AI-Driven Approaches to Reshape Forensic Practices: Automating the Tedious, Augmenting the Astute

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EXECUTIVE SUMMARY

Forensic investigation is ushering into a new era of transformation propelled by rapid technological developments and innovations. The criminals are getting smarter, and crimes are becoming more complex; in such a time dissemination of justice requires commensurate technological enhancement. This chapter explores the vast potential of AI in revolutionizing Forensic Science and provides a succinct overview into the applicability of artificial intelligence (AI) and machine learning (ML) to facilitate classification, characterization, discrimination, differentiation, and recognition of forensic exhibits. This chapter further delves into the fundamental principles of supervised, unsupervised, semi-supervised, and reinforcement learning approaches and describes common ML methods which are frequently employed by researchers of this field.

BACKGROUND

Forensic Science, an interdisciplinary discipline, applies principles of various scientific branches to link individuals, locations and objects involved in criminal activities and aid in investigation and adjudication of civil and criminal cases (Houck, 2007). With increasing number and complexities of crime, growing awareness among criminals, transport revolution, weakening of social cohesion and faster dissemination of information, the importance of forensic science and criminalistics is increasing more and more in investigation and dissemination of justice. This domain requiring meticulous observation and keen analysis often falters in court of law because of human biasness and errors. As the twenty first century ushers into a digital world, inventions and innovations endowed with the capacity to swiftly analyse vast quantities of data and discern intricate patterns offer a comprehensive solution to interpret and solve complex criminal cases. In the labyrinth of forensic enquiry, Artificial Intelligence (AI), a burgeoning integration of human intelligence and machine ingenuity, promises to revolutionize traditional investigation methodologies and augment the capabilities of forensic experts and law enforcement agencies; ushering in an age marked by swifter processing, sharper insights, greater accuracy, higher precision and bias free results.

Artificial Intelligence

Artificial intelligence (AI) is defined as science behind imbuing computers and machines with the capability to simulate intellectual task akin to those performed by humans (Iqbal & Alharby, 2020). The earliest references of artificially intelligent machines can be traced back to ancient Indian, Greek, Chinese and Roman mythologies where several instances of automated systems and robots appear. Mary Shelly in 1818 in her novel Frankenstein writes about creation of an artificial monster from corpses that is able to think for itself after being brought to life with electricity (Pfeiffer, 2023).

It may seem incredulous to envision AI without computers in contemporary times. However, the inception of AI predates the advent of modern computers, albeit largely limited to theoretical concepts and fictional narratives. The first most significant contribution in this field date back to 1943, when McCulloch and Pitts described mathematical models of neurons in brains based on detailed analysis of biological originals. This was followed by perhaps one of the most significant pioneers in the realm of AI, who attempted to address the groundbreaking question 'Can a machine think?' and devised an applicable test widely known as "Turing Test" (Warwick, 2012).