IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

The Role Of Forensic Technology In Solving Cold Cases: A Study Of Dna Analysis, Digital forensics, And Technological Advancements.

[1]Name of 1st Author is Deekshith Gowda.s, [2]Name of 2nd Author is Prof.Dr.Amith Anand

[1]Designation of 1st Author is Student, [2]Designation of 2nd Author is Professor

[1]Name of Department of 1st Author is School of Legal Studies,REVA university

[1]Name of organization of 2nd Author is School of Legal studies , REVA University, Bangalore, India

Abstract.

Cold cases—unsolved criminal investigations that remain open due to a lack of evidence or leads—pose significant challenges to law enforcement agencies worldwide. Traditional investigative methods often fall short in resolving these cases, leading to prolonged periods without justice for victims and their families. However, advancements in forensic technology have revolutionized the approach to cold case investigations. This paper explores the transformative impact of modern forensic tools, focusing on DNA analysis, digital forensics, and emerging technologies such as artificial intelligence (AI) and forensic genealogy. By examining case studies and current practices, the study highlights how these technological advancements have enhanced the accuracy, efficiency, and scope of criminal investigations, breathing new life into previously stagnant cases.

Index Terms **- Component, Formatting Style, Styling, Insert.**

Introduction

Cold cases are a habitual problem in the felonious justice system, constantly leaving victims' families without check and communities without resolution. similar cases, which are defined by their extended ages of inactivity, generally stem from shy substantiation, the absence of substantiations, or the limitations of earlier investigative styles. The preface of new forensic technologies has opened up new possibilities forre-investigating similar cases, bringing stopgap for justice indeed decades after the crimes were committed.

DNA testing, digital forensics, and AI- enabled tools have radically bettered the response capabilities of the police. DNA profiling enables police to identify individualities grounded on body fluids indeed with demoralized samples. Digital forensics facilitates carrying and assaying computer data, relating important information else not available to investigators. New technologies, similar as AI and forensic line, further enhance investigative procedures by feting patterns and connections that could be missed by mortal analysis.

This paper explores the pivotal part of similar forensic technologies in cracking cold cases, studying their styles, uses, and the problems in their relinquishment. Through a detailed study, the exploration hopes to emphasize the significance of advances in technology in contemporary felonious examinations and the prospect of eventually delivering justice to open cases

DNA Analysis and Cold Case Resolution

DNA analysis has come a pillar in working cold cases, furnishing unmatched delicacy in the identification of malefactors. Since its use in forensic analysis in the late 1980s, DNA profiling styles have progressed from rudimentary restriction scrap length polymorphism(RFLP) to more advanced technologies similar as short tandem reprise(STR) analysis and coming- generation sequencing(NGS). These developments have also largely boosted the perceptivity and delicacy of DNA testing, which has made it possible to examine bitsy and demoralized samples that were heretofore supposed infelicitous for analysis.

The creation of public DNA databases, like India's Combined DNA indicator System(CODIS)- type depository through the DNA Technology(Use and Application) Regulation Bill, 2019, has further bettered thecross-referencing capacity of law enforcement associations. The databases enable the comparison of DNA biographies from crime scenes with known individualities, which makes questionable identification and the vindication of the innocent possible.

One of the most prominent exemplifications demonstrating the power of DNA substantiation in working cold cases is that of the identification of the Golden State Killer. Using forensic line, law enforcement officers matched DNA from crime scenes with genealogical information contained in intimately available line databases, climaxing in the arrest of Joseph James DeAngelo Jr. numerous times after the crimes had been committed. also, in India, the 1984 Bawankhedi butchery case saw a advance when ultramodern DNA analysis conclusively linked the indicted after times of inconclusive disquisition.

These exemplifications punctuate the revolutionary eventuality of DNA analysis in cracking cold cases. By allowing the reopening of natural substantiation with increased perceptivity, DNA profiling has given new life to dormant examinations, bringing justice to victims and their cases.

