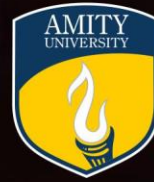# ABSTRACT BOOK

AMITY UNIVERSITY

AMITY INSTITUTE OF FORENSIC SCIENCES

ORGANISES

2nd INTERNATIONAL CONFERENCE

ON

FORENSICS, SECURITY & LAW

2nd ICFSL 2025

International Conference on Forensics, Security & Law

THEME: RECENT ADVANCEMENTS IN FORENSIC SCIENCES & NATIONAL SECURITY

📅 20th & 21st March 2025

🕐 10:00 Hrs.-17:00 Hrs. (IST)

📍 E-2 Auditorium, Amity University Campus, Sector-125, Noida (New Delhi/NCR), India

🌐 www.amity.edu/aifs/ICFSL2025/

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About Amity University

Amity University Uttar Pradesh is part of Amity Education Group which has been sponsored and promoted by Ritnand Balved Education Foundation (RBEF) has over 2,00,000 students studying across over 2000 acres of hi-tech campuses. Today Amity Education Group has 12 Universities, 28 schools and pre-schools, 17 global Campuses Over 2250 patents are filed by the Faculty, Scientists and Researchers. The faculty has 500+ collaborative funded projects from Government, Industry and International agencies. Amity Group has 10000+ Faculty including eminent Scientists with diverse disciplines. The Amity faculties are featured in the list of top 2% scientists in the world published by researchers of Stanford University. Amity University Uttar Pradesh has been accredited by National Assessment and Accreditation Council (NAAC) with 'A+' Grade in 2018, WASC Senior College and University Commission (WSCUC), USA and Quality Assurance Agency for Higher Education (QAA), UK. In addition, Amity University Uttar Pradesh has been ranked amongst the top Universities in ASIA by QS. The focus on quality has led the University to be ranked # 49 among all Indian Universities in NIRF 2024, the # 1 Private University since the last nine years by India Today and amongst the top 3% Universities globally by QS and Times Higher Education.

About Amity Institute of Forensic Sciences

Amity Institute of Forensic Sciences, Amity University Uttar Pradesh, Noida, India is a leading premier institute dedicated to nation service. It offers higher education in forensic sciences at three programmes levels: UG- B.Sc. (Forensic Sciences) (Honours / Research), PG- M.Sc. (Forensic Sciences) & M.Sc. (Cyber Forensic & Cyber Security) and Doctorate- Ph.D. (Forensic Sciences) in Full Time and Part Time. All the courses aim to instil in student's professional acumen, skills and capabilities to deal with different areas of life.

Amity Institute of Forensic Sciences is an institute of Amity University came into existence by an act under the Amity University (Uttar Pradesh) Act, 2005 and it has also been listed under 'Educational Institutions' in the U.P. Govt. website (http://www.upgov.nic.in/). Its main aim is to conduct important professional courses that can ensure employment to passing-out students. In addition, several short-term training and capacity building programmes are being offered by the institute. The institute has organized National and International conferences, workshops, seminars, faculty development programs, refresher courses, value added courses and quiz competitions

About Conference (ICFSL- 2025)

The 2nd International Conference on Forensics, Security & Law, themed "Recent Advancements in Forensic Sciences & National Security," brings together leading minds from diverse fields such as forensic science, criminology, law enforcement, national security, legal studies, and technology. The conference will provide an interdisciplinary platform for academics, researchers, professionals, and policymakers to explore the most recent developments, challenges, and solutions in these critical areas. In the wake of an evolving global landscape characterized by technological advancements, increased security risks, and emerging threats, this conference aims to foster dialogue and collaboration that will shape the future of forensic science and national security practices.

Forensic science, with its rapid advancements, has become indispensable for solving crimes, ensuring justice, and enhancing national security. The world today faces a variety of security threats, including terrorism, cybercrime, organized crime, and bioterrorism, which demand innovative solutions. In this environment, forensic sciences have emerged as a powerful tool in both identifying perpetrators and safeguarding nations. The fusion of forensic science with national security initiatives has created new synergies, allowing for more accurate crime-solving methods and the ability to anticipate and counter security threats more effectively. Recent breakthroughs in DNA analysis, digital forensics, artificial intelligence (AI), and machine learning have revolutionized the field, allowing forensic experts to process evidence faster and more accurately. These technological advancements have had far-reaching implications for national security, enabling better detection of threats and enhancing investigative capabilities in ways that were unimaginable a few decades ago.

The conference theme underscores the urgent need to integrate these advancements into national and international security frameworks. With cybercrime on the rise, national security agencies are increasingly reliant on digital forensics to prevent, detect, and mitigate attacks. At the same time, forensic science must keep pace with the growing complexity of crimes and the ever-evolving strategies of criminals. Thus, this conference seeks to serve as a catalyst for research and development that addresses these needs while fostering cooperation across borders.

Message from Patron in Chief

It is a matter of great pride that Amity Institute of Forensic Sciences (AIFS), Amity University Uttar Pradesh (AUUP), Noida campus is organizing Second International Conference on Forensics, Security & Law (ICFSL 2025) on the theme "Recent Advancements in Forensic Sciences & National Security" from Thursday, 20th March to Friday, 21st March, 2025.

As we navigate an era of complex global security concerns, the integration of forensic science with national security strategies has become more crucial than ever. With the IT revolution, many further facets such as cyber forensic, cloud forensic, computer forensics among many others have come within the overall gamut of forensic sciences which are extremely crucial for national security. In this context, the theme of the conference deserves appreciation as it aims to discuss the rapid advancements in forensic methodologies, AI-driven investigations, crime analytics among many others which have revolutionized the way justice is served, and security threats are mitigated.

I extend my hearty welcome to all the distinguished scientists, academicians, subject experts and other eminent participants from the industry, various national and international universities, institutions and research establishments. I am sure that their deliberations on such an important theme will be an enriching experience for brilliant faculty members, scientists, research scholars, students and other worthy participants and the conference would pave the way for forging bonds and mutual cooperation, undertaking joint projects and joint publications for achieving long-term goals and establishing significant and long-term contacts for mutual benefits. My sincere appreciation to all the distinguished members of the International Advisory Committee and National Advisory Committee for their valuable advice.

I compliment Dr. Himanshu Khajuria and Dr. Biswa Prakash Nayak, Joint Coordinators, Amity Institute of Forensic Sciences (AIFS), AUUP, Noida campus and all the members of organising committee of ICFSL 2025 including Dr. Amarnath Mishra, Organising Chair & Convener, Dr. Aqueeda Khan, Co-convener as well as the dedicated faculty members, brilliant and vibrant students, research scholars and staff for their praiseworthy efforts in ensuring the success of this conference under the valuable guidance of Prof. (Dr.) Balvinder Shukla, Vice Chancellor, AUUP. The most strategic and visionary leadership of Dr. Atul Chauhan, Chancellor, AUUP and President, Ritnand Balved Education Foundation (RBEF), would lead to outcome based and result oriented success of the Conference.

I warmly welcome all participants and hope they have a memorable and enriching experience that not only contributes to the goals of the ICFSL 2025 but also leave a profound impact on the fellow participants.

(Dr. Ashok K. Chauhan)
Founder President
Ritnand Balved Education Foundation (RBEF)
(The Foundation of Amity Institutions and the
Sponsoring Body of Amity Universities)

Message from Co-Patron

It is my great pleasure to welcome all distinguished speakers, researchers, academicians, professionals, and students to the 2nd International Conference on Forensics, Security & Law on the theme "Recent Advancements in Forensic Sciences & National Security" organised from 20th – 21st March 2025 at Amity University Noida campus. This conference serves as a vital forum for thought leaders and experts to share insights, exchange knowledge, and explore innovations that are shaping the future of forensic sciences and security.

Forensic science has become an essential pillar of the modern justice system and national security framework. The rapid technological advancements in artificial intelligence, digital forensics, biometrics, and cyber investigations are revolutionizing crime detection, evidence analysis, and intelligence gathering. As threats to security evolve—ranging from cybercrime and digital fraud to global terrorism—our collective responsibility is to develop and adopt new methodologies that strengthen investigative processes, enhance security measures, and uphold the rule of law.

At Amity University, we are committed to fostering academic excellence and interdisciplinary research that addresses real-world challenges. Our Amity Institute of Forensic Sciences and Amity Law School, Noida have been instrumental in advancing forensic education and legal studies, equipping future professionals with the expertise needed to navigate the complexities of law enforcement, crime investigation, and national security. This conference reflects our dedication to providing a platform for scholars and practitioners to collaborate, innovate, and contribute to meaningful progress in these fields.

I extend my heartfelt appreciation to the organizing committee for their tireless efforts in bringing together such an esteemed gathering of experts. I encourage all participants to engage actively, share their expertise, and build valuable networks that will pave the way for ground-breaking research and practical applications in forensic science and security studies.

Wishing you all an enriching and successful conference!

Prof. (Dr.) Balvinder Shukla
Vice Chancellor
Amity University Uttar Pradesh, India

Message from Conference Advisor

It is my privilege to welcome you to the 2nd International Conference on Forensics, Security & Law (ICFSL-2025), a prestigious platform that brings together experts from forensic sciences, national security, and law to exchange knowledge and explore cutting-edge advancements.

Scientific and technological innovations continue to reshape forensic investigations, offering greater precision, efficiency, and reliability in solving crimes and strengthening security frameworks. From AI-driven forensic analysis to cybercrime, interdisciplinary collaboration is now more essential than ever. This conference provides a unique opportunity to engage in meaningful discussions, showcase pioneering research, and foster global collaborations that will drive future breakthroughs.

At Amity University, we are committed to advancing research and education in science and technology. Through ICFSL-2025, we aim to facilitate knowledge-sharing among academicians, professionals, and policymakers, ensuring that forensic science continues to evolve as a powerful tool for justice and security.

I sincerely thank the organizing team, speakers, and participants for their dedication to making this event a success. I hope this conference inspires new research directions and meaningful innovations that will contribute to the advancement of forensic sciences and security solutions.

Wishing you an engaging and enriching experience at ICFSL-2025.

Prof. (Dr.) Sunita Rattan
Dean, Science & Technology Domain
Amity University Uttar Pradesh, Noida, India

2nd ICFSL 2025
International Conference on Forensics, Security & Law

AMITY UNIVERSITY
— UTTAR PRADESH —

विज्ञान एवं प्रौद्योगिकी विभाग
DEPARTMENT OF SCIENCE & TECHNOLOGY
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Anusandhan National Research Foundation

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निदेशक–सह–मुख्य न्यायालयिक वैज्ञानिक

Dr. S.K. Jain, M.Sc Ph.D
Director-cum-Chief Forensic Scientist
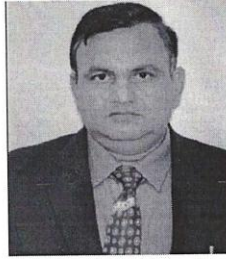
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E-mail : cfs-dfss@nic.in**

सत्यमेव जयते

Message from Guest of Honour

The field of forensic science has become an indispensable tool in modern law enforcement and national security. As crimes grow more complex and technologically advanced, the role of forensic experts in crime investigation, intelligence gathering, and legal proceedings has ever been more critical. The 2nd International Conference on Forensics, Security & Law, centered on "Recent Advancements in Forensic Sciences & National Security," provides a vital platform for experts to discuss innovative solutions, emerging trends, and best practices in forensic investigations.

The integration of advanced forensic techniques, such as digital forensics, DNA analysis, and AI-driven crime detection, has revolutionized the way investigations are conducted. This conference brings together professionals from multiple domains to explore collaborative approaches that strengthen forensic capabilities and enhance national security measures. The insights and research shared in this forum will undoubtedly contribute to shaping policies and methodologies for a more secure nation.

I extend my best wishes to all participants, researchers, and organizers for a successful and enriching conference. May this event serve as a catalyst for advancements that drive forensic science and security towards greater effectiveness and global impact.

Dr. S. K. Jain

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Please visit us at : www. dfs.nic.in

Message from the Organising Chair

It is with great pleasure and immense pride that I welcome you to the 2nd International Conference on Forensics, Security & Law, themed "Recent Advancements in Forensic Sciences & National Security." This conference serves as a platform for scholars, researchers, and professionals from around the globe to engage in meaningful discussions, exchange knowledge, and explore innovative solutions in the ever-evolving domains of forensic science and security.

As advancements in forensic sciences continue to shape criminal investigations, legal proceedings, and national security strategies, it is imperative to foster interdisciplinary collaborations and leverage cutting-edge research. This conference brings together leading experts to discuss contemporary challenges, novel methodologies, and future directions that will drive the field forward.

I extend my heartfelt gratitude to all the esteemed speakers, participants, and contributors whose efforts have made this event possible. A special thanks to the organizing committee and supporting institutions for their dedication in ensuring the success of this conference.

We hope this gathering ignites fruitful discussions, inspires new research directions, and strengthens collaborations in forensic sciences and security. Wishing you all a productive and enriching experience!

Dr. Amarnath Mishra, *M.Sc., M.Phil., Ph.D., LL.M.*
Associate Professor
Amity Institute of Forensic Sciences
Amity University Uttar Pradesh, Noida, India

ABSTRACTS

FORENSIC ANALYSIS OF DIGITAL IMAGE INTEGRITY: A STUDY USING FOTOFORENSIC

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Abstract

In the digital age, picture tampering is becoming more common, which makes it difficult to preserve the validity of visual content. This study investigates the FotoForensic tool's ability to identify image tampering through the use of comparing approaches, metadata analysis, and Error Level Analysis (ELA). This study demonstrates the tool's capacity to identify splicing, cloning, object removal, and other alterations by examining a collection of real and altered photos. Important discoveries highlight FotoForensic's advantages in identifying metadata irregularities and compression level discrepancies while resolving its drawbacks, including possible false positives. Additionally, case studies supporting the tool's usefulness in digital forensics are included in this study. Future improvement suggestions include adding AI-based techniques, supporting more file formats, and enabling real-time analysis. In a variety of fields, such as journalism, law enforcement, and content verification, the study emphasizes the value of picture forensics in thwarting false information and protecting the integrity of digital media.

Keywords: Digital image, Error level analysis, FotoForensic, Image processing, Metadata

REAL-TIME SKIN DISEASE IDENTIFICATION USING CNN INTEGRATED WITH CLOUD

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Abstract

Skin cancer remains one of the most common and dangerous tumors worldwide, demanding immediate identification and treatment. Different types of skin cancer, such as melanoma, actinic keratosis, basal cell carcinoma, and squamous cell carcinoma, present significant challenges for automated identification due to variations in appearance and severity. Among these, melanoma is particularly unpredictable, but early detection can significantly enhance treatment success. In this study, we explore skin lesion categorization using deep convolutional neural networks (CNNs), with a focus on a transfer learning method. We leverage the VGG19 architecture as a feature extractor to categorize skin lesion images into six categories without any data augmentation. To increase classification accuracy, a fully connected neural network was trained using the obtained features. The model was trained with a dataset of over 7000 dermatological images, incorporating dropout layers to mitigate overfitting. Performance validation was conducted using K-fold cross-validation. Our results demonstrate that pre-trained CNNs, when fine-tuned on specific skin lesion images, can yield robust accuracy in skin cancer detection. This approach holds promise for aiding dermatologists in the early diagnosis of skin cancer, potentially improving patient outcomes through timely intervention.

Keywords: Convolutional Neural Networks (CNNs); Transfer learning; VGG19; Overfitting; K-fold

DIGITAL FOOTPRINTS IN THE HIMALAYAS: FORENSIC PERSPECTIVES ON CYBER FRAUD IN UPPER HIMACHAL PRADESH

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Abstract

The rapid advancement of technology has brought unparalleled convenience and comfort to modern life, but it has also increased vulnerability to cybercrime. Young individuals and senior citizens are often victims of cyber fraud, as the former can be easily influenced, and the latter may fall prey due to their innocence. The upper region of Himachal Pradesh, known for its serene landscapes and isolated communities, is now facing a growing wave of cyber fraud that threatens to disrupt its digital ecosystem. This study aims to examine the regional cybercrime landscape by identifying the most common types of cybercrimes and pinpointing the area's most vulnerable to these threats. Through an in-depth analysis of recent cyber incidents, common fraudulent tactics, and regional factors contributing to these crimes, this research provides actionable insights into the local cyber threat ecosystem. Additionally, the study evaluates the level of cyber awareness among internet users, focusing on safe computing practices and cybercrime prevention strategies, to inform effective countermeasures. This study employed a mixed-methods approach, combining primary and secondary data collection methods. A questionnaire-based survey was administered to 101 respondents to gather primary data, which was subsequently analysed using MS Excel. The survey instrument consisted of 14 structured questions designed to assess the prevalence and awareness of cybercrime among individuals in Himachal Pradesh. Secondary data was sourced from a range of publications, including books, national and international journals, e-newspapers, and reputable websites. Our results show that the male population was more likely to be victimized than the female population. The majority of victims fell within the 17- 22 age range. Smartphones were the primary device used for victimization, and social media fraud was the most common type of cybercrime encountered. Our study highlights the urgent need for enhanced cybersecurity awareness in rural areas to mitigate cybercrime risks and threats.

Keywords: Cybercrime, cyber security, Victimization and Awareness

THE STUDY ON YOUNG MIND TO DETERMINE ANGER ISSUE IN DELHI NCR REGION

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Abstract

This study aims to explore the prevalence and predictors of anger issues among young people living in the Delhi NCR region. Given the significant effects of anger on mental health, social interactions, and academic performance, this research has utilized a mixed-methods approach, integrating quantitative data collection with qualitative methods to gain a more comprehensive understanding of the issue. The study has examined various factors that contribute to anger issues, including poverty, inequality, exposure to violence, limited access to resources, family dynamics, peer pressure, social media influence, academic stress, trauma exposure, and other cultural factors including societal expectations, cultural norms, and emphasis on competition add to the complexity of challenges individuals are likely to face. Additionally, the study has looked into the coping strategies that young individuals use to manage their anger, like exercise, mindfulness, creative expression, seeking social support, aggression, violence, substance abuse, and self-harm. The findings from this study offers valuable insights into the prevalence and predictors of anger issues among young people in the Delhi NCR region. These insights can guide the creation of targeted interventions, such as anger management programs, school-based counselling services, and community initiatives, aimed at promoting mental well-being and mitigating the adverse effects of anger on the lives of young individuals in this rapidly urbanizing area.

Keywords: Anger Management, Young Minds, Mental Health, Interventions, Self-Harm

VIRTOPSY IN MEDICOLEGAL CONTEXTS: A COMPREHENSIVE REVIEW OF ITS POTENTIAL AND CHALLENGES

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Abstract

Autopsy examination plays a crucial role in investigations involving unnatural deaths, helping to determine the mode, manner, and cause of death. The practice of postmortem examination dates back to ancient civilizations, as evidenced by Kautilya's treatise Ashumritakpariksha, which detailed various causes of death and their corresponding postmortem findings. Similarly, historical records from ancient Rome describe Antistius conducting a postmortem examination of Julius Caesar's wounds in 44 BC. Despite its historical descriptions and medicolegal significance, autopsies are often resented by families and societies owing to the invasiveness of traditional procedures, often perceived as a violation of deceased's physical integrity and dignity. Virtopsy or virtual autopsy is a non-invasive alternative to these traditional practices, which could aid in the medicolegal study of body after death. It involves application of advanced imaging techniques like CT scans, MRI and 3D surface scanning which could allow Forensic experts to determine causes of death and assess injuries. These techniques, though expensive and require sophisticated instruments, has great prospects as it not only provides a promising solution to issues associated with conventional practices but also produces a detailed digital record which could serve as visual archive for further examination. This review gives a brief overview of this innovative technique along with its potential medicolegal applications in the court of law. It further explores its advantages over traditional autopsy procedures, enlists its limitations and discusses its potential for integration with AI to automate the process and minimize human inaccuracies and biases.

Keywords: Autopsy, Virtopsy, CT Scans, MRI, Artificial Intelligence

COMPARATIVE ANALYSIS OF FORENSIC SCIENCE LAWS: INDIA'S NEW CRIMINAL LAWS AND GLOBAL FRAMEWORKS

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Abstract

This research paper aims to examine the scope and impact of the forensic science methodology introduced under India's new criminal laws. Law is dynamic, and the demands of 21st century necessitate a scientific lens in addressing legal matters, especially in the realm of criminal justice system. Forensic science, defined as the application of scientific methods and techniques to investigate crimes, may play a pivotal role in strengthening the legal framework. The purpose of this study is to analyse the effectiveness of forensic science methods inculcated under India's new criminal laws by analysing their alignment with global standards. The study aims to identify the institutional challenges, gaps and resources needed for the convergence of forensics and law. This research paper has employed a combination of descriptive and analytical research methodologies. The descriptive approach is used to provide a detailed literature review of the forensic science provisions introduced under India's new criminal laws, along with their interpretation in the case laws by judiciary. The analytical approach is used to analyse existing framework in comparison with global frameworks to provide strengths, limitations and required reforms. Forensic science has the potential to overhaul the Indian legal framework. Major advantages of integrating forensic science into the criminal justice system may include the increase in accuracy and efficacy in delivering justice, enhancement in transparency and reduction in wrongful convictions. An increase in research and development, expert capacity building, and infrastructure may be crucial to alleviate the stress that may arise due to mandatory forensic provisions. Additionally, global collaboration may help align India's forensic practices with international standards.

Keywords: Forensic science, New criminal laws, Global- forensic legal framework.

P-007

IMMIGRATION THROUGH FRAUD PASSPORTS AND ITS EMERGING DETECTING TECHNOLOGIES: A COMPREHENSIVE REVIEW

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Abstract

Identity is a fundamental aspect of human life, ensuring access to rights and recognition within a society. The same has been stated in Article 6 of the Universal Declaration of Human Rights. In the modern world where immigration and international travel have become an integral part of human society, the passport embodies this purpose by serving as an identity, proving the authenticity and credibility of individuals to travel across the globe while maintaining legal recognition. However, with the increasing crime of identity theft and identity fraud through passports, it is becoming a rising concern for many nations' security and individual rights. Criminals achieve identity fraud by manipulating embedded physical security features such as holograms, watermarks, microprintings, laser engravings, UV-reactive security toner and inks etc. These manipulations can be detected by employing methods like biometric verification, automated document authentication systems, database cross-verification, optical character recognition [OCR], machine-readable zones etc. Yet, such cases are being encountered increasingly in forensics, due to the lack of an international standard passport format and issuance process. Consequently, making it challenging for official personnel to analyse what parameters should be considered to check for the genuine passport. Therefore, in view of the above, this issue underscores the need for international cooperation, standardized formats and procedures, firm policy frameworks, and the need to incorporate advanced security protocols. The development of an adaptive technology to combat such frauds and to create public awareness to safeguard individuals against such crimes is also equally important. This article explores the various methods which are being used to manipulate passports to mislead the identity of a person to commit immigration fraud, as well as the strategies which should be employed for its prevention, while emphasizing the global cooperation to mitigate such crimes.

Keywords: Identity Theft, Passport Fraud, Optical Character Recognition, Embedded Physical Security Features, Immigration Fraud.

AN ANALYSIS OF ROLE OF BLOCKCHAIN IN FORENSIC SCIENCE

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Abstract

The integration of blockchain technology into the field of forensic science presents a revolutionary approach to data management, evidence tracking, and enhancing the integrity of investigative processes. This paper explores the potential applications of blockchain within forensic frameworks, emphasizing its capabilities in creating immutable records and facilitating transparent data sharing. By establishing a decentralized ledger, blockchain ensures that evidence is tamper-proof and easily traceable, significantly mitigating risks of data manipulation and loss. The study delves into various use cases, including digital forensics, crime scene evidence management, and supply chain integrity for forensic materials. Additionally, it addresses challenges such as interoperability with existing forensic systems, the need for IT infrastructure, and the implications of legal frameworks surrounding digital evidence. Moreover, the paper highlights the importance of collaboration between forensic scientists, law enforcement agencies, and blockchain developers to create effective solutions that leverage this technology. The researcher will also investigate the currently available investigation tools that can assist in rendering the evidences on blockchain to be admissible in court proceedings leading to ethical integration into the legal domain. The research methodology used will be entirely doctrinal. Case studies from law enforcement agencies that have piloted blockchain solutions are presented to illustrate practical applications and outcomes. The findings indicate that blockchain not only enhances the accountability of forensic operations but also promotes trust among stakeholders involved in the criminal justice system. As forensic science evolves in response to technological advancements, the incorporation of blockchain technology could serve as a critical tool in ensuring the accuracy and reliability of forensic evidence, ultimately leading to fairer judicial outcomes.

Keywords: Blockchain, Forensic Science, Data Integrity, Evidence Management, Digital Forensics

P-009

ELECTROCHEMICAL DETERMINATION OF ANTIPSYCHOTIC DRUG QUETIAPINE FUMARATE USING NICKEL OXIDE NANOPARTICLE DECORATED MULTIWALLED CARBON NANOTUBES

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Abstract

Quetiapine fumarate (QTPF) is a widely prescribed antipsychotic drug used to treat schizophrenia, bipolar disorder, and major depressive disorder. Its sedative properties, however, have led to misuse in cases of drug-facilitated sexual assault (DFSA). Rapid, cost-effective, and sensitive detection of QTPF in biological and pharmaceutical samples remains a critical challenge due to the limitations of traditional analytical methods. We developed a novel electrochemical sensor based on a glassy carbon electrode (GCE) modified with a nickel oxide nanoparticle-decorated COOH-functionalized multiwall carbon nanotube (NiO@f-MWCNT) nanocomposite for sensitive detection of QTPF. The nanocomposite was synthesized and characterized using advanced spectroscopic techniques (FTIR, Raman, UV-Vis, XPS, P-XRD) and microscopic methods (FE-SEM, TEM). Electrochemical measurements were conducted using linear sweep voltammetry (LSV), optimizing the performance of sensor under ideal conditions. The NiO@f-MWCNT modified GCE exhibited exceptional sensitivity toward QTPF, with a linear detection range of 1.00×10^{-7} - 2.00×10^{-3} M and a detection limit of 5.10×10^{-9} M (S/N = 3). The sensor demonstrated excellent stability, reproducibility, and selectivity, effectively minimizing interference from matrix effects. Furthermore, the sensor successfully quantified QTPF in diverse real-world samples, including blood serum, urine, beverages, and pharmaceutical formulations, yielding reliable results. This study introduces a highly sensitive and selective NiO@f-MWCNT-based electrochemical sensor for QTPF detection, addressing the critical need for rapid and costeffective analysis in forensic and clinical applications. The synergistic properties of NiO and f-MWCNT enhance electron transfer and catalytic activity, positioning this sensor as a robust tool for routine analysis of QTPF in various matrices.

Keywords: NiO nanoparticle, f-MWCNT, Quetiapine fumarate, Electrochemical sensor, Linear sweep voltammetry (LSV).

SILVER VS. GOLD NANOPARTICLE: A COMPARATIVE STUDY ON LATENT FINGERMARK DETECTION

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Abstract

Latent Fingermark is the most crucial physical evidence present on the crime scene, facilitating the identification of the individual. The main challenge of forensic scientist lies not only in detecting the fingermarks but also enhancing them for accurate analysis. In past, methods of visualizing fingermarks have been developed significantly such as iodine fuming, super glue, silver nitrate, ninhydrin, and cyanoacrylate fuming which have been enhanced by nanoparticlebased techniques such as metal nanoparticles, metal oxide nanoparticle, etc, which are nondestructive, highly sensitive, and selective. Therefore, this review aims to elucidate specifically about metal nanoparticles i.e. silver and gold nanoparticles. In the first section of the review, synthesis of silver nanoparticle (AgNPs) by chemical reduction and electrochemical method and gold nanoparticles (AuNPs) by similar methods such as citric method is included with their distinctive properties. Further, Fingermark enhancement techniques are categorized into Single Metal Deposition (SMD), which requires one step and works across a wide pH range (2.5-5.0), and Multi-metal Deposition (MMD), which involves six baths and operates within a narrow pH range (2.5-2.8), offering varying levels of enhancement for clearer ridge details. Following this, the instruments such as Scanning Electron Microscopy(SEM), Transmission Electron Microscopy(TEM), Atomic Force Microscopy(AFM) for structural and morphological analysis, Energy Dispersive X-Ray Spectroscopy(EDX), X-Ray Diffraction(XRD), X-Ray Photoelectron Spectroscopy(XPS) and X-Ray Fluorescence(XRF) for compositional and elemental analysis, UV-Vis Spectroscopy, RAMAN Spectroscopy, SALDI-MS(Surface Assisted Laser Desorption/Ionization Mass Spectroscopy) and MALDI-MS(Mass Assisted Laser Desorption /Ionization Mass Spectroscopy) for spectroscopic and chemical analysis aiding in detailed Fingermark evaluation were discussed. Additionally, this review compares the effectiveness of silver and gold nanoparticles along with future enhancement in ecofriendly, sensitive and non-destructive forensic techniques.

Keywords: Latent Fingermark, Gold Nanoparticle (AuNPs), Silver Nanoparticle (AgNPs)

3D PRINTING TECHNOLOGY IN THE CRANIOMAXILLO-FACIAL RECONSTRUCTION: A BOON IN FORENSIC SCIENCE

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Abstract

3D Printing is a vital tool evolving from a novel concept of facial reconstruction in the forensic science, particularly in the craniomaxillofacial reconstruction. 3D Printing is a method of manufacturing in which material like plastic are deposited upon another layer of material to produce a 3D object. Therefore, this review aims to elucidate about the use of 3D printing in the craniomaxillofacial reconstruction in the forensic investigation. In the first section of the review, craniomaxillofacial reconstruction it involves repairing the bone and tissue of the skull face and jaw due to any accident. This technology is important in creation of precise models of human face that require for the human identification from the crime scene. Further this review includes the use of several materials such as biocompatible plastics like PEEK and PLA, metals like titanium for strength, ceramics for bone structures and bioinks for regenerative purpose, 3D printing enhances the forensic methodologies which create highly precise and accurate models of face. Several 3D methods are used for facial reconstruction include Fused Deposition Modeling (FDM) for bone replicas, Stereo lithography (SLA) for high resolution identification, Selective Laser Sintering (SLS) for structural implants, and PolyJet printing for multimaterial representation of tissue of different textures and densities. These methods in the forensic science facilitate the investigation process by improving facial reconstruction which enhances the individual identification. The 3D printing technologies in the forensic science improves the methodologies that are used in creating the custom facial prostheses and it is admissible in the court of law. Further, this review suggests that 3D Printing could make medical care more affordable, expand the scope of realistic facial reconstructions.

Keywords: 3D Printing, Fused Deposition Modeling (FDM), facial reconstruction

AUTOPSY STANDARDS AND ITS ETHICO- LEGAL CONCERNS IN INDIA

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Abstract

The criminal process in a homicidal case revolves around four major questions; who, where, why and how. Medico- legal autopsy plays a vital role in criminal process by aiding the authorities to reach to a logical conclusion on the aspect of cause of death. Perhaps this the reason for calling the forensic surgeons as the voice of the dead. The recent development in medico- legal autopsy including night autopsy and virtual autopsy has attracted lots of issues which are legal, ethical and its practicability. This paper aims at critically examining the legal framework governing post-mortem examination in India with a special emphasis to the state of Kerala. The paper will further explore on impact of medico- legal autopsy on the aspect of posthumous rights, interest of the family of the deceased and how far the principle of larger public interest will justify the post- mortem examination. Further, the paper also attempts to unleash the potential legal and ethical concerns regarding clinical autopsy as well. For accomplishing this venture a doctrinal approach is adopted by carefully scrutinising the statutory provisions, various guidelines and circulars. The decisions of the Supreme Court and various High Courts have been relied upon for understanding the jurisprudential discourse between the criminal process and the rights of the dead. It can be seen that the limitation in providing effective medico- legal service especially autopsy is not merely restricted to infrastructural and human resource concerns. On the other hand, the hindrance in clinical autopsy is largely ethical. The lack of common guidelines, absence of proper monitoring or supervisory mechanism, limiting the jurisprudential underpinning of right of the dead to mere burial rights etc contributes significantly for the fall of effective medico- legal and clinical autopsy service in India.

Keywords: Criminal Process, Autopsy, Posthumous Rights, Public Interest

IDENTIFICATION OF DIFFERENTIALLY EXPRESSED GENES AS POTENTIAL THERAPEUTIC TARGETS FOR THE TREATMENT OF PEMPHIGUS USING TACROLIMUS

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Abstract

Background: Pemphigus is a rare, chronic, autoimmune blistering condition affecting the skin and mucous membranes. It is a treatable benign disorder, but it may persist as a localized illness for years. The disease affects all racial groups and can occur at any age. The overall mortality rate is around 13.1%. Methods: This study aims to carry out characterization of Differentially Expressed Genes (DEGs) present in the patients affected by Pemphigus using Limma (a R/Bioconductor package). Further verification of these DEGs as potential therapeutic targets was performed using ShinyGO. We combined system biology and bioinformatics approaches for the retrieval of data, enrichment and network analysis followed by docking with drug Tacrolimus. Result: From the set of DEGs, we selected top 6 hub genes (CD2 enhances the activation and multiplication of autoreactive T cells essential for the autoimmune response and blister development , CD28 is a crucial costimulatory molecule that supplies a 2nd signal for complete T cell activation, T cell development and activation depend on CD3D, part of T cell receptor complex,CXCLA4, IFNG, ICOS) due to their significance in the disease causing and pathophysiology as per in the literature. After docking genes ICOS and IFNG with tacrolimus, we received binding affinity of -6.7 and -6.9 respectively. Conclusion: We conclude that identified DEGs can serve as potential biomarkers. IFNG and ICOS can work as potential drug targets to treat Pemphigus by targeting Natural killer cell mediated cytotoxicity and T cell receptor signalling pathways, respectively.

Keywords: Pemphigus, Autoimmune, Pathways, DEGs.S

UNDERSTANDING FORENSICS IN DIGITAL WARFARE

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Abstract

With respect to the Russian-Ukrainian war that has devastated not just the countries involved but the whole world, it is very important for us to look at the case from the view of Rome Statute, because this and the countless other wars have again and again shown us the adverse effects they have on our civilization as a whole. We believe, in fact, that the forensic pathologists, and forensic experts in general, are the only professional figures specialised in providing scientific evidence of crimes compatible with war crimes. Our research sheds light on the medico-legal aspects in the context of war, with particular attention to case studies of war crimes, cyber-attacks in the near past, electronic and ballistic warfare and their definitions according to forensic science. Our objective is to assess various types of cyber war crime, humanitarian crimes, their medico-legal aspects and providing a solid theory on how to deal with such cyberattacks as well as conventional war crimes through the study of various cases in the modern and past decades. Forensic scientists in the UN are currently dealing with the crimes that the Russian-Ukrainian war has shown us in the Geneva Convention, this paper aims to help us understand the prosecution of these heinous international crimes.

Keyword: Humanitarian crimes, Ballistic warfare, Cyber-attacks, international law

P-015

COMBATING ORGANIZED CRIMES IN THE DIGITAL AGE: GLOBAL IMPLICATIONS, CHALLENGES AND STRATEGIES

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Abstract

Organized crimes remain a pervasive and evolving threat to global security, economic stability, and social cohesion. Defined by structured hierarchies, transnational networks, and diversified illicit activities, organized crimes groups engage in drug trafficking, human smuggling, cybercrime, and money laundering. These groups leverage globalization, technological advancements, and weak governance to expand their operations, often integrating legal and illegal enterprises. The digital age has further enabled cybercriminal networks to conduct sophisticated operations, such as ransomware attacks and identity theft, challenging traditional law enforcement methods. The socio-economic consequences of organized crimes are severe, undermining democratic institutions, perpetuating corruption, and fuelling violence. Vulnerable populations, particularly in regions with weak governance or high inequality, bear the brunt of its impact. Efforts to combat organized crime have included international cooperation, legislative reforms, and advanced surveillance technologies. However, the adaptability of criminal networks demands a multifaceted approach addressing root causes like poverty, unemployment, and institutional fragility. The research methodology used in the paper is mostly doctrinal and comparative with reliance on statutes, books, scholarly articles and reports. This paper explores the dynamics of organized crimes, its global reach, and the challenges it poses to law enforcement and governance. It also evaluates strategies for mitigation, emphasizing cross-border collaboration, community engagement, and preventive measures. Through case studies and analysis of emerging trends, the study underscores the need for innovative solutions to disrupt criminal networks while promoting sustainable development and social justice. Combating organized crime requires a holistic approach, balancing enforcement with strengthening legal frameworks and empowering communities.

Keywords: Vulnerable Population, Transnational Networks, Social Justice, Law Enforcement

VIRTUAL AUTOPSY

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Abstract

Virtual autopsy, or 'virtopsy', is an advanced non-invasive technique that utilizes imaging technologies such as computed tomography, magnetic resonance imaging, and 3D surface scanning to examine postmortem of bodies. This innovative technology solves the problems with intrusive procedures and ethical issues while providing a ground-breaking substitute for conventional autopsy techniques. The process involves generating high-resolution, three-dimensional images of the body, which enables forensic experts to assess internal and external injuries, detect fractures, identify foreign objects, and analyze soft tissue and organ structures without physical dissection. Virtual autopsy holds particular value in cases where cultural or religious beliefs prohibit invasive autopsies, allowing a dignified yet thorough examination. This review paper talks about the applications of virtopsy in forensic investigations of trauma-related deaths, such as those resulting from accidents, homicides, or mass disasters. This aids in age estimation, determination of the cause of death, and identification of deceased individuals. This improves its diagnostic accuracy by integrating reconstruction software with image-guided biopsies. Additionally, virtopsy data can be archived and digitally shared among experts, fostering collaborative decision-making and long-term case reviews. Despite its numerous advantages, the virtual autopsy is not without limitations. High equipment costs, the need for trained personnel, and the dependency on sophisticated software can pose challenges. Moreover, it cannot entirely replace traditional autopsy methods, especially in cases requiring histopathological analysis. In conclusion, virtual autopsy represents a transformative step in forensic medicine, combining technological innovation with medical expertise. As advancements in imaging and artificial intelligence continue, virtopsy is poised to complement traditional methods, offering a holistic and efficient approach to postmortem analysis.

Keywords: Virtual Autopsy, Forensic Imaging, Computer Tomography, Trauma Analysis, Forensic Medicine.

UNVEILING THE TRUTH: FORENSIC TOXICOLOGY AND THE ROLE OF DATE-RAPE DRUGS IN DRUG FACILITATED SEXUAL ASSAULT

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Abstract

Sexual assault on a woman is one of the most egregious crime prevalent in the so-called civilized human society. Historically, it has been defined as a felony and punished severely from times when murder and other serious offences were not even considered as crime. However, literature and drawings from pasts reveal its continued existence across all societies, with some even glorifying this rather dark aspect of the most intellectual beings on this earth. In modern times, this crime has taken a more serious form with perpetrators finding new treacherous ways to harass and exploit women. Date-rape drugs has increasingly been used these days to facilitate sexual assault especially in the cases where perpetrators are victim's acquaintances. These drugs are available in a variety of forms and chemical composition and are often used by perpetrators to incapacitate the victims, rendering them unable to consent or resist. This paper reviews various common and uncommon drugs used in Drug Facilitated Sexual Assault (DFSA) and their toxicological aspects. Additionally, the paper also addresses the potential challenges associated with the forensic investigation of these drugs.

Keywords: Date-rape drugs, DFSA, Acquaintances, Forensic investigation

RETENTION AND DEGRADATION OF FRESHWATER DIATOMS ON CLOTHING: A QUANTITATIVE APPROACH

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Abstract

With an expanding empirical study base attempting to discover and comprehend some of the geographical and temporal elements determining their validity as trace evidence, freshwater diatoms provide useful circumstantial forensic indications. Prior research has shown that the initial transfer of freshwater diatoms to clothes is influenced by recipient surface properties, environmental variability, and individual species attributes. Nevertheless, no prior study has attempted to consider how these and other factors may affect the durability of transplanted diatoms during study durations. Thus, the purpose of this study was to determine and investigate the dynamics of diatom retention on garments during hours to weeks of usage. The influence of clothing material, seasonality, and time since wear (persistence interval) on the overall quantity and species-richness of diatoms retrieved as well as their relative retention (%) over time was investigated in a series of trials. Nine garment swatches were worn for a month in the spring after being submerged in freshwater. Up to a month was spent retrieving subsamples at regular intervals (e.g., 30 minutes, 1 hour, 8 hours, and 24 hours), extracting diatoms using the H2O2 technique, and examining them under a microscope. To create a seasonal comparison, the same experiment was conducted on three different types of clothing in the winter. Three phases of diatom persistence on clothes were generally identified by the results: quick initial loss, varied intermediate degradation, and maintained long-term presence. The number of diatoms collected and retention dynamics over time were greatly influenced by clothing material, with intricate relationships found with seasonality.

