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Vehicle Security System (VSS)

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ABSTRACT:

With the increasing number of vehicles, vehicle security has become a significant concern. This paper presents an integrated solution using Global System for Mobile Communications (GSM) and Global Positioning System (GPS) technologies to enhance vehicle security. The system is designed to track and control vehicles remotely, providing a cost-effective and reliable solution for monitoring automobiles. The system uses a microcontroller board, a GPS receiver, and a GSM module to provide real-time vehicle location and status, which is particularly useful in car theft situations and for monitoring drivers. In case of unauthorized access, the system can lock the engine, trigger an alarm, and send an alert message with the vehicle's location. Despite potential limitations such as false alarms, privacy concerns, and maintenance, the benefits of this system outweigh the drawbacks, offering vehicle owners peace of mind and enhanced safety measures. The system can also be adapted for other applications where infrequent but critical information is required.

Keywords: Anti-theft, Anti-Theft Detection, Embedded Systems, GSM, GPS, Real-time Monitoring, Telematics, Global Positioning System (GPS), Global System for Mobile Communication (GSM), Arduino UNO Board, GSM 900A Module, GPS NEO-6M Receiver.

Introduction:

The persistent threat of theft has long plagued vehicle owners, prompting the development of increasingly sophisticated anti-theft systems. From traditional locks and keys to modern GPS and GSM technologies, the evolution of these systems mirrors the ongoing battle between security and theft. An immobilizer, for instance, is a vital component in modern vehicles, ensuring that only authorized individuals can start the engine.

Today, vehicle tracking systems predominantly rely on GPS technology, coupled with GSM or GPRS modems, to transmit location data to a central server. This information, accessible via the internet, empowers vehicle owners to monitor and safeguard their assets remotely. Research by Shah et al. [11], Singh et al. [12], and Ramani et al. [13] underscores the importance of such systems in enhancing vehicle security and facilitating timely responses to accidents or thefts.

In this paper, we present a vehicle security system leveraging GPS and GSM technologies. Unlike costlier alternatives, our system offers an affordable yet robust solution to combat theft and provide real-time tracking capabilities. By integrating GPS for positioning and GSM for communication, our embedded system continuously monitors vehicle status and can trigger alerts, immobilize the engine, and initiate alarms in response to unauthorized access attempts.

Our system's versatility extends beyond theft prevention; it also serves as a reliable tool for monitoring vehicle status and location. Whether detecting intrusions, sending location updates, or remotely immobilizing the engine, our solution equips vehicle owners with comprehensive control and peace of mind.

The following sections delve into the technical aspects of our system, detailing its components, functionality, and potential applications. Through this research, we aim to contribute to the ongoing discourse on vehicle security, offering practical insights into the implementation of cost-effective yet efficient anti-theft measures.

Problem Statement:

We seek to develop an efficient security system using an embedded setup comprising GPS and GSM technologies to tackle vehicle theft and promptly detect accidents.

Objectives:

- Design and develop a GSM and GPS tracking system tailored for vehicle security.
- Implement remote vehicle control functionality, allowing owners to enable/disable the vehicle using a mobile phone in case of theft.
- Configure the system to automatically send SMS alerts to hospitals and reference contacts, providing the accident location in real-time.
- Establish a notification system to send predefined messages to the vehicle owner in the event of theft, ensuring prompt awareness.

- Integrate with Google Maps to initiate real-time tracking of the vehicle's position via a dedicated vehicle tracker app, enhancing theft detection capabilities.
- Enhance vehicle security measures to safeguard against theft and unauthorized access.
- Enable immediate communication with emergency service providers by sending instant messages along with the current vehicle location in the event of an accident.

LITERATURE REVIEW

[1] M.Veeraiah, B.Nandini, P. Koteswara Rao, M. Jaswanth and M. Jyotsna used the fingerprint module where placing the finger in this module can be started by the authorized person only, which provides more security. They have placed an Accident Detection module as well.
[2] Anjan T L, Nikhil Satish, Abhinandan Kumar, Abhinav Narayan and Kiran S M used a password to access the vehicle, if the password is correctly entered then the circuit is built into the engine ignition system. If not, the ignition of the vehicle will not light up and the vehicle shall not start.
[3] Adnan Shamim, Eurusha Pious and Muhammad Adil have proposed a system in which when you insert the key it redirects to your Android Application. The mobile application is in the main control of the system and can specify the commands after then.
[4] Akinwole Bukola has designed an antitheft system with an authentication unit which is used for verifying the users of the vehicle by matching the captured fingerprints with the predefined fingerprints in the database.
[5] M. Bandyopadhyay, N. Mandal, S. Chattopadhyay and B. Roy have implemented an embedded system, GPS, and GSM Technology. It is a multi-processor operation technique. This module only provides an anti-theft system in automobiles and it's very flexible.
[6] Dr. G. Uday Kiran Bhargava, B. Ravi Kumar, and A. Karna Rao have proposed a model that can monitor, prevent and get the location during the accident and prevent an accident when vehicles come in close contact with each other with the help of the sensor.
[7] Harsha P. Pawar, Snehal A. Chavan, Sayali S. Chavan, and Tejasvi S. Yadav have proposed a system that will show the locations of the vehicles on mobile. The owner can get accidental details and location if the vehicle is being used by any other person. The owner can lock the vehicle by himself as well
[8] M. Benedict Tephila, G. Gokul, K. Imthyas Ahamed, and R. Indiran used IoT devices with Raspberry Pi along with ultrasonic and Vibration sensors. They equipped a camera for the facial recognition system as a part of the system feature.

