RCMOS - Multidisciplinary Scientific Journal of Knowledge.
ISSN: 2675-9128. São Paulo-SP.

Year V, v.1 2025. | submission: 2025-08-24 | accepted: 2025-08-26 | published: 2025-08-28

Artificial intelligence applications in traffic control: operational efficiency and compliance with legal limits

Artificial intelligence applications in traffic control: operational efficiency and compliance with legal limits

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SUMMARY

This article comprehensively investigates the use of artificial intelligence (AI) as a tool to support traffic enforcement, highlighting its operational application by the Military Police. The article examines the functioning of intelligent systems—such as automatic license plate recognition (ALPR), cameras equipped with computer vision to detect risk behavior, and algorithms capable of identifying violations in real time—highlighting their potential to optimize overt policing, minimize subjectivity in traffic stops, and increase the efficiency of police actions. It also analyzes the legal and ethical framework governing the topic, in light of the Brazilian Traffic Code (CTB) and the General Personal Data Protection Law (LGPD), as well as the impact of these technologies on driver privacy. Finally, it presents guidelines for the responsible and strategic implementation of AI in traffic enforcement, reconciling technological innovation with the protection of fundamental rights and the strengthening of public safety.

Keywords: artificial intelligence, traffic control, Military Police, ALPR, legality.

ABSTRACT

This article comprehensively investigates the use of artificial intelligence (AI) as a tool to support traffic enforcement, highlighting its operational application by the Military Police. The article examines the functioning of intelligent systems—such as automatic license plate recognition (ALPR), cameras equipped with computer vision to detect risk behavior, and algorithms capable of identifying violations in real time—highlighting their potential to optimize overt policing, minimize subjectivity in traffic stops, and increase the efficiency of police actions. It also analyzes the legal and ethical framework governing the topic, in light of the Brazilian Traffic Code (CTB) and the General Personal Data Protection Law (LGPD), as well as the impact of these technologies on driver privacy. Finally, it presents guidelines for the responsible and strategic implementation of AI in traffic enforcement, reconciling technological innovation with the protection of fundamental rights and the strengthening of public safety.

Keywords: artificial intelligence, traffic enforcement, military police, ALPR, legality.

1 INTRODUCTION

In recent decades, Brazil has experienced rapid growth in its vehicle fleet, driven by population growth, urban expansion, and easier access to private transportation. This phenomenon, while representing advances in mobility, has also contributed to the intensification of traffic complexity in cities, increasing accident rates, violations, and congestion. Given this scenario, the role of traffic enforcement becomes increasingly strategic for maintaining order, user safety, and the flow of urban and highway traffic.

The Military Police's traditional traffic control approach, through on-site inspections, manual checks, and direct visual analysis, while still essential, has proven limited given the volume of vehicles and the sophistication of violations committed. The need to increase the effectiveness of their actions, reduce human error, and optimize operational resources has led police forces to seek technological solutions that can enhance their operational capabilities.

In this context, artificial intelligence (AI) is emerging as a promising tool in the field of road safety. Applied to traffic enforcement, AI enables automated license plate recognition (ALPR), the identification of risk behaviors, real-time analysis of violations, and the production of statistical data that supports tactical planning.
Its adoption has the potential to transform the way approaches are carried out, making them faster, more accurate and less dependent on the agent's intuition or subjectivity.

However, the use of smart technologies in public safety demands critical reflection on their legal and ethical limits, especially regarding citizens' privacy and the protection of personal data. Police actions must comply with the constitutional principles of legality, proportionality, and human dignity, in addition to respecting the provisions of the General Data Protection Law (LGPD) and the Brazilian Traffic Code (CTB).

Therefore, this article aims to analyze the main applications of artificial intelligence in traffic enforcement, assessing its impact on the Military Police's work, its operational benefits, and the associated legal challenges. Ultimately, it seeks to propose pathways for the safe, effective, and responsible adoption of these technologies, in line with fundamental rights and the strengthening of public safety.

2 THEORETICAL BASIS

The application of artificial intelligence (AI) in traffic control requires an understanding of its technical foundations and the technologies that enable it in the context of road safety.
In this section, the main concepts related to AI and the specific tools already applied or with potential for use in military police work will be presented.

