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IOT Based Car Theft Detection and Prevention System

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Abstract:

The increasing number of vehicle theft incidents highlights the limitations of conventional security mechanisms such as mechanical locks and alarm-based systems. These traditional approaches lack real-time intelligence, remote accessibility, and preventive control. This research paper presents a deeply integrated IoT-based Car Theft Detection and Prevention System that combines sensing, communication, and cloud-based decision-making to enhance vehicle security. The proposed system utilizes a NodeMCU microcontroller interfaced with vibration sensors, GPS, and GSM modules to continuously monitor vehicle status, detect unauthorized activities, and initiate immediate responses. Upon detection of suspicious behavior, the system transmits real-time alerts and precise location information to the vehicle owner while enabling remote immobilization through engine control simulation. The system architecture emphasizes reliability, low-cost implementation, scalability, and real-time responsiveness, making it suitable for modern smart transportation environments.

Keywords — ***Internet of Things, Vehicle Security, GPS Tracking, GSM Communication, Embedded Systems, Engine Immobilization***

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I. INTRODUCTION

Vehicle theft is a persistent global issue that poses economic, social, and safety challenges. Despite the widespread adoption of conventional security systems, modern theft techniques have significantly reduced their effectiveness. Mechanical locks and audible alarms operate as passive security measures and often fail to provide real-time feedback or preventive action once a theft attempt begins.

The evolution of the Internet of Things (IoT) has introduced a paradigm shift in security system design by enabling intelligent devices to sense, communicate, and make decisions autonomously. IoT-based systems allow continuous monitoring, instant data transmission, and remote access, which are essential features for effective vehicle security. By integrating IoT technology with embedded systems, vehicles can be transformed into smart entities capable of detecting threats, notifying owners, and initiating countermeasures in real time.

This paper proposes an IoT-based car theft detection and prevention system designed to overcome the limitations of traditional approaches by offering intelligent monitoring, instant alerts, real-time tracking, and remote engine control.

II. LITERATURE REVIEW

Several vehicle security systems based on GSM technology have been proposed to notify owners through SMS alerts when unauthorized access occurs. Although these systems improve response time, they lack real-time vehicle tracking.

GPS-based tracking systems were later introduced to monitor vehicle location. While GPS improves vehicle recovery, many systems act only as tracking tools and do not prevent theft.

Recent IoT-based systems integrate sensors, microcontrollers, and cloud platforms to enable real-time monitoring and control. Motion and vibration sensors detect unauthorized movement, while microcontrollers such as ESP32 process sensor data and trigger alerts. Some systems also include engine locking mechanisms to actively prevent theft.

However, challenges such as false alerts, network dependency, and high implementation cost still exist. Hence, there is a need for a low-cost, reliable, and real-time IoT-based vehicle security system, which is addressed in this project.

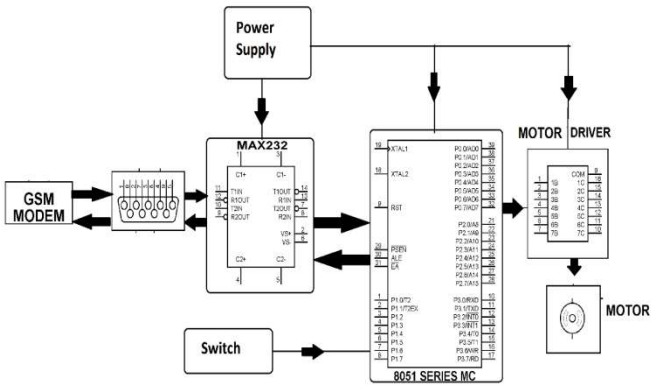
III. PROBLEM STATEMENTS

Vehicle theft is a growing problem in both urban and rural areas, causing financial loss and stress to vehicle owners. Traditional vehicle security systems such as mechanical locks and basic alarm systems are no longer sufficient, as they do not provide real-time alerts or location tracking. In many cases, the vehicle owner becomes aware of the theft only after the vehicle has already been moved or stolen.

