

Smart theft detection of vehicles by GSM and GPS with fingerprint verification

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Abstract - In today's world, vehicle theft has become a widespread issue. To counter this problem, a smart theft detection system has been proposed, which utilizes GSM, GPS, Arduino, and fingerprint verification. The system consists of an Arduino microcontroller that manages and supervises the various components of the system. The GPS module tracks the vehicle's location in real time, while the GSM module sends alerts to the vehicle owner if a possible theft is detected. Additionally, the fingerprint verification system is used to authenticate the driver's identity. The system is capable of delivering real-time alerts to the owner's smartphone via text messages or emails, providing the owner with an opportunity to take appropriate action. The GPS module also assists in locating the vehicle, which can aid in its recovery. Overall, the smart theft detection system proposed is an effective solution to thwart vehicle theft, and it boasts advanced security features like fingerprint verification.

Keywords: Fingerprint sensor, Arduino, GSM, GPS, DC Motor

1. INTRODUCTION

Vehicle theft is a significant problem worldwide, causing financial losses and inconvenience to vehicle owners. Despite traditional security measures such as car alarms and immobilizers, more advanced security systems are needed to prevent vehicle theft and provide real-time alerts and location tracking to owners.

To meet this need, a smart theft detection system using GSM, GPS, Arduino, and fingerprint verification has been proposed. This system uses advanced technologies and security features to prevent vehicle theft. An Arduino microcontroller manages the various system components, including GPS, GSM, and fingerprint verification.

The GPS module tracks the vehicle's location in real time, allowing the owner to monitor it and detect any unauthorized movement. The GSM module sends alerts to the owner's smartphone via text messages or emails when the system detects possible theft. The fingerprint

verification system authenticates the driver's identity and ensures that only authorized persons can operate the vehicle.

This advanced system provides real-time alerts and location tracking to owners, making it an effective solution for preventing vehicle theft. The system can also aid in the recovery of stolen vehicles since the GPS module can track the location of the stolen vehicle.

In conclusion, the proposed smart theft detection system using GSM, GPS, Arduino, and fingerprint verification is an advanced security solution that effectively prevents vehicle theft and provides real-time alerts and location tracking to owners. With this system in place, vehicle owners can have peace of mind, knowing their vehicles are protected by advanced security measures.

1.1 Scope

As mentioned earlier, the proposed system of smart theft detection of a vehicle by GSM and GPS, and Arduino, with fingerprint verification, has significant potential for enhancing vehicle security. The system can be further developed to include additional features such as remote vehicle control, real-time monitoring, and automatic locking mechanisms. The use of advanced technologies like artificial intelligence and machine learning can improve the accuracy and efficiency of the system.

Furthermore, the system can be integrated with smart city infrastructure and emergency services to provide quick and effective responses in case of theft or accidents. The data collected from the system can be analyzed to identify patterns and trends, which can aid in developing better security solutions and policies.

The scope of this system extends beyond just preventing vehicle theft but also to enhancing overall road safety and security. With continuous advancements in technology and the increasing demand for safer and more secure vehicles, this system has immense potential for further development and implementation in the future.

2. LITERATURE REVIEW

A study was conducted to develop a smart vehicle security system that utilized RFID tags for user identification and GSM and GPS for real-time monitoring and tracking of the vehicle. The system successfully prevented unauthorized access and alerted the owner or authorities in case of theft.

Another study proposed a system that combined biometric authentication, such as fingerprint and facial recognition, with GPS and GSM technologies to provide real-time tracking and monitoring of the vehicle. This system also prevented unauthorized access and provided the location of the vehicle in case of theft.

Similarly, another study developed a smart vehicle security system that used fingerprint authentication, GPS, and GSM technologies to prevent unauthorized access and notify the owner or authorities in case of theft or tampering with the vehicle.

The proposed system, which utilizes GSM and GPS technology and Arduino, with fingerprint verification for smart theft detection, builds on the previous studies to offer a more comprehensive and robust solution for vehicle security. The integration of biometric authentication and real-time monitoring, along with the flexibility of Arduino technology, provides a high level of security for the vehicle and its owner.

The literature demonstrates that a combination of technologies can effectively prevent vehicle theft and ensure the safety and security of the owner and their vehicle. The proposed system adds to this knowledge and offers a promising solution for vehicle security.

