft, making cars safer and more secure.

KEYWORDS: Vehicle Security, IoT, GPS-Based Theft Detection, Remote Monitoring, Anti-Theft.

I. INTRODUCTION

There has to be immediate implementation of effective anti-theft technologies to protect vehicles in light of the disturbing rise in car thefts globally. Theft of motor vehicles not only endangers public safety but also costs people and insurance companies a lot of money. New, cutting-edge solutions that make use of these technologies have arisen to combat this rising worry, and they provide better protection for cars against theft and unauthorised entry. A vehicle anti-theft system is an all-encompassing security measure that can stop carjacking, theft, and abuse. A variety of technologies are utilized by these systems to prevent theft and guarantee the safety of vehicles and their passengers. These include global positioning system (GPS) tracking, remote monitoring, immobilization, and alarm systems.

Some of the most important features of today's anti-theft systems include the ability to remotely turn off the engine from a mobile device, the ability to detect theft using global positioning systems (GPS), and an alarm system that notifies both the owner and the authorities in the case of theft or tampering. Internet of Things (IoT) technology has made anti-theft systems smarter and more linked, facilitating their interaction with other smart devices and platforms for remote monitoring. By allowing owners to access their vehicles from any location and receive real-time notifications, this connection improves the efficacy of anti-theft measures. Vehicle anti-theft systems not only make individual automobiles safer, but they also aid in the fight against criminal organizations that traffic in stolen vehicles. These systems are vital for public safety and crime prevention since they discourage theft and make it easier to recover stolen cars. The vehicle crimes result in vehicle theft and trafficking, which affect owners, companies which are responsible for insurance, and public safety in all countries, and have connections to major organized crime networks.

II. RELATED WORK

Many different technologies were used to control the vehicle when it is lost. Previously it was very difficult to determine the position of the automobile but now by using GPS technology it became very easy to track the position of the vehicle. A system is designed to note the location of the vehicle and to identify the theft by passing the information to the automobile owner. Such system includes GPS and GSM modules to determine the position of the vehicle and to deliver the information to the owner. This system is designed for continuous monitoring of the vehicle and to describe the status of the vehicle on request [3]. Face recognition system is used to identify theft. This face recognition system will be placed inside the vehicle. When a person switches ON the vehicle, it captures the image and compares the new image with the stored image and verifies whether the image is already there in the list or not. If the image is not found in the list, the message will be sent to the automobile owner. Now the owner is allowed to see the image of the thief and location of the vehicle [4].

III. LITERATURE SURVEY

1. Rajasekar Kommaraju and Rangachary Kommanduri's research focuses on IoT-based vehicle theft detection, particularly addressing thefts in flat-top vehicles that are susceptible to control by external components. Their study proposes novel strategies to overcome these vulnerabilities, employing shields to detect interference attempts. An RFID card serves as the authorized key, requiring authorized personnel to input passwords via keypads for engine activation. Incorrect password entries trigger continuous buzzer alerts.
2. O. A. Awad and D. A. Bahr's 2019 system for preventing automobile theft integrates a Raspberry Pi and LTE communication technology. The system, hidden within the vehicle, responds to theft by disconnecting incoming calls from the owner's mobile phone, triggering GPS to transmit the vehicle's location via SMS through GSM, potentially viewable on Google Maps. Additionally, it activates the Pi-Camera to capture an image of the offender, sending it to the owner via superior internet services, while allowing the owner to remotely control the ignition module to halt the engine.
3. P. Chandra Shreyas and colleagues proposed a blueprint in 2019 for tracking and monitoring theft, enabling owners to identify offenders. Upon vehicle activation, GPS tracks position variations while an embedded camera captures an image of the burglar, sent to Raspberry Pi. Data, including GSM module inputs, is stored in the cloud and relayed to the owner. Using a special mobile app, the owner can disable the vehicle and remotely access it via the cloud.
4. Tahesin Attar and colleagues introduced an "Advanced Vehicle System based on IoT" in 2018, utilizing cloud technology to enhance safety and automate theft prevention with minimal delay. They employed cordless communication and cost-effective Bluetooth systems alongside GSM for messaging. Their system integrated Infra-Red Sensors, Bluetooth modules, Limit Switches, and a mobile app, with key-pad password entry controlling entrance opening and safety harness locking. Alarm signals alert the owner of intrusions detected by IR sensors, with a microcontroller linked to an alarm via Bluetooth. The system addresses issues such as tow truck usage by employing limit switches, sending signals to the controller, and relaying orders to the dashboard via Bluetooth. Users can remotely instruct the engine and turn it off via GSM-based ruling signals.
5. In 2019, O. A. Awad and D. A. Bahr developed an integrated anti-theft system for automobiles using Raspberry Pi and LTE technology. Upon detecting a theft, the system disconnects a call from the owner's mobile, activates GPS to send the vehicle's location via SMS, captures an image of the offender, and allows the owner to halt the vehicle's ignition remotely.

