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APPLICATION OF ARTIFICIAL INTELLIGENCE IN FORENSIC SCIENCE

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Abstract-

The overarching goal of this effort is to use existing science and technology as well as emerging technologies like Artificial Intelligence (AI) to discover better and more comprehensive ways to enhance, expand, and safeguard forensic science approaches across all of its subfields. Current and potential future uses of artificial intelligence in forensic science are discussed in the article. Some fields that potentially benefit from AI include digital forensics, image processing, crime scene reconstruction, blood pattern recognition and analysis, and satellite monitoring. From the initial stages of a crime scene investigation all the way through to the final verdict handed down by a judge, AI has shown great promise in terms of the accuracy of its results.

1. INTRODUCTION

Forensic Science is the use of scientific ideas, methodologies, and procedures to serve the cause of justice. It Forensic investigation entails employing efficient scientific procedures and methodologies to examine the crime and administer justice to the persons involved. Forensic science originated in ancient Rome, when those accused of crimes were required to plead their cases before a public gathering in the forensic forum. The forensic expert was responsible for rendering the final verdict after hearing the testimonies of both the victim and the suspect.

1.1 Artificial Intelligence

Artificial Intelligence (AI), often known as machine intelligence, refers to the capacity of machines to exhibit intelligence comparable to that displayed by humans and animals. Artificial Intelligence textbooks characterise the discipline as the study of "intelligent agents", which are machines that sense their surroundings, gather information, and take actions based on that knowledge to increase their odds of successfully fulfilling their goals. The term "Artificial Intelligence" is commonly used in everyday language to refer to machines that mimic the cognitive functions of humans, such as learning and problem-solving.

1.2 Artificial Neural Networks

Artificial Neural Networks (ANN) are computational systems that mimic the structure and function of organic neural networks seen in animal brains. These systems lack the programming necessary to execute certain activities, as it would require a substantial amount of code and may not be effective for all jobs. The user's text is. Artificial Neural Networks (ANN) carry out tasks by acquiring knowledge from provided instances. As an illustration, individuals can acquire the ability to identify images containing dogs in image recognition by analysing labelled sample photos categorised as either "dog" or "no dog" then applying this knowledge to identify dogs in other pictures. For instance, they accomplish this without any prior knowledge of dogs, photographs that exhibit dog-like characteristics, such as having four legs and a specific body structure. Instead, the pixels are transferred individually throughout the picture, generating distinguishing features based on the provided samples and processing them.

In Forensic Science, there are six concepts that must be taken into consideration simultaneously: The first principle is the Law of

Individuality. The sequence of principles is as follows: secondly, Locard's Principle of Exchange; thirdly, the Principle of Comparison; fourthly, the Principle of Analysis; fifthly, the Principle of Probability; and lastly, the Law of Progressive Change. The fundamental concepts of forensic science revolve around Locard's principle of exchange, which posits that when two things make contact, they inevitably leave traces on one another. This idea is essential in the foundation of Forensic Science & Investigation, as well as in AI. It demonstrates that even a pattern alone can be sufficient to identify a suspect and assist us in carrying out our procedures from the Crime Scene to the Courtrooms.

Applications of artificial neural networks in the field of forensic science. ANN (Artificial Neural Networks) and Artificial Intelligence have the potential to significantly assist in the field of Forensic Science, if they are done correctly. Some of its applications will have the ability to accurately delineate its extensive scope in the field of forensics.

2. DEFINITIONS

2.1 Artificial Intelligence

Describing Artificial Intelligence is a challenging task as there is no universally accepted and well defined concept for it. Many existing concepts attempt to define Artificial Intelligence as the creation of a computer process that exhibits intelligent behaviour. However, the notion of intelligence itself is not clearly defined. Another common definition is the creation of a computer process that can mimic human actions. However, this raises questions about whether humans always act intelligently and what happens when a machine consistently outperforms a human. There are several interpretations of "logical action," which refers to doing activities that are beyond the capabilities of a machine. However, it is unclear if this implies that an Artificial Intelligence programme ceases to be considered as such once it is designed to carry out these duties. These are equally useless in this conversation. For the sake of this study, we will use a practical

approach and define Artificial Intelligence as the development of a computer system that exhibits behaviour that an average human would perceive as intelligent. This text discusses some kinds of Artificial Intelligence and methodologies that may be of interest to those in the digital forensics sector.

2.2 Knowledge Representation

The primary focus in the majority of Artificial Intelligence programmes is the process of interpreting information, also known as information interpretation in the field of Artificial Intelligence and ontologies. This is a guide on how to analyse and understand the facts that we wish to debate. It explains how to organise and present information in a structured manner, enabling us to engage in meaningful arguments. It is crucial to bear in mind that our understanding of knowledge can pertain to the characteristics of objects in a specific field (information), the ability to interpret particular data (awareness of applicable rules and techniques in a given context), or the implementation of specific procedures (strategic or meta-awareness). When AI was in its infancy, the idea of ontology was not seen as a challenging topic. Rather, each application required a distinct method of knowledge representation. There would be obvious benefits to establishing a uniform worldwide ontology for digital forensics. For instance, it would provide a structured approach to evaluating digital evidence in a cross-border lawsuit spanning more than one jurisdiction. The establishment of an all-inclusive and user-friendly database of case records would also be made easier with its help. The efficacy of experts, whether they be people or AI gadgets, may be assessed with this technique. Additionally, it has demonstrated outstanding performance in other areas of Artificial Intelligence, making it a potentially useful tool for training automated forensic practitioners. When building a consistent and reusable set of contextual information to be used by AI algorithms, structured ontology might be helpful.

