

Artificial Intelligence in Forensics & Criminal Investigation in Indian Perspective

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Abstract:- With the development of computer and robotic science now machines are able to behave like human beings. Machines are to perform complicated tasks such as cognitive thinking, visual perception, speech recognition, and learning from past experience at a much higher speed and accuracy than human beings. This ability of a machine to behave like a human being in solving complicated problems is known as artificial intelligence (AI). There is increasing use of this technology in many fields. Government organizations and private companies use this technology to detect and prevent crimes. The idea of AI is also increasingly applied in the field of the criminal investigation. This enables meticulous crime investigation such as bloodstain pattern recognition and analysis, fingerprint analysis, DNA analysis, etc. Now complicated forensic findings are better understood. It helps in the 3D crime scene reconstruction also. Thus, in the coming days, AI technology will be very helpful for forensic scientists in a criminal investigations for a better legal administration.

Keywords:- Artificial Intelligence, Criminal Investigation, Machine Learning, Artificial Neural Network, Digital Forensics

I. INTRODUCTION

In this era of modern technology, many complicated things are solved more accurately within a reasonable short duration with the help of computers. This is possible due to the recent advances in the field of computer science and technology. In many fields of science now machines and computer technologies are utilized to perform human-like tasks such as critical thinking, analysis, reasoning, planning, creativity, and decision-making to solve very vast and complicated problems.¹ This ability of machines & computers may be defined as Artificial Intelligence (AI). They are so intelligent that AI systems are capable of adapting their behavior to a certain degree by analyzing the effects of previous actions and working autonomously. AI is useful almost in all walks of day-to-day life. It is also used extensively in health research and health care systems. Recently during the Covid-19 pandemic, this technology was used for thermal imaging in airports and elsewhere.² It can help recognize infection from computerized tomography lung scans. It has also been used to

provide data to track the spread of the disease. It is also used in the diagnosis and robotic surgeries.

Gradually the idea of AI is also utilized in criminal investigation and in the coming days this going to be a part of the system.³ In the current scenario this is going to be even more useful in Forensic Science and Criminal Investigation because experts are facing many challenges due to the huge amount of data, tiny pieces of evidence in the chaotic and complex environment, traditional laboratory structures, and sometimes insufficient knowledge which may lead to failure of investigation or miscarriage of justice.⁴ For example for the analysis of a suspected fingerprint we need to analyze a huge amount of different fingerprint patterns manually which is very tedious and time-consuming work and there are always some chances of human errors too.

Investigation work is very much simplified now by using the technology of digital forensic science. Thorough examination and comparison of a huge volume of evidence such as images, videos, audio, fingerprints, handwriting, etc. within a very short time that is also error-free are possible due to this technology.⁵

This review article examines the overall view of the application of IA in various fields of forensic & criminal investigation.

II. HISTORY OF ARTIFICIAL INTELLIGENCE

In 1950 Alan Turing published his influential paper 'Computing Machinery and Intelligence' in which he described 'machine' and 'thinking.'⁶ Further studies were conducted and in 1956 John McCarthy defined 'Artificial Intelligence' and he is known as the father of Artificial Intelligence.⁷ Gradually simple processes of reasoning and thinking were developed which lead to the concept of the video game. During 1980-1987, more complex systems were developed using logic rules and reasoning algorithms that mimic human experts. This began the rise of expert systems, such as decision support tools that learned the "rules" of a specific knowledge domain like those that a physician would follow when performing a medical diagnosis.⁸ During the year 1993 – 2009 Biologically inspired software known as "neural networks" came on the scene. These networks mimic the way living things learn how to identify

complex patterns and, in doing so, can complete complex tasks. Character recognition for license plate readers was one of the first applications.⁹ Now much more complicated advanced software is developed and such software is being applied in automated facial and object detection and recognition as well as medical image diagnostics, financial patterns, and governance regulations.¹⁰

III. ARTIFICIAL INTELLIGENCE (AI) APPLICATIONS IN FORENSIC SCIENCE

The application of AI in the field of forensic science is manifold. Facial & voice recognition, handwriting identification, identification and age estimation from teeth, etc. are now possible with high accuracy. Identification of an unknown person from skull bone is done by creating a 3D image and by superimposition technique. Trace evidence such as blood & body fluid stains, lip prints, gunshot residues, weapon marks, etc. can be analyzed and compared faster and more accurately than the forensic experts.^{4,10-13}

Pattern recognition is another important aspect of crime investigation. It is a process of automatic machine recognition, which is categorized according to the type of learning procedure used to generate the output value. Identification and comparison of specific types of patterns of suspected data are crucial elements of forensic science. The experts have to analyze a huge amount of data with heavy statistical and probabilistic reasoning techniques. A pattern could be anything like a fingerprint image, a handwritten cursive word, a human face, or a speech signal. Human brains like AI known as Neural Networks have been used for such complicated analysis.¹⁴⁻¹⁶

Another important application is pattern recognition, analysis, classification, and processing of fingerprints. These automated AI-based systems can substantially bring down the number of comparisons at the time of matching with high accuracy. The technique of this pattern recognition is also used in the analysis of signatures and handwriting. Some algorithms of pattern recognition and neural network models of AI are aiding experts to recognize the gender of writers.