Methodology:

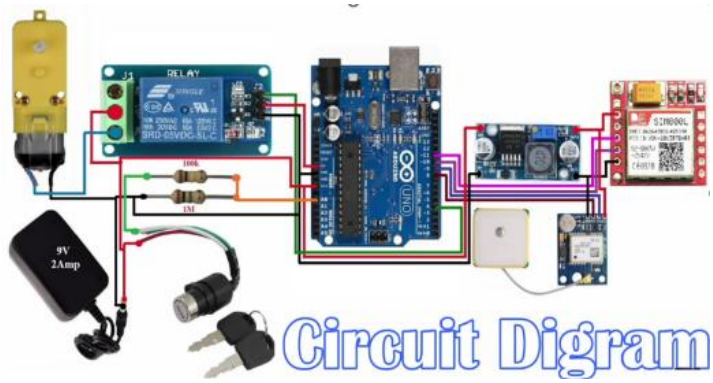
The project focuses specifically on two-wheelers, comprising monitoring and control phases. In the monitoring phase, users track and trace their two-wheelers, while the control phase responds to user inquiries and commands. The system operates on a request/response algorithm. A request SMS prompts the GSM module, embedded with an Arduino microcontroller board, to process the request. The Arduino board reads the request, extracts essential information, and compares it with predefined patterns. Upon recognizing the request, it utilizes a GPS receiver to obtain vehicle location coordinates and prepares a response. The response, containing latitude and longitude coordinates, is transmitted back to the user as a reply SMS. Arduino Uno serves as the microcontroller for this project, tailored specifically for two-wheeler security applications. The research implements state-of-the-art technology to develop a robust security system tailored for two-wheelers. The GPS system functions by receiving radio frequency signals from GPS satellites. A block diagram illustrates the vehicle's positioning and control process. Upon system activation, the main microcontroller monitors incoming SMS via the GSM module. Instructions to lock the vehicle trigger the activation of the relevant security mechanisms optimized for two-wheeler use. Upon detecting valid sensor signals, the main microcontroller processes the data and relays it to the owner via SMS.
In case of theft suspicion, the owner can send SMS commands to stop the engine and activate security features. Upon vehicle retrieval, the owner can send commands to deactivate security measures. The monitoring system deactivates, and the main microcontroller resumes SMS processing.

Technology Intervention:

A. ARDUINO UNO: The Arduino Uno microcontroller board, based on the ATmega328P microchip, offers a versatile platform for development projects. Featuring a range of digital and analog input/output pins, it seamlessly integrates with various development shields and interfaces. The board supports IDE (Integrated Development Environment) programming via USB connection and can be powered through a USB cable or an external 9V battery, accommodating power inputs ranging from 7V to 20V.
B. GPS RECEIVER-NEO-6M: The NEO-6M GPS receiver module is designed to accurately determine the installed location. Also known as GPS receivers, these modules provide latitude, longitude, and UTC (Coordinated Universal Time) coordinates. Utilizing signals transmitted by GPS satellites, these modules continuously update location data, enabling precise positioning.
C. GSM 900A MODULE: The GSM 900A module, equipped with a Subscriber Identity Module (SIM) card, functions similarly to a mobile phone. It connects to a cellular network, enabling communication via SMS. Widely used in various applications, including Internet of Things (IoT) and embedded systems, the GSM SIM900A module operates on GSM 900MHz and DCS 1800MHz bands, facilitating reliable communication.
D. POWER SUPPLY: The Arduino Uno can be powered via USB connection or an external power source. External power, typically supplied through an AC-to-DC adapter or battery, ensures stable operation within the specified voltage range of 7V to 12V. The SIM900A GSM module operates within a voltage range of 3.4V to 4.5V, with peak current consumption of up to 2A during data communication. Therefore, a high-quality power supply capable of delivering 2.5A to 3A is recommended for reliable operation. The GSM module is powered using a 12V-2A adapter in this setup, ensuring adequate power supply for seamless communication.

