

# FORENSICS

India's First Forensic Science Oriented Bi-Monthly issue

JUN - JUL 2024



From the Expert's Desk



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# *From the Management's Desk*



**Dr. N. SSHA REDDY  
CHAIRMAN**

It is with immense pride and excitement that I announce the launch of India's first bimonthly magazine dedicated entirely to forensic science. This magazine represents a significant milestone in our ongoing efforts to advance forensic science education and practice within our country. Our publication will offer comprehensive coverage of various aspects of forensic science, featuring insightful articles penned by students, faculty members, and esteemed professionals from across the nation. This initiative aims to create a vibrant platform for knowledge sharing, fostering collaboration and innovation within the forensic science community. I am confident that this magazine will not only showcase the remarkable advancements and expertise within our field but also inspire and educate the next generation of forensic scientists. I extend my heartfelt thanks to everyone involved in this groundbreaking endeavor and look forward to witnessing the positive impact it will have on our community.



**Dr. N. SATISH REDDY  
VICE-CHAIRMAN**

I am thrilled to announce the launch of India's first bimonthly magazine dedicated to forensic science. This magazine will cover a wide range of topics within forensic science, featuring articles from students, faculty, and professionals across the country. Our aim is to create a platform for sharing knowledge and showcasing the latest advancements and expertise in our field. This initiative highlights our commitment to improving forensic science education and practice. I look forward to seeing the diverse contributions from our talented community and the positive impact this magazine will have on forensic science in India. I appreciate the Department of Forensic Science for initiating this magazine.

# From the Editor's Desk

Welcome to the inaugural issue of India's first bimonthly forensic science magazine! As we launch this pioneering publication, I am thrilled to share with you a collection of meticulously curated content that delves into the fascinating world of forensic science. Our mission is to bring you the latest research, insightful articles, and groundbreaking developments in the field. Each issue aims to illuminate the intricacies of forensic science, offering valuable perspectives from experts and practitioners who are at the forefront of this dynamic field. This magazine is a testament to our commitment to advancing forensic science in India and beyond. Your support and enthusiasm are crucial as we embark on this exciting journey together. We hope you find our content both informative and inspiring, and we look forward to your continued engagement and feedback.



*Vilas Anil Chavan*

**Editor-in-Chief**



*Darshan Murafi*

**Editorial Head**

As Editorial Head, I'm thrilled to bring you this groundbreaking publication that explores the latest affairs in forensic science.

Our aim is to provide you with insightful research, expert analyses, and practical updates. Your support is essential as we embark on this new venture, and we're excited to share our journey with you.

Thank you for being a part of this pioneering initiative.

# Meet The Team.



**Ameesh Vemuluri**  
Managing Editor



**B V S S Udaynadh**  
Editor, Writer & Fact Checker



**Sanjana Thanjan Shaju**  
Editor & Fact Checker



**Valurowtu Deexitha**  
Writer & Fact Checker

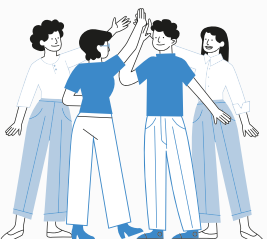


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# UNSUNG HERO OF FORENSIC MEDICINE

## “ALL BODIES ARE SAME”

Meet Mr. Srinivas Putta, a 38-year-old lab attendant in the Department of Forensic Medicine. Despite having only a 12th-grade qualification, Mr. Srinivas has carved out a significant role for himself in this challenging field. Married and dedicated to his work, he has spent years assisting in forensic examinations, playing a crucial role in solving complex cases and contributing to the broader field of forensic science.

Mr. Srinivas Putta was born into a humble family where his father worked as a farmer. This rural upbringing instilled in him a strong work ethic and resilience. In 2004, seeking to contribute to his community, Srinivas joined the Peddapuram Community Health Center as a compounder. In this initial role, he was tasked with writing outpatient records, a responsibility that required meticulous attention to detail. Additionally, he often **accompanied a senior doctor on postmortem visits**, exposing him to the more challenging aspects of medical work early in his career.

During this period, an elderly lab attendant worked in the forensic department, serving as a guide and mentor for Srinivas. Unfortunately, after the elderly attendant passed away, Srinivas was asked to take over the role of lab attendant at the **Peddapuram Community Health Center in 2013**. This transition marked a significant shift in his responsibilities and environment.

Initially, Srinivas faced considerable challenges in his new role. The work involved assisting with autopsies and handling forensic samples, tasks that were far removed from his previous duties. The sights and smells of the postmortem room were particularly overwhelming. His hands would tremble with fear, and those **odors of the Autopsy room** seemed to follow him everywhere. Whether he was eating or using the washroom, it causes a great deal of **psychological distress and trauma**.

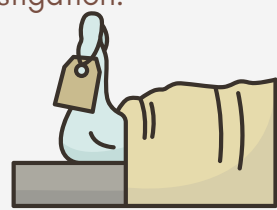
Despite these initial difficulties, Srinivas was determined to succeed. He received substantial support and guidance from his superiors, including doctors and police officers.



who recognized his potential and provided the necessary training and encouragement. Through their mentorship, Srinivas gradually learned the intricacies of forensic work. He developed a deeper understanding of the procedures and techniques required in his new role, which helped him gain confidence.

With time and experience, He became more adept at managing the demands of his job, and the traumatic memories that once plagued him started to fade. **His hands no longer trembled**, and he could perform his duties with increasing precision and efficiency. The smells that once triggered his trauma became mere background sensations as he focused on the important work at hand.

Mr. Srinivas Putta's career in forensic medicine began with a case involving a road accident, which was sadly a frequent occurrence in his area of work. This initial experience provided him with firsthand exposure to the complexities and challenges of forensic investigation.





As he gained more experience, Mr. Srinivas encountered a diverse array of cases involving suspicious deaths. These cases included suicides, unidentified bodies, and tragic incidents involving individuals found near railway tracks or from marginalized communities like beggars.

Over the span of his career, Mr. Srinivas has meticulously handled **over 400 deceased individuals**, with an average of **at least 100 cases of suspicious deaths annually** they used to get. Each case presented unique challenges and required precise forensic examination. The critical nature of his work often necessitated referring cases to the district headquarters hospital for further detailed investigation and analysis.



Mr. Srinivas faced **challenges in collecting femur bones and uterus**. He meticulously followed his superior doctors' guidelines on what to collect, how to package, and where to send these items. He did not have the authority to make independent decisions and always adhered to his superior's instructions. Initially, he often forgot to open the skull during examinations, resulting in **scolding from his superiors**, although they remained supportive.

In his career he has been marked by impactful cases that highlight both the challenges and the profound importance of his work. One of the most poignant incidents involved a sexual assault case concerning a **girl under the age of 13**. The gravity of this case deeply affected Mr. Srinivas emotionally, underscoring the sensitivity and seriousness with which he approaches his responsibilities.

Another notable case that stands out in Mr. Srinivas's career involved a woman whose body was **partially burned**. Her parents suspected it might be their **missing daughter**, but the extent of the burns made identification incredibly difficult. In a testament to forensic science's capabilities, they collected a femur bone from the body. This bone was crucial in **conducting DNA fingerprinting**. They also used **facial reconstruction technology**, which ultimately confirmed the woman's identity. This successful identification brought closure to the grieving family and underscored the critical role forensic science plays in resolving such challenging cases.

In addition to the variety of cases he handled, they also encountered decomposed bodies. These cases presented their own unique set of challenges. During dissections, it was **common to find worms, maggots and flies** infesting the remains, adding to the complexity and difficulty of the examinations. The presence of such advanced decomposition requires a high degree of precision and care to ensure that all necessary forensic procedures to be followed. This attention to detail is crucial in delivering accurate and trustworthy results in every investigation.

