DIGITAL CRIMINOLOGY AND ARTIFICIAL INTELLIGENCE: NEW APPROACHES IN CRIME PREVENTION AND THE GREEK CONTEXT

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ABSTRACT

This article explores the influence of Artificial Intelligence (AI) on crime and criminological analysis in the context of the Digital Age. It outlines AI-related crime types and its applications in crime prevention (predictive policing, risk assessment, victim protection, corrections). Special attention is given to Greece's current state, highlighting police modernization efforts, legislative reforms, and the use of advanced technologies in crime scene analysis. Emphasis is placed on the need for interdisciplinary collaboration to enhance the reliability and effectiveness of criminal investigations. The impact of Artificial Intelligence (AI) on crime prevention and analysis is gaining particular significance within the urban context, as cities face complex security challenges. Understanding the urban environment is crucial for developing policies that enhance safety and quality of life in urban areas. In this framework, the integration of AI is increasingly prominent in crime prevention strategies, where planning takes into account the specific characteristics of urban spaces to implement AI tools in key areas such as predictive policing, risk assessment, and victim protection. Greece is gradually aligning with international trends in AI application, developing machine learning tools that contribute to the modernization of crime investigation and analysis methods, such as homicides, based on findings from crime scenes. This tool is presented as a case study in the current commentary.

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I. Introduction

The dominance of technology and the internet within the framework of the "smart city"[3] has transformed our online presence from a conscious choice into a "default state" (Kaufman & Lomell, 2025:1). The integration of technology into daily life, through the Internet of Things (IoT), simplifies processes and marks the beginning of the Digital Age.

In this new context, crime undergoes a radical transformation. This change affects every aspect of the criminological phenomenon: the crime itself, the processes of criminalization, and the mechanisms of social control. New forms of criminality are emerging, and Artificial Intelligence (AI) is considered, according to one view, a criminogenic factor (Spyropoulos, 2024:642-643). Artificial Intelligence (AI, can amplify criminal activities by both escalating existing crimes and facilitating new forms of digital offenses. A notable example illustrating both aspects is the use of AI in phishing attacks and deepfake scams. This example underscores how AI can both enhance the effectiveness of traditional crimes and introduce novel cyber threats, necessitating advanced prevention strategies and heightened awareness[4].

King et al. (2019: 9–18), Hayward and Matthijs (2020:6-8) describe the impact of AI on criminality as follows:

1. Crimes utilizing AI as a tool, such as the use of drones for smuggling.
2. Crimes against AI, including attacks on its systems, for instance, fraud in medical insurance.
3. Crimes through AI, where it acts as a mediator in the commission of acts, such as in white-collar crimes.

[3] *"Smart city,"* in the sense of a polity that, with the assistance of Artificial Intelligence, becomes more efficient, innovative, democratic, secure, and resilient (Theologi, 2022:196).

[4]Escalation of Existing Crimes: Traditional phishing attacks have evolved with AI, enabling cybercriminals to craft highly personalized and convincing messages that mimic trusted entities, thereby increasing the success rate of these scams.

Facilitation of New Digital Offenses: Deepfake technology, powered by AI, allows for the creation of realistic fake audio and video content. This has led to new forms of fraud, such as impersonating company executives to authorize fraudulent transactions, posing significant challenges to cybersecurity (Hayward, & Maas,2020. 209-211; Murugesan, 2025).

These developments lay the foundation for Digital Criminology, a scientific field that studies how digital technologies influence criminal behavior, control mechanisms, and perceptions of justice (Kaufman & Lomell, 2025: 8& 17). Simultaneously, there is a growing need for criminology to adopt the tools of the digital age to respond to new challenges.

II. Applications of Artificial Intelligence in crime prevention policy

Understanding the urban environment is crucial for developing policies that enhance safety and quality of life in urban areas. In this context, the integration of Artificial Intelligence (AI) is gaining an increasingly prominent role in crime prevention strategies, where planning takes into account the specific characteristics of urban spaces for the implementation of AI tools.