CIRCUIT DESIGN:

These are components are integrated into a cohesive circuit design, leveraging the Arduino Uno as the central controller to manage communication between the GPS receiver, GSM module, and power supply. The GPS module continuously updates location data, while the GSM module facilitates communication with the user via SMS. The power supply ensures reliable operation of the entire system, providing adequate voltage and current levels for optimal performance.

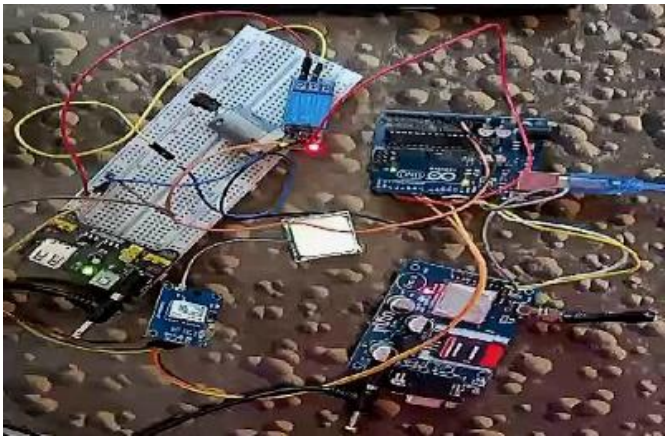


Working Principle:

The automotive tracking system operates on a straightforward network. The GPS receiver's transmitter (TX) terminal connects directly to digital terminal 10 of the Arduino Uno microcontroller board. Using the Software Serial library, terminals 0 and 1 of the Arduino Uno are allocated for serial communication with the GSM 900A module, enabling communication on digital terminals 10 for receiving location data from the GPS receiver. The GPS receiver's receiver (Rx) terminal is linked to digital terminal 3 of the Arduino Uno.

The GSM 900A module's transmitter (Tx) and receiver (Rx) terminals are directly connected to digital terminals 0 and 1 of the Arduino Uno. A 12-volt power supply is utilized for both the GPS receiver and the GSM 900A module. Optionally, an LCD display's data bus terminals 4, 5, 6, and 7 are connected to digital terminals 5, 4, 3, and 2 of the Arduino Uno, respectively. The LCD's command pin register selector (RS) and enable (EN) terminals are connected to digital terminals 2 and 3 of the Arduino Uno, while the read/write (RW) terminal is connected to GND. Digital pin 6 is used to adjust the contrast and brightness of the LCD.

The project's logic is configured using MS Windows 10 as the platform and an integrated development environment (IDE) for the Arduino Uno. The project utilizes an Intel Core i5 CPU with 8 gigabytes of RAM as the primary hardware for computation and analysis. Other hardware components are interconnected as illustrated below.



Conclusion:

The utilization of global positioning frameworks has become indispensable for individuals seeking effective vehicle security measures. Vehicle tracking systems are increasingly popular not only in urban areas but also in smaller towns. This integrated system empowers users to track their vehicles effortlessly from anywhere and at any time. As vehicle theft rates rise, individuals have found an efficient way to monitor their vehicles remotely without being physically present. These systems play a crucial role in curbing thefts and enhancing vehicle security. Typically, GPS receivers (such as the NEO-6M) and GSM modules (like the GSM 900A) are employed in such systems.

With this framework, users can determine their vehicle's location and track its movements in real-time. The system offers reliability and security, making it a preferred choice for vehicle owners. Upgrading the system is straightforward, allowing for easy adaptation to future requirements without the need for extensive reconfiguration. Additionally, the utilization of efficient modules, such as those used in this project for SMS communication, contributes to the system's effectiveness.

While GSM modules support various generations like 2G, 3G, and 4G, only 2G is supported in certain regions due to frequency band variations. However, the GSM module seamlessly interfaces with the Arduino Uno microcontroller board using AT commands. Moreover, the GPS module reliably receives signals from GPS satellites, ensuring accurate positioning.

Vehicle tracking systems represent a significant advancement in fleet management, offering functionalities crucial for locating stolen or accident-affected vehicles. These systems find extensive applications in the transportation sector, notably in taxi operations. They facilitate location management, dispatching reserved taxis to customers, and optimizing routes to avoid congestion. Furthermore, civil vehicle systems like buses and trains benefit from route optimization and real-time location tracking, aiding congestion management efforts. Overall, vehicle tracking systems offer real-time location data capture, storage, analysis, and transmission to monitoring authorities for further actions.

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