ARTIFICIAL INTELLIGENCE IN MODERN JUSTICE SYSTEMS

Amar Singh[1]

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ABSTRACT

In the digital era, technological innovation and its usage has increased criminal activities. It remains a major challenge for police, court, correction and law enforcement agencies to determine the crime and criminal involved. The modern judicial system of the country is working in close coordination with police, law-enforcing agencies, attorney, and the authorities following the procedures using advance technology to advance access to justice for all. Its main role is to prevent crime, protect the innocent, investigate cybercrime and punish the guilty (criminal). The technology has also provided a major edge in detection to apprehension that can improve accuracy in investigations and policing too through forensic solutions. It helps people to seek and obtain redress through formal and informal institutions. Further, technologies can advance access to justice by creating more streamlined and accessible processes. The Emerging Technologies such as Artificial Intelligence (AI) is transforming modern criminal justice, aiding in decision-making and crime prevention and being used by the law enforcement agencies (Organizations, legal offices, and defence providers) around the globe. With the assistance of AI, real-time statistics can be obtained and that may help authorities respond quickly to criminal activities. AI is impacting language processing by enabling various advancements like machine translation, chat bots, and personalized learning tools, preserving rare languages and understanding nuanced language variations. This paper explores the application of AI in language processing and forensic tools that are used by the various law enforcement agencies and modern criminal justice system.

Keywords: Crime, Criminal, Forensic, Natural Language Processing, Justice system, Digital

[1] Amar Singh, *Osmania University*.

INTRODUCTION

The term "Technology" widely known, as sophisticated machines performing so many routine task and complicated task rapidly, effectively and efficiently, with and without the involvement of human (Moriarty, 2017). In the era of digital transformation, the technology is involved in every aspect of life. The use of technology has become important part of law enforcement and has brought major changes in various aspects of life, including the legal system. Emerging Technology and innovation have open up new opportunities in accessing, analysing, and processing information in law enforcement. The interplay between law and technology can result in better crime detection and justice delivery. In the age of intelligence, the Justice System is no exception to it. (University., 2023).

Globally, the crime rates are increasing day by day as the technology is evolving. The modern offenders are using intelligent technologies to commit sophisticated crimes (including cybercrime) and evade detection. As the intelligent technologies are evolving, the prevention and detection of crime with apprehension of criminals becoming a major challenge for Justice System in most of the countries. It may be due to traditional way of investigation or resistant towards the adoption of emerging technology. The use of intelligent technologies by criminals has brought sophistication in crimes and has given it strength to global nature. The Justice System (JS) left with no option other than improving their capabilities to combat the menace of sophisticated crime vis-à-vis using enhanced abilities and making the investigation more efficient.

There is a need of Robust Legal Technology (RLT) (Mishra P. K., 2024) that should bring efficiency and effectiveness at each stage (cops, crime/criminal, court, correction) of JS, in order to tackle the crime and capture the criminals within no time. The RLT should be such that the law enforcement and various agent of the JS should use new and existing tools and apply techniques in tricky and ingenious ways to the conduct of crime, the crime prevention and control operations of the police, the judicial processing functions of the courts and the warehousing, rehabilitation, and monitoring functions of corrections systems. The robustness of legal technology can achieve by the use of Emerging Technologies such as Artificial Intelligence and its integration with other technologies.

As the technology evolves, the Modern justice system needs to be renovated by incorporating the advanced technology for efficiency and transparency. The primary actors in justice system – the

criminals, the people who measure and analyse crime, the police, judges, prosecutors, defence attorneys and corrections officers - are all interested in using information technologies such as Artificial Intelligence and other technological form (example: Electronic databases, surveillance systems, pharmaceuticals, explosives, weaponry) to achieve their various objectives. (Moriarty, 2017). AI[2] is a relatively fast-growing technology, mostly characterized by a certain degree of coherence persisting over time and with the potential to exert a considerable impact on the socio-economic domain(s), which observed in terms of the composition of actors, institutions and patterns of interactions among those, along with the associated knowledge production processes. It has most prominent impact, however, lies in the future and so in the emergence phase is still somewhat uncertain and ambiguous (Daniele Rotolo, 2015) that also raises ethical and legal concerns.

ARTIFICIAL INTELLIGENCE IN MODERN JUSTICE SYSTEM

Artificial Intelligence (AI) refers to the simulation of human intelligence in machines that are programmed to think and act like humans. It involves the use of algorithms and computer programs to perform tasks that typically require human intelligence, such as visual perception, speech recognition, decision-making, and language translation and processing, among others (Agarwal, 2013).