IV. PROBLEM METHODOLOGY

COMPONENTS USED

This third-generation GPS module uses Patch Antenna On Top (POT) technology to give precise location and speed data, which is essential for efficient vehicle tracking, particularly in city environments. It provides information like the current date, time, longitude, and latitude through its built-in battery backup and capacitors, eliminating the need for any external components.

The GSM module connects to the vehicle's owner through a data link; it is a mobile communication device. Through serial data transmission, it receives signals from monitoring stations and notifies the host server of any unauthorized vehicle movement. In order to receive messages together with location data, Arduino sensors are used.

ESP 8266: The ESP 8266 is an open-source firmware that allows users to update or rebuild modules according to their needs. This module is perfect for blending into the Internet of Things (IoT) environment because it has Micro USB for programming and power board connection.

A low-cost microcontroller unit (MCU) with integrated Wi-Fi capabilities is the ESP8266. It allows for basic Internet of Things development when coupled with other host microcontrollers, such as Arduino, or it can run on its own. It provides flexibility for Internet of Things applications with its 32-bit 80MHz CPU, 16 GPIO pins, and many interfaces.

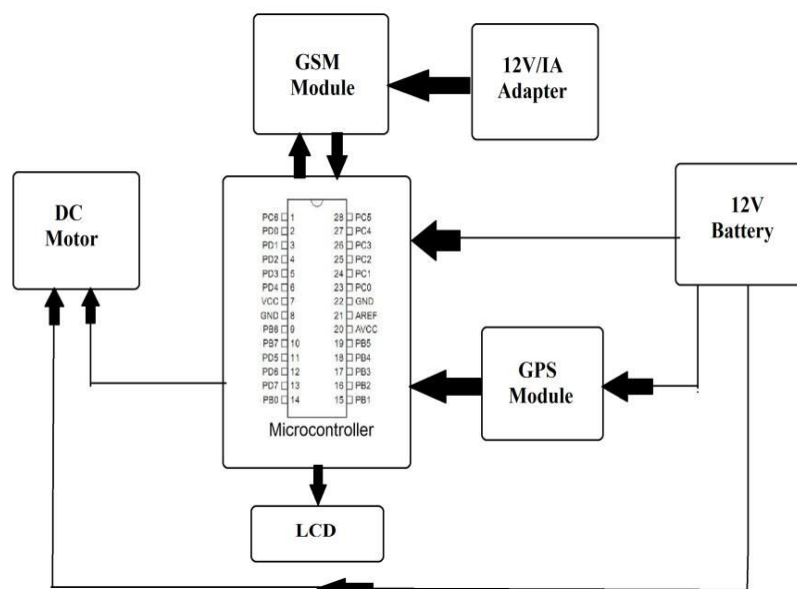
Direct Current (DC) Motor: A DC motor is a type of electric motor that uses DC power to turn mechanical shafts. It creates motion by using an external magnetic field and current-carrying conductors in an electromagnetic interaction.

Global Positioning System (GPS): This system, which is based on satellites, offers accurate positioning, directions, and times all around the world. Satellites, ground stations for control and monitoring, and individual GPS receivers used by users all work together to send signals that can be used to determine time, location (in three dimensions), and altitude.

An electromechanical switch, a relay may automatically turn things on and off. The anti-theft system's security measures rely on relays, which allow for the control of circuits using low-power signals or the management of numerous circuits with a single signal.