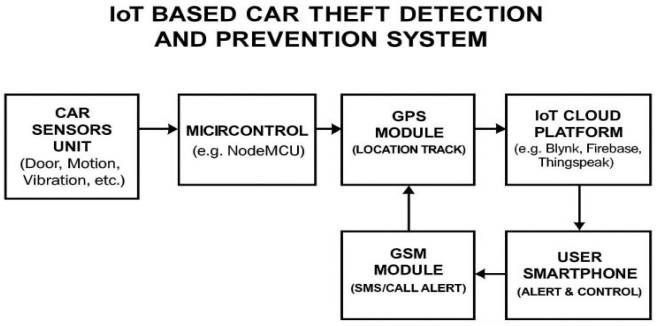
Existing security solutions are often expensive, complex, or depend heavily on continuous internet connectivity, making them unsuitable for many users. Additionally, many systems focus only on alerting the user but do not actively help in preventing the theft or tracking the vehicle's location effectively.

Therefore, there is a need for a simple, affordable, and reliable system that can detect unauthorized vehicle movement, immediately notify the owner, and provide real-time location information. The system should also be capable of helping prevent theft by enabling quick response actions. This project aims to address these issues by developing an IoT-based car theft detection and prevention system using sensors, GSM communication, and GPS tracking to enhance vehicle security.

IV. SYSTEM ARCHITECTURE



V. DESIGN OF THE PROJECT



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6.1 External Interface Requirements

User Interfaces

The system provides a user interface through SMS alerts and a mobile/web IoT dashboard. In case of theft or unauthorized access, alert messages along with the vehicle's real-time GPS location are sent to the owner. The user can also view vehicle status remotely using a smartphone.

Hardware Interfaces

The system uses a microcontroller (ESP32/Arduino) interfaced with GPS module, GSM module, vibration/door sensor, and relay module. Sensors detect unauthorized activities and send signals to the controller for further action. The

relay is used to disable the vehicle ignition as a prevention measure.

Software Interfaces

The software is developed using the Arduino IDE with open-source libraries for GPS tracking, GSM communication, and sensor interfacing. The system logic processes sensor inputs and triggers alerts and control actions accordingly.

Communication Interfaces

Wireless communication is achieved using GSM (SMS) and/or Wi-Fi. GPS provides real-time location data, which is transmitted to the vehicle owner. A stable network signal is required for accurate tracking and alert delivery.

6.2 Other Non-Functional Requirements

Performance Requirements

The system detects theft attempts and sends alerts with minimal delay. Location updates are provided in near real time to assist in quick vehicle recovery.

Safety Requirements

The system operates at low voltage levels, ensuring electrical safety. Ignition control is implemented carefully to avoid damage to vehicle components.

Security Requirements

Basic security is ensured through authorized access to alerts and control functions. Due to hardware limitations, advanced encryption mechanisms are limited but can be improved in future versions.

Software Quality Attributes

Availability: The system remains functional as long as power supply and network connectivity are available.

Reliability: The system provides accurate alerts and location tracking under normal operating conditions.

Scalability: Additional sensors or features can be integrated with minimal changes to the system.

6.3 Software and Hardware Requirements

Software Requirements:

Arduino IDE

Embedded C / C++ (Arduino Language)

Libraries Used

Wire.h → I2C communication

MPU6050.h → Motion sensor interface

TinyGPS++.h → GPS data processing

SoftwareSerial.h → GSM & GPS serial communication

Mobile Phone

Hardware Requirements:

ESP32 (NodeMCU)

MPU6050 Sensor

GSM Module (SIM800C)

GPS Module (NEO-6M)

BO Motor / Relay Module

Power supply

VII. TEST CASES

In this phase, all the modules of the **IoT-Based Car Theft Detection and Prevention System using ESP32, MPU6050, GPS, and GSM** are integrated and tested to ensure proper functionality of the system. Testing is carried out at different levels to verify that each module works correctly and meets the expected requirements. The testing process helps identify errors, improve system reliability, and ensure smooth and real-time theft detection and alert operation.

The following testing techniques are used in this project:

- **Black Box Testing**
- **Integration Testing**
- **Scenario-Based Testing**

Requirement Gathering and Analysis

In this phase, the basic requirements of the **IoT-Based Car Theft Detection and Prevention System** are identified. The system is designed to

detect unauthorized vehicle movement using vibration sensors and provide real-time alerts to the vehicle owner.

