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Artificial Intelligence as an Information Gathering Tool In the Search for Missing Persons in Mexico

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ABSTRAC: This article analyzes the role of artificial intelligence (AI) as an emerging tool in collecting information to locate missing persons in Mexico, in the midst of an ongoing humanitarian crisis. The general objective is to evaluate how the use of AI technologies can support localization processes, optimize the processing of large volumes of data and contribute to the exercise of the right to the truth. The research is based on a qualitative and descriptive approach through document analysis and is supported by quantitative data obtained from case studies, official reports and records on disappearances. The work addresses the use of technologies such as facial recognition, satellite image analysis, natural language processing; Likewise, advances in operational efficiency are established. The results indicate that AI can positively enhance the effectiveness and speed of searches, especially if it is articulated jointly between State institutions and civil society. The conclusions highlight the need to establish adequate regulatory frameworks that guarantee a focus on human rights, as well as promote the participation of indirect victims.

Keywords: Artificial intelligence, disappearance of persons, human rights, technology, Mexico.

I. INTRODUCTION

In postmodernity, the disappearance of persons represents a complex, painful, and persistent problem in Mexico. The development of this phenomenon transcends existing legal frameworks and directly affects thousands of families, representing not only a serious human rights violation but also a structural challenge for the Mexican State. According to the National Search Commission (CNB), more than 110,000 people were reported missing or

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disappeared as of April 2024 throughout the country, placing Mexico among the nations with the highest number of disappearances in the world (CNB, 2024).

Over the past fifteen years, the phenomenon has grown exponentially, particularly in contexts marked by armed violence, organized crime, institutional corruption, and a criminal justice system characterized by impunity. According to the UN Committee against Enforced Disappearances (CED, 2022), the disappearance crisis in Mexico stems not only from the direct actions of criminal groups but also from the tolerance or participation of state authorities at various levels, which deepens the distrust of indirect victims toward the institutions responsible for searching for and seeking justice for their missing relatives.

The application of new technologies has begun to be explored as a way to strengthen activities by state authorities, as well as from a social perspective, in the search for missing persons. For example, artificial intelligence, in particular, can be useful as a strategic tool, given its capacity to analyze extensive datasets, recognize patterns, connect disparate information, and develop projections that facilitate more efficient location efforts (Smuha et al., 2021).

Along the same lines, AI uses techniques such as computer vision, data mining, natural language processing (NLP), and machine learning. Furthermore, intelligent systems can process official databases, forensic reports, social media information, images, videos, phone calls, citizen complaints, and more. Processing large amounts of information simultaneously can help identify hidden patterns in disappearances, locate connections between seemingly isolated cases, and generate priority search routes or areas (Ravindran et al., 2023).

Furthermore, it follows that these capabilities can have a positive impact on search commissions, specialized prosecutors' offices, and civil society organizations, which often face limitations in terms of personnel and material resources to carry out extensive searches, especially in areas dominated by criminal groups. In this sense, AI can act as a multiplier of human capabilities, contributing to decision-making and supporting fieldwork through the use of advanced technologies.

However, the use of artificial intelligence applied to searching for missing persons also poses significant challenges from a legal, ethical, and even technical perspective. This stems from the massive processing of personal data to which it will have access, which entails risks to the rights of direct and indirect victims, especially when there are no clear legal frameworks for the protection of this data. Furthermore, opaque algorithms can reproduce biases and discriminatorily exclude certain social groups, affecting impartiality in the processing of information. In addition, the lack of federal or state investment infrastructure for the optimal development of these technologies limits the possibilities for large-scale AI use (Floridi et al., 2018; Daza, 2022).

Based on the above, this article aims to analyze the functionality of artificial intelligence as a technological tool applied to the collection and analysis of information in the search for missing persons in Mexico. It establishes the applications that can be used for this specific problem, as well as the limitations and challenges presented from an interdisciplinary perspective, taking into account technical, legal, and ethical considerations. This research is based on the premise that while AI cannot replace human action in search processes, it can act as a strategic resource that reinforces and expands operational capabilities, provided its application is carried out ethically, responsibly, and with a human rights approach.

II. METHODOLOGY

The disappearance of people in Mexico is a complex and painful problem that not only directly affects those who have disappeared, but also profoundly impacts their families and communities, who face a difficult path when demanding the search and location of their loved ones. This research arises from a question posed as an analytical response to the limitations encountered in search processes and the role of AI in addressing this

problem. Therefore, the research approach is qualitative, allowing for an analysis of the problem from the general characteristics of human searches to the incorporation of AI in these searches, as well as its limitations and opportunities.

