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Poster · October 2024 DOI: 10.13140/RG.2.2.27660.42883



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# Application of Artificial Intelligence In Forensic Science



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### INTRODUCTION

Forensic sciences contribute to the criminal justice system by providing solutions with scientific methods relying on its interdisciplinary nature. With technological developments, artificial intelligence (AI) is also has integrated into forensic sciences. Alan Turing's article "Computing Machinery and Intelligence" published in 1950, and later in 1956, the British mathematician John McCarthy introduced the term "Artificial Intelligence" at a conference. Al technology expanded into almost every field and a forensic science is one of them. In forensic sciences, Al is used in many disciplines such as crime scene investigation, trace and pattern analysis, ballistic examinations, facial reconstruction. It also used in analyzing large amount of data when the manpower is limited. Additionally, AI can improve communication between forensic units. This study aims to examine the application areas of AI in forensic sciences.

### MATERIAL AND METHODS

Existing literature was scanned using Google Scholar, EBSCO Host, ScienceDirect, Embase/Elsevier databases with the keywords "artificial intelligence" and "forensic| science" together. The studies reached were thoroughly reviewed.

# RESULTS

Al is a set of systems that make predictions, recommendations and decisions. It solves complex tasks by imitating human behavior and intelligence. Some of the Al applications in forensic sciences are digital crime scene modeling, processing and analysis of biometric-data, image, video, audio analysis and improvements, speaker recognition and comparison, big data analysis, detection of cybercrimes. Considering the potential of AI, it is predicted that the use of these systems in forensic sciences will increase further.

#### **Crime Scene Investigation**

Crime scene reconstruction aims to gather information regarding the commission of the crime and the subsequent events. The integration of AI at the crime scene enables the collection, processing, analysis, and detailed mapping of the data through the use of cameras, drones, and sensors. The data is rapidly processed and evaluated in a comprehensive manner, thereby facilitating the judicial process and contributing to the resolution of the crime.

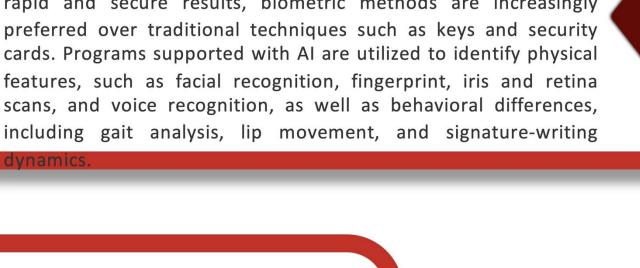


### **Digital Forensics** While AI can create opportunities for new cybercrimes to occur,

it also facilitates the detection of pre-existing or incipient crimes. It can detect or prevent crime by decrypting special language or terms used in cases such as the production and trade of illegal substances, the production and trade of illegal weapons, child pornography, and the planning of terrorist acts.

# **Forensic Biometrics Analysis**

Biometric data are characteristics that enable the physiological and behavioral distinction of individuals. Due to their ability to provide rapid and secure results, biometric methods are increasingly preferred over traditional techniques such as keys and security cards. Programs supported with AI are utilized to identify physical features, such as facial recognition, fingerprint, iris and retina scans, and voice recognition, as well as behavioral differences,



# **Forensic Biology and Genetics**

The application of AI in forensic biology contributes to the meticulous examination and differentiation of complex evidence. It can be utilized particularly in fields such as DNA analysis, forensic entomology, forensic medicine, forensic pathology, and forensic microbiology. By identifying exclusionary characteristics and anomalies during the identification process, it can facilitate the interpretation of DNA profiles for forensic scientists.

> **Multimedia Forensics** Audio and video recordings, as well as CCTV footage collected from the crime scene or seized during the investigation, are analyzed using artificial intelligence algorithms. These algorithms process and evaluate the data that would typically require days to examine within minutes, while also detecting potential manipulations. Advanced analytical algorithms provide a holistic approach to evidence through data integration.

## AI IN FORENSIC SCIENCE

Artificial intelligence basically contributes to the acceleration of judicial processes by analyzing large amounts of data in a short time. In order to analyze this data, artificial intelligence must first be trained through Machine Learning (ML) and Deep Learning (DL). The accuracy of the information provided during the learning of AI affects the subsequent analysis. In this process, it is necessary to ensure the security of the data provided and to pay attention to ethical principles. Since it is not possible to take risks in forensic sciences, the use of AI is still being tested in a controlled manner, but as indicated in El Din's study like any immature technology needs time

and mistakes to progress.



Al can be used in impression examination and pattern analysis applications where forensic physical analysis is performed. By integrating with relevant databases and software, it can help forensic scientists with image processing in matching bullets and cartridge cases, bloodstain pattern analysis, contacting tool marks with suspicious tools, physical match examinations, footwear and tire tread examinations.

In addition to printed documents, money, paintings, etc., things like voice, photos, videos, and documents in digital media can also be forged. With Convolutional Neural Networks (CNN) and Generative Adversarial Networks (GAN), forgeries in this field have increased. Artificial intelligence can be used in the production of these forgeries as well as their detection.

**Forensic Forgery Detection** 

**Forensic Physics** 

**Criminology and Crime Prevention** To prevent crime, it is necessary to know the history, criminology and statistics of crime. By training AI on this subject, it can measures are taken before the crime occurs. In this process, while it can give a more objective result by making an evaluation independent of the biases that may exist in humans, it can also show human-like behaviors due to the biases in the data and trainers loaded during machine learning.

**Data Forensics** 

# **Forensic Anthropology**

Forensic anthropology and odontology engage in the examination of human remains to facilitate identification and ascertain the cause of death. These disciplines employ a range of methodologies to analyze skeletal and dental features, providing crucial insights in forensic investigations. The incorporation of AI into the reconstruction processes of skeletal structures, facial features, or bone morphology enhances the accuracy and efficiency of these analyses. By leveraging AI technologies, researchers can achieve more reliable outcomes in a shorter timeframe, thereby significantly improving the overall effectiveness of forensic identification efforts.

Forensic science often requires intelligent analysis of large amounts of complex data. In cases where forensic scientists need to analyze many files, they can only decide which file is important after accessing/opening that file. By aggregating big data, AI can analyze, simplify and make complex data understandable in a short time. Therefore, AI seems to be an ideal approach to deal with many problems that arise during implementation in a realistic timeframe

# DISCUSSION – CONCLUSIONS

With the widespread usage of AI, new types of crimes have emerged. But also, AI is integrated into the technologies that are used in the crime solving and crime prevention. In this study, the use of AI technologies in forensic sciences is explained and current methods are discussed.

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