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ARTIFICIAL INTELLIGENCE IN CRIMINAL INVESTIGATION

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Abstract

The advancement in the field of technology has become ineluctably foreordained and in every sphere. Over the years transition has been witnessed in the criminal investigation and this transmission has dramatically shifted in the present scenario only by the means of advancement and development in Artificial Intelligence. In simplified terms it may be accentuated that Artificial Intelligence is the ability of a machine or a computer program to perform task which are human like such as visual perception, speech recognition, cognitive thinking, and decision making, solve complex problems with comparatively negligible error. The development of Artificial Intelligence has also been applied in the area of criminal justice with special emphasis to criminal investigation. In the existing scenario, the experts of criminal investigation witness several challenges due to huge amount of data, tiny pieces of evidence in the chaotic and complex environment, traditional infrastructure of the labs and at times insufficient knowledge which may lead to miscarriage of justice. At this juncture, with innumerable challenges, Artificial Intelligence becomes one weapon to fight against these challenges which also includes machine learning, deep learning. Artificial Intelligence at present aids the field of both forensics and criminal investigations through different approaches like Data analysis, Pattern recognition, Image processing, Computer Vision, Data Mining etc. Other methods include formulating logical evidence, 3D reconstruction of crime scenes, handling evidence effectively and its effective analysis to reach a logical conclusion at various levels of investigation. Furthermore, Artificial Intelligence based algorithms has the potential to detect the huge amount of data in order to discover risk and also make prediction of future crime and criminal behavior.

Introduction

The criminal investigation has mostly become advanced recently, accurate forensic examination and independent unbiased judicial system are the tripod for the success for criminal justice. A single fingerprint may require a large amount of suspected fingerprint data to examine and this also eventually becomes taxing and tedious.[1] Digital forensics and smart investigation are highly advancing fields and requires more intelligent analyzing techniques for solving the complex issues.[2] Thus, investigation using the conventional intensive means and manual approaches are incapable of dealing with issues and complications. The human expert or investigator or practitioner can be tired, biased, prejudiced, incompetent or emotional during the investigation process. This eventually results in miscarriage of justice. The issue that pertains here is what if all the tasks mentioned above are performed by a machine or computer programmer that acts intelligently like that of an artificial intelligence?

Artificial Intelligence

Intelligent Machines have long been a subject matter of movies and fiction. However, presently, we live in an era in which Artificial Intelligence has become a reality and it is having real impact in our daily lives. A particular branch of computer science that mainly concerns with the creation of intelligent machines which works as humans is known as artificial intelligence. This majorly involves the development of machines or computers which are able to act like humans processes such as learning, reasoning, adapting, self-correction etc. and act rationally. The machines, although do not have the cognitive capability similar to that of the human beings. These machines or computer programs are highly advanced in nature to perform human like tasks such as visual perception, speech recognition, cognitive, decision making, and learning from experiences and solve complex problems with higher speed and less error and mistakes in comparison to that of human beings. Machine Learning, Deep Learning and Neural Network are connected to each other and they all fall under the purview of artificial intelligence.

Artificial Intelligence (AI) and Criminal Intelligence

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[1]MOSES, K., CHAPTER 6: AUTOMATIC FINGERPRINT IDENTIFICATION SYSTEMS (AFIS).The fingerprint sourcebook.(National Institute of Justice, Washington DC), 6-1, 2011.

[2]Mitchell F.,*The use of Artificial Intelligence in Digital Forensics: An introduction*,DIGITAL EVIDENCE & ELEC. SIGNATURE L. REV.*,* 735 (2010).

