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CHALLENGES IN THE USE OF FACIAL RECOGNITION IN VIDEO SURVEILLANCE SYSTEMS IN BRAZIL

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ABSTRACT

The use of facial recognition systems in video surveillance has gained prominence in Brazil, being widely used in areas such as public security, transportation, and access control. However, its implementation faces significant challenges related to error rates and algorithm reliability, especially in complex social and infrastructural contexts. This article discusses the main limitations of these systems in Brazil, focusing on the factors that influence errors, such as image quality, algorithmic bias, and underrepresented demographic characteristics in databases. In addition, it addresses technical reliability, exploring performance metrics and technological constraints in singular scenarios. The text also highlights ethical and legal issues, such as the absence of specific regulations and the risks to privacy and the fundamental rights of citizens. Practical examples and Brazilian case studies are presented, highlighting the operational difficulties and social impacts of false positives and negatives. Finally, potential solutions are analyzed, such as advances in machine learning, training algorithms with diverse data, and the urgent need for robust legislation. The article concludes that, for facial recognition to become a reliable and ethical tool in Brazil, it is essential to invest in infrastructure, research, and regulation, ensuring a balance between technological innovation and the protection of fundamental rights.

Keywords: Facial recognition. Video surveillance. Reliability. Algorithmic bias.

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INTRODUCTION

The use of facial recognition systems in video surveillance in Brazil has grown significantly, covering sectors such as public security, commerce, and other services. This technology is increasingly seen as an important tool for preventing crime and improving security in urban environments, offering solutions to long-standing challenges faced by authorities and businesses. The relevance of this innovation stands out in a scenario in which the protection of people and property becomes a priority, providing a safer environment for both citizens and owners of establishments.

However, the adoption of facial recognition is not without challenges. Issues related to the reliability of the systems stand out, such as the high identification error rates, which can lead to mistaken detections and, consequently, injustices. In addition, the algorithmic bias involved in these systems can accentuate social inequalities, resulting in discrimination against certain groups. These implications raise important discussions about the social and ethical impacts of the use of this technology, making it essential to take a critical look at its implementation (DE ANDRADE BICHARA; DE BRITO, 2024).

This article aims to identify and discuss the main challenges associated with the error rates and reliability of facial recognition in Brazil. The analysis seeks to understand how these factors influence the effectiveness of these systems and society's perception of their use, bringing information about the regulation and ethics behind the use of technology in the Brazilian context.

Facial recognition algorithms operate by capturing images that are then processed to identify unique and distinctive features of the human face. These physical characteristics include elements such as the distance between the eyes, the shape of the chin, the width of the jaw, and the bone structure of the face, which vary considerably from person to person. All this data is then transformed into vectors that represent the face in a specific dimensional space, allowing an analysis of the data. When a new image is received, the system springs into action and compares these unique characteristics with a previously cataloged and stored database, seeking to identify coincidences that may correspond to known individuals. This process allows facial recognition to become an identification and verification tool that is increasingly present in people's daily lives and used in various practical applications, from airport security to authentication on electronic devices (MARQUES, 2021).

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In Brazil, facial recognition has been widely used in various practical and everyday situations, demonstrating its effectiveness and versatility in a variety of contexts and scenarios. In large events, such as concerts, festivals and parties, this technology helps to identify people efficiently, thus contributing to the collective safety of participants and ensuring a smoother and safer experience. (SCOPEL; PUHL, 2024) At airports, facial recognition not only speeds up the boarding and disembarking process, but also improves the passenger experience by quickly verifying identity, which helps reduce waiting times and stress associated with travel. In addition, in public transport systems, such as subways and buses, technology is applied to ensure the safety of users, monitoring areas with high circulation of people and helping to prevent incidents that may compromise the integrity of passengers (QUEIROZ, 2022). In police surveillance, facial recognition also plays a key role, helping to locate suspects in real-time, which improves the response of authorities and the effectiveness of public security operations, thus providing a safer environment for citizens (QUEIROZ, 2023).