In 2013, Mr. Srinivas noticed a big increase in the number of forensic cases, including suspicious deaths and suicides, at the Peddapuram Community Health Center. This rise continued for a few years but then slowly went down. However, after the COVID-19 pandemic, there was a sharp rise in cases again, **especially suicides**, due to higher stress and mental health problems caused by the pandemic.

The increase in these cases after COVID-19 showed the serious impact of the pandemic on people's mental health. Many more people took their own lives as they faced greater economic, emotional, and psychological challenges.

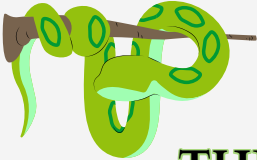
He always hopes for a decrease in cases like accidents and suicides because fewer such cases mean a healthier and safer society. He believes that with more awareness, support, and preventive measures, the number of these tragic cases can be reduced, reflecting a stronger and more resilient community.

In his job, He not only handles the outcomes of these incidents but also promotes preventive steps. **He stresses the importance of mental health support, road safety awareness, and community education to help lower the number of these cases.** His experiences highlight the need for efforts to create safer and healthier environments, where accidents and suicides happen less often.

He also advises the younger generation on the importance of forensic science and forensic medicine in today's society. He highlights that these fields play a crucial role in solving crimes, understanding the causes of death, and providing justice. He encourages young people to consider careers in these areas, emphasizing that they are not only challenging and rewarding but also essential for maintaining law and order and promoting public health. His own experiences serve as a testament to the vital contributions of forensic professionals in addressing and resolving complex cases.



*Interviewed by Mr B V V S Udaynadh  
Drafted by Ms V Deexitha*



# THE ROLE OF WILDLIFE IN RELIGIOUS PRACTICES: AN EXAMINATION OF TRADITIONAL BELIEFS AND THEIR IMPACT ON WILDLIFE

Author: Jnana Sai Prasad Bandi

The Indian subcontinent, renowned for its rich biodiversity, is home to a vast array of iconic wild flora and fauna. However, this natural treasure trove has also become a hotspot for poaching due to the increasing global demand for illicit wildlife products. Wildlife trade in India encompasses a diverse range of items, including mongoose hair, snake skins, rhino horn, tiger and leopard claws, bones, skins, and whiskers, elephant tusks, deer antlers, turtle shells, medicinal plants, timber, and caged birds like parakeets, mynas, and munias. While a significant portion of India's wildlife trade caters to the international market, direct domestic demand remains limited. India's prominent role in global wildlife trafficking is alarming, ranking among the top 20 countries for overall wildlife trafficking and in the top 10 for trafficking by air. The World Wildlife Report 2020 by the United Nations Office on Drugs and Crime highlighted the global scale of this issue, revealing that between 1999 and 2018, authorities worldwide seized specimens from 6,000 different species of flora and fauna.


Wildlife trafficking in India is driven by the demand for raw materials such as red sandalwood and ivory for luxury products, and animal parts like rhinoceros horn and tiger parts for traditional medicine. The traditional medicine markets in China and Vietnam are major consumers of pangolin scales, rhino horns, and various parts from big cats, birds, Asiatic black bears, musk deer, wolves, and jackals. This trade not only depletes the natural habitats of their inhabitants but also introduces added threats such as the spread of invasive species and the emergence of new zoonoses.

Notably, some of the most virulent viral diseases, including Ebola, Marburg virus disease, SARS, and COVID-19, have emerged in areas with close human-wildlife contact, such as wet markets. Despite having a strong legal and policy framework to regulate and restrict wildlife trade, India faces numerous challenges in combating illegal trade. These challenges include porous international land borders, a growing aviation market, and the use of social media as online marketplaces by wildlife traffickers. Addressing these issues is crucial to preserving India's biodiversity and protecting global health.

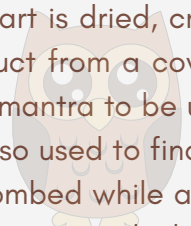
## RITUALS AND BLACK MAGIC PRACTICES INVOLVING WILDLIFE

Hatha Jodi, the root of a rare plant believed to resemble a pair of clasped hands, is used in various traditional rituals. The process begins with purification, where the Hatha Jodi is cleaned with holy water, dried, and dipped in oil before being set aside for several days. It is then wrapped in a red cloth and worshipped with vermilion, flowers, rice, and indrajal while chanting specific mantras using a divine mala. Once purified, the Hatha Jodi is kept in a silver box with red cloth, vermilion, rice, and clove, and is maintained through daily rituals involving incense and mantra chanting. Vashikaran, a form of hypnotism or control, can also be performed using Hatha Jodi. This involves a ritual with various ingredients, including a photograph of the target, a lemon, vermilion, red cloth, rice, black sesame, the person's horoscope, and a dough idol. The ritual is conducted by drawing a star with black sesame seeds on a red cloth, placing rice and lemon at the star's corners, and chanting mantras over the photograph and dough idol.

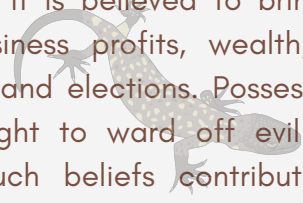




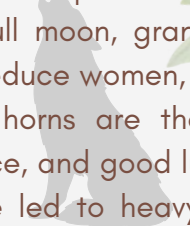
Siyar Singhi, or the horn of a jackal, is another object of black magic practices, particularly during Diwali or Holi. The process involves conducting a daily ritual for 11 days leading up to Diwali, which includes placing the Siyar Singhi in a red cloth, lighting a lantern with mustard oil, sprinkling holy water, and covering it with rice, cloves, and cardamom. Mantras are chanted, and the ritual continues until Diwali. For enhanced effects, the Siyar Singhi is stored in a silver box marked with the Pushya Nakshatra and accompanied by a Hatha Jodi.



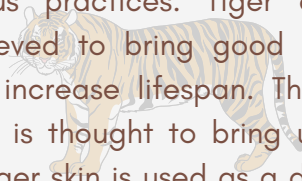
Owls are used in various black magic practices, each part serving different purposes. For vashikaran, the owl's blood, ear tufts, or heart may be used. The ear tufts are mixed with castor seeds and milk, dried, powdered, and administered to the target. The heart is dried, crushed, mixed with gorochan (a product from a cow's bile duct), and enchanted with a mantra to be used as a hypnotic paste. Owls are also used to find hidden wealth. A captured owl is combed while a mantra is recited, and specific feathers are plucked and taken to a cemetery on Ekadashi. The feathers are used in rituals involving chanting mantras, with the final step involving placing the feathers under a pillow to receive guidance in a dream. For fortune-telling, owls are subjected to cruel methods such as starvation and beating until they speak. Black magic practitioners may also sacrifice owls on Amavasya night to gain power over supernatural elements, performing the ritual in secret to attain the desired power.



The genital organ of the male monitor lizard, often misrepresented as the root of a divine plant called Hatha Jodi, is highly sought after in religious practices. It is believed to bring incredible luck, great business profits, wealth, and success in gambling and elections. Possessing Hatha Jodi is also thought to ward off evil and protect the family. Such beliefs contribute to the drastic decline in the monitor lizard population, as males are heavily targeted, leading to the potential unsustainability of the species.

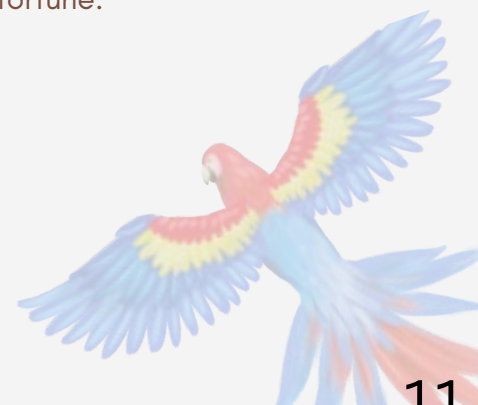


The golden jackal is another species deeply embedded in religious practices. It is believed that the alpha of a jackal pack develops horns while howling at the full moon, granting the ability to see in the dark, seduce women, and win gambling. These imaginary horns are thought to increase wealth, intelligence, and good luck. However, such superstitions have led to heavy trade of jackals, severely impacting their population.



