

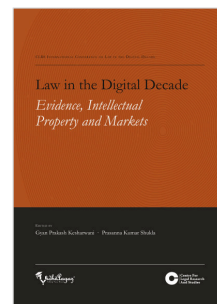
CHAPTER 6

Artificial Intelligence Enhanced Forensics and Child Rights Protection: Policy, Law and Ethics

Yamini Patel and Grishma Bhavsar

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CHAPTER 6

Artificial Intelligence Enhanced Forensics and Child Rights Protection: Policy, Law and Ethics

YAMINI PATEL* AND DR. GRISHMA BHAVSAR**

The integration of Artificial Intelligence (AI) into forensic science is transforming criminal investigations across jurisdictions. In India, where child sexual abuse cases are prosecuted under the Protection of Children from Sexual Offences Act, 2012 (POCSO) framework, forensic evidence plays a decisive role in ensuring fair trials and safeguarding child rights. However, the adoption of Artificial Intelligence (AI) assisted forensic tools such as automated DNA analysis, pattern recognition, facial analytics, and digital evidence processing raises complex legal, ethical, and procedural concerns that remain insufficiently examined within the existing statutory structure.

It argues that while Artificial Intelligence (AI) has the potential to enhance accuracy, speed, and objectivity in evidence collection and analysis, the absence of clear legal standards, accountability mechanisms, and child sensitive protocols may risk procedural injustice and secondary victimization. Artificial Intelligence (AI) in forensic investigation can advance social justice only when governed by a rights-based, child centric legal framework.

Keywords: Artificial Intelligence, Forensic Evidence, Child Rights, Algorithmic Accountability, Social Justice.

1 INTRODUCTION

Artificial Intelligence (AI) has emerged as one of the most significant technological developments in contemporary forensic science, transforming the manner in which criminal investigations are conducted and forensic evidence is examined. Advances in machine learning, computer vision, and predictive analytics have enabled forensic laboratories to analyse complex biological, digital, and multimedia evidence with greater speed and precision than conventional methods.¹ Artificial Intelligence (AI) assisted tools are increasingly employed in DNA mixture interpretation, facial comparison, fingerprint analysis, image enhancement, voice recognition, and cyber forensic investigations, thereby improving the efficiency of evidence identification and reducing investigative delays.² These developments have attracted considerable attention from governments, forensic institutions, and law enforcement agencies across the world because of their potential to strengthen criminal justice administration while addressing the growing volume of digital evidence.³ Nevertheless, the integration of Artificial Intelligence (AI) into forensic practice is not merely a technological advancement; it also raises fundamental questions regarding transparency,

* PhD Research Scholar at GLS University, Ahmedabad, Gujarat, India.

** Assistant Professor at GLS University, Ahmedabad, Gujarat, India.

¹ National Institute of Justice, Artificial Intelligence and Forensic Science: A Frontier for Innovation in Criminal Justice (U.S. Dep't of Justice 2024).

² INTERPOL, Toolkit for Responsible AI Innovation in Law Enforcement (2023).

³ Europol, Facing Reality? Law Enforcement and the Challenge of Deepfakes (2022).

explainability, accountability, algorithmic bias, and the admissibility of Artificial Intelligence (AI) generated evidence before courts.⁴ The increasing reliance on automated decision support systems therefore requires a careful examination of whether technological innovation remains compatible with constitutional guarantees, procedural fairness, and the rule of law.⁵

These concerns assume greater significance in cases involving child sexual abuse, where the search for scientific accuracy must be balanced with the protection of children's rights and the preservation of their dignity throughout the criminal justice process. The Protection of Children from Sexual Offences Act, 2012 (POCSO Act) establishes a specialised legal framework that recognises children as vulnerable participants in criminal proceedings and mandates child friendly procedures during investigation, evidence collection, and trial.⁶ Recent legislative developments, including the Bharatiya Sakshya Adhiniyam, 2023 and the Digital Personal Data Protection Act, 2023, further underscore the importance of authenticity, privacy, and responsible data governance in an increasingly digital justice system.⁷ Despite the growing use of Artificial Intelligence (AI) in forensic investigations, limited legal scholarship examines its impact on child protection, evidentiary fairness, privacy, and ethical standards. Against this backdrop, this study examines the legal, policy, and ethical implications of using Artificial Intelligence (AI) in forensic investigations involving child sexual abuse. It argues that while Artificial Intelligence (AI) possesses considerable potential to improve forensic accuracy and strengthen child protection, its legitimacy ultimately depends upon transparent governance, human oversight, judicial accountability, and a regulatory framework that places the best interests of the child at the centre of technological innovation.⁸

