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IOT-Enhanced Vehicle Security and Recovery System

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***Abstract*— The field of vehicle security and recovery has undergone a radical transformation with the incorporation of Internet of Things (IoT) technologies into vehicular systems. In order to meet the ever-changing challenges of protecting vehicles from theft and unauthorized access, this paper introduces an innovative IoT-enhanced vehicle security and recovery system. The suggested system creates an extensive network of sensors, actuators, and communication modules inside the vehicle infrastructure by utilizing the capabilities of the Internet of Things. Early detection of suspicious activity is made possible by continuous monitoring of the vehicle's surroundings and status made possible by real-time data collection and analysis. The system utilizes sophisticated algorithms to initiate prompt response mechanisms, such as remote immobilization and GPS-based tracking, in the event of a security breach.**

***Keywords*— IoT (Internet of Things), Vehicle Security, Theft Prevention, GPS-based tracking, Real-time Monitoring, Remote Immobilization**

I. INTRODUCTION

Efficiency, connection, and security have all significantly improved as a result of the integration of Internet of Things (IoT) technologies into a variety of businesses in recent years. Vehicle security and recovery is one prominent sector where IoT has had a significant impact. The increased use of smart devices and networked systems has rendered conventional techniques for protecting vehicles from theft and illegal entry less effective. Statistics show that the recovery rate of stolen vehicles is still relatively low, which emphasizes the need for creative strategies to deal with this ongoing issue. This study offers an IoT-enhanced vehicle security and recovery system with the goal of revolutionizing the protection and recovery of vehicles, acknowledging the shortcomings of current security solutions. Using the Internet of Things' power, this system aims to build an extensive network of sensors, actuators, and communication modules integrated into the vehicles infrastructure by utilizing the power of the Internet of Things. This network makes it possible to continuously monitor the status and surrounds of the vehicle, which enables the early detection of potentially dangerous activity and security breaches. In the case of a theft or unwanted access, the suggested solution makes use of real-time data collecting and processing to enable pre-emptive security actions like remote immobilization and GPS-based tracking. The system has the ability to utilize advanced algorithms to promptly trigger response mechanisms, hence reducing the likelihood of vehicle theft and improving the possibilities of recovery.

II. LITERATURE REVIEW

[1] D. Narendra Singh, K. Tejaswi (M. Tech) (2013): The security system in smart cars uses an ARM processor to allow real-time user verification using face recognition. In the event that authentication fails, the ARM starts a sequence of actions that include locking the car and notifying the owner via MMS, with optional GPS-based SMS location tracking.

[2] R. Ramani, S. Vallarmathy, Dr . N. Suthanthira Vanitha, S. Selvaraju, R Thangam, M Thirupathi (2013): explained the tracking and locking system for vehicles makes use of GPS and GSM for tracking location and remote control. In the event of theft, SMS commands to the microcontroller enable engine immobilization and require password authentication for door access and restart.

[3] Vikram Kulkarni & Viswa Prakash Babu – "Face Detection Embedded Smart Car Security System" (2015) The suggested system uses facial recognition to quickly identify possible thieves. It also sends an MMS notice to the owner and allows SMS tracking of the vehicle's location and speed in real time.

[4] An IoT-Based Approach for Vehicle Theft Detection, K. Kaminozhi, D. Mukesh, and M. Ashok (2017): proposed This system makes it impossible for thieves to succeed in their theft efforts by enabling undetectable driver verification, real-time car tracking, location updates, and alerting neighbouring police stations in the event of suspected theft.

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[5] Champa Bhagavathi. R, Gowri. B. R, Kasturi. R, and Pooja. C. "Detection and Prevention of Vehicle Theft Using GSM and GPS,"(2016): implemented using a PIC18F46K22 controller, GPS, GSM, and one-time password modules, a high-level authentication vehicle theft detection and location system has been created. Future improvements could include functions for parental guidance and speed control.

[6] A. Alshmarani and L. Jamjoom. "A Wirelessly Controlled Digital Car Lock for Smart Transportation." (2018): focused to create an Internet of Things (IoT)-based wireless car lock system that can be operated by a smartphone for shared vehicle use. Authorized users connect to the automobile via the internet to request access, get a digital code on their cell phones, and operate the car lock with a customized Android app that pairs with an embedded controller via Bluetooth.