AI is transforming criminal justice, aiding in decision-making, predictive policing in crime prevention and legal research. It used by the law enforcement agencies (Organizations, legal offices, and defence providers) around the globe in different ways: to assist the human in difficult task, improve human capabilities and replace humans with fully automated processes and robots. (Nicole Ezeh, 2025). With the assistance of AI, real-time statistics obtained from various sources (surveillance cameras, social media, and crime reports) and that may help authorities respond quickly to criminal activities.

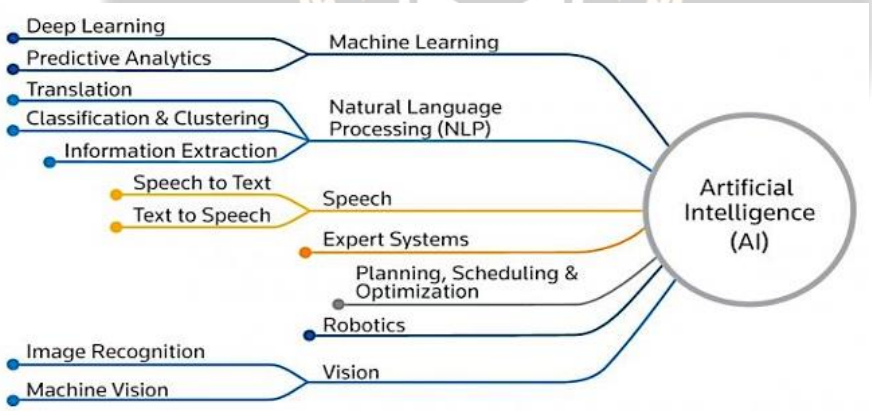
AI is capable to assist the crime laboraties for complex DNA mixture analysis, digital evidence analysis,image analysis that help law enforcement with situational awareness. If technology such as robotics and drones are included in public safety system with AI, it can help society and law enforcement agencies for a safe alternative. Integration of AI with computer-aided response and

[2] Timothy Havens, Associate Professor of Computer Systems, Michigan Technological University, quoted in *Artificial Intelligence (AI) vs. Machine Learning (ML): 8 Common Misunderstandings*, *The Enterprisers Project* (May 19, 2020), https://blogs.mtu.edu/computing/2020/05/19/tim-havens-quote-in-enterprisers-project/.

live public safety video enterprises can help law enforcement respond to incidents, prevent threats, stage interventions, divert resources, and investigate and analyze criminal activity. AI powered Speech recognition system is rapidly transforming the law enforcement due to the usage of AI-algorithms that converts the spoken words into machine readeable form.It can play a crucial role in preventing and solving crimes, including terrorist acts.

According to the Future of Professionals Report 2024 by the Thomson Reuters Institute, 79% of law firm respondents anticipate that AI will have a high or transformational impact on their work within the next five years, while 42% believe that AI's transformational potential has surged. According to the reports by the Federal bureau of investigation, the crime rates have dropped by 3.3 % and 6.3 % co-in the USA.

Various law enforcement agencies are using AI for anticipating, investigating, detecting, and preventing crime evidence, predictive policing (Veritone). The prosecution uses AI for Evidence analysis, case management, and sentencing. The Judiciary uses AI for Case Management, Risk Assessment, Virtual Courtrooms and Other areas: Forensic Science (DNA Analysis), Combating Cybercrime, Monitoring Online Platforms, whereas Natural Language Processing (sub field of AI) is used by both Lawyers and Clients to streamline legal research, Law Enforcement Agencies



Source: (Pickell, 2025)

Figure 1. Artificial Intelligence and its Sub-field

NATURAL LANGUAGE PROCESSING (NLP)

In recent years, advancements in Natural Language Processing (NLP) have significantly impacted the legal domain by simplifying complex tasks, such as Legal Document Summarization (LDS)[3], Legal Argument Mining (LAM)[4] enhancing legal text comprehension for laypersons, and improving Legal Question Answering (LQA)[5] and Legal Judgement Prediction (LJP). (FARID ARIAI and GIANLUCA DEMARTINI, March 2025)

In general, NLP is the application of AI on human linguistics. NLP is a subset of AI. It's the branch of AI that permits computers to understand, interpret, and manipulate human language. NLP makes possible for humans to talk to machines. NLP itself has a number of subsets, including natural language understanding (NLU), which refers to machine reading comprehension, and natural language generation (NLG), which can transform data into human words. NLP makes it possible for computers to extract keywords and phrases, understand the intent of language, translate that to another language, or generate a response. (Overby, 2020). Some of the examples include Google's predictive search suggestions, spell checkers and voice recognition. NLP is a bright industry, expected to grow $27.6 billion by 2026 and projected to reach US$ 3081.5 million by 2028, from US$ 843 million in 2021, at a CAGR of 20.1% during 2022-2028. (Reports, Jul 09, 2020). NLP is serving as a vital tool for expediting judicial proceedings in the legal domain (Raphael Souza de Oliveira, 2025). Some of the ways NLP can help both Lawyers and Clients (Flynn, 2021) are

a) *Improve legal research:* Rigorous research is essential for all legal processes, but it takes a long time for settling a personal injury claim, that discourages the clients. NLP-powered legal search engines can shorten the legal research processes, where it translates the plain language into "legalese"6. Advanced NLP programs not only search for specific keywords but also search for concepts, analyse a case study or document and suggest other similar cases for lawyers to review, to search and find faster what they need.