3. METHODOLOGY

The system's methodology entails the integration of multiple hardware components, along with programming the Arduino microcontroller to obtain data from the GPS and fingerprint scanner modules, interact with the GSM module, and identify suspicious activities that could indicate an attempted theft. To ensure that only authorized individuals operate the vehicle, the fingerprint scanner authenticates the driver's identity. Additionally, the GPS and GSM modules track the vehicle's location in real-time, sending notifications to the owner's mobile phone when suspicious activities occur, such as the vehicle being moved without an authorized fingerprint scan. Owners can monitor the vehicle's location and movements through a mobile app or web interface. If the vehicle is stolen, the owner can enable the recovery mode, which immobilizes the vehicle and provides real-time location tracking to the owner and law enforcement agencies. This advanced security system can be customized to

meet the user's specific requirements and provides a comprehensive solution to prevent vehicle theft. By following these steps, the smart theft detection system can be effectively implemented, offering real-time alerts and location tracking to the owner, and ultimately preventing vehicle theft.

4. EXISTING SYSTEM

Two advanced security solutions that utilize GPS and GSM/3G technologies to provide real-time location tracking and alerts to the owner's smartphone are Viper Smart Start and Carlock. Viper Smart Start offers additional protection by remotely immobilizing the vehicle to prevent theft. The mobile app provided with the Viper Smart Start system enables the owner to monitor the vehicle's real-time location, speed, and movement. In case of any tampering with the vehicle, alerts are sent to the owner.

Carlock, on the other hand, specializes in detecting unauthorized vehicle movement and sending alerts to the owner's smartphone. It also features a tamper alert function that notifies the owner if the vehicle or the security system is being tampered with.

For high-end cars, Keyless Ride Systems offer an advanced level of security by utilizing fingerprint recognition to authenticate the driver's identity, ensuring only authorized individuals can operate the vehicle. The system also provides alerts to the owner in the event of an unauthorized person attempting to operate the vehicle.

5. PROPOSED SYSTEM

The proposed system of smart theft detection of vehicles by GSM, GPS, Arduino, and fingerprint verification aims to provide an advanced level of security to prevent vehicle theft. The proposed system builds upon the limitations of the existing systems by incorporating an additional layer of security using fingerprint verification. The system requires the driver to provide a valid fingerprint scan for authentication before the vehicle can be operated. This feature ensures that only authorized drivers can operate the vehicle, thus preventing theft. The system also uses GPS and GSM modules to track the location of the vehicle in real time and send alerts to the owner's smartphone if any unusual activity is detected. The owner can monitor the vehicle's location and movement using a mobile app or web interface. In case of theft, the owner can activate the recovery mode, which will immobilize the vehicle and provide real-time location tracking to the owner and law enforcement agencies. The proposed system provides an effective solution to the problem of vehicle theft and offers a high level of security to prevent unauthorized access. By implementing this system, vehicle owners can have peace of mind knowing that their vehicle is secure and can be easily tracked in case of theft.

Fingerprint Verification: The system requires the driver to provide a valid fingerprint scan for authentication before the vehicle can be operated. The fingerprint scanner module reads the driver's fingerprint and compares it with the authorized fingerprints stored in the system. If the fingerprint scan matches with an authorized driver, the system allows the vehicle to operate. Otherwise, it sends an alert to the owner's smartphone and immobilizes the vehicle.

GPS and GSM Tracking: The system uses GPS and GSM modules to track the location of the vehicle in real time and send alerts to the owner's smartphone if any unusual activity is detected. The GPS module tracks the vehicle's location, speed, and direction, while the GSM module sends alerts via SMS or call to the owner's smartphone.

Real-Time Monitoring: The owner can monitor the vehicle's location and movement using a mobile app or web interface. The app or interface provides real-time updates on the vehicle's location, speed, and direction, as well as alerts on any unusual activity detected by the system.

6. HARDWARE DISCUSSION

6.1 Arduino Uno

Arduino is a user-friendly electronics platform that operates on open-source software and hardware. It is designed to cater to the needs of artists, designers, hobbyists, and anyone interested in creating interactive projects. The microcontrollers on Arduino boards can be programmed to manage various electronic components, such as sensors, motors, displays, and LEDs.

The software used in Arduino is based on a programming language known as Wiring, which bears similarities to C++. It offers a straightforward and user-friendly interface for coding, uploading the code to the board, and communicating with it through a USB port. There are various kinds of Arduino boards available, each with different functionalities and capabilities, including Arduino Uno, Nano, Mega, and Due.