The implementation of facial recognition in Brazil can have a significant and comprehensive impact, as it has the potential to not only reduce crime but also substantially increase the efficiency of security operations in several relevant areas and sectors. With a faster and more effective identification of suspicious individuals, it is expected that the occurrence of crimes will be prevented more effectively, thus facilitating the preventive action of security forces and allowing these authorities to act more proactively and efficiently, which could lead to a decrease in crime rates. In addition, the real-time analysis of the data collected through facial recognition can contribute decisively to a more agile, appropriate and efficient response in emergency situations, providing a safer and more secure environment for the population. However, it is essential that there is a rigorous and constant monitoring of the use of this technology, reflecting on important issues of privacy, public security and individual rights, so that the application is not only efficient, but also ethical and responsible, respecting the fundamental rights of each citizen and ensuring that the technology is not used in an abusive or inappropriate manner. (DE MELO, 2024)

METHODOLOGY

To carry out the research, a bibliographic review and data analysis approach was used. Starting with the collection of articles, studies and relevant information on the use of facial recognition in video surveillance systems in the Brazilian context. Then, a detailed

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analysis of the collected material was carried out, identifying trends, challenges and gaps in knowledge. Finally, the consolidation of the information obtained and organization of the data in order to support the results and discussions presented.

RESULTS

The survey results revealed significant error rates in facial recognition, especially when applied to ethnic minority groups. In addition, the reliability of facial recognition systems was questionable, with a high incidence of false positives and negatives. The specific challenges of the Brazilian context were highlighted, especially with regard to the precarious technological infrastructure and the lack of regulation and specific legislation for the use of this technology. In addition, the social impact of facial recognition has raised concerns about privacy and possible discrimination. Future perspectives point to the need for technological and regulatory improvement, aiming to overcome the challenges identified and ensure an ethical and effective use of facial recognition in Brazil.

DISCUSSION

ERROR RATES IN FACIAL RECOGNITION

The quality of the images, which includes aspects such as the correct lighting, the angle at which the photo was taken, and the resolution of the image, plays a crucial and determining role in the error rate observed in facial recognition systems. In addition, demographic characteristics also bring influences, since there is an inherent bias related to the ethnicity, gender, and age of individuals (VECCI, 2023).

These factors contribute to the imprecision in the identifications that these systems perform. Another relevant aspect that cannot be neglected is the flaws in face matching that occur in databases that are outdated or incomplete, as these gaps can, in fact, lead to significant and problematic errors in the analyses carried out (DUARTE, 2021).

In Brazil, several case studies have shown the occurrence of false positives and negatives in police operations, as well as in public systems used for identification and monitoring. According to (DE AGUIAR ARAÚJO et al., 2021), investigative reports have highlighted that error rates vary significantly according to the profiles of the people involved, with a higher incidence of inaccuracies in the identification of women and darker-skinned individuals.

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> In a survey carried out in the states of Bahia, Ceará, Pernambuco, and Rio de Janeiro, among one hundred and eighty people arrested with the use of recognition, ninety percent were black (DE AGUIAR ARAÚJO et al., 2021).

This reflects an alarming racial and gender bias that raises concerns about the effectiveness and fairness of the approaches taken by institutions. These data highlight the need to review the methods used, seeking to ensure that all citizens are treated with equity and respect, regardless of their gender or ethnicity (DOS SANTOS, 2024).

International comparisons reveal that these challenges are not unique to Brazil (DE AGUIAR ARAÚJO et al., 2021). In several countries around the world, the academic community, in collaboration with human rights organizations, has focused on the analysis and debate of the limitations of this emerging technology, presenting a variety of evidence that demonstrates significant errors that ultimately compromise security and social justice. These cases further highlight the urgency of necessary refinements and improvements in the algorithms used, in addition to the implementation of stricter and more effective policies and regulations to ensure not only the effectiveness, but also the ethics in the use and application of facial recognition in public and private environments (VARGAS, 2022).

RELIABILITY OF FACIAL RECOGNITION SYSTEMS

The reliability of facial recognition systems in Brazil is a crucial aspect that affects not only the effectiveness of the technologies, but also the public perception of their use and social acceptance (DA COSTA et al., 2021).