The research is exploratory and descriptive, in accordance with its main objective: to explore and describe the use of AI in the search for missing persons in Mexico, as well as to identify patterns and previous results in the application of technologies such as facial recognition, geospatial data analysis, and natural language processing in disappearance investigations. The descriptive level allows for a detailed view of the use of AI technologies in real-world situations, the results, and the associated limitations.

This research employs a documentary and applied theoretical approach, as it is based on the analysis of existing sources and aims to contribute to the development of proposals that guide public policies with a human rights focus. The research design is non-experimental and cross-sectional, since variables are not manipulated and the data analyzed correspond to a specific point in time. The research is based on secondary sources obtained through techniques such as document analysis, systematic review of academic and scientific literature, and content analysis applied to institutional reports, case studies, reports from national and international organizations (such as the CNB, the UN, and Human Rights Watch), and specialized articles.

The techniques mentioned above allow us to reconstruct a critical overview of AI functionality, the challenges to its effective implementation, and the ethical dilemmas faced by those involved. In this way, the present study articulates technological analysis with a critical human rights perspective, proposing an analytical framework that identifies both the advances and limitations of AI use in the search for missing persons and that serves as a basis for future lines of research and regulatory processes.

III. DEVELOPMENT AND DISCUSSION

The disappearance of people in Mexico is one of the most serious problems facing the country, constituting not only a grave violation of the human rights of the disappeared but also of their families, who spend years searching for them without answers. The complexity of this problem stems from the fact that it does not occur in isolation but is linked to other crimes such as kidnapping, torture, homicide, and others. Technological advancements are prompting a re-evaluation of how artificial intelligence can be incorporated as a tool in the search for missing persons, given its capacity to analyze vast amounts of information, identify patterns, and generate predictions that can be useful in locating them.

According to data from the National Search Commission (CNB, 2024), more than 113,000 people have disappeared in Mexico. This figure highlights the severity and magnitude of the problem. Hence the importance of strengthening mechanisms for locating and identifying missing persons within a context of deep-rooted structural violence in Mexico, linked to organized crime, corruption, impunity, and limitations in search and rescue efforts.

Facial recognition based on deep neural networks is one of the most significant technological developments applied to locating people. Technologies such as FaceNet, DeepFace, and ArcFace have demonstrated a remarkable ability to accurately recognize human faces, even under adverse conditions, such as low-quality images or when faces exhibit physical alterations due to aging or violence. These tools are becoming increasingly valuable for strengthening identification efforts in complex situations.

The accuracy of these technologies exceeds 97% in forensic scenarios, according to the results of a study by Silva, Martinez, and Ramirez (2022), since these technologies are trained using specific databases containing the faces of people reported missing. This facial matching capability has been applied to platforms such as

IdSonora and RePU (Public Registry of Missing Persons), where the system can detect matches between photographs on social media, surveillance videos, and institutional databases.

Simultaneously, natural language processing (NLP) has become a critical tool for analyzing complaints, statements, digital publications, and field reports. This technology allows not only the extraction of relevant information but also the recognition of entities (names, places, dates), emotions, and contextual reactions within the data. Trained models have improved the ability to understand and categorize documents related to disappearances, thus facilitating the detection of coincidences between seemingly isolated cases. Examples of these models include BERT and GPT-4 (Chen & Zhao, 2023).

In addition, social networks play an important role of influence since the semantic analysis of networks has made it possible to find clues about the whereabouts of people by finding information within comments, geolocated publications or hashtags, as demonstrated with the AI searcher project implemented by the searchers mothers collective of Sonora in collaboration with independent developers (Moreno Sánchez, Torres & Delgado, 2023).

Furthermore, data mining and machine learning are essential for predicting risk zones and generating heat maps of disappearance concentrations. Supervised algorithms such as Random Forest and Gradient Boosting Machines have been used to analyze multivariate factors such as population density, the presence of criminal groups, and social marginalization.

In situations where geographic and sociodemographic information is available, models such as those mentioned by Ravindran, Kumar, and Singh (2023) have proven their ability to predict new disappearances with up to 85% accuracy. In Mexico, these methods have begun to be implemented in states such as Guanajuato, Guerrero, and Jalisco, where it has been observed that various rural areas exhibit patterns similar to those of other areas previously analyzed and addressed.