2.1. CONCEPT AND TYPES OF ARTIFICIAL INTELLIGENCE

Artificial intelligence can be defined as the branch of computer science dedicated to developing systems capable of simulating human cognition—that is, systems that learn, reason, make decisions, and solve problems autonomously. AI operates using complex algorithms and large volumes of data (big data), enabling the performance of tasks previously exclusive to human intelligence.

Among the most relevant approaches in the context of traffic control are:

- Machine Learning: algorithms that allow systems to “learn” from received data, adjusting and improving their performance over time without the need for manual reprogramming.

- Deep Learning: a sub-area of machine learning that uses artificial neural networks in multiple layers, capable of interpreting unstructured data such as images and videos — essential for the visual recognition of violations and traffic patterns.

- Computer Vision: technology that allows machines to interpret images and videos in a similar way to the human eye, being essential for reading license plates, identifying dangerous maneuvers, using a cell phone while driving, not wearing a seatbelt, among other infractions.

These integrated technologies provide intelligent systems capable of detecting, recording, and analyzing traffic violations automatically, with a high rate of accuracy and in real time.

2.2. TECHNOLOGIES ASSOCIATED WITH SUPERVISION

In the field of road safety, AI is applied through devices and systems that directly collect and analyze traffic data. Key technologies associated with AI-enabled enforcement include:

- ALPR (Automatic License Plate Recognition): Also known as automatic license plate recognition, this system uses cameras and computer vision algorithms to capture and interpret the characters on vehicle license plates. After reading, the data is cross-referenced with police, administrative, or judicial databases, enabling the identification of vehicles with restrictions, such as stolen, robbed, delinquent, or used in criminal activities.
- Smart Traffic Violation Detection Cameras: AI-powered devices capable of detecting driver misconduct, such as speeding, running red lights, using cell phones while driving, and disregarding crosswalks. These cameras operate autonomously and in real time, reducing the need for direct police intervention.

- Urban Sensors and Big Data Integration: Sensors installed in traffic lights, crosswalks, roads, and overpasses capture information on vehicle flow, average speed, sudden stops, and other indicators. When connected to big data and AI systems, these sensors enable the generation of heat maps, identification of critical points, and the construction of predictive accident models, supporting the Military Police's operational planning.

3 PRACTICAL APPLICATIONS IN TRAFFIC INSPECTION

The incorporation of artificial intelligence-based systems into traffic enforcement has led to significant advances in the ability to monitor, respond to, and deter illegal behavior. Smart technologies enable more strategic and data-driven action, reducing the reliance on exclusively on-site enforcement and expanding the scope of Military Police actions.

3.1. AUTOMATIC RECOGNITION OF INFRACTIONS

The use of computer vision systems and AI algorithms in traffic enforcement has enabled the automatic detection of various traffic violations, even without the direct presence of an officer on site. Among the most common cases are:

- Running a red light, often associated with cross-traffic collisions and run-overs at urban intersections;
- Excessive speed, which compromises road safety, especially in school areas and heavy traffic zones;
- Dangerous or evasive driving, identified by cameras capable of reading movement patterns and abrupt braking;
- Illegal parking, including parking in prohibited areas, pedestrian crossings or spaces reserved for people with disabilities.

In addition to spot detection, the systems can be programmed to map hotspots with a higher incidence of violations, contributing to the redistribution of personnel, installation of monitoring devices, and educational campaigns. Analysis of repeat offense patterns also allows for targeted actions against frequent offenders, promoting a preventive and strategic approach.

3.2. EXPERIENCES IN BRAZILIAN STATES AND ABROAD

Several Brazilian states are already successfully experimenting with AI in traffic enforcement. In São Paulo, the Detecta system integrates security databases with smart cameras that issue real-time alerts about vehicles reported stolen, infringed, or involved in crimes. The project has been essential for recovering vehicles and identifying ongoing crimes.

In the Federal District, AI-powered cameras have been installed on busy avenues to automatically read license plates, record violations, and automatically notify drivers. In Minas Gerais, the focus is on integrating urban cameras, the Military Police, and an automated ticketing system.