Tigers are one of the most traded animals globally, leading to a drastic decline in their population. In India, tiger body parts are used in various religious practices. Tiger canines and claws are believed to bring good luck, protect from evil, and increase lifespan. The right front paw of a tiger is thought to bring unimaginable wealth, while tiger skin is used as a divine mat for rituals, believed to enhance the benefits of the rituals performed on it.

## **DRIVERS BEHIND THE USE OF WILDLIFE IN RELIGION**



The use of wildlife in religious practices often lacks scientific proof and logical basis. Many recorded cases in India highlight the irrationality of these superstitions. Animals subjected to these practices endure severe physical and mental torture, with death often being their only release. Under the guise of religion, individuals commit such reprehensible acts, driving animals to retreat deeper into forests to escape human civilization. Holy books of various religions often portray animals as either holy beings or symbols of evil, leading to their perceived religious or superstitious value. Additionally, individuals calling themselves babas (godmen), tantriks (witchdoctors), and sorcerers spread false beliefs and create new superstitions, promising incredible wealth and good fortune.

## THE BROADER IMPACT OF ILLEGAL WILDLIFE TRADE:

Illegal wildlife trade poses a significant threat to biodiversity and ecosystems, as these are relatively non-renewable resources. In a culturally diverse country like India, home to numerous ethnic groups, it is challenging to implement a common strategy for wildlife conservation. Cultural superstitions and beliefs drive people to seek health and wealth through wildlife products, exacerbating the problem. Indigenous communities, traditionally reliant on forest resources for their existence, face difficulties in transitioning away from these practices quickly.

In the fight against illegal wildlife trade, wildlife forensics plays a crucial role. This scientific discipline involves applying forensic science techniques to investigate crimes involving wildlife. By analyzing evidence such as DNA, hair, bones, and other biological materials, forensic experts can identify species, determine the origins of wildlife products, and link suspects to illegal activities. Forensic analysis can accurately identify the species involved in the trade, which is essential for enforcing wildlife protection laws, particularly in distinguishing between protected and non-protected species. DNA analysis can trace the geographic origin of wildlife products, helping authorities pinpoint poaching hotspots and trafficking routes, which is vital for targeting enforcement efforts and protecting vulnerable populations. Forensic evidence can connect poachers, traffickers, and consumers to specific wildlife crimes, including analyzing items like clothing, weapons, and vehicles for traces of wildlife products.

Wildlife forensics provides robust scientific evidence that can be used in court to prosecute offenders, enhancing the legal framework for deterring wildlife crimes and securing convictions. Additionally, by understanding the genetic diversity and health of wildlife populations, forensic science contributes to conservation strategies aimed at maintaining healthy and sustainable ecosystems.



Given the complexity and sophistication of wildlife trafficking networks, integrating wildlife forensics into enforcement strategies is essential. It empowers authorities with the tools needed to combat this illicit trade effectively and protect biodiversity. Efforts to combat illegal wildlife trade must focus on sensitizing local communities about the importance of wildlife conservation and its potential economic benefits through sustainable practices. Through this article, we request authorities, organizations, and individuals to take wildlife trafficking and its forensic investigation as serious concerns. Only through collective awareness and action can we hope to preserve the invaluable biodiversity that enriches our planet. Protecting wildlife is not just about preserving species; it is about safeguarding our natural heritage and ensuring the health of our ecosystems.

## About the Author



**B. Jnana Sai Prasad**

He holds a B.Sc in Forensic Science and MBA in Homeland Security. He has expertise in Wildlife Forensics, Security studies (Cyber, Physical and in other verticals).





# INSECTS AS SILENT WITNESSES



*EXPLORING THE ROLE OF ENTOMOTOXICOLOGY IN FORENSIC INVESTIGATION*

Author: Souparnika.C, Gopika V.P, Donkina Nagesh

## **Introduction**

A combination of the Greek terms "entomon," which means insect, "toxikos," which means poison, and "logos," which means subject matter, results in the phrase entomotoxicology. Etymologically speaking, then, it is the study of xenobiotics as they relate to insects. Pounder initially used the term in 1991.

The study of applying toxicological analysis to carrion-eating insects to ascertain the presence of drugs and toxins in their intoxicated tissues is known as entomotoxicology. Entomotoxicology looks on how these compounds affect arthropod growth as well, to help with forensic PMI estimations. The first report of identifying a drug in a corpse by analysing maggots feeding on the body was made in 1980 by Beyer and associates.

Entomotoxicology can be divided into two main categories:

1.1 Entomological analysis of substance: caused variations in the rate at which insects developed, which in turn affected how the PMI was calculated.

1.2 Toxicological analysis of drugs within insects: Because of storage excretion and bio accumulation in insect metabolism, which produce concentrations of compounds higher than in the surrounding tissues, toxins may be more easily recognised.

One of the most important parts of a criminal investigation into a death is figuring out the cause of death. Identifying this aspect once the body has completely decomposed could be difficult. Instances of postponed recovery are likely to occur in cases of drug overdose deaths in remote locations or suicide deaths. It may also occur when the deceased are covered up on purpose. Insects are the only reliable substitute specimen that can be utilised for forensic investigations when conventional toxicological samples, such as tissue, bodily fluids, and internal organs, have either degraded or are not available. Insects are vital to forensic research because they feed their larvae on dead bodies. During their active feeding on cadaveric tissue, the larvae's metabolic system absorbs xenobiotics, which include medicines and other hazardous compounds found in the tissue. Moreover, these xenobiotics are transferred up the food chain to other arthropods that consume the larvae. Insects (larvae) also constitute an adequate toxicological sample since the cadaver has a lot of insects on it and the puparial case is not damaged for a long time. The study of whether insects can be used as alternative toxicological samples is known as entomotoxicology.

In forensic investigations where human remains have been removed, analyzing insect evidence can be crucial.

Toxicological and molecular investigations of bugs can help identify victims and determine causes of death by linking larvae to their last meal. Certain fly species can cause myiasis, and examining larvae can indicate the duration of neglect. Proper professional collection and analysis of this evidence are essential for accurate presentation in court.

Forensic medicine is highly interested in this area due to the growth in drug-related mortality, primarily from heroin and cocaine, as well as deaths from poisoning and/or hazardous chemical intake that occur accidentally or suicidally. Standard toxicological techniques such as gas chromatography (GC), thin-layer chromatography (TLC), high pressure liquid chromatography (HPLC-MS), radio-immune analysis (RIA), and gas-mass analysis (GC-MS) can be used to easily analyse insects after the most representative specimens have been homogenised. The person's consumption of drugs and toxins during their life is integrated into the metabolism of Diptera larvae, who feed on human tissues that have been intoxicated. These chemicals are not only transferred from the human organism to Diptera at this stage in the food chain, but they are also transferred when beetles eat blowfly larvae.