2 LEGAL FRAMEWORK GOVERNING CSA INVESTIGATIONS IN INDIA

The investigation of child sexual abuse (CSA) in India is governed by an interrelated statutory framework that seeks to balance effective criminal investigation with the protection of children's rights. At the centre of this framework is the Protection of Children from Sexual Offences Act, 2012 (POCSO Act), which establishes a child centric system of investigation and trial. Unlike ordinary criminal legislation, the Act not only defines offences against children but also prescribes safeguards to minimise secondary victimisation.

It mandates child friendly procedures for recording statements, conducting medical examinations, preserving confidentiality, and ensuring expeditious trials before Special Courts.⁹ Consequently, forensic investigation under the POCSO Act is not merely an evidentiary exercise; it is an integral component of child protection that must uphold the dignity, privacy, and best interests of the child throughout the investigative process.¹⁰

The procedural framework governing criminal investigations is provided by the Bharatiya Nagarik Suraksha Sanhita, 2023 (BNSS), which authorises investigating agencies to collect scientific evidence,

⁴ Frank Pasquale, *The Black Box Society: The Secret Algorithms That Control Money and Information* (Harvard Univ. Press 2015); Cathy O'Neil, *Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy* (Crown 2016).

⁵ Constitution of India arts. 14 & 21; Justice K.S. Puttaswamy (Retd.) v. Union of India, (2017) 10 SCC 1.

⁶ Protection of Children from Sexual Offences Act, No. 32 of 2012, India Code (2012).

⁷ Bharatiya Sakshya Adhiniyam, No. 47 of 2023, India Code (2023); Digital Personal Data Protection Act, No. 22 of 2023, India Code (2023).

⁸ UNESCO, *Recommendation on the Ethics of Artificial Intelligence* (2021); OECD, *OECD Principles on Artificial Intelligence* (2019).

⁹ Protection of Children from Sexual Offences Act, No. 32 of 2012, India Code (2012).

¹⁰ Convention on the Rights of the Child arts. 3, 16 & 19, Nov. 20, 1989, 1577 U.N.T.S. 3; Constitution of India arts. 14 & 21.

conduct medical examinations, seize relevant material, and forward evidence for forensic analysis.¹¹ While these provisions recognise the increasing importance of scientific methods in criminal investigations, they do not expressly regulate the use of Artificial Intelligence (AI) in forensic decision making. As a result, investigators may employ AI assisted technologies without statutory standards governing their validation, reliability, or accountability, creating uncertainty regarding the legal status of algorithm assisted forensic findings.

The evidentiary framework is contained in the Bharatiya Sakshya Adhiniyam, 2023 (BSA), which recognises scientific opinion, expert testimony, and electronic records as admissible evidence, subject to the requirements of authenticity and reliability.¹² However, the growing use of AI assisted forensic tools introduces new evidentiary challenges. Unlike conventional expert analysis, AI systems often generate conclusions through complex computational models that are not readily explainable before a court. This creates tension between technological efficiency and the principles of transparency, judicial scrutiny, and the accused's right to effectively challenge expert evidence during trial.

The increasing prevalence of cyber enabled child sexual offences further expands the role of digital evidence in criminal investigations. Online grooming, child sexual abuse material (CSAM), encrypted communications, and social media interactions frequently require specialised cyber forensic examination. The Information Technology Act, 2000 provides the legal basis for recognising electronic records and investigating cyber offences, thereby facilitating the collection and preservation of digital evidence.¹³ Although AI applications such as automated image classification, metadata reconstruction, and behavioural pattern analysis are increasingly used in digital forensics, their deployment remains largely governed by general evidentiary principles rather than a dedicated statutory framework.