Overall retention patterns remained stable throughout the year, even though fewer diatoms were retrieved in the winter. Even weeks or months after an initial transfer, the results show that diatoms may be retrieved from clothes, providing a valuable environmental trace signal for forensic reconstructions spanning investigation periods. Cotton, acrylic, and viscose clothing were shown to be the most dependable temporal repositories of diatom trace evidence, with a greater quantity of forensic assemblage accessible for forensic comparisons. The influence of clothing material and seasonality on persistence was also examined.

Keywords: Geographical, Freshwater, Diatoms, Species, Degradation

REVOLUTIONIZING MEDICINE: THE DUAL NATURE OF BOTULINUM TOXIN AS A NEUROTOXIN AND THERAPEUTIC DRUG

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Abstract

Introduction: Botulinum toxin, known as the most potent biological toxin, has transformed into one of the most powerful therapeutic agents. Extracted from the serotypes of the Clostridium botulinum bacterium, it serves a dual role as both a lethal poison and a valuable medical tool. This toxin's journey from causing the deadly disease botulism to its widespread use in cosmetic procedures as Botox showcases the dichotomy of nature.

Methods: The research involved a comprehensive literature review of the properties, development, and applications of Botulinum toxin. Data was gathered from case studies, and historical records to analyze its dual nature.

Results: The findings highlight the toxin's ability to block neuromuscular transmission, leading to its efficacy in treating muscle spasms, chronic migraines, and cosmetic applications. Despite its toxic nature, precise and controlled use has made it a cornerstone in therapeutic practices.

Conclusion: Botulinum toxin epitomizes the balance between danger and utility in medical science. Its evolution from a lethal poison to a therapeutic agent underscores the potential of scientific advancement in transforming harmful substances into beneficial tools

Keywords: Botulinum toxin, Neurotoxin, Therapeutic agent, Botox, Clostridium botulinum

FROM SOCIAL MEDIA TO COURTROOMS: ROLE OF DIGITAL FORENSICS IN HUMAN RIGHTS EVIDENCE

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Abstract

Digital evidence like photos, videos, and social media posts can be used to document human rights violations, but they also need to be authenticated, as this research explores further. With social media playing a greater role in documenting abuses like police violence, political dissent, acts of terrorism, and genocide, maintaining the credibility and authenticity of such content is paramount. This study explores public awareness of digital forensics and how individuals engage with human rights-related content online. It also examines the ethical considerations of sharing unverifiable material and the gaps in public knowledge regarding verification processes. The research employs a mixed-method approach, combining qualitative case studies with quantitative surveys. Case studies analyze real-world instances where digital forensic techniques have been used to authenticate social media content. Surveys assess the public understanding of digital evidence verification, ethical concerns, and trust in digital forensics. In-depth interviews with forensic experts and legal professionals provide insights into challenges faced in politically sensitive contexts. Preliminary findings indicate significant gaps in public awareness regarding the authentication of digital evidence. Forensic experts face challenges in verifying content due to misinformation, deepfake proliferation, and legal constraints. The study highlights how verifiable digital evidence influences court decisions, enhances public trust, and informs policy changes. The research emphasizes the necessity of integrating digital forensic methodologies into human rights investigations. Strengthening forensic authentication processes can enhance the reliability of digital evidence in legal proceedings, improve public awareness, and mitigate ethical risks associated with misinformation. The study also calls for greater collaboration between forensic experts, legal professionals, and policymakers to develop standardized digital human rights documentation verification frameworks.

Keywords: Digital Forensics, Human Rights Documentation, Social Media Evidence. Authentication Techniques, Legal Outcomes

IDENTIFICATION LAWS OF INDIA: HISTORICAL EVOLUTION AND THE ARBITRARINESS DILEMMA

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Abstract

Introduction: The Identification of Prisoners Act, 1920, enacted during British rule in India, provided for the collection of measurements (finger-impressions and foot-print impressions) of certain classes of convicted and non-convicted individuals. However, it lacked a scientific approach and raised concerns regarding vast discretionary powers vested in law enforcement. Recognising these shortcomings, the Law Commission of India (1980) and the Malimath Committee Report (2003) recommended the incorporation of modern identification techniques such as DNA profiling in criminal investigations. In response, the Criminal Procedure (Identification) Act, 2022, was enacted to enhance investigative efficiency by broadening the scope of measurements (to include biological samples) and the categories of individuals from whom they can be collected. Yet, it risks enabling class legislation and facilitating the exercise of arbitrary power by the executive, potentially contradicting Article 14 of the Constitution of India. This study critically examines the consonance of the Indian criminal identification laws, starting from the 1920 Act to the 2022 Act, with the fundamental right to equality.

Methods: The study adopts a doctrinal research approach. It analyses legislative enactments, government reports, judicial pronouncements, and constitutional principles, particularly the right to equality under Article 14 of the Constitution of India.

Results: Findings reveal that even though the 2022 Act modernises investigative techniques, it risks enabling class legislation and conferment of unfettered arbitrary powers on the executive, both of which are antithetical to the right to equality.

Conclusion: While the 2022 Act represents progress in forensic investigations, its implementation must align with constitutional safeguards. Legislative refinements establishing objective classification criteria and limiting administrative discretion, strong privacy protocols, and robust oversight mechanisms are essential to balance law enforcement objectives with individual rights.

Keywords: Criminal Identification, Biological Samples, Measurements, DNA Fingerprinting, Right To Equality

FORENSIC ENTOMOLOGY: EVOLUTION, ADVANCEMENTS, AND FUTURE PROSPECTS IN CRIMINAL INVESTIGATIONS

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Abstract

Forensic entomology is the application of entomological principles and techniques to medicolegal issues, providing vital insights in criminal investigations through the examination of insects associated with crime scenes or human remains. This study provides a comprehensive review of Forensic Entomology, exploring its historical development and assessing its ongoing relevance in modern forensic investigations. The study comprehensively assesses the significance of necrophagous insects, including blowflies, fleshflies, and beetles, in accurately determining the postmortem interval (PMI), a key factor in legal proceedings. Beyond PMI estimation, the review further explores the utility of entomological evidence in detecting signs of antemortem wounds, determining the presence of toxins or drugs within human remains, and evaluating complex cases of neglect and abuse. The research contrasts traditional methods of entomological analysis with advanced techniques such as DNA analysis and molecular entomology, demonstrating the advancements in the field. Finally, it examines the potential and emerging role of artificial intelligence in enhancing forensic entomological analysis, showcasing the evolving and increasingly sophisticated landscape of this vital scientific discipline. This review underscores the multifaceted contribution of forensic entomology to legal investigations, highlighting its past, present, and future significance.

Keywords: Forensic Entomology, Postmortem Interval, Molecular Forensic Techniques, Artificial Intelligence

FIBER INNOVATIONS IN BODY ARMOR: A JOURNEY OF PROTECTION AND PROGRESS

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Abstract

The realm of bullet protection armor has shown tremendous transition of materials, beginning from conventional materials like steel, polyamide fibers, aramids to incorporation of high-performance fibers such as Ultra high molecular weight polyethylene (UHMWPE), carbon fibers, polyurethane, nanocomposites and natural fibers, ultimately advancing to intelligent body armors in the present day. This review has put light on the historical development and advancements of the body armour as a personal protective equipment (PPE) in the civilian and defence industry. Advancements in fiber technology aims to provide safety and protection as well as comfort, mobility and lightweight. Para-aramid fibers are more advantageous than polyamides. Carbon fiber reinforced polymer (CFRP) reinforced with Kevlar and alumina produced an armor which is most resistant against hemispherical nose shaped bullets. Similarly, polyurethane is used for hard bulletproof vest when combined with aramid and glass fibers due to its high ballistic performance. It also discusses the use of environmentally friendly natural fibers such as date fibers, hemp fibers, sisal fibers when combined with synthetic fibers to produce a more ballistic resistant vest. Kevlar reinforced with natural fiber was more resistant. From the last few years, advanced nanocomposites such as graphene, carbon nanotubes (CNT) and nanoclay are now gaining widespread attention in the market. In this review, various materials along with their manufacturing and functionalization techniques are critically analysed. Moreover, it also discusses the challenges dealt with various materials while focusing on potential future innovations in ballistic protection. Modern technology consisting of smart vest and a smart helmet using Internet of Things (IoT) and artificial intelligence are amongst the attractive areas of this review. The increasing demand and need for sustainable development emphasize further innovations on these fibers to improve their properties and their integration with multilayered armor systems (MAS).

Keywords: Body armor, Textile fibers, Ballistic performance, Impact resistance

P-024

FORENSIC PSYCHOLOGY MEETS AI: A NEW FRONT

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Abstract

Online grooming is a growing concern, especially for vulnerable individuals like minors. This study looks at how forensic psychology and artificial intelligence (AI) can work together to fight online grooming, marking a new frontier in criminal investigations and prevention. Traditionally, forensic psychology has played a key role in understanding criminal behavior, profiling offenders, and assessing the psychological impact on victims. However, with the advancement of AI, forensic practices are evolving, as machine learning and natural language processing enable real-time detection of grooming behaviors. AI can identify manipulation tactics, predict risky interactions and spot potential offenders through digital analysis and language patterns. Integrating AI with forensic psychology not only improves behavioral profiling but also facilitates early intervention and supports justice and victims' well-being. Additionally, AI can help monitor and assess risks, giving law enforcement and online platforms the tools to stop grooming before it worsens. This paper offers a conceptual framework for understanding the synergy between AI and forensic psychology in online grooming investigations and suggests future directions for research and application.

Keywords: Forensic psychology; AI; Online grooming; Investigation; Wellbeing; Justice

P-025

ANALYSING FORENSIC EVIDENCE IN CRIMINAL JUSTICE SYSTEM

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Abstract

The present research paper examines and explores the way forensics and law intersect with one another primarily focusing upon the ethical and legal concerns of criminal justice system. Examining both legal and technical viewpoints, this paper investigates the crucial role that forensic evidence plays in the pursuit of justice. By assessing current procedures and methods for gathering, analysing, and interpreting forensic evidence, the study focuses on the ethical difficulties of prejudice, privacy, and the effect on public trust in the legal system. The study intends to fix these problems in order to provide a stronger framework that preserves justice and public trust in forensic methods, also highlighting the necessity to reform and improve the accuracy of forensic science such as standardized procedures, improved training, and independent monitoring.

Keywords: Criminal Justice, Forensics, Privacy, Access to Justice, Digital Evidence

P-026

THE FORENSIC SIGNIFICANCE OF INSECT BIODIVERSITY AND REGIONAL FAUNAL VARIATIONS IN WILDLIFE AND ANIMAL ABUSE INVESTIGATIONS

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Abstract

Forensic entomology can be a very useful tool in wildlife forensics & animal cruelty case investigations by providing scientific evidence for estimating the geographic origin of insects associated with the decomposed, remaining, and abused animals. Despite its extensive uses in human cases, its role in non-human & animal cases remains underexplored. Besides, very few studies have been conducted on the impacts of climates, geographic variation, altitude, and habitat on insect communities used as entomological evidence in wildlife forensics. This study aims to evaluate the role of necrophagous & parasitic insects in identifying the geographic locations in wildlife forensics & animal cruelty cases by integrating with DNA barcoding & stable isotope analysis & also provides insights on field sampling, laboratory analysis, and geospatial mapping of insect species found on carcasses & mistreated animals. It employs a multifaceted approach to determine the geographic origins, including field sampling and recording environmental data as insects are preserved for morphological & molecular identification. Field sampling involves collection of insects from carcasses and mistreated animals across diverse ecological zones. Environmental influences including ambient temperature are also analyzed as insects are highly habitat-specific. Laboratory analysis includes taxonomic identification using morphological keys, DNA barcoding & isotope analysis and after that, findings are compared to the known origin of insect biogeographic databases. By offering species-specific geographic origin & habitats, this study explores insights on enhancing the application of forensic entomology in wildlife forensics investigation by assisting the cases involving animal cruelty, neglect, poaching, and illicit wildlife trade. The result also supports the use of forensic entomology as a tool for legal enforcement in animal cruelty cases by increasing the protection of wildlife through scientifically validated evidence. Also, it emphasizes the need for standardized forensic protocols for wildlife and the integration of entomological evidence with other forensic fields & methodologies.

Keywords: Wildlife forensics, Geographic origin, Forensic entomology, Animal Cruelty, Poaching, Necrophagous insects

P-027

CRIME MAPPING ANALYTICS PREDICTIVE SYSTEMS AND FORENSIC SCIENCE: A COMBINED APPROACH FOR EFFECTIVE CRIME INVESTIGATION IN PREDICTIVE POLICING

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Abstract

In the era of technological advancements controlling crime rates is necessary; Involving AI in traditional Policing operations can assist in locating where and when crime will occur, this results in a new era of policing "Predictive Policing" where the location of hotspot mapping and risk terrain modelling can be obtained, and the software used by the Indian Police for predictive policing is Crime Mapping, Analytics, and Predictive Systems (CMAPS) that combines Geographic Information System (GIS), Artificial intelligence (AI), and Machine Learning (ML) to strengthen law enforcement. CMAPS is being operationalized by Delhi Police in partnership with the Indian Space Research Organisation (ISRO) for the effective use of space technology-based tools for ensuring internal security it aims to check the effectiveness of CMAPS for crime prediction and prevention and to look at the technological advancements and ethical issues. The efficiency of the forensic investigation for the detection of crime hotspots was obtained with the assistance of the database prepared from criminal reports, GIS mapping, and AI-driven predictive models. The data-driven decision-making provides a change in traditional policing. The beneficial side of using CMAPS is seen in crime reduction and using police resources effectively. It propels forensic examiners with AI-powered analysis for crime mapping, aiding in the quick solution of the case, enhancing criminal identification, and giving an indication of the areas of future crime its merging with forensic science enables effective suspect tracking and behavioural modelling, as well as evidence-based decision-making, and thus it is an integral part of modern law enforcement.

Keywords: Predictive policing, CMAPS, Hotspot mapping, Forensic investigation.

DETERMINING THE CHRONOLOGICAL ORDER OF INK DEPOSITION: LASER PRINT VS. BALLPOINT – "A MICRO-ANALYTICAL APPROACH"

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Abstract

The determination of the sequence of printing and writing is one of key challenge faced by the forensic document experts to determine the authenticity and validity of documents. Oftenly to create the altered documents, the forger takes genuine signature on a blank sheet and later on use that paper to print the content of interest over it. A laser printer, a widely used digital printing instrument, rapidly produces high-quality text and graphics. Therefore, laser printers and ballpoint pens are used by forgers to disrupt the integrity of the documents. This study focuses on the examination of the overlapping of printed matter with that of the ball pen ink of different colours. For this study samples were prepared in two different categories i.e. print over pen and pen over print. In each category 50 samples were prepared consisting intersection of laser printer print (black toner) with the strokes of ball point pen ink (black, blue, red). The sequence of intersecting strokes has been observed under VSC 8000 HS. Examining the sequence of intersecting strokes using a VSC 8000HS helps to determine which ink stroke was applied first at a point where lines cross over each other, by utilizing different light wavelength. Also, three-dimensional imaging capabilities analyse the subtle variations in ink depth and surface topography, revealing the order of the strokes based on how they affect each other at the intersection point. This study establishes valid conclusion that different light wavelengths, such as spotlight and fluorescence light influence the glossiness and continuity of the pen vs print at the intersection. In addition, three-dimensional imaging plays a crucial role in determining the continuity of the ink.

Keywords: Intersections, Ball point pen inks, Laser Printer, Forensic Document Examination

P-029

EMPOWERING WOMEN THROUGH TECHNOLOGY: ASSESSING THE EFFECTIVENESS OF SAFETY APPS AND DEVICES

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Abstract

Women empowerment is a critical and pressing issue in today's society, as it enables women to assume important roles and contribute to national development. However, women remain highly vulnerable to various risks and crimes, such as rape, domestic violence, kidnapping, eve teasing, harassment, and abuse. Reports indicate a rising trend in crime and violence against women over the years, highlighting the need for effective preventive measures (Mahmud et al., 2017). According to NCRB Crime in India Report 2022, the crime rate against women has been increased by 20% in 2022 as compared to 2020. Hence, it calls for an urgent need for law enforcement agencies to adopt evidence-based decision making based on data analysis using various tools and technology. The use of technology to enhance women's safety and security has become increasingly crucial in recent times. This study explores various current technologies with a focus on their security features, usability, adoption rates, user engagement, and associated costs by reviewing various research papers and applications features. The aim is to explore how these technologies enhance women's safety, both in India and globally and mitigate incidents related to women and providing them a safe and secure environment. The findings provide insights into various apps/devices for women safety by India and globally and evaluates user satisfaction by analysing user feedback which eventually helps in addressing issues and challenges related to app/device. Such technologies empower women to their advantage and safety and foster a more tech-friendly environment for women's safety and security.

Keywords: Safety Apps, Safety Devices, Women's Safety, Technology, Digital security

P-030

THE ROLE OF CYBER FORENSICS IN COMBATING FINANCIAL CRIMES AND MONEY LAUNDERING

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Abstract

In today's digital age, financial crimes and money laundering are growing threats that take advantage of technology to hide illegal activities. Cyber forensics has become an essential tool in fighting these crimes, helping investigators trace, analyze, and uncover digital evidence related to illegal financial transactions. Through analyzing the data from computers, mobile devices, online banking systems, and even social media, cyber forensics experts can identify suspicious activities and piece together a criminal's trail. This research paper focuses on how cyber forensics is used to combat financial crimes like fraud, identity theft, and money laundering, where criminals try to hide the origin of illegal funds. Money laundering is a process where criminals make illegally gained money appear legitimate by moving it through various transactions and financial systems. As more people and businesses use digital methods for financial transactions, detecting money laundering has become more challenging. Cyber forensics plays a vital role in breaking through these challenges. Experts analyze transaction data, track electronic money movements, and uncover patterns that might otherwise go unnoticed. By reviewing emails, online transactions, website activities, and more, forensic investigators can often identify and expose money laundering operations. This paper also discusses the growing importance of cooperation between financial institutions, law enforcement agencies, and technology experts to combat these crimes. Financial institutions are increasingly using advanced tools and methods, including cyberforensics, to detect fraudulent activities and prevent money laundering. Law enforcement agencies, on the other hand, rely on cyber forensics to build strong cases by gathering digital evidence that can be used in court. Through these collaborative efforts, cyber forensics can significantly reduce the impact of financial crimes and help bring criminals to justice.

Keywords: Cyber Forensics, Financial Crimes, Money Laundering, Digital Evidence, Fraud, Financial Systems, Online Transactions, Law Enforcement, Financial Institutions, Crime Investigation

MAKING MANDATORY FORENSIC EXPERTS IN NEW CRIMINAL LAWS: ISSUES AND CHALLENGES

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Abstract

Indian courts are of the view that certain examinations cannot be conducted inside the Courtroom. Hence, we need to have special Labs where we can conduct Laboratory Examination which would result in an increasing number of criminal cases. The New criminal laws came into existence, and we were relieved from the colonial British Laws. But with newer things coming into place, we have become more complacent. Nowhere in the world, there is a mandatory forensic expert examination which has been enshrined with the new law, which is Bhartiya Nyaya Suraksha Sanhita (BNSS). Now, it has become very imperative to understand the ground reality vis-a-vis the strong reason that the conviction rate is very poor in comparison to the number of cases that are being investigated. There is a lot more confusion which needs clarity from conundrum. Is our state prepared for forensic experts? There are only one or two institutions in the whole country which provides for Forensic Education but when it is made compulsory Forensic Experts at every district; How the government is going to spend money for the permanent body at every district. The outcome of the Forensic Examination is also very pertinent to take into consideration because it may ultimately result in a futile exercise, waste of money and time. It is imperative and need of the hour to study how the state government is going to work in this very particular domain to increase the conviction rate.

Keywords: Forensic Experts, Mandatory Forensics, Criminal Law Reform, Admissibility of Evidence

P-032

CRYPTOCURRENCY & BLOCKCHAIN FORENSIC INVESTIGATION

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Abstract

Cryptocurrency has gained popularity in recent years due to its decentralization, fast and secure transactions, and financial potential. However, its growing popularity has resulted in a rise in fraudulent activities including as frauds, phishing attacks, Ponzi schemes, and illegal financial transactions. The absence of explicit forensic techniques and the anonymity of blockchain networks make it difficult to trace fraud. This paper outlines some cryptocurrency fraud schemes and provides a clear list of blockchain forensic tools that can examine illegal transactions. In addition, the study outlines how artificial intelligence (AI), and machine learning (ML) can be applied to support forensic investigations by identifying suspicious patterns of transactions and enhancing fraud detection accuracy. The study experiments with various ML classification techniques and determines that the random forest (RF) classifier is superior to others, with a 97.5% reliability. Furthermore, forensic evidence preservation techniques, such as the Interplanetary File System (IPFS) and blockchain-based smart contracts, are examined for how well they preserve fraud-related information. Although AI-based blockchain forensics hold promise, there are numerous challenges, such as privacy, no cross-chain investigation techniques, and the dynamic nature of fraud schemes. This analysis outlines the current challenges and future concepts for enhancing forensic techniques, emphasizing the need for legal regulations, improved technical solutions, and international collaboration to enhance cryptocurrency fraud investigations.

Keywords: Artificial intelligence, Blockchain, Cryptocurrency, Digital forensics, Financial learning, Machine learning

P-033

WHEN DESIRE TURNS DEADLY: THE PSYCHOLOGICAL CROSSROAD BETWEEN GREED AND CRIME

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Abstract

Greed has long been recognized as a powerful motivator, driving individuals to achieve success, wealth, and power. However, when unchecked, greed can escalate into criminal behavior, leading to financial fraud, violent crimes, and corruption. This study explores the psychological mechanisms that link greed to crime, drawing from case studies, secondary data, and expert opinions in forensic and behavioral sciences. By analyzing the cognitive biases, neurobiological factors, and social conditions that contribute to greed-driven criminality, this research identifies key patterns in criminal behavior. Findings suggest that moral disengagement, impulse control, and environmental triggers play a significant role in determining whether greed manifests as ambition or criminal activity. Understanding these psychological crossroads is crucial for law enforcement, forensic psychologists, and policymakers in developing preventive measures and intervention strategies.

Keywords: Greed, Crime, Forensic Psychology, Behavioral Science, Psychological Profiling

P-034

INK PROFILING IN FORENSIC SCIENCE: TLC-BASED ANALYSIS OF ROLLING BALLPOINT PEN INKS

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Abstract

Document forgeries and falsification are commonplace nowadays, even in India. Since ballpoint ink pens are among the most used pen kinds worldwide, they are most likely to be connected to instances of document fabrication and forgery. The colours of ballpoint pen ink differ depending on the manufacturer. Additionally, pens have a distinct ink composition for pen makers, similar to human DNA and fingerprints. The main goal of ink analysis is to categorize and identify the different ink components, such as colorants, vehicles, and additives. Thin-layer chromatography (TLC) is a widely used forensic technique for figuring out the composition of ink, particularly in document analysis. This study focuses on the TLC analysis of ink from rolling ballpoint pens to identify changes in ink formulas and evaluate their potential for forensic identification. Using an optimized solvent solution, 15 ink samples from five distinct brands—Reynolds, Hauser, Linc Pentonic, Linc Glyser, and Cello Butterflow (red, blue and black) were gathered and put through chromatographic separation on silica gel plates. The Silica gel plates were heated at 60 degrees centigrade for 20mins in order to activate the silica gel. Sample inks were diluted with pyridine solution at a ratio of 1:2 respectively. Solvent solution at a ratio of 70:35:30 is taken combining ethyl acetate, ethanol and distilled water respectively. Colour distribution, separation patterns, and retention factor (Rf) values were used to examine the resultant chromatograms and separating colour tones. The classification identifies ballpoint ink used for document forgeries in the early stages. According to the results, rolling ballpoint pen inks have unique chromatographic profiles that allow for brand and even batch-level discrimination.

Keywords: Ball Point Pen, Ink Analysis, TLC, Chromatography, Forgery, Fabrication

P-035

MEDIATION AND FORENSIC EVIDENCE IN FAMILY LAW: AN ANALYSIS OF CONTEMPORARY JUDICIAL TRENDS IN INDIA

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Abstract

Advancements in science have affected all strata of society and judicial machinery is not untouched by it. Forensics, as a branch of science, provides valuable evidence that helps in judicial decision-making process. Historically, forensic evidence has played a crucial role in criminal cases but recently their use in civil disputes is also gaining popularity. This, however, presents before us an interesting conundrum where one or both parties to a suit are willing to accept forensic evidence to establish a fact but the court in its wisdom does not allow its application. This phenomenon is commonly observed in cases involving paternity or inheritance where forensic evidence can be used to establish a fact that might go against a presumption laid down in law. Mediation proceeding, on the other hand, is a platform that is commonly referred by family courts as the first step towards dispute settlement and is neither bound by the strict procedure of court, nor by the presumptions laid down in law. Mediation proceedings thus have the potential to fully utilize the findings of forensic evidence and apply the same to deliver complete justice to parties. This paper will analyze the contemporary judicial trends with regards to acceptance of forensic evidence in family disputes. This paper will also identify what challenges are faced by courts in accepting forensic evidence in family disputes with special reference to mediation proceedings. While highlighting instances of judicial skepticism towards the use of forensic evidence and giving due regard to possibility of error in such evidence, this paper will provide harmonized suggestions for utilization of forensic evidence in family disputes especially during mediation proceedings.

P-036

DOCUMENTS DIGITAL FORGERY DETECTION USING DEEP LEARNING METHODS

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Abstract

Document forgery has become a major problem due to the rapid proliferation of publicly available tools such as Canva and Adobe Photoshop. Their editing features result in high-quality forgeries, making it difficult to detect digital forgeries using existing techniques such as spectroscopy and chromatography. Forged documents lead to lasting consequences involving identity theft, financial losses, and illegal trade. Deep learning (DL) models provide an innovative solution to solve the problem of document forgery. The manuscript implemented EfficientNet-B0, EfficientNet-B7, and Efficient NetV2 models to mitigate document forgery. The performance of the EfficientNet series was compared on publicly available Real Text Manipulation datasets and forged handwritten document databases. After the analysis, the study concluded that EfficientNet-B0 is an effective model for detecting document forgery with high accuracy. Incorporating the EfficientNet-B0 model into the real-time application will assist forensic document examiners in document verification.

THANATOTRANSCRIPTOME: A NEW FRONTIER IN POSTMORTEM FORENSIC INVESTIGATION

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Abstract

Post-mortem molecular analysis has reached a new frontier with the advent of thanatotranscriptome studies, transforming our knowledge of death-associated biological processes and their forensic applications. The thanatotranscriptome is a new area of post-mortem forensic science, and it deals with the examination of RNA expression patterns in deceased persons. It is a new technique that analyses the post-mortem changes in gene expression to get insights into the time and cause of a person's death. The study of the degradation patterns of different RNA molecules, it can ascertain the post-mortem interval more accurately than through conventional techniques. It has the potential to give information on the cause of death, environmental conditions, and even the presence of toxins or drugs in the body. The review addresses the rapidly emerging field of thanatotranscriptomics and its revolutionary role in forensic investigations. Since scientists are still studying this area, it can potentially revolutionize forensic science by giving a clearer and more precise image of the biological processes occurring after death, ultimately making criminal investigations and legal actions more accurate and dependable. Recent advances in RNA sequencing technologies have revealed that gene expression continues in a regulated manner after death, generating distinctive molecular profiles that can be utilized for forensic applications.

Keywords: Apoptosis; Gene expression; RNA; Post- mortem interval; Thanatotranscriptome

P-038

HEAVY METALLIC TOXICITY IN AYURVEDA MEDICINE

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Abstract

Heavy metals including lead, mercury, cadmium, copper, arsenic, iron, chromium, and silver are naturally occurring elements that are present in variable concentrations across all ecosystems. They are used in many modern-day applications, such as agriculture, medicine, and industry. Many of the heavy metals are essential to body function in very small amounts. But, if these metals accumulate in the body in concentrations sufficient to cause poisoning, then serious damage may occur. These metals are important in cases of poisoning. The wide range of metallic substances that might be involved in any case of suspected poisoning holds both the careful collection of appropriate specimens and also the selection of proper toxicological analytical procedures. Metal poisoning holds forensic relevance so as to ascertain the cause of it, acute or chronic exposure, manner of the poisoning as homicidal, suicidal or accidental, and hence the awareness and knowledge regarding the toxicity of metals on humans is important. There are some techniques used in labs for analysis of heavy metallic poisons such as AAS which is more preferable and some more are there. This work is based on the tools and techniques for determination of metallic poison by using the appropriate mode of analysis.

Keywords: Yog Raja guggulu, Ayurvedic formulation, Lead estimation

FORENSIC ANALYSIS OF FACTORY RESET MOBILE DEVICES: EXTRACTION OF EVENT LOGS USING UFED AND THEIR SIGNIFICANCE IN CRIMINAL INVESTIGATIONS UNDER INDIAN LAW

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Abstract

A factory reset removes all user data from the system and brings the mobile device back to its original system state. This implies that the factory reset process clears out all user data such as contacts, messages, installed apps, and settings. However, it does not place any information on a mobile device's storage; rather, it marks the information as free space for the operating system to overwrite at some future point. However, some remnants of activity are maintained in traces of the event logs which document such system actions as app installs, data deletion, software updates, and security events. Forensic tools such as UFED may be able to recover information from these logs after a factory reset, revealing timestamps for the moment of resetting, attempts to access the device prior to and immediately after the reset, configurations in the operating system, and information on residual metadata. This research examines to what extent event logs of different forensic tools can recover data from factory-reset phones (Xiaomi, Samsung and Apple) and compares their effectiveness in recovering event logs. This also includes analysis on how event logs may offer information as forensic evidence during investigations of criminal activity, including timestamps that denote when data was wiped. By analysing the recovered event logs, this research discusses the potential for event logs to establish the intent, reconstruct user activity, and provide evidence for law enforcement to use in liability determination. Furthermore, the study assesses the evidentiary value of such kind of digital proof within India's criminal justice system with reference to the recent amendments and provisions in India's legislation. The findings indicate that a forensic examination of event logs is of immense importance regarding future accountability in courts as well as the strengthening of admissibility of digital evidence.

Keywords: Factory Reset Forensics, Mobile Event Log Analysis, Digital Evidence Recovery, Forensic Tools, Legal Admissibility of Digital Evidence

P-040

WEARABLE ELECTRONIC FINGER FOR DATE RAPE PREVENTION: A FORENSIC APPROACH

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Abstract

Introduction: Date rape is a pervasive issue with devastating consequences for victims. This study introduces a wearable electronic finger designed to detect and prevent date rape. This innovative technology has the potential to empower individuals particularly women to take control of their safety and prevent date rape. The Wearable Electronic Finger features sensors to monitor, the presence of date rape drugs in drinks, alerts the wearer and emergency contacts via Bluetooth connectivity, innovative approach to date rape prevention, portable, discreet, and user-friendly design, potential to reduce date rape incidents and empower victims.

Methods: A comprehensive literature search was conducted by using a major database, including PubMed, Scopus, web of science, and google scholar. The searching terminology used were wearable electronic finger, date rape drug detection, portable sensor, and personal safety device. the search was limited to English language articles published within last 10 years. The study must have involved the development or testing of a wearable electronic finger for detection of date rape drugs.

Results: Wearable electronic fingers demonstrate high sensitivity towards target date rape drugs, with detection limitations from 0.1-10 ppm. The studies showed that they having a capability to differentiates among different drugs through sensors, also they having a convenience response time for detection.

Conclusion: Wearable electronic finger has emerged as a promising technology for detecting a date rapes drugs in real time. The reviewed studies demonstrate the effectiveness of this device in detection of drugs and their sensitivity. While still there are some kinds of limitations to be addressed, such as its durability and miniaturization.

Keywords: Date Rape Prevention, Wearable Technology, Electronic Finger

P-041

CYBER CRIMES IN INDIA'S POLITICAL LANDSCAPE: ELECTION MANIPULATION, DEEPFAKES, AND DISINFORMATION WARFARE

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Abstract

Cyber law and politics in India have become more unwieldy with the rise of new technologies that facilitate election tampering, deepfakes, disinformation warfare. Since digital platforms are an essential part of political discourse, the rules of cybercrime are ambiguous, and thus may serve as a way for some manipulative tactics to operate a legally grey area. This research shows how political cybercrimes circumvent cyber laws in India and the loopholes that exist within the legal system which allow for such cybercrimes to take place. This research adopts qualitative research approach in the method of doctrinal as to legal statutes and some cyber manipulations' instances. In order to dive deeper into the effectiveness of these laws in curbing public digital election fraud, synthetic media misuse and large-scale disinformation campaigns, further court rulings and government reports would be examined. India's cyber regulations would be compared with the best practices in international law. The findings would show that although India has already enacted laws to deal with cybercrimes, enforcement gaps and legislative loopholes permit political actors to use digital tools to their electoral advantages. The effects of this have included deepfake videos, AI generated misinformation and propaganda via bots, and all in a matter where there have been no clear legal repercussions for doing so. It sheds light on the growing viewpoint of judiciary on digital election integrity and the importance of the regulatory body in fighting cyber enabled political fraud. Hence, the research would showcase that India's existing legal framework needs to be reformed to cope up with the speedy developing cyber threats in the political domain. Regulatory mechanisms must be strengthened, an AI-based detection system should be implemented, and strict legal accountability should be implemented regarding political cyber-crimes. Unless reforms would be made, the misuse of cyber technologies will persist in undermining electoral democracy and public trust in the political institutions.

P-042

COMPARATIVE ANALYSIS OF CONVENTIONAL AND GEOMETRIC MORPHOMETRIC TECHNIQUES IN HUMAN IDENTIFICATION FOR FORENSIC APPLICATION

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Abstract

Forensic Anthropometry is the study of estimating and making sense of the human body's parameters and proportions. It will measure humans within group and with other animal groups. Anthropometric data used to estimate sex, age, race, stature. Anthropometry played a key role in victim identification and solving cases. In 2004 and 2011 Tsunamis, it supports to identifying the remains. In the buckskin girl case, anthropometry estimated the victim's profile, guiding investigators to possible DNA matches, eventually resolving the decades- old cold case effectively. In forensic anthropometry recognition of skeletal remains are accomplished via two methods, namely conventional morphometrics and geometric morphometrics. The conventional morphometric means the traditional method of determine particular anatomical leading points on the human body to evaluate size and shape via direct linear parameters such as length, width, and interval between the points, through stadiometer, anthropometric indices and meters. moreover, geometric morphometric means a statistical technique that helps to study the shape of high points of human body parts, as well as to understand the geometric link between them, by using the tools like ITK-SNAP (used to determine the bone volumes and μCT), FORDISC (helps to determine sex, ancestry and stature by gauge the vertex), 3- Dimensional scanners (geometric measurements such as distances, angles and curvatures) and RadiANT (used to measure US images). The traditional morphometry gives quantitative comparison but often losing shape information but, in geometric morphometric it provides spatial relationships and allowing for more precise shape comparison. The present article results, from the two anthropometric techniques statistical software is a supporting tool that will rise the accuracy of estimation which will be used in forensic analysis.

Keywords: Forensic Anthropometry, Traditional Morphometric, Geometric Morphometric

ASSESSING BLOODSTAIN AGE: IMPACT OF TEMPERATURE AND LUMINOL USING UV-VISIBLE SPECTROSCOPY

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Abstract

One of the most crucial evidence found at a crime scene is blood. The age estimation of the blood plays the most significant role in reconstruction of the crime scene, to find out when the crime occurred. Determining the age of a bloodstain can either confirm or refute its connection to the crime, provided that other pieces of evidence establish the time of the incident. This study mainly focuses on how the temperature varies along with the application of luminol, which influence the estimation of bloodstain age. To carry out the analysis, 18 blood samples were subjected to different temperature conditions, and luminol test, out of which 9 samples were treated with luminol and 9 remain untreated. The assessment of samples was carried out by using UV-visible spectroscopy. The experimental results have highlighted the impact of temperature on bloodstain characteristics. Significantly, it was determined that an increase in temperature correlated with a decrease in the absorbance of the blood sample. And it indicates the changes in molecular properties of the sample. Furthermore, the higher temperature conditions were associated with the degradation of the blood sample, suggesting that elevated temperatures contribute to the deterioration of the bloodstain. Conversely, when the temperature was decreased, the absorbance of the blood sample increased, particularly when compared to room temperature. This observation implies that lower temperatures might possess a preserving effect on the blood samples, leading to higher absorbance values. These findings emphasize the intricate relationship between temperature variations and the age estimation of bloodstains, offering valuable insights for forensic investigations.

Keywords: Forensic Science, Age of bloodstain, Luminol, Temperature, UV-visible spectroscopy

INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS: A SUPERIOR NON-DESTRUCTIVE ANALYTICAL TECHNIQUE FOR MUSEUM ARTEFACTS

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Abstract

Our cultural heritage has been preserved in museums, that contain priceless artifacts that reflect our history and cultural identity. However, these organizations remain susceptible to the risk of theft and the introduction of counterfeit artefacts. In today's linked social structure, a surge in artifact theft and counterfeit cases has given rise to significant worries. considering copper artefacts as key sources of evidence in forensic cases when confronted with replicas and fake museum artefacts. In March 2004, burglars stole Tagore's 1913 Nobel Prize medal, certificate, and personal items from the Visva Bharati university museum at Shantiniketan. The case has not yet been resolved and in September 2022, A very rare ancient silver coin, minted as an act of defiance by Jewish rebels against the Roman Empire over 2,000 years ago and plundered from Israel in 2002, was returned to Israeli authorities in New York international recovery effort. At the same time in an artefact theft or counterfeit it is significant to find out the authenticity of the artefacts to preclude comping up incidents, for analysis, we are using active methods in certain instances, energy-dispersive X-ray fluorescence (ED-XRF), and scanning electron microscopy (SEM) fall short of the capabilities of the very reliable analytical technique known as instrumental neutron activation analysis (INAA). The elemental composition of a sample can be determined by INAA using the nuclear properties of the elements, specifically their ability to absorb neutrons and emit prompt ionising radiation. Ionising radiations also can be emitted by the radionuclides formed due to neutron absorption of host elements. INAA technique is more preferred due to non-destructive analysis of the sample, which is the current effort to determine the trace elements that might serve as an artifact's signature. So, this article aims to provide insight into the techniques that have been developed in recent years that can be useful in forensic investigation of artefacts theft and counterfeit cases.

Keywords: Museum Artefacts, Instrumental Neutron Activation Analysis, Non-Destructive Technique

P-045

RECENT ADVANCEMENTS IN ARTIFICIAL INTELLIGENCE FOR MALWARE DETECTION IN FORENSIC INVESTIGATIONS

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Abstract

The rapid advancement of Artificial Intelligence (AI) has revolutionized cybersecurity, introducing both groundbreaking innovations and severe risks. One of the most alarming developments is AI-generated malware, which exhibits advanced adaptability, evasion capabilities, and automation. This paper examines the impact of AI-driven malware, its evolving nature, and the challenges it poses to existing cybersecurity defenses.AI-powered malware leverages machine learning and deep learning to enhance its complexity, making it significantly more dangerous than traditional threats. It possesses polymorphic and metamorphic properties, allowing it to modify its code dynamically, evade detection, and bypass security tools. Additionally, AI enables the automation of cyberattacks, including intelligent phishing schemes and misinformation campaigns, making cyber threats more sophisticated and widespread. One of the primary concerns is the ability of AI-generated malware to out manoeuvre conventional security defences. Existing antivirus solutions and heuristic-based detection methods struggle against AI-enhanced threats that continuously evolve and adapt. This highlights the need for AI-driven countermeasures, such as behavioural analysis and adversarial learning, to detect and neutralize these threats effectively. However, using AI for cybersecurity also raises ethical concerns, as the same technology that enhances defence mechanisms can be exploited to develop even more advanced cyber threats. Beyond technical challenges, AI-generated malware presents ethical and legal dilemmas, necessitating a global effort to establish security regulations and ethical AI frameworks. Collaboration among governments, researchers, and cybersecurity professionals is critical in combating this growing threat. In conclusion, AI-generated malware is a formidable and evolving challenge. The inadequacy of current defences underscores the need for innovative AI-driven security solutions. Addressing this threat requires proactive global collaboration to strengthen cybersecurity frameworks and prevent AI-enhanced cyberattacks from escalating further.

Keywords: AI-Generated Malware, Cybersecurity, Cyberattacks, Forensic Investigation

CHALLENGES IN IMPLEMENTING DNA DATABASES: PRIVACY AND HUMAN RIGHTS CONCERNS

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Abstract

DNA databases are increasingly being used by law enforcement agencies around the world to help solve crimes and identify suspects. These databases store DNA profiles collected from crime scenes, convicted criminals, and sometimes even people who are not involved in any crime. While DNA databases have proven to be valuable tools for solving cases, they also raise significant concerns regarding privacy and human rights. This research paper examines the challenges faced in implementing DNA databases, particularly focusing on the privacy issues and the potential for misuse of personal genetic information. One of the main concerns is how the collection and storage of DNA samples might violate an individual's right to privacy. DNA carries sensitive personal information about an individual's health, family history, and even traits. Storing this data in a database could potentially lead to unauthorized access or misuse, either by law enforcement or malicious actors. For instance, if DNA samples are wrongly collected from innocent people or stored indefinitely, it could lead to violations of privacy, as individuals may not have given consent for their genetic information to be used in this way. Additionally, there are concerns about the possibility of racial or ethnic profiling. DNA databases may disproportionately affect certain communities particularly minority groups leading to biased practices in the criminal justice system. The inclusion of individuals who have never been convicted of a crime also raises ethical questions. Should people who are not guilty of any crime have their DNA stored in a national database simply because they are suspects in a criminal investigation? This paper explores these challenges and discusses the balance between using DNA databases for public safety and protecting individuals' rights. It highlights the need for clear regulations on who can access these databases, how the data should be stored, and under what circumstances DNA samples can be collected.

