

**The Role of Artificial Intelligence in Modern Criminal Justice System:
Opportunities and Challenges**

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Abstract

Artificial Intelligence (AI) is increasingly transforming the criminal justice system by enhancing various facets such as law enforcement, judicial processes, and crime prevention. AI-driven tools, including predictive policing algorithms, risk assessment instruments, and facial recognition systems, provide the opportunity to increase the effectiveness and precision of criminal justice operations. For instance, AI can analyze vast datasets to identify crime patterns, assist in forensic investigations, and support decision-making in judicial proceedings. Nevertheless, there are many obstacles to overcome before AI may be successfully incorporated into the criminal justice system. The possibility of algorithmic bias is one of the main worries, since AI systems may unintentionally reinforce preconceptions already in previous data, resulting in discriminatory actions against particular demographic groups. Additionally, issues related to transparency and accountability arise, as the proprietary nature of many It might be challenging to evaluate the fairness and dependability of AI algorithms because their decision-making processes can be obscured. Privacy concerns are also paramount, especially with AI applications that involve surveillance and data collection, which may infringe upon individual rights.

This study attempts to investigate the two facets of artificial intelligence's function in contemporary criminal justice by looking at both the advantages and disadvantages of the technology. Through a critical analysis of current AI applications in law enforcement and judicial contexts, the paper will assess the effectiveness of these technologies in achieving their intended outcomes. Furthermore, it will delve into the ethical, legal, and social implications of AI deployment in criminal justice, considering how to balance technological advancements with the protection of civil liberties. By evaluating case studies and existing literature, the paper seeks to provide a comprehensive understanding of how AI can be harnessed responsibly to enhance the criminal justice system while mitigating potential risks.

Keywords: Artificial Intelligence, Criminal Investigation, Judiciary, Policing, criminal Justice, Evidence

Introduction

AI is a branch of computer science that is developing quickly. John McCarthy, considered the father of artificial intelligence, lived in the middle of the 1950s., defined it as “the science and engineering of making intelligent machines” (see sidebar, “A Brief History of Artificial Intelligence”).¹ AI presents a number of issues for all legal systems worldwide. Since there is

¹ The Society for the Study of Artificial Intelligence and Simulation of Behaviour, “What is Artificial Intelligence.”

disagreement about the precise definition of the term "artificial intelligence," the first of these problems relates to the same idea. The definition by the European Commission can be used here as a useful reference point. According to the Commission, AI refers to

“systems that display intelligent behaviour by analysing their environment and taking actions – with some degree of autonomy – to achieve specific goals. AI-based systems can be purely software-based, acting in the virtual world (e.g. voice assistants, image analysis software, search engines, speech and face recognition systems) or AI can be embedded in hardware devices (e.g. advanced robots, autonomous cars, drones [...]).”²

Through process automation, improved decision-making, and increased efficiency, artificial intelligence (AI) is rapidly emerging as a key technology in a number of industries, including healthcare, banking, and transportation. In the realm of criminal justice, AI might completely change how courts handle cases, how law enforcement organizations function, and how security is maintained in prisons.³ The demand for improved decision-making processes, more effective ways of crime detection and prevention, and better resource allocation has fueled the development of AI technologies in criminal justice systems.

For instance, predictive policing algorithms are being used to forecast criminal activity, while machine learning models assist in risk assessment during sentencing and parole decisions.⁴ Despite these advancements, the integration of AI in criminal justice also raises significant ethical, legal, and social concerns, particularly regarding bias, transparency, accountability, and the potential for misuse.⁵

Experience-based learning is a component of human intelligence. An application of artificial intelligence called machine learning allows computers and their software to gain knowledge from past experiences, imitates this skill. In terms of criminal justice, pattern recognition is quite important. We frequently learn to discriminate between people, things, information, circumstances, and complex human emotions. Humans are also skilled at seeing patterns. In terms of computer hardware and software algorithms, artificial intelligence seeks to replicate human capabilities.

The key areas where AI is being integrated in India is Judicial Process, Case Management, Legal research, and Law enforcement which involves using data-driven algorithms to manage the cases based on their long pending period, relevancy of the subject matter. Apart from this the researchers take the help of artificial intelligence tools in their respective research. The Investigating agencies like policing may also integrate the AI in there methods like by analyzing historical crime data and identifying patterns, the great help of AI can be taken by law enforcement agencies in India anticipate potential criminal hotspots and deploy officers

² European Commission, ‘Artificial Intelligence for Europe’, cit., 1.