The protection of children's personal information has acquired greater significance following the enactment of the Digital Personal Data Protection Act, 2023 (DPDP Act). Investigations involving child victims routinely require the processing of highly sensitive personal data, including medical records, biometric information, forensic images, and electronic communications. The DPDP Act incorporates principles such as lawful processing, purpose limitation, data minimisation, and enhanced protection for children's personal data.¹⁴ These safeguards assume particular importance where AI systems retain, analyse, or continuously learn from sensitive datasets, raising concerns regarding privacy, data security, and secondary use of information beyond the original investigative purpose.

Although India's legal framework recognises the growing importance of scientific and digital evidence, none of the existing statutes specifically regulates AI generated forensic outputs. There are no statutory standards governing the validation of forensic algorithms, independent auditing of AI systems, disclosure of algorithmic methodologies, or judicial assessment of AI assisted expert evidence. Similarly, neither the POCSO Act nor the Bharatiya Sakshya Adhiniyam prescribes procedural safeguards for evaluating the reliability, explainability, or accountability of AI generated forensic reports. This regulatory silence creates a significant gap between technological innovation and legal preparedness.

Unless supported by clear legal standards and robust institutional oversight, the increasing reliance on AI assisted forensic technologies may undermine evidentiary fairness, procedural transparency, and

¹¹ Bharatiya Nagarik Suraksha Sanhita, No. 46 of 2023, India Code (2023).

¹² Bharatiya Sakshya Adhiniyam, No. 47 of 2023, India Code (2023).

¹³ Information Technology Act, No. 21 of 2000, India Code (2000).

¹⁴ Digital Personal Data Protection Act, No. 22 of 2023, India Code (2023).

the child centred objectives that underpin India's legal framework for the protection of children from sexual offences.¹⁵

3 CASE LINKED ILLUSTRATIONS FROM INDIA

Indian courts have increasingly recognised the importance of forensic and digital evidence in the investigation and prosecution of sexual offences, particularly those involving children. Although no reported decision directly examines the admissibility of Artificial Intelligence (AI) assisted forensic evidence in POCSO cases, several judicial pronouncements demonstrate the growing reliance on scientific methods and digital technologies in criminal investigations. These decisions provide the legal foundation for evaluating the future role of AI in forensic investigations while also highlighting the absence of specific judicial standards governing AI generated evidence.

a) *Mukesh v. State (NCT of Delhi) (2017)*

Although not a POCSO case, the Supreme Court relied extensively on DNA forensics and scientific evidence, demonstrating how decisive forensic credibility can be in sexual offence trials.¹⁶

b) *State of Himachal Pradesh v. Rajesh Kumar (2019)*

The Court emphasized the evidentiary value of DNA profiling in a POCSO matter, showing how scientific evidence can outweigh testimonial inconsistencies.¹⁷

c) *Alakh Alok Srivastava v. Union of India (2018)*

Directions were issued regarding online child sexual abuse material and the need for technological mechanisms to detect and prevent circulation, highlighting the growing intersection of technology and child protection.¹⁸

d) Digital Evidence in Online Grooming and CSA Material Cases

Courts have had to assess chat records, metadata, and device forensics in POCSO prosecutions, indicating a shift toward digital/AI assisted evidentiary reliance.¹⁹

These cases show courts trusting forensic and digital outputs, even though AI governance norms are absent.

4 AI (ARTIFICIAL INTELLIGENCE) APPLICATIONS IN CONTEMPORARY FORENSICS

Artificial Intelligence is reshaping forensic science by enabling faster processing, pattern recognition, and analytical interpretation of complex evidence. In CSA investigations, where time sensitive biological traces and large volumes of digital material are common, AI assisted tools increasingly support investigators and forensic experts in managing evidentiary complexity.²⁰ One of the most important applications is in DNA analysis and probabilistic genotyping. Traditional DNA interpretation becomes difficult when

¹⁵ UNESCO, Recommendation on the Ethics of Artificial Intelligence (2021); NIST, AI Risk Management Framework (AI RMF 1.0) (2023).

¹⁶ *Mukesh & Anr. v. State (NCT of Delhi) & Ors.*, (2017) 6 SCC 1.