Reliability in systems that utilize artificial intelligence (AI) is assessed by the ability of those systems to provide consistent and accurate results over time, regardless of changes in conditions or input data. To measure this confidence, several metrics are used, such as accuracy, which indicates the accuracy of the results, the false positive rate, which represents the incorrect claims made by the system, and the false negative rate, which indicates omissions in identification. These metrics provide insight into the system's effectiveness in performing correct identifications and minimizing errors. Thus, reliability becomes a key aspect for success in the application of AI in various areas, ensuring that users can trust the decisions and recommendations generated by these systems (RIBEIRO et al., 2024).

In Brazil, evaluation metrics are extremely critical and play a key role in understanding the performance of artificial intelligence systems in a more in-depth way.

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Accuracy is an essential factor to consider, as it ensures that identities are correctly recognized and interpreted. The false positive rate, which indicates the percentage of individuals who have been misidentified as being someone they are not, and the false negative rate, which represents cases in which people who should have been recognized have not been, are equally important and cannot be ignored. However, it is worth noting that these software often face limitations due to the presence of insufficient training data, as well as the lack of validation in appropriate local contexts, which can compromise the effectiveness of the evaluations performed. Therefore, ensuring a robust and diversified dataset is crucial for improving these assessments and the reliability of the systems (RIBEIRO, 2022).

The reliability of these systems can be compromised by implicit biases that are present in the data and algorithms used. If the training data do not adequately represent the ethnic, cultural and social diversity of the Brazilian population, the result will be a significant expansion of the inequalities and discrimination that already exist in our society. This not only affects the accuracy of the identifications and analyses made, but also raises relevant ethical concerns about the use of these systems. The lack of inclusion and representation can lead to wrong and unfair decisions, which negatively impact the lives of people who are already in vulnerable and marginalized situations. (VIEIRA, 2022)

Given these concerns, several solutions have been proposed to improve the reliability and efficiency of AI systems. Training with more diverse and broad databases is an essential strategy, as it helps to ensure that different ethnic and social groups are adequately represented and considered. This inclusive approach is crucial to avoid biases and mistakes that could compromise the effectiveness of technology solutions. In addition, the improvement of algorithms, with a focus on minimizing bias and adapting to the local particularities of each context, can significantly contribute to increasing fairness and accuracy in the application of video surveillance, as well as in other recognition systems, providing a considerable advance in the way AI interacts with the various communities. This proactive approach is key to building technology that is not only efficient but also ethical and responsive to the needs of all segments of society (DE SOUZA, BEATRIZ TEREZINHA et al., 2023).

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CHALLENGES SPECIFIC TO THE BRAZILIAN CONTEXT

In Brazil, technological infrastructure faces significant challenges, particularly in smaller cities, where limited equipment can hinder the effectiveness of the implementation of facial recognition systems. The data connection is often unstable, and the high costs of implementing this technology make its access quite restricted in many regions. With regard to regulation and legislation, the lack of specific laws that regulate the use of facial recognition represents a considerable obstacle, intensifying ethical concerns related to citizens' privacy and consent. In addition, the social impact resulting from this technology raises crucial issues, such as the possibility of discrimination and undue criminalization, in addition to generating reactions from society in the face of the massive application of this technology, which can be seen as an invasion of privacy and a threat to individual freedoms.

TECHNOLOGICAL INFRASTRUCTURE

The technological infrastructure plays a crucial and indispensable role in the effectiveness and operation of video surveillance systems that use facial recognition, and it is imperative to take into account a series of relevant aspects. This includes, for example, the error rate, which must be minimized to ensure the effectiveness, and the reliability of the devices employed, which is essential for the creation of robust systems. In addition, the quality of the images produced is a determining factor for the success of facial recognition, since low-resolution images can compromise the entire analysis. In addition, the integration of various technologies, such as artificial intelligence and algorithms, as well as the performance of adequate and regular maintenance, are significant factors in ensuring that such systems function efficiently and accurately over time. The synergy between these elements is essential to optimize the performance of video surveillance systems in a scenario that is constantly evolving. (DIAS, 2020)