AI is applied in four key areas:

A. Predictive Policing: Algorithms based on spatial and temporal patterns predict potential criminal activities (Theologi, 2022:24& 73).

B. Risk Assessment: Tools like COMPAS are used to predict recidivism and support judicial decisions (Berk, 2021:209-212; Lin, Jung, Goel et al. 2020:1&6).

C. Victim Protection: Data analysis from social media platforms detects incidents of domestic violence or child abuse (Singh & Nambiar, 2024; L'Hoiry, Moretti, Antonopoulos, 2024:1-2).

D. Correctional System: Algorithms predict conflicts, improve inmate education and mental health, and prevent recidivism (Youvan, 2024:4, 13& 19)

Greece is gradually aligning with international trends in the application of artificial intelligence (AI), adopting machine learning tools aimed at predicting criminal behaviors such as homicide and suicide. However, the implementation of these technologies remains in its early stages. The following section presents a machine learning tool developed domestically, which analyzes crime scenes evidence to support law enforcement/police authorities in determining whether a particular incident constitutes a homicide or a suicide.

III. The Greek context

Greece faces challenges in solving unsolved crimes, particularly in the analysis of crime scenes[5]. According to the Annual Statistical Yearbook of the Hellenic Police (2020–2024), there has been a 22.4% increase in completed homicides. The number of solved cases reached 87.3% in 2024, compared to 45.7% in 2020, indicating an improvement in homicide resolution. In contrast, unsolved crimes decreased by 71.4%, from 54.3% in 2020 to 12.7% in 2024. The lowest resolution rate was recorded in 2021, at 47%, while during 2022–2023 this rate fluctuated around 85%. These data show significant progress in solving homicides, although the management of unsolved cases remains a challenge for the authorities.

This trend becomes increasingly complex when examined within the framework of large urban areas, where the dynamics of crime are influenced by distinct social, economic, and demographic factors. Notably, during the final quarter of 2024—specifically from October to December—a nationwide increase of 60% in homicides was recorded, underscoring a sudden and alarming escalation in lethal violence.

In the context of homicide analysis, particular emphasis is placed on the role of urban centers, where the investigative landscape is markedly more intricate and demanding. Metropolitan areas such as Athens and Thessaloniki consistently report the highest incidence of such crimes, primarily attributed to elevated levels of criminal activity and high population density, as indicated by the Hellenic Police in their reports. The general upsurge in crime within large cities creates high-risk environments for violent incidents, while the sheer scale of urban populations complicates effective policing and the implementation of targeted preventive measures[6].Moreover, densely populated and culturally diverse communities, when coupled with persistent social inequalities and underlying tensions, contribute to the

[5]The crime scene is the physical location where a crime was committed or discovered, encompassing all traces related to the act, and constitutes a crucial area for the collection of evidence (Dimopoulos, 2021).

[6]According to detailed statistical data from the Hellenic Police's Annual Statistical Yearbook, available at: www.astynomia.gr/statistikes-epetirides.

emergence of a multifaceted urban reality. Within this complex setting, the effective resolution of homicides necessitates the adoption of technologically advanced investigative tools and a multidisciplinary approach that integrates law enforcement, forensic science, and academic expertise.

Recent legislative initiatives, such as Law 5187/2025 (Government Gazette 48/A/21-3-2025), aim to reorganize the Hellenic Police and upgrade the training of uniformed personnel, focusing on the modernization of crime investigation methods. The Hellenic Police recognizes the need for modernization, adopting advanced equipment and scientific methods for the collection and utilization of evidence. Through the Directorate of Criminal Investigations (D.E.E.) and the Center for Security Studies (Ke.Me.A.), it participates in the European RISEN project[7], funded by the EU's HORIZON 2020 program, utilizing 3D imaging and non-destructive analysis techniques for the accurate documentation of crime scenes. These reforms are expected to enhance the authorities' capacity to handle unsolved cases.