The hybrid intelligence of human and machine, both are profitably aiding the modern Criminal Investigation.[3] This hybrid intelligence of humans and machines detects various clues, gunfire, bombs or explosives on the crime scene, the criminal activity from huge volumes complex data such as videos, images, text files, emails, audio files and monitoring fraud risk.[4] The development and deployment of Artificial Intelligence are aiding the police personnel for not only investigation or crime detection, but also crime prevention and prediction. Extra ordinarily advanced algorithms of AI are developed to detect the patterns in crime and suspicious anomalies, predict future spots, assess the criminal risk factors and uncover criminal networks.[5]

Application of the Advanced Artificial Intelligence in the Criminal Investigation Process

Pattern Recognition

Pattern Recognition is considered to be a process of automatic machine recognition which may be categorized according to the type of the learning procedure which is used mainly to generate the output value. One of the crucial elements of investigation is that of the identification and comparison of specific types of pattern in the suspected data. Human beings are considered to be efficient at recognizing patterns and through experience, learn how to differentiate between the objects, people and complex human emotions, information and conditions. AI replicates this human capability in algorithms and computer hardware.The experts have an obligation to analyze a huge amount of data with statistical and probabilistic reasoning techniques. In the present scenario, The Artificial Intelligence under the category of neural networks is used in various spheres to interpret the visual scenes, speech recognition, face recognition, fingerprint recognition, iris recognition etc.[6]

Fingerprint Pattern Identification

Deep Learning being a category of Artificial Intelligence has been used to identify the fingerprint pattern and has made immense success in the field of computer vision and pattern recognition as

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[3] Franke, K., & Srihari, S. N. *Computational forensics: Towards hybrid-intelligent crime investigation.*IN THIRD INTERNATIONAL SYMPOSIUM ON INFORMATION ASSURANCE AND SECURITY(pp. 383-386), IEEE. (2007, August).

[4]Joshi, N., *The rise of AI in crime prevention and detection* (2019, November 30), https://www.allerin.com/blog/the-rise-of-ai-in-crime-prevention-and-detection

[5]Rigano, C.,*Using artificial intelligence to address criminal justice needs*, NATIONAL INSTITUTE OF JUSTICE, 280 (2019).

[6]Kasar, M. M., Bhattacharyya, D., & Kim, T. H.,*Face recognition using neural network: a review*,10(3) INTERNATIONAL JOURNAL OF SECURITY AND ITS APPLICATIONS, 81-100 (2016).

it does not require handcrafted feature extraction. Deep Learning has the capability to automatically learn the features and structures under a sufficient number of input training data. It is these advantages of the Artificial Intelligence that it makes it suitable for various tasks in automatic fingerprint identification. Also with high accuracy that the AI based systems have, it can bring down the number of comparisons.

Human Face Recognition

Artificial Intelligence have been developed by many researchers for automatic human face recognition even while most of the systems include and are mainly based on neural networks.[7]

Handwriting Pattern Recognition

Algorithms have also been developed in the machines like Artificial Intelligence to recognize the gender of the writer[8]. Furthermore, it is also to be accentuated that pattern recognition has been most commonly used to recognize and compare the signature, handwriting pattern images.

Gun Shot Detection

The pattern signatures in the gun shot analysis may also be interpreted by the algorithms of AI. The Gun shot detection software seeks to detect the occurrence of gunfire and determine the precise location of the gunshot. Gunshot detection can be understood as falling under the purview of AI because the designers of the software rely on machine learning in order to train their systems to identify the audio signature of gunfire and to isolate it from all the other sound interferences commonly found in urban settings.[9]

Multimedia analysis

Artificial Intelligence provides such capacity which overcomes the capacity of human beings as well, although it may be emphasized that the cognitive capability of the Artificial Intelligence cannot be compared to that of human beings. Video Analysis and Image Analysis is used in the

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[7]Kasar, M. M., Bhattacharyya, D., & Kim, T. H.,*Face recognition using neural network: a review,*10 (3) INTERNATIONAL JOURNAL OF SECURITY AND ITS APPLICATIONS, 81-100 (2016).

[8]Kulik, S. D.,*Neural Network Model of Artificial Intelligence for Handwriting Recognition*, JOURNAL OF THEORETICAL & APPLIED INFORMATION TECHNOLOGY, *73*(2) (2015).