[7] "Adaptive speed control and vehicle security using speech processing," G. Kruti kamani, E. Esaki Vigneswaran: In order to lower the risk of auto theft, the suggested system included speech processing in its automobile security system for user-authenticated door control. It also uses radio frequency identification (RF-ID) technology to enforce speed limits in places that are designated for that purpose.

III. METHODOLOGY

The process for creating an all-encompassing system architecture to incorporate sensors, actuators, and communication modules into the vehicle infrastructure is part of the IoT-enhanced vehicle security and recovery system methodology. This include deciding which parts to use to monitor the parameters of the vehicle and putting reaction mechanisms in place. In order to facilitate real-time data gathering and analysis and the early detection of suspicious activity, communication protocols are set up. In order to reduce security breaches and facilitate vehicle recovery, algorithms for remote immobilization and GPS-based tracking are being developed.

BLOCK DIAGRAM

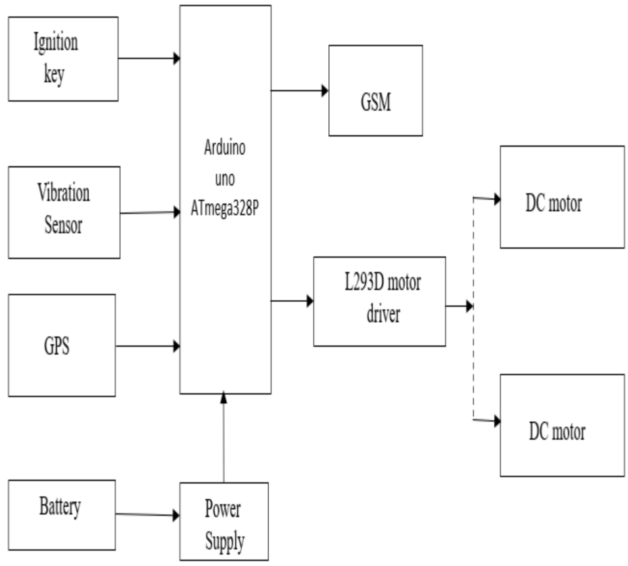

Fig.1. Block Diagram for IoT-Enhanced Vehicle Security and Recovery System

CIRCUIT DIAGRAM

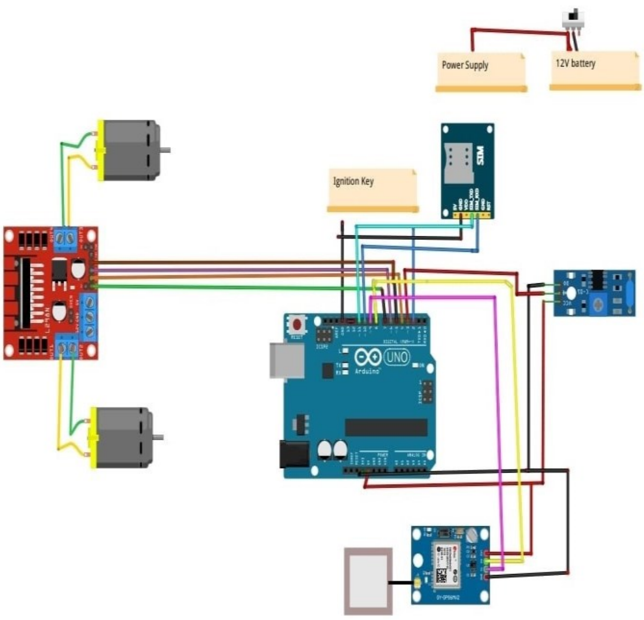

Fig.2. Circuit Diagram for IoT-Enhanced Vehicle Security and Recovery System

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FLOW CHART

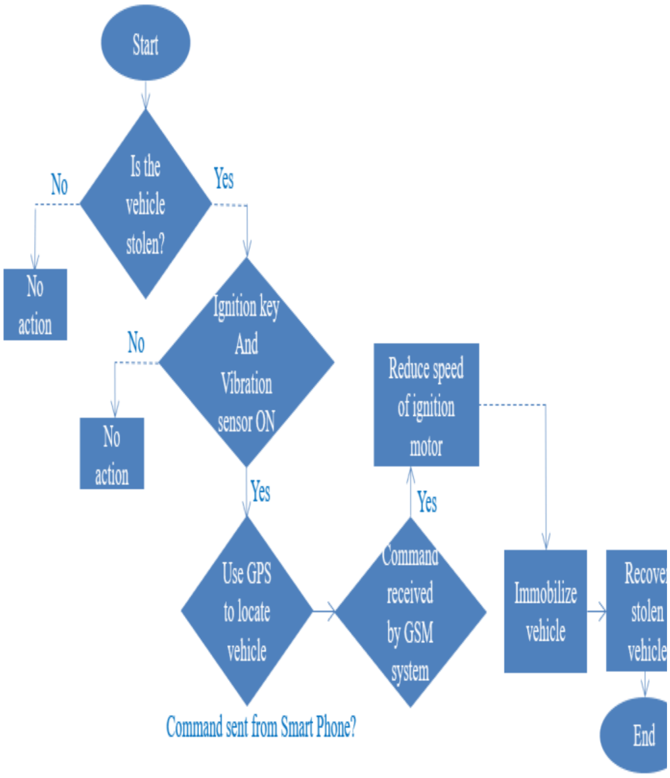

Fig.3. Flowchart for IoT- Enhanced Vehicle Security and Recovery System

COMPONENTS REQUIRED

1. ARDUINO UNO:

A microcontroller board based on the ATmega328 is called the Uno with Cable. It contains six analog inputs, a 16 MHz ceramic resonator, 14 digital input/output pins (six of which can be used as PWM outputs), a USB port, a power jack, an ICSP header, and a reset button. It comes with everything needed to support the microcontroller; all you need to do is power it with a battery or an AC-to-DC adapter or connect it to a computer via a USB cable to get going. The future release of Arduino 1.0 will be known by the