¹⁷ *State of Himachal Pradesh v. Rajesh Kumar @ Raju*, (2019) 14 SCC 268.

¹⁸ *Alakh Alok Srivastava v. Union of India*, (2018) 17 SCC 291.

¹⁹ See, e.g., *Shinoj v. State of Kerala*, CrI. A. No. 2389 of 2024, 2025 LiveLaw (Ker) 654 (Kerala High Court, Oct. 17, 2025) (chat records in a POCSO appeal; redacted conversations inadmissible even with a Section 65B certificate); *Just Rights for Children Alliance v. S. Harish*, 2024 INSC 716 (computer forensic analysis report on the accused's mobile phone).

²⁰ Christopher Rigano, Using Artificial Intelligence to Address Criminal Justice Needs, NIJ Journal No. 280 (Nat'l Inst. of Justice, U.S. Dep't of Justice 2019), NCJ 252038.

samples are degraded, contaminated, or mixed. AI driven software assists experts in interpreting complex DNA mixtures and generating statistical probability assessments with improved speed and consistency. In CSA cases, where delayed reporting often weakens biological evidence, such tools can significantly influence evidentiary outcomes.²¹

AI is also used in image and video enhancement. In cases involving child sexual abuse material (CSAM), CCTV footage, or low-quality visuals, AI algorithms can enhance clarity, reconstruct blurred frames, and detect relevant visual patterns. This allows recovery of usable evidence from otherwise compromised material.²² Another emerging use is facial comparison and pattern recognition. AI systems compare facial features across datasets to assist in identifying suspects involved in CSAM circulation or online grooming networks. While technologically helpful, this use also raises concerns about reliability and potential misuse without legal oversight.²³

AI plays a crucial role in digital evidence analytics. CSA investigations frequently involve chat histories, emails, social media communication, metadata, and device logs. AI tools can automatically sort, categorize, and reconstruct timelines from extensive datasets, helping investigators trace grooming behaviour and communication patterns efficiently.²⁴

AI is increasingly used for:

- Automated DNA profiling and probabilistic genotyping
- Image/video enhancement in child exploitation material and CCTV recovery
- Facial comparison and pattern matching across datasets
- Digital evidence triage (chat logs, metadata, geolocation timelines)
- Voice and text analytics to identify grooming behaviour, coercion, and threatening communications
- AI assisted detection and classification of Child Sexual Abuse Material (CSAM) using image hashing and automated content recognition

5 EVIDENTIARY ADMISSIBILITY AND ALGORITHMIC OPACITY

Under the Bharatiya Sakshya Adhiniyam, 2023, scientific and electronic evidence is admissible only when the court is satisfied about its authenticity, reliability, and proper certification. The statute recognizes expert opinion and electronic records as valid forms of proof, but it presumes that the expert can explain the basis of the conclusion in a manner open to judicial scrutiny and cross examination.²⁵ A further concern is whether the defence can meaningfully challenge such evidence. Fair trial principles depend on the opportunity to test the reliability of prosecution evidence through cross examination. If the methodology of the AI system is undisclosed due to intellectual property claims or technical complexity, the

²¹ John M. Butler, *Advanced Topics in Forensic DNA Typing: Interpretation* (Elsevier 2015).

²² Europol, *AI and Policing: The Benefits and Challenges of Artificial Intelligence for Law Enforcement*, Europol Innovation Lab Observatory Report (2024); Laura Sanchez, Cinthya Grajeda, Ibrahim Baggili & Cory Hall, *A Practitioner Survey Exploring the Value of Forensic Tools, AI, Filtering, & Safer Presentation for Investigating Child Sexual Abuse Material (CSAM)*, 29 *Digital Investigation* S124 (2019).

²³ Clare Garvie, Alvaro Bedoya & Jonathan Frankle, *The Perpetual Line-Up: Unregulated Police Face Recognition in America* (Georgetown Law Center on Privacy & Technology 2016).

²⁴ Casey, Eoghan, *Digital Evidence and Computer Crime* (3rd ed., Academic Press 2011).