In the field of multimedia analysis also AI is widely used. It can give accurate results in the analysis of images, video, or CCTV footage in a criminal investigation.⁴ The AI algorithms developed for multimedia analysis could not only learn complex tasks but also can develop and determine their own independent complex facial recognition features & parameters to accomplish given tasks. These advanced AI algorithms have the potential to match faces, identify weapons, compare voices and detect complex events such as accidents or crimes.

AI technology is also successfully applied in the field of narco-analysis. Artificial neural networks (ANNs) can analyze brain images during narco-analysis to detect whether the person is telling lie or not. ANNs technology also helps in forensic ballistics. It can guide experts in searching gunpowder, and

cartridge cases and help them for comparison of bullet marks, firearm identification, and other ballistic evidence from the database itself with the help of image processing without any manual interference.

Day by day AI technologies is also gaining popularity in the field of Forensic Medicine. It helps in crime scene reconstruction. The time since death can be now better predicted by analyzing Lactate Dehydrogenase, Aspartate Aminotransferase, triglycerides, cholesterols, etc. This data with the pH level of the blood can be interpreted and compared to different databases to estimate the time since death. Advanced algorithms of AI enable the identification of unknown bodies from teeth, especially in mass disasters. It is also useful in sex determination from skeletal remains.

AI technology is also used to develop e-nose for sensing and analyzing different aromas released from various sources for forensic applications also. These e-noses are aiding the investigators in the detection of various explosive materials, biological and chemical weapons.

The rise of AI technologies is aiding the police and security professionals in not only crime detection, but also crime prevention and prediction. Some of the advanced algorithms of AI are developed to detect crime patterns and suspicious anomalies, predict future crime spots, assess criminal risk factors, and uncover criminal networks. Machine-learning and AI algorithms enable to predict the future crime spots by analyzing the spread of crime types, crime location, weapons, and changes in facial expressions in advance.¹⁵⁻¹⁶ This helps law enforcement agencies in crime detection and prevention.

IV. AI IN THE INDIAN SCENARIO

In 2015 Maharashtra police started using AI technologies in crime control by acquiring the “predictive policing software”. As a part of the scheme, the department has also procured Universal Forensic Extraction Devices (UFED) of leading global brands used in digital forensics and investigations. Such devices can retrieve data, even deleted data, from mobile phones, social networking sites, hard disks, and various other devices. They can also recall audio-visual data from drone and CCTV cameras.¹⁷

As per the 2016 crime report, Uttar Pradesh (UP) has the highest crime rate in India. To handle this UP police started using various AI technologies such as crime mapping analytics, and predictive systems in partnership with ISRO. In December 2018, the Director-General of Police Om Prakash Singh launched an AI-powered mobile application named ‘Trinetra’. Trinetra has a record of 5 lakh criminals which contains a picture, address, and criminal history of each criminal. This information has been collected through the inputs from district police, prison department, and Government Railway Police

(GRP). Trinetra has successfully assisted in catching one high-profile criminal in Lucknow.¹⁸

Delhi Police used AI & other Forensic Technologies in the investigation of 755 cases in North East Delhi violence in 2020. About 945 CCTV footage and video recordings from smartphones were analyzed by using facial recognition and other AI technologies and culprits were arrested. In another incident one person named Solanki, 26 yrs., was shot dead on 24th Feb'2021 behind Rajdhani School, Delhi. The mobile phone of the suspect was seized and examined. The crime was established from the analysis of the Google Map installed on his mobile phone. More than 400 cases have been solved and 342 charge sheets have been filed by the Delhi Police by the end of 2020.¹⁹

V. CONCLUSION

The field of Forensic Science and Criminal Investigation is advancing day by day with the application of the latest scientific technologies. AI is currently aiding almost all prominent fields of Forensic science with its different approaches such as data analysis, image processing, pattern recognition, etc. The major breakthrough is its application in the early detection and prevention of cybercrime. New AI technologies are coming up and definitely, these will enable the forensic investigative and policing systems in the detection and prevention of crimes very effectively by different law enforcement agencies.

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