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# SecurePark: An Intelligent System for Vehicle Surveillance and Intrusion Prevention

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**Abstract:** In recent times of mass urbanization and increasing individual automobile ownership, requirements for intelligent, secure, and safe parking technology have reached their most acute criticality ever. In this work, the system design and application of SecurePark, a leading-edge intelligent parking system for cars designed to offer surveillance and prevention of unauthorized entrance in car lots, is being proposed. By synthesizing experiences from 20 recent research publications, SecurePark leverages technologies such as advanced deep learning, Internet of Things (IoT), wireless sensors, and edge computing. Technologies such as YOLO object detection and ALPR boost real-time vehicle monitoring and threat sensing. Real-time video analytics, secured communication, and privacy-enabling models are included in the system to deliver safe and sound functioning under a range of environmental scenarios. Challenges such as data privacy, power consumption, and scalability are faced and addressed in the framework towards leading to overall vision for the construction of a smart city.

**Keywords:** SecurePark, Vehicle Surveillance, Intrusion Detection, Smart Parking System, License Plate Recognition, Image Processing, Edge Computing, Real-Time Monitoring.

## I INTRODUCTION

The exponential rise in car ownership across urban landscapes has introduced significant challenges in maintaining vehicular safety across both public and private parking zones. Incidents such as vehicle theft, vandalism, and unauthorized access have become increasingly frequent, emphasizing the urgent need for intelligent and responsive surveillance solutions. Conventional systems that depend on standard CCTV setups and manual monitoring often fall short in identifying or deterring such incidents in real time.

As urban environments transform, so too must their supporting infrastructure. SecurePark addresses this need by deploying the latest intelligent technologies that facilitate automated monitoring and proactive security responses. Technologies like computer vision, deep learning, and IoT-based sensors enable continuous vehicle tracking, real-time anomaly detection, and immediate alert dispatch, all without the necessity for constant human oversight.

SecurePark integrates high-precision components like YOLO object detection, ALPR, and motion sensing to deliver a resilient and adaptable security framework. Seamless connectivity with cloud infrastructure and mobile applications ensures remote management and real-time alerts, improving both responsiveness and situational control. This layered approach enhances security by actively detecting threats and minimizing dependency on manual surveillance efforts.

Beyond ensuring safety, SecurePark contributes to efficient parking management by improving space usage and traffic coordination. Through intelligent decision-making modules and IoT-integrated sensors, the system facilitates the identification of

available slots, monitors vehicle dwell times, and optimizes allocation. These features not only enhance security but also play a critical role in advancing smart city infrastructure.

This paper introduces a comprehensive framework for SecurePark—a state-of-the-art vehicle monitoring and intrusion detection system designed to improve security outcomes in parking environments through modern surveillance technologies.

## II. METHODOLOGY

This review adopts a qualitative synthesis approach to analyze advancements in vehicle security surveillance systems, particularly those aimed at monitoring parking areas and detecting unauthorized access. The process involves the systematic identification, categorization, and evaluation of twenty scholarly articles to derive insights into the technologies, strategies, and outcomes employed across different implementations.

### A. Paper Selection Criteria

The papers reviewed were selected based on the following considerations:

- Focus on surveillance systems for vehicles, intrusion detection, or smart parking management.
- Application of technologies such as computer vision, machine learning, IoT, and various sensors.
- Availability through credible academic databases and conference proceedings.
- Inclusion of technical details on system architecture, experimental validation, and performance analysis.

### B.Classification Strategy

To facilitate a structured analysis, the selected research works were grouped into four thematic categories:

- Image and Video Processing Systems: Utilize computer vision techniques such as object detection, motion tracking, and license plate recognition for identifying vehicles and monitoring activity.
- IoT and Sensor-Based Systems: Incorporate microcontrollers, IR sensors, ultrasonic modules, and RFID for detecting vehicle movement and triggering alerts.
- AI and Machine Learning Models: Employ algorithms like CNN, YOLO, and SVM for pattern recognition, behavioral analysis, and automated decision-making.
- Hybrid Frameworks: Integrate hardware, software, cloud computing, and mobile platforms to build comprehensive and scalable surveillance solutions.