### Using Insects as a Toxicological Sample

Five stages can be distinguished in the decomposition process, which begins as soon as a person dies:

- Fresh
- Bloated
- Decay
- post-decay
- skeletal



The smell that a dead body releases as it decomposes attracts a wide range of

insects and terrestrial arthropods. Insects are typically the first animals to arrive near a dead body. Blowflies can deposit their eggs on carrion some hours after a death. Metamorphosis is the process by which an insect changes from one life stage to the next. First, the corpse is covered in a vast number of eggs. After hatching from the eggs, the maggot consumes the body and proceeds through three larval instars. At the third instar, mature maggots leave the food source to pupate in the proper place, usually the soil. Occasionally, empty puparia cases left behind by the adults emerging from the pupa can be seen on the clothing of the deceased, under the ground, or beneath the carpets in the room. Puparia case serves as a last resort for toxicological samples when bodies are recovered at the skeletonized state. Drugs and other dangerous substances may accumulate inside the larvae's cuticle throughout growth and development, and during pupariation, these compounds may transform into sclerotized puparium. Entomotoxicologists can examine the following organic components of interest: fly scavengers and predators; larvae, pupae, and adult insects; puparial cases; exuviae (cast beetle skins); and beetle excrement (frass). In toxicological examinations, beetles (Coleoptera) and true flies (Diptera) are the two most utilised insects. The bug species that have been examined the most within the family are *Lucilia sericata* and *Calliphora vicina*.



### Sample Collection and Preservation

Sample collection and preservation are crucial for providing a more accurate and reliable assessment of the postmortem interval (PMI) and for serving as a specimen for further toxicological examination. Given that drug redistribution can result in

variations in drug concentration in larvae. , samples can be taken from the corpse as well as from various body parts. To determine the most appropriate medium, researchers have examined a variety of killing and preservation techniques as well as how they affect the duration of the larvae. In a single experiment, specimens of larvae were either killed in hot water at 80°C and 100°C for one, thirty, sixty, and ninety minutes, and then they were submerged in a 10% formalin, 80% ethanol, and 95% ethanol preservative. It was discovered that the larvae's length differed greatly based on how they died. The type of preservative used also had varying effects on the length of the larvae and the larvae of different insect species. It was discovered that larvae died at 80°C for 30 seconds of immersion bring the least amount of change in length from their starting point, making this mode of death appropriate. It was stated that the ideal preservation medium was 80% ethanol. Nevertheless, research by Midgley and Millet shown that beetle larvae cannot be killed using the previously described technique. The length of the beetle larvae varied significantly across the three methods employed to kill them: immersion in 70% ethanol for one minute, freezing at -20°C for one hour, and immersion in hot water at 90°C for one second. Therefore, the authors recommended measuring beetle larvae while they are still alive, if possible. The easiest way to measure the length of huge larvae collected is to calculate the mean length after the larvae are killed with ethanol. The entire corpse, including the area up to ten metres surrounding it, can be used to collect insects. Dead insects and eggs can be preserved in 70-95% ethanol. Larvae can be killed in hot water at 80°C for thirty seconds and then stored in 70-95% ethanol. Pupae

can be stored in a temperature range of 2-6°C with a punched lid. Adult flies can be killed in a vial frozen at -20°C. The dead specimen can be stored in 70-95% ethanol. For toxicological analysis, specimens are kept at -4 °C. The procedure is the same as for toxicologically interesting human tissues or fluids.

### **Extracting Samples**

When it comes to human tissue, there are some advantages to the extraction of xenobiotic compounds from insect samples. As is occasionally the case with human tissue, emulsion does not obstruct the analysis, and sampling is easy and quick. In one experiment, measurements from larvae were successful, but due to matrix interferences, measurements from human tissue could not be made. Samples of larvae are retrieved and processed similarly to samples of human tissue. Different drugs and poisons are extracted using different extraction techniques, such as liquid-liquid and solid phase extraction, depending on the chemical properties of the substances that need to be located. Solid phase extraction is believed to provide the best organic toxicant purification from aqueous extracts of entomological specimens.

### **1) Qualitative Analysis**

In cases where appropriate samples such as tissue, blood, or urine are unavailable for toxicological analysis, insects may serve as a useful indicator of possible drug exposure in poisoning-related deaths. For instance, cocaine in the skeletal muscles and larvae of a deceased individual at the skeletonized stage was identified using GC-MS. Similarly, amphetamine and alcohol were discovered in the maggots on a deceased body that as



estimated to be one month old. The analyses were conducted using methods including immunoassay, HPLC, GC, LC-MS, LC-MS/MS, and GC-MS. The immunoassay technique is a useful tool for screening a variety of drug classes for a certain class of drug, even though the results are not definitive.

It offers quick sample analysis and an answer to the question of whether further confirmatory tests need to be performed. Forensic entomotoxicology has been the primary use of the immunoassay method for the detection of morphine substances from a range of substrates and materials. Using this technique, it was possible to demonstrate the distribution of morpholine throughout the insect's body, including the larvae's integument, cuticle, and haemolymph. An HPLC method revealed that flies could efficiently metabolise 76% of morphine, excreting only 24% of the drug in its original form. This approach has also proven useful for both quantitative and qualitative research on a range of drugs and pesticides. Insects that consumed rabbit carcasses that had been slaughtered with parathion were examined by Wolff, and parathion was found in a variety of bug species using the HPLC technique. In certain species, the low concentration of parathion makes quantitative estimation impossible. The "gold standard" method for verifying the presence of chemicals in samples is the combination of mass spectrometry and chromatography techniques. Increased selectivity, sensitivity, accuracy, and reproducibility are achieved by this method, which calls for tiny amounts of samples. This technique has been used in the forensic investigation of drug addiction cases to identify different substances on different matrices.

## 2) Quantitative Analysis

When compared to the substrate that they are feeding on, the drug concentration in larvae and insects decreases significantly. It is typically discovered that the larvae consuming the substrate that has been treated with a higher dose or concentration have higher concentrations in their tissues. When morphine was present in two different diets at concentrations of 17.5 nmol $g^{-1}$  and 7 nmol $g^{-1}$ , for example, the larvae fed on the former diet had a higher morphine concentration. This might not always be the case, though. When three distinct medication doses were administered to larvae, the drug concentration in the larvae fluctuated over time. The drug concentration in the larvae decreases during the post-feeding stage because there is no active xenobiotic uptake from the meal. The larva successfully eliminates medications and other dangerous compounds from its body as it matures, leaving fewer of them in its adult form. However, it has been discovered that the concentrations of several drug classes, such as antidepressants, are higher during the post-feeding stage. Bioaccumulation might be the cause of this occurrence. Since a small number of pharmaceuticals is known to build up in the puparium's cuticle, medications can be recognized from puparial instances that are empty. However, the technique must be sensitive enough to detect these low drug concentrations in cases involving insects, larvae, and pupae. In this research, a drug molecule from larvae grown on minced beef meat containing 0.01 mg/kg of morphine was not detectable by the immunoassay approach. To measure the drug, only larvae fed on minced meat containing 0.1 mg/kg and 1 mg/kg of morphine were employed.

Similarly, the HPLC method was unable to quantify a material from larvae fed on minced beef containing 500 ng/g and 1000 ng/g of morphine. For the purpose of measuring the medicines, only larvae feeding on beef minced with morphine above 2500 ng/g were permitted. However, it was noted that larvae fed on 2500 ng, 5000 ng, and 10,000 ng of minced morphine meat, respectively, had drug levels as low as 765 ng, 2720 ng, and 3010 ng. The LC-MS and GC-MS procedures are the most effective ways to measure pharmaceuticals at lower levels of production. Pien demonstrated that, beginning with a single larva and puparia, the drug Nordiazepam and its metabolite Oxazepam could be identified and measured down to the Pg level. This method has been utilised by several researchers to measure drugs from different human and animal body sections. Different drug concentration levels in the liver, heart, lung, blood, brain, urine, and skin have been reported. Since the liver is where xenobiotic processing takes place, drug concentrations in the liver are often higher than in other organs. Thus, it is important to carefully analyze the quantitative results.

