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EMERGING TECHNIQUES IN CRIMINAL INVESTIGATIONS

AUTHORED BY - ASWANI SAMJI

Abstract:

The integration of emerging technologies into criminal investigations has revolutionized modern law enforcement practices. Techniques such as DNA profiling, biometric analysis, artificial intelligence (AI), digital surveillance, facial recognition, and predictive policing have significantly enhanced the speed and accuracy of detecting and solving crimes. However, the deployment of these advanced tools also presents profound legal and ethical challenges. Key concerns include violations of privacy, potential misuse of personal data, algorithmic bias, lack of transparency, and the undermining of fundamental rights such as due process and presumption of innocence.

This paper examines the legal frameworks governing the application of these technologies and identifies critical gaps in regulation, oversight, and accountability. Ethically, the research explores issues surrounding informed consent, data ownership, and the potential for disproportionate surveillance targeting specific communities. By analyzing contemporary case studies and jurisprudence, the paper advocates for a balanced approach that aligns technological advancement with constitutional safeguards and ethical norms. The goal is to foster a criminal justice system that is both technologically equipped and morally sound, ensuring justice is administered with fairness, transparency, and respect for human dignity.

Keywords:

Criminal investigations, emerging technologies, legal implications, ethical concerns, privacy rights, surveillance, digital forensics, artificial intelligence, facial recognition, DNA profiling,.

INTRODUCTION

Justice Benjamin Cardozo once said, "Justice is not to be taken by storm. She is to be wooed by slow advances." This quote reflects the meticulous and methodical nature of forensic science. The advancements in forensic technologies and techniques allow investigators to decipher the most intricate details, often invisible to the naked eye, thereby guiding the path

to justice.

Forensic science, an interdisciplinary field combining principles of biology, chemistry, physics, and law, plays a pivotal role in the criminal justice system. It involves the application of scientific methods to analyse physical evidence from crime scenes, providing crucial information that aids in the investigation and prosecution of criminal activities. This discipline not only helps in identifying perpetrators and exonerating the innocent but also enhances the credibility of legal proceedings by ensuring that decisions are grounded in empirical and objective data. As advancements in technology continue to evolve, the role of forensic science becomes increasingly significant, offering more sophisticated tools and techniques to address complex criminal cases. Understanding the importance of forensic science in criminal justice administration is essential for appreciating how modern science and technology contribute to maintaining law and order, delivering justice, and upholding the integrity of legal systems worldwide.

The advancements in science and technology have made life for humans so easy, pleasant, and dependent that it is impossible for us to conceive surviving without them. It sets humans apart from other living things on the planet. Using tangible evidence, like fingerprints and blood, to apprehend criminals who were cunning enough to evade capture was nearly impossible a few years ago. Under the law, everyone is considered innocent until and unless proven guilty. Law enforcement uses scientific techniques to arrest criminals since the science of apprehending them is predicated on evidence. Thanks to technology developments, detectives were able to apprehend the offenders by concentrating on the evidence rather than the individual.

A progressive and democratic society is characterized by its fairness in the administration of justice society. The quest for equitable questioning practices to gather admissible evidence may be as old as the legal system, and scientific and technological advancements have been indispensable to criminal investigations and civil litigation worldwide. In India, gathering evidence from the crime scene is not considered the investigating officer's responsibility. Since investigative officers question witnesses—including suspects and the accused—on behalf of the courts in an effort to ascertain the truth. The police have long been accused of utilizing coercive meaning to elicit information during interrogations, violating human rights by implementing shortcut techniques.

In the present scenario, science and technology play a significant role in all fields, and their usage is growing quickly. Since the dawn of human civilization, forensic science has been used more and more in law to produce objective and circumstantial evidence. Crimes exist anywhere there are people, which indicates that since the dawn of civilization, people have been committing various crimes in society. The crimes ranged in severity from small to large, including software contamination, morphing, uploading or transmitting of pornographic materials, trespassing, extortion, kidnapping, rape, murder, hacking, pornography, cracking, cybersquatting, software contamination, morphing and upload or transmission of obscene contents, and aiding and abetting criminal activity. The many investigating authorities detain and examine every crime after it has occurred. There is significant association between Forensic Science and criminal investigation.