²⁵ Bharatiya Sakshya Adhiniyam, 2023, Sec. 39, 57, 61, 63 (expert opinion and electronic records).

defence is deprived of the ability to question error rates, bias, or data integrity. This weakens the adversarial process that underlies criminal justice.²⁶

Further, courts traditionally assess scientific evidence by examining validation studies, peer acceptance, and known error margins. In the case of AI tools, questions arise as to whether error rates, training datasets, validation protocols, and audit records are disclosed to the court. Without such disclosure, AI derived forensic conclusions risk being accepted on blind technological trust rather than proven reliability.²⁷

6 IMPLEMENTATION GAPS: INFRASTRUCTURE AND TRAINING

Despite the growing recognition of Artificial Intelligence (AI) as a valuable tool in forensic investigations, its effective implementation in child sexual abuse (CSA) cases remains constrained by significant institutional and operational deficiencies. The availability of AI enabled forensic infrastructure is uneven across Indian States, with many forensic laboratories lacking the technological capacity, specialised software, and computational resources required to deploy advanced AI applications. These disparities contribute to delays in forensic examination and limit the consistent use of AI assisted techniques in criminal investigations.²⁸

The successful integration of AI into forensic practice also depends on the competence of the professionals responsible for its use. However, specialised training on AI assisted forensic technologies remains limited among investigating officers, forensic experts, prosecutors, and members of the judiciary. In the absence of adequate technical knowledge, there is a risk that AI generated findings may either be accepted without sufficient scrutiny or rejected due to a lack of understanding of their scientific basis.²⁹ This challenge is further compounded by the absence of standard operating procedures governing the validation, verification, documentation, and audit of AI assisted forensic tools. Without uniform protocols, the reliability and reproducibility of AI generated evidence may be questioned during judicial proceedings.

Another significant concern is the increasing dependence on proprietary AI software developed by private entities. Many of these systems operate through closed algorithms that are neither independently audited nor subject to mandatory regulatory certification. The absence of statutory standards for algorithmic transparency, software accreditation, and forensic validation creates uncertainty regarding the reliability and admissibility of AI assisted evidence.³⁰ Consequently, the implementation gap extends

²⁶ Rebecca Wexler, *Life, Liberty, and Trade Secrets: Intellectual Property in the Criminal Justice System*, 70 *Stan. L. Rev.* 1343 (2018).

²⁷ President's Council of Advisors on Science and Technology, *Forensic Science in Criminal Courts: Ensuring Scientific Validity of Feature-Comparison Methods* (2016); P. Jonathon Phillips et al., *Four Principles of Explainable Artificial Intelligence*, NISTIR 8312 (National Institute of Standards and Technology 2021).

²⁸ Ministry of Home Affairs, Government of India, Reply to Lok Sabha Unstarred Question No. 3452, *Infrastructure in Forensic Laboratories* (Dec. 17, 2024); Press Information Bureau, Government of India, *National Forensic Infrastructure Enhancement Scheme* (July 31, 2024).

²⁹ Department-related Parliamentary Standing Committee on Home Affairs, Rajya Sabha, Report No. 254, *Cyber Crime: Ramifications, Protection and Prevention*, para. 4.1.16 (Aug. 20, 2025); Laura Sanchez, Cinthya Grajeda, Ibrahim Baggili & Cory Hall, *A Practitioner Survey Exploring the Value of Forensic Tools, AI, Filtering, & Safer Presentation for Investigating Child Sexual Abuse Material (CSAM)*, 29 *Digital Investigation* S124 (2019); United Nations Office on Drugs and Crime (UNODC), *Education for Justice (E4J) University Module Series: Cybercrime, Module 4: Introduction to Digital Forensics* (2019).

³⁰ UNESCO, *Recommendation on the Ethics of Artificial Intelligence* (2021); National Institute of Standards and Technology (NIST), *Artificial Intelligence Risk Management Framework (AI RMF 1.0)* (2023); European Commission, *Ethics Guidelines for Trustworthy Artificial Intelligence* (High Level Expert Group on AI, 2019).

beyond technological limitations and reflects a broader disconnect between India's progressive legal framework for child protection and the institutional preparedness required to responsibly integrate AI into forensic investigations.