### **Correlational Analysis**

There is a lot of disagreement over the connection between drug concentrations in the substrate and insects. Even though correlation studies with maggots may be conducted using both qualitative and quantitative methods, some scientists remain sceptical of this approach. Their thesis is predicated on the notion that a number of factors, such as drug pharmacokinetics, metabolism, drug redistribution, drug accumulation, feeding activity of larvae, and several others, may have an impact on correlation studies but are currently

unknown. In the discipline of entomotoxicology, a thorough examination of 29 human cadavers suspected of poisoning deaths was carried out. The researchers were unable to discover any correlation between the drug content in samples of larvae and human tissue. There was no repeatability found when inter-larval and inter-site variance were examined. The highly unpredictable mobility of the larvae was the explanation for the variation in drug concentration in the larvae, as reasoned. The authors came to the conclusion that any attempt to determine the cause and circumstances of death using this method is very doubtful and dishonest from a scientific standpoint, given the profusion of ambiguous components in the analysis. It is improbable that there is a quantifiable relationship, they added. It was predicted that unless there was significant insight gained, this subject would remain, at best, a lab curiosity and, at worst, a scientific hoax. Several writers also conducted trials in which a quantitative link could not be established, hence providing evidence against correlation research. On the other hand, a few investigations have shown a connection between drug concentrations in substrates and larval specimens. Liu found a connection between the liver tissues and the amount of malathion present in larvae. Burel found that feeding beef steak contaminated with morphine hydrochloride to *Thanatophilus sinuatus* larvae in their second and third instars resulted in the strongest relationship. An association was found by between third-instar *Lucilia sericata* larvae fed on rabbit corpses treated with morphine. Similarly, a number of authors have observed a quantitative relationship between the number of drugs in the substrate and the larvae. Since the larvae in most of these

trials were fed minced meat rather than allowing the drug to go through its usual metabolic pathway, the results may not correspond to real-world poisoning scenarios. To date, very few studies have looked closely at how drugs are metabolized, redistributed, accumulated, and excreted in insects. Consequently, caution must be used when interpreting the findings of such a study until suitable baseline data are available.

### **Trends in Analytical Techniques**

The capacity to identify and detect drugs in decomposed or putrefied tissue depends on how well extraction techniques and analytical technologies are applied. In the past, materials could be difficult to analyze due to the damaged matrix when using methods like chromatography and immunoassay. The matrix affected the analysis's findings and increased the possibility of falsely positive outcomes for the method. Additionally, the methods used were less sensitive. Because fewer interferences were seen when employing larvae and insects as proxies, these samples were sought after as an alternative.

Prior to the development of sensitive techniques such as LC-MS and GC-MS, which enable the confirmatory identification and quantification of low-level toxic concentrations in a highly degraded matrix, maggots held some forensic value as alternative toxicological samples. However, their usefulness has since diminished. Only once the corpse has reached the skeletonized stage and there are only insects, puparial cases, and insect frass remaining for analysis is this field useful and applicable.

For entomotoxicological research, chromatographic methods in conjunction with mass spectrometry have been the most often utilised analytical methodology, and this combination is the preferred strategy.

These days, spectroscopic methods backed by statistical tools like PCA (Principal Component Analysis), SPA (Successful Projection Algorithm), and GA (Genetic Algorithm) are being utilised to study entomological specimens non-destructively. Spectroscopic techniques are employed because they overcome the accessibility barrier caused by pricey instruments such as GC-MS and are sensitive, repeatable, and need few samples with minimal sample preparation. In this UV-spectrophotometry is used to identify the antidepressant medication fluoxetine from entomological specimens. The substance was identified by the authors from exuviae and from *D. Maculatus* in all developmental stages. Statistical techniques are combined with Near Infrared (NIR) Spectroscopy to analyse flunitrazepam in insect specimens. Statistical techniques were used to gather information regarding potential variations in flunitrazepam concentration (classification) and biochemical changes for insects (larvae, puparia, and adults). As a result, the application of statistical methods facilitates the objective interpretation of data that is precise, trustworthy, and repeatable. Although the results were encouraging, the authors suggested that more research methods be done and that a larger vibrational spectra database containing a greater variety of fly and insect species be produced.

## Determination of PMI

Fly estimation of the postmortem interval (PMI) is used in judicial investigations. In order to identify the bug and determine its size and stage, juvenile larvae, pupa, and insects are removed from the body. The PMI from the insect succession on the cadaver is determined by taking into account a number of variables, such as climate, season, geographic region, exposure to solar radiation, synanthropy, substrate type, latitude, altitude, body location and position, size, cause of death, presence of clothing, intra- and inter-specific competition, and larval migration. It has been noted that when toxic compounds are present, the pace at which larvae grow can either increase or decrease. It was shown that the presence of malathion decreased the growth rate of fly larvae. It was found that the larvae feeding on poisoned tissues were smaller in size, and that the postmortem interval estimate changed by 36 hours for the larvae collected from poisoned liver tissues and 28 hours for those taken from poisoned muscle tissues. Methamphetamine was found to alter the PMI and speed up larval growth when assessed from puparia and larvae, respectively, by 18 and 48 hours. The presence of codeine in the tissue also altered the postmortem interval estimation by 48-96 hours when the larval age was determined using the larvae weight. It was shown that in tissues containing butylscopolamine bromide, fly development lagged by 54 hours.

However, if enough doses of butylscopolamine bromide are ingested before to death, this drug may considerably distort estimations of the postmortem period due to

its effect on the growth rate of larvae. Therefore, erroneous PMI assessment may arise if the presence of dangerous compounds in tissues is ignored.

## Forensic Significance

- Calculating the PMI (Postmortem Interval):

Forensic investigations require the determination of the deceased's time of death. Insects such as flies and beetles have a predictable technique of colonising a body. Using entomotoxicology, forensic investigators can determine the postmortem interval by examining the chemicals present in these insects. When the dead were exposed to harmful chemicals, this can be inferred from the chronology of toxin buildup in insects.

- Identification of Poisoning:

Entomotoxicology can help determine the presence of pharmaceuticals or toxins in situations where poisoning is suspected. When insects feed on a dead body, they can gather materials from the surrounding area, which could lead to information on the cause of death. Determining if poisoning happened can be aided by analyzing the tissues of the insect to determine the presence and concentration of poisons.

- Verification of Drug Use:

To verify drug use or overdose, entomotoxicological analysis may be utilized. Drugs and their metabolites can encounter insects; examining the tissues of the insects can identify the existence of these chemicals. In situations involving drug-related deaths or criminal activity, this information may be very helpful.

- **Environmental Context:**

When examining a crime or death, entomotoxicology takes the surrounding circumstances into account. Insects may be exposed to different compounds in different contexts, and examining these substances can provide information about what was going on at the time of the incident.