[3] Isabel Gallegos & Kaylee George, *The Right to Remain Plain: Summarization and Simplification of Legal Documents*, Stanford University CS224N Project Report (2022), https://web.stanford.edu/class/archive/cs/cs224n/cs224n.1224/reports/custom_116652906.pdf.

[4] Ivan Habernal et al., Mining Legal Arguments in Court Decisions, 32 *Artif. Intell. & L.* 1 (2024), https://link.springer.com/article/10.1007/s10506-023-09361-y.

[5] Jens Frankenreiter & Julian Nyarko, Natural Language Processing in Legal Tech, in *Legal Tech and the Future of Civil Justice* 63 (David Freeman Engstrom ed., Cambridge Univ. Press 2023), https://www.cambridge.org/core/books/legal-tech-and-the-future-of-civil-justice/natural-language-processing-in-legal-tech/963F237942CA584BA07791DB6DFAF3EA.

[6] Legalese: Meaning and Clear Definition, *LegalTerms.net* (2025), https://legalterms.net/what-is-legal-legalese/.

b) *Drafting and analysing lawful (legal) documents*: NLP can help buy lawyers avoid mistakes, word choice, syntax that creates unintentional vagueness in a contract or legal document, while drafting documents. It can help lawyers to protect their client's reputation.

c) *Automating Routine documentation and drafting work*: As per the legal trend report, majority of the legal clients expect the lawyer to be available outside of business hours and expect the result with in less time. So, the lawyer tries to automate the drafting process to reduce stress, save time, have considerable relief from client. Some NLP-based automation tools draft basic versions of contracts, can organize and file documents automatically based on the language.

d) *Predicting Rulings and prediction model*: Advanced NLP program uses an algorithm that can analyse past case studies, builds predictive models to predict how a court may rule in proceeding. These models can help lawyer to frame a more effective argument. A 2025 study created an NLP model that could predict 98% accuracy with rich and high-quality word characteristics for the prediction of text nature (Khan, 2025).

Despite NLP's potential and growing uses in law, there are some challenges that are listed below.

a. NLP has limited understanding of context and meanings, nuance of the human language leading to unidentified sarcasm and idioms. This causes errors, inaccuracies, or irrelevance

b. NLP can analyse data and provide insights, but it lacks ethical reasoning and emotional intelligence required for certain legal situation and cases.

c. NLP systems are limited to existing legal precedent. It cannot understand the law in the way humans do, as they operate on patterns and information present in their training data and are not adapt to emerging legal concepts or rapidly evolving areas of law.

d. The information used to train an NLP model may contain skewed, unfair, or unrepresentative patterns often reflecting existing prejudices or systemic inequalities in society. Biased NLP systems can aid unfair outcomes, affecting decisions related to legal advice, contract reviews. Legal professional should remain attentive in identifying and mitigating these biases.

e. Security and privacy concerns arise, as most of the legal documents always contain high confidential details about individuals, organizations, and legal matters. Legal professionals should be caution about the storage and handling of sensitive information, while using NLP tools to prevent unlawful access or data leaks.

The best NLP tools for legal research are LEGALFLY, Lex Machina, Case Text, Paxton AI, Blue J Legal, Harvey AI, Westlaw, Bloomberg Law (MacSweeney, 2024).

AI AND FORENSIC SCIENCE

Forensic science is the use of scientific methods or expertise to investigate crimes or examine evidence that might be presented in a court of law (NIST). It comprises diverse field of discipline ranging from finger print and DNA analysis to anthropology and wildlife forensics. It plays a major role in judicial process, civil and criminal investigation. Forensic scientists make use of tools and techniques to interpret crime scene evidence for investigations.