³ McCarthy, C. (2019). AI in policing and criminal justice. Digital Policy, Regulation and Governance, 21(3), 256-263. <https://doi.org/10.1108/DPRG-05-2019-0034>

⁴ Angwin, J., Larson, J., Mattu, S., & Kirchner, L. (2016). Machine bias: There’s software used across the country to predict future criminals. And it’s biased against blacks. ProPublica. Retrieved from <https://www.propublica.org/article/machine-bias-risk-assessments-in-criminal-sentencing>

⁵ O’Neil, C. (2016). Weapons of math destruction: How big data increases inequality and threatens democracy. Crown.

proactively to prevent crimes. This approach aims to enhance public safety and reduce crime rates, particularly in major urban centers like Delhi, Mumbai, Kolkata where law enforcement faces significant challenges due to high population density and diverse socio-economic conditions. However, the implementation of predictive policing in India also raises concerns about privacy, data security, and potential biases in the algorithms used.

In this paper the researcher has highlighted the ways in which Artificial intelligence is impacting the whole criminal justice system and also the ways in which it can more utilised for the advancement of Justice. Further, several opportunities and challenges in implementing the artificial intelligence in the modern criminal justice system has also been discussed.

Artificial Intelligence in Criminal Investigation and Predictive Policing

□ Use of AI for crime pattern analysis

In policing, artificial intelligence (AI) improves crime pattern analysis by analyzing large datasets to spot trends, forecast criminal activity, and allocate resources as efficiently as possible. Artificial intelligence (AI) systems are able to identify crime hotspots and predict the locations and times of crimes by examining demographics, environmental factors, and previous crime data. Law enforcement organizations can more efficiently deploy people by concentrating on regions with higher crime probabilities thanks to this predictive capabilities, which helps to deter potential offenses.

Additionally, AI assists in offender profiling by examining behavioral patterns, helping predict potential criminal actions and facilitating early interventions. For instance, AI can analyze past behaviors to assess the risk posed by individuals, allowing for tailored preventive measures.⁶

Furthermore, surveillance film analysis is improved by AI-driven techniques, which quickly identify suspects and reveal hidden patterns inside criminal networks. AI gives law enforcement actionable intelligence by combining data from several sources, including social media and public records, enhancing the efficacy and efficiency of investigations.

But using AI in law enforcement brings up ethical issues, such as possible algorithmic biases and privacy issues. Maintaining public trust while utilizing AI's advantages in crime pattern research requires ensuring accountability, transparency, and adherence to regulatory requirements.

□ Predictive policing and its ethical implications

Predictive Policing generally uses the artificial intelligence and data analysis in order to predict the potential criminal activities. This is done by analysing the data of crime which aims to enhance the crime prevention and the best use of resource allocation within the department. However this concept raises the significant ethical consideration.

The issue which concern the most is the reinforcement of systemic biases. This predictive model is based on the history of criminal activities of suspect which can reflect biased policing practices ultimately leads to the discrimination against the marginalized communities. For

⁶ Scope of Artificial Intelligence in the Criminal Justice System, available on <https://legalvidhiya.com/scope-of-artificial-intelligence-in-the-criminal-justice-system/> date 17/03/2025 at 6:18 PM

example, if certain person has a history of committing theft, the use of AI may target him, leading to increased surveillance and criminalization.

There are also issues with accountability and transparency. The public's ability to examine and comprehend the decision-making processes of many predictive police algorithms is restricted due to their proprietary nature. By making it difficult to identify and address possible biases, this opacity erodes public confidence in law enforcement.

□ AI-assisted facial recognition and surveillance

Artificial intelligence is used by AI-assisted facial recognition technology to recognize people by examining their faces in pictures or videos. In surveillance, this technology is used to keep an eye on public areas, improve security, and help police find perpetrators. Facial recognition systems can swiftly identify individuals on watchlists, bolstering security at airports, stadiums, and other public venues. By cross-referencing facial data with criminal databases, authorities can expedite suspect identification, as demonstrated by the NYPD's use of AI in high-profile investigations.⁷ However at the same time one thing also which is to be ensured is that the Organizations which employ facial recognition for secure access to facilities, ensuring that only authorized personnel gain entry.

