

## ARTIFICIAL INTELLIGENCE: AN ODYSSEY IN FORENSIC ODONTOLOGY

**DR. VINOD V.C<sup>1</sup>, DR. ROZA R. BAVISKAR<sup>2\*</sup>, DR. AJIT V. KOSHY<sup>2</sup>.**

<sup>1</sup>Prof. and Head, Department of Oral Medicine and Radiology. M.A. Rangoonwala College of Dental Science, Pune-01, Maharashtra, India.

<sup>2\*</sup>Post Graduate Student, Department of Oral Medicine and Radiology. M.A. Rangoonwala College of Dental Science, Pune-01, Maharashtra, India.

<sup>2</sup> Prof. and Head, Department of Oral and Maxillofacial Pathology. M.A. Rangoonwala College of Dental Science, Pune-01, Maharashtra, India.

Corresponding Author

Dr. Roza R. Baviskar.

Post Graduate Student, Department of Oral Medicine and Radiology. M.A. Rangoonwala College of Dental Science, Pune-01, Maharashtra, India.

Email:rozabaviskar@gmail.com.

### ABSTRACT

Electronic globalization along with a gigantic technological advancement during last few decades has made a huge impact on our everyday life. Globally, an advance of field of technology that is rapidly growing is Artificial intelligence (AI) is a breakthrough in digital science and has entranced the brains of scholars worldwide. In the today's scenario, when crime-related occurrences are at rise in the society, the identification of the victim, criminal, or the mode of crime becomes a brain-storming process. With the advance of big data analysis technology, the application of technologies including mode identification, in-depth learning, and computer vision technique, the artificial intelligence technology has welcomed ground-breaking progress. In recent years, forensic researchers at home and abroad have conducted many studies based on artificial intelligence technology, such as face recognition, age and gender identification, DNA analysis, postmortem

interval estimation, injury and cause of death identification, showing the feasibility and advantages of using artificial intelligence technology to solve forensic identification problems. The goal of this study is to provide a high-level overview of AI as it may be applied in digital forensics. The purpose of this paper is to attempt at having an overview of the application of AI in forensic odontology.

## KEYWORDS

artificial intelligence, forensic odontology, forensic science, Data Analysis and Pattern Recognition.

## INTRODUCTION

The term Forensic is derived from a Latin word “forensic” meaning “before the forum” ,a place where legal conflicts are debated and discussed .The field of forensic odontology (FO) or forensic dentistry deals with dental knowledge and their application in various ways for identification of criminal and prove them in front of civil law that are enforced by police agencies in the system of criminal justice.<sup>1</sup>

Forensic science is the application of scientific methods or expertise to the investigation of crimes or the examination of evidence that may be submitted in a court of law. From fingerprint and DNA analysis to anthropology and animal forensics, forensic science encompasses a wide range of subjects.<sup>2</sup> Despite their diverse backgrounds, all forensic scientists confront the same set of problems.

Artificial intelligence hereafter referred to as “AI” which by far is one of the better tools today used by specialists in forensic science or can also destroy the expertise of a forensic expert by being its worst enemy. One of the quotes that we remember is. “The greatest danger of artificial intelligence is that people conclude too early that they understand it” - Eliezer Yudkowsky. Human beings are still trying to wrap their heads around the concept of Artificial Intelligence.<sup>3</sup> (AI) is an advanced form of digital programming. What makes AI different from a standard piece of software is its ability to process massive amounts of data while maintaining a high degree of analysis.AI is more like a problem-solving tool than a killer robot. In fact, its impressive data processing capability is what makes it an excellent partner for digital forensics and incident

response activity. “Artificial intelligence” which by far is one of the better tools today used by specialists in forensic science or can also destroy the expertise of a forensic expert by being its worst enemy.<sup>3</sup>

## **ARTIFICIAL INTELLIGENCE**

The term “AI” was coined in 1956. Artificial intelligence is the replication of human intellect in that are programmed to think, act, and imitate our behaviors. In Computer Science, AI can be split into two primary fields; Machine Learning (ML) and Deep Learning (DL). In forensics, Artificial Intelligence and Machine Learning play a very crucial role.<sup>4</sup> The datasets used for training the models are critical, and data pre-processing is a key step in ML.<sup>5</sup> An overview of the datasets available for training AI models in Digital Forensics is provided by Grajeda et al. AI success is due to the convergence of three factors (Russell and Norvig, 2010): Computation, Big Data, and AI algorithmic advancement.