The need for:

- Immediate theft detection
- Real-time SMS alerts
- Live vehicle location tracking
- Vehicle movement prevention

is analyzed to ensure the system is **low-cost, reliable, and easy to use**.

System Design

During the system design phase, the overall architecture of the theft detection system is planned. The **ESP32 microcontroller** is used for data processing and control operations. The **MPU6050 sensor** is used to detect vibration or movement. The **GPS module** provides real-time location, and the **GSM module** sends SMS alerts to the registered mobile number.

The system is designed to ensure **parallel operation** of modules, fast response time, and reliable communication.

Implementation

In this phase:

- All hardware components are assembled and connected
- ESP32 is programmed using Arduino IDE
- Sensors, GSM, GPS, relay, and buzzer are interfaced
- Theft detection logic is implemented

All components are made to work together as a **single integrated system**.

Deployment

After successful implementation and testing:

- The system is tested under real and simulated theft conditions
- SMS alert delivery and GPS location accuracy are verified
- Vehicle stop mechanism is checked

Once all tests are passed, the system is installed in the vehicle and made ready for **real-world usage**

SR. No.	Component Used	Total Quantity	Cost
1	ESP32	1	Rs. 350
2	MPU6050	1	Rs. 150
3	GPS NEO-6M	1	Rs.250
4	SIM800C	1	Rs.980
5	12 V Battery	1	480
6	Key set	1	420
7	Adjustable Wheel	1	50
8	Yellow motor(BO)	2	135
9	Motor wheels(BO)	2	70
10	Chessy	2	300
11	Spacers 60mm	4	32
12	Copper Clad.(PCB)	1	50
TOTAL COST OF PROJECT			3267

Maintenance

The maintenance of our project ensures that the system works properly and continuously after implementation.Regular checking and updating help to improve performance and reliability.

Risk Identification:

The IoT-based Car Theft Detection and Prevention system involves hardware components, wireless communication, and real-time monitoring, which introduce certain risks. One major risk is sensor malfunction, where vibration or door sensors may generate false alerts or fail to detect actual theft attempts. Another risk is network connectivity failure, which may delay alert messages or GPS location updates due to poor GSM or internet signal.

Security and privacy risks are also present, as unauthorized access to communication modules may lead to misuse of vehicle data. Power-related issues such as battery or power failure can affect system availability and prevent real-time monitoring. These risks are considered while designing the system to ensure reliable and secure operation.

Risk Analysis:

The risks involved in the project are analyzed based on probability and impact, considering constraints related to system performance, connectivity, and power availability.

Table: Risk Analysis

ID	Risk Description	Probability	Impact
1	Sensor malfunction or false alert	Medium	High
2	Network or Connectivity Failure	Medium	Medium
3	Security and Privacy Breach	Low	Very High
4	Battery or Power Failure	Medium	Medium