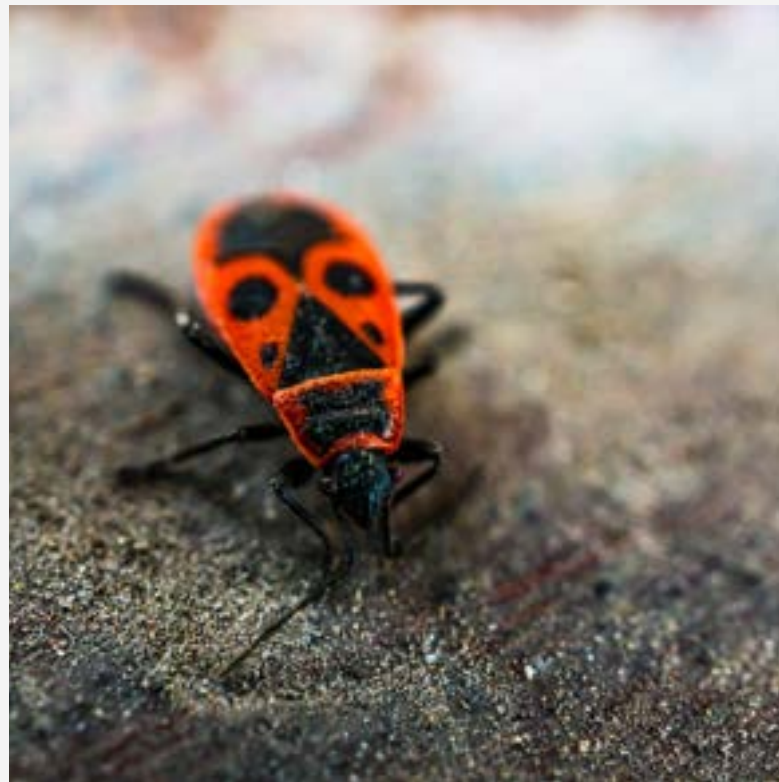
### **Limitation**

Entomological specimens can yield high-quality toxicological specimens. However, not enough research has been done to develop an assessment that assesses a drug's concentration in tissue using entomological data. Samples of pupae and third-instar larvae do not contain any drug concentrations, and drugs are only found in larvae when the rate of absorption outpaces the rate of excretion. These findings suggest that medication does not bioaccumulate during the larvae's life cycle. This suggests to entomologists that toxins eventually find their way out of larvae's bodies when there isn't a reliable source of toxins. Since entomotoxicology is still in its infancy, there is a great need for more study in this area.

### **Conclusion**

As the previous discussions have demonstrated, insects and larvae are reliable toxicological specimens, especially when the materials required for a standard toxicological test are not accessible. Before concluding that there could be no

quantitative association and that maggots only play a qualitative function, much research is needed to understand the pharmacokinetics of drugs in insects. The majority of entomotoxicological investigations have been conducted to identify medications in insect specimens; very few studies have been conducted on cases of pesticide and insecticide poisoning. Because insecticides and pesticide poisonings are so common in our culture, researchers should continue to explore this area. Lastly, as poisons can either raise or decrease postmortem interval estimation, the postmortem interval estimation should be properly completed while accounting for their presence in the tissues.



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# FORENSIC DATA EXTRACTION FROM UVC CAMERA-EMBEDDED SPY DEVICES

## A Case Study

Author: Prakhar Prasoon, Gouri R.Uplenchwar,

### INTRODUCTION

A spy camera, also known as a covert or hidden camera, is a device employed to capture images or videos of subjects, frequently individuals, without their awareness. These cameras are often concealed from the subjects' view, either by being camouflaged as other objects or by remaining entirely unseen. Such covert cameras are commonly utilized as a means of surveillance. In the realm of surveillance, the term "hidden camera" denotes recording subjects without their knowledge or consent, while "spy camera" implies that subjects would object to being recorded if aware of its presence. Conversely, "security camera" refers to visible cameras or those accompanied by notices, ensuring subjects are aware of being filmed.

Hidden cameras find diverse applications including property security, personal monitoring, photography, and entertainment, although their usage extends to espionage or surveillance by law enforcement, intelligence agencies, corporations, and various entities. Unfortunately, they are also employed for illicit activities such as criminal reconnaissance, stalking, or voyeurism.

The utilization of hidden cameras poses significant challenges to personal privacy rights. These covert devices often raise ethical concerns as they capture footage without individuals' knowledge or consent, potentially intruding upon private spaces or sensitive situations. Legal considerations surrounding their use vary considerably based on jurisdiction, encompassing laws related to surveillance, privacy, and consent.

In many regions, the legality of hidden camera uses hinges on factors such as the location of recording, the expectation of privacy in that particular space, and the purpose for which the recordings are being made. Consequently, navigating the legal landscape around hidden cameras involves a complex interplay of local laws, regulations, and ethical considerations. Many spy cameras leverage USB Video Class (UVC) Cameras for their exceptional bandwidth, reliability, and seamless integration. These cameras feature prominently across various applications, including biometric and access control systems, robotic vision, medical imaging, surveillance drones, augmented reality, and numerous other fields. UVC cameras operate as USB-powered devices with built-in standard video streaming capabilities, facilitating smooth connectivity with host machines.

These cameras are characterized by standard and class-specific descriptors, which are data structures employed to outline the capabilities of a USB device. The comprehensive set of class-specific video control (VC) unit/terminal descriptors provides a complete description of the video function to the host.

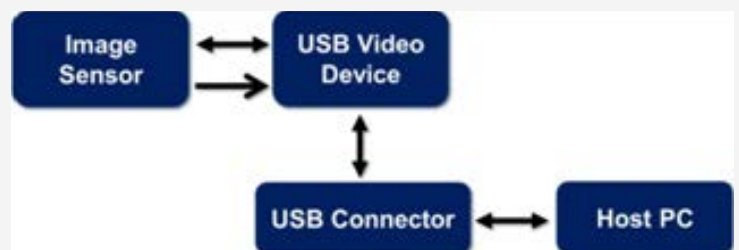


Figure 1: Block diagram of USB video class application

In the laboratory, a case involving a suspected 'm MHB Keychain Spy Camera' shown in Figure-2 was received for examination. The forensic examination entails analyzing a spy device, a memory card, and a photograph of the suspect to determine if the individual was present in the video clips recorded by that particular spy camera. The memory card was subjected to Physical Extraction using Cellebrite Universal Forensic Extraction Device (UFED) Touch 2 Device Version

7.60.0.222 which created UFED Dump file which was further parsed using Cellebrite Physical Analyzer Version 7.62.0.59. Also, it has been imaged and examined using Encase Version 6.19 as 'E01' image.

specifically designed for data extraction from diverse digital devices, including memory cards. This tool established a connection with the memory card, initiating a comprehensive physical extraction process. This process aimed to capture both visible and deleted data, generating a UFED dump file—a complete, unaltered copy of the memory card's content in a raw format. The steps involved in extraction of the data from the memory card has been shown in Figure 4.



Figure 2: MHB Keychain Spy Camera with micro-SD Memory Card 32GB

## MATERIALS AND METHODOLOGY

Upon its connection to the FRED Forensic Workstation, the initial step involved evaluating its functionality. The spycamera, identified as General-UVC during this process, exhibited a blinking indicator that served as confirmation of its operational status, thereby validating the functionality of the device. The analysis commenced by utilizing the specialized hardware Cellebrite Universal Forensic Extraction Device (UFED) Touch 2 Device Version 7.60.0.222 shown in Figure 3,



Figure 3: Cellebrite UFED Touch2 Device

Initially, the memory card underwent connection to the UFED Touch 2 via the Cellebrite Memory Card Reader (set to Write Blocked mode) shown in Figure 5, where the Mass Storage option was activated. Subsequently, the 'Mass storage device' was specifically chosen, followed by the selection of the Physical method within the extraction type, opting for the Method 1 mode. Lastly, the destination hard drive was connected, and the extraction location interface involved the selection of the 'Removable Drive' option.



Figure 4: Steps involved in the extraction of data from Memory Card



Figure 5: Cellebrite Memory Card Reader

Subsequently, the data obtained in the UFED dump file having '.ufdx extension' underwent analysis using the Cellebrite Physical Analyzer Version 7.62.0.59 shown in Figure 6. This software facilitated the interpretation and organization of the extracted data. Through parsing and structuring, it transformed the complex raw data into a comprehensible format, enabling systematic examination and identification of relevant evidence by forensic examiners.



Figure 6: Parsing of .ufdxfile using Cellebrite Physical Analyzerv7.62

Moreover, the memory card which was imaged and same was analysed using Encase Version 6.19 in '.E01' format. Extracted data accessible from the memory card has been retrieved along with their MAC properties. This cardinal standard methodological approach involving specialized hardware and advanced software tools ensured a systematic and detailed process for extracting, analysing, and interpreting digital data from memory cards, supporting forensic analysis and legal validations.