7 TOWARD A CHILD CENTRIC AI FORENSIC FRAMEWORK

The paper proposes:

1. Statutory guidelines for AI use in CSA forensics

There is a need for statutory or delegated guidelines specifically regulating the use of AI in CSA forensics. These guidelines should define permissible uses, validation requirements, documentation standards, and limitations to ensure that AI tools operate within the protective mandate of child friendly investigation.³¹

2. Accreditation and audit of forensic AI tools

Second, accreditation and periodic audit of AI forensic tools must be made mandatory. Independent forensic authorities should certify software accuracy, test error rates, and verify reliability before such tools are used in investigations. This prevents unverified proprietary systems from influencing criminal trials.³²

3. Disclosure norms for algorithmic reliability in court

Third, courts must require disclosure norms when AI derived evidence is produced. Details regarding algorithmic methodology, validation studies, and known limitations must be placed on record to allow meaningful cross examination under the Bharatiya Sakshya Adhiniyam, 2023.³³

4. Child data minimization and deletion standards

Fourth, strict child data minimization and deletion standards must be enforced in line with the Digital Personal Data Protection Act, 2023. AI systems must not retain or reuse child forensic data beyond the purpose of investigation and trial. Encrypted storage, access control, and mandatory deletion timelines are essential.³⁴

5. Specialized training for justice stakeholders

Fifth, specialized training should be provided to police officers, forensic experts, prosecutors, and judges. Stakeholders must understand both the capabilities and limitations of AI tools to prevent blind reliance on technological outputs.³⁵

6. Judicial checklists before admitting AI derived evidence

Sixth, a judicial admissibility checklist should be evolved for courts before accepting AI derived forensic conclusions. This checklist may include verification of tool accreditation, disclosure of error rates,

³¹ See Ministry of Home Affairs (Women Safety Division), Government of India, Advisory on Mandatory Action by Police in Cases of Crime against Women, F. No. 15011/190/2020-SC/ST-W, para. 2(vi) (Oct. 2020) (noting the guidelines of the Directorate of Forensic Science Services for the collection, preservation and transportation of forensic evidence in sexual assault cases).

³² International Organization for Standardization, ISO/IEC 17025:2017, General Requirements for the Competence of Testing and Calibration Laboratories (2017); Forensic Science Regulator (U.K.), Code of Practice, Version 1 (Mar. 2023).

³³ Bharatiya Sakshya Adhiniyam, 2023, Sec. 39, 57, 61.

³⁴ Digital Personal Data Protection Act, 2023, Sec. 4, 5, 9.

³⁵ Department-related Parliamentary Standing Committee on Home Affairs, Rajya Sabha, Report No. 254, Cyber Crime: Ramifications, Protection and Prevention, para. 4.1.16 (Aug. 20, 2025).

expert explanation of methodology, and confirmation of data protection compliance. Such a checklist would operationalize fairness in practice.³⁶

8 CONCLUSION

AI enhanced forensics holds transformative promise for POCSO investigations. Yet, without a child centric legal framework ensuring transparency, accountability, and data protection, these tools risk undermining fair trial standards and child rights.

AI integration into forensic processes under the Protection of Children from Sexual Offences Act, 2012 offers transformative potential for investigating child sexual abuse with greater speed, precision, and scientific reliability. Tools such as facial recognition, digital pattern analysis, age estimation, and intelligent evidence sorting can reduce investigative delays and human error while strengthening evidentiary chains. In a system where forensic lapses often weaken prosecution, AI enabled methods can significantly improve the quality and timeliness of evidence collection and analysis.

A child centric regulatory framework is therefore essential to govern AI use in POCSO investigations, ensuring data minimization, privacy protection, algorithmic accountability, and judicial oversight. Embedding transparency, accreditation of forensic AI tools, and specialized training for justice stakeholders can convert technological capacity into genuine social justice. The path to Viksit Bharat 2047 lies not merely in adopting AI, but in governing it wisely for the most vulnerable.

* * *

³⁶ Anvar P.V. v. P.K. Basheer, (2014) 10 SCC 473; Arjun Panditrao Khotkar v. Kailash Kushanrao Gorantyal, (2020) 7 SCC 1.