Keywords: DNA Databases, Privacy, Human Rights, Criminal Justice, Genetic Information, Law Enforcement, Racial Profiling, Ethical Concerns, Privacy Rights, Data Security

ANALYZING REDDIT SENTIMENT-INSIGHTS INTO ONLINE COMMUNITIES AND USER OPINION USING CNN

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Abstract

Social media platforms like Reddit function as intricate ecosystems where users express many opinions and share diverse experiences on countless topics. In this study, we delve into the application of sentiment analysis, a sophisticated model of NLP systematically evaluate, quantify emotional content that permeates user discussions. Our approach the deployment by advanced MLA designed to sift through and large volumes of textual data extracted from comments and posts across multiple subreddits. By utilizing techniques such as tokenization, vectorization, and various sentiment classification models— (CNNs) and recurrent neural networks (RNNs)—we aim to uncover nuanced sentiment trends and discernible behavioural patterns that might otherwise remain obscured in the raw data. The insights we gather from this rigorous analysis will provide significant advantages to various stakeholders, including marketers seeking to tailor their strategies according to user sentiment, researchers aiming to deepen their understanding of social dynamics, and platform moderators interested in maintaining community health and fostering positive interactions.

Keywords: Reddit function, Recurrent Neural Networks (RNNs)

ARTIFICIAL INTELLIGENCE AND HUMAN RIGHTS – A DOUBLE-EDGED SWORD

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Abstract

"Jarvis", an AI enabled video analytics platform is assisting Uttar Pradesh Police Administration to monitor inmates in 70 prisons. Indian government has shown its intent to create the largest facial recognition system of the world for policing. The rapid advancement of artificial intelligence (AI) has transformed various industries, including the domain of national security. AI has immensely benefitted the counterterrorism strategies, intelligence gathering and security threat detection. AI powered systems has enabled the governments world over to identify security threats and neutralize it too through AI supported surveillance systems, predictive analysis and decision-making tools with efficiency. Technological integration in law is a commendable step but it raises substantial legal and constitutional concerns due to lack of comprehensive legal framework which can fix the limit and liability. The widespread use of AI backed security strategies raises serious concerns related to privacy rights, civil liberties and government snooping. This research paper examines the delicate balance between safeguarding human rights and leveraging AI for national security. AI driven facial recognition technologies are deployed for mass surveillance also referred as "dragnet surveillance" to tract individual and monitor public places is of grave concern. Though such steps enhance security but also hold potential to infringe on privacy rights, leading to data breaches, unauthorized access to personal information, discrimination and wrong profiling of individuals especially of disadvantageous groups. Another issue concerns the lack of accountability, fairness and transparency in security measures powered by AI technologies. The researchers argue that rights-based approach to AI driven governance in policing is mandatory. It is a must to establish robust legal frameworks by the policymakers keeping in mind the interest of all stakeholders to prevent AI from being misused. A balanced approach integrating national security with human rights protection will decide the future of Nations and its citizen in the AI driven world.

Keywords: Artificial Intelligence, National Security, Accountability, Surveillance, Human Rights.

P-049

ARGUMENTS AGAINST THE ADMISSIBILITY ANDCREDIBILITYOF BITE MARK EVIDENCE IN THE INDIAN LEGALSYSTEM

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Abstract

When Judge Edward Cowart admitted the testimonies of dental experts Dr. Richard Souviron and Dr. Lowell Levine about Ted Bundy's dental evidence in relation to the murders of Lisa Levy and Margaret Bowman, history was made as a person was convicted largely based on scientific testimonies. However, the usage of bite mark evidence has resulted in false convictions: the case of Steven Chaney, wherein the over-reliance on forensic odontologist Dr. Jim Hales's testimony caused the court to sentence him to life imprisonment in 1987 even though Chaney had a solid alibi at the time of the murder. The NIST's 2022 report questioned the scientific soundness of bite mark evidence on three grounds: a) the anterior dental impressions are not individualistically unique, b) the dental imprints of a person are not accurately transferred to the skin of the victim, and c) there are no marked characteristics in dental impressions that can be used to point towards a person explicitly. Unlike the United States of America calling for a cessation of the use of bite mark testimony around 2015-2017, the Indian judiciary has subsumed the admissibility of bite mark evidence within the domain of expert evidence or testimony under Section 39of the Bharatiya Sakshya Adhiniyam, 2023, as late as 2020 in the case of Shatrughna Baban Meshram v. State of Maharashtra. This paper seeks to gauge the degree of acceptability of bite mark evidence within the Indian legal system. Survey responses from advocates, medical practitioners, forensic experts, dental experts, and legal professionals, and RTI responses from government FSL authorities are used to conclude that medico-legal experts do not believe in the uniqueness and credibility of bite-mark evidence. Akin to the United States, the paper argues against the admissibility of bite mark evidence in the Indian criminal justice system.

Keywords: Section 39 of the Bharatiya Sakshya Adhiniyam, 2023, Bite Mark Evidence, Forensic Odontology, Daubert's Test, Medico-Legal Jurisprudence.

P-050

THE ROLE OF WILDLIFE FORENSICS IN CONSERVING THE ONE-HORNED RHINO: A CASE STUDY OF KAZIRANGA NATIONAL PARK

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Abstract

The Greater One-Horned Rhinoceros (Rhinoceros unicornis), one of the most critically endangered species, has since recovered largely due to conservation efforts at Kaziranga National Park. Despite, the species has seen a decline in reported poaching cases but still, it is at the peak of vulnerability from the highly active illegal wildlife poachers. To further strengthen conservation efforts, the incorporation of wildlife forensic science can be an important factor in upgrading law enforcement and crime prevention efforts against poaching. Forensic methods in Ballistics, DNA profiling, and Forensic Entomology provide useful tools for wildlife crime investigation. Wildlife forensics enables investigators to link firearms to perpetrators as well as match DNA samples to individual criminals through genetic evidence while identifying age-based time elapsed since death when insects develop on bodies. Furthermore, complex surveillance technology such as drone monitoring enables real-time surveillance, offers improved mechanisms to detect illegal activities on the spot. This research recommends the application of forensic methods to wildlife conservation so to enhance current protective procedures. The combination of forensic science with traditional conservation practices allows authorities to improve anti-poaching measures and secure the lasting survival of this famous animal species.

Keywords: Wildlife Forensics, One-Horned Rhinoceros, Kaziranga National Park, Poaching, Ballistics Analysis, DNA Profiling, Forensic Entomology

INK ON PAPER: A STUDY OF LINE QUALITY AND FLUID DYNAMICS IN HANDWRITTEN DOCUMENTS

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Abstract

Handwriting and document analysis is a major area of forensic science. The present research attempts to study the line quality of handwritten documents, which is useful for comparing and analysing questioned documents. This study examines the differences in line quality produced by 0.5mm ballpoint pens, commonly used in daily life. The objective is to determine whether any differences exist between different pens of the same tip calibre. For this study, a stereomicroscope was used to capture images of handwritten documents collected by the researcher. Specialized software was then used to measure line quality. The results indicate that even when using pens of the same calibre, the line quality varied depending on the pen. This variation was observed not only in standard writing but also in scribbling motions such as vertical and horizontal strokes, where differences in line quality were also evident. Furthermore, the study applied Fick's time-dependent diffusion law of fluid dynamics to determine the age of ink. Combining line quality data with Fick's law of diffusion provided valuable insights. It was found that handwriting produced with pens of the same calibre exhibited disparities, and if such writing was added at a later time, diffusion analysis could help detect alterations or additions to the original writing. These findings highlight the practical application of fluid dynamics laws in handwriting analysis and the detection of alterations in questioned documents.

Keywords: Line Quality, Image Analysis, Fluid Dynamics, Age identification, Justice.

BEYOND TRADITIONAL TECHNIQUES: COMPACT POWDER AS ALTERNATE METHOD FOR LATENT FINGERPRINT ENHANCEMENT

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Abstract

Fingerprint is one of the commonly found type of evidence in the crime scene sometimes it may be visible and sometimes invisible, the main work of the fingerprint expert is to apply appropriate powder available to develop the invisible i.e. latent fingerprint. This study is an attempt to investigate the viability of compact powder as an alternative method for the Development of latent fingerprints. Compact powder, a common cosmetic product, offers a potentially cost-effective and accessible solution. If there is any uncertainty if the traditional powder is not available then as alternate approach can a cosmetic i.e. compact powder be used as an alternate to develop the latent fingerprint. The study involves controlled experiments to assess factors such as powder adhesion, clarity of ridge patterns, and contrast on different substrates. The investigation selected the different non-porous and porous surface materials for developing latent fingerprint as well as the basic equipment's for the same. Then the compact powder was selected and initially analysed using Scanning Electron Microscopy (SEM) & Energy Dispersive X-ray-spectroscopy (EDX) to know the morphology and properties present in the compact powder then the fingerprint was dusted to develop latent print from various surfaces. Preliminary results indicate that compact powder can successfully develop clear and distinguishable latent fingerprints, particularly on smooth, non-porous surfaces. The findings suggest that compact powder could serve as a practical alternative in forensic investigations, especially in resource-limited settings. The research has revealed that a simple compact powder can be an alternate to develop the latent print at crime scene. There has been no prior research exploring the application of compact powder as a substitute for conventional fingerprint powder in scenarios where the latter is scarce or unavailable.

Keywords: Latent Fingerprint, Compact Powder, Non-Porous, Justice.

WILDLIFE CRIME AND FORENSICS: CHALLENGES AND ADVANCES IN ENFORCEMENT

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Abstract

This study examines the pivotal contribution of forensic science to combating wildlife crime, an expanding transboundary phenomenon with serious ecological and legal consequences. With the proliferation of illicit wildlife trafficking and deforestation, conventional enforcement tools are frequently inadequate to deliver convictions. This study seeks to assess the efficacy of forensic techniques in investigating wildlife crime, weigh current challenges, and identify ways to strengthen enforcement and conservation. The paper starts by outlining the international legal framework for wildlife conservation, focusing on international conventions and local laws that regulate the enforcement of wildlife crimes. It then initiates a comprehensive discussion of forensic methods such as DNA profiling, toxicology, and fingerprinting. These techniques are vital for species identification, verifying evidence, and linking suspects to crimes. The study also examines conservation strategies for flagship species in India, assessing successes and continuing challenges. Core barriers such as infrastructural shortcomings, availability of resources, and gaps in forensic competence, form a crucial part of the study. Further, community participation and preventive forensic measures and their role in reducing wildlife crimes are discussed. A doctrinal research approach is followed where the analysis draws on legal tools, forensic case studies, academic literature, and government documents. It looks at this through the prism of gaps in forensic infrastructure, an assessment of the status of wildlife forensic science in India, and recommendations for improving investigative and enforcement capacities. The paper concludes by calling for policy reforms, greater investment in forensic labs, and greater international cooperation to enhance the role of forensic science in enforcing wildlife crime.

Keywords: Wildlife Crime, Forensic Science, Conservation Strategies, Law Enforcement.

P-054

BIOMETRIC SURVEILLANCE FOR NATIONAL SECURITY: INTERNATIONAL COOPERATION VS NATIONAL SOVEREIGNITY

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Abstract

Introduction: Biometric surveillance leverages biological characteristics to enhance security, particularly in

border control and counterterrorism. As its adoption grows, two distinct approaches have emerged: International Cooperation, which facilitates data sharing among nations to strengthen security efforts, and National Sovereignty, which prioritizes independent control over biometric data to protect privacy and national interests. This paper explores these contrasting frameworks and their implications for national security.

Methods: This study adopts a qualitative approach using a comparative method and case study analysis, drawing on primary and secondary data to examine biometric surveillance governance. For International Cooperation, it analyzes cases such as the Five Eyes Alliance & Biometric Intelligence Sharing. For National Sovereignty, it examines countries like China, Russia, that prioritizes independent biometric data control.

Results: The International Cooperation Approach strengthens border control and counterterrorism by enabling shared biometric databases, enhancing efficiency in crime prevention through pooled resources. However, it raises concerns about mass surveillance, data privacy, and the need for robust legal frameworks to govern cross-border data sharing. The National Sovereignty Approach prioritizes data privacy and security within national legal frameworks, allowing tailored security measures. While this approach safeguards individual rights and national control, it may limit international collaboration, hindering efforts to combat transnational threats and reducing the effectiveness of counterterrorism initiatives due to restricted intelligence sharing.

Conclusion: A balanced approach to biometric surveillance, combining national sovereignty and international cooperation, is crucial for robust national security. National control safeguards borders, and protects privacy, while international collaboration enhances intelligence-sharing and global counterterrorism efforts. The hybrid strategy can effectively combat evolving security threats by upholding national interests while fostering selective international cooperation.

Keywords: Biometric Surveillance, National Security, International Cooperation, National Sovereignty.

AQUA LINK: A HYBRID WATER-BASED COMMUNICATION NETWORK FOR MARITIME SECURITY IN EXTREME ENVIRONMENTS

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Abstract

Antarctica's extreme conditions and lack of reliable telecommunication infrastructure pose significant challenges to maritime security, real-time data collection, and scientific research. Existing satellite and radio-based systems suffer from latency issues, high costs, and signal failures. Previous research has examined remotely piloted aircraft (RPA) for data collection, NVIS communication, and remote sensing. However, they all face challenges in providing secure and reliable connectivity. Aqua Link introduces a hybrid water-based communication system integrating hydro-optic laser transmission, underwater acoustic relays, and AI-driven smart routing to ensure low-latency, high-reliability connectivity for national security operations, emergency response, and research missions in remote maritime zones. Introduction: Maritime security operations in Antarctica are hindered by unreliable communication networks due to extreme weather, satellite blind spots, and infrastructure limitations. The lack of secure, real-time connectivity affects coastal surveillance, border control, and emergency response. Previous research indicates difficulties in collecting data through RPA (Robotic Process Automation), NVIS communication, and remote sensor networks, which struggle with high latency, environmental limitations, and cybersecurity risks. Furthermore, although Starlink has achieved notable progress in satellite communication, it encounters challenges like inconsistent coverage in polar regions, vulnerability to jamming, excessive energy consumption, and bandwidth saturation in specific locations. These shortcomings highlight the necessity for a robust, multimodal communication strategy. This paper presents Aqua Link, a hybrid communication system based on water, aimed at improving maritime security via seamless, AI-driven multimodal communication networks.

Methods: Aqua Link integrates hydro-optic laser transmission, underwater acoustic relays, and AI powered smart routing for secure, adaptive data transmission.

Key components include: ● Hydro-Optic Signal Transmission: Laser-based water communication to bypass satellite blind spots. ● Underwater Acoustic Relays (Hydro-Satellite Link): SONAR-based transmission between ships, relay buoys, and satellites. ● AI-Optimized Routing: Dynamic selection of the best transmission medium based on environmental factors. ● Self-Sustaining Relay Buoys: Solar and kinetic-powered buoys ensure long-term operation. Data from simulated network stress tests and real-time environmental sampling were used to compare Aqua Link's performance against traditional NVIS-based communication methods.

Results: As Aqua Link is still in the conceptual and simulation phase, no real-world tests have been conducted. However, preliminary simulations suggest a 65% improvement in communication reliability, with projected reductions in signal dropouts and latency by 40% in adverse conditions (Ramirez et al., 2023). Aqua Link's water-based relays are expected to provide uninterrupted transmission. The AI-driven routing is projected to optimize network stability, and relay buoys are anticipated to maintain connectivity for over 30 days without maintenance. The system is designed to enhance maritime surveillance, border security, and emergency response capabilities, but further testing is needed for validation.

Conclusion: Aqua Link represents a paradigm shift in maritime security communication, ensuring fail-safe, covert, and high-speed data transmission in remote waters. Unlike NVIS or RPA-based communication, Aqua Link's multi-modal integration of optical, acoustic, and satellite networks provides a resilient, cyber-secure alternative for border protection and search & rescue (SAR) operations. Future research will explore its applications in Arctic security, deep-sea exploration, and extraterrestrial communication on Europa and Titan.

Keywords: Maritime Security, Hybrid Communication Networks, Underwater Acoustics, AI-Powered Routing, National, Security

P-056

ENHANCING CRIMINAL INVESTIGATIONS THROUGH LAYERED VOICE ANALYSIS: A FORENSIC AND LEGAL PERSPECTIVE ON AI-DRIVEN DECEPTION DETECTION

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Abstract

Layered Voice Analysis (LVA) is a recent advancement in Deception Detection Techniques (DDTs) that identifies psycho-physiological responses through voice modulation analysis. Beyond deception detection, forensic voice analysis plays a crucial role in speaker identification, tape authentication, and evaluating contested statements. In India, the legal framework for forensic voice analysis has evolved through amendments to the Bhartiya Sakhsya Adhiniyam and key judicial rulings, though specific legislation on voice sample testing remains absent. Internationally, voice identification has long-standing applications, with advanced technologies such as LVA and Phonexia Voice Biometrics demonstrating high accuracy in forensic investigations and meeting court admissibility standards. The integration of Artificial Intelligence (AI) has further enhanced forensic voice analysis, addressing traditional limitations by enabling rapid and precise identification of individuals and emotional cues. Ongoing research, such as Muiredach O'Riain's project on machine learning for forensic audio classification, highlights AI's transformative potential in this domain. Additionally, geometric approaches like Bayesian analysis offer improved reliability despite challenges posed by voice alterations due to illness or environmental factors. Advancements in technology and AI-driven innovations present promising avenues for enhancing the accuracy and reliability of forensic voice analysis in legal contexts. This study aims to establish a theoretical framework for LVA's application in criminal investigations, particularly in detecting deceptive or manipulative behaviour in suspect narratives. However, continued research and development are essential to address existing challenges and maximize its effectiveness in criminal investigations, ensuring its role as a robust tool in the pursuit of justice.

Keywords: Layered Voice Analysis, Deception Detection Techniques, Forensic Voice Analysis, Artificial Intelligence, Machine Learning, Legal Framework, Bayesian Analysis.

ASSESSING ONLINE RISK THROUGH PERSONALITY DIMENSIONS

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Abstract

Introduction: The pervasive role of digital platforms in daily life has amplified the relevance of cyber psychology, particularly in understanding how personality traits influence online risk-taking behaviours. This study investigates the relationship between personality disorders, specifically narcissistic personality disorder (NPD) and borderline personality disorder (BPD) and online risk-taking. It further examines contrasting patterns among individuals with internet-related anxiety and explores unique risk behaviours within gamer populations.

Methods: A quantitative research design was employed, utilizing standardized psychological assessment tools to measure personality dimensions, risk-taking behaviours, and motivations for online activities, including sexually explicit content. The study sample comprises adolescents, adults, and gamers to explore developmental and behavioural differences. Conduct disorders were assessed in adolescents, personality disorders in adults, and behavioural patterns in gamers were analysed based on daily gaming hours. Variables such as socio-economic status, gender, and age were also considered to identify demographic influences on online risk behaviours.

Expected Findings: It is anticipated that individuals with NPD and BPD will exhibit significantly higher online risk-taking behaviours compared to those with internet-related anxiety. Motivations behind risky online activities, including sexually explicit behaviours, are expected to vary across demographic groups. Gamers, particularly those with high daily gaming hours, are predicted to display distinct risk-taking patterns compared to non-gamers.

Conclusion: This study aims to highlight the complex interplay between personality traits, demographic factors, and online risk behaviours across diverse populations. By including gamers alongside adolescents and adults, the research seeks to provide comprehensive insights that can inform targeted interventions to mitigate online risk-taking behaviours, particularly among vulnerable and high-risk groups.

Keywords: Cyber Psychology, Risk-Taking Behaviour, Personality Disorders, Online, Behaviour, Adolescents and Adults

INTERTWINING OF THE FORENSIC PSYCHOLOGICAL INTERVENTIONS AND RESTORATIVE JUSTICE FOR EFFECTIVE CRIMINAL JUSTICE SYSTEM

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Abstract

Punitive approaches have been traditionally preferred to control crime. With the advent of modern criminology, experts are suggesting to adopt a restorative approach in penalising the offender. In the present era, the penalisation methods are oscillating between punitive and restorative approaches. Restorative methods focus on the reformation of the offender and thus help him/her to reintegrate with society and also to reduce recidivism. The psychological and behavioural issues of offender play a very crucial role in contemplating the forensic psychological interventions in achieving restorative justice within the context of criminal justice system. Alter criminal behaviour and social reintegration are some of the mechanisms which provide strategic ways for forensic psychological interventions for achieving reformative justice. This research paper will assess the effectiveness of various theories of forensic science psychology by analysing its functionality within the purview of reformative justice. It will also evaluate the various methods of forensic psychology such as the theoretical and empirical approach and its strategies involved. It will also try to identify the gaps and challenges in its implementation. The impact these methods on the offender and the victim will also be a significant part of the study. Few case studies will also be explored for its better understanding. The research paper will conclude with suggestions for achieving the goals of the restorative justice.

Keywords: Forensic Psychological Intervention, Restorative Justice, Offender, Victim, Criminal Justice System

"A NOVEL GREEN APPROACH FOR SPOT DETECTION OF CONCENTRATED SULPHURIC ACID IN VITRIOLAGE CASES"

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Abstract

The idea is to develop on spot detection method for sulphuric acid, which is one of the most frequently found exhibits in Vitriolage cases. Its detection plays a crucial role in a number of fields including Forensic science, Environmental monitoring, Industrial processes, Chemistry and Medical diagnostic cases. The most commonly used techniques are the litmus paper tests and titration techniques which have been widely used from the ancient times, but it possesses a large number of disadvantages, including lack of sensitivity, selectivity, and portability. The main idea of this project is to come up with on-spot detection which can serve as rapid, sensitive, and portable solutions for preliminary identification, which further helps in understanding the sequence of event during the crime scene reconstruction, thus serving the Scene of crime (SOC) officers to lead the case in a proper direction for serving the justice with improved performance, reliability, and accessibility for ensuring the quality by using qualitative analysis keeping in mind of the colour, intensity of sample, weather conditions and contaminates. This approach focuses on–spot detection of sulphuric acid using fruit extract thus serving to be environmental friendly in a number of fields including vitriolage cases to confirm the presence of sulphuric acid present in liquid condition. The results have revealed to not show the presence of positive colour produced from sulphuric acid to different acid, liquids and salts being tested. It can be concluded that the present method has the capability for measuring sulphuric acid using fruit extract with high precision, accuracy and can be conducted easily in laboratories.

Keywords: Sulphuric acid, Vitriolage cases, Qualitative analysis, Environmental-friendly

THE ROLE OF FORENSIC SCIENCE IN INVESTIGATING CRIMES AGAINST WOMEN AND CHILDREN IN LIVE-IN RELATIONSHIPS: A MULTI-DISCIPLINARY APPROACH

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Abstract

Live-in relationships, though legally recognized in many regions, often lack the legal protections afforded to married individuals, making women and children in these arrangements vulnerable to abuse and exploitation. Investigating crimes such as domestic violence, sexual assault, and child abuse in live-in relationships presents unique challenges. Forensic science plays a pivotal role in ensuring justice by providing essential evidence. This paper examines the role of forensic science in investigating crimes within live-in relationships through a multi-disciplinary approach, integrating forensic science, law, psychology, and social work. This research uses a mixed-methods approach, including case studies, literature review, and interviews with forensic experts, law enforcement professionals, and legal practitioners. The study focuses on forensic techniques such as DNA analysis, digital forensics, and psychological profiling to explore their application in live-in relationship crime investigations. A comparative analysis of international legal frameworks is conducted to understand how forensic science is employed in different jurisdictions. The study finds that forensic science is crucial in solving crimes in live-in relationships, particularly in identifying and validating evidence of abuse. DNA, digital evidence, and psychological assessments strengthen victim testimonies and help establish the truth in such sensitive cases. However, challenges include inconsistent legal protections for individuals in live-in relationships and social stigma, which often discourages victims from coming forward. The research highlights the importance of a collaborative, multi-disciplinary approach to address these complex issues. Forensic science plays a vital role in investigating crimes against women and children in live-in relationships, but its effectiveness is maximized through multi-disciplinary collaboration. Legal reforms, improved forensic training, and stronger victim support systems are essential to ensure safety and justice for these vulnerable individuals.

Keywords: Live-In Relationships, Abuse And Exploitation, Digital Evidence, And Psychological Assessments

P-061

AI AND IOT: TRANSFORMING THE LEGAL LANDSCAPE FOR A DIGITAL ERA IN FORENSICS

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Abstract

The convergence of Artificial Intelligence (AI) and the Internet of Things (IoT) is revolutionizing the legal field. Traditionally, legal practices have relied on manual processes, extensive documentation, and human intuition. However, AI and IoT technologies are transforming these practices by introducing automation, enhancing accuracy, and providing unprecedented access to real-time data. In law firms, AI is streamlining tasks such as legal research, case analysis, and predictive analytics. By swiftly processing vast amounts of data, AI enables legal professionals to make informed decisions and strategize effectively. IoT devices, through their interconnected nature, offer new avenues for evidence collection and regulatory compliance. These devices, ranging from smart cameras to environmental sensors, provide continuous data streams that are critical in legal investigations and enforcement. As these technologies become more pervasive, addressing issues of data security, privacy, and ethical considerations is essential. Legal frameworks must evolve in tandem with technological advancements to address these concerns adequately. This research aims to explore the transformative impact of AI and IoT on legal practices, examining both the opportunities they present and the challenges they pose. By understanding the capabilities and limitations of these technologies, legal professionals can better navigate the changing landscape and harness the potential of AI and IoT to create a more efficient and transparent legal system.

Keywords: Artificial Intelligence, IoT, Evidence, Automation and Law

DIGITAL FORENSICS IN CRIMINAL INVESTIGATION: A CRITICAL ANALYSIS WITH SPECIAL REFERENCE TO ADMISSIBILITY BEFORE COURTS

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Abstract

All facets of contemporary society, including the legal system, have undergone radical change since the introduction of digital technology. Technological developments frequently result in a power imbalance that benefits the side with the greatest access to and skill with technology during court proceedings. The fairness of legal proceedings is severely impacted by this power disparity. In the courts, for example, people with access to the most advanced technology are able to gather, evaluate, and present evidence more successfully and efficiently than those without, giving them an unfair edge. The right to a fair trial and the scientific validity of digital evidence are under threat in modern criminal investigations aided by computing technology. Any civil or criminal trial's admissibility of evidence is a critical phase that significantly influences the verdict. Through the development of numerous new types of electronic evidence, technological innovations continue to provide novel and distinctive difficulties to the judiciary and courts. The ease with which electronic evidence can be falsified, altered, and forged presents another difficulty, making it more challenging to determine its admissibility and validity. With particular reference to the search and seizure of digital evidence and its relationship to the Indian Constitution's recognised right to privacy, this article aims to trace the evolving legal framework around the admissibility of digital or e-evidence.

Keywords: Digital forensics, Digital Forensic investigation, Criminal justice system, Admissibility, Technological advancements

ENHANCING FINGERPRINT IMAGES USING CONVENTIONAL MS OFFICE IMAGING TOOL FOR CLARITY OF MINUTIAE

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Abstract

Introduction: Fingerprints are considered as a mean of individual identification in most of the criminal and civil cases. Fingerprint experts thrive to compare the disputed fingerprint impressions collected from the scene of crime or on any disputed document with the specimen fingerprint impressions. Comparison is done for the class and individual characteristics usually using photo enlargements, magnifying glass, digital scan enlargements, stereomicroscope, comparison microscope, or digital microscopes. Many times, it becomes challenging for the fingerprint experts to study, examine, and compare the dull or smudged fingerprint images where the ridge characteristics (minutiae) are not clear. It has been a concern in many cases and the expert opinion in such cases remain inconclusive.

Methods: The current study explores the utilization of conventional MS Office tools to enhance the resolution and clarity of smudged fingerprint impressions by changing settings like sharpness, contrast, brightness, transparency, colour presents etc. For this purpose, a total of 50 smudged and 50 clear fingerprint impressions were collected from the same source (same individual) from the real and prepared forensic cases. The samples were then analysed through magnifying glasses, digital enlargements, and stereomicroscopes along with image enhancing through MS Office tools as mentioned. The following steps were followed during the examination of fingerprint impressions: Scanning, Enlargement, Image Enhancement, Examination, and Comparison of Fingerprints.

Result: The study demonstrated that fingerprint images, whether blurred, smudged, or unclear could be significantly enhanced using simple image-enhancing tools such as Microsoft, PowerPoint, word, and Photoshop. The analysis of various fingerprint samples before and after enhancement revealed the following key observations:

1. Improved clarity of minutiae
2. Image resolution and enlargement
3. Effectiveness and basic enhancement

Conclusion: The study demonstrates that fingerprint clarity for forensic analysis can be successfully increased using non-specialized image-enhancing methods. Digital enhancement even improved patent prints made with conventional inking, demonstrating the necessity of standard enhancement methods. While future research can investigate sophisticated tools for better analysis of indistinct ridge impressions, forensic specialists should incorporate basic digital techniques to increase accuracy.

Keywords: Fingerprints, Smudged and Dull Fingerprints, Image Enlargement

P-064

PERSONALITY PROFILING OF EDUCATORS ENGAGED IN THE SEXUAL HARASSMENT, ABUSE AND VIOLENCE AGAINST MINORS WITHIN EDUCATIONAL SETTINGS THROUGH CASE STUDIES

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Abstract

Background: The sexual abuse of minors by educators is a grave issue that inflicts significant psychological harm on victims, often leading to enduring trauma and emotional distress. The present study examined the psychosocial and behavioural patterns of educators who commit sexual assault against minors, focusing on how factors such as narcissism, psychopathy, and impairments in impulse control contribute to these offenses. The study also considered how institutional deficiencies, power dynamics, and trauma may perpetuate patterns of violence and abuse in educational settings

Methodology: The study employed the PRISMA framework to examine the prevalent psychological characteristics and behavioural patterns of educator misconduct, analysing publications indexed in databases such as Sage, SpringerLink, Web of Science, Scopus, and PsycINFO. The review prominently featured the studies on criminal profiling, grooming behaviours, the impact of trauma on victims, institutional neglect, and the potential role of emotional literacy programs in preventing abuse.

Results: Numerous offending educators exhibited traits associated with emotional detachment, narcissistic entitlement, and manipulation, among others. Prevalent strategies employed to exploit young individuals include grooming behaviours, coercive manipulation, and persistent infringements of boundaries. Furthermore, the trauma endured by victims typically results in profound emotional and psychological distress, leading to long-term consequences such as PTSD, anxiety, and difficulties in forming trust-based relationships. The perpetuation of such abuse is frequently enabled by institutional neglect and inadequate protection regulations. Research have also demonstrated the essential role of emotional literacy programs in establishing secure classrooms and equipping children with the skills to recognize and record inappropriate behaviours. The Protection of Children from Sexual Offences (POCSO) Act of 2012 in India safeguards children from sexual assault perpetrated by educators and other adults. The legislation emphasizes to create specialized courts to adjudicate certain cases to prevent and control national threat and promote human rights. The awareness and implementation of Article 19 of the UN Convention on the Rights of the Child that safeguards child both within and outside the home environment is the need of the hour.

Conclusions and Implications: Comprehending the personality characteristics and abusive inclinations of educational personnel who perpetrate sexual assault on students is crucial for policy reform, early intervention, and prevention efforts. Integrating the approaches by researchers, academicians, social workers, mental health professionals and policymakers into national security initiatives can enhance minor's safety in school settings.

Keywords: Crime against Minors, Educators, Personality Profiling, Sexual Abuse Harassment and Violence, Schools

BLOCK CHAIN-BASED QUANTUM-RESILIENT FINANCIAL SYSTEM

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Abstract

The swift progress in quantum computing presents a major risk to the safety of existing cryptographic protocols, including those utilized in financial block-chain systems. Established block-chain networks, such as Bitcoin and Ethereum, depend on classical cryptographic algorithms—like 256-bit elliptic curve signatures—that are susceptible to quantum attacks, especially with the introduction of Shor's algorithm. To tackle these issues, we suggest creating a Quantum-Resilient Block-chain (QRB) that incorporates quantum-safe cryptographic algorithms from the beginning. This hybrid strategy utilizes post-quantum digital signatures and quantum-enhanced consensus techniques (like Proof-of-Stake or Proof-of-Work), ensuring strength against both classical and quantum threats. During the transition period, the block chain adopts a hybrid cryptography model, progressively advancing to entirely quantum-secure protocols as quantum computing powers increase. Our method ensures the integrity, security, and traceability of financial transactions by employing quantum-safe cryptographic approaches, which shield against the dangers posed by quantum adversaries, while enabling future-proof, scalable solutions for secure digital finance in a quantum-driven landscape.

Keywords: Quantum-Safe Cryptography, Post-Quantum Blockchain, Hybrid Cryptography, Quantum-Enhanced Consensus, Quantum-Resilient Digital Signatures

JUSTICE DELAYED OR JUSTICE DENIED? LEGAL BARRIERS IN SEXUAL ASSAULT FORENSIC EXAMINATIONS

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Abstract

Forensic investigations provide objective evidence that can confirm victim testimonies and identify perpetrators, making them crucial to securing justice in sexual assault cases. These tests, however, may be hampered by a number of legal obstacles, delaying or denying survivors justice. The main legal restrictions on forensic examinations in sexual assault cases are examined in this review. These include evidentiary standards, procedural hurdles, resource constraints, and restrictive laws and policies. The well-being and access to justice of victims are severely impacted by these obstacles, which can result in anything from major delays in investigations and prosecutions to the dismissal of cases. Potential remedies like standardized procedures, more financing for forensic services, policy changes, better training for law enforcement and medical personnel, and improved victim support services are also examined in this review. It is imperative to address these legal barriers in order to provide survivors of sexual assault with prompt and efficient justice.

Keywords: Sexual Assault, Forensic Investigations, Legal Barriers, Justice Delayed, Justice Denied, Evidentiary Standards.

P-067

AGE ESTIMATION FROM DNA METHYLATION PATTERNS

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Abstract

Without modifying the DNA sequence, DNA methylation (DNAm) is an epigenetic modification that controls gene expression. Because certain methylation sites change predictably over time, it is essential to biological aging. The creation of extremely precise age estimation models based on DNAm patterns—often referred to as epigenetic clocks—has been made possible by recent developments in epigenetics. Machine learning algorithms trained on methylation data from thousands of people are the foundation of epigenetic age estimation. According to these models, the methylation levels of CpG sites regions of DNA where cytosine is methylated correlate with age. Among the most well-known predictors are those made by Horvath and Hannum, which have uses in aging studies, medicine, and forensic science. They have proven to be remarkably accurate, frequently estimating age to within a few-year margin. DNA patterns can provide biological age, which is a reflection of an individual's health and rate of aging, in addition to chronological age prediction. Differences between biological and chronological age could be a sign of environmental factors, lifestyle choices, or disease susceptibility. This has prompted research into longevity studies, personalized medicine, and DNAm-based biomarkers for age-related diseases. There are still issues despite its potential, such as tissue variability, environmental effects, and the requirement for sizable, varied datasets. Future studies will try to improve cross-population accuracy, fine-tune epigenetic clocks, and find more profound connections between DNAm and aging processes. DNA methylation-based age estimation is anticipated to develop into a useful tool for biomedical research, legal investigations, and the prevention of age-related diseases as technology advances.

Keywords: DNA methylation, epigenetic, age estimation, CpG sites, Horvath and Hannum

A NEW ERA OF DRUG DETECTION: EMERGING TECHNOLOGIES IN FORENSIC TOXICOLOGY

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Abstract

Advances in forensic drug detection are necessary due to the significant challenges posed by the advent of fentanyl and its analogs in illegal drug markets. When new psychoactive medicines are introduced quickly, traditional methods including spectroscopic techniques, gas chromatography-mass spectrometry, and immunoassays usually fall behind. This review examines new technologies that enhance forensic investigations' sensitivity, specificity, and real-time monitoring. Fentanyl analogue detection has been improved thanks to AIdriven prediction models and advanced high-resolution mass spectrometry, which has reduced false positives and negatives. Field application efficiency is increased by the portable, rapid, and economical drug screening made possible by the integration of biosensors, nanotechnology, and electrochemical sensors. Microfluidic systems and lab-on-a-chip devices enhance forensic processes by offering real-time, non-invasive detection alternatives. Additionally, by improving the accuracy of sample analysis, attenuated total reflectance-Fourier transform infrared spectroscopy has shown promise in forensic toxicology. Important challenges still exist in spite of these developments, such as sample complexity, cross-reactivity, and regulatory compliance. Further research into interdisciplinary cooperation, data standardization, and technology integration is required to overcome these limitations. In order to address the opioid crisis, improve forensic accuracy, and guarantee successful drug detection, forensic technologies must continue to advance. These developments enhance public safety and law enforcement capabilities in addition to strengthening forensic toxicology.

Keywords: Forensic Toxicology, Fentanyl Detection, Emerging Technologies, Mass Spectrometry, Biosensors

P-069

EMERGING TECHNIQUES IN PMI ESTIMATION

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Abstract

Estimating the postmortem interval (PMI) is an important part of forensic investigations because it helps determine how long it has been since death. Traditional methods rely on body decomposition analysis, entomological data, and temperature-based algorithms. However, these methods have limitations because of environmental variability and individual differences. Emerging techniques take advantage of advances in molecular biology, spectroscopy, and artificial intelligence to improve accuracy and reliability. Metabolomic profiling, microbial community analysis, and advanced imaging techniques like hyperspectral imaging are all popular approaches. Estimating the postmortem interval (PMI) is an important part of forensic investigations because it helps determine how long it has been since death. Traditional methods rely on body decomposition analysis, entomological data, and temperature-based algorithms. However, these methods have limitations because of environmental variability and individual differences. Emerging techniques take advantage of advances in molecular biology, spectroscopy, and artificial intelligence to improve accuracy and reliability. Metabolomic profiling, microbial community analysis, and advanced imaging techniques like hyperspectral imaging are all popular approaches.

Keywords: PMI Estimation, Proteomics, Postmortem Microbiome, Machine Learning, Spectroscopy.

P-070

BEYOND THE SCALPEL: ADVANCING MEDICO-LEGAL AUTOPSY

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Abstract

The medico-legal examinations conducted during autopsies enable the investigation of the cause and manner of death, aid in criminal investigations, and guarantee justice in court. Due to technological advancements, autopsy practices that traditionally depended on manual dissection and observational methods have experienced significant changes. Modern imaging methods such as computed tomography, magnetic resonance imaging, and three-dimensional imaging have made non-invasive autopsy and virtopsy possible. Forensic experts may detect illnesses, fractures, and haemorrhages without jeopardising the body's integrity, which allows for extremely detailed views of internal components. Virtuopsy increases the accuracy of diagnoses and respects the cultural ethics and religious beliefs associated with traditional autopsies. New developments include augmented reality for interactive forensic investigations, virtual reality 3D imaging for training and simulations, and artificial intelligence for automated image processing. Notwithstanding their revolutionary promise, obstacles including exorbitant expenses, a dearth of standardized procedures, and restricted accessibility prevent their broad implementation. To close the gap between conventional methods and technological advancements, future research orientations will prioritize interdisciplinary cooperation, ethical issues, and ongoing training. By adopting these developments, medico-legal autopsies can reach previously unheard-of levels of precision, dependability, and public acceptance, ushering in a new era of forensic medicine.

Keywords: Medico-legal examination; Virtopsy; 3D imaging; Artificial Intelligence.

PERSONALITY DISORDERS AND CRIME AMONG JUVENILE DELINQUENTS: A STUDY USING PRISMA MODEL FOR REHABILITATION AND REINTEGRATION OF JUVENILE OFFENDERS FROM GLOBAL PERSPECTIVES

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Abstract

Children who have been convicted are sheltered to juvenile institutions and receive a range of correctional and therapeutic services. Past reviews state that juvenile crime recidivism, escapes from facilities, and the adoption of criminal behaviours influenced by the violence observed in juvenile residential settings. This compels us to look at the primary reasons behind a child's criminal conduct and if correctional facilities in any way assist in the continuing of criminal activity after they have been placed there.

Aim: To identify the predisposing personality disorder contributing to delinquency in juveniles and review the global perspectives for rehabilitation and reintegration into their communities.