3. APPLICATIONS

Artificial Intelligence may be utilised to address long-standing challenges that have perplexed specialists for decades. Forensic science uncovers evidence from crime scenes to facilitate clear judgement and establish guilt. However, since the majority of the work is currently carried out by humans, it is subject to human limitations such as time constraints and potential errors. Adopting artificial intelligence would significantly enhance efficiency, streamline processes, and eliminate errors. Artificial Intelligence has the potential to enhance the precision of decision-making by providing the following applications:

3.1 Crime Scene Reconstruction

This method necessitates certain inputs, such as the detection of any item at the location of the crime, such as a deceased individual or a fragment of glass. By thoroughly collecting and analysing all aspects of the input, the system will autonomously generate 3 to 4 animated movies. This advancement will greatly benefit Forensic Experts, as it eliminates the need for human building of animated crime scenes. The user's text is enclosed in tags.

3.2 Data Acquisition and Recovery Objectives

Cyber forensic experts often encounter a significant challenge when analysing a file: determining its importance can only be done by accessing or viewing the file. Another issue arises when the suspect modifies the file extension, such as changing it from .doc to .exe. This further complicates the task at hand. In order to eliminate these two issues, the Artificial Neural Network (ANN) will internally examine the files and present only the material that is suitable for a Cyber Expert.

3.3 Cyber Forensics

Artificial Neural Networks (ANN) are highly valuable in investigating cybercrimes committed over internet networks. They can effectively track the online actions of individuals who may be engaging in legal or illicit web browsing. This includes identifying those who utilise proxy servers and accumulate significant online traffic to potentially compromise a server's security. The user's text is. When it comes to investigating things such as tracing phone conversations and other actions, Police and Forensic Experts encounter a political obstacle. In order to eliminate this issue, ANN will utilise its pattern recognition technology in conjunction with remote sensing and satellite capabilities to determine which phone calls should be traced and which should not.

3.4 Data analysis

Digital forensics is a rapidly developing field that focuses on the analysis of extensive and constantly changing data sets. Artificial Intelligence is an effective approach for efficiently handling and resolving large datasets. Artificial Intelligence may be utilised to do a meta-analysis of meta-data collected from many sources and consolidate them to streamline complex data. This will convert data of this nature into a more concise and comprehensible format within a very little timeframe.

3.5 Pattern recognition

An essential component of forensic science is identifying various patterns within extensive datasets. Identification of Trends is based on reliable evidence and a probabilistic approach. Artificial Intelligence has the potential to enhance its ability to identify complicated data trends. Some elements may involve the identification of different types of goods or the reliance on a human interpretation of information. This may involve the detection of visual patterns where the algorithm aims to distinguish various segments of an image or a person. Likewise, certain types of pattern recognition can take place, such as identifying patterns in written communication, such as email messages, or patterns in audio recordings. Pattern recognition techniques strive to encompass all. Possible data kinds to get optimal performance. Implementing these methods, whether through machine learning or Artificial Intelligence, is challenging in practice. Artificial Intelligence is frequently employed in such investigations to effectively minimise the occurrence of false positive or false negative

results. Artificial Intelligence will offer an extensive repository of information to the judicial system, enabling quick and accurate responses when necessary. Enhancing communication among all members of the investigative team Forensic inquiry necessitates interaction between forensic statisticians, attorneys, police investigators, and other individuals. When there is a lack of clear communication between these parties, it can lead to wrong conclusions or misunderstandings of facts, which in turn can cause justice to be delayed or faulty. Artificial Intelligence facilitates the bridging of the coordination gap among the several players in this region.

3.6 Establishing Repositories

Artificial Intelligence will facilitate the creation of an electronic repository capable of storing all forensic digital processes, data, assets, and reports. As storage capacity expands rapidly, with devices such as USB drives, hard drives, optical media, and flash drives capable of storing vast amounts of data, forensic science experts are facing growing difficulties in managing and analysing this information. Artificial Intelligence has the potential to serve as a viable tool for legal reasons, allowing for the storage, interpretation, and use of such data.

4. CONCLUSION

Artificial Intelligence has been active for less than half a century, and within our field, we have made significant advancements in technology and techniques. However, we must continue to exert great effort to ensure the well-being of humanity. The study specifically focuses on two Artificial Intelligence technologies that may be implemented in Forensic Science. However, there are further reported and unspecified solutions that can also be integrated in this field. It is now premature to determine the full extent of Artificial Intelligence's applicability in Forensics due to being in the early phases of development. Currently, Artificial Intelligence is employed in two main ways: 1) Automating

particular modules, such as searching for a specific file type, and 2) Assisting professionals in accomplishing specific tasks. Scientists are already conducting experiments in conjunction with other existing technologies. The transition to Artificial Intelligence will need a significant amount of time, and it remains to be seen which advancements will shape the future. It may be deduced that Artificial Intelligence will extend the impact of the Digital Revolution (Intelligent Systems) to the field of Forensic Science. This will be a transformative breakthrough in the industry that will enhance our quality of life.

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