

**ISSUES OF IMPLEMENTING VIDEO SURVEILLANCE SYSTEMS ON AVOMOBIL  
ROADS**

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**Annotation:** This article analyzes the technological advancements, effectiveness, and socio-legal aspects of video surveillance systems at intersections. Research indicates that these systems play a crucial role in enhancing security and optimizing traffic flow. However, their implementation must consider human rights and privacy issues.

**Keywords:** video surveillance systems, IP cameras, effectiveness of video surveillance systems, static video surveillance systems, mobile video surveillance systems, automatic license plate recognition systems, infrared and thermal cameras.

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Video surveillance systems, an integral part of modern urban infrastructure, perform essential functions such as ensuring public safety, monitoring compliance with traffic regulations, and enhancing personal security. The current state of intersection surveillance systems, their technological advancements, effectiveness, as well as their social and legal aspects, need to be continuously analyzed.

In recent years, video surveillance systems have significantly evolved. The use of high-resolution digital IP cameras is increasingly replacing early analog cameras. With the advancement of artificial intelligence (AI) and machine learning algorithms, modern systems can perform functions such as real-time facial recognition, automatic license plate recognition, and anomaly detection.

Video surveillance systems consist of high-resolution cameras capable of capturing images even at night using infrared (IR) radiation, along with servers and data storage devices. These systems include key components such as video data processing and analysis capabilities, automatic video analysis to detect suspicious activities and enable rapid response, and cloud technologies for securely storing and managing large volumes of video data.

The effectiveness of intersection surveillance systems depends on various factors. Research indicates that these systems are an effective tool for reducing traffic violations, lowering crime rates, and preventing accidents. For example, AI-powered systems help reduce congestion by automatically managing traffic flow and optimizing signaling systems.

The widespread implementation of video surveillance systems also raises concerns about personal privacy. Different countries have legal restrictions and regulations in place to protect privacy when using such systems. Additionally, some researchers argue that video surveillance could contribute to the emergence of a surveillance state. Therefore, it is crucial to implement this technology while ensuring that human rights and personal privacy are not violated.

The future development of intersection surveillance systems is closely tied to advancements in artificial intelligence, big data processing, and 5G networks. These systems are expected to become more accurate and efficient. However, as technology advances, legal and ethical issues become even more relevant. Therefore, when implementing these systems, it is essential to consider both technological innovations and legal and ethical standards.

Video surveillance systems on roadways are categorized into several types:

Static video surveillance systems – These cameras are installed in fixed locations and continuously monitor specific areas. They are mainly used at intersections, barriers, and hazardous road sections.

They are equipped with advanced technologies such as facial recognition and license plate recognition.

Mobile video surveillance systems – These systems use cameras mounted on moving patrol vehicles or drones, allowing real-time monitoring of traffic and the detection of violations.

Automatic license plate recognition (ALPR) systems – These systems automatically identify vehicle license plates and compare them with a database. They are used to enhance security, reduce crime, and automate payment systems.

Infrared and thermal cameras – Designed for operation at night and in adverse weather conditions, these cameras are used for analyzing road conditions and integrating with driver warning systems.

Modern video surveillance systems are based on advanced technologies such as artificial intelligence, computer vision, and cloud computing. Machine learning algorithms are used to detect and classify moving objects. Computer vision enables real-time analysis of road conditions. The integration of various sensors and cameras into a unified system enhances efficiency. Cloud computing simplifies the storage and processing of video data.



### **Video surveillance cameras on roadways**

Video surveillance systems improve road traffic safety, reduce crime, and are highly effective in managing traffic flow. They provide the capability for quick responses to emergencies. However, issues related to privacy and personal data protection, the high financial costs of implementing new technologies, weak network infrastructure, and cybersecurity threats need to be addressed for proper implementation.

The implementation of video surveillance systems on roadways is a crucial factor in ensuring road traffic safety, reducing violations, and effectively managing traffic flow. With technological advancements, these systems are expected to become more efficient by integrating artificial intelligence (AI), the Internet of Things (IoT), and cloud technologies. In the future, scientific research in this field is likely to develop further, offering innovative solutions.