Internationally, cities like London, New York, and Tokyo lead the way in the use of AI in traffic. In London, algorithms analyze driver behavior and average speed between stops, applying automatic penalties. In New York, AI systems monitor the use of dedicated lanes, while in Tokyo, sensors connected to traffic lights and drones map traffic flow and identify risks in real time.

These experiences demonstrate the technical feasibility and operational effectiveness of AI applied to inspection, serving as a reference for Brazilian states.

3.3. MILITARY POLICE PERFORMANCE WITH AI SUPPORT

The Paraná Military Police is fully equipped to integrate artificial intelligence technologies into its traffic enforcement routine. Practical applications include:

- Fixed cameras installed at intersections, neighborhood entrances and state highways, operating continuously to record and process violations;
- Mobile cameras attached to operational vehicles, with automatic license plate reading and detection of irregularities while police officers are on patrol;
- Drones with embedded AI, capable of aerial monitoring of events, inspecting hard-to-reach areas or carrying out special traffic operations.

In addition to data collection, the effectiveness of these tools depends on their integration with existing systems, such as SINESP (National Public Security System), DETRAN (Department of Motor Vehicles), CIOSP (Integrated Public Security Operations Center), and PMPR regional command centers. The unification of this information allows military police officers to receive real-time alerts while patrolling, optimizing their approaches and increasing the assertiveness of their actions.

Modernizing traffic enforcement with AI, therefore, represents not only a technological gain, but an opportunity to make policing more proactive, precise, and aligned with national and international best practices.

4 LEGALITY AND ETHICAL LIMITS OF AI-BASED SUPERVISION

The adoption of artificial intelligence-based technologies in the field of public safety, especially in traffic enforcement, requires strict adherence to the legal frameworks and ethical principles governing the democratic rule of law. While such tools represent significant advances in terms of operational efficiency, their use must be guided by criteria that ensure respect for civil liberties, privacy, and human dignity.

4.1. APPLICABLE LEGISLATION

The use of artificial intelligence in police work must comply with existing Brazilian legal standards. In the traffic sector, Law No. 9,503/1997 stands out, establishing the Brazilian Traffic Code (CTB), which defines the responsibilities of traffic authorities, the legal procedures for issuing citations, and the applicable violations.

Furthermore, Law No. 13,709/2018, known as the General Personal Data Protection Law (LGPD), establishes guidelines for the collection, storage, and processing of personal data by public and private entities. While license plate reading alone does not necessarily represent personal data, cross-referencing with other information—such as the owner's name, address, CPF number, or traffic violation data—can constitute indirect identification of the individual, subjecting such practices to the requirements of the LGPD.

The application of AI in traffic control must also observe the constitutional principles of legality, proportionality, purpose, and transparency, ensuring that the technology is used within the limits authorized by law, for legitimate purposes, and in a non-excessive manner.

4.2. PRIVACY AND DRIVER RECOGNITION

One of the main challenges related to the use of intelligent systems in monitoring is the balance between the public interest in road safety and respect for citizens' privacy.
Technologies such as cameras with facial recognition, data cross-referencing, and real-time monitoring can have significant impacts on an individual level.

Although the main focus of these systems is the vehicle's license plate—a piece of data linked to the asset, not the person—the use of this information, when combined with registration databases, can allow for the reconstruction of individuals' routes, habits, schedules, and travel patterns, opening the door to risks of undue surveillance, illegal harassment, or misuse of the information collected.

Another sensitive point is the potential lack of citizen consent regarding the processing of their data, which, in the case of public administration, must be compensated for by strict adherence to the purpose and necessity of the collection, as per Article 23 of the LGPD. Automated monitoring cannot, therefore, exceed the limits of reasonableness nor compromise fundamental rights guaranteed by the Constitution.

4.3. NEED FOR STANDARDIZATION AND TRANSPARENCY

Although current legislation offers important parameters, there are still specific regulatory gaps regarding the use of AI by police forces in traffic operations. The lack of clear and standardized rules can create legal uncertainty for both citizens and the public officials responsible for operating these systems.