Methods: The study was conducted in compliance with PRISMA guidelines through the structured literature search done across the databases Taylor and Francis, Nature, ScienceDirect, SagePub, Wiley, and ResearchGate from 2015 to 2025, including Psychological and legal analysis and observational studies across the Asian, American, and European continents with required inclusion and exclusion criteria.

Results: The research indicated that based on growing intensity of crimes the juveniles in incarceration exhibit heightened levels of anger, irritability, and impulsivity, which are attributed to underlying psychiatric disorders. Notably, antisocial personality disorder emerged as a significant moderator influencing criminal behaviour.

Conclusion: The study emphasized proposing psychological interventions under laws and justice based on human rights i.e. the role of mental health professionals, social workers, communities, policy makers to create the reintegrative system associated with juvenile homes. The successful rehabilitation of juveniles depends on a multifaceted approach that considers mental health, education, emotional support, and family involvement in youth. This understanding calls for a shift in how both India and Western countries perceive juvenile offenders not as lost causes or criminals, but as individuals in need of holistic development in the form of guidance, care, and support to re-enter society as productive and emotionally healthy adults.

Keywords: Personality Disorders, Crime, Juvenile Delinquents, Rehabilitation and Reintegration, Global Perspectives.

P-072

COMPARATIVE ANALYSIS OF SOCIAL ANXIETY IN CONVICTED INMATES OF OPEN AND TRADITIONAL PRISON SYSTEMS

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Abstract

The current focus of rehabilitation of convicts within prisons has seen a shift from the traditional incarceration with minimal facilities and opportunities as punishment to a more open environment to ensure a convict's reformation and reintegration into the society. The current research, therefore, focuses on comparing the level of social anxiety amongst inmates incarcerated under traditional jail system and those who are under the open jail system in Yerwada Jail, Pune, Maharashtra. Utilizing the Liebowitz Social Anxiety Scale (LSAS, Liebowitz, 1987), the current research has tried to analyze and understand the levels of anxiety, apprehension and avoidance of social situations in the two groups of inmates (N=60), convicted inmates in open prison system (N=30) and convicted inmates in traditional system (N=30). The results were analyzed w.r.t. the external circumstances surrounding the two individual prison systems. The discussion focuses on how the two different methods of incarceration affect the physiological well- being of the inmates as well as focusing on the way forward, especially recommendations for further research into policies for rehabilitation and reformation to ensure recidivism rates.

Keywords: Forensic Psychological Assessment, Open Prisons, Traditional Prisons, Prison Population, Aggression in inmates, Social Anxiety

P-073

UNLOCKING THE UNSPOKEN: EVALUATING THE DRAW-A-PERSON (DAP) TEST AS A PSYCHOLOGICAL ASSESSMENT AND INTERVENTION TOOL IN CORRECTIONAL FACILITIES

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Abstract

How do we truly understand a person who has learned to mask emotions, distrust authority, and remain guarded in an environment that values strength over vulnerability? What if a simple drawing could reveal the unspoken fears, suppressed traumas, and hidden struggles of an inmate? Behind prison walls, where silence speaks louder than words, and emotions are buried beneath hardened exteriors, understanding the true psychological state of inmates has remained a challenge. Many carried unspoken traumas, unresolved conflicts, and suppressed identities, making traditional self-report assessments unreliable and inadequate. In an environment where trust was scarce and verbal expression remained guarded, accessing the mind beyond what was spoken required a different approach. This study explored the Draw-A-Person (DAP) test as a psychological key—a tool capable of unlocking subconscious emotions that inmates either could not or would not express openly. Behind every line, shape, omission, and distortion, a hidden narrative emerged—a silent plea, a repressed conflict, an unhealed wound. Through the DAP assessments of 10 inmates at Sabarmati Central Prison, conducted across four sessions during their counselling, distinct patterns of aggression, paranoia, dependency, cognitive distortions, and emotional dysregulation surfaced. These findings illustrated how projective testing accessed deeper psychological layers that traditional assessments often overlooked, making it a powerful tool for forensic psychology in correctional settings. By analysing these subconscious projections, this study evaluated the effectiveness of the DAP test not just as a diagnostic tool but also as an intervention method. The results suggested that DAPbased assessments helped in identifying emotional dysregulation, cognitive distortions, and behavioural challenges that verbal therapy alone struggled to uncover. Moreover, patterns observed over multiple sessions provided insight into psychological progress, resistance, or deterioration, offering a dynamic perspective on inmate mental health. This research emphasized the need for integrating projective techniques like the DAP test into correctional psychology frameworks, allowing for more precise interventions, tailored rehabilitation strategies, and a deeper understanding of inmates psychological needs.

Keywords: Draw-A-Person (DAP) Test, Forensic Psychology, Correctional Mental Health, Psychological Intervention

INVESTIGATING VIRTUAL CRIMES IN THE METAVERSE: THE ROLE OF FORENSIC SCIENCE IN DETECTING, PREVENTING, AND PROSECUTING CYBERCRIME IN IMMERSIVE DIGITAL WORLDS

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Abstract

The rapid development of the metaverse—an immersive digital space integrating virtual and augmented realities—has led to an increase in virtual crimes, ranging from identity theft to intellectual property infringement. With the rise of these new forms of cybercrime, there is an urgent need to investigate the role of forensic science in detecting, preventing, and prosecuting virtual crimes in these immersive environments. This study aims to explore how forensic methods can be applied to the metaverse and identify the challenges associated with cybercrime in digital worlds. The research adopts a qualitative approach, reviewing existing literature on virtual crime and forensic science in the context of immersive digital worlds. Case studies are analysed to examine the types of crimes occurring in the metaverse, and forensic techniques such as digital footprint tracking, blockchain forensics, and avatar analysis are explored. Additionally, legal frameworks and the role of international cooperation in prosecuting virtual crimes are examined through policy analysis. The study finds that digital footprints, transaction logs, and blockchain data can be vital in identifying perpetrators of virtual crimes. The forensic analysis of avatars and metadata also plays a crucial role in linking virtual actions to real-world identities. However, challenges in jurisdiction, evidence preservation, and the anonymous nature of the metaverse complicate the detection and prosecution of cybercrime. Legal frameworks are currently insufficient to address these issues, with many gaps in international cooperation.

Keywords: Metaverse, Blockchain data, Cybercrime

FORENSIC SCIENCE AND COUNTERTERRORISM: TRACING FINANCIAL AND DIGITAL FOOTPRINTS OF TERROR NETWORKS

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Abstract

The introduction sets the stage for the research, highlighting the critical role of forensic science in counterterrorism efforts. It explains how terrorist networks leave behind financial and digital footprints, which can be traced using forensic methodologies. The introduction also provides an overview of the research, including its objectives, scope, and significance. It emphasizes the importance of understanding the intersection of forensic science and counterterrorism, and how this knowledge can be used to disrupt and dismantle terrorist networks

Methods: This topic explains the research methodology used to investigate the application of forensic science in counterterrorism. It describes the use of forensic accounting, cyber forensics, and digital intelligence to track terrorist networks. The methods section also discusses the use of case studies and advanced technological applications to analyze and interpret the data. It provides an overview of the tools and techniques used to collect and analyze the data and explains how the research findings were validated and verified.

Results: The results topic presents the findings of the research, highlighting the effectiveness of forensic science in disrupting terrorist operations. It provides an analysis of the financial and digital footprints left behind by terrorist networks and explains how these footprints can be used to identify and track terrorist activity. The results section also discusses the challenges and limitations of using forensic science in counterterrorism efforts and provides recommendations for future research.

Conclusion: The conclusion summarizes the key findings of the research, emphasizing the critical role of forensic science in counterterrorism efforts. It reiterates the importance of understanding the intersection of forensic science and counterterrorism and highlights the need for further research in this area. The conclusion also provides recommendations for policymakers and practitioners, emphasizing the need to integrate forensic science into counterterrorism strategies and to develop new methodologies to combat evolving terrorist threats.

Keywords: Counterterrorism, Digital footprints, Digital intelligence

P-076

ANALYZING THE PROBATIVE VALUE OF FORENSIC EVIDENCE IN INDIAN COURTS WITH SPECIAL REFERENCE TO DECEPTION DETECTION TECHNIQUES

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Abstract

In the last few decades, forensic science has emerged as a linchpin in the justice delivery system across the globe. But in India, the use of various Deception Detection techniques (like Brain mapping, Narco-analysis, Polygraph Test etc.) to determine and establish the truth has sparked a countrywide debate regarding human rights and privacy issues it entails. Although, keeping in view the level of sophistication in new types of crimes in this digital world, strengthening the forensic science for detection of crimes is the need of the hour. But such forensic reports cannot form the sole basis of conviction or acquittal of a suspect/accused person. Moreover, under the garb of procuring truth through such scientific methods, the fundamental rights of an individual guaranteed by the Constitution of India cannot be put at the back burner. So, there is an urgent need to balance the use of such scientific innovations along with the statutory laws of the country. The most pressing priority is to ensure that our fundamental rights like personal freedom and right to privacy under article 21 and protection against self-incrimination under article 20(3) of Constitution of India do not get violated because of these scientific and technological advancements. This paper outlines the brief understanding of what does Deception Detection Techniques (DDTs) mean and how does it work? Thereafter, it discusses about the applications of DDTs in criminal justice system and also discusses about the concerns associated with implementation of such technology and that too, in the absence of any legislative backing and judicial oversight. It further covers the perspective of other nations regarding determination of measures for balancing the benefits and dangers that has been posed by this technology with its implementation/usage. Lastly, it suggests few measures that should be implemented before such technologies are applied in different domains of investigative or justice systems, so as to guarantee the citizens for protection of their variety of fundamental rights.

Keywords: Forensic Reports; Expert Opinion; Evidentiary or Probative Value; Privacy; Deception Detection Techniques (DDTs).

FORENSIC METALLURGY: AN APPROACH TOWARDS INVESTIGATING MATERIAL FAILURES

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Abstract

Forensic metallurgy plays a crucial role in crime scene investigations involving material failures, and counterfeit metals detection, offering scientific methods to analyse and interpret evidence related to metallic components in criminal cases. By applying metallurgical principles, forensic metallurgists can determine whether failures in metal structures, tools, or weapons resulted from accidents, intentional acts, or long-term degradation. This approach is particularly valuable in cases of product tampering, structural collapses, vehicular accidents, and sabotage. A key aspect of forensic metallurgy in crime investigations is the identification of failure mechanisms such as fatigue, corrosion, brittle fracture, and impact damage. Authors have used metallurgical microscopes which helps to enhances the accuracy of material failure investigations. Metallurgical microscope was integrated with specialized metallurgy software, enabling us for high-resolution imaging, automated defect detection, and comprehensive microstructural analysis. The microscope helped us in identifying grain structures, inclusions, phase compositions, and fracture patterns, which are critical for determining the cause of failures in metallic objects. The authors were able to identify the micro-structure of copper, steel and aluminium after thorough analysis of processed samples. It was found that the microstructures present in all three materials had a unique shape and size. Authors suggest that these microstructures can be easily used to identify and individualize exhibits recorded from the crime scene. Thus, reflecting a new dimension to investigating agencies as well as judiciary in dealing with metal failures and forgeries.

Keywords: Metallurgy, Chemical Etching, Microstructures, Counterfeit Metals, Forensic Physics

REGULATING THE GENETIC SURVEILLANCE OF THE DNA DATABASES – A POLICY PERSPECTIVE

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Abstract

The establishment of national DNA databases, which preserve the genetic profile of offenders, has shown to be essential in solving major crimes. This has led to the creation of new, more complex ways to investigate, ranging from "familial searching" to "forensic genetic genealogy," which uses commercial genealogy databases to help police solve crimes. Numerous nations have begun to establish national DNA databases that save the genetic information of individuals who have been convicted of crimes as well as those who have been arrested, victims, missing, or who are considered persons of interest, in an effort to broaden the scope of forensic genetics. These regulations spell out the specifics, including the authorities that are authorized to access and use DNA databases, as well as the necessary procedures. Since these intricate regulations have the potential to impact non-discrimination, the presumption of innocence, data protection, and people' rights to privacy, they have often been the subject of heated debate and discussion. For lawmakers who are tasked with making sensitive regulatory choices, the task of finding a good balance between the effectiveness of this investigative weapon and a reasonable and required intrusion into the private lives of residents has been a significant difficulty. The main topic of the paper is the problems and challenges that come up with two of the newest and most widespread changes in genetic forensics: using the so-called "familial searching technique" and DNA analysis outside of national databases to find long-distance family contacts. Despite their usefulness, these new tools bring up significant ethical and legal questions and this paper seeks to explain these complicated issues by highlighting the necessity to find a middle ground between the public's desire for efficient and quick identification of unknown criminals and the risky trend towards "genetic surveillance."

Keywords: DNA Evidence, Genetic Databases, Surveillance, Right to Privacy, Human Rights

DECODING HANDWRITING: A META- ANALYTICAL PERSPECTIVE ON THE VALIDITY AND CHALLENGES OF FORENSIC GRAPHOLOGY

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Abstract

Handwriting analysis or forensic graphology has been used in criminal investigations, document authentication and psychological profiling. But is it scientifically valid? This meta-analytical study reviews the reliability, accuracy and limitations of forensic graphology by synthesising all the existing literature, experiments and case reports. The study looks into the cognitive and motor mechanisms of handwriting, the stability of handwriting traits, the impact of psychological and environmental factors and the challenges of disguise and forgery. A systematic review of the empirical research highlights the variations in expert conclusions, inter-examiner reliability issues and the bias in handwriting analysis. Also, the study evaluates the effectiveness of quantitative methods like automated handwriting recognition and machine learning algorithms in making handwriting analysis more objective. Findings show that while some handwriting characteristics like slant, pressure and letter formation can be consistent markers of authorship, the lack of standardisation limits the field's forensic admissibility. The integration of AI driven handwriting analysis and biometric methods has shown promise in improving accuracy, but challenges remain in differentiating natural variations from intentional modifications. This study emphasizes the need for interdisciplinary collaboration between forensic experts, cognitive scientists and data analysts to develop standard protocols, improve training methods and increase the scientific robustness of handwriting analysis. By addressing these challenges forensic graphology can become a more reliable tool for investigations. This study shows the key points on the strengths, limitations and future of forensic graphology and a balanced view of its role in modern forensic investigations.

Keywords: Handwriting Analysis, Criminal Tendency, Behaviour, Graphology, Personality, Forensic Graphology

ARTIFICIAL INTELLIGENCE AND INDUSTRIAL SECURITY: NAVIGATING LEGAL AND ETHICAL COMPLEXITIES

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Abstract

AI is redefining the standards of risk management and industrial security around the world by making a shift from traditional methods to more proactive and intelligent threat detection strategies. Support for AI powered systems in industrial sectors is increasing as security operation centres that employ automation, predictive analytics and robust platforms to counter cyber and physical threats to industrial infrastructure are on the rise. This paper will examine the use of AI in industrial security transformations; its applicability, shortcomings, and the regulatory challenges. The research will combine legal doctrinal analysis, case studies and comparative regulatory reports to assess the claims of AI optimizing security infrastructures. Industrial security and automation risk mitigation has greatly benefited from AI powered autonomous suspicion evaluation, unsupervised pattern recognition, cyber threat assessment, and other modalities. With behaviour analysis of the network, deep learning algorithms improve intrusion detection by creating a boundary for false positives and incidents, enabling the detection of anomalies that exceed previously established predications. AI biometric security, predictive analytics, and robotic security patrols provide robust perimeter defences and prevent cyberattacks on Industrial Control Systems (ICS). However, the journey toward undisturbed implementation is full of hurdles like algorithmic bias, ethical dilemmas of surveillance, cyber threats, and regulatory splits. The findings will show that the adoption of AI has improved the efficiency of real time threat detection and predictive risk assessment systems have lessened system downtime and improved autonomous response capabilities. Still, they have raised significant legal concerns in compliance with India's Digital Personal Data Protection Act (DPDP), utilization of data sovereignty, and assigning responsibility for AI caused breaches. As artificial intelligence systems assume the real time industrial security decision making processes, matters of corporate liability, the due diligence expectations, and legal compliance emerge as paramount issues. This paper argues for the adoption of robust regulatory measures for AI powered security and makes the case for AI liability frameworks, cross border data protection policies, and ethical governance of AI. Blockchain security and quantum encryption AI models will change legal requirements to ensure secure responsibility and fair AI utilization.

Keywords: AI Governance, Industrial Security, Cybersecurity Law, Legal Accountability, Data Protection

GENTRIFICATION AND CRIME: DOES URBAN REDEVELOPMENT REDUCE OR RELOCATE CRIME?

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Abstract

Introduction: Gentrification, characterized by the influx of higher-income populations into previously lower-income urban areas, is often associated with improved infrastructure and increased economic activity. However, its impact on crime remains a subject of debate. Some studies suggest that gentrification leads to crime reduction due to better policing and increased investments, while others argue that it displaces crime to adjacent neighborhood rather than eliminating it. This research seeks to evaluate the relationship between urban redevelopment and crime dynamics, analysing whether crime rates truly decline or shift geographically.

Methods: This study employs a multi-method approach, incorporating spatial analysis through Geographic Information Systems (GIS) to track crime patterns before and after gentrification. Additionally, census data, law enforcement records, and qualitative interviews with residents provide insights into socioeconomic shift and community perceptions of safety

Results: Findings indicate that while property crimes often decline in gentrified neighborhoods due to increased security measures and surveillance, violent crimes and social tensions may rise in neighboring areas due to economic displacement. Low-income communities, pushed out by rising rents, frequently experience a surge in crime as a result of socioeconomic instability. Moreover, policing strategies may contribute to changes in crime reporting rather than actual reductions in crime.

Conclusion: Gentrification alone does not serve as a sustainable crime reduction strategy. To mitigate crime displacement, urban planners must incorporate inclusive policies that balance redevelopment with affordable housing, community engagement, and social equity initiatives. Collaborative efforts between policymakers, law enforcement, and urban planners are essential to ensuring that gentrification contributes to safer and more inclusive cities rather than exacerbating existing social inequalities

Keywords: Gentrification, Urban Redevelopment, Crime Displacement, Socioeconomic Impact, Urban Planning

FORENSIC SCIENCE IN THE AGE OF AI: ENHANCING INVESTIGATIONS WHILE PRESERVING HUMAN JUDGMENT

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Abstract

The integration of Artificial Intelligence (AI) into forensic science has revolutionized the way investigations are conducted, offering unprecedented speed and precision in analysing evidence. AI plays a critical role in various forensic domains, including digital forensics, DNA analysis, fingerprint matching, facial recognition, and crime scene reconstruction. For example, AI can process massive datasets from digital devices, enhance blurred images or videos, and identify patterns in complex DNA mixtures with remarkable accuracy. These advancements not only save time but also reduce human error in repetitive tasks. Forensic science often involves interpreting ambiguous or incomplete evidence, where human judgment is irreplaceable. While AI can flag potential matches or anomalies, it lacks the ability to understand the broader context of a case or make nuanced decisions based on years of professional expertise. Moreover, in real-case scenarios, AI tools often face limitations due to the requirement of a minimum number of samples for accurate processing. In forensic DNA analysis, for instance, AI-driven tools struggle with degraded or low-quantity samples, leading to inconclusive results. Similarly, in facial recognition, insufficient or low-quality image data can result in misidentifications, raising ethical concerns in the justice system. Human investigators bring moral reasoning, critical thinking, and the pursuit of justice to forensic science—qualities that AI simply cannot replicate. Understanding the psychological aspects of a crime or recognizing subtle behavioural cues in witness testimonies requires a level of insight that machines do not possess. These errors underscore the need for human oversight to validate AI outputs and ensure justice is served fairly. Ultimately, AI should be viewed as a powerful tool that complements, rather than replaces, human expertise. The future of forensics lies in striking a balance between leveraging AI's computational strengths and preserving the irreplaceable value of human intuition and ethical reasoning. By working together, humans and AI can achieve more accurate, reliable, and just outcomes in the pursuit of truth.

Keywords: Artificial Intelligence, Forensic Science, Crime Scene Investigation, Evidence Processing, Criminal Justice.

EXAMINING THE OVERLAPPING STROKES OF PRINTTED MATTER, AND STAMP: IMPLICATION FOR DOCUMENT AUTHENTICATION

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Abstract

Documents serve as a major evidence in legal, financial, and administrative matters. Examination of the overlapping strokes helps to determine authenticity, identify potential alterations, and assess the reliability of the document. Examination of the intersecting strokes of printed matter and stamp is one of the essential steps taken to authenticate the document and presents with the key challenge for the expert as well. In printing method, laser printing is a widely used method for producing text and images on documents. Handwritten signatures and annotations are frequently added to documents to provide authenticity and personal verification, and stamps / Seals are often used in official documents to authenticate them. It is essential for a document expert to authenticate the document and intersecting strokes often seen as a challenge by them. Fraudulent modifications can involve post-printing alterations, backdated additions, or unauthorized insertions, all of which can have significant legal implications. This study focuses on determining the chronological order of the printed matter (black toner), and blue stamps. Video Spectral Comparator 8000HS was used to analyze under different light sources and three-dimensional characteristics to identify and examine the overlapping strokes. The results indicated that specific light settings like Flood light, fluorescent light 665nm, fluorescent light 530nm and specifically three-dimensional layering of the document give distinctive results for precise understanding of the sequence of the overlapping stroke.

Keywords: Forensic Document Examination, Overlapping Strokes, Video Spectral Comparator (VSC), Ink Analysis, Spectral Light Sources, And Forgery Detection

COMPARATIVE ANALYSIS OF HAND DIMENSIONS AND THEIR PREDICTIVE ACCURACY FOR STATURE AND GENDER BETWEEN ADOLESCENTS AND YOUNG ADULTS

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Abstract

Introduction: Human identification is a fundamental aspect of forensic science, particularly in cases involving fragmented or dismembered remains. Hand measurements serve as reliable anthropometric markers for estimating stature and gender, offering a non-invasive alternative when DNA analysis is impractical. This study assesses the correlation between hand dimensions and stature, determines gender classification accuracy, and identifies the most reliable predictors of stature and gender among individuals aged 16–28 years.

Methods: A cross-sectional study was conducted on 280 participants (140 males and 140 females) divided into two age groups (16–20 and 21–28 years). Anthropometric measurements—including height, hand length (HL_R, HL_L), hand breadth (HB_R, HB_L), palm length (PL_R, PL_L), and finger lengths [index (IFL_R, IFL_L) and ring fingers (RFL_R, RFL_L)]—were recorded using a measuring tape and digital Vernier caliper. Statistical analyses, including descriptive statistics, Pearson correlation, multiple regression, discriminant function analysis, and independent t-tests, were conducted using SPSS software.

Results: Regression analysis identified Avg_HL (average hand length), HB_R, and RFL_L as the most significant predictors of stature. Discriminant function analysis using Avg_PL (average palm length), Avg_HB (average hand breadth), and HB_L achieved 85.70% accuracy in gender classification. Gender differences were observed, with females showing stronger stature prediction from hand length, while males relied more on hand breadth. Age-related variations indicated that RFL was a stronger predictor in younger females and HL_L in older females, whereas HB_R was more predictive in younger males and Avg_RFL in older males.

Conclusion: This study establishes hand measurements as reliable markers for stature and gender estimation, emphasizing gender-based and age-related variations and the necessity of population-specific models in forensic investigations. Their cost-effectiveness, accessibility, and non-invasive nature make them valuable in forensic anthropology, biometric security, and medical research, particularly when DNA analysis is not feasible, reinforcing their forensic and clinical applicability.

Keywords: Forensic anthropology, Human identification, Stature estimation, Gender determination, Hand measurements, Anthropometry, and SPSS statistical analysis.

DEEP LEARNING FOR MEDICAL IMAGE ANALYSIS: A COMPARATIVE STUDY OF CONVOLUTIONAL NEURAL NETWORKS (CNNS) AND TRANSFER LEARNING TECHNIQUES

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Abstract

Deep learning has revolutionized the field of medical imaging, enabling accurate and efficient diagnosis and treatment of various diseases. This review paper presents a comprehensive comparative study of Convolutional Neural Networks (CNNs) and transfer learning techniques in medical image analysis. We discuss the strengths and weaknesses of each approach, their applications in various medical imaging tasks, and the challenges and limitations associated with their use. The study highlights the potential of deep learning to transform medical image analysis, including image classification, object detection, and segmentation. We also discuss the importance of data quality, model interpretability, and clinical validation in ensuring the safe and effective deployment of deep learning models in clinical practice. Furthermore, we outline future research directions and opportunities in this rapidly evolving field, including the development of more robust and generalizable deep learning models, the integration of multimodal imaging data, and the application of explainable AI techniques to enhance model interpretability. Overall, this study aims to provide a comprehensive overview of the current state of the art in deep learning for medical image analysis, highlighting both the opportunities and challenges associated with this rapidly evolving field.

Keywords: Conventional Neutral Network, Deep Learning, Medical Image Analysis

BIOTERRORISM: HISTORICAL PERSPECTIVES AND FUTURE DANGERS, WITH AN EMPHASIS ON BOTULISM

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Abstract

With the ability to affect not just public health but entire societies, bioterrorism is still a major worldwide concern. We have seen firsthand over the years how biological agents can be used as weapons, resulting in panic, terror, and terrible outcomes. With a particular focus on botulism, this poster explores historical bioterrorism events, looks at present threats, and considers the possible risks of biological weapons in the future. The 2001 anthrax attacks in the United States, in which anthrax spores were sent through the mail and caused five fatalities and numerous infections, are among the most iconic and terrifying instances of bioterrorism. This attack demonstrated how susceptible public systems are to biological threats. Even though smallpox hasn't been used in bioterrorism recently, its high death rate and ease of spread raise concerns about its potential as a weapon. There still are numerous biological threats, but botulism—which is brought on by the Clostridium botulism toxin—is becoming more and more recognized as a possible weapon. Among it has so many uses, botulism toxin can be aerosolized or added to food and water sources. It is a very powerful toxin. Its capacity to cause rapid paralysis, particularly of the breathing muscles, makes botulism extremely dangerous and, if left untreated, can result in death. The potential for widespread incapacitation and the difficulty in identifying early symptoms that resemble common illnesses make this type of biological weapon concerning. The role of botulism in bioterrorism, its potential applications in the future, and ways to better prepare for such a threat will all be covered in this presentation. We will also talk about the global effort to stop the misuse of biological agents and the significance of continuing research into vaccines and treatments like antitoxins. This poster seeks to increase awareness of the threats posed by biological weapons, especially botulism, and emphasize the necessity of readiness and vigilance in safeguarding public health by considering historical events, present difficulties, and potential hazards.

Keywords: Bioterrorism, Botulism, Biological agents, Bioweapon, Vaccine, Toxin, Epidemic, Incapacitation, Threats

DEVELOPMENTS IN FORENSIC TECHNOLOGY AND THEIR EFFECT ON SEXUAL JURISPRUDENCE AND FORENSIC GYNECOLOGY

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Abstract

In order to combat sexual violence and ensure that victims receive justice, the disciplines of forensic gynecology and sexual jurisprudence are essential. The way that sexual assault cases are looked into, handled, and brought to court in has undergone a dramatic transformation in parallel with developments in forensic advanced technologies. Because of significant advancements like low-template DNA analysis, forensic experts can now extract DNA from even from most deteriorated samples of criminal identification and furthermore, due to the rapid growth in ability to solve cold cases and link criminals with multiple crimes has started to improve. Digital photography, 3D imaging, and forensic imaging technologies, have further bolstered injury documentation, by delivering astonishingly accurate and detailed evidence that can be used in court. Additionally, virtual autopsies employing sophisticated CT and MRI scans offer non-invasive techniques to assess internal injuries, providing a more detailed understanding of the trauma resulting from sexual assault. These technologies' amalgamation into sexual jurisprudence is trying to enhance the manner courtroom proceedings are undertaken. These days, forensic specialists—like gynecologists and DNA experts—play a crucial role in court cases by providing expert testimony that supports arguments and results in successful prosecutions. Artificial intelligence (AI) and machine learning are also offering to help lawyers process enormous quantities of data, of discover trends in cases of sexual violence, and produce more accurate predictions about the consequences of legal proceedings. Future developments in AI, DNA databases, and digital forensics will strengthen law enforcement's and defense lawyers' responsibility to check into and prosecute cases of sexual assault. These rapid advancements hold the potential to improve the effectiveness of the legal system, lessen prejudice, and eventually guarantee that survivors obtain the justice they are due. A more effective, victim-centered approach to resolving to sexual violence which would also result from the ongoing development of forensic gynecology and sexual jurisprudence, help to guarantee that survivors receive assistance, offenders are held accountable, and justice will be served.

Keywords: Sexual assault, Legal proceeding, Criminals, Forensic gynaecology, DNA analysis

SIGNIFICANCE OF MITOCHONDRIAL DNA IN DEGRADED FORENSIC SAMPLES

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Abstract

Mitochondrial DNA (mtDNA) is polymorphic and has many copies in a cell, it is often used for DNA analysis of highly damaged samples. There is a situation when nuclear DNA is damaged or scarce due to multiple reasons such as heat, humidity, enzymatic degradation, bacterial and fungal activity, poor collection and preservation conditions. In that scenario, mtDNA typing is a helpful technique for evidence analysis. A greater number of mitochondrial genomes in a sample can provide details about its origin. Since mtDNA sequence data is a powerful tool for determining the identity of a person who has been separated from their family through maternal lineage, it has also shown to be incredibly helpful in human rights disputes. It is challenging to extract genomic DNA from partially burned tissues and bones, however, mtDNA has slightly more chances of extraction because of the presence of numerous copies. In this study, we aim to develop a modified technique distinct from the traditional available technique which includes extraction and sequencing of mtDNA from degraded forensic samples such as tissues and bones. This will turn out to be a revolutionary method for mtDNA extraction from flawed samples and will help to establish an accessible platform for analysis as well as sequencing.

Keywords: Mitochondrial DNA, Forensic samples, Mitochondrial Sequencing, Degraded DNA.

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EXPLORING THE ROLE OF PERSONALITY IN CYBER HYGIENE BEHAVIOUR

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Abstract

Background: In the digital age, cyber hygiene behavior to maintain the security of devices and data is vital in preventing cyberattacks like phishing, malware, and identity theft. Cyber hygiene refers to the practices and steps that individuals and organizations take to maintain the security, health, and cleanliness of their devices, networks, and data. Those individuals with good cyber hygiene follow best practices for security and protect their personal information. Similarly, weak cyber hygiene practices cost not only the individual but also society at large. The big five personality factors, such as openness, conscientiousness, extraversion, agreeableness, and neuroticism, have been associated with cyber hygiene behavior. Earlier research has stated that personality factors are a better predictor of cybersecurity behavior; however, which personality factor plays a crucial role is still equivocal. In contrast, few researchers have asserted that conscientiousness and openness were found to be associated with good cyber hygiene behavior. Therefore, to have a comprehensive understanding of students' cybersecurity behavior, the present study is an attempt to find the association between personality factors and cyber hygiene among university students.

Methods: The present study is a cross-sectional, correlational design conducted at the Rashtriya Raksha University (RRU) Shivamogga campus, Karnataka. A total of 50 students were selected using simple random sampling methods and were administered the cyber hygiene questionnaire and NEO-Five factor inventory. Results: The result showed a significant relationship between Big Five factors and the cyber hygiene practices of the students.

Conclusion: Personality factors play an important role in maintaining a secure cyber practice, which in turn prevents them from cyberattacks.

Keywords: Cyber Hygiene, Cyber-Attack, Personality, Extraversion, Neuroticism, Agreeableness.

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EXPLORING THE RELATIONSHIP AMONG CYBER HYGIENE PRACTICE, EXPERIENCE OF CYBER-ATTACK AND EMOTIONAL DYSREGULATION AMONG IT EMPLOYEES

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Abstract

Background: Cyberbullying, cyber victimization, and other cyberattacks increase as digital technology advances. Cyber-attacks refer to malicious attempts to compromise the security of digital systems, leading to unauthorized access, data breaches, or service disruptions. Cyber hygiene involves the practices and behaviors individuals adopt to protect their personal information and devices from such threats, including secure password management, regular software updates, and safe data handling. Emotional dysregulation indicates the difficulty in managing one's emotional responses, which can influence their reactions to cyber incidents. Earlier research reported that cyber victimization damages emotional well-being. Studies also have reported anxiety and distress of not using the internet via smartphones or computers. Better cyber hygiene practices help to cope with cyber risks and attacks. Therefore, the current study aims to assess the cyber hygiene practice, experience of cyber-attack, and emotional dysregulation among IT employees.
Methods: The present study is a cross-sectional and correlational design. The data was collected using a purposive sampling method of 50 IT employees from a private organization in Shivamogga. Participants completed a sociodemographic data sheet, a cyber hygiene questionnaire, and a difficulties in emotion regulation scale. The data was analyzed for descriptive statistics and Pearson correlation using SPSS.
Results: The results showed a significant relationship between cyber hygiene and cyber-attack and also between cyber-attack and emotional dysregulation. Conclusion: The current study highlights the importance of promoting better cyber hygiene to mitigate the impact of cyberattacks and reduce emotional distress in professional settings. Future studies should focus on the types of cyberattacks associated with emotional dysregulation among the IT employees.

Keywords: Cyber Attack, Cyber Hygiene, Emotion Dysregulation, Software, Digital Systems.

NANOMATERIALS IN FOOD: A REGULATORY APPROACH FOR HUMAN HEALTH IMPLICATION AND FORENSIC NANOTECHNOLOGY ESTIMATION

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Abstract

Drawing from the current advancements in nanotechnology, it is anticipated that applications in this field will provide a number of benefits to the food sector, encompassing enhancements in both quality and preservation. Meanwhile, a rising number of studies show that being in contact with some Engineered nanomaterials, or ENMs, has the capacity to cause health difficulties and that further research is needed to understand the biological effects of nanofood intake. In this chapter, We present information on the toxicity profiles of regularly used Metal (oxide) nanoparticles (NPs) are an example of an ENM. and we examine the possible consequences for food safety and health hazards associated with consuming nanofoods. We also summarise the available data on the (potential) usage of ENMs in the food business. The description of a range of health problems linked to human exposure to ENMs implies that there is good reason to be concerned about both the potential for systemic poisoning and gut health. The toxicological nature of the hazard, exposure levels, and danger to consumers from nanotechnology-derived food is still under investigation, and this chapter underlines the significant gaps that require more research and regulation.

Keywords: Nanotechnology, Food, Health, Toxicity, Nanofood, Preservation, Nano-Forensic

FTIR SPECTROSCOPY IN FIRE FORENSICS: A NOVEL APPROACH TO IDENTIFY POLLEN SIGNATURES AT EXTREME TEMPERATURES

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Abstract

Pollen grains from ten floral species were analysed using Fourier Transform Infrared (FTIR) spectroscopy to assess their molecular stability under extreme temperatures, as encountered in fire-related forensic cases. Samples were subjected to temperatures ranging from 25°C to 1000°C for durations of 1, 2, 6, and 24 hours. FTIR spectra revealed that up to 500°C, the molecular structure and composition of pollen grains remained largely unchanged up to 24 hours. At 1000°C spectral changes were observed, including the disappearance of some peaks; however, sufficient spectral features persisted to allow identification of pollen type. This study demonstrates the robustness of FTIR spectroscopy in identifying pollen grains exposed to high temperatures, offering a non-destructive, cost-effective and efficient alternative to electron microscopy. The findings highlight the potential of FTIR spectroscopy to expand forensic palynology applications by enabling the creation of a comprehensive spectral profile for high-temperature pollen analysis. The integration of FTIR spectroscopy in high-temperature pollen analysis provides a novel approach for solving crimes, particularly in cases such as fire accidents, vehicular fires and arson investigations. By combining botanical expertise with advanced microscopy and chemometric techniques, forensic palynology efficiently expands its role in legal investigations worldwide.

Keywords: Palynology, Non-destructive, FTIR Spectra, Forensic Investigation, High Temperature Analysis.

BADGE BASED RESIN: A NOVEL METHOD FOR THE DURABLE PRESERVATION OF POWDER DEVELOPED LATENT FINGERPRINTS

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Abstract

The preservation of latent fingerprints is crucial in forensic investigations, as it helps identify individuals involved in criminal activities. Traditional lifting methods, although widely used, have limitations in durability, clarity, and applicability to various surfaces. This paper explores a novel method for preserving powder-developed latent fingerprints using bisphenol A diglycidyl ether (BADGE) based resin, offering several advantages over conventional lifting techniques. While methods like tape lifting, hinge lifters, and gel-lifters exist, they present drawbacks compared to the BADGE-based resin method for long-term preservation. BADGE-based resin, with its enhanced clarity, strength, and resistance to environmental degradation, ensures the long-term preservation of fingerprint details with minimal distortion under adverse conditions. Unlike hinge lifters that rely on adhesive materials prone to damage or residue, the BADGE resin offers a more rigid and durable medium, preserving prints with better clarity. Its structural integrity allows for precise handling without distortion, which is vital for textured or irregular surfaces. Additionally, the resin is less affected by environmental factors like temperature and humidity, which can compromise adhesive properties in hinge lifters. Adhesive tape lifters may leave residue on prints, potentially distorting or damaging delicate impressions. Gel lifters are prone to deformation under pressure, especially with temperature and humidity fluctuations, affecting adhesive strength. The resin's hardened structure preserves fine details of fingerprint ridges and minutiae, ensuring a clear, stable record over time. This study evaluates the effectiveness of BADGE based resin for fingerprint lifting and preservation, considering factors such as preservation quality, ease of application, and future analysis potential. The results indicate that BADGEbased resin offers superior clarity and structural integrity, making it a promising alternative for forensic fingerprint preservation. This method has significant potential to enhance the reliability and accuracy of fingerprint analysis in criminal investigations.

Keywords: BADGE, Resin, Latent Fingerprints, Preservation, Forensic Investigation.

AN AI-DRIVEN APPROACH TO DARK WEB SURVEILLANCE USING BERT

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Abstract

Introduction: The dark web, primarily accessed through anonymity networks like Tor, has become a notorious platform for illicit activities, creating substantial challenges for cybersecurity experts and law enforcement agencies. The Tor network, designed to obscure users' identities, makes it difficult to track and monitor online behaviour.

Methods: In response to this, our study introduces an AI-driven system that utilizes advanced natural language processing (NLP) techniques, specifically the BERT model, to analyze Tor browsing history and content from dark web sites. By training this system on a comprehensive dataset containing both surface web and dark web data, it can accurately flag potentially harmful content.

Results: The BERT-based system's ability to process complex language patterns allows it to differentiate between illegal and legal content, detecting subtle nuances in language. The AI-driven approach significantly enhances real-time monitoring and content classification on the dark web.

Conclusion: This AI-based system represents a major step forward in protecting the digital world from emerging dangers, enabling cybersecurity professionals and law enforcement to act proactively in identifying and mitigating threats posed by dark web activities.

Keywords: Dark Web, Digital Forensics, BERT, NLP, F1 Scores.

AN ANALYTICAL STUDY ON VICTIMOLOGY OF MEN UNDER MARITAL SCENARIO WITH SPECIAL REFERENCE TO FORENSIC PERSPECTIVE

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Abstract

There are many different circumstances that may lead to men being victims in marital situations. Some of these circumstances include domestic abuse, cruelty, false claims, financial troubles, and other similar situations. Men, like women, can be victims of domestic violence, but currently the law regarding domestic violence is inadequate. There is a need for the creation of additional preventative measures and specialized legislation to protect men experiencing domestic abuse and false allegations. in matrimonial offenses Forensic science relies on evidence gathered from a crime scene, such as physical objects, witness statements, or official records. Without such evidence, it's challenging to identify the crime from a domestic perspective. This crucial evidence aids investigators in establishing facts and making reliable conclusions in legal and criminal proceedings. Additionally, forensic evidence might be a potential tool to protect innocent husbands from false allegation cases. The field of forensic science has the potential to serve as a useful instrument in safeguarding the interests of mankind. One of the responsibilities of the forensic scientist is to determine the nature of domestic abuse and to determine if the allegation in marital cases is true or not. The purpose of the study is to explore and analyse the domestic violence against men and its effective measurement with reliable and unbiased forensic investigation. It will also analyze the judiciary approach regarding victimology of men under domestic violence with reference to forensic investigation or evidence based on secondary data and literature review as well as reports from government organization.

Keywords: Victimology Of Men, Domestic Violence, Forensic Evidence, Forensic Investigation.

COMPARATIVE STUDY OF STATIC ANALYSIS TECHNIQUES FOR ANDROID MALWARE DETECTION

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Abstract

Introduction: Android has gained popularity in recent years due to its open-source nature and increasing user population. The increase in the population of Android users has also increased the number of Android applications or apps developed for them, this has resulted in these Android applications being targeted by malicious software. Malware or malicious software is software purposefully designed to harm a target system, gain authorization to it or to prevent it from performing its regular operations. These can be in the form of a virus, trojan, worm, adware, etc. The increasing popularity of Android malware makes it difficult for malware detectors to keep up with the growing number of malware in the wild. Static analysis is a type of malware analysis that deals with analyzing the malware sample without running it. This review paper attempts to provide a comparative study of the different static analysis methods used in Android forensics. Methodology: Identification of research from recognized scientific articles was performed. The methodology and trends followed by different studies for Android malware analysis were studied. Methodologies were compared based on their performance in their studies. Conclusions were drawn based on the best practices revealed by the research.