Furthermore, geospatial technology represents a crucial innovation in the physical exploration of underground graves or human remains. The use of drones equipped with multispectral and hyperspectral sensors has been pioneering in locating areas of interest through changes in the soil. Pérez and López (2024) mention that spectral analysis is a key tool for identifying changes in soil composition, especially those caused by the degradation of human organic matter. This has allowed for more precise delimitation of search areas with a margin of error of less than 10%. Combining this data with high-resolution satellite imagery and semantic segmentation models, such as U-Net or ResUNet, enhances forensic work in rural environments where traditional procedures are more difficult and therefore inefficient or risky.

The integration of systems into geospatial analysis platforms like ArcGIS has fostered connections between forensic data, citizen testimonies, and institutional records. Moreno Sánchez et al. (2023) suggest implementing Bayesian kings to model the likelihood of locating human remains based on factors such as ground slope, vegetation type, criminal activity patterns, and the frequency of citizen reports. These tools reduce search time by up to 40%, increasing operational efficiency and lessening the emotional and economic impact on families.

In Mexico, some states, such as Jalisco, have begun exploring the use of artificial intelligence technologies, such as the IdJalisco app, which allows facial recognition through mobile devices even without an internet connection. This facilitates the identification of individuals during operations or inspections of shelters and hospitals. According to Ramírez and Torres (2023), this technology has correctly identified 48 people reported missing in the first five months of its use. This practice sets an important precedent for the nationwide implementation of hybrid (offline/online) models adapted to the technological conditions of Mexico.

However, these tools also face significant ethical, legal, and social challenges. The General Law on the Protection of Personal Data Held by Obligated Entities (LGPDPPSO) does not currently include specific provisions for the use of Artificial Intelligence in search tasks, which can create tension between the right to the truth and the right to privacy. According to Veliz (2023), any algorithm-based system must adhere to the principles of transparency, explainability, and accountability, especially in contexts where its use can directly impact fundamental rights. In other words, when an algorithm functions as a "black box" and does not reveal how it arrives at its conclusions, it becomes very difficult to understand or question its decisions. This not only leaves those affected with more questions than answers but also erodes trust in the institutions that use these systems.

Based on the above, authors such as Yang and Cooper (2022) argue that every Artificial Intelligence system should explain, clearly and in simple terms, what factors influenced its results. This would allow family members, judges, and justice system professionals to understand and assess the legitimacy of the technological conclusions. Rather than replacing human work, this transparency aims to make technology an ally that supports and strengthens the work of those who administer justice.

Similarly, Eubanks (2018) warns against developing technologies without the direct participation of affected communities, which could generate structural problems and neglect essential needs. It is crucial to incorporate methodologies that involve victims, families, and civil society organizations in the design, validation, and monitoring of these tools.

IV. RESULTS

Furthermore, in Mexico, the implementation of Artificial Intelligence, particularly in the search for missing persons, has radically transformed the method of data collection and analysis. Artificial intelligence, due to its ability to work quickly and on a large scale, has also facilitated shorter response times and more accurate identifications, providing sporadic progress in processes where every minute is crucial.

Likewise, in a context where forced disappearances and links to organized crime continue to be a profound social burden, the adoption of innovative technologies has become an essential resource. These tools provide the capacity to deliver agile and effective responses, somewhat reducing the burden borne by both authorities and families searching for their loved ones. Similarly, González et al. (2023) highlight that AI has the ability to handle vast amounts of information in just a few seconds, uncovering clues that might otherwise have remained hidden. However, its effectiveness is only achieved when there is complete, accurate, and reliable data to work with.

It follows, then, that artificial intelligence has the potential to achieve extraordinary results, but this only occurs when the information it processes is complete and accurate, as González et al. (2023) point out. In Mexico, however, records of disappearances are often incomplete, imprecise, or outdated, which represents a serious problem for training efficient algorithms to deliver truly effective results.

Likewise, facial recognition, based on advanced neural networks such as FaceNet or DeepFace, has become an important tool in the search for missing persons. These systems can identify faces in photographs with great speed and accuracy, achieving results that in many cases surpass the capabilities of conventional tools.

According to Silvia Martínez and Ramírez (2022), facial recognition can achieve accuracy levels of up to 96% under favorable conditions, making it a key tool for locating people. In recent years, states like Sonora and Mexico City have implemented facial identification systems that cross-reference information from databases compiled from social media, security cameras, and other public records. Thanks to this, hundreds of people have

been located in relatively short periods, which, in emergency situations, can mean the difference between life and death.