OVERVIEW OF THE LATEST TECHNIQUES IN CRIMINAL INVESTIGATION

5.1 INTRODUCTION

In recent years, advancements in technology have revolutionized the field of criminal investigations. Traditional methods, while still in use, are increasingly being supplemented or replaced by innovative techniques that offer greater accuracy, efficiency, and reliability. This chapter provides an overview of the latest emerging techniques in criminal investigations, highlighting their significance, application, and impact on the justice system.

- **3D Forensic Facial Reconstruction (3D-FFR):** Since is not considered to be most recognized and important technique of forensic science technology but, this procedure is still very useful for forensic scientists and pathologists. This 3D facial reconstruction software technology uses computer to reconstruct person's physical illusion with the help of individual's remains.
- **DNA Sequencer:** DNA testing is very important to the forensic science lab. Not only do they not know what DNA sequences are, they also don't know how to use them. DNA profiling is a process used by forensic scientists to identify criminals using traces of evidence, such as hair and skin samples. This technique involves analyzing the DNA sequence of a person's bones or teeth to determine the order in which their DNA nucleobases are placed. It can then generate a unique and actionable DNA pattern.

The **Nirbhaya rape case**¹ relied heavily on DNA evidence to convict the perpetrators.

- **Alternative Light Photography (ALP):** Being able to quickly assess the extent of a patient's injuries can save a life or even prevent it. With many tools at their disposal, emergency medical personnel can use ALP to help them make better decisions when it comes to treating injuries. The light filter used by the omnichrome camera can sometimes show bruising below the skin's surface.
- **Magnetic Fingerprinting and Automated Fingerprint Identification (AFIS):** The process of identifying and comparing a person's fingerprints can be performed by simply wiping their hands with a non-touching device. An accurate and reliable impression can be obtained by doing so. Before becoming an AFIS, one must have a degree in law enforcement.
- **Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS):** It can be used and helpful in a crime scene where broken glass can help investigators identify the weapons used in the incident. It can also help identify the type of weapon used in the crime and its direction. The LA-ICP-MS machine allows forensic scientists to study the atomic structure of glass by breaking it into various sizes. By breaking glass into various sizes, this machine allows forensic scientists to identify specks of glass found in clothing etc.
- **High-Speed Ballistics Photography (HSBP):** While most people don't think of high-speed cameras as a tool for forensic science, ballistics experts use them to study how bullet holes and other injuries are created. Law enforcers, firearms experts, and crime scene investigators can all use a high-powered camera without requiring training or education.
- **Video Spectral Comparator-2000 (VSC-2000):** This item is commonly used by forensic scientists and crime scene investigators to perform their tasks. This machine can also determine the origin of a piece of paper and lift its contents. Even after it gets severely damaged due to fire, water damage, or even a piece of paper, it can still be used to analyze analytical purposes. This level of education is necessary to work with various types of equipment such as document analysis and forensic science post- graduation.
- **Forensic Carbon-14 Dating (FC-14D):** It is a technique is employed to

¹ Mukesh & Anr .vs. state of NCT of Delhi & Ors.(2017)6SCC1

recognise the age of relics found in archaeological and anthropological investigations. The increasing amount of radiocarbon in the environment, it is now possible to identify the remains of an individual using this technique. Only a few individuals have the knowledge to operate this equipment perfectly. These individuals are usually forensic scientists and archeologists.