Conclusion: This study suggests that the use of static analysis along with deep learning techniques can help to better detect and analyse Android malware. Further developments in static analysis techniques with deep learning are required.

Keywords: Malware, Android, Static Analysis, Malware Detection

DEEPFAKES: AN EMERGING DIGITAL THREAT

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Abstract

Deepfake technology has become an emerging issue in the digital world, and it raises serious issues related to privacy, security, and media trust. The term "deepfake" became popular after the emergence of artificial intelligence-based content manipulation, especially using deep learning methods like Generative Adversarial Networks (GANs). The fast evolution of deepfake technology raises some issues, such as the enhanced capability of Artificial Intelligence (AI) models to evade existing detection tools, the danger of being used in social engineering attacks, and the challenge in authenticating digital evidence. The law governing deepfake abuse remains in its nascent stages, with most jurisdictions struggling to apply strict laws against its unethical uses. This paper discusses diverse methods for detecting deepfake media, including forensic examination, detection of artifacts, machine learning-driven classification, analysis in the frequency domain, and behavioural analysis of manipulated audiovisual content. Legacy methods are dependent on identifying differences in lighting, facial emotions, and lip matching, while AI-based models take advantage of neural networks to discern real and fabricated content. Moreover, this paper indicates the pressing demand for effective overall global policies and strict cybersecurity laws to hold offenders responsible for criminal misuse of deepfake technology to commit fraud, spread misinformation, and steal identity. This increasingly emerging threat should be tackled using a proactive system that combines technical innovation, legislative enforcement, and ethical standards for protecting digital integrity in the coming years.

Keyword: Deepfake, Artificial Intelligence, Machine learning, Generative adversarial   network

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DIGITAL FORENSICS IN THE INTERNET OF THINGS (IOT)

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Abstract

The Internet of Things (IoT) has made a drastic transition in the way we interact with other devices and systems around us. On one hand, with the proliferation of smart homes, automated vehicles, and industrial equipment, IoT has created many new possibilities, but on the other hand, increased vulnerabilities in the privacy and security sector. This study examines the current position of digital forensics in IoT environments including techniques like network traffic analysis, memory acquisition, cloud forensics, device fingerprinting, and firmware analysis to gather and analyze data. A comparative analysis of existing IoT forensics tools and approaches is conducted, alongside an exploration of emerging techniques for evidence collection and its admissibility in court. The increasing complexity of IoT networks requires specialized tools and techniques to gather and analyze digital evidence from various sources. IoT devices vary largely in terms of protocols, software, security features, etc, making it difficult to adopt a single standardized forensic approach. The findings reveal several challenges, including encryption issues. Digital forensics in IoT still lacks standardization in techniques and tools adopted for investigation. To conclude, with advancements in AI and digital crimes, there is a need for investigators to stay up to date in order to overcome the challenges IoT environments possess. Need for advancement is felt to address the existing gaps and improve the effectiveness of digital evidence extraction from IoT devices.

Keywords: Digital Forensics, Internet of Things (IoT), Evidence Extraction and its admissibility, Cybersecurity.

THE SIGNIFICANCE OF FORENSIC SCIENCE IN DOCUMENTING AND RECOGNIZING THE ANTI- TRANSGENDER HATE CRIMES

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Abstract

Introduction: Forensic science helps identify and document anti-transgender hate crime by providing objective, scientifically verified evidence that can support bias-motivated violence. Forensic pathologists examine wounds, cause of death, and other physical evidence for the presence of excessive brutality or particular patterns that suggest a hate crime, while computer forensics specialists recover cyber threats or targeted harassment that might confirm motive. Trace evidence such as DNA or fingerprints identifies suspects at crime scenes, bolstering prosecution cases with unassailable proof. Forensic linguistics examines slurs or messages at crime scenes for bias intent, while crime scene reconstruction specialists allow law enforcement agencies to learn about the chain of events leading up to the crime, important for establishing premeditation or targeted discriminatory attack. Forensic psychologists evaluate suspect motivation and behavior, providing the courts with the ability to discern if antitransgender bias contributed to the crime. Forensic science must counteract systemic biases within the collection of data and the reporting of it; most jurisdictions underreport and mischaracterize anti-transgender violence, making the documentation by forensic science crucial for prosecution and for bringing about accountability. Forensic science documenting anti-transgender crime with precision helps the prosecution but at the same time helps effect positive change within the legislative framework that protects marginalized populations such that such crime decreases over the years

Methods: A multidisciplinary approach will be required for garnering data for the research like, integrating forensic science, criminology, sociology, and LGBTQ+ studies. The author will focus on Literature Review, Case Study Analysis, Forensic Evidence Assessment, Media and Legal Analysis, Comparative Research (International Analysis).

Results: The results will be mainly focused on the following key points. • Forensic Anthropology and Hate Crimes Against Transgender People • In forensic investigations, misgendering • Recording Transphobic Violence Trends • Social and Legal Obstacles to the Identification of Anti-Transgender Hate Crimes • Underreporting in Statistics and the Function of Forensic Databases • The Relationship Between Hate Crimes and Hate Speech • Difficulties in Transgender Victims' Forensic Identification.

Conclusion: Forensic science must document and identify anti-transgender hate crimes, but misgendering, lack of inclusive methods, and legal limitations in transgender identity recognition make it difficult. To properly recognize transgender victims in the legal system, forensic anthropology, data gathering, and legislative changes are needed.

Keywords: Forensic Science, Transgender, Hate Crimes, Forensic Anthropology, Forensic Identification.

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EFFECTIVENESS OF DNA-FINGERPRINTING IN DETECTING FOOD ADULTERATION THROUGH ANALYSING PSYCHOLOGICAL MOTIVES BEHIND FOOD FRAUD.

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Abstract

Background: Food adulteration and fraud pose significant threats to public health, economic stability, and consumer trust. DNA fingerprinting has emerged as a powerful forensic tool for ensuring food authenticity by accurately detecting adulterants and misrepresented food products. This study explores the effectiveness of DNA fingerprinting in identifying food fraud while analyzing the psychological motives behind food adulteration.

Methodology: The research employs a thematic analysis approach, utilizing qualitative data from case studies, expert interviews, and literature reviews. Key themes explored include financial incentives, competitive pressures, cognitive dissonance, and ethical desensitization, which drive individuals or organizations to engage in food fraud. The study also examines how regulatory gaps and consumer awareness impact fraudulent practices.

Findings: DNA fingerprinting significantly enhances fraud detection by precisely identifying species used in food products, thus reducing the prevalence of adulteration. Psychological motives such as greed, market survival, and low perceived risk of penalties are major drivers of food fraud. The study highlights the need for stricter regulatory enforcement, improved consumer education, and the integration of forensic food analysis in routine inspections.

Conclusion: DNA fingerprinting serves as a reliable scientific method to combat food fraud while understanding the psychological motives behind adulteration can aid in designing better preventive measures. This research contributes to forensic food sciences by bridging scientific detection methods with behavioural insights, ultimately promoting food safety and integrity. Future research should explore the integration of AI-driven food authentication methods alongside behavioral deterrents to minimize food fraud risks.

Keywords: DNA fingerprinting, food adulteration, food fraud, forensic food analysis, psychological motives, consumer trust, regulatory enforcement.

VIRTUAL AUTOPSY: THE FUTURE OF POSTMORTEM INVESTIGATION

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Abstract

Introduction: Virtual autopsy, or virtopsy, is a new, non-invasive postmortem imaging technique that uses advanced imaging technology such as computed tomography (CT), magnetic resonance imaging (MRI), and 3D surface scanning to investigate causes of death. The technique is revolutionizing forensic pathology by offering a digital alternative to the traditional autopsy, which is invasive and time-consuming.

Objective: This poster presentation will address the potential of virtual autopsy as a novel technology in postmortem examination, its advantages, applications, and future in forensic science.

Methods: The lecture will describe case studies and research articles in which virtual autopsy has been performed successfully. It will also address the integration of imaging modalities, 3D reconstructions, and AI to enhance diagnostic efficacy and accuracy.

Results: Virtual autopsy has been extremely beneficial with regard to visualization of injury, evidence preservation, and sharing of digital information for multi-center analysis. Virtual autopsy is best utilized in cases of trauma, decomposing bodies, or religious/cultural refusal of autopsies.

Conclusion: As a cutting-edge technology, virtual autopsy holds a very bright future in postmortem examination. It combines high-end imaging modalities with AI-driven analysis to offer a faster, more accurate, and less invasive way of accomplishing the same. This presentation will encourage the wider application of virtual autopsy in forensic practice and how it can revolutionize the subspecialty of forensic pathology.

Key words: Virtopsy, virtual autopsy, postmortem imaging, forensic pathology, 3D reconstruction, CT, MRI, artificial intelligence.

IMPACT OF ARTIFICIAL INTELLIGENCE ON SOCIETY AND AVIATION INDUSTRY.

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Abstract

Artificial intelligence(AI) is a branch of computer science that enables machines in such a way that involves data whose scale exceeds what humans analyze. AI is transforming various sectors including- Society and aviation Industry, by enhancing efficiency, safety, decision making process. Artificial intelligence relies on various data research methods to collect, process and analyses data for training models. These methods ensure AI system makes accurate predictions and informed decisions. Proper data collection, processing and validation are essential for developing reliable AI system. AI has led to significant advancements across industries and daily life. Some positive outcomes includes healthcare advancements, improved communication, economic growth etc. and some negative impact like misinformation, privacy concerns, biasedness, job displacement, etc. Moreover, AI shaping the future of technology and society. The Impact of AI on Aviation Industry in profound ways like improved safety, better customer experience, fuel efficiency and sustainability, etc. and Some negative challenges like cyber security risks, high implementation cost, etc. Despite all these challenges, AI continues to shape a more intelligent and interconnected future, driving progress while requiring responsible implementation to balance benefits and risks.

Keywords: Artificial Intelligence, Aviation Industry, Machine Learning, Sustainable Aviation.

DOMESTIC VIOLENCE AGAINST WOMEN AND ITS TYPES, CAUSES, EFFECTS AND REMEDIES

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Abstract

Domestic violence against women is a widespread issue that affects individuals from each and every aspect. It is performed in various forms including physical, emotional, sexual, and financial abuse which cause long lasting physical and psychological scars to the victims. Therefore, this study aims to analyze the different types of domestic violence, its root causes, its effects on women's well-being and possible remedies to address this pressing issue. This study uses a qualitative research approach, analysis case studies, psychological assessments, and data analysis from research on domestic abuse and its legal reports. The paper categorizes different types of violence and explores the socio-cultural and economic factors contributing to the problem. Moreover, the findings indicate that domestic violence is often driven by patriarchal norms, economical dependence, lack of legal awareness social stigma. Victims suffer from various consequences such as low self-esteem, post-traumatic stress disorder (PTSD), depression, anxiety and in extreme cases suicidal tendencies. Moreover, the Findings reveal that victims suffer from severe emotional distress, leading to long-term psychological issues. Women often experience chronic anxiety, depression, and suicidal tendencies. Therefore, the addressing domestic violence requires a multi-directional approach including stricter legal frameworks, psychological support systems, economic empowerment programs and increased societal awareness. The Strengthening law enforcement, providing safe shelters, and promoting educational on gender equality can help combat domestic violence and support survivors in their recovery.

Keywords: Domestic Violence, Women, Abuse, Mental Health, Legal Remedies

JUVENILE DELIQUENCY:- REASONS, JUSTICE & ELUCIDATION

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Abstract

'Jin Charaaghon Ko Hawaon Ka Koi Khauf Nahi, Un Charaagon ko Hawaon Se Bachaya Jaye'(Those Lamps that are not Fearful of Strong Winds, They must be protected from the Winds, Let us do That) - Justice Kuldeep Tiwari, Judge Punjab & Harayana High Court Chandigarh

"All kids need is a little help, a little hope and somebody who believes in them". Juvenile Deliquency is a serious problem and it is detrimental for the social order of Nation. This term is used to describe criminal acts of the criminal offenders who are not major i.e., under 18 years of age. The rate of increasing Juvenile Crimes all over the World is a serious threat. India is also facing this problem. This problem is due to rise in birth rate and low incomes, lack of welfare for the children, lack of education and lack of various other facilities. It is a very serious concern for the Nation like India and can be cured by taking some initiatives for the children. Till now the Indian Legal System has provided 'Juvenile Justice Act,1986' , 'The Juvenile Justice (Care and Protection of Children), 2000', 'The Juvenile Justice Amendment Act,2017' and some clauses in the Indian Constitution under Article 15(3), 39(e), 39(f), 45, 47 and 21-A for the welfare and facilities provided to children. Therefore, this Research Paper is a detailed document on Juvenile Deliquency; its factors, reasons, aims steps for procurement of children. Although India is a developing country but the main concern is about the future generation involving in crimes and disfiguring their lives.

Key words: Juvenile Deliquency, Reasons, Indian Legal System, Aims, Initiatives

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THE IMPACT OF MEDIA ON JUVENILE DELINQUENCY

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Abstract

This research paper analyze that the media plays a crucial role in shaping the attitudes and behaviors of young individuals. While it serves as a source of information and entertainment, excessive exposure to violent content, substance abuse and delinquent behaviors in media can negatively influence juveniles. Therefore, this study explores the impact of various media forms – T.V., social media and digital content-on juvenile delinquency and examines the psychological and social factors contributing to this issue. A qualitative research and analytical approach is used, including case studies and psychological research. The study evaluates the correlation between media exposure and youth crime rates while considering other contributing factors such as family environment, peer influence and socioeconomic conditions . Moreover, the findings suggest that media can play a dual role-both as an instigator and a deterrent to juvenile delinquency. Exposure to aggressive social media trends, glorification of criminal behavior in movies can desensitize young minds, leading impulsive actions. However, responsible media use, educational programs and awareness campaigns can help lessen the negative influence. Parental supervision and media literacy are key factors in reducing the risks associated with harmful media exposure. However, media alone is not the sole cause of juvenile delinquency, its influence is significant. A balanced approach such as promoting responsible media consumption, strengthening parental controls and encouraging positive content can help reduce juvenile offenses and foster healthier youth development. Future policies should focus on content regulations and awareness programs to create a safer media environment for young minds.

Keywords: Media Influence, Juvenile Delinquency, Youth Crime, Violence, Social behaviour.

LIMULUS AMEBOCYTE LYSATE (LAL) TEST AND RISK ANALYSIS

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Abstract

The Limulus Amebocyte Lysate (LAL) test is a vital bioanalytical instrument for measuring endotoxins produced by Gram-negative bacteria, and it is essential for maintaining the sterility of medications, medical equipment, and healthcare supplies. Endotoxins, which are mostly made up of Lipid A, have strong immunogenic properties and can cause harmful physiological reactions such septic shock and multi-organ failure. To determine endotoxin contamination, the technique uses the coagulation cascade of amebocytes extracted from horseshoe crabs. The LAL test has drawbacks despite its great sensitivity, such as the potential for false-positive interferences, moral quandaries about ecological sustainability, and prohibitive operating costs. Furthermore, its specificity is limited to the detection of endotoxins, which means that adjunct techniques must be incorporated for a thorough evaluation of microbial risk. To strengthen biosafety protocols and increase public health resilience, continuous advancements in diagnostic methods and strict regulatory actions are essential.

Keywords: Gram negative bacteria, endotoxin, LAL, immunogenic, sustainability

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LAW AND JUSTICE CRIME AGAINST WOMEN AND CHILDREN: A CRITICAL ANALYSIS

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Abstract

Law and justice serve as the pillars of a civilized society, ensuring the protection of fundamental rights and the enforcement of legal norms. However, crimes against women and children remain a grave concern, highlighting deep-rooted societal issues and gaps in legal enforcement. These crimes include domestic violence, sexual assault, human trafficking, child abuse, and cyber exploitation, which not only violate human dignity but also hinder social progress. Therefore, this paper examines the legal framework governing crimes against women and children in India, including key legislations such as the Protection of Women from Domestic Violence Act, 2005, the Criminal Law (Amendment) Act, 2013, the Protection of Children from Sexual Offences (POCSO) Act, 2012, and the Juvenile Justice (Care and Protection of Children) Act, 2015. Despite stringent laws, challenges persist due to societal stigma, low reporting rates, and procedural delays in the justice system. The study also explores landmark judicial pronouncements that have shaped the legal discourse on gender justice and child protection. Furthermore, it discusses the role of law enforcement, NGOs, and public awareness campaigns to prevent and address such crimes. The technological advancements, such as digital evidence collection and online reporting mechanisms, have also contributed in strengthening legal enforcement. Moreover, this paper concludes that the laws exist to safeguard women and children , delay but effective implementation, speedy justice, and societal change are necessary to curb these crimes. A multi-pronged approach, including legal reforms, sensitization programs, and victim-centric policies, are essential to ensure justice and create a safer environment for women and children.

Key words: Domestic Violence, Sexual Assault, Human Trafficking, Child Abuse, Cyber Exploitation

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LAW & JUSTICE INTERNATIONAL CRIME GENOCIDE, WAR CRIMES, AND THE ICC: BRIDGING THE GAPS IN GLOBAL JUSTICE

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Abstract

The research paper analysis the rise of international crimes and limitations of international criminal court.The paper includes wide spread issues arose at international level in order to provide an efficient relief. To outline the issue various reports have been consider and statistics. However to find Command Responsibility and Linkage Evidences between Perpetrators and Suspects .The rise in crimes like Genocide, War crimes , Crimes against Humanity and Crime of aggression leads to widespread violence and Injustice dues to limitations of international criminal courts and national courts.Analysing the issue raised by African countries and reviewing the new goals set by international criminal court to reduce international crime and providing justice along with the contribution of United Nation (UN) Organisation to reduce and control International Crime rates. In order to overcome these issues there must be universal mechanism for enforcement of International law and improvement in Hague Convention , to prevent institutional restriction and state manipulation, Investigating international crimes is more typical than investigating an ordinary crime in the situation where there is no proper mechanism and procedure to investigate and lack of investigating authority. The implication of these improvements will help to reduce International Crimes and better working of International law and improvement in international criminal courts working.

Keywords: International Crime, International Criminal Court, Genocide, War Crimes.

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COMPUTER FORENSICS ARTIFICIAL INTELLIGENCE THE ROLE OF ARTIFICIAL INTELLIGENCE AT AIRPORTS.

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Abstract

The paper analysis the role of artificial intelligence at airports. It includes the increasing demand of air travel, coupled with security concerns and operational complexities, necessities the artificial intelligence at airports. In order to detect and identify theft before reaching the terminal this will provide greater ability to protect passangers and airport community. Artificial intelligence(Al) powered systems optimize baggage handling, steamline check in and boarding processes, and improve air traffic control. Also providing real time flight updates and services. What could this look like? Imagine even an early version-informed by cameras, sensors, and an airport network. Despite these benefits the artificial intelligence (AI) there a cyber security issue and also not cost effective. But despite these challenges artificial intelligences (Al) continue to shape a more intelligent and interconnected future, driving progress while requiring responsible implementation to balance benefits and risks. By integrating Artificial intelligence (AI), airports can handle growing passangers volumes while insurancing safety and efficiency. The use of Artificial intelligence(AI)-driven analytics also helps in crowd management, reducing congestion and improving resource allocation. As global air traffic increases, Artificial intelligence(Al) adoption becomes essential for sustainable airport operations, leading to a more seamless, secure, and efficient travel experience.

Keywords: Artificial Intelligence, Airport Community, Passanger Safety, Airport Operations.

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LAW AND JUSTICE WHITE COLLAR CRIME IMPACT OF WHITE COLLAR CRIME IN INDIAN SOCIETY

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Abstract

White collar crime in India significantly impacts the society as it results in very huge economic losses through fraud, embezzlement and tax evasion which leads to decline in investor confidence , reduce foreign direct investment and lowering the rate of economic growth . The main goal of white collar crime is to gain money, bproperty ,or other assets, or to gain some personal advantage. White collar is a non violent but economically harmful and illegal activity . White collar crime can have a devastating impact on victims, investors, and customers, White collar crime is a nonviolent crime where the primary motive is typically financial in nature. Researchers use surveys, data analytics, and artificial intelligence (Al) to study white collar crime . surveys are perhaps among the more common research strategies used to study white collar crime . survey methods include on-site administration surveys face to face interviews telephone interviews, and mail surveys . White collar crime can have significant economic social and legal consequences Financial losses white collar crime can cause billions of dollars in losses for individuals, corporations and governments . white collar crime can erode trust in institutions and authorities leading to a decrease in societal morale . White collar crimes are often detected through investigations by law enforcement agencies . investigations may involve analyzing financial records interviewing witness and using technology. Recent years have also seen developments in finance and technology that have prompted white collar crime such as computer based cybercrime, health care fraud and property crime which relates to issues such as copyrights patents and trade secrets .Moreover white collar crime cases can be lengthy complex and involve a number of countries those suspected of such crime can be investigated by law enforcement agencies, they may also be the subject of legal action (litigation) brought by people who say they have suffered losses as a result of such crimes.

Keywords: White Collar Crime, Non-violent Crime, Financial Crime, Tax evasion, Economic losses.

BEHAVIOURAL SCIENCES CRIMINOLOGY TECHNOLOGICAL ADVANCEMENTS IN CRIMINOLOGY: CHALLENGES AND INNOVATIONS IN DIGITAL AGE

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Abstract

This research paper analyzes the correlation between the recent technological developments in criminology which had paved a way for challenges and solutions in the criminal justice system. Moreover, the transformation in criminology has occurred majorly during the 21st century with the welcoming of new digital trends. To answer this question, the priority of analytical method combined with descriptive theories provided an optimal set of tools for searching and revealing the main computerised or electronic trends in criminology. The increase in digitalization has resulted in changing behaviour and usage of technologies by the criminals, as earlier it was very difficult task to track or use such things to find out the origins of crime comparing it with today though there are many challenges faced by people to get the exact data details of a criminal yet it's beneficial in many ways for digging up the facts. Through this research paper I have underlined the advancements in the criminology field by mentioning the latest measures and innovations that had happened in past years and affected the atmosphere gradually.

Keywords: Criminal Justice System, Digital Trends, Computerised, Innovations, Digitalization.

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CRIME SCENE INVESTIGATION AND RISK MANAGEMENT CRIME SCENE INVESTIGATION METHOD TECHNIQUES OF CRIME SCENE INVESTIGATION

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Abstract

Crime scene investigation is a critical component of criminal justice, requiring a meticulous and scientific approach. The study examines the crime scene investigation method, emphasizing the importance of a structured protocol in collecting and analyzing evidence. The research highlights the key steps involved in crime scene investigation, including documentation, evidence collection and forensic analysis. The study demonstrates how a systematic approach to crime scene investigation can enhance the quality of evidence, increase the chance of solving crimes, and ultimately contribute to justice. The findings of the research have significant implications for law enforcement agencies, forensic scientists and policy makers seeking to improve the effectiveness of crime scene investigation methods. Physical evidence collection such as collecting and analyzing physical evidence such as fingerprints, DNA, foot prints and digital evidence collection such as computer files, emails and social media activity and witness interview conducting with witness to gather information about the crime are the some of the types of crime scene investigations. Also reconstructing the crime scene to understand the events surrounding the crime, analyzing evidence using forensic science techniques such as DNA analysis and fingerprint comparison, conducting surveillance to gather information about suspects and their Activities are some of the techniques commonly used for the investigation.

Keywords: Scene investigation, Evidence collection. Forensic analysis, Crime reconstruction

SECURITY THREATS IN SEMICONDUCTOR IP DESIGN AND SUPPLY CHAIN

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Abstract

Due to increasing complexity in the semiconductor design and manufacturing number of vulnerabilities has increased in the entire lifecycle of semiconductor manufacturing from design to end-of-life. This paper deals with cybersecurity threats in the intellectual property (IP) design of silicon and semiconductor chips while aiming at vulnerabilities in design, production, and supply chain stages. Some threats that cause serious risk to chip integrity and security are Malicious design tampering, insertion of hardware trojans, manipulated tools, external components and so on. There are some potential attack vectors such as intentional design mistakes, compromised synthesis and mapping, and manipulation during fabrication and deployment phase. By using threat detection model integrating with AI/ML to proactively minimise the security risks and ensure integrity associated with semiconductor integrity. This research paper highlights the importance of security frameworks to ensure the security of critical semiconductor infrastructure.

Keywords: Semiconductor security, IP design threats, hardware Trojans, AI/ML threat detection, supply chain vulnerabilities

THE IMPACT OF ENCRYPTION TECHNOLOGIES ON NETWORK FORENSIC INVESTIGATIONS

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Abstract

Network forensic investigations have undergone significant changes due to expansion of encryption technology usage. Although encryption technologies improve data confidentiality and integrity while also preserving the privacy, it presents crucial obstacles for forensic analysts during network traffic surveillance and analysis. End-to-end encryption along with TLS 1.3 secure protocols and encrypted DNS mechanisms create obstacles for investigators attempting to gather forensic evidence as they reduce visibility of potential cyber threats. This study examines how encryption affects forensic operations by studying the evolving methods which analyse encrypted network activities. The research study combines three analytical dimensions through encryption protocol review, analysis of forensic tools which includes DPI and traffic fingerprinting, and examination of encryption-dependent cyber investigations in actual cases. This research examines AI-driven traffic analysis models as potential approaches for handling the encryption issue. Research conclusions indicate that even though encryption interferes with traditional forensics, various alternative techniques such as machine learning-based traffic classification, behavioural analytics, as well as analysis of metadata provide valuable insights. However, the performance of these techniques differs depending on strength of encryption, protocol obfuscation, and network architecture. Furthermore, legal and ethical considerations limit forensic investigations since they could involve privacy violations and non-compliance with regulations. Modern encryption advancements demand network forensic methods to adapt which would ensure effective cybercrime investigations. Lawful interception mechanisms together with advanced threat intelligence and Artificial Intelligence form the essential elements for investigators to overcome their investigative barriers. Future research should prioritize building forensic facilitating approaches that defend privacy rights while maintaining security-based laws for investigation access.

Keywords: Network Forensics, Encryption Technologies, Traffic Analysis, Cybercrime Investigation, Cyber Forensics

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ADVANCING FORENSIC CASTING: A NOVEL MATERIAL FOR CAPTURING TYREMARKS, FOOTWEAR IMPRESSIONS AND TOOLMARKS

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Abstract

Forensic investigations heavily rely on impression evidence such as tyremarks, footwear impressions, and toolmarks to establish links between suspects and crime scenes. The accurate preservation of such evidence is crucial, necessitating the use of high-fidelity casting materials. Over the years, various materials have been used for casting impression evidence, such as plaster of Paris (POP) and dental stone. However, these materials exhibit significant limitations, such as fragility, poor detail reproduction, and sensitivity to environmental conditions. This review explores advancements in forensic casting materials, emphasizing polymer-based alternatives that offer superior accuracy, durability, and reliability. The review highlights the evolution of casting materials from conventional mineral-based compounds to modern polymer-based formulations, demonstrating that polyurethane, polyvinylsiloxane, and latex-based materials provide enhanced flexibility, strength, and finedetail replication. Moreover, polymer-based materials present a cost-effective alternative while maintaining excellent durability. Various mixing techniques, material compositions, and application methods to optimise casting performance have also been discussed. This review underscores the importance of adopting advanced polymer-based casting materials in forensic science. Their enhanced flexibility, durability, and cost-effectiveness makes them an apt solution for all types of impression evidence, including tyremarks, footwear impressions, and toolmarks. By improving the accuracy and longevity of forensic casts, these materials strengthen investigative methodologies and increase the reliability of evidentiary analysis in criminal cases.

Keywords: Footwear Impressions, Forensic Casting, Impression Evidence, Polymer-Based Materials, Tyremarks

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A MEMORY FORENSICS APPROACH - CLASSIFYING FILE-BASED AND FILELESS MALWARE USING MACHINE LEARNING

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Abstract

Introduction: As the digital world has grown, so have the threats that come with it. What started with simple viruses and worms has now evolved into more complex forms of malware. Fileless malware, unlike its file-based counterparts, doesn't rely on executable files. Instead, it hides in plain sight by hijacking legitimate system processes to carry out harmful activities, making it harder to detect.

Methods: In response to this, we explore how machine learning can help in classifying both file-based and fileless malware. To do this, we used the Volatility tool to analyze memory dumps from a virtual environment. Four key Volatility plugins—netscan, psscan, hivelist, and dlllist—were used to extract relevant data. By focusing on unique features, such as memory footprints, we developed a classification model using random forest algorithms.

Results: Our model achieved an accuracy of 87%, based on data collected from the Malware Bazaar website. Everything was done with netscan, psscan, hivelist, dlllist main plugins and it was a try to understand what other plugins in the Volatility are able to do and used, such as malfind, cmdline, ldrmodules. These plugins could help improve the chances of finding digested malware activity especially the fileless malware.

Conclusion: Our analysis revealed that network and process-related features were the strongest indicators of malware, highlighting their importance in detecting these threats. Although the model performed well, there's still room for improvement, especially in minimizing errors and boosting accuracy.

Keywords: Malware, Memory forensics, Volatility, Machine learning.

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INSECTS AS TOXICOLOGICAL SPECIMENS: A COMPREHENSIVE REVIEW ON THE TOXICOLOGICAL ANALYSIS OF ENTOMOLOGICAL SAMPLES TO DETECT THE PRESENCE OF PESTICIDES IN CADAVERS

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Abstract

Forensic Entomotoxicology is the scientific study wherein entomological specimens can be used as an alternative to traditional toxicological samples like blood and viscera, for analysis. Blowflies, being the first colonizers of decomposing bodies, are attracted towards the natural orifices and wounds. The larvae of these insects feed on the tissues of the dead body and have been found to have greater tolerance towards some poison and drug doses which are considered lethal for humans. This makes the larvae and pupal cases of these insects valuable and can be used as entomotoxicological samples for the detection of the toxic substances in the dead body which were administered ante-mortem. The aim of this study is to compile, discuss and compare the different methods that have utilised by researchers for the collection and preservation of insect samples, and extraction and identification of the poison from these samples. A comprehensive review was conducted wherein several research articles were reviewed from search engines like Google Scholar, ScienceDirect, PubMed Central, ResearchGate and Elsevier using keywords like 'entomotoxicology', 'Forensic entomology', 'pesticide detection', 'extraction of pesticides', 'toxicological analyses', etc. The findings of this review revealed that there is no standardized protocol established that can be followed for entomotoxicological analysis. Through this study, the different methods used for the collection, preservation, extraction and identification of pesticides were compared and the most effective methods were identified. Ultimately, these methods were used to form an efficient step-by-step guide for the systematic toxicological analysis of the samples, ensuring more reliable results in forensic investigations.

Keywords: Entomotoxicology, pesticides, blowflies, toxicology, extraction.

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INSANITY DEFENSE: EXISTING GAPS AND REQUIREMENT OF AMELIORATION IN THE LIGHT OF MENTAL HEALTH CARE HEALTH, 2017 & BHARTIYA NYAYA SAMHITA

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Abstract

Background/Introduction: The Mental health care act of 2017 introduced several key changes to make the mental heathcare system in the country a very humane and medically and scientifically up to date andat par with global standards. The BNS which replaced the erstwhile Indian Penal Code (IPC) maintains the fundamental of the principle of insanity defense on the concept of understanding the essence of action or the accuracy or inaccuracy of it. The non stigmatization of mental illness as embedded in the MHCA is a revolutionary measure. Thispaper critically explores the gaps in the existing system and tries to provide highlights of need to align legal policy with contemporary mental health care principles.

Discussion: The BNS in section 23 retained to be the critical component of the framework of criminal responsibility of an insane as exhibited earlier in sec 84 of IPC. This make an individual not liable for his action in view of the mental inability to comprehend the rightness or wrongnessof their act due to a mental disorder. However, this disagrees with the modern concept of mental health care science which recognizes voluntary disablement and emotional instabilityaffecting one's mental capacity. The approach to correctly apply insanity defense in legal practice and perform careful scientific evaluation is challenging and needs to be balancedperfectly to administer justice.

Conclusion: While being a progressive step towards developing a humane health care services in the country, there is a need to balance the MHCA with the BNS in the context of mental healthcare services and legal mechanism to perform examination and ascertain the responsiblyof amentally ill patient's criminal responsibility.

Key Words: Bhartiya Nyaya Samhita, Mental Health care Act 2017, mental illness, insanitydefense, criminal responsibility.

A TECHNOLOGICAL JOURNEY INTO DOCUMENT DATING: CURRENT TRENDS AND FUTURE POSSIBILITIES

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Abstract

Precisely ascertaining the age of written documents is a crucial challenge in forensic science, historical studies, and court trials. The conventional techniques, including handwriting analysis, investigation into the composition of ink, and paper study, have been employed in document dating for years. Improved scientific techniques, however, have greatly accelerated the precision in age estimation. Current chromatographic techniques, such as High-Performance Liquid Chromatography (HPLC) and Gas Chromatography-Mass Spectrometry (GC-MS), yield detailed information on ink degradation with age. Non-destructive spectroscopic analytical techniques, such as Fourier Transform Infrared Spectroscopy (FTIR), X-ray Fluorescence (XRF), and Raman Spectroscopy, enable thorough chemical characterization of document materials without compromising their integrity. Furthermore, radiocarbon dating of paper pulp and ink constituents has enhanced the accuracy of dating historical documents. Artificial intelligence (AI) and machine learning have also transformed document analysis. Statistical models and deep learning algorithms examine large datasets to determine sound patterns of paper deterioration and ink aging. AI-based handwriting analysis is also capable of identifying changes and evolutionary trends in handwriting styles. These advances have serious forensic applications, greater document authentication in fraud investigation, criminal investigation, and historical authentication. There are issues, though, such as the necessity for standardization, concern regarding the environment, and the challenge of dating contemporary synthetic inks. This review offers an in-depth analysis of existing document dating techniques, their reliability, and limitations. It also examines future research avenues, with an emphasis on interdisciplinary research that involves chemistry, physics, and artificial intelligence to enhance the credibility of forensic document analysis.

Keywords: Document Age Estimation, Forensic Science, Ink Analysis, Paper Dating, Spectroscopic Techniques, Artificial Intelligence

ANALYSING THE ROLE OF SOCIAL MEDIA IN EXACERBATING CRIME AGAINST WOMEN

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Abstract

Introduction: The exponential growth of social media has transformed interpersonal communication but has also introduced significant challenges, especially concerning women's safety. Platforms that were initially designed to foster connectivity are now being exploited for cyberstalking, harassment, and various forms of abuse, thereby exacerbating crimes against women. This study aims to examine the mechanisms by which social media platforms contribute to these issues, identifying specific features and behaviors that amplify the risks to women online.

Methods: The research employs a mixed-methods approach, combining quantitative data analysis from reported cases of online harassment with qualitative interviews of affected women. Data was gathered from law enforcement reports, surveys conducted with female social media users, and case studies illustrating real-world instances of cybercrimes against women. Statistical analysis was applied to understand the correlation between social media activity and crime frequency, while thematic analysis was used to interpret interview data on personal experiences and psychological impacts.

Results: Findings reveal that anonymity, widespread accessibility, and inadequate content moderation on social media platforms play significant roles in escalating online crimes against women. Cases of cyberstalking and harassment are notably prevalent, with women under 35 being particularly vulnerable. Interviews highlighted emotional and psychological distress among victims, revealing a lack of sufficient recourse on most platforms and limited legal protections, especially in jurisdictions without robust cyber laws.

Conclusion: The study concludes that while social media platforms offer valuable connectivity, they also require enhanced regulatory oversight and improved safety mechanisms to protect women. Recommended interventions include stricter user verification processes, more effective content monitoring, and comprehensive legal frameworks tailored to address online crimes against women. Addressing these issues holistically could foster a safer and more inclusive digital environment for women.

Keywords: Digital Entrepreneurship, E-Commerce Innovation, Emerging Technologies, Tools and Techniques, Business Model, Data Security.

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PEDIATRIC FORENSIC GYNECOLOGY SERVICES IN INDIA: STANDARDIZING POCSO ACT AND BNS WITH HEALTHCARE AND MEDICOLEGAL PRACTICE

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Abstract

Background/Introduction: In today's era of scientific advancements, the need to develop a scientifically validated pediatric forensic gynecology services are crucial for management of sexual crimes in accordance with the Protection of Children from Sexual Offenses (POCSO ACT) of 2012, and the Bhartiya Nyaya Samhita. Despite the available mechanism of prompt reporting and guidelines for comfortable examinations and timebound trials, critical deficits persist. Challenges are faced due to lack of strict adherence to section 27 of the POCSO Act especially in relation to medical standard operating protocol, cultural inhibition towards disclosure of incidents and infrastructure deficiencies in remote areas. This paper is an attempt to look into the existing guidelines and the ground situation in forensic pediatrics services in the country.

Discussion: 1.Clinical compliance: harmonizing the BNS legal requirements with standard operating procedure of medical examination such as colposcopy, photographic visualization of the anogenital region to augment scientific evidence collection

2. Medicolegal cooperation: Reporting of abuse in case of perpetrator from family as per mandatory reporting required under section 19 of the POCSO Act while conserving confidentiality and identity of the survivor is challenging

3. Existing barriers: Unavailability of one stop crisis centers and deficiency of children friendly facilities (e.g. shortage of female examiners, inadequate chain of custody mechanisms) are major challenges

Conclusion:

Bolstering and developing a scientific and up to date forensic gynecology practice mechanism in the country is pivotal BNS act. The need of the hour is integration and development of areas such as teleconferencing to deliver forensic services to rural areas, and extension of one stop centers for examination and care. A more survivor centric approach is the need of the hour in accordance with BNS's emphasis of ethical treatment and POCSO's victim rehabilitation measures.

Keywords: POCSO Act, Bharatiya Nyaya Sanhita (BNS), child sexual abuse, medico-legal protocols, one-stop crisis centers (OSCCs)

ANALYSIS OF AGE AND GENDER USING LIP IMPRESSION

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Abstract

INTRODUCTION: Lip prints are acquiring popularity in forensic science because they are unique, stable, and capable of providing personal identification. The study of lip prints is known as Cheiloscopy. These prints of lip are providing key evidences in homicide, rape cases, and other criminal practices. On the other hand, latent lip prints are unseen or disguised and must be revealed to be captured in a picture. Different techniques are utilized to identify and create latent prints depending on the kind of surface the lip print has been left on.

METHODOLOGY : A total of 300 samples were collected. 150 samples were males and 150 were females. From the population of the 15–70 age range, they were further divided into two groups: The participant's lip impression was collected using a dark color lip stick, After applying the lipstick give a minute to settle. After that, the tape was carefully taken off, leaving a distinct impression of the ridges and grooves of the lips. The lip print was transferred into a plain white sheet.

RESULT : 1. Descriptive analysis results The analysis of lip print pattern shows distinct characteristics for each lip print pattern. No two lip prints show similarities, establishing the uniqueness of the lip prints. In group 1 having 0-25 years showed 37.3% most common in Type I Group 2 having 26-70 years showed 51.3% most common in Type I

2. Independent T-test The independent sample T test indicated no statistically significant differences in the lip type between male and female where t-value was found to be 0.073 and p-value was 0.942, Since p-value is greater than 0.05, equal variance is assumed.

3. Chi-Square Test:

Group 1: The most common lip print type is Type 1. The p-value 0.475 is bigger than the significance level =0.05 α=0.05. Group 2: The most common lip print type is Type 1. The p-value 0.043 is less than the significance level =0.05. this suggests that the relationship between age and lip type is statistically significant.

4. Pearson's co-efficient Group 1: The relationship between lip type and age is -0.115 which is weak negative correlation. Group 2- The correlation between age and lip type is -0.167, which is weak negative correlation.

CONCLUSION: This study has substantially advanced the area of forensic cheiloscopy by relating lip print patterns to age and gender in a way that is quantitatively meaningful. The statistical validation of regression analysis and chi-square tests emphasized how reliable lip prints are for the identification of people, particularly in situations where additional biometric information might not be accessible. In a nutshell, the study shows how cheiloscopy can revolutionize the field of forensic science by linking theoretical knowledge with real-world applications.

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EXAMINATION OF BIRDS NEAR AIRPORTS IN INDIA DURING BIRDHEAT OR FLITE ACCIDENTS.

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Abstract

Bird strikes pose a significant threat to aviation safety, causing aircraft damage, flight delays, and financial losses. In India, the proximity of airports to natural habitats increases the risk of such incidents, necessitating advanced forensic investigations. This study adopts a multidisciplinary approach, integrating DNA barcoding, polymerase chain reaction (PCR), feather microscopy, and toxicological screening to accurately identify bird species from biological remains collected after bird strikes. Additionally, analysis of feathers and tissues provides insights into bird health, migration patterns, and environmental pollution. The study also addresses fraud detection in bird strike claims, including false insurance reports and tampering with evidence. By implementing forensic techniques, investigators can differentiate genuine incidents from fraudulent claims, ensuring transparency in aviation safety protocols. Furthermore, ecological management strategies are explored to mitigate bird populations near airports, reducing future strike risks.

