

# ARTIFICIAL INTELLIGENCE IN FORENSIC SCIENCE

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**Abstract** - The work aims to find improved and extensive ways to Boost, Broaden and Vest Forensic Science techniques in all its branches by using current science & technologies and also employing the new, latest and upcoming technologies, such as Artificial Intelligence (AI). The paper converses the present-day and probable forthcoming applications of AI in Forensic Science. For example, AI can be employed in Blood Pattern Recognition & Analysis, Crime Scene Reconstruction, Digital Forensics, Image-processing and of course Satellite Monitoring. AI has a vast variety of applications, with preliminary being the investigation of crime scene till the ultimate judgment is being delivered by the court of law, AI show high potential in precision of result.

**Key Words:** Artificial Intelligence, Artificial Neural Network, Forensics, Data Analysis and pattern recognition.

## 1. INTRODUCTION

**Forensic Science** is the application of scientific principles, methods and techniques for the purposes of justice. It involves the use of effective scientific techniques and methods to investigate the crime and serve justice to involved parties. The word Forensic science has its roots embedded in ancient Roman times, where when an individual was charged with a crime, he/she was made to present the case before a group of public individuals in the forensic, meaning forum. The forensic was accountable for delivering the final judgment, after hearing the case from victim and from suspect.

### 1.1 Artificial Intelligence

Artificial Intelligence (AI) sometimes called as machine intelligence, is machine's ability to show intelligence which is similar to the intelligence shown by humans and animals. Top Artificial Intelligence textbooks define this field as the study of "intelligent agents": any machine that senses its environment to perceive information and then take action according to the received data to maximize its chances of successfully achieving its goals. In the language of ordinary or familiar conversation, the term "Artificial Intelligence" is often used to describe the machines which imitate the "cognitive" functions of humans i.e. the intelligence functions that the human mind performs, including but not limited to "learning" and "problem-solving".[11]

### 1.2 Artificial Neural Networks

Artificial Neural Networks (ANN) are computing systems like biological neural networks that form up animal brains. These systems are not programmed to perform specific tasks, that would take so many lines of code and won't even work for all the tasks.[10] ANN perform tasks by learning from the given examples. For example, they may learn to recognize photos that have dogs in them in image recognition by examining example photos that have been labeled as "dog" or "no dog" and using the findings to recognize dogs in other pictures. For example, they do so without any previous awareness about dogs, photos that have dog-like features, four legs and body form. Instead, they transfer pixel by pixel across the image pixel and produce identifying characteristics from the examples given and processed.

Simultaneously, in Forensic Science there are six principles which are to be considered: First, Law of Individuality Second, Locard's Principle of Exchange, third, Principle of Comparison, fourth, Principle of Analysis, Fifth, Principle of Probability and lastly, Law of Progressive Change[13]. The most basic principles of forensic science are the Locard's principle of exchange which states that "when two entities come in contact with each other they leave a trace on each other". This principle is fundamentally responsible for the basis of Forensic Science & Investigation, and also for AI in the sense that even a pattern will be enough to identify the suspect and will help us to perform our proceedings from Crime Scene to Courtrooms.

Artificial Neural Network Applications in Forensic Science ANN and Artificial Intelligence will be of great help, if implemented properly in Forensic Science Fields. Some of its applications will be able to define its vast extent in Forensic World.

## 2. DEFINITIONS

### 2.1 Artificial Intelligence

It is not easy to describe Artificial Intelligence, there is no well-established definition of Artificial Intelligence. Most of the concepts that exist tend to describe Artificial Intelligence in terms of "creating a computer process that acts intelligently" (but what is intelligence?) or "creating a computer process that can imitate human actions" (do people always act intelligently, what happens if a machine usually

performs better than a human being?). Many meanings apply to "logical action" (but what is logical?) or "doing tasks that are impossible for a machine to do" (does this mean that since an Artificial Intelligence program has been built to execute the function, it is no longer Artificial Intelligence?) which are similarly unhelpful in this discussion. Therefore, to simplify the challenge for this paper, a realistic approach is followed and Artificial Intelligence is described as "creating a computer process that behaves in a way that an average person would consider intelligent". Many of the various forms of Artificial Intelligence and Artificial Intelligence techniques which may be of interest to people in the digital forensics' community are also discussed.[13]