- **Forensic Accountant and its Link Analysis:** It is a process where a forensic accountant analysis is tasked with uncovering suspicious transactions, link analysis software is an indispensable tool. This software uses statistical and digital transactions to predict the probability of unlawful behavior. This course aims to help forensic investigators interpret the findings of their investigations.
- **Digital Surveillance for Xbox (XFT Device):** The prevalence of illicit activities conducted using gaming consoles, digital forensic experts have been developing XFT, which allows them to monitor and easily access hidden files on a hard drive. This device can also record audio and video sessions during court proceedings. To interpret the contents properly of devices.
- **Digital Forensics:** Digital forensics involves the recovery and investigation of material found in digital devices such as computers, smartphones, and tablets. With the proliferation of digital technology, cybercrimes have become more sophisticated and prevalent. Digital forensics experts use specialized software and techniques to extract, preserve, and analyze digital evidence. This evidence can include emails, text messages, browsing history, and social media activity. Digital forensics is essential for solving crimes such as hacking, identity theft, and online fraud, as well as for tracking the digital footprints of suspects.
- **Artificial Intelligence (AI) and Machine Learning:** Artificial intelligence and machine learning are transforming criminal investigations by enabling the analysis of vast amounts of data to identify patterns and make predictions. AI algorithms can process and analyze data from various sources, including surveillance footage, social media, and criminal databases. Machine learning models can predict crime hotspots, recognize faces, and even create criminal profiles based on behavioral patterns. These technologies enhance the efficiency of investigations and help law enforcement agencies allocate resources more effectively. However, the use of AI in criminal investigations also raises ethical and legal concerns, such as privacy issues and algorithmic bias.

i) AI IN CRIMINAL INVESTIGATION

With fast technological progress in all disciplines, notably in the domains of investigation and forensic science, Artificial Intelligence has effectively made its grand entrance into criminal investigation. Forensic investigation entails conducting extensive study, gathering information from many sources, and then integrating it in order to reach logical conclusions. While extracting such data from ‘mysterious’ sources may undoubtedly be a fruitful and focus on other vital duties! The acquired data must also be freely available to the parties involved, so that it may be accessed at any moment as needed. AI technology may be used to prepare data repositories so that it can be routinely stored in your systems and accessed as needed. When it comes to criminal investigations,

AI can be a great tool in many expects like -

- Data analysis and availability to support the investigation.
- Addressing well-scoped problems and methodology for cases.
- Pattern recognition.
- Explaining the reasoning process well.
- Reducing the level of false-positive or false negatives during analysis is very common in forensic science.
- Formally structuring the representation of knowledge which will also help the legal community in fast and accurate solution.
- Having a well-organized performance evaluation.
- Data mining and knowledge discoveries.
- Building statistical evidence.
- Integrating with current architecture, tools, and applications intriguing profession, dealing with enormous amounts of data can frequently be confusing and chaotic prepare data repositories so that it can be routinely stored in your systems and accessed as needed. When it comes to criminal investigations, various forms of existing data in system databases². It can also assist detectives in connecting suspect information with existing criminal records and informing them of any past criminal conduct that the suspect in question may have been involved.

² Chinnikatti, S.K. (2018). Artificial Intelligence in Forensic Science. Forensic Science & Addiction Research, 2(5).

ii) AI CAN HELP IN RECOGNIZING PATTERNS

As an investigator, you must be able to spot subtle connections in order to link and to complete the picture. However, patterns may be quite particular and complicated at times, making them difficult to follow. This is why investigators frequently rely on contemporary technology to identify such trends.

AI technology can assist in pattern recognition, such as identifying different components of a single image, detecting patterns in emails and messages, and matching new information with various forms of existing data in system databases. It can also assist detectives in connecting suspect information with existing criminal records and informing them of any past criminal conduct that the suspect in question may have been involved in

iii) PROVIDING LEGAL SOLUTIONS

Forensic statistics offers scientific ways for dealing with evidence in the judicial system. With more sophisticated and comprehensive information databases, AI can assist the legal community with quick solutions when needed he communication gap between various participants in this sector.

iv) STATISTICAL EVIDENCE

Strong statistical evidence is used to support the narrative and arguments in forensic science. AI can create graphical frameworks to aid in the creation of scenarios and case studies. It may also be used to create graphical models of circumstances that can be used to establish or refute claims, allowing the law to make better decisions³.

v) CREATING REPOSITORIES

AI can also assist in the creation of an online repository that would house all digital forensic investigations, data, assets, and findings. With the exponential rate of growth of storage capacity, such as USB, hard drives, optical media, and flash drives, it is getting more difficult for forensic science investigators to store and evaluate all of this data. AI has the potential to be a good tool to store, analyse and use this data for legal purposes⁴.