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FORENSIC SIGNIFICANCE AND SPECTRAL ANALYSIS OF SOIL: A REVIEW

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Abstract

Soil forensic analysis is an innovative cross-discipline that has the potential to provide compelling physical evidence with tremendous applications to criminal, counter-terrorism, and environmental crime investigations. A huge number of living organisms can also provide an a biological signature to help with soil comparisons in the organic component of the soil. Physico-chemical and biological properties of soil play a role in making plant nutrients available; their measurement by conventional laboratory methods is laborious and time-consuming. Spectroscopy is quicker timely, cheaper, non-intrusive, straightforward, and sometimes more precise than the traditional method and does not require any harmful chemicals. The methodology is widely applicable for determining the effects of land use on these key indicator soil properties; within a reasonable range of soils, the methodology is sufficiently accurate.

Keywords: ATR-FTIR, Evidence, FIBS, LIBS, MS, MIRS, Soil, VIS-NIR.

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BEHAVIOURAL SCIENCES BRAIN MAPPING BENEFITS OF BRAIN MAPPING TECHNIQUES AND APPLICATIONS

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Abstract

Brain mapping has revolutionized our understanding of the human brain enabling researchers to visualize and analyse its intricate structures and functions. This study reviews recent advances in brain mapping techniques, including functional magnetic resonance imaging (fMRI).We discuss how brain mapping has elucidated the neural mechanism underlying various cognitive, emotional, and behavioural processes, and such as decision making, emotional regulation, and social cognition. The findings have significant implications for the diagnosis and treatment of neurological as well as for the development of personalized interventions and therapies. This research highlights the potential of brain mapping to transfer our understanding of human behaviour and promote innovative solutions for improving mental health and well-being. Brain mapping has revolutionized our understanding of the human brain, enabling researchers to visualize and analyse its intricate structures and analyse. There are several types of brain mapping including structural brain mapping this involves creating detailed maps of the brain's physical structure including the location and shape of different brain regions. Functional brain mapping involves mapping the brain's functional activity such as which areas of the brain are active when performing different tasks. Connectivity brain mapping involves mapping the connections between different brain regions including the strength and direction of these connections. Brain mapping techniques includes Magnetic Resonance Imaging (MRI) waves to create detailed images of the brain's structure. Diffusion Tensor Imaging (DTI) of water molecules in the brain to map the brain's white matter tracts.

Keywords: Brain mapping, Functional MRI, Behavioural Neuroscience, Neuroplasticity.

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TACKLING REAL -TIME INTRICATE CASES WITH PRECISION FOR UNVEILING FORGERIES IN FORENSIC QUESTIONED DOCUMENT EXAMINATION: A SCIENTIFIC INNOVATIVE APPROACH

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Abstract

Introduction: Forensic questioned document examination is a crucial discipline in forensic science, aiding in the authentication and verification of documents in legal and criminal investigations. Complex cases, such as forged and fabricated documents, numeral alterations, and the addition of alphabets, present significant challenges due to the sophistication of modern fraudulent techniques. Traditional examination methods often fall short in detecting intricate alterations, making it essential to incorporate advanced forensic instruments. This study explores the role of sophisticated tools like the High-Resolution Video Spectral Comparator (VSC), Advanced Stereo Zoomed Microscope and Stereo Microscope in resolving complex questioned document cases. By analysing real-time case studies, this research highlights how these technologies enhance forensic document examination, ensuring higher accuracy and reliability.

Methods: A series of real-time case studies involving questioned documents were examined using forensic instrumentation, including the VSC, Advanced Stereo Zoomed Microscope, and other specialized tools. The methodology involved analysing ink differentiation, paper texture, and hidden alterations to detect forgery and fabrication. Various techniques such as spectral imaging, microscopic analysis, and infrared/ultraviolet examination were employed to identify inconsistencies in handwriting, added numerals, and document modifications. The HighResolution Video Spectral Comparator is used to analyse different ink compositions, identify erased or overwritten text, and detect security features embedded in documents. The Advanced Stereo Zoomed Microscope assists in observing micro-level alterations, pressure variations, and surface irregularities. Each case study demonstrates how these instruments contribute to uncovering fraudulent modifications that may not be visible to the naked eye. Comparative analysis with traditional examination methods was also conducted to assess the effectiveness of advanced instruments.

Results: The findings revealed that sophisticated forensic tools significantly improve the detection of document alterations. The High-Resolution VSC effectively identified ink variations and concealed modifications, while the Advanced Stereo Zoomed Microscope enhanced the analysis of stroke patterns, pressure variations, and paper fibres. In cases of added alphabets and numeral alterations, the integration of multiple forensic techniques proved essential in identifying subtle discrepancies. The study demonstrates that while traditional methods alone may be insufficient in complex cases, advanced forensic instrumentation provides a more conclusive approach to questioned document examination.

Conclusion: The research underscores the importance of utilizing advanced forensic tools in tackling complex questioned document cases. Although forensic document examination has certain limitations, the application of sophisticated instruments such as the High-Resolution VSC and Advanced Stereo Zoomed Microscope significantly enhances the accuracy of forgery detection and document authentication. This study emphasizes the need for continuous technological advancements in forensic questioned document analysis to address emerging challenges in document fraud investigations.

Keywords: Forensic Questioned Document Examination, Handwriting, Forgery, HighResolution Video Spectral Comparator (VSC), Advanced Stereo Zoomed Microscope, RealTime Complex Cases.

EXTREMITY INJURY PATTERNS AMONG PILLION RIDERS IN FATAL TWO-WHEELER ACCIDENTS: A COMPREHENSIVE ANALYSIS

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Abstract

Background: Two-wheeler accidents are a significant cause of morbidity and mortality worldwide, with pillion riders being particularly vulnerable to severe injuries. This study analyses the demographic, behavioural, and injury patterns among pillion riders in fatal 2- wheeler accidents to identify key risk factors and propose safety measures.

Methods: This retrospective descriptive study was conducted at the Department of Forensic Medicine and Toxicology, Gandhi Medical College, Secunderabad, over one year (October 2023 to September 2024). A total of 100 cases of pillion riders involved in fatal accidents were analysed. Data on demographic variables, accident characteristics, and extremity injury patterns were extracted from autopsy and police records. Statistical analyses included descriptive and inferential methods, with a p-value of <0.05 considered significant.

Results: Young adults aged 18–25 years (28%) and males (78%) were the most affected. Occupation analysis showed students (24%) and employed individuals (22%) as the largest groups. Helmet usage was alarmingly low (6%). Most accidents occurred during the evening (46%) and night (38%), predominantly on main roads (48%) and highways (42%). Upper extremity injuries were more frequent (100% contusions, 82% fractures), while lower extremities commonly sustained contusions (48%) and fractures (30%).

Conclusion: The findings emphasize the need for improved protective measures, such as enhanced helmet usage and safety gear, particularly targeting young and occupationally active individuals. Stricter enforcement of road safety regulations and public awareness campaigns are crucial to reducing fatalities and injury severity among pillion riders.

Keywords: Pillion Riders, Extremity Injuries, Two-Wheeler Accidents, Road Safety, Helmet Usage.

A PSYCHOLOGICAL ANALYSIS OF GROUP DYNAMICS AND INDIVIDUAL TRAITS AMONG INMATES CONVICTED OF THE SAME CRIME

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Abstract

What drives individuals to commit the same crime? Are there shared psychological patterns among offenders acting within a group, or does each individual possess a distinct personality profile that influences their role in the crime? Criminal behaviour is often analyzed from legal, sociological, and environmental perspectives, but understanding the psychological makeup of offenders convicted of the same crime offers deeper insight into their cognitive distortions, emotional regulation, and behavioural tendencies. This study focuses on 12 individuals convicted of the same crime, exploring both group dynamics and individual psychological traits. By using a multi-method forensic assessment approach, the study incorporates the Draw-A-Person (DAP) Test, Millon Clinical Multiaxial Inventory (MCMI), and Bender-Gestalt Test (BGT) to examine their subconscious emotions, cognitive rigidity, aggression levels, and underlying psychopathology. The DAP Test reveals subconscious conflicts, self-perception, and emotional disturbances; MCMI identifies personality disorders, clinical syndromes, and maladaptive traits; and BGT assesses neuropsychological functioning and impulse control. The findings aim to identify recurring psychological themes, such as paranoia, antisocial tendencies, emotional instability, dependency, aggression, and cognitive impairments, providing a comparative analysis of individual and group psychological frameworks. Additionally, the study investigates how group influence, peer dynamics, and shared criminal motivations shape decisionmaking and behaviour within the crime. By integrating projective and clinical psychological assessments, this research offers a nuanced understanding of criminal cognition, with implications for risk assessment, forensic profiling, correctional interventions, and rehabilitation strategies. This study bridges the gap between forensic psychology and criminology, contributing valuable insights into offender rehabilitation and reducing recidivism rates.

Keywords: Group Offending Behaviour, peer dynamics, Subconscious Indicators of Crime, Psychopathology of Offenders.

HUMAN DNA RECOVERY FROM GUT CONTENT OF THE VARIOUS INSECTS FOUND IN THE CRIME SCENE: A REVIEW

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Abstract

DNA analysis is one of the most important prospects in the field of forensics for identification, either victim or suspect. Whether it's maggots or any other insects, they mostly feed and develop on the body of the victim, so they can be a good resource of human DNA. Insects help in PMI calculation also as environmental factors like temperature, humidity, weather pattern, etc. plays a crucial role in the development and growth of the insects found in the crime scene or in the body of the victim. Different insects have their unique significance for the purpose of human DNA identification from the study of their gut contents. Some of the common insects that are found are houseflies, maggots, blowflies, cockroaches, bed bugs, mosquitoes, lice, etc., which can be helpful with the DNA analysis to reveal different evidence against the crime. This study sheds light on the different types of insects that can be used for the analysis and which method is best to do so. It is found that the third instar larvae, which are actively feeding on corpses, can be considered as the best source of human DNA, but within a limited time only, as with time, the quality and quantity of the human DNA decreases in the gut of the insects due to digestion process. Methods like STR analysis reveal a complete profile of human DNA recovered from the gut contents. But, if the quantity and quality of the found DNA is insufficient for the analysis, then SNP is the better method to approach, as it helps in amplification of partial DNA. This study suggests the potential success of the identification of human DNA by analyzing various environmental insects that can help in identifying the victim, the location of the crime, and the time since death.

Keywords: DNA recovery, Human DNA, Gut content Analysis, STR analysis, SNP analysis.

CHAIN OF CUSTODY AND EVIDENCE GATHERING IN VIRTUAL ENVIRONMENTS USING CLOUD FORENSICS

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Abstract

Because of its unmatched scalability and flexibility, cloud computing has completely changed the digital environment. New forensic difficulties have been brought about by this change, though, namely in the areas of evidence gathering, preservation, and chain of custody administration. Multi-tenant designs, data volatility, encryption techniques, jurisdictional restrictions, and reliance on Cloud Service Providers (CSPs) are some of the elements that make cloud forensics intrinsically complicated. These difficulties frequently make it more difficult for forensic investigators and law enforcement to locate and verify digital evidence for cybercrime investigations. In order to illustrate how forensic techniques are used in real-world situations, this paper looks at case studies of ransomware attacks, insider threats, and cloud data breaches. The 2019 Capital One data breach, for instance, which made over 100 million records public, emphasizes the value of memory forensics and log analysis in cloud-based investigations. The Tesla insider threat event serves as another example of how forensic investigators used SIEM (Security Information and Event Management) technologies and CloudTrail data to track down unwanted access attempts. Furthermore, we examine certain forensic instruments utilized in cloud investigations, including: In hybrid cloud systems, FTK (Forensic Toolkit) and EnCase are used to collect and examine digital artifacts. For doing memory forensics in virtualized environments, use Volatility & Rekall. For forensic logging and threat analysis in Infrastructure-as-a-Service (IaaS) models, use Google Chronicle, AWS CloudTrail, and Azure Monitor. A magnet AXIOM & X1 Social Discovery: Forensic collection of social media data stored in the cloud. Two open-source tools for real-time forensic examination of cloud-hosted systems are Velociraptor and GRR Rapid Response. Additionally, we talk about forensics-as-a-service (FaaS), blockchain-based forensic logging, and AI-driven threat detection as cutting-edge ways to enhance evidence integrity and guarantee adherence to legal requirements like NIST 800-86, ISO/IEC 27037, GDPR, and the CLOUD Act. This research offers a thorough method for improving cloud forensic preparedness, guaranteeing a safe and verifiable chain of custody, and fostering better cooperation between law enforcement and cloud service providers in cybercrime investigations by combining case studies, forensic tools, and legal frameworks.

Key Words: Cloud Forensics, Chain of Custody, Digital Evidence, Cybercrime Investigation, Forensic Tools.

PERSONALITY ANALYSIS OF CHILDREN IN CONFLICT WITH THE LAW: COMPARING PETTY AND HEINOUS CRIME OFFENDERS

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Abstract

Children in Conflict with the Law are minors who have been accused of committing an offense that violates legal statutes and are currently residing in an observation home. These children come from diverse backgrounds and exhibit varying psychological and behavioral characteristics, which may influence their involvement in criminal activities. Understanding their personality traits can provide valuable insights into their behavioral tendencies and potential rehabilitation strategies. This study aims to analyze and compare the personality traits of Children in Conflict with the Law involved who committed petty and heinous crimes. The data for this study was collected using the HEXACO Personality Inventory. The participants were selected from the residents of the Boys Observation Home in Noida. An independent samples t-test was conducted revealing a significant difference in two personality traits: Emotionality (p=0.006), Agreeableness (p < 0.001) and Conscientiousness (p < 0.001). This suggests that offenders involved in heinous crimes tend to be more emotional, agreeable and conscientious compared to those who have committed petty crimes. This study contributes to the growing body of research on children in conflict with the law with implications for intervention and rehabilitation programs aimed at reducing recidivism among juvenile offenders.

Keywords: Children in conflict with the law, Personality, Petty Crime Offenders, and Heinous Crime Offenders.

A COMPARATIVE STUDY OF THE LIFECYCLE OF DERMESTES MACULATUS ON DIFFERENT ORGANS OF PIG AT A CONSTANT TEMPERATURE (35°C)

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Abstract

Many species of beetles (Coleoptera) have high forensic value as they are amongst the dominant insects present from mid-to-late decay stages of decomposition. To arrive at the minimum PMI, an entomologist needs to know the life cycle of an insect. Thus, the development of Dermestes maculatus (DeGeer) on three different organs (liver, heart, kidney) of the pig was studied at a constant temperature of 35°C in the BOD incubator. Females laid eggs within 24 hours of mating. The development period between larval instars and newly emerged beetles was observed. Their replicates were also carried out. The eggs were hatched after 48 hours of oviposition on all the different organs. The mean total time from the egg-laying period to emergence of adults was 32, 29, and 30 days for the liver, heart, and kidney, respectively. The pig liver has the longest developmental period, which is 32 days. The total development period of D. maculatus from egg laying to the emergence of adults on different organs of the pig was found to be in the order of liver > heart > kidney. On the liver, nine instars' larvae were recorded; meanwhile, on the heart and kidney, eight instar larval stages were recorded. This study holds value in forensic scenarios whereby the lifecycle of D. maculatus is being used to arrive at a PMImin.

Keywords: Dermestes maculatus, Pig Organs, Developmental Period, Temperature, Developmental Stages.

USE OF ARTIFICIAL INTELLIGENCE AND ONLINE DISPUTE RESOLUTION PLATFORM TO SOLVE LESS SEVERE CYBERCRIME: A FASTER AND SMARTER WAY TO GET JUSTICE

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Abstract

Cybercrime is increasing rapidly, with cases like online scams, identity theft, and digital harassment becoming more common. Traditional courts often get overloaded with these cases, causing long delays in justice. While serious cybercrimes need to go through criminal courts, smaller issues could be solved faster through Online Dispute Resolution (ODR) platforms supported by Artificial Intelligence (AI). This paper explores how using AI with ODR can help resolve less severe cybercrimes more quickly, making justice more accessible and reducing pressure on courts. This research uses both empirical (data-based) and non-empirical (theoretical) methods. The empirical part includes surveys and interviews to understand public awareness and willingness to use AI-ODR platforms. The non-empirical aspect involves reviewing literature, legal texts, and case studies of successful ODR systems like Modria, while comparing India's IT Act, 2000, with global standards. This mixed-method approach provides a comprehensive understanding of the technological, legal, and social factors influencing the adoption of AI-driven ODR in India. The study shows that AI can help speed up investigations by analyzing digital evidence and detecting patterns of criminal behavior. ODR platforms provide a faster and more affordable way to resolve smaller cybercrimes without needing long court procedures. The research also highlights that many people are unaware of these platforms, but with proper education and trust-building measures, public acceptance could increase. Combining AI and ODR for handling smaller cybercrimes can make justice faster, reduce the load on courts, and allow law enforcement to focus on more severe threats, helping improve national security. The paper emphasizes the need for policy changes to include ODR in India's legal framework and suggests raising public awareness to make this system more effective.

Keywords: Artificial Intelligence, Online Dispute Resolution, Cybercrime

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THE DIGITAL GRIP: EXAMINING INTERNET ADDICTION, SOCIAL MEDIA INFLUENCE, AND GAMING DEPENDENCY IN MODERN SOCIETY

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Abstract

Rapid expansion of digital technology has intensified worries about internet addiction, overuse of social media, and gaming addiction. In this paper explain the underlying psychological mechanisms driving these habits, their effects on mental well-being, and society's consequences of excessive digital interactions. Based on the analysis of the available research and empirical reports, we are drawing attention to risk factors, cognitive and emotional outcomes, as well as avenues for intervention. Moreover, we examine the function of algorithms, reward systems, and online interactions in perpetuating addictive behaviour. The results highlight the importance of an equilibrium digital lifestyle and suggest models for preventing the adverse effects of excessive internet and gaming usage.

Keywords: Internet Addiction, Social Media, Gaming Disorder, Digital Dependency, Mental Health, Psychological Impact, Behavioural Addiction, Online Engagement, Intervention Strategies, Cognitive Effects.

ADVANCES IN FORENSIC ODONTOLOGY

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Abstract

Forensic Odontology also known as "forensic dentistry", is the usage of dental evidences found at the crime scene in legal context, specifically for solving the criminal cases. It is the extending branch of forensic anthropology that involves analyzing and identifying human teeth. It is used in both criminal as well as in civil cases. Here we discuss about various advances that took place in forensic odontology, which not only provide varied details of an evidence but also help in solving cases easily. There are various advances involved in the branch of forensic odontology like the pathological advances which are used for enhancing the ability to identify individuals, analyze trauma and uncover important clues related to criminal investigation. Pathological advances mainly include DNA Analysis and Denture Identification methods. The recent techniques in DNA profiling can be, Polymorphism Typing, Restriction Fragment Length, Y-chromosome analysis, etc. Denture identification methods involves two methods like, surface marking method and inclusion method. The next advancement in forensic odontology is radiological advancement, which is a varied branch itself involving various techniques. It helps in comparison of antemortem and postmortem radiographs, analyzing dental conditions, etc. There are various techniques in radiological advancement like Cone- Beam Computed Tomography (CBCT), Digital Radiography, Advance Imaging, 3D Resolution, etc. All these techniques allow detailed visualization of teeth, roots, and surrounding bones, in complex criminal cases and mass disasters. Apart from pathological and radiological advances in forensic odontology, we also have celioscopy, which is identification on the basis of lip traces and palatal rugoscopy, which is identification on the basis of rugae patterns. Trauma analysis is also involved in forensic odontology and it has various techniques which again help in forensic odontology advancements. Techniques for trauma analysis in forensic odontology can be, radiographic examination, forensic photography, etc. Bite mark analysis and its techniques like, 3D Imaging, Digital Bite Mark Comparison is also involved in advances in forensic odontology.

Keywords: Advance Identification Techniques, Genetic Polymorphism, Bite Mark Analysis.

EVALUATING DRUG STABILITY IN FORENSIC SPECIMENS: IMPLICATIONS FOR TOXICOLOGICAL ANALYSIS

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Abstract

During the pre-analytical stage, sample handling is a crucial factor to consider. Significant delays are common in a forensic setting, in contrast to a clinical environment where the interval between sample collection and testing is typically brief. The pre-analytical phase within forensic contexts may include the duration spanning from the moment of the victim's demise and/or discovery, the performance of the autopsy and acquisition of specimens, the preservation of samples, their transportation to the laboratory, and subsequent storage prior to analytical evaluation, all of which can be extended. Specimens must be maintained at the appropriate temperature. Most samples should be stored either frozen (-20°C or below) for short-term storage (less than 2 weeks) or refrigerated (4°C). Samples such as hair, nails, and dried blood specimens affixed to filter paper are exempt from this regulation, and therefore they may be preserved at ambient temperature. This review focuses on various 48 recommendations for mitigating the degradation of drug concentrations during analysis and storage.

Keywords: Drug of abuse, Screening Analysis, Urine sample, Drug test, GC-MS

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BITE MARK ANALYSIS: OBSERVATION OF DISTORTION WITHIN PHOTOGRAPHY AND POSITIONING OF TEETH IN RELATION TO SUBSTRATUM

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Abstract

Human bitemark analysis is one of the most complicated and significant part with in Forensic odontology. For analyzing the bitemark, photographic accuracy while recording, measurements, positioning and similarity in tooth characteristics against the substratum is observed. An attempt has been made to analyze and evaluate the distortion within photography and positioning of the teeth with respect to substratum at different angle. In this study, hundred subjects (50 males: 50 females) were selected to give self-inflicted bites on their forearm part in 3 different angles viz: full bite, right-side bite and left-side bite. For each of the bite it was photographed at 4 different angles (120o, 90o, 60o, 40o) to select the best photographic angle. It is observed that photographic angle changes with the change in curvature of substratum, when images are superimposed of known photographic angles and determining the degree of distortion produced at different angle. This investigation suggests that several photographs of the bitemark should be taken at measured angles that can help in arriving at the accurate opinion.

Keywords: Forensic Odontology, Bite marks, Distortion, Morphometric measurements

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EVOLVING ROLE OF FORENSIC SCIENCE IN CRIMINAL JUSTICE: THE RELIABILITY AND LEGAL STANDING OF NARCO ANALYSIS IN INDIA

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Abstract

Forensic science is not an individual subject, but it is an umbrella term that consists of other disciplines of science and touches almost every boundary of medical subjects. It is an exercise of common sense coupled with the experience and knowledge already acquired from other branches of medicine, obstetrics, and surgery. The evolution of the forensic science field over the past twenty-five years has made dramatic scientific breakthroughs (DNA typing, physical evidence databases, related scientific instrumentation). Due to limited resources forensic techniques are not utilized in most criminal investigations. As our society has grown more complex, it has become more dependent on the rules of law to regulate the knowledge and technology of science and the enforcement of such laws. Each year, as government finds it increasingly necessary to regulate those activities which intimately influence our daily life, science merges more closely with civil and criminal laws. The criminal justice system is no more different from it and it has also been effected by the changing scenario of newer technologies. Deception detection tests is one of those new technologies which are employed by the criminal justice system to know about the truths behind various crimes committed. The technique used is deception detection tests are narco analysis, lie detection, brain mapping, and polygraph tests. The present paper explores the applicability of forensic science in criminal investigation and its role in maintaining law and order. It also examines narco analysis as a forensic tool, discussing the various chemicals used, their effects on the human body, and their reliability in extracting truthful confessions. By intertwining forensic advancements with legal principles, this study highlights the growing dependency of the criminal justice system on scientific methodologies to ensure effective law enforcement. The proposed research paper is based upon doctrinal research methodology based on available legislation, case studies, regulation, Reports, Record of National crime record Bureau (NCRB). Researcher aim is to provide clarity, consistency and deeper understanding of Legal Framework for forensic science in criminal justice system in India.

Key Words: Forensic science, Criminal investigation, Narco analysis, Justice, Medical jurisprudence.

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OPTOMETRIC EVIDENCE IN FORENSIC SCIENCE: THE ROLE OF OCULAR TRAUMA AND RETINAL HEMORRHAGES IN CRIMINAL INVESTIGATIONS

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Abstract

Introduction: Forensic optometry has emerged as a critical discipline in criminal investigations, particularly in cases involving ocular trauma and retinal hemorrhages. The human eye's delicate structure makes it a valuable forensic marker for determining the mechanism, timing, and intent of injuries in cases such as assault, child abuse, and strangulation. Despite its potential, forensic optometry remains underutilized due to a lack of standardized protocols and interdisciplinary collaboration.

Methods: This study reviews the anatomical and physiological basis of ocular trauma, including blunt force injuries, sharp force trauma, thermal and chemical burns, and asphyxial findings. Advanced imaging techniques such as optical coherence tomography (OCT), fundus photography, and fluorescein angiography were employed to document and analyze retinal hemorrhages and other ocular injuries. Additionally, artificial intelligence (AI)-based tools were utilized to enhance the accuracy and objectivity of forensic interpretations.

Results: The findings highlight the forensic significance of retinal hemorrhages in differentiating accidental injuries from inflicted trauma, particularly in cases of shaken baby syndrome (SBS) and strangulation. Advanced imaging modalities enabled precise documentation of ocular injuries, while AI-driven analysis improved the differentiation between antemortem and postmortem changes. Case studies demonstrated the critical role of ocular evidence in securing convictions and resolving legal disputes.

Conclusion: Forensic optometry offers invaluable insights into criminal investigations, but its full potential remains untapped due to challenges in legal admissibility, lack of standardized protocols, and limited interdisciplinary collaboration. Future research should focus on developing evidence-based guidelines, integrating AI technologies, and fostering collaboration between forensic scientists, ophthalmologists, and legal professionals to enhance the field's credibility and applicability in medico-legal contexts.

Keywords: Forensic Optometry, Ocular Trauma, Retinal Hemorrhages, Criminal Investigations, Shaken Baby Syndrome.

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PUBLIC PERCEPTION AND ACCEPTANCE OF FAMILIAL DNA SEARCHING IN CRIMINAL INVESTIGATIONS: A UAE BASED STUDY

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Abstract

Familial DNA searching (FDS) and related techniques have emerged as powerful tools in criminal investigations, allowing law enforcement to identify potential suspects through genetic relationships. This survey-based study provides a comprehensive analysis of public perception and acceptance of Familial DNA searching (FDS) for criminal investigations among the UAE residents and citizens, focusing on the perception and acceptance of the method and the factors influencing attitudes towards this investigative tool. The study encompasses a comprehensive methodology, demographic analysis, and survey findings, elucidating the nuanced perspectives of diverse demographic cohorts. This highlights the importance of clear guidelines, ethical deliberations, and community awareness to ensure Familial DNA searching (FDS) and related techniques is responsibly incorporated into forensic enquiries. This study also examines the future implications of familial matching for law enforcement agencies, emphasising the significance of public perception and acceptance for the efficacy of genetic genealogy as a forensic tool. The findings provide actionable insights to inform policies and practices, ensuring the harmonious integration of genetic ancestry testing into the criminal justice framework.

Keywords: Familial Matching, Genetic Genealogy, Acceptance, Perception

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VIABILITY OF STYLOMETRY USING MACHINE LEARNING IN FORENSIC LINGUISTICS - A BRIEF REVIEW

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Abstract

Forensic linguistics applies linguistic knowledge to legal contexts, where determining text authorship carries significant implications for legal proceedings and scholarly investigations. Stylometry serves as a quantitative approach in this field, examining unique writing characteristics by utilizing measurable linguistic elements such as word choice, sentence structure, and punctuation patterns. These features, often subconscious, serve as reliable markers for distinguishing individual authors, enhancing the evidential value of linguistic analysis in legal proceedings. This review explores the viability of stylometry using machine learning (ML) in forensic linguistics, emphasizing its role in authorship attribution and its implications for the criminal justice system. Incorporation of artificial intelligence (AI) and ML has fundamentally altered stylometry, making it possible to analyse vast datasets and uncover complex stylistic patterns. Techniques like support vector machines, neural networks, and deep learning models, such as convolutional and recurrent neural networks, have markedly improved the reliability of authorship attribution, even in varied genres and contexts. Computational stylometry further expands these capabilities, leveraging natural language processing (NLP) to handle vast linguistic corpora. Despite these advancements, its utility in the field of forensics face significant challenges such as the need for methodological standardization, the subjective nature of language analysis, limitations in available training data, and difficulties adapting to rapidly evolving digital communication patterns. This paper examines these challenges while highlighting the potential of AI/ML driven stylometry in forensic linguistics and suggests key areas for improvement to enhance its reliability and legal applicability.

Keywords: Forensic Linguistics, Computational Stylometry, Authorship Attribution, Machine Learning, Text Corpora

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BLADED EVIDENCE IN A GRUESOME PARRICIDE: FATAL STAB CASE WITH A RETAINED KNIFE.

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Abstract

Stab wounds inflicted anywhere in the body are of utmost forensic concern because they invariably aid in pinpointing the concerned weapon, which is one of the most important opinion required from of the autopsy surgeon. Stab wounds to the neck often result in a deadly outcome. In such a scenario having a weapon in situ raises many questions which shall be dealt with in this unique case report. We report a case of a female victim, the grandmother of the accused, having a perforated through and through neck injury with a retained knife embedded in the neck sideways. External examination revealed a single perforating stab wound with the knife's hilt protruding out. On dissection of the neck muscles, it showed severance of major structures which will be discussed in depth along with its forensic perspective. There were no defensive injuries. This case highlights the forensic importance of retained weapons in stab wounds which aids in crime reconstruction and further legal investigations.

Keywords: Parricide, Stab Wound, Post-Mortem, Retained Weapon, Forensic Evidence, Knife

COMPREHENSIVE REVIEW OF HEAVY METAL CONTAMINATION: ENVIRONMENTAL DISTRIBUTION, HEALTH IMPACTS, AND DETECTION STRATEGIES

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Abstract

Heavy metals (HMs) being persistent in environmental matrices such as soil, air, water & plants causing pollution that has been a critical situation affecting human and environment. These elements originate from natural processes as well as industrial and agricultural activities. There accumulation in the environment affects human health leading to several problems such as reproductive issues, neurological disorders, water imbalance and many more by entering in the food chain. Dissolution of HMs in environmental matrices can lead to toxic nature of these as well as their accumulation in the plants affecting its growth and nutritional value. This review paper summarises sources, effects of HMs and detection methods available for these HMs in different environmental matrices. This paper also compares both traditional methods such as ICP-MS, AAS, etc with emerging detection methods such as nanomaterial- based methods on the basis of their detection limits (LODs). There is high need to develop more detection methods to identify these HMs presence in the environment with high sensitivity, accuracy, efficiency and integrity which will help in monitoring conditions of the environment.

Keywords: Heavy Metals (Hms), Detection, Pollution, Nanomaterial, Environmental Distribution

UNSEEN SCARS: THE SILENT IMPACT OF MENTAL HARM AND A FORENSIC CALL TO ACTION

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Abstract

The Supreme Court of India recently remarked on the need to make criminal trials victimcentric. Taking a cue from this observation, this paper attempts to propose the use of forensic science to aid victims, particularly those of marital abuse, by comprehending and assessing the degree of mental harm caused to them. While physical harm is more straightforward to assess due to its visibility and is typically addressed by doctors, the victim compensation schemes under Section 357A CrPC focus primarily on physical victimisation, detailing categories of physical harm and corresponding compensation amounts. Compensation is often quantified based on medical certifications, and recovery is ordered from the accused perpetrator(s). However, a comparable framework for assessing and addressing mental harm remains conspicuously absent. This gap marginalises forms of abuse that cause significant mental harm, whether or not accompanied by physical harm. Spousal violence, or domestic violence, encompasses abusive behaviours within intimate relationships, wherein one partner dominates the other through physical, emotional, psychological, or sexual abuse. This paper proposes the integration of forensic profiling and risk assessment tools for quantifying harm and understanding its implications. Spousal violence risk assessment evaluates potential risk factors and the likelihood of future incidents by analysing the offender's history, behaviour, and psychosocial dynamics. The study considers models of risk assessment, including unstructured clinical assessments, actuarial assessments, and structured professional judgment, each with its own strengths and limitations. Tools such as the Spousal Assault Risk Assessment Guide (SARA), Violence Risk Assessment Guide (VRAG), Domestic Violence Screening Instrument-Revised (DVSI-R), and Ontario Domestic Assault Risk Assessment (ODARA) are analysed for their application and effectiveness. Furthermore, mental health instruments like the Beck Depression Inventory (BDI) and Hamilton Anxiety Rating Scale (HAM-A) are evaluated for their utility in forensic settings. Case studies underscore the practical application and validation of these tools, demonstrating their role in predicting recidivism, guiding interventions, and enhancing accuracy and justice in forensic risk evaluations. This framework aims to bridge the gap in addressing mental harm, fostering ongoing research and refinement of assessment tools to adapt to evolving societal and legal contexts, and ultimately contributing to more effective prevention, intervention, and rehabilitation strategies.

Keywords: Marital Abuse; Intimate partner violence; Mental abuse; Verbal abuse; Physical abuse

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CHALLENGES FACED BY FORENSIC EXPERTS IN TESTIFYING EVIDENCE IN CRIMINAL COURTS IN INDIA

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Abstract

Forensic evidence is a field which is evolving as an important branch when Criminal justice system is looked at. Forensic experts in India plays eminent role in helping the Judiciary, by providing specialized knowledge to Judges and Juries to understand Complex Scientific or technical evidence in an easy way. At the same time the forensic professionals face significant challenges, specifically in terms of the pressure to present the complex findings effectively, navigate cross examination and ensure their testimony remains reliable under intense scrutiny. The testimony of the forensic experts and their findings are crucial in making decisions in Criminal offences. Criminal laws specifically talk about the appointment of forensic experts to find collaborative evidence to prove the guilt of the accused in a case at hand. The paper explores the role of forensic experts in Indian courtroom, examining the challenges they face during direct testimony and cross examination and offers strategies to improve their effectiveness and credibility. The researcher has combined both qualitative and quantitative approaches to come up with holistic view of the Challenges that forensic experts face in Indian legal system. The researcher will scrutinize literature available, case study, and various talks and interviews given by forensic professionals.

Keywords: Forensic Experts, Court, Cross-Examination, India, Criminal Laws, Role

EMERGING TRENDS IN CYBERCRIME: UNVEILING THE 21ST CENTURY THREAT LANDSCAPE AGAINST JUVENECENCE

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Abstract

The 21st century has witnessed unprecedented advancements in technology, reshaping the lives of youth in transformative ways. However, this digital evolution has also created fertile ground for emerging forms of cybercrime, targeting a generation increasingly dependent on the virtual world. This paper aims to explore these new dimensions of cyber threats against youth, focusing on their nature, impact, and the need for adaptive countermeasures. Among the most alarming trends is the rise of cyber predation and grooming, facilitated by social media platforms and online gaming spaces. Criminals exploit these digital avenues to manipulate, exploit, and harm vulnerable individuals. Additionally, "cyberbullying" has evolved into sophisticated forms of harassment, leveraging deepfake technology and anonymous platforms to amplify psychological trauma. Another growing concern is "sextortion," where malicious actors use compromising content to coerce or extort victims, often leaving young individuals trapped in cycles of fear and silence. Emerging technologies, such as artificial intelligence and the Internet of Things (IoT), have also introduced new risks. These technologies are exploited for identity theft, phishing schemes, and even real-world crimes via data breaches from connected devices. Moreover, youth are increasingly drawn into "cyber hustling" or digital scams, where they inadvertently become perpetrators of financial fraud, lured by promises of easy money. This abstract emphasizes the urgency of addressing these evolving threats through a collaborative approach involving policymakers, educators, parents, and technology developers. A qualitative analysis examines case studies, reports, and victim testimonies to identify patterns in emerging cyber threats.

Keywords: Cybercrime, Youth, Cyber Threat, Artificial intelligence, Cyber Law

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ANALYSIS OF NON-DISTAL PHALANGES FINGERPRINT IN THE INVESTIGATION AND IDENTIFICATION OF THE PERPETRATOR

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Abstract

The middle and proximal phalanges prints are found in most of the crime scenes. In the past, crimes have gone unsolved due to ignorance of middle and proximal phalanges by the investigators. Fingerprint experts had collected these prints but they avoided the middle and proximal phalanges prints because they needed more information of their characteristic type. They consider middle and proximal phalanges to be non-relevant for identifying a suspect/culprit/criminal. Middle and Proximal phalanges are also systematically classified as distal prints and are valuable for narrowing down the suspects. Distal phalanges of the fingers and the palms have become traditional subjects of Dermatoglyphics studies. they play a major role in the identification and individualization of the person from the traditional era. It is the need of the hour that forensic investigators weigh in on the importance of middle and proximal phalanges in investigations and identification.

KEYWORDS: Dermatoglyphics, Forensic science, Distal phalanges, Middle phalanges.

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ACADEMIC PERSPECTIVES ON JUSTICE: A COMPARATIVE STUDY OF ATTITUDES TOWARDS EX-OFFENDERS' REINTEGRATION"

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Abstract

Introduction: Reintegration of ex-offenders into society remains a global challenge, often hindered by public stigma and policy inefficiencies. This study examines how academic background influences attitudes towards ex-offender reintegration, focusing on students from Law, Forensic Science, Psychology, and other academic fields. Understanding these perspectives is crucial for shaping interdisciplinary criminal justice policies and fostering rehabilitative approaches.

Methods: A total of 373 students participated in a structured questionnaire-based survey assessing their attitudes on punitive versus rehabilitative justice. The data underwent descriptive statistics, ANOVA, post-hoc Tukey's HSD tests, correlation analysis, and factor analysis. Differences in attitudes were analyzed based on academic discipline, gender, and age, using SPSS and statistical visualizations for clarity.

Results: Findings indicate significant disciplinary differences ($p < 0.05$):

- Law students favoured punitive justice, supporting strict sentencing.

- Psychology students strongly endorsed rehabilitative policies, emphasizing mental health and counselling.

- Forensic Science students displayed a balanced perspective, supporting both punitive and rehabilitative approaches.

- Students from Other Fields showed diverse and inconsistent attitudes, suggesting less exposure to criminal justice education.

- Age negatively correlated with punitive attitudes ($r = -0.35$), and exposure to criminology positively correlated with rehabilitation support ($r = 0.42$).

Conclusion: The study highlights the critical role of education in shaping justice attitudes. Policies should integrate interdisciplinary learning, awareness campaigns, and rehabilitative frameworks to foster balanced perspectives. These findings offer actionable insights for policymakers, educators, and justice reform advocates.

Keywords: Justice Attitudes, Ex-Offender Reintegration, Academic Disciplines, ANOVA, Policy Implications

EXPOSING GRAB MARKS ON FABRICS: A FORENSIC APPROACH TO LATENT FINGERPRINTS

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Abstract

Fingerprints are the papillary ridges present on the bulbs of each finger. Due to the presence of sweat pores, they often leave an invisible impression on the surface they come in contact with. Different development techniques are used to visualise the latent (invisible) fingerprints based on their interaction with the sweat composition on various surfaces. Among all, porous surfaces, especially fabrics, highlight the development of latent fingerprints as a major challenge. In this study, an attempt was made to ascertain the effectiveness of the silver nitrate method on multiple fabrics for the development and identification of fingerprints. Fingerprints were collected from a single subject on nine types of fabrics with different pre-treatments to ensure uniformity in the study. The developed fingerprints were evaluated based on quality metrics and categorized as good or bad prints for identification purposes. A definite result was obtained as some fabrics on development were able to give level 1 information, i.e. ridge pattern, while most of the fabrics were successful in providing the grab mark details. Although ridge details were not consistently visible, the grab marks proved to be potential evidence. In cases like assault or struggle, this study can be highly beneficial for the reconstruction of events.

Keywords: Development Methods, Fabrics, Fingerprint, Grab Marks, Quality Metrics, Surface

FORENSIC DETECTION OF CAFFEINE: A RAPID AND SENSITIVE COLOR TEST USING IODINE METHANOL

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Abstract

Caffeine, a methylxanthine alkaloid, is a naturally occurring stimulant found in plants such as Coffea arabica (coffee), Camellia sinensis (tea), and Theobroma cacao (cocoa). It is widely present in beverages, pharmaceuticals, and dietary supplements. While caffeine is generally considered safe in moderate doses, excessive consumption or misuse can lead to toxicity, making its detection crucial in forensic investigations. Cases involving drug adulteration, overdose, poisoning, and forensic toxicology often require rapid and reliable methods for caffeine identification. However, conventional analytical techniques like chromatography and spectrophotometry, though highly accurate, require sophisticated instruments and time consuming sample preparation, limiting their use in field applications. This study introduces a novel colorimetric method for caffeine detection using iodine and methanol, which has not been previously reported in forensic science. When iodine is dissolved in methanol. Upon the introduction of caffeine, a distinct color change occurs due to the formation of a charge-transfer complex, as caffeine donates electrons to iodine, leading to a visually detectable shift in color. This color test is rapid, cost-effective, and highly sensitive, capable of detecting trace amounts of caffeine, making it ideal for preliminary forensic screening. The simplicity of this method allows for on-site forensic applications, particularly in drug seizure analysis, toxicology assessments, and beverage tampering cases. It provides a quick qualitative indication of caffeine presence, which can assist forensic investigators in making immediate decisions regarding sample composition. However, due to the potential for interference from other electron-donating compounds, confirmatory techniques such as chromatography or spectrophotometry remain necessary for definitive identification and quantification. This study explores the reaction mechanism, detection limits, and potential interferences associated with this newly developed colorimetric detection technique. By optimizing these parameters, this method can serve as an effective preliminary forensic tool, aiding in the rapid screening of caffeine in various forensic and toxicological samples.