[9]*Artificial intelligence-based system warns when a gun appears in a video*, PHYSORG (7 July 2017), https://phys.org/news/2017-07-artificial-intelligence-based-gun-video.html.

criminal justice and law enforcement communities to obtain information regarding people, objects and actions to support criminal investigations. AI's capability to overcome errors committed by humans during image, video or CCTV footage during criminal investigation cannot be denied. The traditional algorithms assist human beings in a limited aspect to the predetermined features like eye shape, eye color, distance between the eyes for facial recognition and demographics for pattern analysis. Furthermore, it may be emphasized that the analysis of videos and images can be labor intensive, taxing and tiring requiring a significant investment in terms of personnel along with expertise in concerned subject matter. And these analysis of video and images are prone to human error due to the hefty amount of information, fast pace technological advancement in terms of smart phones and operating systems and a limited number of specialized personnel with the accurate expertise and knowledge to process such information.

The AI algorithms have the potential to overcome such human errors and function as experts. Furthermore, these machines do not tire like human beings and thus can conduct the searches and analysis effectively. The AI algorithms which are developed for multimedia analysis has the capability to learn complex tasks and also develop and determine their own independent complex facial recognition features and parameters. These technological advancements in the AI has the potential to match faces and identify weapons, compare the voices and detect such complex events like that of accidents or crimes which are beyond imagination of the human beings.[10]These advancement in the technological aspect has provided an aid to the officers and the investigators in order to conduct independent and accurate investigation without compromising on the miscarriage of justice.

DNA Analysis

When understood from the broadest perspective, DNA Analysis consists of the application of genetic testing for crime-assessment and legal purposes.[11] The use of DNA as a forensic material is a branch of forensic science that examines genetic material required in criminal investigations. AI plays a significant role in determining the DNA analysis because of the new capacity it offers

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[10]Rigano, C., *Using artificial intelligence to address criminal justice needs*,NATIONAL INSTITUTE OF JUSTICE. ISSUE, 280 (2019).

[11]*DNA Forensics: The application of genetic testing for legal purposes*, GENEED https://geneed.nlm.nih.gov/topic_subtopic.php?tid=37.

to significantly speed up the DNA sequence matching process where collected DNA is matched with the DNA contained within the given database.

How will Artificial Intelligence make Criminal Investigations More Manageable?

One of the greatest issues and challenges for the law enforcement agencies of today's world is that there exists huge amount of data which is involved and included in the investigation process, and this eventually causes backlogs and delays in the investigative work. Investigators and experts who are a part of the process need to have the ability to analyze these digital assets to discover, interpret and analyze these information which pertains to each case and is potentially admissible before the court. To deal with the issue and struggle of the data overload, some of the nations have already adopted for AI developed machine learning tools. These AI and machine learning based tools has the capability to analyze, interpret data from the videos, sensors and biometrics that are considered to be admissible before the Court. These solutions basically utilize Artificial Intelligence to make connections between those data points which could have been missed by the human beings or per se particularly the investigators. If not missed by human beings, then also it could have taken a longer time to have been discovered. This therefore, proves to be a crucial and a significant differentiator in cases which are urgent like that of kidnapping wherein the victim has to be found and brought to a safe place as soon as possible.

These new machines and Ai based tools will allow for the cases to be effectively run through the use of Digital Intelligence, or data that is captured from any of the digital sources. It may also be effectively utilized by the investigators, investigating agencies to conduct the interpretation and analysis of the data effectively to run operations in due time without compromising on the miscarriage of justice.

These AI based tools which is based on algorithms are completely data driven and therefore, factors like that of race, sex, caste, religion does not play a role. Therefore, these tools are more effective in determining as to who is more likely to be a victim, hotspot for the crimes and therefore accordingly such steps may be taken by the police and the investigators.