VIII. OVERVIEW OF RISK MITIGATION, MONITORING, MANAGEMENT

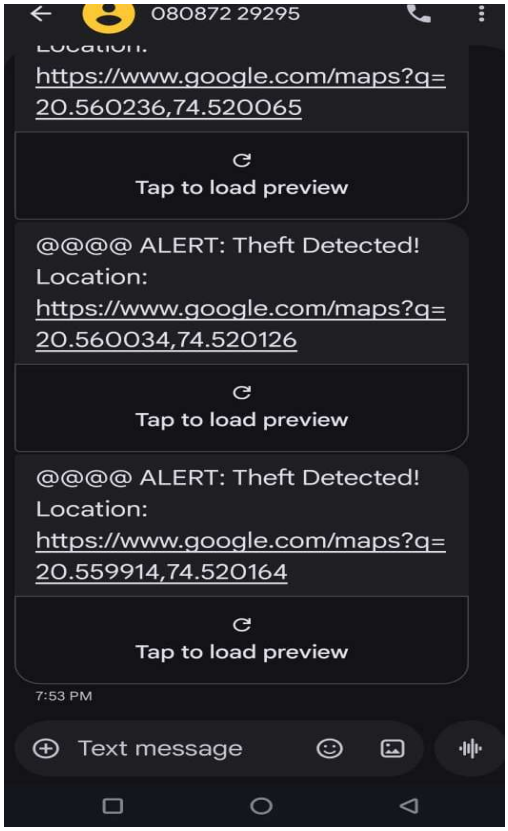
The risks associated with the IoT-based car theft detection and prevention system are addressed through effective risk mitigation, monitoring, and management strategies. Sensor malfunctions and false alerts are reduced through proper calibration and testing, while network or GSM failures are handled by retry mechanisms and temporary data storage. Security risks are minimized using authentication and restricted access, and power issues are managed with stable and energy-efficient components. Continuous monitoring of sensors, network connectivity, GPS location, and battery status ensures early detection of anomalies, while preventive maintenance and software updates maintain system reliability. In case of theft attempts, immediate alerts and vehicle immobilization provide a rapid response, and feedback from monitoring is used to improve system performance and reduce future risks, ensuring a secure, reliable, and effective vehicle protection system.

Product Scope:

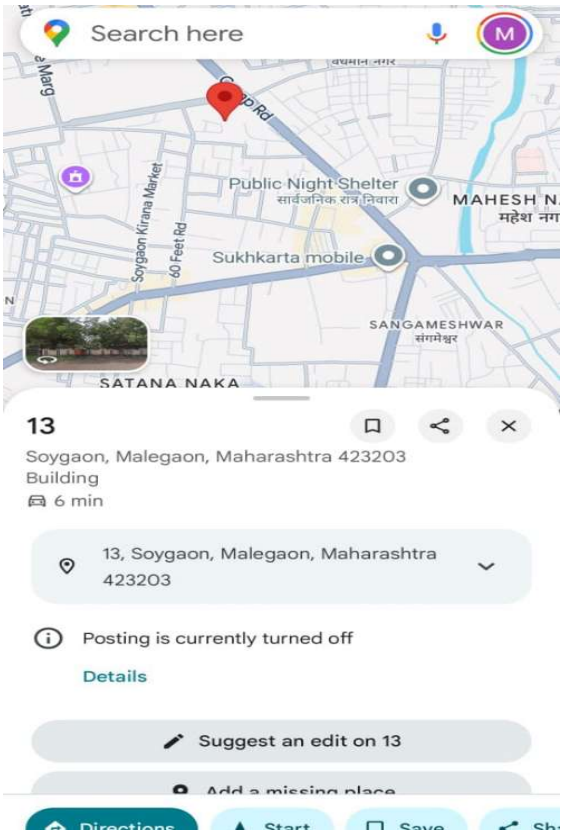
The IoT-based Car Theft Detection and Prevention System is designed to enhance vehicle security by providing real time monitoring, alerting, and preventive control. The system detects unauthorized access through sensors (vibration and door sensors) and immediately alerts the owner via SMS and IoT dashboard. It also provides GPS based vehicle tracking and can temporarily disable the vehicle ignition to prevent theft.

This product is low-cost, reliable, and easy to install in any vehicle without complex modifications. It is primarily intended for personal and educational use, demonstrating the integration of IoT technology in vehicle security. The system ensures real-time protection, remote monitoring, and quick response, and can be further enhanced in the future with advanced security features, mobile app integration, and AI-based threat detection.

IX. RESULT



SMS ALERT



LOCATION OF CAR

CAR MODEL

X.CONCLUSION

The IoT-based car theft detection and prevention system successfully enhances vehicle security by continuously monitoring the vehicle status and detecting unauthorized access. The system uses sensors and a microcontroller to identify theft attempts and immediately sends alerts to the owner through GPS and GSM/Wi-Fi communication. Real-time location tracking helps in quick vehicle recovery and effective prevention of theft.

This project provides a low-cost, reliable, and smart security solution suitable for modern vehicles. It demonstrates how IoT technology can improve safety, monitoring, and control of vehicles remotely. Although designed mainly for educational purposes, the system has strong potential for real-world applications with further enhancements such as mobile app integration, advanced encryption, and AI-based threat detection..

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