Keywords: Caffeine Detection, Colorimetric Method, Wattmann Filter Paper, Forensic Screening, Iodine-Methanol.

AN INVESTIGATION ON THE POTENTIAL USES OF BENZALKONIUMCHLORIDE (BAC) FOR THE IMPROVEMENT OF FINGERPRINT DEVELOPMENT

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Abstract

Introduction: This study examines the potential of Benzalkonium Chloride (BAC), a quaternary ammonium compound traditionally used for its antimicrobial properties, as an enhancement agent for latent fingerprints on non-porous surfaces such as glass.

Methodology: Fingerprint samples were collected from donors with varying ridge quality (strong, medium, and weak) and treated with BAC at concentrations ranging from 0.1% to 3%. The BAC was applied using three methods: hand rubbing, spraying, and dipping. To develop the latent fingerprints, Cyanoacrylate Fuming and Magnetic Fluorescent powder were employed.

Results: The results indicated that BAC, particularly at a concentration of 0.1%, significantly enhanced the visibility and clarity of the fingerprints, with the greatest improvement observed in weak donor prints. However, higher BAC concentrations negatively affected fingerprint quality, suggesting that optimal BAC concentration is critical for consistent enhancement.

Conclusion: This research demonstrates the potential of BAC as an effective, accessible, and economical tool for improving latent fingerprint development, particularly on difficult-to-process surfaces. It also highlights the need for careful control of BAC concentration and application technique to ensure reliable forensic results. The findings provide valuable insights for advancing forensic practices and offer a new approach to fingerprint enhancement, potentially overcoming challenges presented by low-quality prints and variable environmental factors.

Keywords: Latent Fingerprint Examination, Benzalkonium Chloride (BAC), Fingerprint Enhancement, Cyanoacrylate Fuming, Magnetic Fluorescent Powder, Assessment Scores and Statistical Analysis.

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AI-DRIVEN FORENSIC LOG AUTHENTICATION: ENHANCING INTEGRITY, ANOMALY DETECTION, AND COMPLIANCE IN DIGITAL EVIDENCE MANAGEMENT

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Abstract

Ensuring the integrity and authenticity of forensic logs is critical for digital evidence management, cybersecurity investigations, and legal proceedings. Log tampering, regulatory non-compliance, and insider threats undermine forensic reliability, necessitating a robust authentication framework. This paper presents an AI-driven forensic log authentication model that integrates machine learning, blockchain notarisation, and compliance auditing to secure forensic logs and strengthen digital evidence validation. The framework employs Random Forest classification to verify log authenticity, distinguishing between genuine and tampered records. It further applies Isolation Forest-based anomaly detection to uncover insider threats and security anomalies. A blockchain-based notarisation system secures forensic logs by ensuring immutability and verifiable evidence trails, while timestamped digital signatures establish a legally admissible chain of custody, enhancing forensic credibility. To ensure forensic and regulatory compliance, the model performs automated compliance auditing against key frameworks, including GDPR, the U.S. CLOUD Act, and the Indian IT Act. Noncompliant logs are flagged to prevent evidentiary challenges, ensuring admissibility under legal standards. The framework aligns with ISO 27037 and NIST SP 800-86, reinforcing forensic best practices in log collection, preservation, and validation. Experimental results demonstrate that the proposed system achieves 89.2% accuracy in forensic log authentication, successfully detects insider threats, and flags compliance risks in 23% of logs, reinforcing forensic integrity. Integrating AI-driven authentication with compliance enforcement mechanisms ensures that digital evidence remains trustworthy, legally admissible, and resistant to tampering. The proposed framework enhances forensic investigations and cybersecurity operations, providing an automated, scalable solution for forensic log management in cloud environments.

Keywords: Forensic Log Authentication, AI-Driven Digital Evidence, Blockchain for Cybersecurity, Anomaly Detection in Digital Forensics, Compliance Auditing in Cybersecurity.

EXAMINING THE FORENSIC ASPECTS OF CLOTHING DAMAGED BY MECHANICAL TEARS IN COTTON FABRIC

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Abstract

Background: This research delves into the forensic analysis of mechanical tears found on cotton fabrics; a type of textile frequently encountered in forensic investigations. This study seeks to explore the nature of mechanical tears that arise from pulling or blunt force trauma, focusing on their morphological features, microscopic details, and the disruptions observed in the fibres.

Methods: In this study, we applied simulated damage to 16 cotton fabric samples within a controlled environment, aiming to closely mimic the conditions encountered in real-world forensic investigations. Mechanical tears were generated through a systematic approach involving controlled tearing by Human Participants Trials Method and Tearing Resistance Tester Machine. A detailed microscopic analysis was performed using a digital microscope and a Scanning Electron Microscope to examine the characteristics of fibre ends, the arrangement of yarn, and the patterns of tearing. Further, the statistical analysis focused on key distinguishing features, including frayed edges, fibre fractures, and secondary deformations, to enhance forensic interpretation.

Result: Statistical analysis done using SPSS and Python demonstrated that blunt force primarily affects fibres along the direction of applied force. ANOVA results showed that tear dimensions varied significantly across samples, supporting the hypothesis that blunt force results in distinct damage patterns. The regression model accurately predicted tear size based on fibre damage.

Conclusion: The findings indicated fraying and fibre breakage, accompanied by disruptions in the yarn structure. This research emphasizes the importance of microscopic fabric analysis in understanding tear mechanisms and recognizing patterns of textile damage within forensic investigations. The results present a structured method for linking the type of damage to the patterns seen in cases of mechanical tears caused by blunt force impacts in forensic investigations. This offers important criteria that can aid investigators in reconstructing crime scenes and correlating evidence effectively. Future studies will investigate how the density of fabric weave and the effects of environmental degradation influence the characteristics of damage.

Keywords: Clothing, Cotton, Damage, SEM, Fibre, Blunt Force impact, Tear

DEVELOPMENTS IN CYBER FORENSICS IN INDIA: COMBINING LEGAL FRAMEWORKS WITH TECHNOLOGICAL INNOVATIONS

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Abstract

The swift proliferation of digital technologies has necessitated the evolution of robust cyber forensic frameworks within legal structures worldwide. It was in late 2000s that the Indian subcontinent realised the value of the forensics in the digital medium with the incident of the Taj Hotel. Supplementing legislative reforms, India has established the specialized structures within its premier forensic evidence examination agency under National Forensic Science Labs, to address cybercrimes. Remarkably, the Cyber Crimes Research and Development Unit (CCRDU) and the Cyber Crime Investigation Cell (CCIC) have been instrumental in collecting information on cybercrime cases and conducting investigations, respectively. These units play a pivotal role in coordinating with state police forces and other organizations to combat cyber threats. The paper follows the approach of analysing the secondary data wherein, the cybercrime statistical data, released by the NCRB (National Crime Records Bureau) has been utilised to bring out the current picture of such crimes in India. In support of the same, the procedure that been followed in the forensics labs with respect to the digital evidence has also been examined. The paper highlights the aspect of the forensic labs being not equipped with the required software for the examination, leading to the misleading results from the evidences. Apart from this, challenges persist including the need for continuous upskilling of law enforcement personnel and ensuring the examination of evidence in the correct manner. This paper in the whole provides a comprehensive analysis of India's current cyber forensic framework, evaluates the effectiveness of recent initiatives, and proposes recommendations to fortify the integration of cyber forensics within the Indian legal system.

Keywords: Cyber Crime, Cyber forensics, Investigation & Technology.

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BEYOND TRADITIONAL BANKING: ROLE OF AI-POWERED BLOCKCHAIN TECHNOLOGY IN COMBATING EBANKING FRAUDS

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Abstract

Advent of World Wide Web has revolutionized the whole communication technology. Continuous progress and innovation in the field of Information and Communication Technology has made significant changes and achievements which are noteworthy. This has also caused a new form of crime committed over the network which is popularly known as the e- banking frauds. In the past few decades there has been a great transition from banking to digital banking resulting in the evolution of financial frauds. That's why it become so important to have a sound and effective mechanism to overcome such activities. The most authentic and genuine one is the Artificial Intelligence which proves to be operative and effectual in dealing such types of frauds. AI plays a remarkable role in the digitalized banking services and regarded as the future of banking, where AI-based techniques would be used to identify the fraudulent transactions. It caters the needs of the ongoing technological developments by incorporating deep learning, predictive analysis and machine learning as a tool for enhancing the level of existing banking services and achieving customer satisfaction. The paper delves into the insight of role of AI based techniques such as AI powered blockchain technology which would help in finding, preventing as well as combating e-banking frauds. The purpose of this paper is threefold: first, to explore and analyse the challenges and complexities associated with deployment of blockchain technology; second, to illuminate how e-banking frauds can be prevented through the use AI-powered blockchains; and third, to provide a progressive viewpoint highlighting the broad acceptance of blockchain for potential future advancements in Indian Cyberspace.

Keywords: Information and Communication Technology, Artificial Intelligence, blockchain technology, Cyberspace.

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THE ROLE OF FORENSIC SCIENCE IN UPHOLDING AND STRENGTHENING CHILD RIGHTS UNDER THE POCSO ACT, 2012

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Abstract

Child sexual abuse (CSA) is a global issue affecting women and children, regardless of age, gender, ethnicity, or socio-economic status. It often goes unreported, causing repeated abuse and posing challenges in public health, justice, and human rights. Child trafficking and poverty exacerbate CSA, leading to coerced marriages and sexual violence. Despite global efforts, CSA remains unreported. India implemented the POCSO Act, 2012, in line with the UNCRC,1989. The enforcement of CSA laws often relies on reliable forensic evidence for investigation and prosecution. Recent advancements in forensic sciences have improved the capacity to collect, analyse, and present evidence in CSA cases, ensuring victims' justice and fortifying the legal process. This paper examines the role of forensic advancements in investigating child sexual abuse and their impact on the POCSO Act, 2012. It highlights challenges such as delayed reporting, vulnerability of child witnesses, and lack of physical evidence, which traditional methods often fail to address, leading to low conviction rates and inadequate justice for victims. The study explores the use of evidentiary tools in sexual abuse investigations, focusing on forensic science concepts like Lockard's Principle, admissibility rules, accreditation, contamination, forensic fraud, and chain of custody. Furthermore, the paper explores the integration of forensic evidence into the POCSO Act, 2012, highlighting the need for specialized training for law enforcement and judicial personnel, the creation of child-friendly forensic examination protocols, and the establishment of multidisciplinary teams to manage CSA cases. The study concludes by emphasizing the need for collaboration among forensic experts, legal professionals, and policymakers to improve child protection laws. It suggests that India can achieve its goal of protecting children and delivering justice by utilizing forensic advancements to investigate and prosecute child sexual abuse cases. This paper offers actionable insights for stakeholders fighting child sexual abuse, contributing to the broader discourse on the intersection of forensic science, law, and child protection.

Keywords: POCSO, UNCRC, CSA.

RAPID AND NON-DESTRUCTIVE APPROACH FOR THE IDENTIFICATION AND DISCRIMINATION OF CIGARETTE TIPPING PAPERS USING ATR-FTIR SPECTROSCOPY

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Abstract

Cigarettes are addictive and people over time become habituated to smoking a particular brand. Therefore, their identification and brand-discrimination could be important during forensic investigations. Whenever a smoked or unsmoked cigarette is recovered at the crime scene, the tipping paper being a part of cigarette butts would always be found. It could serve as corroborative evidence not only in cases of physical and sexual assaults, theft, burglary and dacoity but also in cases of illegal trading and smuggling of illicit and counterfeit cigarettes. Thus, in the present study, 21 brands of cigarette-tipping paper have been analysed using ATR-FTIR spectroscopy with chemometrics for brand discrimination and determination of geographical origin. Visual assessment of individual peaks produced in all spectra in the mid-IR region (4000-600 cm-1) was performed before subjecting to statistical analysis. The structural pattern of the dataset was explored using PCA, and three clusters were observed. Support vector machine was used for discrimination of samples and 100% training and validation accuracy was achieved. Normal white and brown commercially available papers were differentiated from cigarette-tipping paper with 100% accuracy. In addition, the geographical origin of samples determined through PLS-DA and 100% accuracy was achieved. Smoked samples were also analysed and linked with the unsmoked samples to simulate an actual crime scenario. The outcomes would help in establishing a link between the suspect and victim to the crime scene and narrowing down the suspect pool. This study proposes an alternative approach for analysing cigarettes in a non-destructive and ecofriendly manner to highlight and amplify the potential of cigarettes as evidence.

Keywords: Cigarette-tipping paper, ATR-FTIR spectroscopy, brand discrimination, geographical origin, chemometrics

A QUICK APPROACH TO DETECT TIMBER ADULTERATION USING ATR-FTIR SPECTROSCOPY AND CHEMOMETRICS

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Abstract

Illegal timber harvesting, logging, and adulterating legitimately protected timber species is a major threat to biodiversity. Timber adulteration is one of the criminal activities involving substituting a high-value timber species with a low-grade timber species by applying colorants to mimic the superficial resemblance of the high-value timber to maximize profit. Identifying and differentiating these precious species is a prerequisite to combat timber-related crimes in wildlife forensics. Several methods have been used for timber species identification and differentiation, such as DNA barcoding. Most of these techniques are destructive and time-consuming. To address all these issue, in this study, a quick and non-destructive approach has been used to detect timber adulteration by identifying and discriminating selective timber species using IR spectroscopy along with unsupervised (principal component analysis), and supervised (linear discriminant analysis, and partial least square discriminant analysis) chemometric tools that successfully differentiated Tectona grandis (Teak) from Magnolia champaca (Champ) with 96.25% accuracy, Swietenia macrophylla (Mahogany) from Magnolia champaca (Champ) with 97.5% accuracy, and Artocarpus heterophyllus (Jack) from Mangifera indica (Mango) with 100% PCA LDA training accuracy. Partial Least Square-Discriminant Analysis (PLS-DA) successfully differentiated the analysed species with 100% accuracy. The reliability of the built models was assessed by performing a validation test that showed 100 % accuracy. A blind test was also performed that showed 100% accuracy for both PCA-LDA and PLS-DA. The use of ATR-FTIR spectroscopy and chemometric tools such as PCA, LDA, and PLS-DA proved to be effective in detecting timber adulteration, which will help the investigating agencies to combat timber-related crimes. It can also be used as a screening tool before DNA barcoding wherever required for other high-value, luxurious, timber-yielding species.

Keywords: Timber, Wildlife Forensics, Chemometrics, ATR-FTIR

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A STUDY ON 3D SUPERIMPOSITION FOR DEFORMED BULLET MATCHING: BRIDGING THE GAPS IN FIREARM EXAMINATION

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Abstract

Introduction: In majority of the cases where firearm related crimes are involved, it is less likely to recover an intact bullet at the time of investigation. In such, deformed/fragmented bullet accounts as evidence in majority of cases. The fired projectiles can not only define the origin of the bullet but, can also create a bridge between the weapon and the bullet also, answering questions viz. range of fire, direction of firing, velocity of firing and so on. However, due to their deformed structures it becomes challenging for the examiners to analyse and reach to a precise conclusion regarding the identity of the fired projectile. The current study focuses onto the forensic potential of 3D Superimposition as a tool of reliability and precision in firearm examinations by establishing a correlation and devising a SOP that can be adopted as an effective one against the traditional techniques.

Methods: Bullets of various calibres were fired at controlled distances and were examined using high resolution 3d scanning and superimposition systems. Findings were complemented by the collected physical matrices and integrated x-ray scans within the superimposition software that demonstrated robustness of the technique. The physical matrices aided the methodology when segregation of calibre was done and ascertained which deformed projectile needed to be matched with which non deformed projectile.

Results: The potential matching was evaluated using the superimposition technique that used colour mapping to display overlapping surfaces where 9x19mm calibre showed the highest match rate out of the total population when superimposed at the base periphery.

Conclusion: The analysis showed a strong correlation between the deformed and intact bullets. This will not only act as a tool of identification but also will help us to digitize database of deformed as well as standard bullets which can be very useful in real time.

Keywords: Firearms, Deformed Bullets, Scanning, 3D Superimposition, Origin Of Bullet, Bullet Morphology, 3D Surface Scanner.

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UNDERSTANDING LEGAL ACCOUNTABILITY FOR ILLEGAL DUMPING OF HAZARDOUS WASTE IN OCEANS THROUGH MARINE FORENSICS TECHNIQUES

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Abstract

The ocean is a complex and interwoven ecosystem with each biotic and abiotic factor influencing every other component directly or indirectly. When one habitat vanishes, organisms that rely on that niche can no longer survive. Illegal dumping occurs when solid wastes are discarded or caused to be dumped or placed on any property, either public or private, without proper authorization or legitimate purpose. Illegal dumping on oceans or Marine Dumping can also be stated as that it is as the deliberate disposal at sea of wastes or other matter from vessels, aircraft, platforms or other man-made structures, as well as the deliberate disposal of these vessels or platforms themselves. This can include various materials, including dredged materials, industrial waste, radioactive waste, plastic debris, and other forms of litter. Most commonly, people choose to illegally dump because they do not want to pay for disposal or because local disposal options do not appear to be available or convenient. Marine dumping can destroy or degrade important habitats for aquatic species and cause coastal erosion and salutation, which affect the health and productivity of the marine environment. In addition to eutrophication, ocean dumping can destroy entire habitats and ecosystems when excess sediment builds up and toxins are released. Although ocean dumping is now managed to some degree, and dumping in critical habitats and at critical times is regulated, toxins are still spread by ocean currents. Alternatives to ocean dumping include recycling, producing less wasteful products, saving energy and changing the dangerous material into more benign waste. But to give a major impact and prevent marine dumping of hazardous waste with the help of forensic science techniques, we can apply different methods like by identifying pollutants and tracing their origins, tracking illegal dumping activities, investigating and finding the vessel offenders, taking help of the legal enforcement support or restoring marine ecosystems through environmental impact assessments. By combining scientific expertise with modern technology, marine forensics provides strong evidence to prosecute offenders and prevent further environmental damage through illegal dumping of the hazardous waste in the oceans.

Keywords: Hazardous Waste, Illegal Dumping, Marine Dumping, Marine Forensics, Ocean Dumping, Marine Pollution.

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UNMANNED AERIAL VEHICLES: A NEW PERSPECTIVE ON CRIME SCENE MANAGEMENT

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Abstract

Crime scene documentation is a critical aspect of forensic investigations, traditionally relying on photography, manual sketching, and measurements. However, these conventional methods are often time-consuming, prone to human error, and limited in capturing the full scope of a crime scene. The integration of Unmanned Aerial Vehicles (UAVs), or drones, into crime scene documentation represents a paradigm shift in forensic investigations. The advent of drones and Unmanned Aerial Vehicles (UAVs) has transformed forensic investigations by providing high resolution aerial perspectives, rapid deployment, and enhanced accuracy. Drones enable real-time evidence collection while minimizing contamination risks, making them invaluable in crime scene analysis. Their ability to generate detailed 3D models and precise mapping enhances scene reconstruction, offering forensic teams an advanced tool for investigation and courtroom presentations. The applications of drones extend beyond crime scene documentation to accident reconstruction, disaster response, search and rescue, and surveillance. Drones offer rapid deployment, enabling the capture of comprehensive overviews of large or inaccessible scenes, facilitating the creation of detailed 3D models and Ortho-mosaic maps through photogrammetry. High-resolution imagery, coupled with thermal imaging capabilities, enables the detection of minute trace evidence and hidden objects, significantly improving evidence collection. Furthermore, UAVs mitigate risks to investigators by allowing remote assessment of hazardous environments, such as fire scenes or locations with potential structural instability. As technology evolves, innovations such as AI-driven analytics, thermal imaging, and LiDAR scanning will further optimize forensic capabilities. This research synthesizes current advancements in drone technology and their applications in enhancing the efficiency, accuracy, and safety of crime scene analysis of crime scene investigations, establishing drones as an indispensable tool in modern forensic science.

Keywords: Crime Scene, Aerial Surveillance, 3d Photography, Evidence Collection, Forensic Technology.

THE VULNERABLE MINDS: PSYCHOLOGICAL MANIPULATION AND TERRORIST RECRUITMENT IN CYBERSPACE

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Abstract

Terrorism has evolved into a global challenge, extending its influence into cyberspace. Terrorist organizations leverage the internet to spread propaganda, recruit youth, and orchestrate illegal activities. This paper examines the role of cyberspace in modern terrorism, emphasizing how terrorist groups manipulate digital platforms for communication, recruitment, and ideological indoctrination. The study explores various online tools used by extremist organizations, including websites, social media, gaming platforms, and encrypted communication channels. The psychological mechanisms behind youth radicalization, such as cognitive development, social learning, and group identity, are analysed to understand how individuals are drawn into extremist ideologies. Additionally, the paper highlights the challenges of regulating cyberspace while balancing privacy rights. The findings underscore the need for proactive measures, including parental guidance, digital literacy programs, and expert-led monitoring of high-risk online behaviours. A strategic approach combining cyberpsychology research and law enforcement efforts is essential to mitigating the digital spread of terrorism and protecting vulnerable populations from online radicalization.

Key Words: Cyber space, Youth and Radicalization.

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AMMUNITION USUALLY FIRED THROUGH COUNTRY MADE FIREARMS: A STUDY ON FORENSIC INTEREST

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Abstract

Gun violence by country made/improvised firearms is in increasing order in the country. The production of country made firearms in the illegal factories/workshops is blooming, and their use in murder, threatening and other types of crime is a serious concern not only for law enforcement agencies but also for the common public in different states and union territories of the country. The gunsmiths make country made/improvised firearms like pistols, revolvers, pipe guns and other types of guns in such a way to chamber the factory made standard ammunition in such firearms. The state forensic science laboratory of Tripura routinely receives different types of country made/improvised firearms along with their ammunition and magazines to know the working mechanism, condition of the firearms, country of origin, year of manufacture, status of activeness (live/inactive) of the ammunition, etc. The present study analyzes the data of different types of ammunition received in the Ballistics division of the laboratory during the last 5 years. This study on the databank of different types of ammunition usually fired through country made firearms will be helpful for firearm experts, forensic students, law enforcement agencies and other forensic fraternity to get in-depth knowledge on various features of such ammunition.

Key words: Country Made Firearms, Ammunition, Working Mechanism, Databank

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ENHANCING PSYCHOLOGICAL AUTOPSIES WITH ARTIFICIAL INTELLIGENCE: A FORENSIC SCIENCE PERSPECTIVE

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Abstract

Introduction: Forensic science is rapidly evolving with advancements in Artificial Intelligence (AI) and machine learning. Psychological autopsies, crucial in suicide investigations, traditionally rely on interviews and medical history but suffer from subjectivity, time constraints, and limited scalability. This study explores the integration of AI-driven forensic tools such as natural language processing (NLP), sentiment analysis, and behavioural biometrics to enhance the accuracy and efficiency of psychological autopsies.

Methods: This research utilizes machine learning algorithms to analyse linguistic markers, digital footprints, and neurobiological patterns associated with suicidal ideation. AI-based NLP models (BERT, GPT) and sentiment analysis tools (VADER, CNNs) are applied to social media datasets and forensic case studies to identify risk patterns. A comparative analysis is conducted between traditional psychological autopsy methods and AI-driven approaches to assess predictive accuracy and reliability.

Results: Findings indicate that AI-driven psychological autopsies achieve an 85-92% accuracy rate in detecting suicide risk factors, significantly outperforming traditional methods. Machine learning classifiers (Random Forest, SVMs) demonstrate high predictive validity (AUC score ~0.92), reducing investigator bias and improving risk assessment efficiency.

Conclusion: The integration of AI into forensic science presents groundbreaking opportunities in suicide investigations, risk assessment, and national security applications. This research highlights the urgent need for AI-augmented forensic frameworks, ensuring ethical considerations, legal compliance, and interdisciplinary collaboration for real-world forensic implementation.

Keywords: Artificial Intelligence, Psychological Autopsy, Digital Forensics, Behavioural Analysis, Machine Learning.

PRIORITIZATION OF FACTORS INFLUENCING LEGAL PROTECTION OF AUTOMATIC CASE SCHEDULING IN COURT THROUGH AI USING THE ANALYTIC HIERARCHY PROCESS MODEL

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Abstract

The National Judicial Data Grid highlights a significant surge in pending cases within Indian courts. Key contributing factors include delays in scheduling hearing dates, the absence of strict time constraints on case hearings, inconsistent judge allocation, and irregular case prioritization. The lack of a unified legal framework further exacerbates these challenges. Integrating artificial intelligence into case scheduling is essential to address these inefficiencies and streamline the process. This study focuses on identifying and prioritizing the key factors that should be considered when drafting legislation for automated case scheduling. The authors employ the Analytic Hierarchy Process (AHP), a methodology for assessing intangible criteria through pairwise comparisons, to rank these factors. Based on an extensive literature review, the study identifies four primary factors and nine sub-factors. Data was collected from 20 judges across various high courts and district courts in different states using pairwise comparison questionnaires to assess the relative importance of each criterion. The findings of this study offer valuable insights for legislative bodies to identify and emphasize critical aspects of AI-driven case scheduling. While previous research has examined the necessity of legal frameworks for AI integration in the judicial system, the application of AHP for prioritizing factors in drafting a legal framework specific to automated case scheduling is a novel approach. This study contributes to this domain by framing the issue as a Multi-Criteria Decision Making (MCDM) problem and employing AHP to determine the significance of various factors influencing AI integration in automatic case scheduling.

Keywords: Legal framework, automatic case scheduling, Artificial intelligence integration, analytic hierarchy process

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REVIEW ON IDENTIFYING ILLEGAL WILDLIFE TRADE PATTERNS USING AI

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Abstract

The illegal wildlife trade (IWT) is a growing global crisis, threatening biodiversity, disrupting ecosystems, and fuelling organized crime. Traditional enforcement methods often fall short in identifying and preventing these illicit activities. However, advancements in Artificial Intelligence (AI) have introduced new avenues for combating wildlife trafficking. This review explores AI-driven approaches, including deep learning models (CNNs, YOLO, Vision Transformers) for species identification and automated monitoring. AI-powered natural language processing (NLP) tools detect coded messages used in online wildlife trade networks, uncovering hidden patterns in black-market transactions The integration of AI with IoT and aerial surveillance technologies has further enhanced real-time wildlife tracking, allowing for predictive analytics in smuggling route identification AI-driven blockchain analytics offer transparency in tracing illegal transactions related to wildlife products. Despite its potential, challenges remain, including data biases, ethical concerns, and the risk of AI misuse in surveillance. This review highlights existing research gaps and proposes multi-modal AI frameworks that integrate computer vision, NLP, and predictive analytics for more effective wildlife trade detection. By bridging technology with conservation efforts, AI can revolutionize wildlife protection, making enforcement strategies more efficient and proactive.

Keywords: Illegal Wildlife Trade, Artificial Intelligence, Deep Learning, Computer Vision, Species Identification, NLP, Blockchain, IoT, Drone Surveillance, Biodiversity Conservation.

AUTOPSY: A WINDOW INTO THE HUMAN BODY AND MIND

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Abstract

An autopsy, also known as a post-mortem examination, is a medical procedure involving the thorough dissection of a deceased individual's body to determine the cause and manner of death by examining internal organs and tissues, providing crucial information for medical research, diagnosis of disease and legal investigations. In cases of suspicious death where the cause may not be readily apparent; it can also be used to evaluate the effectiveness of treatment and contribute in understanding disease progression. There are usually 3 to 4 kinds of autopsy which are: Medicolegal, clinical, psychological and virtual autopsy from which virtual autopsy is also known as "Virtopsy," it is considered to be as non-invasive . A virtual autopsy is considered a non-invasive postmortem procedure because it uses medical imaging techniques like CT scans or MRI to examine a deceased body without physically cutting or manipulating the body, unlike a traditional autopsy which requires incisions to access organs and tissues for examination. Essentially a virtual autopsy only involves scanning the body externally to create an 3D image for analysis, leaving the body intact. As it utilize the advanced imaging techniques like computed tomography scan (CT) to create a detailed 3D reconstruction of a deceased body, enabling forensic pathologists to assess injuries, organ damage and potential causes of death without physically dissecting the body, offering advantages like minimizing invasiveness, facilitating investigations in culturally sensitive situations, and preserving evidence for future review, particularly in cases of decomposed or traumatized bodies; however, its accuracy can depend on the imaging quality and may require complementary traditional autopsy procedures in certain situations to fully determine the cause of death.

Keywords: Autopsy, Virtual Autopsy, Virtopsy, Digital Forensics

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BURARI DEATH CASE: RITUAL MASS SUICIDE OR A WELL PLANNED MURDER

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Abstract

Introduction: The Burari Death case is one of the most perplexing mass suicides in modern history, where 11 members of the Chundawat (Bhatia) family were found dead in their home in Delhi, India in 2018. The article explores the psychological, forensic and sociological aspects of the case, examining the influence of familial beliefs, spiritual ideologies and potential external manipulation.

Methods and Methodology: Primary data was collected in the form of handwritten diaries, sacred clothes, prayer beads, pictures of deities', digital evidences in the form of cell phones ,CCTV footages were recovered from the scene of crime. This suggested a deep-rooted faith in a supernatural intervention leading to a mass ritual believed suicide . The study also investigates forensic findings, police reports, and media interpretations, analyzing the role of paranoia, delusion, and group dynamics in mass suicides. The primary and the secondary data quantification was done on the basis of availability via mass media communication (newspaper articles , broadcasting debates).

Result: Experts studied linguistic patterns in the recovered handwritten notes. By looking at the way they wrote, researchers were able to get a sense of what might have motivated them and what mental state they were in before the tragedy. Handwriting examination of recovered diaries suggested shared psychosis. This case involved the mysterious deaths of 11 family members in 2018, initially suspected as homicide but later linked to a ritualistic mass suicide. Forensic analysis confirmed asphyxiation due to hanging, with no signs of foul play.

Conclusion: This study explores forensic findings, psychological evaluations, and the role of ritualistic beliefs in mass suicides. The case highlights the importance of forensic psychiatry, toxicology, and psychological autopsies in understanding such tragedies and underscores the need for mental health awareness and early intervention.

Keywords: Burari Death, Mass Suicide, Asphyxia, Ritual Mass Murder, Forensic Psychiatry.

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INVESTIGATING ONLINE GAMING ADDICTION, MENTAL HEALTH, AND YOUTH CRIME IN MOHALI

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Abstract

The rapid rise of online gaming among youth has raised serious concerns about its impact on mental health and potential links to criminal behaviour. This study explores the correlation between excessive gaming, depression, and addiction using the PHQ-9 survey, conducted via Google Forms among youth in the Mohali region. The survey focuses on identifying the most popular games, including BGMI, Fortnite, Call of Duty, and GTA, which dominate youth gaming preferences. Results indicate a significant number of participants exhibit symptoms of depression and addictive behaviour, aligning with an increase in violent tendencies and real-world criminal activities. Recent incidents in India, where children influenced by violent video games have committed serious crimes, highlight the urgency of addressing gaming addiction. This research emphasizes the need for awareness, parental supervision, and policy interventions to mitigate the adverse effects of gaming on youth mental health and prevent potential future crimes.

Keywords: Online Gaming Addiction, PHQ-9 Survey, Mental Health, Youth Crime, BGMI, GTA, Mohali, India.

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OVERDOSE TOXIC EFFECTS OF WHEY PROTEIN AND ITS IMPACT ON HUMAN HEALTH

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Abstract

Whey protein is widely consumed for its high nutritional value and muscle-building benefits, especially among athletes and fitness enthusiasts. However, excessive intake of whey protein can lead to adverse health effects, often overlooked in pursuit of rapid muscle gain. This study explores the toxic effects of whey protein overdose and its impact on various physiological systems in the human body. Excessive protein intake can burden the kidneys, potentially leading to renal dysfunction in individuals with pre-existing conditions. Overconsumption may also disrupt liver function, alter gut microbiota, and contribute to digestive issues such as bloating, nausea, and diarrhoea. Additionally, long-term high protein intake can affect calcium balance, increasing the risk of osteoporosis and metabolic disturbances. This review further highlights potential cardiovascular risks associated with excessive whey protein consumption, including increased cholesterol levels and blood pressure abnormalities. Understanding the consequences of whey protein overdose is essential for promoting safe dietary practices and preventing potential health risks. Future research should focus on establishing optimal consumption guidelines and identifying individual susceptibility factors to protein overdose related toxicity.

Keywords: Whey Protein, Overdose Toxicity, Renal Dysfunction, Metabolic Disturbances, Human Health, Cardiovascular Risk.

THE IMPACT OF "CLIMATE CHANGE ON COASTAL SECURITY AND DISASTER" PREPAREDNESS

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Abstract

Climate change poses significant threats to coastal security and disaster preparedness, impacting vulnerable coastal communities and critical infrastructure worldwide. This study examines the direct and indirect effects of climate change on coastal security, focusing on rising sea levels, increased frequency of extreme weather events, and shoreline erosion. The purpose of this research is to understand the extent of climate-related vulnerabilities and assess existing disaster preparedness strategies, aiming to provide insights into adaptive measures that can strengthen coastal resilience. A mixed-methods approach was employed, combining qualitative interviews with government officials and community leaders, as well as quantitative analysis of historical climate and disaster data from regions experiencing high climate impact. Key objectives included assessing the preparedness of coastal areas to respond to and recover from climate-induced disasters, evaluating gaps in current policies, and recommending adaptive solutions tailored to specific coastal needs. Findings indicate a substantial gap in preparedness, particularly in lower-income and densely populated coastal regions, where resources for adaptation are limited. Results reveal that a proactive, regionspecific approach involving infrastructure upgrades, community training, and policy changes can mitigate some risks. Furthermore, the study identifies the need for international cooperation in addressing transboundary climate risks impacting coastal regions globally. The study concludes that while significant challenges persist, coordinated action and investment in adaptive measures are critical to enhance resilience against climate change impacts. Increased policy support, cross-sector collaboration, and greater public awareness are essential for building sustainable, disaster-resilient coastal regions, capable of withstanding climate uncertainties. Ongoing research and community engagement remain pivotal in adapting strategies to evolving climate patterns.

Keywords: Climate Change, Coastal Security, Disaster Preparedness, Sea Level Rise, Adaptive Measures

QUANTITATIVE AGE ESTIMATION OF THE FINGERPRINTS DONOR THROUGH ATOMIC FORCE MICROSCOPY: NANOSCALE ANALYSIS OF MORPHOLOGICAL VARIATIONS

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Abstract

Dactylography is a highly advanced scientific discipline that focuses on the analysis of fingerprint patterns for the purpose of individual identification. Fingerprints are one of the few forms of concrete evidence that investigators can get from the crime scene, which demonstrates a direct connection between the perpetrators and the crime scene. Amidst the current period of scientific progress in fingerprint sciences, experts remain cautious about some unresolved matters that need scientific scrutiny, such as accurately determining the age of the individual based on fingerprint samples obtained from crime scenes. This study focuses on the specific issue with an optimistic viewpoint. A total of 200 fingerprint samples, belonging to five different categories based on age and sex, were collected. These categories include individuals of both male and female sexes of the 5 age ranges such as 10-20, 20-30, 30-40, 40-50, and 50- 60. The samples were placed on clean glass slides and examined using the Atomic Force Microscope (AFM), a precise tool for studying the detailed characteristics of the samples at the nanoscale. The quantitative data and graphical depiction of the unprocessed latent fingerprints obtained from the AFM equipment effectively demonstrated the distinctions among the five age groups. This study demonstrates the possibility of using instrumentation approaches to determine the age of the fingerprint donor in a non-destructive and non-invasive way.

Keywords: Atomic Force Microscope, Latent Fingerprints, Forensic Science, Age Estimation

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ASSESSING THE COGNITIVE STYLES AND EMOTIONAL MATURITY AMONGST THE CONVICTS OF OPEN AND TRADITIONAL PRISON SYSTEMS: A COMPARATIVE STUDY

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Abstract

The impact cognitive thinking styles on the emotional maturity of an individual is an under researched topic, and when one focuses on a specific population of convicts in the two types of prison systems of India: open and traditional. Utilizing two very well-known standardized psychometric assessments - Psychological Inventory of Criminal Thinking Styles (PICTS; Walters, 1995a, I995b) as well as Emotional Maturity Scale (Singh and Bhargava, 1990), the current research aims to explore the potential variations on the convicts' cognitive styles and emotional maturity as influenced by their environmental influences in convicts residing within the traditional prison system (N=38) and open prison system (N=29) of Yerwada Central Jail, Pune, Maharshtra (Total N=67). The results are analysed and further discussed w.r.t a better understanding of the complex interplay between cognitive styles, emotional maturity and its effects on the understanding of criminal behaviour. Future implications are also discussed that can hopefully offer guidance for future policies, programs and therapies designed to address the specific needs of the individuals within the criminal justice system.

Keywords: Forensic Psychology, Criminal Behaviour, Cognitive Thinking Styles, Convicts, Emotional Maturity, Emotional Intelligence

A NOVEL CASE OF TRI-ALLELIC PATTERN INHERITANCE AT THE D13S317 LOCUS IN THE GUJARATI BRAHMIN POPULATION OF INDIA

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Abstract

Background: Polymorphic Short Tandem Repeats (STRs) loci can be genotyped for their application in forensic DNA examination and kinship testing since they follow conventional Mendelian inheritance patterns. However, exceptional events like point mutations in the primer binding site, mutations in the repeat region, chromosomal aneuploidies, and chimerism cause an abnormal number of peaks in the electropherogram during STR typing. These events act as a bottleneck in compliance with the law of inheritance and are the shortcomings in STR fragment analysis results. Here, we document a rare type 2 tri-allelic pattern observed at the D13S317 locus in the Gujarati Brahmin population of India. Method: Extracted genomic DNA from the blood samples of 453 healthy individuals (153 females and 300 males) were subjected to autosomal STR typing using the commercially available GlobalFiler™ Express PCR Amplification Kit. Capillary electrophoresis-based Fragment analysis was performed using the ABI 3500 Genetic Analyzer and further analysed using GeneMapper ID-X (v.1.6). Result: In this case, a Type 2 tri-allelic pattern (8, 9, 11) at the D13S317 locus has been identified in a male participant. Further, investigating the cause of this event, the mother displayed an aberrant genotype of 9, 11 alleles with heterozygous peak imbalance of 1:2 proposing a Type 2(B) tri-allelic pattern at the same locus. These findings infer that an intrachromosomal segment duplication event causes the tri-allelic pattern and its inheritance at the D13S317 locus. Conclusion: This work aims to enhance our knowledge of the tri-allelic pattern inheritance at the D13S317 locus, facilitating its better interpretation in STR analysis. Additionally, it aids in effectively curating genetic data explicitly false allele variants in the human population.

Keyword: D13S317, Tri-allelic pattern, intra-chromosomal duplication, Short Tandem Repeats (STRs).

SEASONED WITH CONTAMINATION: FORENSIC INVESTIGATION OF HEAVY METALS IN SPICE POWDERS

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Abstract

Heavy metal contamination has become a prevalently ugly trend in the context of the food industry, which poses a significant risk to public health. This study is aimed towards accurate quantification of heavy metal contamination in seasoning powders to ensure consumer safety. The main aim of this study was to detect and quantify heavy metal adulterants like arsenic, lead, cadmium, and other potential contaminants in commercially available turmeric, chilli, and coriander powders. Acid extraction was performed to isolate metal content, followed by instrumental analysis for qualitative and quantitative assessment. Calibration curves were generated and compared with standard metal solutions to determine the concentration of heavy metals in the seasoning powders. Three specialised instruments, including UV-visible spectroscopy, High-Performance Liquid Chromatography (HPLC), and Attenuated Total Reflectance Fourier Transform Infrared Spectroscopy (ATR-FTIR), were used to make a comprehensive analysis. UV-visible spectroscopy was employed for preliminary screening of metal complexes, while HPLC was used for chelation analysis, and ATR-FTIR assisted in detecting molecular interactions indicative of metal contamination. Additionally, physical and chemical tests were also conducted as screening techniques to identify visible and sensory adulteration markers. The study provides insights into the extent of heavy metal contamination in commonly used seasoning powders and highlights the need for stricter regulatory oversight in spice production and distribution. By integrating multiple analytical methods, this research aims to establish a forensic framework for detecting and preventing metal adulteration in food products, ensuring public health safety and consumer awareness. The findings will contribute to forensic food safety measures, emphasising the necessity of stringent monitoring and standardisation to mitigate health hazards associated with contaminated spices in the market.