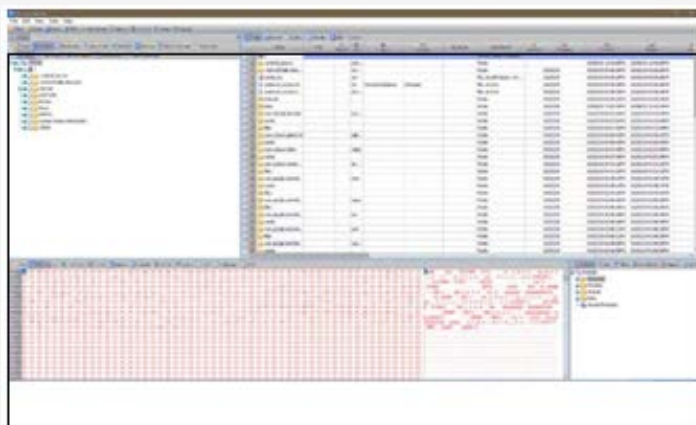


Figure 7: Analysing imaged data using EncaseSoftware

## RESULTS AND DISCUSSION

After the forensic examination and analysis of the suspected 'm MHB Keychain Spy Camera', utilizing tools like Cellebrite UFED Touch 2 and Encase, significant digital data was recovered from the memory card. After analyzing it with Cellebrite Physical Analyzer Version 7.62.0.9, seven video clips and 7,529 images were recovered. Subsequently, when the same memory card was imaged with Encase Version 6.19, the same seven video clips were retrieved, but the number of images retrieved was less, a discrepancy in the number of images was noted in comparison to UFED Physical Analyzer. This variation in the quantity of images emphasizes the significance of using diverse forensic techniques to ensure thorough data retrieval. It also brings attention to the possible differences in outcomes between various forensic tools during the analysis of digital evidence. Further file property studies like file extension, Hex codes, codecs, metadata and other pixel properties are required, particularly concerning the involvement of the accused individual in the video recordings.

## CONCLUSION

The examination and analysis involving the 'm MHB Keychain Spy Camera' and its associated memory card utilized comprehensive forensic methodologies. The extraction and analysis conducted through tools like Cellebrite UFED Touch 2 and Encase resulted in the recovery of crucial digital content, comprising seven video



clips and a significant number of images. Notably, discrepancies in image counts between the tools were observed, emphasizing the importance of employing multiple forensic techniques for comprehensive data retrieval and analysis in such cases. This case study underscores the critical role of forensic procedures in uncovering digital evidence, albeit needing further expert scrutiny, especially concerning the presence of the accused individual in the recorded video clips. However, the conclusions drawn from the retrieved data, including the presence of the suspect in the video clips recorded by the spy camera, would require further study and analysis by forensic experts and legal authorities including the codecs and metadata of the images and the videos for the authentication generated by such UVC-Cameras can scientifically strengthen the authentication and veracity.

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# MINING FORENSICS: A COMPREHENSIVE OVERVIEW

Author: Rakesh Mia

## Abstract

Mining forensics is a specialized domain within forensic science dedicated to the investigation and analysis of mining-related incidents and activities. This field addresses the causes and legal ramifications of various mining events, emphasizing its role in improving safety, regulatory adherence, and environmental management. This article provides a detailed examination of mining forensics, including its significance, methodologies, challenges, and practical applications. By exploring relevant case studies and recent technological advancements, we aim to highlight how mining forensics contributes to enhancing operational safety and compliance within the mining industry.

## Introduction

Mining forensics involves applying forensic science techniques to the investigation of incidents and issues within the mining sector. The importance of this field has grown due to the substantial environmental, economic, and safety consequences associated with mining activities. Mining forensics addresses a range of issues, from accidents and equipment failures to environmental contamination and illicit mining practices. By identifying root causes, establishing liability, and formulating preventative measures, mining forensics plays a pivotal role in advancing safety standards, regulatory compliance, and environmental protection in the mining industry.

### Importance of Mining Forensics

Mining operations are inherently hazardous, with risks including equipment malfunctions, geological instabilities, and human errors.

The consequences of mining-related risks can be catastrophic, resulting in loss of life, extensive environmental damage, and significant financial losses. Mining forensics plays a crucial role in mitigating these risks by addressing various critical areas:



**1. Enhancing Safety:** Forensic investigations into mining accidents and near-misses help identify safety lapses and systemic issues. By analyzing these incidents, mining forensics provides actionable recommendations to improve safety protocols and prevent future occurrences.

**2. Regulatory Compliance:** Adherence to mining regulations and industry standards is essential for maintaining legal and operational integrity. Forensic analysis can uncover instances of non-compliance and facilitate corrective measures, ensuring that mining operations meet required standards and regulations.

**3. Environmental Protection:** Mining activities often have profound environmental impacts, including contamination of air, water, and soil.



Forensic methods are employed to trace the sources of environmental damage, assess the effectiveness of remediation efforts, and guide strategies for minimizing future environmental harm.

**4. Fraud and Illegal Mining Detection:** Forensic techniques are instrumental in detecting fraudulent activities and illegal mining operations. By uncovering these illicit practices, mining forensics supports law enforcement and regulatory agencies in protecting resources and upholding legal standards.

### **Methodologies in Mining Forensics**

Mining forensics integrates methodologies from various scientific disciplines to address and investigate mining-related incidents. Key methods include:

#### **1. Accident Investigation**

Accident investigation in mining forensics involves a structured approach to uncovering the causes behind mining accidents. The process encompasses several critical steps:

- Site Examination: Conducting a thorough inspection of the accident site to collect physical evidence and assess the conditions leading to the incident.
- Witness Interviews: Collecting testimonies from individuals who were involved in or witnessed the incident to gather insights and corroborate evidence.
- Document Analysis: Reviewing operational records, maintenance logs, safety protocols, and other relevant documentation to identify discrepancies or lapses in procedures.
- Material Analysis: Analyzing samples of rock, soil, and equipment to investigate material failures or malfunctions that may have contributed to the accident.

- Geospatial Analysis: Employing Geographic Information Systems (GIS) to map the spread of contamination and analyze spatial patterns to understand the impact and dispersion of pollutants.

#### **2. Geotechnical Forensics**

Geotechnical forensics focuses on the stability and integrity of geological materials and structures within mining operations. Methods include:

- Soil and Rock Testing: Performing laboratory tests on soil and rock samples to assess their physical properties, strength, and stability.
- Slope Stability Analysis: Evaluating the stability of slopes and excavations to identify potential failure mechanisms and risks.
- Structural Analysis: Analyzing the integrity of mine infrastructure, such as tunnels and support systems, to detect structural weaknesses or failures.

These methodologies collectively contribute to a comprehensive understanding of mining incidents, facilitating effective investigations, regulatory compliance, and improvements in safety and environmental protection.

- Ground Penetrating Radar (GPR): Imaging subsurface structures to detect anomalies.
- Seismic Surveys: Assessing ground stability and identifying fault lines.
- Slope Stability Analysis: Evaluating the integrity of mine slopes and waste dumps.

#### **3. Digital Forensics**

Digital forensics in mining involves analyzing electronic data related to mining operations. This includes:

- Data Recovery: Extracting data from damaged or corrupted storage devices.
- Log Analysis: Reviewing digital logs for evidence of tampering or unauthorized access.

- Simulation and Modeling: Using software to recreate incidents and predict outcomes.

## Challenges in Mining Forensics

Mining forensics faces several challenges that can complicate investigations and impact outcomes:

### 1. Harsh Environments

Mining sites often present challenging conditions, such as extreme temperatures, high pressures, and hazardous substances, which can hinder forensic investigations.