## 2.2 Representation of Knowledge

In most Artificial Intelligence programs, the most significant principle is the interpretation of information (referred to as interpretation of information in Artificial Intelligence and ontologies. This is, how to interpret the facts regarding which we want to argue and how we systematically arrange the representation of knowledge so that we can argue about it. It is important to remember that our interpretation of knowledge can be about the properties of artifacts in the domain (information), how certain data can be interpreted (awareness of what rules and techniques to implement in a given situation) or even how certain processes (strategic or meta-awareness) are implemented. In the early days of Artificial Intelligence, ontology was not seen as a challenge and for each application, a new representation of information was developed. The creation of uniform international ontology for digital forensics would have obvious benefits, for example in a multi-national case involving a variety of jurisdictions, in that it would provide a structured structure for the examination of digital proof, but would also have other benefits in that it would allow a broad, accessible case archive to be produced. It could help assess the efficiency of professionals, whether they be human or Artificial Intelligence devices and may offer a practical tool for educating automated forensic practitioners which has proven incredibly effective in many Artificial Intelligence areas. The use of structured ontology may also prove useful in the development of a normal, reusable set of context information which could be used by Artificial Intelligence techniques.

## 3. APPLICATIONS

Artificial Intelligence can be applied to solve the problems that experts have been having for decades. Forensic Science though reveals information from the crime scene to help make the judgment clear and charge the guilty of the crime, but as most of the work is still performed by humans and humans take time to perform operations and also make human errors while doing so, taking the approach of Artificial Intelligence will make things much faster, smoother and error-free.

Artificial Intelligence can improve the accuracy of judgment taken by offering these applications:

### 3.1 Crime Scene Reconstruction

This system will require some inputs like the presence of any object at the crime scene, say dead body, or any object like a glass piece. After extracting and analyzing each and every aspect of input, it will try to figure out 3 to 4 animated videos on its own and that will be of great help to Forensic Experts as compared to now, which involves manual construction of animated crime scenes.[2]

### 3.2 Data Acquisition & Recovery Purposes

Generally, Cyber Forensic Experts come across a major problem in analyzing a file, i.e. which file is important, can be decided only after accessing/opening that file. Another problem is that even if the suspect has changed the file extension, say from .doc to .exe, then the above problem becomes a very tedious job. To eradicate these two problems, ANN internally analyze the files and will display only that content that is appropriate to Cyber Expert.

### 3.3 Cyber Forensics

In crimes that are performed over an internet network, ANN will be of great usage, because it will tell us the activities of a web surfer, who is surfing legally or illegally (will be using proxy servers and will be accumulating enough on-line-traffics over a server to crack it down).[9]

In investigation matters like phone calls tracing and other activities, Police and Forensic Experts face a political problem. To eradicate this problem also, ANN will decide which phone calls to trace and which not through its pattern recognition system through remote sensing and satellite facilities.

### 3.4 Data analysis

Digital forensics is a highly computationally emerging area that involves the study of large and dynamic data sets. Here Artificial Intelligence is a good method for managing and solving these broad data sets.