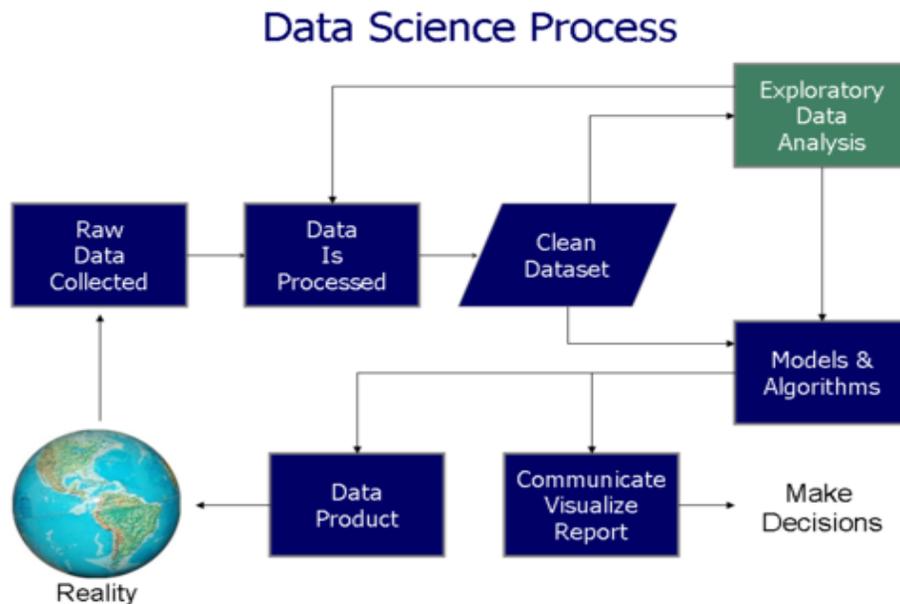
**Computation:** It means the exponential increase in computing and storage power.<sup>5</sup>

**Big Data:** The world was entrenched in big data before it even realized that big data existed.<sup>6</sup> By the time the term was coined, big data had accumulated a massive amount of stored information that, if analyzed properly, could reveal valuable insights into the industry to which that particular data belonged.<sup>7</sup> Today Big Data can be used to solve complex problem due to variety of data collected, the volume of this data and how quick it is accessing.

**Algorithmic advancements:** An algorithm is a be a model of data. Each observed data point is considered to be an expression of random variable generated by a probability distribution.

## **HOW IS AI AIDING FORENSIC SCIENCE?**

Digital forensics is an upcoming field 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 can reduce the data of this form into a simplified and understandable format in a relatively short period of time.



Data Science Process, credit: Wikipedia.

## PATTERN RECOGNITION

Identifying specific types of patterns in large data is one of the crucial elements of forensic science.<sup>8</sup> 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.<sup>9</sup> AI can come to recognize such patterns in complex data in a more accurate manner. 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<sup>9</sup> (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. Some of the features may involve locating certain types of pictures or based on an understanding of how humans perceive information.<sup>8</sup>



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.

## **WHY GAINING THE EDGE IS IMPORTANT?**

### **COMBINING AI IN A FORENSIC INVESTIGATION CAN HELP IN FOLLOWING WAY-**

It introduces automation.

Detect criminal activity from the vast amounts of unstructured data they have collected, such as from AI in a forensic investigation videos, images, emails, and text files.

## **MODUS OPERANDI**

There is a temptation during an investigation to rely on previous experience and knowledge, through an intuition-driven approach. The amount of data that must be analyzed is not only increasing, but its nature and how it is interpreted is constantly changing. This only serves to amplify human biases.<sup>10</sup> Data-driven advanced analytic models, which incorporate text analytics and network analysis, are used to rank risks rather than at a transaction level. Advanced analytics techniques, such as machine learning, and cognitive-data analytics are then finally applied.<sup>10</sup> Cognitive-data analytics, which is self-learning, allows data to be digested dynamically and in real time.<sup>10</sup> Data mining takes place, patterns are seen and recognized, and natural language is analyzed. These are all processed together, much in the same way as the human brain operates.<sup>10</sup> This is how forensic investigators can gain an edge during an investigation.<sup>10</sup>

## **ADVANTAGES AND LONG -TERM CONSEQUENCES OF AI**

In a forensic investigation, combining people and AI can offer a firm an advantage: It implements automation, which saves substantial time and money while allowing investigators to focus more on areas where fraud may occur. It assists businesses with detecting illegal behavior from massive volumes of unstructured data, such as videos, pictures, emails, and text files. It's a more dynamic method than rule-based testing, which can only assess fraud risk across a single data set. It eliminates information silos that might hamper an analytics-aided

investigation: this occurs when locally-tailored processes prohibit integrated data exchange, creating hurdles to an inquiry.<sup>11</sup>

## THE LONG-TERM CONSEQUENCES OF AI.

AI could lead to mass unemployment for humans, which could cause social unrest. The ethics of AI; e.g.- autonomous weapons should not be developed as they are unethical. Traditional forensic identification relies on forensic experts to manually extract information and provide identification opinions based on medicine, biology and other fields of knowledge combined with personal work experience, which is not only time-consuming and require great effort, but also affected by subjective factors that are difficult to overcome.

## LIMITATION

There is no danger in using AI as a tool to verify a diagnosis, but the easy drift is that the practitioner is subordinated to proving what the machine says. In the current state of data science research, AI algorithms are not interpretable, and it is not possible to interrogate AI to understand a reasoning. It is often described as black boxes.

Enormous data is required for training and precision and therefore it is difficult to achieve accuracy in rare conditions or diseases.

## CONCLUSION

Artificial intelligence is the appropriate technology to store, evaluate and use product data collected for forensic evidence in legal cases. Forensic experts are now guided to step into the era of artificial intelligence as a helpful tool for research and possibly even future routine forensic analyses. For the future, a lot of improvement is required to interpret the reasoning of the system, which is able to recognize things better than a human. Technology can make the job easier, but it will never be able to replace ,as forensic science is an area of specialists. Therefore, to understand the countless notions and the system involved in artificial intelligence will

have a strong benefit in the future. AI may assist in addressing the weaknesses harshly criticized in conventional dental care (Watt et al. 2019).<sup>12</sup>

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