name "Uno," which translates to "one" in Italian. Going future, the Arduino reference versions will be the Uno and version 1.0. The reference model and most recent USB Arduino board is the Uno. Either an external power supply or a USB connection can be used to power the Uno R3. It chooses the power source on its own. Batteries or wall-warts that convert AC to DC can supply external (non-USB) power. To connect the adapter, insert a 2.1mm centre-positive connector into the power jack on the board. The Gnd and Vin pin headers of the POWER connection can accept battery leads. An external supply of 6 to 20 volts can power the board. However, the 5V pin may only give five volts, and the board can become unstable, if the supply is less than seven volts. The voltage regulator may overheat and harm the board if more than 12V is used. The 7–12 volts range is advised.

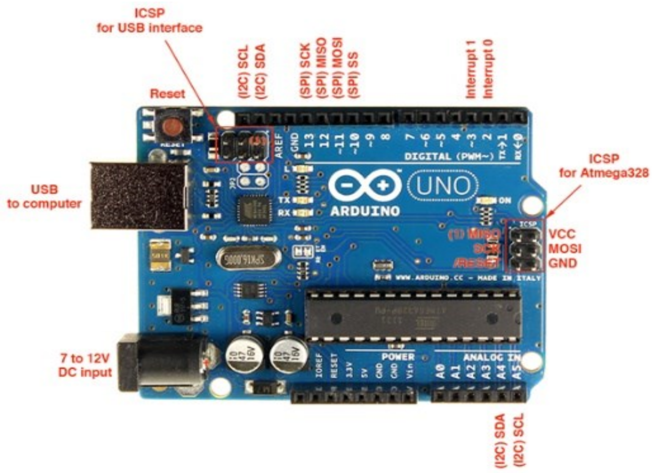

Fig.4. Arduino UNO

2. IGNITION KEY:

An ignition key is a tool used to turn on and off a car's engine. The ignition switch, which is normally found on the dashboard or steering column of the vehicle, accepts a physical key that is inserted. The starting motor receives a signal from turning the key, or pushing the button in keyless systems, and engages to turn the engine over. Fuel is fed into the cylinders by the engine as it spins, and when the fuel-air mixture ignites thanks to the spark plugs, the engine starts. The ignition key can be removed from the ignition switch once the engine is running, but the car won't stop running until the driver moves the key back to the off position. The driver engages the engine's fuel supply and cuts off the engine's electrical power by turning the key to the off position. Although physical ignition keys have been widely used for a long time, keyless entry and ignition technologies are frequently found in contemporary cars. Electronic key fobs or cards that interface with the car's computer to provide keyless entry, engine starting, and occasionally even remote start capabilities are a possible component of these systems.