The combined application of technologies and machine learning algorithms enables more effective data analysis, enhancing the detection of hidden patterns and accelerating crime resolution. The collaboration of forensic laboratories with universities promotes research and the development of new methods. Modernization requires legislative initiatives, technological upgrading, and interdisciplinary collaboration to ensure reliable forensic investigations. The integration of these technologies into crime investigation in Greece is an innovative step towards strengthening the effectiveness of law enforcement agencies.

IV. The innovative tool for analyzing crime scenes

The development of an innovative tool began during the 2019–2020 period as part of the diploma thesis of the second author at the School of Electrical and Computer Engineering, Faculty of Engineering, Aristotle University of Thessaloniki under the supervision of Alexiadis Minas, Assistant Professor of the same department. The project was carried out in collaboration with the Hellenic Police and the Forensic Medical Department of Piraeus. This collaboration allowed for the combined utilization of technological and scientific knowledge, enhancing the ability of law

[7]For more information about the RISEN project: www.risen-h2020.eu.

enforcement to distinguish more accurately and swiftly between homicides and suicides, contributing to the modernization of crime investigation methods in Greece. These two categories—homicides and suicides—were specifically chosen due to their high criminological significance and frequency, as they represent the most common forms of violent death. Accurate differentiation between them is crucial to ensuring justice, as misclassification can lead either to impunity or wrongful accusation. Furthermore, the structured forensic data generated for such cases provides an ideal foundation for the implementation of artificial intelligence and machine learning tools aimed at supporting investigative processes.

The study examined 89 solved deaths related to homicide and suicide cases, committed during the period 2008–2023 and investigated by the Sub-Directorate for Crimes Against Life and Property, which falls under the Directorate for Combating Organized Crime (D.A.O.E.) of the Hellenic Police. The data from these crime scenes were collected through interviews with the relevant authorities and categorized into 25 different variables, with the aim of creating a model to determine the distinction between homicide and suicide through a binary conclusion.

For the development of this model, the R programming language was used in combination with its graphical interface, RStudio[8], enabling the application of statistical and probabilistic methods. Based on the 25 categorized variables, the R tool was used to create models that supported the decision-making process, providing reliable estimations for distinguishing between homicide and suicide.

The categorized data were fed into a Naïve Bayes classifier[9], which, through random reshuffling and separation, created three sets: the Training Set, the Validation Set, and the Testing Set[10]. The Training Set was used to train the models, while the

[8]R is an open-source programming language and environment for statistical computing and graphics, widely used for data analysis and statistical modeling. RStudio is an integrated development environment (IDE) for R, offering tools for code writing, data visualization, data management, and report generation, enhancing user productivity (R Project, 2020).

[9]The Naive Bayes algorithm is a classification method based on Thomas Bayes' Theorem, assuming that the features of the data are independent of each other. It is widely used in applications such as text analysis and spam detection (Verykios et al., 2015).

[10]Data splitting is fundamental to the development of reliable machine learning models. The algorithm is trained with the training set, optimizes its hyperparameters using the validation set, and is finally evaluated with the test set to assess its generalization to new, unseen data (Brownlee, 2020).

Validation Set was used to assess the models' efficiency and validity during the training process.

For this process, the data were split into two ratios: 70% for the Training Set and 30% for the Validation Set, as well as 80% for Training and 20% for Validation. The results from both splits were compared to evaluate their impact on the models' performance. The Testing Set, which included unseen data, was used for the final evaluation of the models.

Among the models produced, those selected were the ones that, in addition to satisfactory Accuracy, demonstrated a high Recall rate and good Precision, with a minimal Training Error[11]. These models ensured a better balance among the key indicators, contributing to a faster and more accurate distinction between homicides and suicides.

From the analysis, a reliable model emerged with high accuracy and full compliance with the defined specifications. To understand how the model arrived at its final decision, a Feature Importance[12]analysis was conducted. The analysis showed that the victim's behavioral and psychological profile (such as psychosocially stable, diagnosed with a mental health disorder, criminal background etc.)and the presence or absence of the weapon or means used in the commission of the act were the most influential factors in the decision-making process.