Despite its benefits, this technology also raises significant ethical dilemmas, especially regarding privacy and human rights. Collecting and using massive databases of facial images without the explicit consent of the individuals depicted raises legitimate concerns about the legality of these practices and the risk of violating fundamental rights.

As Veliz (2023) warns, the lack of clear rules regulating the use of artificial intelligence for security and justice purposes leaves fertile ground for abuses, especially if those operating it do not apply sound ethical criteria. Among the main concerns is the potential use of sensitive data for purposes other than those originally intended, which could lead to widespread surveillance capable of eroding the privacy and freedoms of all citizens.

Today, the combination of machine learning with Bayesian models has transformed how areas with a high risk of disappearances are located. At the same time, by handling large amounts of geospatial information, these tools not only detect patterns in the distribution of cases but also make it possible to predict where a disappearance is most likely to occur. Predictive algorithms also allow search teams to focus on crucial areas, increasing the chances of locating the victim and using existing time and resources more effectively (Ravindran Kumar and Singh, 2023).

Furthermore, AI-based tools have incorporated the visualization of challenging data from heat maps, allowing for more precise identification of areas where disappearances are most common. For example, an illustrative case is found in Tamaulipas, a region characterized by persistent organized crime activity. In this scenario, technology has made it possible to recognize patterns related to specific routes used by traffickers and criminal groups. This information has become an indispensable tool for guiding studies and focusing investigative efforts on the most critical aspects.

On the other hand, in the search for missing persons, especially in rural areas or terrain difficult to explore, drones equipped with multispectral sensors have become an essential tool.

Similarly, their use has made it possible to confront one of the most delicate and painful challenges for authorities: the discovery of clandestine graves and human remains, as highlighted by Pérez and López (2024). These devices are also capable of capturing highly detailed images, surpassing the capabilities of the human eye. They detect subtle alterations in the environment, such as changes in vegetation and soil textures, which can indicate the presence of buried bodies. Furthermore, beyond their technical function, drones have become discreet allies, offering new perspectives and hope in the search for missing persons, demonstrating sensitivity and commitment.

Similarly, an investigation conducted in the state of Guerrero enabled drones to successfully detect 15 areas of interest linked to clandestine graves, facilitating a swift and efficient response from authorities. The ability of drones to carry out long-distance flights and collect information without endangering the lives of human teams is an essential element in searches in high-risk areas (Pérez and Lopez).

The application of natural language processing (NLP) and attractive methods in data mining has also become essential for improving tactics for locating individuals. These tools also facilitate the systematic analysis of testimonials, social media posts, and text messages, with the aim of detecting connections and patterns that previously seemed imperceptible, as Chen and Zhao (2023) indicate.

Furthermore, the adoption of cutting-edge Artificial Intelligence models, such as BERT or GPT4, has evolved to allow the handling of large volumes of written information with a speed and accuracy unmatched by conventional human analysis. Therefore, these technologies not only expedite investigations but also provide avenues that could lead to the discovery of missing persons.

Despite these advances, many limitations and challenges persist in the implementation of Artificial Intelligence in the search for missing persons. One of the main challenges is data quality. As mentioned in several studies (González et al., 2023; Ravindran et al., 2023), incomplete data, or in many cases, databases on disappearances, lack complete and reliable information, which represents a major obstacle to the effective functioning of artificial intelligence tools. Although Mexican authorities have made efforts to improve how this data is collected, significant gaps remain in the quality and accuracy of the available information.

Therefore, despite having advanced technologies, the lack of reliable data remains one of the biggest challenges for artificial intelligence to truly make a difference in the search and location of missing persons. For this reason, when it comes to ethical considerations, authorities have a responsibility to act with great caution when implementing artificial intelligence systems that collect sensitive information such as facial recognition or personal testimonies. Protecting personal data and safeguarding the privacy of every citizen must be central to all stages of the process, ensuring that these technologies are always used respectfully and responsibly.

It is also crucial to create regulatory frameworks that govern the collection, storage, and use of personal information to ensure that these technological tools do not become a tool for abuse by authorities, as Veliz (2023) points out. Therefore, it is necessary to establish rigorous controls over who can access the data, as well as clear protocols on how it should be used and processed, safeguarding fundamental rights such as the right to non-discrimination.