Fig.5. Ignition key

3. VIBRATION SENSOR:

Another term for the vibration sensor is a piezoelectric sensor. These flexible sensors are employed in a variety of process measurements. By converting to an electrical charge, this sensor leverages the piezoelectric effects to measure changes in force, temperature, acceleration, pressure, and strain. This sensor immediately measures capacitance and quality, which is also used to determine scents in the air. The method by which a vibration sensor detects system vibrations is through the use of various optical or mechanical principles. These sensors' typical sensitivity ranges are 10 mV/g to 100 mV/g, while they can potentially have lower and greater sensitivity levels. Depending on the application, the sensor's sensitivity can be chosen. Therefore, it is critical to understand the range of vibration amplitude levels to which the sensor will be subjected during measurements. In many different fields, vibration sensors are essential for safety monitoring, predictive maintenance, and performance optimization.

Fig. 6. Vibration Sensor

4. GSM MODULE:

Global system for mobile communication, or GSM, is a type of mobile communication modem. At Bell Laboratories, the GSM concept was invented in 1970. It's a mobile communication system that's commonly used worldwide. GSM uses the 850MHz, 900MHz, 1800MHz, and 1900MHz frequency bands to provide mobile voice and data services. It is an open, digital cellular technology. The time division multiple access (TDMA) technique was used in the development of the GSM system, which is a digital system designed for communication. After the data has been reduced and digitalized, a GSM transmits it via a channel carrying two distinct streams of customer data, each scheduled for a certain time slot. Data speeds ranging from 64 kbps to 120 Mbps can be carried by the digital system. A GSM modem is a gadget that can be used as a modem or a mobile phone to enable network communication between computers and other processors. In order to function, a GSM modem needs a SIM card and can connect to a network within the range that the network operator has subscribed to. It can be linked via Bluetooth, USB, or serial connection to a computer.

Fig.7. GSM Module

5. GPS:

The Global Positioning System (GPS) is a satellite-based system that calculates and measures its position on Earth using both satellites and ground stations. Navigation System with Time and Ranging (NAVSTAR) GPS is another name for GPS. For accuracy purposes, a GPS receiver must receive data from a minimum of four satellites. There is no information transmitted to the satellites by the GPS receiver. A GPS receiver locates itself accurately wherever it is by using a constellation of satellites and ground stations. These GPS satellites use radio frequency (1.1 to 1.5 GHz) to send information signals to the receiver. A GPS module or ground station may calculate its position and time using this received data. A GPS receiver determines its distance from GPS satellites by receiving information signals from them. A global positioning system (GPS) gadget uses trilateration, a mathematical method, to estimate the user's position, speed, and elevation. A GPS device can determine the precise distance or range to each GPS satellite being monitored by continuously gathering and examining radio signals from many GPS satellites and applying the geometry of circles, spheres, and triangles. Although it doesn't depend on angle measurement for its computations, trilateration is an advanced form of triangulation. GPS receiver module output is provided in NMEA string format, which is the industry standard for marine electronics. Defaulting to a 9600 Baud rate, it outputs serially on the Tx pin.

Fig.8. GPS

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6. L293D MOTOR DRIVER:

An integrated circuit chip called a motor driver is typically used to regulate motors in autonomous robots. An interface between Arduino and the motors is provided by the motor driver. The L293 series of motor driver integrated circuits—L293D, L293NE, etc.—is the most widely utilized range. Two DC motors can be controlled concurrently using these integrated circuits. The L293D is made up of two H-bridge. The most basic circuit for managing a motor with a low current rating is the H-bridge. The motor driver IC will just be referred to as L293D. There are 16 pins on the L293D. The L293D is a 16-pin integrated circuit that has eight pins on each side that are used to operate a motor. Each motor has two INPUT pins, two OUTPUT pins, and one ENABLE pin. The L293D is made up of two H-bridge. The most basic circuit for managing a motor with a low current rating is the H-bridge.