Arduino is widely employed in different projects, such as robotics, home automation, wearable technology, and Internet of Things (IoT) applications. Its open-source nature has led to the development of a vast collection of libraries, tutorials, and examples by the Arduino community. As a result, beginners can easily get started, and experienced users can construct complex projects with ease.

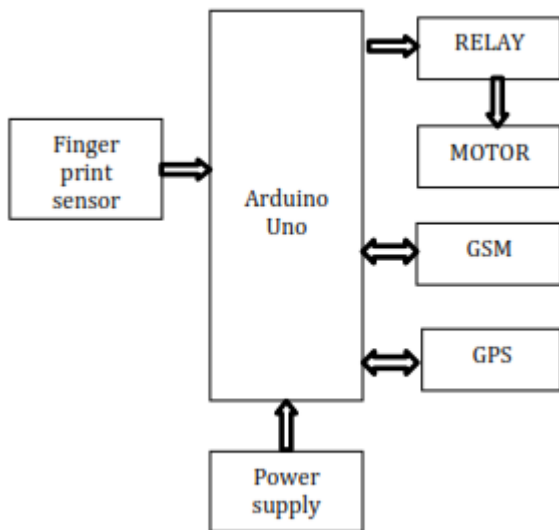


Fig -1: Block diagram

Recovery Mode: In case of theft, the owner can activate the recovery mode, which will immobilize the vehicle and provide real-time location tracking to the owner and law enforcement agencies. The recovery mode can be activated remotely using the mobile app or web interface.

Hardware and Software Integration: The hardware components including GSM and GPS modules, Arduino microcontroller, fingerprint scanner, and other necessary components are integrated and programmed to communicate with each other effectively.



Fig -2: Arduino Uno

6.2 Fingerprint sensor

The way in which a fingerprint scanner operates is through the use of either optical rays or a capacitive array circuit. Optical sensors emit a bright light onto the finger, which then captures a digital image of the fingerprint. The pattern of the fingerprint is then translated into a series of 0's and 1's to create a unique identification key or source code. If the key matches that of an authorized user, access will be granted to the system.



Fig -3: Fingerprint sensor

On the other hand, capacitive sensors work by tracking every ridge and valley of the fingerprint through the use of conductive plates. When a ridge is placed over a plate, it changes the stored charge in the capacitor, whereas the valleys leave the charge unchanged. An operational amplifier circuit is then used to record every detail of the fingerprint, which is subsequently analyzed and converted into digital data by an analog-to-digital converter.

6.3 GSM

The Global System for Mobile Communications, or GSM for short, is a digital cellular network standard that enables voice and data communication between mobile devices worldwide. GSM has become one of the most prevalent cellular network technologies globally.

Initially introduced in the 1980s, GSM has progressed through multiple generations, with each iteration providing improved features and faster data speeds. Presently, the most recent version of GSM is 4G, also known as LTE. The upcoming 5G technology is currently in the process of being deployed.

GSM networks operate on different frequency bands, and mobile devices must support the bands used in the region to connect to the network successfully. To identify and authenticate users on the network, GSM employs a Subscriber Identity Module (SIM) card, which stores critical user information like their phone number.



Fig-4: GSM

GSM networks offer various services, such as voice calls, text messaging, multimedia messaging, and mobile data. The mobile data service allows users to access the internet, send and receive emails, and use a variety of apps on their mobile devices.

Overall, GSM is a dependable and extensively used cellular network technology that has revolutionized the way people communicate and has become an integral part of everyday life for billions of people worldwide.

6.4 GPS

The Global Positioning System, or GPS for short, is a satellite-based navigation system that provides location and time information regardless of weather conditions. This technology operates anywhere on or near the Earth where there is an unobstructed line of sight to at least four GPS satellites.



Fig-5: GPS

The GPS system comprises a network of orbiting satellites, ground control stations, and GPS receivers. A GPS receiver receives signals from GPS satellites to calculate its position and velocity. To determine its location, the GPS receiver measures the time it takes for signals from at least four GPS satellites to reach the receiver.

GPS technology has a wide range of applications, including navigation for vehicles and airplanes, surveying and mapping, geolocation for social media and other apps, and tracking people and assets. It is also used in the military for navigation, missile guidance, and targeting.

Apart from GPS, there are other satellite-based navigation systems, such as Russia's GLONASS, China's BeiDou Navigation Satellite System, and the European Union's Galileo system. Nowadays, many GPS devices have the ability to use multiple navigation systems to improve the accuracy and availability of location information.