Artificial Intelligence in Courtroom Procedure and Decision Making

□ AI-powered legal research and case analysis

In the legal field, artificial intelligence (AI) is transforming case analysis and legal research by improving accessibility, accuracy, and efficiency. AI-powered legal research tools can quickly process large volumes of legal data, giving attorneys access to relevant information faster than with conventional techniques. Because of this acceleration, legal practitioners are able to concentrate on more strategic areas of their work, which leads to increased productivity. AI is capable of quickly examining large case files and legal documents, locating pertinent case law, and precisely extracting important information.⁸

AI's ability to identify patterns within legal data facilitates predictive analytics, aiding lawyers in forecasting case outcomes and developing informed legal strategies. By analyzing historical case data, AI can provide insights into judicial decision-making trends, assisting attorneys in crafting more effective arguments.

The capabilities which AI has is with no match with any other system like AI can be extended to review and analysis the document and contracts, the AI powered tools not only analyse the legal documents but also can identify the discrepancies and further it could ensure the compliance of relevant laws and regulation. Such automated process reduces both the time and effort of the researcher, academician, advocate, attorneys to resolve the complicated task.

The use of AI can also be made in order to enhance the access to justice by assisting in pro bono matters. There are various law firms which have incorporated the use of AI to process

⁷ US News report available on <https://nypost.com/2024/12/06/us-news/the-next-frontier-for-catching-a-killer-prevalent-surveillance-ai-drones/> dated 17/03/2025 at 10:25 PM

⁸ AI in legal research: Streamline workflows and save time available on <https://www.evenuplaw.com/guides/artificial-intelligence-in-legal-research> dated 18/03/2025 at 3:40 PM

there large volume of documents in Public interest Litigation. The use of AI enabled them to undertake projects which were previously resource intensive.⁹

□ Use of AI in bail and sentencing decisions

Recently, Punjab and Haryana High Court used the Artificial Intelligence in one of the bail matter which depicts the integration of AI in the Judicial process too. Now AI is increasingly integrated into the Judicial Process and particularly in bail hearing and sentencing decisions aiming to enhance efficiency and objectivity.

Artificial intelligence (AI)-powered risk assessment technologies evaluate information including criminal history, flight risk, and community connections to help courts decide whether to grant bail. Judges can use these technologies to make data-driven decisions by predicting the risk that a defendant would commit a new crime or skip court. Supervised machine learning algorithms, for example, may analyze large datasets to find recidivism-related trends, which helps with bail decisions.¹⁰

Whereas in Sentencing decisions, various factors were evaluated by AI such as severity of offence, previous convictions, and sentencing guidelines, these all factors got combined and provide appropriate penalties. By analyzing historical sentencing data, AI can identify trends and suggest sentences that align with past precedents, promoting consistency and fairness. Some jurisdictions have implemented AI-infused statistical programs to predict outcomes and assist in sentencing decisions.¹¹

At the There is also a risk of overreliance on Artificial Intelligence, it cannot be discarded that in order to ease their work the Judges may rely heavily on the recommendation made by AI, this ultimately undermine their discretionary power. Some judges emphasize the value of human judgment while expressing doubts about AI's capacity to render just rulings.¹²

□ Risks of bias and fairness in AI-driven judicial processes

As we have seen that AI is integrated in Judicial process at great level which offers potential benefits in consistency and efficiency. But at the same time the integration of AI in legal Process raises significant concerns against bias and fairness. The AI is derives its power from the data feeded and such AI systems which are trained on historical data of a person concerning his antecedents may inherit existing biases in present. Suppose if the previous ruling were influenced by certain social factors such as racial, prejudice. AI system could integrate these biases which may lead to unfair outcomes. Another source of Bias in AI can be the Semantic Bias, the language which are used in legal documents can introduce semantic biases. AI model

⁹ “Lawyers turns to AI to expand pro bono work” A special Report Innovative Lawyers: Europe published in Financial Times

¹⁰ Role of AI in Bail Granting Power of Courts by Vibhanshu Shekhar Singh, Published in International Journal of Research Publication and Reviews, ISSN 2582-7421

¹¹ Article “The Place of Artificial Intelligence in Sentencing Decisions” by Kieran Newcomb, Spring 2024 Issue, University of New Hampshire available on <https://www.unh.edu/inquiryjournal/blog/2024/03/place-artificial-intelligence-sentencing-decisions> dated 18/03/2025 at 5:06 PM