In this sense, it is essential that the Military Police — in conjunction with the Executive Branch and traffic management agencies — develop standardized operational protocols that define:

- The limits of the performance of AI tools;
- Legal hypotheses for data collection and cross-referencing;
- The retention time of images and information;
- The criteria for exclusion or anonymization of records;
- External control and audit channels.

The creation of clear, accessible, and transparent internal regulations strengthens the institutional legitimacy of the Military Police and ensures that the use of technology is in accordance with democratic values and the trust of society.

5 OPERATIONAL AND STRATEGIC BENEFITS

The incorporation of artificial intelligence into traffic enforcement provides a series of operational and strategic advantages for the Military Police. These technologies expand monitoring capabilities, increase the effectiveness of traffic controls, and support data-driven decision-making, strengthening road safety and integrated traffic management.

Among the main benefits, the following stand out:

- Optimization of the preparation of infraction reports: the automation of infraction records, through cameras and recognition algorithms, eliminates the need for manual filling, reduces administrative errors and speeds up the issuance of notifications, ensuring greater agility and reliability in administrative processes.
- Reduced subjectivity in police checks: Intelligent systems rely on technical and objective criteria to identify illegal behavior, such as running a red light, speeding, or using a cell phone while driving. This helps reduce checks based solely on visual impressions or subjective suspicion, promoting greater impartiality, predictability, and legal certainty in police actions.
- Improved safety for field officers: By enabling the prior identification of restricted vehicles, AI systems assist officers in preparing for an approach, reducing the risk of unexpected confrontations. Furthermore, the presence of monitoring technologies tends to discourage hostile behavior by offenders, making the operational environment safer.
- Improved strategic planning: Data collected by smart devices is organized into reports that reveal behavior patterns, critical times, locations with the highest incidence of violations, and areas with a high concentration of accidents. This information supports decisions about staff allocation, installation of new equipment, and implementation of more effective educational or enforcement campaigns.

6 CHALLENGES FOR IMPLEMENTATION IN THE PMPR

Despite the promising advances provided by artificial intelligence in traffic enforcement, its effective incorporation into the routine of the Paraná Military Police (PMPR) faces several practical, structural, and cultural challenges. Overcoming these obstacles is crucial to ensuring that the use of technology is safe, efficient, and aligned with the corporation's institutional objectives.

Among the main challenges, the following stand out:

- Infrastructure deficiencies and the need for ongoing investment: Implementing AI-based systems requires robust infrastructure, including high-resolution cameras, mobile devices embedded in vehicles, data storage servers, and specialized software. Furthermore, ongoing maintenance of this equipment is essential, which requires sustainable investment and medium- and long-term budgetary planning.

RCMOS – Multidisciplinary Scientific Journal of Knowledge.
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• Technical training for police officers: The operation of smart technologies requires that officers be prepared to use, interpret, and react to data generated by AI systems. To achieve this, it is essential to offer regular training, technology refresher programs, and training focused on both the operational aspects and the legal understanding of the limits of using the tool.

• Integration between systems and databases: The effectiveness of artificial intelligence in inspection depends on the integration between PMPR systems and other institutional platforms, such as SINESP, DETRAN, CIOSP, and municipal registries. A lack of interoperability between these databases can compromise the agility of information cross-referencing, hindering the generation of real-time alerts and the automation of operational responses.

• Institutional resistance and social perception: Large-scale technological changes often face resistance both internally and within society. Institutionally, there may be concerns about replacing traditional methods or doubts about the technology's effectiveness. On the other hand, some members of the public may express concerns about privacy, constant surveillance, or the misuse of captured images and data. Overcoming this resistance requires transparent communication, trust-building, and a clear demonstration of the initiative's public benefits.

7 PROPOSALS AND FUTURE PERSPECTIVES

For the Paraná Military Police (PMPR) to adopt artificial intelligence in traffic enforcement effectively, safely, and with legal support, it is necessary to establish structured guidelines and propose short-, medium-, and long-term actions. Building a sustainable technological model must consider operational, legal, and institutional aspects, aiming not only for efficiency but also for the legitimacy and social acceptance of new practices.