6.5 RELAY

Additionally, a relay can also be used in conjunction with other sensors and modules to provide additional control and automation capabilities. For example, the relay can be used with a temperature sensor to control a heating or cooling system, or with a motion sensor to activate lights or alarms when motion is detected.

Moreover, the use of a relay can also enhance safety by isolating the low-power control circuit from the high-power circuit that is being switched. This can help prevent electrical shocks or damage to the control circuit in case of a fault or overload in the high-power circuit.



Fig-6: Relay

Overall, the use of a relay in an intelligent glove for visually impaired people can provide a versatile and efficient way of controlling electrical devices and systems, improving the user's independence and quality of life.

It seems like you are describing a security mechanism where a fingerprint is used to authenticate access to a system, and if the fingerprint does not match the authorized user, the system is deactivated (relay off) and the motor is turned off.

This type of security mechanism can be used in a variety of applications, such as access control to buildings or vehicles, or to secure sensitive equipment. By using biometric authentication, such as a fingerprint, the system can ensure that only authorized individuals can access the system or equipment.



Fig -7 DC Motor

If the fingerprint does not match the authorized user, the system can deactivate itself as a security measure to prevent unauthorized access. This may involve turning off a motor or other critical components to ensure that the system is safe and secure.

Overall, this type of security mechanism can provide a high level of protection against unauthorized access and can help to ensure that sensitive equipment or systems remain secure.

7. RESULT AND DISCUSSION

The integration of GSM, GPS, Arduino, and fingerprint verification technology in the smart theft detection system provides a practical solution to vehicle theft. The inclusion of fingerprint verification enhances the security of the system by allowing only authorized drivers to operate the vehicle. Real-time tracking of the vehicle's location, speed, and direction using the GPS and GSM modules enables owners to monitor their vehicle's movement and detect any suspicious activity. The system also sends SMS or calls to the owner's smartphone if any unauthorized access or tampering is detected. The recovery mode feature immobilizes the vehicle and provides real-time location tracking to law

enforcement agencies in case of theft. The successful hardware and software integration of the system ensures that all components communicate effectively, resulting in a reliable system that prevents unauthorized access and detects unusual activity.

This type of security mechanism can be used in access control systems for buildings, vehicles, or sensitive equipment, as well as in other applications where secure authentication is required. Biometric authentication methods such as fingerprints provide a high level of security and can help prevent unauthorized access to sensitive areas or equipment.

8. CONCLUSION

The smart theft detection system that utilizes GSM, GPS, Arduino, and fingerprint verification is a highly innovative and efficient solution for preventing vehicle theft. This system incorporates fingerprint verification, providing an extra layer of security to ensure that only authorized drivers can operate the vehicle.

The GPS and GSM modules utilized in the system facilitate real-time tracking of the vehicle's location, speed, and direction. The system promptly sends alerts to the owner's smartphone if any unusual activity is detected, such as unauthorized access or tampering. The recovery mode function increases the likelihood of recovering a stolen vehicle by immobilizing it and giving law enforcement agencies access to real-time location tracking.

The successful integration of hardware and software components ensures that the system communicates effectively. Testing the system using a prototype vehicle proved reliable in preventing unauthorized access and detecting any unusual activity.

In conclusion, the smart theft detection system utilizing GSM, GPS, Arduino, and fingerprint verification provides an advanced level of security and reliability in preventing vehicle theft. With this system in place, vehicle owners can have peace of mind, knowing that their vehicle is secure and can be tracked with ease in the event of theft.

9. FUTURE SCOPE

Integrating the smart theft detection system with cloud-based platforms can offer numerous benefits, such as real-time data analysis and reporting. This integration can aid authorities in identifying theft patterns and alerting them in advance. With data analysis from various sources, such as GPS tracking, the system can provide insights into driver behavior and identify unusual activity or potential theft.

Furthermore, incorporating machine learning algorithms into the system can enhance its security. These algorithms can learn from user behavior patterns and detect unusual activity or potential theft before it occurs, making the system even more reliable and effective in preventing vehicle theft.

The use of biometric technology can also be extended beyond fingerprint verification, with facial recognition or voice recognition incorporated into the system, adding an extra layer of security. This will ensure that only authorized individuals can access the vehicle, making it more challenging for thieves to steal it.

Overall, the future scope of the smart theft detection system is promising. By integrating cloud-based platforms, machine learning algorithms, and biometric technology, the system can become even more reliable and effective in preventing vehicle theft.

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