Artificial Intelligence, for example, may be used to do a meta-analysis of meta-data obtained from multiple outlets and pool them to simplify complicated data. This will that data of this type in a fairly short period to a simpler and understandable format.[5]

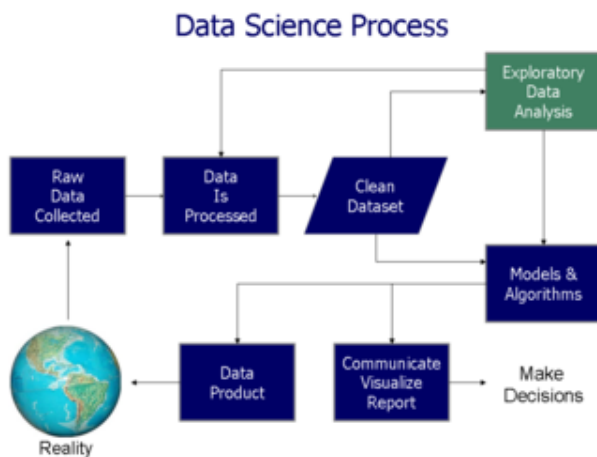


Fig. 1: Flow diagram of data processing

### 3.5 Pattern recognition

One of the key aspects of forensic science is the detection of different forms of trends in large data. Recognition of trends is founded upon solid evidence and probabilistic thinking. Artificial Intelligence can become more effective in the identification of these trends in complex data. Some of the features can include identifying those forms of items or relying on an interpretation of how knowledge is interpreted by humans.

This may include identification of picture patterns (model presented in Fig. 1) where the algorithm attempts to recognize different sections of a picture or an individual. Similarly, certain forms of pattern detection can occur, such as detecting patterns in a letter, such as email messages or patterns in a sound recording.

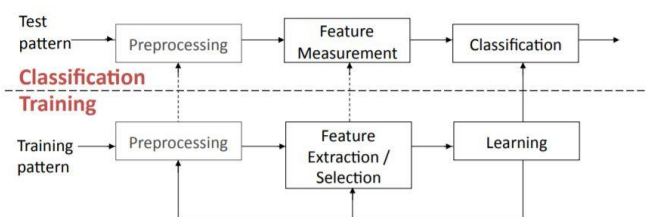


Fig. 2: Flow Diagram of Pattern Recognition

Pattern recognition techniques would aim to fit all potential data types to obtain a high degree of performance. This is hard to do in reality, whether the techniques of machine learning or Artificial Intelligence are utilized. In such studies, the usage of Artificial Intelligence can often reduce the degree of false positive or false negatives.[1]

### 3.6 Providing legal solutions

Forensic reports provide statistical tools for the judicial system to analyze facts. For a more comprehensive and

detailed collection of knowledge, Artificial Intelligence will provide the legal system for fast answers where appropriate.

### 3.7 Improving contact among all investigate team members

Forensic investigation involves contact among forensic statisticians, attorneys, police investigators and others. Miscommunication between such parties can contribute to incorrect decisions or misinterpretation of data resulting in delayed or inaccurate justice. Artificial Intelligence helps to bridge this coordination gap between the numerous stakeholders in this region.

### 3.8 Creating Repositories

Artificial Intelligence will also help to create an electronic archive that can hold all the forensic digital operations, records, assets and reports. With the increasing pace of storage capacity expansion, like USB, hard drives, optical media, flash drives which can hold very large volumes of information, it is becoming more challenging for forensic science researchers to hold and examine all this information. Artificial Intelligence may be a reasonable resource for legal purposes to store, interpret and use such data.

## 4. CONCLUSION

Artificial Intelligence has been in operation for less than 50 years and we are confident that, with respect to our profession, we have accomplished a vast deal of technologies and strategies, but we also have to strive hard for human well-being. The paper only addresses two of the various Artificial Intelligence technologies that can be introduced and there are also other documented and undefined solutions that can be incorporated in the area of Forensic Science. Complete application of Artificial Intelligence in Forensics is much too early to know because we are in the initial stages. At present, Artificial Intelligence is used in 1) Automation of specific modules (e.g. to look for file type) and 2) Guiding experts to complete specific tasks.

Scientists have been experimenting in tandem with other current technology and it will take some time for them to completely migrate to Artificial Intelligence and it will take some time to see what developments will lead to the modern world.

We can infer that Artificial Intelligence will carry the Digital Revolution (Intelligent Systems) into the Forensic Science area. This will be a revolution in the industry that will help our lives improve for the better.

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