Digital Forensics and Technological Traces

DNA analysis has come a pillar in working cold cases, furnishing unmatched delicacy in the identification of malefactors. Since its use in forensic analysis in the late 1980s, DNA profiling styles have progressed from rudimentary restriction scrap length polymorphism(RFLP) to more advanced technologies similar as short tandem reprise(STR) analysis and coming- generation sequencing(NGS). These developments have also largely boosted the perceptivity and delicacy of DNA testing, which has made it possible to examine bitsy and demoralized samples that were heretofore supposed infelicitous for analysis.

The creation of public DNA databases, like India's Combined DNA indicator System(CODIS)- type depository through the DNA Technology(Use and Application) Regulation Bill, 2019, has further bettered thecross-referencing capacity of law enforcement associations. The databases enable the comparison of DNA biographies from crime scenes with known individualities, which makes questionable identification and the vindication of the innocent possible.

One of the most prominent exemplifications demonstrating the power of DNA substantiation in working cold cases is that of the identification of the Golden State Killer. Using forensic line, law enforcement officers matched DNA from crime scenes with genealogical information contained in intimately available line databases, climaxing in the arrest of Joseph James DeAngelo Jr. numerous times after the crimes had been committed. also, in India, the 1984 Bawankhedi butchery case saw a advance when ultramodern DNA analysis conclusively linked the indicted after times of inconclusive disquisition.

These exemplifications punctuate the revolutionary eventuality of DNA analysis in cracking cold cases. By allowing the reopening of natural substantiation with increased perceptivity, DNA profiling has given new life to dormant examinations, bringing justice to victims and their cases.

Technological Advancements: Artificial Intelligence and Forensic Tools.

Artificial intelligence(AI) and machine learning have come more and more an integral part of forensic examinations, furnishing new results to age-old problems in cold case working. AI algorithms are suitable to snappily reuse large volumes of data and fete patterns or anomalies that mortal judges might miss. These

functions are especially useful inre-investigating cold cases, where conventional investigative ways might have hit a dead end.

One of the most prominent uses of AI in forensic wisdom is the application of facial recognition and prophetic modeling to produce compound sketches from substantiation descriptions decades old. Police forces in the United Kingdom have tested AI software that can review videotape footage, fiscal records, social media operation, and other documents at the same time, greatly speeding up the investigative process.

In India, artificial intelligence- grounded case handling systems similar as the Crime and Felonious Tracking Network & Systems(CCTNS) enablecross-jurisdictional data linking and uncover patterns that may go unnoticed else. These systems have been set up especially useful in periodical lawbreaker cases, where it's important to establish liaison between incidents that on the face appear unconnected.

In addition, combining forensic ballistics databases and AFIS has strengthened the capability for comparing physical substantiation from cold cases with expansive records, and perfecting the chances of chancing a match. The preface of AI and other technologies is also causing some concern over implicit bias, error rates, and abuse. Courts are decreasingly being asked to assess not just the materiality but also the trustability and scientific soundness of similar substantiation, as instanced by the use of the Daubert standard in different authorities.
As forensic and AI technologies ameliorate, their use in felonious examinations promises to break cold cases more effectively and precisely. still, it's necessary to address the ethical and legal considerations involved with these technologies to insure their proper and fair operation.

Challenges in Admissibility and Legal Interpretation

Indeed with the outstanding developments in forensic technology, the admissibility of the same in court continues to be a matter of soberness. In India, the Indian substantiation Act, 1872, prescribes the admissibility of forensic substantiation, and Sections 45 to 51 explicitly deal with expert opinion, comprising forensic reports. nonetheless, the supportive value of the substantiation will depend on rigorous compliance with procedural morals and the scrutiny of judicial ministry.

For illustration, DNA substantiation has to be collected, saved, and anatomized under strict chain- of-guardianship protocols to maintain its integrity. Failure in attestation or unauthorized laboratory analysis can affect in the rejection of DNA findings by the courts. Likewise, digital substantiation has to meet the conditions of Section 65B of the substantiation Act, which requires electronic records to be supported by valid instrument to be admitted.

The proper use of new technologies like forensic line and AI also poses great challenges. Matters concerning sequestration, data protection, and concurrence are developing issues in the Indian legal frame. In the absence of strong legislation and transparent guidelines, there's a possibility that the tools will be employed in a manner that violates civil liberties.

