

UNITED STATES UTILITY PATENT APPLICATION

Title of the Invention: AI-Based Integrated Vehicle Safety, Anti-Theft, and Remote Control System

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Filing Date: August 1, 2025

FIELD OF THE INVENTION

The present invention relates to intelligent automotive systems and, more specifically, to an AI-powered platform integrating hot car occupant protection, vehicle theft deterrence, and remote vehicle control via a multifunctional key fob. The system applies advanced sensor fusion, machine learning, and secure wireless control to deliver proactive vehicle protection and increased user convenience.

BACKGROUND OF THE INVENTION

Although many automotive safety features exist, vehicle-related fatalities from heat exposure (e.g., children or pets left in vehicles) and theft remain persistent issues. Traditional systems—such as pressure sensors, basic temperature triggers, or motion-activated car alarms—suffer from limited accuracy or rely on user actions like manually arming alarms or checking rear seats. Similarly, most remote start and keyless entry systems are susceptible to replay or relay attacks due to weak encryption. There is a need for a system that learns, detects, and responds to both human presence and threats to both vehicle security and occupant health, while supporting secure, convenient remote control.

SUMMARY OF THE INVENTION

Provided is an AI-driven car safety and control system designed to:

- Detect human or animal occupants in a parked vehicle.
- Prevent hot car deaths through sensor-driven, situational response.
- Detect and prevent vehicle theft or vandalism.
- Enable remote control of vehicle functions (lock/unlock, alarm, engine start/stop, climate readiness).
- Deliver user feedback via an encrypted two-way key fob and mobile application.
- Operate independently of vehicle ignition, powered by a backup battery.

DETAILED DESCRIPTION OF THE INVENTION

System Overview

Components:

- Multimodal AI Sensor Suite: Includes in-cabin cameras (infrared/low-light, CNN-based vision), mmWave radar (for respiration/movement, through obstacles), intelligent audio sensors (for breathing and intrusion).
- Intrusion Monitoring Subsystem: Exterior vibration, acoustic, and camera-based surveillance with AI classification.
- Embedded AI Processor Module: SoC/edge device running ML models, fusing all sensor data to classify threats and occupant presence.
- Secure Remote Key Fob: Encrypted two-way communication, OLED/LED indicators, haptics, rolling-code credentials.
- Mobile Device Integration: App for real-time monitoring, alerts, remote commands.
- Vehicle Bus Interface (CAN/OBD II): Controls lock, alarm, engine, climate.
- Power Management Subsystem: Vehicle battery and backup battery, with optional solar recharge.

Key Fob & Secure Remote Features

- Supports locking/unlocking, arming/disarming, remote start/stop, climate preconditioning, panic mode, 'Find My Car,' occupant alert acknowledgement.
- Two-way encrypted communication (RF/Bluetooth) with vehicle.
- Rolling code/tokenized challenge-response to foil relay/replay attacks.
- Haptic feedback, OLED/LED indicators for status/alerts.

Remote Start & Climate Control

- Remote start checks all safety conditions before engine start.
- Climate preconditioning logic.
- Automatic climate activation if interior temp is dangerous and occupants are detected.

Operation Flow

1. Vehicle Shutdown: Sensors arm automatically when engine off.
2. Occupant Detection: Sensor fusion, real-time ML. Confidence >95% triggers alerts.
3. Unauthorized Entry Detection: AI on glass vibration/door force/camera for external intrusion.
4. User Alerts/Escalation: Warnings to key fob and mobile app; can escalate alarm, roll windows, or silent alert.
5. Remote Commands: User can respond via fob or app (disarm, start, panic, etc.).
6. Failsafe Mode: If user unresponsive, notifies emergency contact or authorities using onboard GSM module (optional).

CLAIMS

1. A vehicle safety and control system comprising: a multimodal sensor suite including AI-enabled visual cameras, radar sensors, and audio sensors configured to detect living occupants within a vehicle cabin; an intrusion detection subsystem configured to monitor external perimeter intrusion using vibration, acoustic, and image data; an onboard AI processor module configured to fuse sensor inputs and perform real-time occupant presence classification and threat-level assessment; a secure remote key fob device providing encrypted two-way communication for remote vehicle control and occupant alert acknowledgment; a vehicle bus interface enabling control of vehicle functions including locking, alarm, engine start/stop, and climate control; and a power management subsystem including a backup battery to maintain system operation while the vehicle ignition is off; wherein the system is configured to automatically detect human or animal occupants, initiate protective responses based on ambient conditions, detect unauthorized entry attempts, and allow secure remote user interaction via the key fob and mobile application.
2. The system of claim 1, wherein the AI-enabled visual cameras utilize infrared and low-light imaging coupled with convolutional neural network-based computer vision to identify occupant posture and thermal signatures.
3. The system of claim 1, wherein the radar sensors operate at millimeter-wave frequencies to detect micro-movements indicative of breathing through obstacles such as blankets or clothing.
4. The system of claim 1, wherein the audio sensors analyze breathing patterns and low-frequency sounds associated with occupant presence and intrusion events.
5. The system of claim 1, wherein the intrusion monitoring subsystem employs AI-enhanced vibration and acoustic sensors alongside exterior cameras to classify suspicious activity near the vehicle.
6. The system of claim 1, wherein the onboard AI processor performs sensor data fusion using ensemble or neural network models to achieve occupant detection accuracy greater than 95%.
7. The system of claim 1, wherein the secure remote key fob utilizes rolling code or tokenized credentials and provides user feedback via OLED or LED displays and haptic motors to prevent replay or relay attacks.
8. The system of claim 1, wherein remote start is facilitated by the key fob or mobile application subject to verification of vehicle state, and triggers smart climate preconditioning based on external weather conditions.
9. The system of claim 1, further comprising a failsafe mode that, upon absence of user alert acknowledgment, triggers notifications to emergency contacts or authorities via an optional GSM communication module.
10. A method for integrated vehicle occupant protection, theft deterrence, and remote control comprising: sensing occupant presence within a parked vehicle using fused data from AI-enabled cameras, radar, and audio sensors; monitoring external vehicle perimeter for intrusion attempts using vibration, acoustic, and image sensors; processing sensor data in real time on an onboard AI processor to determine occupant presence and threat levels; issuing alerts to a user via an encrypted key fob and mobile app; enabling remote locking, engine start/stop, alarm activation, panic mode, and climate control via secure wireless communications; autonomously activating protective responses including

climate conditioning and alarm escalation based on detected conditions and user input or timeout.

ADVANTAGES OF THE INVENTION

- Combines theft detection, occupant detection, and remote control in one platform.
- AI-driven accuracy reduces false positives, improves speed.
- No user action required to arm system for safety.
- Strong encryption, replay-proof remote access.
- Expandable for fleets, rideshare, pet transport, schools, LEO, etc.
- Smart alerts prevent occupant harm, even if user is remote.
- Proactive anti-theft—system intervenes before loss/damage occurs.

POTENTIAL APPLICATIONS

- Passenger vehicles (OEM/aftermarket)
- Rideshare and rental fleet security
- Delivery/commercial vans
- School/daycare buses
- Pet transport
- Law enforcement/public safety fleets