Additionally, the cases in which the model failed to make accurate predictions were thoroughly examined across both the Training and Validation Sets. These misclassifications were primarily associated with cases presenting atypical or misleading features—such as the location of the incident, the positioning of wounds, or the overall condition of the victim—which resembled characteristics typical of the opposite category. Such complexity often necessitated further analysis by forensic experts to accurately determine the nature of the case.

[11]Accuracy measures correct predictions, Recall measures the percentage of actual positives correctly identified, Precision measures the percentage of correct positive predictions, while Training Error computes the incorrect predictions during the model's training phase (Analytics Vidhya, 2025).

[12]The Importance (or Significance) of each variable refers to its impact on a model's performance, measuring its contribution to prediction or explanation of the target (R Project, 2020).

To verify the validity of the model, testing was conducted on cases from the Testing Set. The evaluation was based on four cases to examine the model's ability to determine whether a homicide had occurred.

The first case concerned a 23-year-old Greek female student who was found dead in her home in Aigaleo, Attica, tied to a chair with no injuries or signs of struggle. Her death was determined to be due to gas inhalation-induced asphyxiation. The scene was orderly, with no signs of forced entry or third-party involvement. The victim's psychosocial condition, which included a history of psychiatric treatment and social isolation, supported the hypothesis of suicide. The model's analysis, taking into account the findings and her personal background, confirmed the suicide assessment with high statistical certainty.

The second case involved a 60-year-old Greek woman, a retiree, who was found dead in her home in Voula, Attica, with multiple stab wounds. The case was treated as a homicide committed by her son, based on the crime scene evidence, family profile, and forensic examination findings. The woman had a psychiatric history and an overprotective attitude toward her children, living with the perpetrator, with no signs of break-in or involvement of another person. In this case too, the model confirmed the initial assessment of criminal activity, reinforcing the correctness of the homicide hypothesis based on the available evidence.

The third case concerned a 31-year-old foreign male, unemployed with a criminal record, who was found in Haidari, Attica. His body was discovered in an outdoor area without signs of disorder or selective search, and no money or valuables had been taken. Despite the absence of such signs, evidence indicating the presence of a third party was found. The cause of death was a fall from a height, and the body bore defensive wounds. The model estimated the probability of homicide at 98%. The case remains under investigation by the authorities.

Finally, a fourth case involved a 25-year-old unemployed Greek male who was found dead in Kypseli, Attica, with no signs of disorder or criminal activity at the scene. His death was caused by a fall from a height, with no defensive wounds or signs of self-inflicted harm. The absence of a suicide note and the lack of an instrument used in the act led the model to predict suicide with an 87% probability.

However, the authorities assessed the case as an accident, a scenario not included in the model's predictions.

To ensure the model's usability, a Graphical User Interface (GUI) was developed to simplify user interaction with the system, allowing for easy variable input and clear result presentation, providing quick quantitative predictions for homicide or suicide.

A future improvement of the study could involve incorporating more samples from solved cases, enhancing the database and the model's ability to handle a wider variety of scenarios. The absence of "accident" as a possible outcome reveals a limited scope within the model. Moreover, the application of more complex classifiers and machine learning algorithms, such as neural networks, could improve the analysis and prediction of different scenarios.

V. Conclusions and recommendations

The use of AI in crime prevention policy raises critical ethical dilemmas: bias, algorithmic prejudice, lack of transparency, and excessive policing of vulnerable social groups. Additionally, issues such as violations of privacy and the lack of accountability are identified.

This highlights the urgent need to establish a regulatory framework that ensures human oversight of AI systems, protects fundamental rights, and emphasizes the superiority of human judgment over algorithms.

The increasing impact of artificial intelligence (AI) on policing, punishment, sentencing, and rising crime rates underscores the necessity for criminologists to systematically engage with the intersection of technology and crime. This engagement aims to mitigate potential excesses of AI by developing proposals and practices that ensure impartiality and legal safeguards.

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