Forensic science has changed the world of justice by incorporating the modern technology. It's helping the lawyer to argue on charge

a. through Interpretation of medico-legal case (MLC) report, Postmortem reports, cross examination of witness through Forensic Experts, Medical Experts, Doctors,
b. by converting the technical terms to interpret the Forensic evidences
c. by connecting the Interpretation of Forensic evidences with the provisions of Law

I. The role of AI in Forensic Science

The AI has emerged the powerful tool in Forensic Science that is processing sophisticated data, analysing crime scene, interpreting DNA and electronically stored data (digital forensic). Over the years, AI has proven to be most important technology in the analysis of evidence. It is contributing to forensic science through its accuracy and object-based data analysis when compared to traditional methods that are based on subjective interpretations and inconsistency. Some of the areas where AI use (P., 2024 Sep) are

a. AI in Crime Scene Investigation and Reconstruction
    - AI-Powered Crime Scene Analysis and Data Integration
    - 3D Crime Scene Modelling and Virtual Reconstruction
b. AI in Forensic DNA Analysis
    - AI Algorithms for Complex DNA Mixture Interpretation
    - AI and Next-Generation Sequencing (NGS) in Forensics
c. AI in Digital Forensics and Cybercrime Investigations
    - Automated Analysis of Digital Evidence
    - AI in Image and Video Forensics
d. AI and Block chain Technology in Digital Forensic Evidence Authentication
e. AI in Forensic Pattern Recognition and Image Analysis
    - AI in Fingerprint Analysis

- AI in Bloodstain Pattern Analysis (BPA)
- AI in Tool mark and Firearm Identification

f. AI in Forensic Toxicology and Drug Identification
   - AI in Toxicological Data Analysis
   - AI in Detecting Novel Psychoactive Substances (NPS)

g. AI in Voice and Audio Forensics
   - AI in Speaker Identification and Voice Biometrics
   - AI in Audio Enhancement and Noise Reduction

h. AI in Forensic Document and Handwriting Analysis
   - Handwriting and Signature Verification with AI
   - AI in Document Forgery Detection

II. AI-Powered Forensic Tools

AI-powered forensic tools are transforming investigations by using natural language processing, machine learning, deep learning to analyse datasets, identify patterns and detect irregularities that cannot be found by traditional methods. These tools are used across multiple forensic disciplines such as

a. *Digital forensics*: Digital forensics compromise collecting, analysing, and preserving electronic evidence for criminal investigations, cyber security incidents, and legal proceedings. AI is revolutionizing digital forensics by through Automated Data Analysis and processing, malware and cyber-attack detection, Image Forensics and Deep fake, rapid evidence analysis, predictive analytics for Crime Prevention and detection, Facial and Biometric Recognition, automating forensic investigations, Speech and Text Analysis, digital evidence reconstruction and Incident response, improving pattern recognition, automatic data analysis and enhancing cyber security threat detection

   AI-powered forensic tools use predictive analytics, including natural language processing (NLP), machine learning, and deep learning to process huge amounts of digital evidence (emails, logs, metadata, network traffic and multimedia files). Some of AI powered digital forensics tools are Magnet AXIOM, Cellebrite Pathfinder, Blacklight (by Black Bag.

b. *Video and image analysis*: It is used to examine various crimes such as fraud, child pornography, and terrorism. It can play a critical role in verifying the authenticity of digital

media used in social media posts and online news stories, voice recognition. Some of AI powered video and image analysis tools are Amped FIVE, Truepic, Clearview AI

c. *Voice and Audio Forensics*: It aids in speaker identification, voice cloning detection, and audio enhancement. Some of AI powered voice and audio Forensics tools are Pindrop, Veritone, and Resemble Detect.
d. *Document analysis*: It is used to detect forgery, plagiarism, or authorship attribution. Some of the AI powered document analysis tools are CopyLeaks or Turnitin, Authorship Attribution AI, Forensic Linguistics AI.
e. *Predictive Policing and Crime Pattern Analysis*: IT analyse crime data to predict potential threats or criminal activity hotspots. PredPol, ShotSpotter, HunchLab are some of the predictive policing and crime pattern analysis tools used.
f. *Crime scene reconstruction*: It helps simulate crime scenes based on data inputs such as photos, measurements, or 3D scans. FARO Zone 3D and VTO (Virtual Training Officer) are tools used for crime scene reconstruction.

CONCLUSION

AI is revolutionizing the modern justice from crime investigation to court proceeding. Law enforcement agencies are using AI for anticipating, investigating, detecting, and preventing crime evidence, predictive policing, evidence analysis, Forensic Science (DNA Analysis), Combating Cybercrime, and Monitoring Online Platforms. The Court are also using AI for case management, sentencing, Case Management, Risk Assessment, Virtual Courtrooms. AI-driven risk assessment tools used to estimate the chances of recidivism and data-driven approaches for sentencing the offender. (Chaturvedi, Emerging Technology Trends And Its Effect On Criminal Justice System, 2025). However, there are ethical issues and concerns about bias in AI algorithms, admissibility in court, deepfake manipulation, privacy violations, and lack of accountability in AI systems that need to be address.

However, to strike a balance between AI revolution and risk, forensic experts must implement ethical AI practices, transparency, and integrate AI as a tool for enlarging human expertise rather than replacing humans.