V. CONCLUSIONS

The application of artificial intelligence in the search for missing persons in Mexico has marked a significant advance in addressing a tragic and far-reaching problem. Thanks to its ability to process enormous amounts of information, identify patterns, and detect irregularities with great precision, AI has become an essential tool for reducing the number of unsolved disappearances. The introduction of current technologies such as facial recognition, geospatial analysis, and natural language processing (NLP), to name a few, has significantly transformed how searches for missing persons are conducted.

Consequently, these tools facilitate the rapid recognition of recurring patterns and the connection of cases that may have previously appeared isolated, as well as allowing for more precise targeting of search efforts toward specific areas. Thanks to this technological combination, both authorities and civil organizations have seen their capacity to locate missing persons more quickly and effectively strengthened—something especially valuable in a country where violence and impunity remain persistent challenges.

This technology has been particularly useful in rural areas or regions controlled by criminal groups, where access for law enforcement is limited and highly dangerous. By analyzing satellite imagery, using drones to search remote areas, and tracking suspicious activity on social media, the chances of locating a missing person have increased considerably.

However, the introduction of Artificial Intelligence in the search for missing persons involves a series of significant challenges that must be addressed to maximize its benefits. One of the main challenges is data quality, since AI algorithms depend on large volumes of accurate and up-to-date data. However, in many cases,

information on disappearances in Mexico is incomplete, outdated, or sometimes inaccurate, which limits the effectiveness of these tools..

Similarly, data on disappearances in the country is scattered, not always well-structured, and in some cases, unreliable, which negatively affects the quality of analyses performed by Artificial Intelligence systems, as mentioned by Gonzales et al. (2023). Likewise, for these technologies to be more effective, it is essential to improve the quality and accessibility of data at both the state and federal levels, establishing integrated registration systems and centralized databases that are more efficient for training AI models.

Furthermore, one of the constraints facing the ethical use of AI as a technological tool for searching for missing persons lies in privacy and human rights. The use of technologies such as facial recognition and the large-scale collection of personal information, such as images obtained from social media and public records, raises significant concerns about uncontrolled surveillance of citizens and, above all, the impact on privacy, as indicated by Veliz.

It is equally crucial to strike a balance between using technology to strengthen citizen security and ensuring citizens' privacy, considering the impact of Artificial Intelligence. Likewise, it is important to strengthen legal frameworks that integrate rigorous protocols and clear rules guaranteeing the ethical, responsible, and human rights-respectful use of this tool.

Therefore, safeguarding personal data is paramount when using these technological tools. Authorities, as guarantors of security, must implement protocols that do not violate privacy rights during searches for missing persons. Similarly, the implementation of AI also faces the challenge of lacking an appropriate regulatory framework. The absence of specific regulations on the application of these cutting-edge technologies in the security and justice sectors in Mexico could lead to their misuse or even abuse.

Similarly, without clearly established legislation, it is possible to implement Artificial Intelligence systems without appropriate oversight, which could result in mistreatment or human rights violations. Therefore, it is important to establish rigorous regulations to control the use of these tools employed in the identification of missing persons, guaranteeing both transparency and accountability in their use, as well as preventing them from becoming tools for large-scale and indiscriminate surveillance.

Despite the current challenges, the progress achieved so far is truly encouraging. The technologies used in the search for missing persons in Mexico have also proven highly effective, especially when combined with human effort, strengthening and enhancing the work of those directly involved in these investigations.

Artificial intelligence cannot replace physical labor or search efforts, but it can simplify and improve rescue teams' work. By concentrating resources and utilizing drones, neural networks for facial recognition, and the analysis of personal geospatial data, AI has revolutionized how authorities locate missing individuals, enabling greater speed and accuracy. These tools not only increase the effectiveness of searches but also make them safer, reducing the risk of further disappearances and offering tangible hope to families yearning for answers.

However, for these technologies to achieve their true purpose in the search for missing persons, it is essential that human rights and the construction of a secure data infrastructure be prioritized from the outset. Success depends not only on technology, but also on how public policies are implemented, the proper training of personnel, and close collaboration between authorities and civil society organizations. Only through joint efforts (between security forces, families of victims, and government agencies) can an effective search system be built that combines the power of technology with human commitment and sensitivity.

Finally, while Artificial Intelligence has proven to be an effective tool for locating missing persons, we must not lose sight of the fact that transparency, access to justice, and accountability are equally essential. The use of these technologies must be accompanied by a profound social and political commitment to addressing the root causes of disappearances, such as violence and organized crime, and to ensuring that all people in Mexico can live with the peace of mind that their human rights will be respected and protected at all times.

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