

## REVIEW ARTICLE

# Need of Artificial Intelligence for Identification of Unknown Dead Bodies: An Indian Perspective

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## ABSTRACT

Identification of unknown dead bodies is one of the most complex and time-consuming challenges faced by forensic medicine and law-enforcement authorities in India. Rapid urbanization, mass disasters, migration, and poor maintenance of biometric records often delay or prevent positive identification, leading to serious humanitarian, legal, and administrative consequences. Artificial Intelligence (AI) has recently emerged as a transformative tool capable of enhancing the accuracy, speed, and reliability of human identification through automated facial recognition, fingerprint matching, dental imaging, skeletal analysis, and DNA data interpretation.

This review explores the growing need and practical scope of AI-driven technologies in the identification of unknown human remains in India. It traces existing conventional methods, highlights their limitations, and discusses how AI can be integrated into national forensic systems such as the Crime and Criminal Tracking Network System (CCTNS) and the National Automated Fingerprint Identification System (NAFIS). The article further examines ethical, legal, and privacy implications under Indian laws and provides policy recommendations for implementation.

The review concludes that AI-based identification, when integrated with standard forensic protocols and supported by robust data governance, can significantly strengthen India's medico-legal framework and ensure faster delivery of justice.

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## INTRODUCTION

The identification of human remains is fundamental to both forensic investigation and the administration of justice. Determining the identity of the deceased is not only a medico-legal requirement but also a humanitarian obligation, enabling families to claim bodies, perform last rites, and pursue legal remedies. In India, with its large and mobile population, the problem of unidentified dead bodies remains substantial. According to the National Crime Records Bureau (NCRB) 2023 report, more than 35000 unidentified bodies are registered annually across the country,<sup>1</sup> a number that may be significantly underestimated due to under-reporting in rural and disaster-prone regions. Traditional identification methods visual recognition, anthropometry, fingerprinting, dental charting, and DNA profiling have evolved over decades,<sup>2</sup> yet each suffers from limitations in scalability, accuracy, or logistical feasibility. The advent of Artificial Intelligence (AI) offers a transformative opportunity to augment these classical approaches by introducing automation, pattern recognition, and predictive analytics into the forensic workflow.<sup>3,4</sup>

This paper reviews the need, relevance, and applications of AI in identifying unknown bodies within the Indian context. It also examines existing infrastructural challenges, regulatory constraints, and the ethical landscape governing digital biometric data.<sup>5,6</sup>

### Background and Rationale

#### *Magnitude of the Problem*

India's complex demographic dynamics migration for labor, natural disasters, communal violence, and poor record-keeping contribute to the recurring accumulation of unclaimed and unidentified bodies. These cases often remain unresolved due to lack of comparative records, incomplete documentation, and delays in forensic reporting.

For instance, during large-scale disasters such as the 2004 Tsunami, 2013 Uttarakhand floods, and repeated railway and industrial

accidents, hundreds of remains could not be identified despite conventional methods.<sup>7,8</sup> The prolonged process burdens morgues, courts, and police departments, while families endure psychological trauma.<sup>9</sup>

#### *Limitations of Traditional Methods*

1. Visual identification relies on relatives or witnesses, often unreliable due to decomposition or trauma.<sup>2</sup>
2. Fingerprint comparison requires good ridge detail and pre-existing records, yet many citizens lack fingerprint data in centralized databases.<sup>10,11</sup>
3. Dental charting is limited by poor dental record maintenance, especially in rural settings.<sup>12,13</sup>
4. DNA profiling, although accurate, is expensive, slow, and dependent on available family samples.<sup>14,15</sup>
5. Anthropometry and superimposition are subjective and depend on expert interpretation.<sup>2</sup>

These shortcomings underscore the need for advanced, automated, and scalable systems precisely the strengths of AI.<sup>3,4,16</sup>

### Artificial Intelligence in Forensic Identification

#### *Definition and Scope*

Artificial Intelligence refers to computational systems capable of performing tasks requiring human intelligence, such as learning, reasoning, and perception.<sup>16</sup> In forensics, AI applies machine learning, deep neural networks, and computer vision to analyze biological or physical evidence.<sup>4,17</sup>

AI's contribution to human identification lies in its capacity to process large biometric datasets rapidly, detect complex nonlinear relationships, and improve continuously with new data.<sup>18</sup>

#### *AI-Driven Facial Recognition*

Facial recognition is one of the most rapidly advancing AI tools. Algorithms such as

convolutional neural networks can extract facial features even from partial or degraded images. In forensic practice, these systems are used for comparing morgue photographs with missing-person databases, reconstructing facial features from skeletal remains using generative AI, and matching CCTV or social-media images with post-mortem data.<sup>18,19,20</sup>