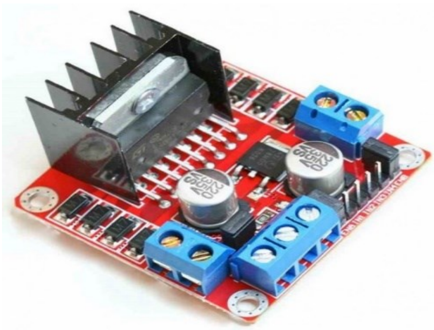

Fig.9. L293D Motor Driver

7. DC MOTOR:

Electrical energy can be transformed into mechanical energy by an electric machine called a direct current (DC) motor. Direct current is used by DC motors to transform electrical power into mechanical rotation. A rotor that is placed inside the output shaft of a DC motor is propelled by magnetic fields that result from the electrical currents generated. The motor's design and electrical input both affect the torque and speed of the output. A stator and an armature are the two main parts of a DC motor. In a motor, the armature rotates while the stator remains motionless. The armature of a DC motor rotates because of the magnetic field generated by the stator. An electromagnetic field that is aligned with the coil's centre is produced by a simple DC motor using a coil of wire that is current-driven and a set of stationary magnets in the stator. To focus the magnetic field, one or more windings of insulated wire are wrapped around the motor's core.

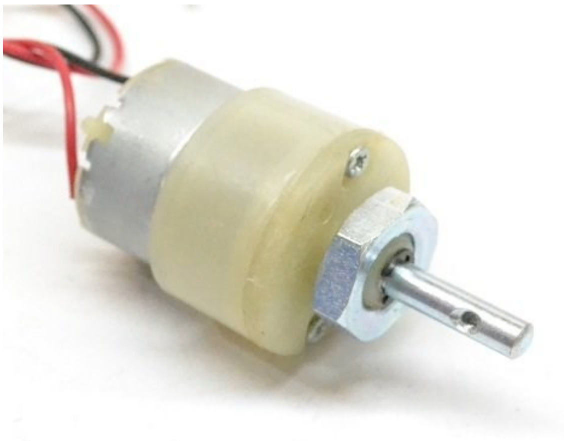

Fig.10. DC motor

IV. RESULTS AND DISCUSSIONS

The suggested IoT-based vehicle theft prevention system's encouraging outcomes demonstrate how well it works to address the enduring problem of vehicle theft. The GPS tracking function of the device proved to be accurate during extensive testing in a variety of environmental conditions, and the GSM connectivity allowed for easy remote immobilization with commands from a smartphone. Simulations conducted in real environments showed how the technology might progressively slow down the car, making it more difficult for criminals to avoid being discovered and increasing the chances of recovery. Offering consumers peace of mind and authorities an effective tool for theft prevention and recovery, the system is a significant improvement in vehicle security because to its high reliability, cost-effectiveness, and user-friendly interface. As a result of these findings, vehicle security and recovery techniques have advanced significantly and the system's ability to reduce the risks of theft and unauthorized use has been demonstrated. The system shows how IoT technology might improve automobile security measures, although more testing and tweaking may be needed to maximize its efficiency.

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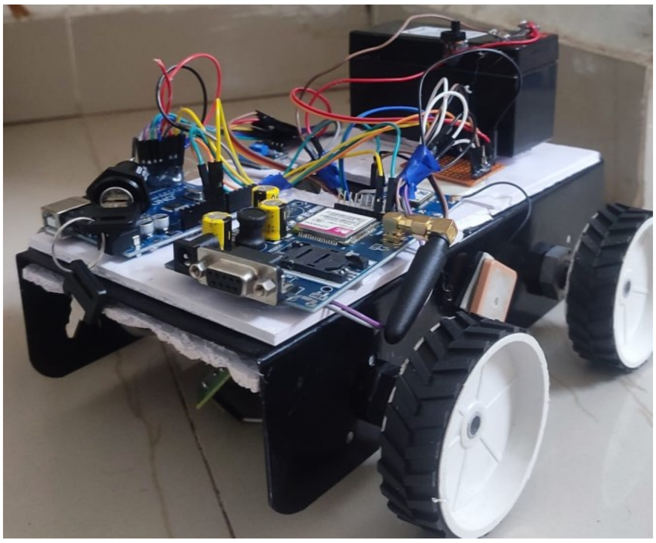

Fig.11. Hardware implementation for IoT-Enhanced Vehicle Security and Recovery system