Among the main proposals and perspectives for the future of AI application in traffic, the following stand out:

• Development of a state protocol for the use of AI in traffic enforcement: the creation of specific standards, based on the principles of legality, proportionality, and transparency, will allow for standardizing operational procedures, delimiting the use of captured data, establishing data retention periods, and defining criteria for auditing and external control. This protocol would serve as a reference for all PMPR battalions and operational units, ensuring legal certainty and uniformity in the application of the technology.

• Implementation of pilot projects in strategic areas: a viable alternative to begin the modernization process is the gradual adoption of AI through pilot projects in municipalities with high vehicle density or a high rate of traffic accidents.
By analyzing the operational, technical and social results of these tests, it would be possible to adjust methodologies, correct flaws and expand the model with greater efficiency and legitimacy.

- Active participation of the Military Police in municipal and state urban mobility councils: The inclusion of the Military Police in forums for debate and formulation of public mobility policies contributes to the alignment of technological initiatives with the objectives of smart cities. Participation in these forums allows the force to directly influence the development of integrated traffic and safety policies, in addition to strengthening inter-institutional dialogue.
- Development of proprietary systems or establishment of technological partnerships: The PMPR can invest in the creation of internally developed platforms, in cooperation with universities and research centers, ensuring greater control over data and technological independence. Alternatively, agreements can be established with companies specializing in road safety and artificial intelligence solutions, provided that public procurement regulations and legal data protection requirements are observed.

8 CONCLUSION

The application of artificial intelligence to traffic enforcement represents a milestone in the modernization of public safety practices, especially regarding the work of the Military Police. The use of intelligent systems, such as cameras with automated violation detection, license plate recognition, and risk behavior analysis, has demonstrated great potential for increasing operational efficiency, reducing subjectivity in traffic stops, and providing qualified support for decision-making in the field.

The operational benefits go beyond automation: they represent progress in building a more preventative, evidence-based policing model with greater responsiveness to the complexities of contemporary traffic. The production of reliable data, integration with other public systems, and increased safety of personnel are clear evidence of the positive impact that AI can offer to traffic management.

However, the use of smart technologies requires appropriate legal and ethical frameworks. It is essential that the implementation of these resources be carried out under strict legal criteria, respecting citizens' privacy, the protection of personal data, and the public purpose of police action. To this end, specific regulation of the use of AI in road safety is urgently needed, with transparent protocols, continuous auditing, and public participation.

The Paraná Military Police, by strategically investing in technological innovation, personnel training, and institutional partnerships, has the opportunity to assume a national leadership role in the ethical, efficient, and democratic application of artificial intelligence in traffic enforcement. With planning, responsibility, and respect for fundamental rights, the force can establish itself as a benchmark in a policing model focused on intelligent road safety and strengthening public trust.

9 REFERENCES

BATISTA, Mariana. *Artificial intelligence and public security: applications and ethical limits.* Brazilian Journal of Police Sciences, Brasília, v. 13, n. 1, p. 121–139, Jan./Jun. 2022.

BRAZIL. *Brazilian Traffic Code.* Law No. 9,503 of September 23, 1997. Institutes the Brazilian Traffic Code. Official Gazette of the Union: section 1, Brasília, DF, September 24, 1997.

BRAZIL. *General Personal Data Protection Law (LGPD).* Law No. 13,709 of August 14, 2018. Provides for the protection of personal data and amends Law No. 12,965/2014 (Civil Rights Framework for the Internet). Official Gazette of the Union: section 1, Brasília, DF, August 15, 2018.

GONÇALVES, João Paulo. *Technology and public security: challenges and opportunities in the digital age.* São Paulo: Atlas, 2021.

PARANÁ STATE MILITARY POLICE – PMPR. *Operational reports on traffic enforcement with technological support: 2022–2024.* Curitiba: PMPR Intelligence Directorate, 2024.

SECRETARIAT OF PUBLIC SECURITY OF THE STATE OF SÃO PAULO – SSP-SP. *Detecta System: effectiveness report and operational indicators.* São Paulo: SSP-SP, 2023.