India's National Automated Facial Recognition System (NAFRS) initiative, proposed by the NCRB,<sup>20</sup> aims to link all state police databases. Integrating post-mortem images of unidentified bodies with NAFRS could enable real-time search and matching.<sup>21</sup>

### **Fingerprint and Palm Print Identification**

AI enhances fingerprint matching by automating minutiae extraction and ridge-flow classification.<sup>10</sup> The National Automated Fingerprint Identification System (NAFIS), launched in 2022,<sup>22</sup> uses AI-based indexing to manage millions of prints. Extending NAFIS to include post-mortem fingerprints could dramatically increase identification rates.<sup>11</sup>

### **Dental and Craniofacial AI**

AI-assisted dental imaging systems analyze radiographs and CT scans to identify unique dental patterns, fillings, and pathologies.<sup>12,13</sup> Craniofacial reconstruction using AI can create lifelike digital faces from skull morphology. When circulated among missing-person portals, these reconstructions often yield positive leads.<sup>18,23</sup>

### **DNA and Genomic AI**

AI supports DNA profiling by automating sequence interpretation, mixture deconvolution, and kinship prediction.<sup>14,15</sup> In India, integration of AI into the Combined DNA Index System (CODIS) could improve turnaround time and reduce manual error.<sup>24,25</sup>

### **Integration of AI into the Indian Forensic Ecosystem**

India's forensic infrastructure includes systems such as CCTNS, NAFIS, and NAFRS.<sup>26</sup> However, these databases often operate in silos, limiting cross-matching. AI-driven interoperability could bridge this gap.<sup>25</sup>

A proposed workflow would include data acquisition, AI-based pre-processing, automated matching, expert validation, and continuous retraining of models.<sup>4,17,24</sup>

## **Legal and Ethical Considerations in India**

### **Regulatory Landscape**

The admissibility of AI-generated evidence must align with the Indian Evidence Act (1872) and Information Technology Act (2000). While digital evidence is recognized, AI algorithms lack explicit legal validation; experts remain responsible for interpretation.

### **Data Privacy and Consent**

Biometric data handling is governed by the Digital Personal Data Protection Act 2023<sup>5</sup> and ICMR ethical guidelines.<sup>27</sup> AI projects involving deceased individuals must ensure confidentiality and limited access.<sup>6</sup>

### **Bias and Reliability**

AI models trained on limited or non-representative datasets may produce biased results.<sup>6, 27,28</sup> Therefore, region-specific datasets and transparent validation are critical.<sup>24</sup>

## **DISCUSSION**

Traditional forensic identification methods are time-consuming and resource-intensive.<sup>2</sup> In contrast, AI offers automation and scalability.<sup>3</sup> However, human expertise remains indispensable; hybrid human-AI models enhance objectivity and reliability.<sup>9,28</sup>

### **Challenges of Implementation in India**

Barriers include data fragmentation, infrastructure gaps, lack of standardization, insufficient training, and legal ambiguity.<sup>25,29</sup> Addressing these requires coordinated reforms across agencies.

### **Opportunities Unique to the Indian Context**

India possesses strong digital infrastructure through Aadhaar,<sup>25</sup> an advanced AI workforce,<sup>30</sup> and supportive governmental programs such as *Digital India* and *Make in India*.<sup>30</sup> Judicial acceptance of digital evidence further facilitates AI adoption.

### **Ethical and Humanitarian Dimensions**

Identification of unknown dead bodies is a humanitarian duty.<sup>9</sup> AI should enhance, not replace, empathy.<sup>6</sup> Ethical use requires informed consent, data minimization, and accountability under ICMR and the DPDP Act.<sup>5, 27</sup>

## Capacity Building and Research Priorities

Research priorities include standardized datasets,<sup>24</sup> explainable AI models,<sup>28</sup> AI training for forensic professionals and collaborative pilot projects with NFSU and NCRB.<sup>21</sup>

## Future Prospects

AI may evolve to predictive reconstruction and DNA phenotyping,<sup>15</sup> while blockchain could secure forensic records.<sup>31</sup> A *National Forensic AI Grid* integrating CCTNS, NAFIS, and DNA databases could transform identification workflows.<sup>25</sup>

## CONCLUSION

The identification of unknown dead bodies remains a major medico-legal challenge. Traditional methods are limited by manual processes, while AI offers speed, scalability, and precision.<sup>3,4</sup> By embedding AI into India's forensic infrastructure with ethical safeguards,<sup>5,6,27,31</sup> authorities can restore dignity to the deceased and deliver justice efficiently.

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