¹² News Report, The National Judicial College available on <https://www.judges.org/news-and-info/judges-remain-skeptical-on-whether-artificial-intelligence-can-make-decisions-more-fairly-than-they-can/> dated 18/03/2025 at 6:50 PM

which process such language in operation may favour certain community over the other which further may lead to unjust treatment.¹³

Therefore in order to remove this biasness there is a need for incorporation of human judgment alongside AI recommendation which is a crucial part. The outputs of AI must be critically assessed by the legal professional in order to prevent the unjust outcomes and maintain the integrity of judicial proceeding.¹⁴

Artificial Intelligence in Forensic Science and Evidence Analysis

The capability to transform the forensic Science by increasing the accuracy and efficiency of analysis of evidence is well equipped in artificial intelligence (AI). Some of the information like DNA profiling and examination of fingerprints can be processed by AI in more quickest way than any other system available till date, this ultimately will be useful in order to find the pattern and identifying the suspect by minimizing any human error. Such automating processes like data gathering and processing, artificial intelligence (AI) helps digital forensics go through large amounts of electronic data and expedites investigations.

Furthermore, The functions of AI can be utilised in reconstruction of crime scene using the virtual reality and deep techniques, by enabling the investigating authorities to analyse the environment without physical presence.

- Role of AI in digital forensics and cybercrime investigations

Artificial Intelligence (AI) not only revolutionizing the Judicial process or the investigation method but also it revolutionize the digital forensic and cybercrime investigation by analysing data, automation process etc. By the help of automation process daily routine task like log analysis and malware detection can be very well performed by the AI. This will reduce the load on forensic experts and allows them to focus on complex aspect of investigations.

Integration of AI into the Real Time Crime Centers (RTCCs) that allows AI to immediate processing and analysis of data from various multiple sources which aid in threat assessment and strategic planning.

- AI-enhanced DNA analysis and fingerprint matching

Large amounts of genomic data may be quickly processed by AI systems, which can then spot patterns and genetic changes that humans might miss. This ability speeds up diagnosis and makes tailored medicine easier. To further focused gene therapies, artificial intelligence (AI) has been used to create regulatory DNA sequences that control gene expression in particular cell types.¹⁵

- Reliability and admissibility of AI-generated evidence in court

¹³ Javed K, Li J. Artificial intelligence in judicial adjudication: Semantic biasness classification and identification in legal judgement (SBCILJ). Heliyon. 2024 Apr 26;10(9):e30184. doi: 10.1016/j.heliyon.2024.e30184. PMID: 38737247; PMCID: PMC11088250. dated 18/03/2025 at 6:24 PM

¹⁴ Blog “Humanizing Justice: The transformational impact of AI in courts, from filing to sentencing” by Allyson Brunette, Thomson Reuters available at <https://www.thomsonreuters.com/en-us/posts/ai-in-courts/humanizing-justice/>

¹⁵ Article “AI-designed DNA sequences regulate cell-type-specific gene expression” by Andreas R. Pfenning published in Nature

In this digital era, electronic evidence forms an integral part of the legal proceedings. In judicial proceeding emails, social media posts and surveillance footage etc. are used to prove facts and other legal arguments. Although legal persons have developed practices to handle the electronic evidence, but this AI has added new complexity.

Courts evaluate evidence based on authenticity, relevance, and reliability. For AI-generated evidence, establishing authenticity involves demonstrating that the AI system operates as intended without tampering. Reliability requires showing that the AI's methodology is sound and its outputs are consistent. However, the lack of transparency in AI algorithms poses challenges in meeting these standards.

Recognizing these challenges, some jurisdictions have implemented measures to ensure the integrity of legal documents. For example, the Chief Justice of New South Wales issued directives prohibiting the use of AI in drafting critical evidence documents, emphasizing the need for human oversight to maintain accuracy and authenticity.¹⁶

Recently, Justice B.R Gavai of the Supreme Court, has flagged the risk of platforms such as ChatGPT generating fabricated legal facts and Youtubers uploading excerpts to court proceeding as their own content. Further, Justice Gavai emphasised on the need of cautious approach in integrating artificial intelligence within the Judiciary stating that technology must serve as an aid rather than a replacement of human Judgment.¹⁷

Opportunities

Artificial Intelligence offers numerous opportunities to enhance modern criminal Justice System across various domains:

- **Crime detection and Prevention** – By analysing Historical criminal data in order to forecast the potential criminal activities AI facilitates predictive policing, this will enable the investigating authorities to allocate the resources in most useful manner without any wastage of resources. Furthermore, AI powered surveillance system can detect unusual pattern aiding the prevention of crime even before they actually occur
- **Judicial Decision Makings** – AI can be utilised for risk assessment regarding the accused of being flee or appearance on next trial and may also contribute in making decision on bail and sentencing by examining other factors like previous antecedents and sentencing parameter and punishment provided by other judges in similar cases.
- **Administrative Efficiency** – AI has proved its capability in reducing the administrative burden on law enforcement and Judicial Personnel. In India Supreme Court has implemented the AI application in various manner like in automated case management, legal research and documentation, AI-assisted filing and court procedures, conversion of Supreme Court Judgment into 16 regional languages, etc.
- **Investigation and Forensic Analysis** – Apart from the above stated areas the use of AI can be proved fruitfull in Investigation method and analysis of forensic. This will

¹⁶ Australian News Article “Chief Justice bans AI use in key evidence documents”

¹⁷ News Article “Justice Gavai caution against AI replacing human judgment” available on <https://www.hindustantimes.com/india-news/justice-gavai-cautions-against-ai-replacing-human-judgment-in-judiciary-101741617017772.html> dated 19/03/2025

reduce the chance of Human error and improves the efficiency and accuracy. As discussed above one of the example for the application of AI is that, AI is capable of creating the Scene of crime without any human error this will provide a lot of help to the investigating authorities

Challenges

Implementing Artificial intelligence in the modern criminal justice system may face several challenges which can be:

- **Bias and Discrimination** - As we know that the base of working of AI is the training data that was fed up within it's system when it was programmed. So this AI can perpetuate existing biases present in their training data. This can lead to the outcome which can be discriminatory particularly against the marginalized communities. Another way in which the bias and discrimination is expected is the situation when AI is implemented in Judicial process. AI works learns itself from various sources by the programming of algorithm, however when it comes to Judgment which is taken by the Judicial minded person, and such person came on judgment according to the facts and circumstance which depends on case to case basis, here AI may commit bias or discriminate because it answer according to data uploaded or learnt from various sources.
- **Transparency and Explainability** – Many of the artificial intelligence algorithm operates as “black boxes” which makes it difficult to understand because the outcome produced is without any clear insight into their internal decision-making processes. This raise concern about the accountability and fairness. This will raise several issues among the Judges, attorneys as they may find it difficult to interpret AI generated risk assessment or sentencing recommendation without understanding the underlying logic.
- **Data Privacy and Security** - To work properly, AI applications frequently need a lot of personal data, including biometric data like fingerprints and face photos. Concerns regarding possible abuse, illegal access, and the degradation of individual privacy rights are raised by the gathering, storing, and analysis of such sensitive data. For example, while AI-powered face recognition technology can help identify suspects, it can also result in widespread monitoring and the tracking of people without their permission. Furthermore, privacy may be further jeopardized if AI algorithms are opaque and produce conclusions that people cannot challenge or comprehend. Strong data protection regulations, open AI procedures, and constant monitoring are required to address these problems and strike a balance between the protection of human liberties and technical developments.

SUGGESTIONS

1. **Develop Clear Guidelines and Regulations:** Establish comprehensive policies to govern AI use in criminal justice, ensuring fairness, transparency, and accountability.
2. **Address Algorithmic Biases:** Implement measures to identify and mitigate biases within AI systems to prevent unjust outcomes and protect civil rights.

3. **Ensure Human Oversight:** Maintain human involvement in critical decisions, using AI as a supportive tool rather than a replacement for human judgment.
4. **Promote Interdisciplinary Collaboration:** Encourage cooperation among technologists, legal experts, and policymakers to align AI applications with ethical standards and societal values.

By implementing these strategies, the criminal justice system can harness AI's benefits while safeguarding ethical principles and public trust.

CONCLUSION

The criminal justice system could undergo a radical change as a result of artificial intelligence (AI), which could enhance decision-making, accuracy, and efficiency. Its integration does, however, pose certain difficulties that need to be resolved in order to guarantee moral and efficient application.

Offender profiling, evidence analysis, legal research, and predictive policing are just a few of the areas of criminal justice that AI can improve. Despite these developments, issues with biases, accountability, transparency, and the possible decline of human empathy in decision-making processes still exist. AI might unintentionally reinforce current inequities and erode public confidence in the legal system if it is not carefully considered.