Artificial Intelligence has the potential to be a permanent part of our criminal justice ecosystem, providing investigative assistance and allowing criminal justice professionals to better maintain public safety.[12]

Challenges in implementing AI for Criminal Investigation

The challenges may not be considered to be just ethical in nature but also addresses the effectivity of AI and its complexities of procurement and the vagaries of its appropriation by criminal justice professionals. Various software have been deployed and implemented using AI based technology to investigate and at times even predict crimes. The advances of AI general may be considered to be impressive however, it stands to be limited wherein the data is plentiful and already fairly well structured and labelled, such as speech recognition and translation, image recognition, or game playing[13]. Human beings have the capability and potential to quickly learn few rules however, machine learning models must ingest huge amounts of data to produce reliable and accurate decisions. Another challenge created by the deployment of AI tools in criminal justice is that of ethical nature. It creates a controversial issue of clashing with the fundamental principle such as fairness and justice. The issue still lies in the effectiveness of AI to make reliable decisions and predictions in highly unstructured domains of application. Furthermore, it is also to be emphasized that the technical features of the AI are most effective when the environment is stable and the interaction between the variables and outcomes remain constant. However, the criminal offenders and the crimes are advancing and thus, the environment may also not be considered to be stable. Another crucial factor is the harms that may be caused due to the malfunction (false positives or false negatives) caused by the AI based tools. The liability of such a malfunction still remains to be an issue along with the fact that reliability is a very important factor in the investigation process considering that the lives of the innocent must not be implicated at any cost. Another point of concern is that the predictive analysis and effectiveness of AI model rests majorly on the quantity of the data it can ingest and process, the more the data, the better it is. However, larger databases are exposed to the constant attacks of malicious hackers motivated by revenge, gains or sponsored by government agencies.

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[12] Christopher Rigano, *Using Artificial Intelligence to Address Criminal Justice Needs* (2019).
[13] Gary Marcus, *Deep Learning: A Critical Appraisal,* Working Paper,2018, online: https://arxiv.org/abs/1801.00631 at 15-16.

The Way Forward for AI in Criminal Investigation

Having discussed the various applications of AI in different fields of the criminal investigation process and its potential use in the same, it is evidently concluded that AI powered tools and machines help and aid the investigators to shorten the time taken in various tasks at different stages of investigation. However, the risk posed by the deployment of AI cannot be underestimated which has been discussed above. At the same time the potential of Artificial Intelligence cannot be over emphasized and its development that is taking place every single day also cannot be denied. This paves the way for future possibilities to assist and aid the criminal justice system and ultimately also improve the safety of the public. With such rapid technological advancement taking place throughout the world, the use of cameras, videos and social media generates dramatically massive amount of data. AI can detect crimes that would otherwise remain undetected by the human beings and this eventually would ensure greater public safety by investigating potential criminal activity, thus increasing the confidence of the public in the law enforcement agencies and the criminal justice system. With the existing issues in the deployment of AI in the investigation process, the need of the hour is to make more intelligent methods and tools so that automatic investigation of the suspect machines or malicious activities can be analyzed and determined just in time. AI with more enhanced algorithms and predictive policing analytics integrated with computer aided response and live public safety video enterprises, law enforcement will have better potential to identify and respond to threats, investigate, interpret and analyze criminal activity. More accuracy, transparency, lack of biasness and competency with well-defined rules for legal implication (if at all there is a malfunction and a mistake committed by AI based tools) will ensure prominent place of AI in the criminal justice system all throughout the world. AI based software have been deployed in various parts of the world in the criminal justice arena but perfection is yet to be achieved to make it more reliable. Scientists and researchers have been developing more such AI based programs and machines to make the investigating process more sophisticated like any other arena. And thus it can be safely stated that AI based tools in future definitely has the potential to be a permanent part of our criminal justice ecosystem providing massive investigative assistance and allowing the professionals and officers to maintain safety.