Keywords: Food Toxicity, Heavy metal, Heavy metal Contamination, Seasoning Powder, Analytical Techniques, Trace Metal Detection

PROFILING THE DIGITAL OFFENDER: A CYBER PSYCHOLOGICAL TAXONOMY OF HACKERS, TROLLS, AND INCELS

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Abstract

Introduction: The digital era has redefined criminal behavior, with cybercrime projected to cost $10.5 trillion annually by 2025 and 41% of Americans experiencing severe online harassment (Pew Research, 2021). Despite this, traditional criminology struggles to explain the psychological drivers of modern digital offenders. This study addresses this gap by constructing a cyber psychological taxonomy of three key groups—hackers, trolls, and incels—to reveal their motivations, behavioral patterns, and societal impacts. Methodology: A mixed-methods approach was employed: • Thematic analysis of 2,500 forum posts from incel communities (Reddit), hacker manifestos (Dark Web), and troll hubs (4chan). • Psychometric surveys assessing Dark Triad traits (narcissism, Machiavellianism, psychopathy) across 300 self-identified offenders. • Case studies of high-profile incidents, including the Lazarus Group's $625 million crypto heist (2022) and Alek Minassian's 2018 Toronto van attack. Theoretical frameworks like General Strain Theory and Social Learning Theory guided the analysis.
Results: • Hackers exhibited high self-efficacy (78% scored above median in technical mastery) and ideological purpose. • Trolls prioritized chaos, with 92% citing "amusement" as their primary motive and 41% scoring high in psychopathy. • Incels displayed externalized blame (85% attributed failures to societal rejection), aligning with grievance-based radicalization. Commonalities included moral disengagement (70% across groups) and anonymity-seeking behavior.
Conclusion: This study pioneers a unified cyber psychological taxonomy, revealing how technology amplifies both divergent motivations (e.g., hackers' mastery vs. incels' victimhood) and shared traits (e.g., moral disengagement). It advocates tailored interventions: ethical hacking programs, algorithmic accountability for platforms, and mental health-driven deradicalization. By bridging criminology and cyber psychology, this work offers critical insights for mitigating 21stcentury digital harm.

Keywords: Cyber Psychology, Digital Offenders, Dark Triad Traits, Online Radicalization, Behavioral Interventions.

LEVERAGING FORENSIC ADVANCEMENTS TO STRENGTHEN ABAC COMPLIANCE

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Abstract

Introduction: India has emerged as a major global investment hub, attracting multinational corporations across industries. While economic reforms have improved the ease of doing business, corruption remains a significant challenge, with India ranking 96 out of 180 in Transparency International's Corruption Perceptions Index (CPI). Corporate fraud, bribery, and regulatory misconduct pose substantial risks, necessitating robust compliance frameworks. Enforcement of anti-corruption laws such as the Prevention of Corruption Act (PCA), the Foreign Corrupt Practices Act (FCPA), and the UK Bribery Act (UKBA) has intensified, requiring companies to strengthen governance mechanisms. Forensic advancements, including AI-driven financial monitoring and forensic audits, are transforming corporate compliance, helping businesses detect and prevent financial misconduct.

Methods: This study examines corporate compliance failures and enforcement trends in India under PCA, FCPA, and UKBA. It evaluates the effectiveness of AI-driven risk analytics, forensic accounting, and whistleblower-led investigations in mitigating corruption risks. Additionally, the study analyzes third-party due diligence frameworks and forensic audits, identifying best practices for corporate governance.

Results: Findings reveal that companies integrating forensic tools report a 30–50% reduction in corruption-related risks. AI-powered fraud detection and enhanced compliance monitoring have led to early identification of suspicious transactions, stronger internal audits, and reduced legal liabilities.

Conclusion: Forensic science is redefining corporate compliance, shifting from reactive enforcement to proactive risk management. As regulatory scrutiny increases, businesses must move beyond traditional compliance checklists and adopt forensic-backed compliance measures to mitigate financial crime risks effectively. This paper underscores the growing necessity of forensic advancements in protecting corporate integrity, ensuring regulatory adherence, and fostering a transparent and ethical business environment.

Keywords: Forensic Science, Anti-Corruption, Compliance, White-Collar Crime, Corporate

PEERING INTO THE PRINT: STEREOMICROSCOPIC IMAGING OF TONER DISPERSION IN QUESTIONED DOCUMENTS

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Abstract

Background: Toner dispersion is extremely important in the laser printers, thus the measurements of the toner particle size is very important. This paper uses stereo microscopy technique in analysing toner dispersion. This method gives detailed description and assessment of toner particle and dot on the printed material. The use of stereo microscopy enables resolution of structures and dimensions while being able to view them in 3D (Three Dimensional), due to the enhanced examination of the uniformity and adhesion of toner particles.

Methods: The key area of focus in the research is a comparison of dispersion of different company toner in paper. Stereo microscopy can help in detecting differences in dispersion of toner that affect detailed edges and accuracy of prints. This means if the toner particle characteristics such as size, size distribution and chemical composition are enhanced, then printer performance in high resolution areas would be enhanced to the level indicated by this study. This work points out the need to accurately quantify toner dispersion and proves the potential stereo microscopy in enhancing toner performance and print quality. The fundamental objective of this study is to compare the toner dispersion of printed material of five different company laser printers.

Results: The results indicate that the uneven deposition of toners is observable and it will help in identification of printer. By comparing the dispersion properties, different printers can be distinguished based on the toner dispersity and this can aid in examination of question document in case of printed document evidences.

Conclusions: The fundamental objective of this study is to compare the toner dispersion of printed material of five different company laser printers. The different toners have different dispersion measurements, which was found out in this study.

Keywords: Toner Dispersion, Laser printer, Stereo Microscope, Toner Particles, Questioned Documents

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QUANTUM DOT-INFUSED FLUORESCENT INK: A NOVEL APPROACH FOR ANTICOUNTERFEITING AND SECURE DOCUMENT VERIFICATION

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Abstract

Counterfeiting of documents poses a significant challenge to security and forensic authentication. In this study, we present the development of quantum dot (QD)-embedded fluorescent dye inks as a novel approach for document authentication and counterfeit detection. Quantum dots, due to their size-dependent optical properties, high fluorescence intensity, and tuneable emission wavelengths, offer an advanced method for integrating covert security features into inks without altering their visual appearance under normal lighting conditions. The synthesized QD-based fluorescent inks were formulated by dispersing cadmium selenide (CdSe) and Cadmium telluride (CdTe) quantum dots within a stable ink matrix, ensuring compatibility with conventional printing techniques. The inks were characterized using UVViz spectroscopy and fluorescence spectrophotometry, to assess their optical stability, spectral emission properties, and forensic applicability. Furthermore, security performance tests under UV to confirm the effectiveness of these inks in distinguishing authentic documents from counterfeits. The results suggest that QD-based fluorescent inks provide a promising alternative for anti-counterfeiting measures, forensic document examination, and secure printing applications. This research highlights the potential of quantum-based inks in forensic science, offering a novel and robust security feature for document protection.

Keywords: Quantum-Dots, Fluorescent Inks, Document, Security Printing, Justice.

ROLE OF PREOVIPOSITION INTERVAL AND MAGGOT MASS TEMPERATURE IN ESTIMATION OF POSTMORTEM INTERVAL – A PROTOTYPE BODY FARM STUDY

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Abstract

Introduction: Forensic entomology helps in estimation of minimum postmortem interval (PMI) from development of maggots over a cadaver. Development of insects on cadavers is non-uniform in nature and fluctuates in the outdoor environment. Laboratory growth models do not reflect the actual forensic cases with decomposition in outdoor environment.

Methods: A prototype human Body Farm was set-up in the Department of Forensic Medicine & Toxicology, NRS Medical College, Kolkata, a first of its kind in India, with the permission of Institute Ethics Committee, to investigate the pattern of maggot development in field conditions. Unclaimed newborn / amputated body parts on which medicolegal autopsy was conducted were used for the study to set up the mock crime scene in the body farm. Temperatures were recorded in the field, at different levels viz. mock scene, cadaveric, ground level, and from the center of developing maggot biomass.

Results: Maggot mass temperatures exceeded the ambient temperature by a maximum 6.8°C, when scene temperature was 31.7°C for the summer months. This higher maggot mass temperature facilitated the decomposition rate and enhanced the development of maggots. Moreover, the preoviposition interval varied seasonally with an average of 80.8 hours, (beyond 3 days) in winter and an average of 23.4 hours (shorter than a day) in summer. This paradox led to misinterpretation of actual PMI by entomological evidence. The long lag phase before the actual onset of the fly life cycle was found crucial for winter months.

Conclusion: Body farm experiments were useful to address real crime scene casework. Laboratory growth models on insects or small animal experiments are not useful substitutes for interpreting entomological evidence in reality. In a real scenario, the time of oviposition, season, and tracking of maggot mass temperature with other circumstances of death needs to be evaluated. Erroneous interpretation of insect development due to the confounding factors can lead to false opinion regarding post-mortem interval.

Keywords: Body farm, Entomology, Forensic Medicine, Maggot mass, Postmortem interval

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UPCYCLED SILICA FROM COCONUT HUSK FOR FLUORESCENT FINGERPRINT POWDER: A SUSTAINABLE FORENSIC APPROACH

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Abstract

The development of environmental friendly forensic materials from bio-waste offers a sustainable alternative to traditional fingerprint powders. In this study, high-purity silica is extracted from coconut husk and functionalized with ZnS nanodots to produce a fluorescent powder for latent fingerprint detection. Controlled pyrolysis, acid leaching, and alkaline dissolution was employed for silica extraction. The amorphous structure of the extracted silica is confirmed using X-ray diffraction (XRD), while its nanoscale morphology is analysed through scanning electron microscopy (SEM). To achieve fluorescence, ZnS nanodots are synthesized via chemical precipitation and incorporated into the silica matrix. The resulting ZnS-silica composite exhibits strong fluorescence under ultraviolet (UV) excitation, as confirmed through ultraviolet-visible (UV-Viz) spectroscopy and fluorescence spectroscopy. Unlike conventional fingerprint powders, this ZnS-silica hybrid offers enhanced sustainability, cost-effectiveness, and environmental safety by upcycling the agro-waste as a silica precursor. This study highlights the potential of green nanotechnology in forensic science, demonstrating its applicability in crime scene investigations. The successful integration of ZnS nanodots into bio-derived silica paves the way for next-generation forensic powders that prioritize sustainability, innovation, and efficiency in criminal identification and evidence analysis.

Keywords: Sustainable, Fingerprint Powder, Silica, ZnS, Justice.

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EXPLOSIVE RESIDUE DECOMPOSITION IN SOIL: A FORENSIC APPROACH

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Abstract

The forensic investigation of explosive residues in soil plays a crucial role in crime analysis. Understanding the degradation behavior of explosive residues in different soil environments is essential for accurate evidence interpretation. This study examines the decomposition of explosive residues in various soil types, focusing on their persistence and transformation. Red soil, black soil, and alluvial soil were used to assess the impact of soil composition on degradation rates. The soil samples were artificially spiked with toluene and hexamine, two key components of explosives. The study also evaluates the degradation of residues over five time intervals, with hexamine analyzed in both combusted and non-combusted forms. High Performance Liquid Chromatography (HPLC) and Gas Chromatography-Mass Spectrometry (GC-MS) were employed to monitor the concentration of residues and their degradation products at each interval. The study highlights the critical role of environmental factors in residue decomposition, affecting explosive evidence detection and interpretation. By analysing residue behavior in different soil matrices, this study contributes to improving forensic procedures for crime scene investigations involving explosives. The comparison between combusted and non-combusted residues provides forensic specialists with a better understanding of post-explosion residue behavior, aiding in distinguishing between pre- and post-detonation samples.

Keywords: Explosive residues, Degradation, Toluene, Hexamine, HPLC, GC-MS, Justice.

FORENSIC ANALYSIS OF DISAPPEARING (MAGIC PEN) INKS: AN IR SPECTRA-BASED CHEMOMETRIC APPROACH

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Abstract

Introduction: Ink analysis is an important aspect of document examination, particularly in the cases involving frauds. However, with growing awareness, fraudster has resorted to disappearing inks to commit frauds which disappears after a certain duration leaving no visible traces. These disappearing inks usually contain thymolphthalein (blue) which shift from a coloured state to colourless when exposed to air. The study assesses the functional group differences in the disappearing inks available in Indian market and attempts to classify them based on spectral differences.

Method: The current study was carried on 30 blue magic pen inks (disappearing inks) from different manufacturers available online via e-shopping websites. The ink samples were analysed using ATR-FTIR in the range of 4000-400 cm-1 and spectral data was subjected to chemometric classification using clustering methods and discriminant analysis.

Results: The spectral data in the fingerprint region (1500-400 cm^{-1}) was used for chemometric classification of samples using unsupervised method of clustering viz. k-means in 4 groups followed by supervised classification using discriminant analysis. The integrated classification system of k-means with discriminant analysis achieved an original and cross-validated accuracy of 100% and 96.7% respectively.

Conclusion: The study shows FTIR as a potential non-destructive tool for the classification and differentiation of disappearing inks with significant degree of accuracy when integrated with chemometrics.

Keywords: Disappearing Ink, FTIR, Chemometrics, k-means Clustering, Discriminant Analysis

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GOLD FRAUD INVESTIGATION: CASE STUDIES ON COUNTERFEITING METALS IN GOLD JEWELLERIES

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Abstract

Introduction: Gold emerged as the top-performing asset class, with 21% increase in gold value in 2024 and a 124% surge over the past five years, gold has become a prime asset in Indian households; however, this increased demand has led to a rise in counterfeit gold products in Karnataka. This study investigates the authenticity of various gold coins and jewellery items, including bangles, necklaces, earrings, and rings, obtained from reports of fraudulent gold sales.

Methodology: Various gold jewelleries, including bangles, necklaces, earrings, rings, and studs, were examined for counterfeit metals. Jewelleries displaying signs of counterfeiting, such as discoloration or a green colour deposition on the surface of metals. The Suspected areas of concern, such as discoloured chains, filled bangles, and stone-embedded settings, were closely inspected, separated, were selected for further analysis. These selected jewels were then prepared for compositional analysis by direct surface of jewels and dissected jewellery samples to identify counterfeit metals using ED-XRF and ASTM E 1600-23 method.

Results: Common counterfeit metals identified were lead and silver, used to maintain weight and mask the presence of other metals within a gold coating. Results indicated that necklaces and waistbands contained gold ranging from 30% to 81.36% (w/w), while pendants showed significantly lower gold content of 0.018% to 3.327% (w/w). The presence of zinc, copper, and iron in coins, without any gold, further indicates the prevalence of gold counterfeiting.

Conclusion: This study confirms the presence of counterfeit gold in jewellery and coins circulating in Karnataka, with lead frequently employed to mask the other metal content inside gold. The wide variation in gold content, particularly the low percentages found in pendants, highlights the need for rigorous authentication methods to protect consumers from fraudulent products in the Indian gold market.

Keywords: Gold Jewelleries, Lead, pendant, Energy dispersive X-ray fluorescence (EDXRF) spectrometer, Counterfeit metals.

FROM VICTIMIZATION TO INCARCERATION: A FORENSIC VICTIMOLOGY ANALYSIS OF ACE, SOCIAL SUPPORT, AND CRIMINAL PATHWAYS IN INDIAN PRISONS

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Abstract

Introduction: Adverse Childhood Experiences (ACE) are a crucial yet often overlooked factor in criminal behavior. This study examines how early-life victimization influences incarceration outcomes and perceived social support within prisons, analyzed through a forensic victimology framework. By identifying the prevalence and patterns of ACE among inmates in Gautam Budh Nagar District Jail, India, this research aims to highlight the victim-offender overlap and provide empirical insights for evidence-based rehabilitation strategies.

Methods: A cross-sectional study was conducted on 200 inmates (142 males, 58 females) in Gautam Budh Nagar District Jail. ACE scores were measured using a standardized ACE questionnaire, while perceived social support was assessed using the Interpersonal Support Evaluation List (ISEL). Statistical analyses, including t-tests, chi-square tests, Pearson correlations, regression analysis, mediation analysis, and ANOVA, were performed to determine gender-based variations and the correlation between ACE and social support. Additionally, forensic victimology principles were applied to explore systemic victimization and criminal trajectories.

Results: Findings revealed that male inmates reported significantly higher ACE scores than females ($p < 0.001$, $d = 0.81$). Higher ACE scores correlated with longer incarceration sentences ($\beta = 0.42$, $p < 0.001$) and reduced social support ($r = -0.42$, $p < 0.001$). Illiterate inmates exhibited a higher likelihood of severe ACE exposure ($p = 0.013$). Mediation analysis confirmed that serving time partially mediates the relationship between ACE and social support ($p < 0.01$), reinforcing the long-term consequences of childhood victimization on prison adjustment.

Conclusion: This study emphasizes the necessity of integrating forensic victimology in criminal justice policies. Recognizing inmates as victims of systemic trauma can revolutionize rehabilitation approaches. Implementing ACE screening, trauma-informed care, and targeted social support programs in correctional facilities can significantly enhance inmate well-being and lower recidivism rates. These findings advocate for a paradigm shift in prison management from punitive measures to victim-centered rehabilitation, fostering long-term societal reintegration.

Impact Statement: This research bridges the gap between criminology and forensic victimology, offering a transformative approach to prison reform. By addressing childhood victimization within correctional settings, it proposes actionable solutions to reduce criminal relapse and enhance social reintegration.

Keywords: Adverse Childhood Experiences (ACE), Interpersonal Support Evaluation List (ISEL), Forensic Victimology, Prison Social Support, Incarceration, Rehabilitation

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ASSESSING THE EFFICACY OF TAP WATER IN WASHING GUNSHOT RESIDUE FROM SHOOTER'S HAND USING ENERGY-DISPERSIVE X-RAY FLUORESCENCE (EDXRF)

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Abstract

The increasing incidents of firearm misuse and police encounters have raised concerns in forensic investigations. A crucial aspect of forensic ballistics is the identification and analysis of gunshot residue (GSR), which varies based on the type of ammunition used. A notable distinction exists between GSR from standard and country-made ammunition, making residue analysis essential in determining the weapon type. Additionally, the surface on which GSR is found can provide crucial insights into the shooting incident. Examining GSR on the target can help estimate the firing range, while its presence on a suspect's hands may indicate their involvement in shooting. However, to differentiate GSR from other residues, both chemical and instrumental analyses are necessary. This study investigates the persistence of GSR elements after a single wash with tap water. A 7.65 mm country-made pistol was fired from a distance of 1–2 meters, followed by chemical tests for preliminary examination and Energy Dispersive X-Ray Fluorescence (ED-XRF) for confirmatory analysis. The study focused on detecting lead (Pb), barium (Ba), and antimony (Sb) to identify GSR presence. The findings demonstrated that even after washing, trace amounts of inorganic GSR remained detectable on the shooter's hands. ED-XRF analysis provided precise quantification, confirming the persistence of these elements. This research highlights the significance of GSR analysis in firearm investigations, proving that ED-XRF is a reliable tool for detecting and quantifying GSR. The study reinforces the importance of GSR in crime scene reconstruction, helping forensic experts determine firing distances and suspect involvement in firearm-related cases.

EXPLOITING BIO-SURVEILLANCE WITH AI-ENABLED OSINT TECHNIQUES FOR CYBER CRIME ATTRIBUTION: A CONCEPT

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Abstract

Introduction: Cybercrime is an omnipresent national security challenge, with states, non-state actors and even corporations alike increasingly leveraging sophisticated techniques to conduct cyberattacks. These threat actors exploit anonymity in cyberspace to conduct espionage, financial fraud, disinformation campaigns and even sabotage critical infrastructure of the target organization. The likely aim includes Strategic signaling, monetary, competition, compellence, and deterrence in the grey zone domains of warfare with advantages of attributability, deniability and lack of resources to counter offers a low deterrence value.

Methods: This paper explores the potential of integrating Bio Surveillance with Artificial Intelligence (AI) and open-source intelligence (OSINT) to enhance cybercrime attribution for any democratic nation-state. The research methodology being qualitative with an applied research design to examine the concept and recommend plausible outcomes for policy implementation Part 1: Conceptual Framework: Exploiting Bio-Surveillance, With AI-Enabled OSINT Techniques for Attribution The concept of Bio-surveillance and its probable exploitation using AI-enabled OSINT tools for threat naming. Part 2: Application in the Indian Context: The employability of these concepts in a democratic nation like India will be discussed in this part. Part 3: Challenges and Ethical Considerations. The challenges posed in terms of policy implementation for a democratic nation-state will be discussed in this part.

Results: The policy recommendations for a nation-state to address the menace while keeping in mind the issues of privacy and data protection.

Conclusion: The integrated Bio-surveillance and AI-enabled OSINT offers a transformative approach to cybercrime attribution, particularly in the dynamic era of cyber threats and a nation-state must harness these technologies to address its threats to national security.

Keywords: Cyber Attribution, Bio-Surveillance, Artificial Intelligence, OSINT

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DECIPHERMENT OF HOMOGENOUS GEL BALL INK ALTERED HANDWRITING THROUGH STEREOMICROSCOPE AND SPECIFIC IMAGE ENHANCING TOOLS

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Abstract

Introduction: Altered documents are common in disputed cases, often altered through methods like addition, interlineations, modification, correction fluid, overwriting, and erasures. Forensic Document Examiners (FDEs) face challenges in effectively identifying these alterations. Various tools and techniques, such as Alternative Light Sources, photographic enlargements, and microscopic examinations were used for analysis. This research investigates the effectiveness of stereomicroscopy and image enhancement techniques for examining manually altered documents. Stereomicroscopy, combined with image enhancement, provides a detailed, three dimensional view of document surfaces, helping forensic experts identify alterations by observing ink deposits, pressure marks, and surface irregularities.

Methods: A total of 90 handwriting samples, written with gel pen ink were altered using methods such as addition, interlineation, modification, correction fluid, overwriting on correction fluid, and mechanical erasure. These samples were examined using a stereomicroscope with transmitted and oblique lighting, image enhancement tools, photomicrography, and flipped photography. The samples were photographed using a Nikon 3100 DSLR camera and Samsung S24 Ultra (model no-SM-F946B/DS) to capture detailed images. The results from stereomicroscopy and image enhancement were compared for analysis.

Results: Stereomicroscopy provided a detailed view of physical and textural changes, enabling the identification of alterations. Image enhancement greatly improved the visibility of alterations, especially in challenging cases like overwriting on correction fluid. The combination of stereomicroscopy, alternative light sources, and image enhancement proved effective in accurately identifying and characterizing alterations in all 90 samples.

Keywords: Stereomicroscopy, Alteration, Visualization, Dual-Method, Enhancement, Digital Analysis

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EXPANDING THE FORENSIC USE OF THE ACID PHOSPHATASE TEST: RAPID DETECTION OF SALIVA, EARWAX, AND SWEAT UNDER VARIED ENVIRONMENTAL CONDITIONS

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Abstract

The Acid Phosphatase (AP) test has long been used in forensic investigations to detect semen, but this study shows that it can also identify saliva, earwax, and sweat, making it a potentially more versatile tool. We analysed how AP activity responds in different body fluids under various conditions, including temperature changes (-20ºC, 4ºC, room temperature(+25ºC)) and exposure to humidity, dryness, and UV light, effect of surfaces absorbant Vs. non-absorbant for over 30 days. The results revealed that saliva and earwax produce an immediate reaction, making them easy to detect. Sweat also shows a positive result, but it takes more than a minute to appear. Even after long-term exposure to different environmental conditions, saliva and earwax samples continued to react instantly, demonstrating the durability of AP activity. We also found that cold temperatures help to preserve AP activity, while hot, dry conditions cause it to fade faster. The type of surface also matters—absorbant surface holds onto AP activity better than non-absorbant surfaces like glass, making it more useful in forensic evidence Collection. These findings suggest that the AP test could be used for more than just semen detection, as it provides a rapid, reliable, and widely applicable forensic tool for detecting multiple biological fluids, thereby improving crime scene investigations and evidence analysis. However, since several fluids can test positive, forensic investigators should further confirm the results using more specific tests such as immune chromategraphy based approach or mRNA analysis, especially in sensitive cases like sexual assault investigations. This study highlights the need to further explore the forensic potential of the Acid Phosphatase (AP) test beyond semen detection, particularly in identifying and preserving other biological fluids like saliva, earwax, and sweat. Additionally, developing standardized protocols for field applications can improve its effectiveness in crime scene investigations and forensic evidence collection.

Keywords: Acid Phosphatase test, Saliva, Ear wax, Sweat, Forensic Screening

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FORENSIC DETECTION OF EAR WAX USING ALTERNATE LIGHT SOURCES AND BARRIER FILTERS: A NOVEL APPROACH FOR CRIME SCENE ANALYSIS

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Abstract

The detection and visualization of various body fluids such as blood, semen, saliva, etc are commonly used as evidence for crime scene analysis. Among these body fluids, ear wax (cerumen) is often unnoticed, yet it could provide valuable clues for solving crimes. Ear wax contains sebum, dead skin cells, sweat, dust and debris. Its colour and consistency is variable and is detectable for long periods which makes it useful for personal identification. In this paper, we propose a novel and noninvasive ALS-barrier filter-based approach for the detection and visualization of ear wax for forensic analysis. Ear wax is secreted by the ceruminous glands in the ear canal and serves as a protective barrier against dirt and microorganisms. This research aims to explore the potential of ear wax as forensic evidence, as it may be found at crime scenes on various objects such as clothing, handkerchiefs, pens, pencils, bluetooth devices, balaclavas, or any items handled by the suspect or victim. Alternate Light Sources (ALS), in combination with specific barrier filters, are expected to provide an advanced method for detecting and visualizing body fluids that are invisible under normal lighting conditions.It also includes comparative studies of bovine and human samples carried out under different permutations and combination and its effectiveness to differentiate between them.Preliminary studies suggest that ear wax fluoresces under ALS within a set wavelength range, depending on the applied barrier filter. This research further investigates how ALS can be used to detect ear wax and explore its visibility up to 30 days postdeposition, ensuring its reliability as evidence even in delayed investigations. By utilizing ALS technology with the correct barrier filters, this study intends to enhance forensic investigators' ability to locate and document ear wax at crime scenes, improving the accuracy and reliability of evidence collection. This approach is expected to offer significant benefits in detecting trace evidence that may be missed through traditional methods, thus strengthening the overall investigative process. In conclusion, this research aims to validate the potential of ALS and barrier filters as an effective tool for detecting ear wax in forensic investigations, contributing to the reconstruction of events, the identification of suspects, and the overall success of crime scene analysis.

Keywords: Ear Wax, Alternate Light Sources, Barrier Filters, Crime Scene Analysis, Bovine, Human

FORENSIC CLASSIFICATION OF PRESSURE-SENSITIVE ADHESIVE TAPES USING ATR-FTIR INTEGRATED WITH CHEMOMETRIC ANALYSIS

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Abstract

Pressure-sensitive adhesive (PSA) tapes are frequently encountered as forensic evidence in criminal investigations, particularly in cases involving abductions, bombings, package tampering, and improvised restraints. Their forensic examination is critical for establishing links between evidence and suspects, identifying sources, and reconstructing crime scenes. This study aims to differentiate and classify adhesives from three commonly used PSA tape types—insulating tapes, duct tapes, and masking tapes—sourced from different manufacturers.

Methods: A total of 25 PSA tape samples, including insulating tapes (17), duct tapes (5), and masking tapes (3), were collected from local markets in the Bundelkhand region of Uttar Pradesh. The adhesive side of each sample was analyzed using Attenuated Total ReflectanceFourier Transform Infrared Spectroscopy (ATR-FTIR). The spectral data were then processed using chemometric techniques, including Principal Component Analysis (PCA) for dimensionality reduction, followed by supervised classification using Discriminant Function Analysis (DFA), Classification and Regression Tree (CART), and Support Vector Machine (SVM) models.

Results: The infrared spectral data exhibited distinct variations in adhesive composition across different tape sources, though manual comparison alone was insufficient for accurate classification. To optimize the data, Principal Component Analysis (PCA) was applied, effectively reducing dimensionality while preserving critical spectral information. The first seven principal components were then used as input for supervised classification using DFA, CART, and SVM. Notably, the DFA models demonstrated superior performance, achieving 100% accuracy in both original and cross-validated classifications. SVM and CART also achieved 100% and 92% accuracy within the training testing sets respectively.

Conclusion: This study demonstrates that ATR-FTIR, combined with chemometric techniques, is highly effective in differentiating adhesives from insulating tapes, duct tapes, and masking tapes. The integration of supervised chemometric models significantly enhances forensic discrimination, making it a valuable tool for investigative casework.

Keywords: Pressure-Sensitive Adhesive (PSA) Tapes, Adhesives, ATR-FTIR, Chemometrics, Supervised Classification

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FROM FRAGMENTS TO FACES: NOVEL TECHNIQUES FOR POSTMORTEM RECONSTRUCTION OF FACE IN CRUSH INJURY CASES.

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Abstract

Introduction: In this fast paced world, vehicular accidents are one of the most common form of death or disability. Crush injuries due to such accidents often result in severe cranio-facial disfigurement making post-mortem identification difficult, however, there is another aspect where the identity is already established, that is Emotional closure for the bereaved family, to look at the face of their loved ones for the last time. Here comes the application of often overlooked aspect of Humanitarian Forensic which is defined by the International Committee of the Red Cross (ICRC) as humanitarian action which alleviates suffering and protecting human dignity carried out in a neutral manner.

Methodology/Case Discussion: We have used easily available materials to restore and reconstruct the cranio-facial anatomy of the deceased whose head, face and neck was completely crushed under an over speeding heavy vehicle. Through this paper, we not only bring back a form of traditional method for sculpting and restoring cranio-facial anatomy which is cost effective and easily available but also the emphasis on dignity of the dead.

Conclusion: The ability to restore facial integrity in crush injury cases at the time of post-mortem wherein the identity of the deceased is known, serves the humanitarian goal of dignified restitution and reduction in the psychological impact of the family.

Keywords: Humanitarian Forensic, Post-Mortem, facial reconstruction

POROSCOPY IN FORENSIC SCIENCE: EVALUATING THE REPRODUCIBILITY OF FINGERPRINT MICROFEATURES

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Abstract

Introduction: Fingerprint analysis plays a crucial role in forensic identification, with level 3 details, particularly pore microfeatures, offering potential for individualisation. This study aimed to evaluate the reproducibility of fingerprint microfeatures—pore area, inter-distance, and angle—under different conditions to assess their forensic applicability. The research was conducted through three key objectives: (i) investigating the stability of fingerprint microfeatures over a ten-day period, (ii) assessing the impact of water immersion at varying temperatures, (iii) examining the effect of different substrates.

Methodology: Plain fingerprints were collected from participants aged 18-35 years, residing in Delhi-NCR. Participants were selected through convenience sampling. A standardised inking method was used for all participants. Those with visible injuries or conditions affecting their fingertips were excluded. Photomicrographs were captured using a Zeiss Primo Star microscope with a Canon PowerShot G10 camera under 40× magnification. Measurements of pore area, inter-distance, and angles were conducted using Image Pro® software. Data was processed using SPSS version 16. Normality tests were performed before statistical analysis, and the coefficient of variation was computed for pore area, inter-distance, and angle to assess reproducibility and variation across different conditions.

Results: The results demonstrated that pore inter-distance and angle remained relatively stable within or near the 5% reproducibility threshold, while pore area exhibited significant variation across all conditions. Water immersion caused substantial distortion in pore area, whereas inter-distance and angle remained largely unaffected. Similarly, despite challenges posed by different substrates, inter-distance and angle were found to be reproducible.

Conclusion: The study concludes that while pore area is highly susceptible to distortion due to factors such as skin swelling and environmental exposure, pore inter-distance and angle demonstrate strong reproducibility. Results highlight the potential of level 3 fingerprint details in forensic investigations and underscore the importance of further research to refine poroscopy as a reliable identification tool.

Keywords: Fingerprints; Personal identification; Poroscopy; Reliability; Reproducibility

FORENSIC INVESTIGATION OF PERFORMANCE ENHANCING DRUGS (PEDS)

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Abstract

Performance-enhancing drugs (PEDs) have gained significant attention due to their widespread misuse in sports, fitness, and other fields. These substances, including AnabolicAndrogenic Steroids (AAS), Selective Androgen Receptor Modulators (SARMs), Diuretics, and Selective Oestrogen Receptor Modulators (SERMs), Growth Hormones etc are commonly abused by elite athletes and fitness enthusiasts to enhance physical performance, improve physique, or mask the use of other banned substances. The forensic examination of PEDs in biological matrices such as blood, urine, hair, and oral fluid is crucial for regulatory enforcement, anti-doping measures, and criminal investigations. This review provides a comprehensive analysis of the physiological effects, chemical structures, pharmacokinetics, and metabolism of PEDs to highlight their impact on human performance and associated health risks. Additionally, it examines current methodologies used for the identification, analysis, and extraction of PEDs from various biological matrices, emphasizing their forensic implications. Sample preparation techniques such as liquid-liquid extraction (LLE), solid-phase extraction (SPE), and emerging green chemistry-based approaches are discussed in detail. Furthermore, this review compiles data on critical analytical parameters, including the limit of detection (LOD), limit of quantification (LOQ), and extraction efficiency. Advanced instrumental techniques such as gas chromatography mass spectrometry (GC-MS), liquid chromatography-tandem mass spectrometry (LCMS/MS), and immunoassays are evaluated for their effectiveness in routine forensic and antidoping laboratory testing. By bridging forensic toxicology and anti-doping research, this review aims to enhance the understanding of PED analysis and its forensic significance. The findings contribute to the development of improved doping control strategies and the refinement of analytical methodologies for more accurate and efficient detection. This work ultimately supports the integrity of sports and strengthens anti-doping efforts worldwide.

Keywords: Performance-Enhancing Drugs, WADA, Forensic Toxicology, Extraction Methods, Doping Detection, Anabolic Steroids, Sarms, Chromatography, Metabolism, Anti-Doping Regulations

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DNA PROFILING AND FORENSICS- MAKING CRIMINAL INVESTIGATIONS BETTER FOR THE INDIAN LEGAL SYSTEM

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Abstract

In the annals of criminal investigation, the advent of DNA (Deoxyribonucleic acid) profiling stands as a transformative milestone, heralding an era of unparalleled precision and scrutiny in unravelling the intricacies of crime. An integral part of contemporary forensic science, DNA profiling has evolved from its origins as a scientific curiosity to become an indispensable tool in the arsenal of law enforcement agencies worldwide. As we explore the contemporary challenges within DNA profiling, it is imperative to reflect on its profound significance and the seismic shifts it has engendered within the Criminal Justice System. In this paper, we examine the concept of DNA profiling and forensics as provided under India's new criminal laws 2024 and making the case for improving investigations. Our research paper has three main questions: 1. Analysing the legal and constitutional frameworks governing DNA profiling in India. 2. Identifying and critically assessing contemporary challenges associated with DNA profiling in criminal investigations. 3. Evaluating the effectiveness of DNA profiling in Indian criminal cases and proposing recommendations for improvement. Through these objectives, this research endeavours to enhance comprehension regarding the intricate interplay between legal frameworks, constitutional principles, and the contemporary challenges inherent in the assimilation of DNA profiling within the criminal justice system.

Keywords: DNA Profiling, Forensic Sciences, New Criminal Laws; Better Investigations

GREEN-SYNTHESIZED AZADIRACHTA INDICA (NEEM) ZINC OXIDE NANOPARTICLES: SYNTHESIS PROPERTIES AND THEIR APPLICATIONS IN LATENT FRICTION RIDGES DEVELOPMENT

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Abstract

Introduction: Nanotechnology has revolutionised several scientific domains, particularly forensic science, by providing alternatives for the development of latent fingerprints. This study investigates the green produce of zinc oxide (ZnO) nanoparticles utilising Azadirachta indica (Neem) extract, and it also investigates their unique features and prospective forensic applications in the development of latent friction ridges. The synthesis of ZnO nanoparticles has been carried out in an environmentally friendly way, with the extract made from Azadirachta indica leaves providing as a reducing and stabilising agent. Zinc oxide (ZnO) is an inorganic chemical compound, stable zinc oxide nanoparticles were produced using a chemical method. At 60 degrees Celsius, zinc oxide nanoparticles were made using a modified process that incorporated zinc chloride and sodium hydroxide. We focused on the synthesis of ZnO nanoparticles, which requires the creation and application of materials with fewer than 100 nm in one or more dimensions and a cone- shaped morphology. SEM and XRD validated the production of pure phase ZnO nanoparticles. As a result of this research, the developed ZnO nanoparticles were utilised in latent fingerprint detection. The developed fingerprints performed excellently on all surfaces, including porous, semi-porous, or non-porous. These kinds of powders could potentially be used in place of the typical powders that are currently utilised by forensic investigators.

Key-Words: Fingerprint, Green Synthesis, Nanoparticle, Neem

INVESTIGATING THE RELATIONSHIP BETWEEN FORENSIC MICROBIOLOGY AND GEOGRAPHICAL LOCATION IN NORTHERN REGIONS OF INDIA

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Abstract

Introduction: Forensic microbiology has emerged as a critical tool in crime scene investigations, aiding in postmortem interval (PMI) estimation, geographical trace evidence, and bioterrorism analysis. The northern regions of India exhibit diverse environmental conditions, including variations in climate, soil composition, and anthropogenic activities, all of which influence microbial communities involved in decomposition. Understanding these microbial variations is crucial for improving forensic accuracy in different ecological zones. This study examines how geographical factors affect microbial succession in forensic contexts across northern India.

Methods: A systematic review of forensic microbiology studies in northern India was conducted, focusing on microbial succession in cadaver decomposition, soil and water microbiota, and environmental influences. Data from published literature, case reports, and experimental studies were analyzed to determine how microbial signatures vary across distinct geographical zones, including the Himalayas, Indo-Gangetic plains, and semi-arid regions. Key forensic microbiological techniques such as 16S rRNA sequencing and metagenomic analysis were evaluated.

Results: Findings indicate significant regional variations in microbial succession patterns due to differences in temperature, humidity, and soil composition. Cold climates, such as those in the Himalayas, slow microbial activity, leading to prolonged decomposition times, whereas humid environments in the Indo-Gangetic plains accelerate microbial succession. Soil microbiota analyses reveal distinct bacterial communities that can serve as forensic markers. Furthermore, anthropogenic factors, such as pollution and agricultural activities, introduce variations in microbial signatures that may impact forensic interpretations.

Conclusion: Geographical variability in northern India plays a crucial role in forensic microbiology applications. Standardizing forensic microbial techniques and developing region-specific microbial databases will enhance the reliability of forensic investigations. Future research should focus on establishing comprehensive microbial forensic frameworks tailored to India's diverse ecological landscapes.

Keywords: Forensic microbiology, decomposition, postmortem interval, microbial forensics, geographical variation.

RAPID AND SIMULTANEOUS ESTIMATION OF MULTICLASS PESTICIDE BY DERIVATIVE UV-VIS SPECTROSCOPY FOR FORENSIC PURPOSES

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Abstract

Introduction: In recent times, for insect pest management strategies multiclass pesticides with combination of two or more compounds are extensively used owing to its effectiveness. The combination of chlorpyrifos (CHL) and cypermethrin (CYP) is such a common pesticide mixture of an organophosphorus insecticide and a pyrethroid. Pesticides are often associated with various toxic effects in humans, being additionally accountable for a large number of rural suicides or accidental fatalities. For multicomponent analysis, derivative UV-Vis spectroscopy has been used extensively due to its simplicity and cost-effectiveness, however it has not been applied for the analysis of multiclass pesticides. Therefore, in the present study a method for the rapid and simultaneous determination of the pesticides by UV-Vis spectroscopy have been developed.

Methods: Extraction was done by QuEChERS method using acetonitrile as the solvent and salt mixture of anhydrous magnesium sulfate and anhydrous sodium acetate in the ratio of 4:1. The analysis was done using microvolume of the sample and 1st order derivative UV-Vis spectroscopy. The 1st derivative values of each of the pesticides from the mix were calculated by zero crossing point method.

Results: Calibration of 1st order derivative of standard CHL and CYP were prepared with correlation coefficients ≥0.99. The method was validated and the precision study indicated that % RSD was within acceptable limit (<1). LOD for CHL and CYP were 61.905 mg/L and 3.799 mg/L respectively. Whereas LOQ were 187.593 mg/L and 11.512 mg/L respectively. The recovery % recorded for the pesticide mix was in the range of 93-99.9 %.

Conclusion: The present study showed that 1st order derivative UV-Vis spectrometry is an useful analytical technique for routine forensic toxicological analysis of multiclass pesticides. The developed method of analysis offers significant advantages in terms of simplicity, cost effectiveness, and in agreement of green chemistry principles.

Keywords: Chlorpyrifos, Cypermethrin, QuEChERS, Green Chemistry and Forensic toxicology.

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