The quality and effectiveness of video surveillance cameras depend on their technical parameters. Cameras should operate at least at 1080p (Full HD) resolution or higher (4K). Cameras equipped with infrared (IR) lighting systems are capable of capturing high-quality images even at night. Wide-angle lenses with angles greater than 90° provide the ability to monitor movement comprehensively. AI-based cameras assist in detecting violations in real time. Cameras with an IP66/IP67 protection rating are resistant to rain, snow, and dust. Modern cameras are capable of identifying and recording vehicle license plates. When the camera detects movement, it automatically starts recording, which helps reduce data volume. Cameras should be capable of uploading data to the cloud and sharing it in real time.

The effectiveness of video surveillance systems also depends on their software. The software automatically analyzes data such as traffic flow, speed, and traffic violations. It monitors the situation at intersections in real-time, collects traffic flow statistics, predicts violation trends and congestion, and securely stores and archives data. It encrypts personal data while adhering to privacy policies. The software allows for remote control of cameras and equipment and automatically sends notifications to responsible authorities in the event of violations or emergencies. The effective operation of surveillance cameras also depends on the network infrastructure. High-speed data transmission is achieved through fiber-optic internet or 5G/LTE networks. For data security, encryption and protected network segments are used. Data is stored either on-premise or on centralized cloud servers. Backup systems are required to ensure continued operation in case of power outages or network failures. To reduce network load, H.265 or H.264 video compression technologies are used. Data is analyzed on-site before being sent to the central server.

Intersection video surveillance systems are one of the most effective tools for real-time detection of violations and taking necessary actions. The system efficiently manages traffic flow and optimizes signaling systems. It identifies individuals who violate traffic rules and assists law enforcement agencies. The system is also highly effective in rapidly transmitting data during road traffic accidents or other emergencies.

The implementation of video surveillance systems at intersections plays a key role in improving road traffic safety and reducing violations. For their effective operation, high-quality cameras, advanced software, and reliable network infrastructure are essential. In the future, these systems are expected to develop further, with increased use of artificial intelligence and automated control algorithms. Additionally, within the framework of the smart city concept, these systems will be applied for efficient traffic management, environmental monitoring, and enhanced security.

Video surveillance systems are one of the key technologies ensuring real-time monitoring on roads. Integrating these systems with IT components expands the capabilities for traffic control, traffic flow optimization, and violation detection. However, this integration process faces various challenges.

Video surveillance systems are closely linked to several key components of ITS. These systems play a crucial role in real-time monitoring of traffic flow and the development of management strategies. Traffic congestion predictions are made based on video recordings. Violations of traffic rules are recorded through video cameras. The system enables automatic fines to be issued to drivers who violate traffic rules. Various issues may arise during the integration process. Video surveillance systems are developed by different companies, and their interoperability can be limited. High-quality video transmission and storage require significant bandwidth and powerful servers. Face and license plate recognition systems sometimes make errors, which could lead to incorrect decision-making.

Video surveillance systems can pose a threat to individuals' privacy, necessitating the need to comply with privacy and legal regulations. It is unclear in some cases when and by whom this data can be accessed.

The introduction of new technologies and the modernization of existing systems require significant financial investment. Regular maintenance of equipment and software updates incur additional costs. However, specialists working in the field are addressing these issues. The implementation of unified technical standards within ITS is enabling the compatibility of equipment from different manufacturers. Advanced cryptographic methods are being used to ensure the security of video data. Legislation on personal data protection is being improved. Economic issues arising from these processes can be addressed through collaboration between the public and private sectors to fund projects.

**Conclusion:** The integration of video surveillance systems with ITS on roadways plays a significant role in improving traffic management and safety. However, technical, legal, and economic challenges arise in this process. To overcome these challenges, it is necessary to implement comprehensive measures such as standardization, privacy protection, improvement of legal regulations, and financial support.

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