In addition, although forensic technologies are of great mileage in disquisition, they aren't impeccable. unlawful allegations can be caused by data misapprehension, software blights, or mortal failure. The case of 2011 Norway bombing suspect Anders Breivik being inaptly linked using defective facial recognition software is a hard memorial of the risks of technological reliance.

To fight these issues, it becomes necessary to formulate robust legal fabrics that give for the admissibility and ethical aspects of forensic technologies. It involves enforcing standard substantiation collection and analysis protocols, making the use of AI algorithms transparent, and guarding the rights of individualities by constituting data protection.

Conclusion

The reanimation of interest and success in cold- case solving is incompletely due to developments in forensic technology. From the subtle complication of DNA profiling to the mass data- mining capacities of computer forensics and artificial intelligence, investigative tools now have the capacity to expose underpinning links, point to suspects, and indeed clear the incorrectly indicted. Not only do these inventions give new life to stagnant examinations but also restore public trust in the judicial system. In India and across the world,

forensic technology has bridged the peak between archaic procedures and contemporary norms of substantiation, bringing justice within reach indeed in crimes dating back decades.

But the operation of these technologies should be treated with carefulness. Legal fabrics need to acclimatize so that the new styles are respectable, immorally applied, and scientifically proven. To guarantee strict adherence to the norms of substantiation, chain- of- guardianship retention, and the protection of sequestration rights are pivotal to sound use of forensic technology.

Eventually, closing cold cases involves a balance of technological advancement and legal caution. As crime only grows more sophisticated, the operation of forensic technology when partnered with acceptable legal fabrics, trained professionals, and ethical custodianship — provides an unknown chance to insure that delayed justice isn't denied justice.

References

1. Butler, J. M. (2015). *Advanced Topics in Forensic DNA Typing: Interpretation*. Academic Press.
2. Houck, M. M., & Siegel, J. A. (2018). *Fundamentals of Forensic Science* (4th ed.). Elsevier.
3. Jobling, M. A., & Gill, P. (2004). Encoded evidence: DNA in forensic analysis. *Nature Reviews Genetics*, 5(10), 739–751. https://doi.org/10.1038/nrg1455
4. Kruse, W. G., & Heiser, J. G. (2002). *Computer Forensics: Incident Response Essentials*. Addison-Wesley.
5. Kurland, J., & Quick, D. (2012). Cold case reviews: DNA and beyond. *Journal of Forensic Sciences*, 57(4), 927–931. https://doi.org/10.1111/j.1556-4029.2012.02068.x
6. Murphy, E. (2013). *Inside the Cell: The Dark Side of Forensic DNA*. Nation Books.
7. National Crime Records Bureau (NCRB). (2021). *Crime in India – Annual Report*. Ministry of Home Affairs, Government of India. https://ncrb.gov.in
8. Parliamentary Research Service, India. (2019). *The DNA Technology (Use and Application) Regulation Bill, 2019*. PRS Legislative Research. https://prsindia.org
9. Skerker, M. (2010). *An Ethics of Interrogation*. University of Chicago Press.
10. Smith, G. J. D., & O'Malley, L. (2020). The governance of data and algorithmic technologies in policing. *Theoretical Criminology*, 24(3), 491–510. https://doi.org/10.1177/1362480619894531
11. United States Department of Justice. (2019). *Using DNA to Solve Cold Cases*. National Institute of Justice. https://nij.ojp.gov/library/publications/using-dna-solve-cold-cases
12. Zdziarski, J. (2012). *Hacking and Securing iOS Applications: Stealing Data, Hijacking Software, and How to Prevent It*. O'Reilly Media.
13. Case Law: *People v. DeAngelo* (Golden State Killer Case), California Superior Court, 2020.
14. Case Law: *State v. Sanjeev Nanda*, Delhi High Court, 2002.
15. Daubert v. Merrell Dow Pharmaceuticals, Inc., 509 U.S. 579 (1993).
16. Indian Evidence Act, 1872, Sections 45–51 and Section 65B
17. Sharma, B. R. (2013). *Forensic Science in Criminal Investigation and Trials* (5th ed.). Universal Law Publishing.