The LCD shows the current location of the car, either on a map or in text format. It may also provide address information if it is coupled with mapping services. Additionally, it notifies users or authorities through alert messages in the event that it detects suspicious activity that could be a sign of theft.

Adding a 12V battery to the GPS car monitoring and theft detection system makes it more reliable and effective. Security and power management features, when integrated correctly, provide an extra layer of protection against break-ins and theft.



V. PROBLEM IMPLEMENTATION

The following steps are involved in getting the aforementioned parts of a GPS-based anti-theft and vehicle monitoring system to work together:

Initialization

Upon starting the engine or upon detecting motion, the system activates the GPS and GSM modules, allowing the car or vehicle to begin its initialization process.

Where Are You Now? with GPS Monitoring:

GPS Positioning

The global positioning system (GPS) module gets its coordinates (latitude and longitude) from satellite signals. The ESP 8266 microcontroller is then notified of the processed data and instructed to take appropriate action.

Identifying Unauthorized Users:

In order to identify intrusion attempts, the system keeps a constant eye on the vehicle's state and compares it to predetermined parameters.

The system will sound an alarm if it detects any additional illicit key presses after the initial one.

Notification Generation and Distribution:

When the system detects unlawful access, it sends out an alert message with the current GPS coordinates of the car. This warning message is wirelessly transmitted to the owner's mobile phone using the GSM module.

Hands-Free Operation:

After getting the notification, the car owner can log in from anywhere with a smartphone or other device.

To do things like disable the engine, the owner can use the GSM module to transmit commands to the microcontroller.

Turn Off the Engine:

Once the microcontroller gets the signal from the remote, it turns off the engine by activating a relay.

Until allowed access is restored, the vehicle will be rendered immobile and unable to go further.

Visualization and Tracking:

The location of the car is shown on the LCD screen in real-time by means of the GPS module.

In addition, the car owner can keep tabs on system status updates and alert messages displayed on the screen.

Controlling Power:

A 12V battery powers the system, guaranteeing its dependability and uninterrupted functioning.

Optimal energy usage and continued system operation in low-power scenarios are guaranteed by power management features.

Collaboration and Information Sharing:

The GPS and GSM modules, as well as the ESP 8266 microcontroller, DC motor, relay, LCD, and battery, are all tightly coupled and work together to execute their individual tasks.

When components are properly wired, coded, and configured in terms of software and hardware, integration becomes much easier. By adhering to this interdependent procedure, the GPS-based anti-theft system for vehicles efficiently tracks the vehicle's location and state, identifies when it has been entered illegally, sends out notifications, allows for remote control operations, and strengthens protection against theft.

VI. EXPERIMENTED RESULTS AND DISCUSSIONS

The circuit diagram shown in Figure 5.1 illustrates the connection of the Arduino microcontroller with various components involved in the GPS-based vehicle tracking and anti-theft system. The Arduino serves as the central control unit, orchestrating the interactions between different modules and peripherals.

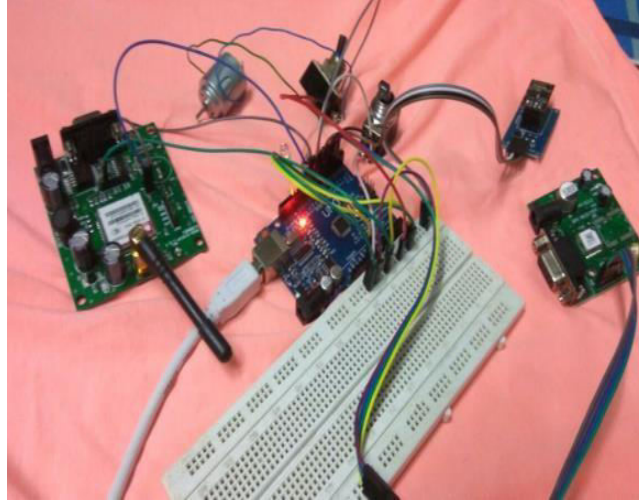


Figure 6.1 Circuit Connecting Arduino And Other Components

The Figure 6.2 showcases the alert message sent to the registered mobile device of the vehicle owner. In case of unauthorized access or suspicious activity detected by the system, an alert message containing relevant information such as the vehicle's location (latitude and longitude) is transmitted to the owner's mobile phone via SMS or other communication channels.