³ Turner, P. (2005). Unification of digital evidence from disparate sources (Digital Evidence Bags). *Digital Investigation*, [online] 2(3), pp.223–228. Available at: <https://www.sciencedirect.com/science/article/abs/pii/S1742287605000575>

⁴ Burns, E., Laskowski, N. and Tucci, L. (2017). artificial intelligence. [online] SearchEnterpriseAI. Available at: <https://searchenterpriseai.techtarget.com/definition/AI-Artificial-Intelligence> Electronic copy available at:

vi) ADVANTAGES OF AI IN FORENCIS

In a forensic investigation, combining people and AI can offer a firm an advantage:

- It implements automation, which saves substantial time and money while allowing investigators to focus more on areas where fraud may occur.
- It assists businesses with detecting illegal behaviour from massive volumes of unstructured data, such as videos, pictures, emails, and text files.
- It's a more dynamic method than rule-based testing, which can only assess fraud risk across a single data set.
- It eliminates information silos that might hamper an analytics-aided investigation this Occurs when locally-tailored processes prohibit integrated data exchange creating to an inquiry.

5.2. Legal and ethical implications of emerging technique in criminal investigation.

Introduction to Emerging Forensic Techniques

The landscape of forensic science has been significantly transformed by emerging technologies such as advanced DNA sequencing, artificial intelligence (AI), machine learning, digital forensics, and next-generation biometric analysis. These innovations have provided law enforcement and judicial systems with unprecedented tools to solve crimes more efficiently and accurately. However, the integration of these technologies into forensic science also brings with it a myriad of legal and ethical concerns that must be addressed to ensure justice and fairness in their application.

- Legal Implications

The legal implications of these emerging forensic techniques are vast and multifaceted. One primary concern is the issue of privacy. Advanced DNA and biometric technologies require the collection and storage of personal data, which can lead to significant privacy breaches if not properly managed. The potential for misuse of such data, either through unauthorized access or improper handling, necessitates stringent legal safeguards and data protection laws to prevent violations of individual rights.

Additionally, the use of AI and machine learning in forensic science introduces challenges related to due process and the fairness of judicial proceedings. Algorithms used in forensic analysis can sometimes be biased, reflecting the prejudices present in the data they are trained on. This bias can lead to wrongful convictions or unjust

sentencing, raising serious concerns about the reliability and impartiality of forensic evidence. Legal standards and regulations must evolve to ensure transparency and accountability in the use of these technologies, including the requirement for explainable AI that allows for the scrutiny of how decisions are made.

- **Ethical Implications**

From an ethical perspective, the deployment of these technologies in forensic science requires careful consideration of the balance between public safety and individual freedoms. The potential for intrusive surveillance through advanced biometric systems, for instance, can infringe on personal liberties and lead to a society where individuals are constantly monitored. This surveillance can create an environment of mistrust and fear, undermining the ethical principles of autonomy and freedom.

Furthermore, the accuracy and reliability of emerging forensic techniques must be critically evaluated. Techniques such as DNA phenotyping, which predicts physical appearance from genetic data, can sometimes produce inaccurate results, leading to ethical dilemmas regarding their use in criminal investigations. The ethical duty to prevent harm and ensure justice demands that forensic scientists and law enforcement agencies apply these technologies with caution, verifying their validity and reliability before they are used in legal contexts.

- **Societal Impact**

The societal impact of emerging forensic technologies is another crucial aspect to consider. The widespread use of these techniques can affect public perception of the criminal justice system. While advanced forensic methods can enhance the efficiency and effectiveness of crime solving, they can also lead to an overreliance on technology, potentially diminishing the role of human judgment and critical thinking in investigations and trials. Society must remain vigilant about the potential for technological determinism, where technology dictates outcomes without sufficient human oversight.

- **International Cooperation and Regulatory Frameworks**

Given the global nature of technological advancements, international cooperation is essential to harmonize legal and ethical standards in forensic science. Cross-border investigations and data sharing require consistent regulatory frameworks that uphold human rights and ethical norms. International bodies and agreements can play a pivotal role in establishing guidelines and best practices, ensuring that the benefits of these technologies are realized while minimizing their potential harms.