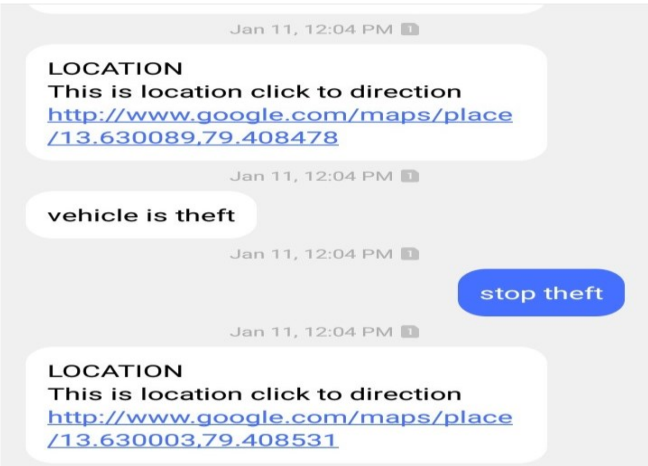

Fig. 12. Alert Message for IoT-Enhanced Vehicle Security and Recovery system

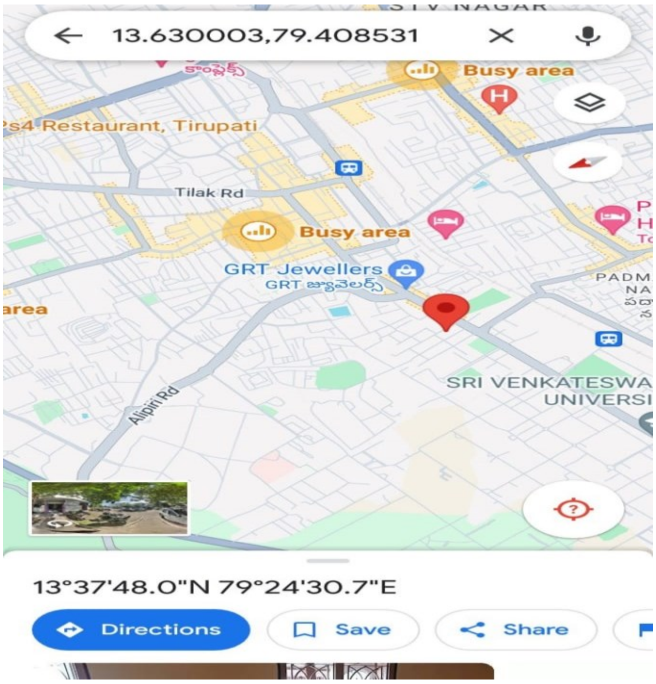

Fig. 13. Live location of Vehicle

V. FUTURE SCOPE

The Internet of Things-enhanced vehicle security and recovery system has a bright future ahead of it, with many opportunities for improvement and expansion. Adding sophisticated machine learning algorithms could be one way to help the system become more accurate and efficient at identifying and handling questionable activity. By guaranteeing that only those with the proper authorization can enter and operate the vehicle, the integration of biometric authentication technology could further improve security. Additionally, investigating the usage of blockchain technology for safe data storage and transfer could strengthen the system's defences against online attacks. Furthermore, the system's capabilities could be increased to incorporate predictive analytics for proactive threat mitigation and predictive maintenance.

VI.CONCLUSION

To sum up, the suggested vehicle security system that makes use of GPS, GSM connection, and Internet of Things (IoT) technologies offers a strong defence against the widespread problem of vehicle theft. The system provides a dependable, affordable, and easy-to-use method of augmenting vehicle security through the integration of GPS for location tracking, smartphone commands, and an embedded controller interfaced with the ignition motor. Real-time communication with the owner is made possible by the seamless integration of various technologies, which also allows for quick theft detection.

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By utilizing real-time data collecting and processing, the suggested IoT-enhanced system creates a strong network of sensors, actuators, and communication modules within the vehicle infrastructure, facilitating the early detection of suspicious activity. The system's advanced algorithms enable it to quickly initiate response mechanisms, such as GPS-based tracking and remote immobilization, when it detects a security breach. Accelerated recovery operations are facilitated by the slowing down of vehicle speed and immobilization. With its efficient way to prevent vehicle theft and greatly increased recovery prospects in the event of unwanted entry, this system represents a promising development in smart mobility.

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