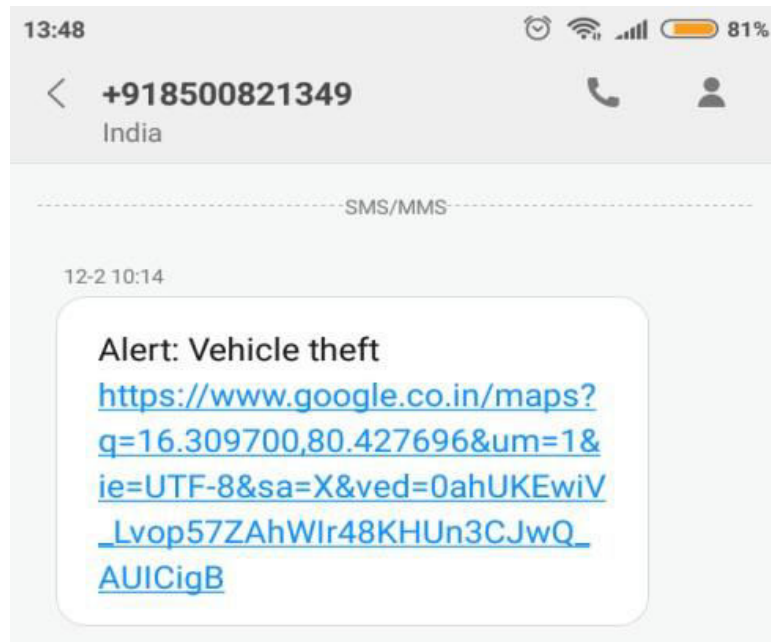


Figure 6.2 Alert Message sent to Registered Mobile

In Figure 6.3, the alert message along with the vehicle's location is displayed. This provides the vehicle owner with real-time updates regarding the status and location of their vehicle, enabling prompt action in response to potential threats or security breaches.

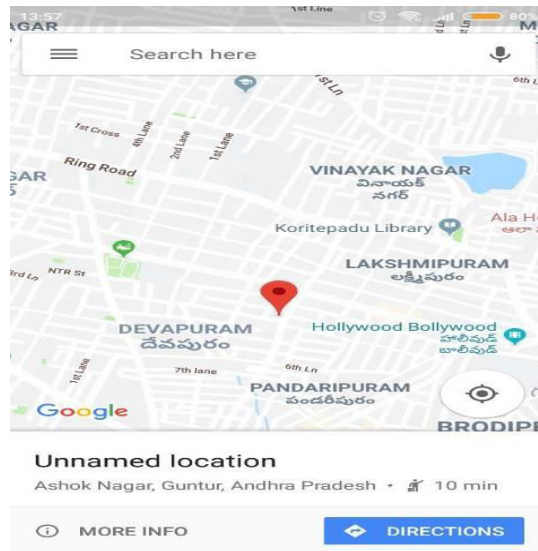


Figure 6.3 Alert Message and GPS Location sent to Owner

The Figure 5.4 demonstrates the utilization of Internet of Things (IoT) technology to post latitude and longitude readings. By leveraging IoT capabilities, the system can transmit location data to online platforms or servers, enabling remote monitoring and tracking of the vehicle's movements.