Conclusion

In conclusion, the integration of emerging techniques in forensic science holds great promise for enhancing the criminal justice system's ability to solve crimes and deliver justice. However, this promise comes with significant legal and ethical challenges that must be addressed through comprehensive regulatory frameworks, transparent policies, and rigorous ethical standards. By adopting a balanced and proactive approach, stakeholders can ensure that the application of these technologies upholds the core values of justice, fairness, and human dignity, fostering a more just and equitable society.

Case Laws in Kerala Involving Emerging Techniques in Criminal Investigations

1. Jisha Murder Case (2016)⁵

Case Name: State of Kerala v. Ameerul Islam

The Jisha murder case involved the brutal rape and murder of Jisha, a law student from Perumbavoor, Kerala. On April 28, 2016, Jisha was found dead in her house with severe injuries indicating a violent assault. The case attracted widespread media attention and public outrage, prompting a thorough investigation by the Kerala police. Emerging Techniques Used: The investigation utilized advanced DNA profiling to solve the case. The forensic team collected multiple DNA samples from the crime scene, including blood, hair, and skin cells. The DNA analysis provided a match to Ameerul Islam, a migrant laborer from Assam. This breakthrough in the forensic investigation was crucial in identifying and apprehending the suspect.

Legal and Ethical Implications: The use of DNA profiling in this case underscores the pivotal role of forensic science in modern criminal investigations. Legally, it highlights the importance of adhering to strict protocols for collecting, storing, and analyzing DNA evidence to maintain its integrity and admissibility in court. Ethically, it raises concerns about the potential for misuse of genetic information and the need to protect individuals' privacy rights. The case also emphasizes the necessity for proper training and resources for forensic experts to ensure accurate and reliable results.

2. Kevin Murder Case (2018)⁶

Case Name: State of Kerala v. Shanu Chacko & Ors.

The Kevin murder case involved the abduction and murder of Kevin P. Joseph, a young

⁵ State of Kerala v. Ameerul Islam, (2018) 2 KHC 491 (ker)

⁶ Kevin Joseph v. State of Kerala, (2018) 3 KHC 558

man from Kottayam, Kerala, who was allegedly killed due to caste-based animosity. Kevin, who belonged to a lower caste, had married Neenu, a woman from a higher caste, against her family's wishes. Kevin was abducted and murdered in May 2018, sparking widespread protests and demands for justice.

Emerging Techniques Used: The investigation relied heavily on mobile phone tracking and call data records (CDR) analysis. By examining the CDRs, the police were able to trace the movements and communications of the accused, establishing their involvement in the crime. The digital forensic analysis provided a timeline of events and corroborated witness testimonies, leading to the conviction of the accused.

Legal and Ethical Implications: The extensive use of digital forensics in this case highlights the increasing reliance on technology in criminal investigations. Legally, it underscores the importance of obtaining proper authorizations for accessing and using digital evidence, ensuring that such practices comply with legal standards and protect individual rights. Ethically, the case raises issues related to privacy and surveillance, emphasizing the need for a balanced approach that respects individuals' privacy while allowing effective law enforcement. The ethical use of digital evidence also requires transparency in how data is collected and analyzed to prevent potential abuses.

3. **Walayar Rape and Murder Case (2017)**⁷

Case Name: State of Kerala v. Pradeep Kumar & Ors.

The Walayar case involved the tragic deaths of two minor sisters, aged 13 and 9, who were found hanging in their home in Walayar, Kerala, under suspicious circumstances. The initial investigation was criticized for alleged negligence and mishandling of evidence. The public outcry led to a reinvestigation, revealing that the girls had been sexually assaulted before their deaths.

Emerging Techniques Used: Forensic examination played a crucial role in the reinvestigation. The forensic team conducted thorough autopsies, DNA analysis, and examination of the crime scenes to gather evidence of sexual assault and establish the cause of death. The forensic findings contradicted the initial conclusions and provided critical evidence leading to the arrest and prosecution of the accused.