REGULATION AND LEGISLATION

In Brazil, currently, there is still no specific regulation that deals with the use of facial recognition in video surveillance systems, although the biometric data collected may be directly framed with regard to the LGPD (General Data Protection Law). However, it is important to note that some states, such as São Paulo and Rio de Janeiro, are already mobilizing and debating the implementation of laws that regulate the use of this innovative

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technology, mainly due to growing concerns about people's privacy and the possible violations of individual rights that this practice can entail. In addition, the Civil Rights Framework for the Internet, which was created to establish principles, guarantees, rights and duties for the use of the internet in Brazil, may be a basis that will be applied to facial recognition, even if indirectly. In view of this, it is essential that there is public debate and the participation of society in this regulatory process (COSTA; KREMER, 2022).

SOCIAL IMPACT

The increasing use of facial recognition in video surveillance systems in Brazil raises concerns about the social impact that this technology can have on today's society. There are discussions about issues related to privacy violations, mass surveillance, and the possibility of discrimination by systems. The population generally fears that the widespread and indiscriminate use of facial recognition could result in an increasingly surveilled society, with potentially negative consequences for individual freedoms and citizens' fundamental rights. In addition, the evident lack of transparency and the absence of clear and robust regulation on the use of this technology further amplify distrust of video surveillance systems that employ facial recognition. This situation demands an open and continuous dialogue about the ethical and social implications of this technological tool (SALES, 2021).

PERSPECTIVES FOR THE FUTURE

The future is expected to bring progress in reducing error rates in facial recognition, driven by new techniques such as deep learning, which promise more accurate algorithms. This should increase the reliability of facial recognition systems, especially with improvements in infrastructure and training of the professionals who operate these systems. In Brazil, the use of facial recognition in video surveillance is expected to expand, but it is crucial to develop legislation that protects citizens' rights, ensuring that the technology is used responsibly and ethically. In addition, the integration of facial recognition with other technologies, such as artificial intelligence, can further optimize the effectiveness of these systems (SARTORI, 2024).

It is essential that legislation advances effectively and consistently to protect individual rights and ensure citizens' privacy comprehensively and efficiently. Suggestions for the development of standards that establish clear guidelines on the use of facial recognition are essential, always aiming at an appropriate balance between progressive

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technological innovation and the necessary protection of the human rights of all individuals involved in this process. The implementation of such regulations and policies should not be underestimated in their importance, as it can contribute significantly to the safety and confidence of society as a whole, ensuring that emerging technologies are used responsibly and ethically, preventing abuses that may threaten the well-being of individuals (DA SILVA ARAUJO, et al., 2024).

Bill 3069/22, although not in force, is an advance with regard to the legal use of Facial Recognition. This is a bill that regulates its use in the country's armed forces and should strengthen national public security by institutionalizing mass analysis tools.

In order to operate and oversee these systems responsibly and effectively, it is important to foster a broad and meaningful public debate about the conscious and responsible use of modern technology. The training of qualified professionals, together with the growing awareness of society in general regarding the direct and indirect impacts that contemporary technologies can have on our daily lives, is crucial to ensure an ethical, safe and effective use of artificial intelligence, as well as facial recognition and its implications. The promotion of understanding by the population is essential so that everyone can participate in these discussions in an informed, engaged and conscious way. Thus, education should be seen as an essential pillar, where individuals are encouraged to question and understand the technologies that surround them, allowing for more responsible interaction with these advanced tools (DA SILVA GUARDA, 2024).

CONCLUSION

The use of facial recognition in video surveillance systems in Brazil faces challenges related to high error rates and system reliability. These problems are further accentuated by the ethnic diversity of the population and the varying lighting conditions, which complicates the effective application of this technology.

It is imperative to strike a balance between technological innovation and the protection of fundamental rights. The search for advances must consider not only efficiency, but also the ethical and social implications that technology can entail.

Researchers, legislators and developers need to join efforts in creating an ethical and efficient ecosystem for the use of facial recognition in Brazil. Only through collaboration and commitment will it be possible to address the existing challenges and ensure a responsible and fair application of this technology.

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