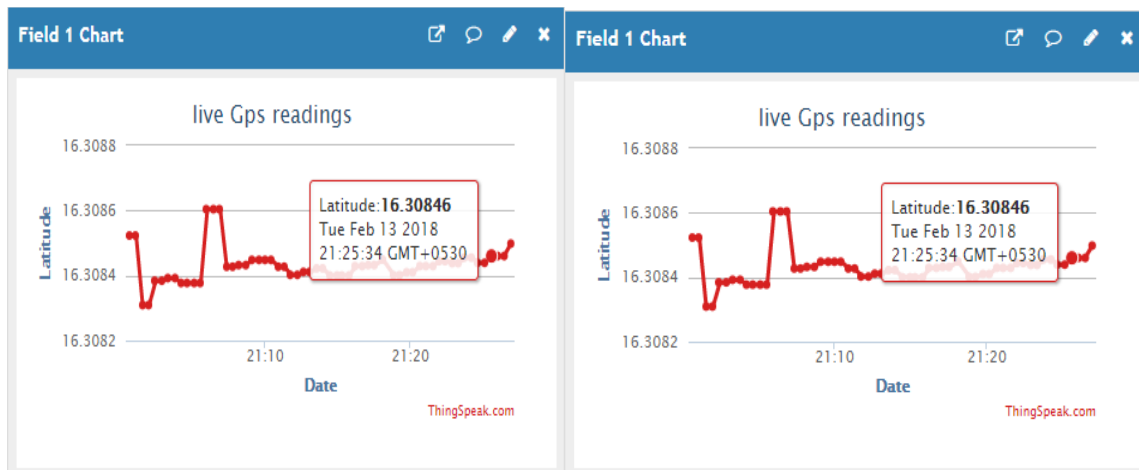


Figure 6.4 Latitude and longitude readings posted using IOT

Table 6.1 Tabulation of Findings

Key Aspect	Findings and Discussion
Detection Accuracy	The system demonstrates high accuracy in detecting unauthorized access and suspicious activities.
Alert Transmission	Prompt transmission of alert messages to the registered mobile device of the vehicle owner.
Location Tracking	Accurate real-time tracking of the vehicle's location using GPS technology.
Remote Control	Capability to immobilize the vehicle's engine remotely, enhancing security measures.

Key Aspect	Findings and Discussion
User Interface	Intuitive LCD display providing real-time information and system status updates.
Power Management	Reliable power supply from the integrated 12V battery, ensuring continuous operation.
Cost-Effectiveness	Affordable solution utilizing readily available components, making it accessible to vehicle owners.
Future Enhancements	Potential for integrating advanced features like geo-fencing and smartphone application support.

The Table 5.1 succinctly summarizes the experimental findings and discussions regarding the GPS-based vehicle tracking and anti-theft system.

VII. CONCLUSION

To combat vehicle theft, the SmartGuard system uses GPS and the Internet of Things (IoT) for remote monitoring and theft detection. The system's real-time tracking capabilities and smooth interaction with the vehicle's engine allow for rapid intervention in the event of unwanted entry and robust security measures. The experimental results show that the system can reliably track locations, send alerts quickly, and have excellent detection accuracy. An improved user experience and easier administration of vehicle security are both made possible by the remote control capabilities and the user-friendly interface.

Additionally, car owners looking for improved security measures can easily purchase the system due to its affordability and dependence on readily available components. The use of a 12V battery for dependable power management increases the system's efficacy in deterring theft by guaranteeing uninterrupted operation. In our day to day life there are many violent crimes among them vehicle theft is also tends to be the greater loss in our economic efforts. The proposed system helps to prevent the vehicle theft for the safety purpose. This also detects the vehicle effectively with low cost. When the third party access the vehicle the GSM module provides the alert message along with the location information in order to reduce the vehicle theft. This presented paper gives very Cost effective and individual automobile anti-stealing pursuit utilizing cloud based plat-form named as Thing Speak, Adriano microcontroller, GPS module, and GSM module are used to create a vehicle anti-theft system. SMS is sent, warning the owner's phone. Trial applications were used to verify the accuracy of the applied functions. Future projects will include the expansion of Android apps for car owner program, system durability testing, and long-term assessment.

VIII. FUTURE SCOPE AND ENHANCEMENTS

Adding geo-fencing features to the SmartGuard system will allow it to create virtual limits and send notifications when a vehicle deviates from them, enhancing security measures even further than they already are. Improving accessibility and user experience may be as simple as creating a specialized software for smartphones that users could use for remote monitoring, control, and receiving notifications in real-time. Incorporating advanced analytics would enable proactive security measures by allowing the system to study vehicle usage trends, identify anomalies, and provide predicted insights. If we looked into ways to improve connectivity, such 5G or LPWAN, we could increase the speed, coverage, and reliability of data transmission, which would make our system more responsive and efficient. It would be even better for recovery rates and the efficiency of law enforcement if the system could be integrated with their systems so that they could work together seamlessly during theft situations.

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