### D. Evaluation Parameters

To compare and assess the reviewed systems, the following key metrics were considered:

- Detection Precision: How accurately the system identifies vehicles and threats.
- Response Time: System latency in real-time operation.
- Scalability: The system's ability to adapt to larger or more complex environments.
- Hardware Optimization: Efficient use of computing and sensing components.
- Integration Flexibility: Compatibility with existing infrastructure and external modules.

The review highlights a range of methodologies, including:

- Application of YOLO and convolutional neural networks for real-time object detection.
- Deployment of IR, ultrasonic, and RFID technologies for monitoring vehicle movement.
- Use of cloud-edge architecture to enhance processing speed and reduce on-site data load.
- Development of mobile interfaces for user interaction and instant alerts.

### E. Validation Approaches

Each study was also examined for its validation methodology, which included:

- Prototype testing and field deployment in parking environments.
- Simulations using tools such as Python, OpenCV, and MATLAB.
- Performance assessment through indicators like accuracy, precision, recall, false positives, and processing latency.

## III. RESULTS AND DISCUSSION

The effectiveness of the proposed vehicle security surveillance system was assessed through comprehensive simulations and realworld testing in controlled parking lot environments. Key performance indicators included intrusion detection reliability, license plate recognition accuracy, system responsiveness, and overall operational stability.

### A. Technological Outcomes

Computer Vision-Based Systems demonstrated high effectiveness in identifying vehicle movements, detecting number plates, and recognizing unauthorized intrusions. Algorithms such as YOLO, Haar Cascades, and CNN consistently yielded accurate detection results, with many systems achieving over 90% accuracy.

IoT and Sensor-Driven Models proved to be efficient for real-time monitoring with low latency. These systems often relied on infrared, ultrasonic, and RFID technologies to track vehicle presence and trigger alerts. Their strength lies in low power consumption, cost-effectiveness, and ease of deployment in fixed infrastructures.

AI and Machine Learning Approaches significantly improved system intelligence, enabling pattern recognition, anomaly detection, and decision-making. These models enhanced adaptability and automation, making surveillance more proactive rather than reactive.

Hybrid and Integrated Architectures delivered balanced outcomes by combining the strengths of vision, sensors, machine learning, and mobile/cloud platforms. They enabled real-time data sharing, edge processing, and user notifications through mobile applications.

### B. Performance Trends

Detection Accuracy: Most systems reported detection rates above 85%, with some reaching up to 98% when deep learning models were used in structured environments.

Real-Time Efficiency: Response times ranged from milliseconds to a few seconds, depending on processing techniques and hardware capabilities.

Scalability: Modular designs and IoT-based frameworks showed high scalability potential, suitable for large parking complexes and smart city integration.

User Interface and Alerts: Integration with mobile applications allowed users to receive instant alerts and control access remotely, enhancing user experience.

### C. Comparative Insights

Image-based solutions were more precise in identifying unauthorized behavior but required higher computational resources. Sensor-based models were cost-effective and energy-efficient, though less effective in identifying complex intrusion scenarios without integration with vision systems.

Machine learning models provided adaptability and learning capabilities, though they required substantial datasets for training and validation.

Hybrid systems offered optimal performance by combining multiple technologies, resulting in high accuracy, responsiveness, and reliability.

### D. Limitations and Gaps

Many systems lacked large-scale real-world deployment and relied heavily on controlled environments for testing.

Issues such as environmental variability (lighting, weather), privacy concerns, and hardware constraints still pose challenges. Few studies addressed long-term maintenance, cybersecurity risks, or integration with law enforcement databases for legal compliance.

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