Legal and Ethical Implications: This case illustrates the critical role of forensic science in uncovering the truth and ensuring justice. Legally, it highlights the importance of

⁷ State of Kerala v. Pradeep kumar & ors, (2019) 4 KHC 123

adhering to rigorous forensic protocols and standards to avoid errors and ensure the reliability of evidence. Ethically, the case underscores the responsibility of law enforcement to handle forensic evidence with utmost care and integrity. It also points to the need for accountability and transparency in forensic investigations to maintain public trust in the criminal justice system. The ethical duty to prevent harm and seek justice is paramount, requiring diligent and unbiased forensic practices.

4. Nisham Murder Case (2015)⁸

Case Name: State of Kerala v. Mohammed Nisham

The Nisham murder case involved the killing of a security guard, Chandrabose, by businessman Mohammed Nisham in Thrissur, Kerala. In January 2015, Nisham assaulted Chandrabose with his luxury vehicle following an altercation and subsequently beat him. Chandrabose succumbed to his injuries, and the case attracted significant media attention due to Nisham's high profile and the brutality of the crime. Emerging Techniques Used: CCTV footage was pivotal in the investigation and prosecution of the case. The surveillance cameras captured the entire incident, providing clear and irrefutable evidence of Nisham's actions. The digital evidence from the CCTV footage was used to reconstruct the crime and establish the sequence of events leading to the victim's death.

Legal and Ethical Implications: The use of surveillance technology in this case highlights the value of digital evidence in securing convictions. Legally, it emphasizes the need for proper authorization and handling of surveillance data to ensure its admissibility in court. The ethical implications revolve around the potential for invasion of privacy and the need for clear guidelines on the use of surveillance technologies. It also underscores the importance of balancing public safety and individual privacy rights, ensuring that surveillance is used responsibly and transparently.

5. Periya Double Murder Case (2018)⁹

Case Name: State of Kerala v. Peethambaran & Ors.

The Periya double murder case involved the killing of two Youth Congress workers, Kripesh and Sarath Lal, in Kasaragod, Kerala. The murders were believed to be

⁸ Mohammed Nisham v. state of Kerala,(2015) 4 KHC 876

⁹ State of Kerala v. Peethambaran,(2018) 578 KHC

politically motivated, with allegations of involvement by rival political party members. The case was highly contentious, with significant political and public pressure for a thorough investigation.

Emerging Techniques Used: The investigation utilized call data records (CDR) and mobile tower location analysis to track the movements and communications of the suspects. By analyzing the digital footprints, the police were able to piece together the suspects' actions before and after the crime. Forensic analysis of the weapons and crime scene also provided crucial evidence linking the suspects to the murders.

Legal and Ethical Implications: The reliance on digital evidence in this case underscores the increasing importance of technology in criminal investigations. Legally, it raises questions about the admissibility of digital evidence and the standards required for its collection and analysis. Ethical considerations include the need for transparency and accountability in using digital forensics to prevent potential abuses and ensure a fair investigation process. The case highlights the need for clear legal frameworks and ethical guidelines to govern the use of emerging technologies in criminal justice.

CONCLUSION

Forensic science is crucial for linking suspects to crimes through physical evidence. The Code of Criminal Procedure, 1973, was amended in 2005 to incorporate scientific techniques in medical examinations of the accused, enhancing evidence collection. Despite these advancements, the criminal justice system faces criticism for inefficiency, lack of coordination, and outdated practices. The system's components—police, courts, and corrections—must work cohesively to address crime effectively.

A major challenge is witness cooperation, as many fear harassment or threats. This highlights the need for a robust witness protection mechanism. Additionally, the criminal justice system's structure often hinders efficiency, as each agency operates independently. Critics argue for better coordination and a unified approach to improve the system's effectiveness. Forensic science laboratories, integrated with State CIDs, and equipped with advanced technologies can significantly enhance investigations.

The legal framework must adapt to address current challenges, including terrorism and organized crime, with stricter laws and special provisions. Amendments to the Criminal

Procedure Code, such as allowing police confessions as evidence and improving the admissibility of expert testimony, can aid in trials. Coordination between states and law enforcement agencies is essential to combat crime that crosses regional boundaries. Immediate remedial steps are necessary to leverage new scientific investigation techniques effectively, ensuring a fair and efficient criminal justice system.