### 2. Complexity of Incidents

Mining incidents can involve multiple factors, including mechanical failures, human errors, and natural events, making it difficult to isolate specific causes.

### 3. Limited Access to Data

Accessing accurate and comprehensive data can be challenging due to issues such as poor record-keeping, data corruption, or reluctance to share information.

### 4. Interdisciplinary Collaboration

Effective mining forensics requires collaboration across various scientific disciplines, which can be complicated by differences in terminology, methodologies, and priorities.

## Case Studies in Mining Forensics

Examining real-world case studies helps illustrate the application of forensic methodologies in the mining sector.

### Case Study 1: The Brumadinho Dam Disaster

In January 2019, a tailings dam at the Córrego do Feijão iron ore mine in Brumadinho, Brazil, collapsed, releasing a massive mudflow that resulted in over 270 deaths and widespread environmental damage. Forensic investigations revealed:

- Negligent Practices: The dam's design and construction did not meet safety standards.
- Warning Signs Ignored: Previous reports had indicated structural issues that were not addressed.
- Lack of Emergency Preparedness: Inadequate response plans exacerbated the disaster's impact.

### Case Study 2: The Mount Polley Mine Spill

In August 2014, a tailings pond breach at the Mount Polley mine in British Columbia, Canada, released millions of cubic meters of wastewater and tailings into nearby water bodies. Forensic findings included:

- Engineering Failures: Design flaws and insufficient maintenance were primary causes.
- Environmental Impact: Long-term ecological damage necessitated extensive remediation efforts.
- Regulatory Gaps: Lapses in regulatory oversight and enforcement contributed to the incident.

## Recent Advancements in Mining Forensics

Advancements in technology and methodologies are enhancing the effectiveness of mining forensics. Key developments include:

### 1. Remote Sensing Technologies

Remote sensing technologies, such as drones and satellite imagery, provide valuable data for monitoring mining sites and detecting anomalies.

### 2. Advanced Analytical Techniques

Techniques like mass spectrometry and electron microscopy enable more precise analysis of materials and contaminants.

### 3. Machine Learning and AI

Machine learning algorithms and artificial intelligence

(AI) are being used to analyze large datasets, identify patterns, and predict potential failures.

#### 4. Blockchain for Transparency

Blockchain technology is being explored for its potential to enhance transparency and traceability in mining operations, particularly in supply chain management and compliance tracking.

### Applications of Mining Forensics

The applications of mining forensics are diverse and extend across various aspects of the mining industry.

#### 1. Safety and Risk Management

Forensic investigations help improve safety protocols, reduce risks, and enhance overall operational safety.

#### 2. Legal and Regulatory Compliance

Forensics provides evidence for legal proceedings, regulatory enforcement, and compliance audits, ensuring adherence to laws and standards.

#### 3. Environmental Stewardship

By identifying sources of contamination and assessing remediation efforts, forensics supports environmental protection and sustainable mining practices.

#### 4. Fraud Prevention and Detection

Forensic techniques can uncover fraudulent activities, such as illegal mining operations and misreporting of resources, protecting assets and revenues.



### Conclusion

Mining forensics is an essential discipline within forensic science, providing critical insights into the causes and consequences of mining-related incidents. Through its methodologies, challenges, and applications, mining forensics enhances safety, compliance, and environmental stewardship in the mining industry. As technology and methodologies continue to advance, the role of mining forensics will become increasingly vital in addressing the complexities and risks associated with mining operations.

## About the Author



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# Forensic Word Sleuth

START

T S P M S A B T K S W A Y K C W E N I T  
Y N S A X Y G L C Z U R G V F U E R W R  
M X I O T U C I A T S C O X W O D W U A  
T S V R Y H T S O O R U L P C L C A A C  
G Q S K P S O P Q I Q T O X Q O R N M E  
U R Z W I R S L M C V S C I Q A C R Y E  
Q F D L T Y E E O E E V I D E N C E H V  
G O L A W H S G P G G A X J N O X L D I  
S A S N Y C B D N X Y O O B O Y L A N D  
B T S S E N T I W I I G T B I G I R T E  
Z V N N C H A I N O F C U S T O D Y A N  
E N E I A S C I S N E R O F A L Z T P C  
A N T H R O P O L O G Y S P G O S B H E  
A X L W T P S G I O K U R U I M E N O S  
S S H L D Q T G U D S R C I T O R H N I  
F G Z O S S S N O P N I E E S T O E O G  
Q F R G A Z J T E G Y S S U E N L U M F  
A B J C K H P C A T O M D V V E O F Y U  
C H L O Y U T S X X A H G Z N Q G B A N  
N R E T T A P S D O O L B I I N Y U R C

Anthropology  
BloodSpatter  
DNA  
Fingerprint  
LatentPrints  
Suspect  
TraceEvidence

Autopsy  
ChainofCustody  
Entomology  
Forensics  
Pathology  
Taphonomy  
Witness

Ballistics  
CrimeScene  
Evidence  
Investigation  
Serology  
Toxicology

# A JOURNEY INTO FORENSIC PSYCHOLOGY

## An interview with Dr. Vismitha Paliwal

*Dr. Vismitha Paliwal, an esteemed academic and practitioner in forensic psychology, began her journey with a profound interest in the complexities of the human mind. Initially inclined towards clinical and counseling psychology, Dr. Paliwal's path took a pivotal turn during her postgraduate studies. Her exposure to various psychological fields, coupled with interactions with legal professionals in her social circle, sparked a curiosity in forensic psychology. This field intrigued her with its potential to address psychological aspects within legal and criminal contexts.*

### **Can you tell us about your early career and your contributions to the field of domestic violence?**

My early career was marked by a deep engagement with victims of domestic violence, a subject that eventually led to the publication of my research as a book. Collaborating with legal experts, I explored the psychological, legal, and moral dimensions of such cases, advocating for the role of counseling in resolving family disputes outside the courtroom. My work underscored the importance of understanding psychological factors in legal settings and highlighted the need for specialized interventions in family courts.

### **Can you tell us about your early career and your contributions to the field of domestic violence?**

The foray into juvenile delinquency revealed the malleable nature of young minds and the potential for behavioral rehabilitation. Every research and practice focused on the roots of criminal behavior in children, aiming to redirect them towards constructive paths. My success in rehabilitating juvenile offenders underscored the importance of early intervention and the role in reshaping behavior.

### **Can you share insights from your work with more severe cases?**

My career also involved working with more severe cases, including murderers and fraudsters. These experiences taught me the significant challenges of engaging with individuals who may not acknowledge their guilt, which is a crucial barrier in the rehabilitation process. I emphasize the need for personalized therapeutic approaches, recognizing

that each individual requires a unique strategy to address their psychological needs and motivations.

### **What are some of the significant challenges you have faced in your work?**

A significant challenge in my work has been the continuity of care, with many clients not returning for follow-up sessions after their initial crises were resolved. My dedication often led me to personally ensure ongoing care, even visiting clients' homes to provide necessary support. This commitment highlights the ethical and practical challenges faced by forensic psychologists in ensuring long-term client engagement and support.



## **What practical advice do you have for aspiring forensic psychologists?**

My practical advice to aspiring forensic psychologists emphasizes the importance of staying informed about current research and trends. I encourage engaging with local legal and law enforcement communities to understand the specific psychological issues prevalent in different regions. This local engagement provides invaluable practical insights and helps build a contextual understanding of the cases psychologists may encounter. Additionally, forming strong connections within these communities can enhance collaboration and improve outcomes for both clients and the justice system.

## **Can you share a memorable case from your career and its impact?**

One of my memorable cases involved pre-operative counseling for a child who had to undergo multiple orthopedic surgeries. My empathetic approach and psychological support were instrumental in helping the child overcome his fears and anxieties, ultimately enabling him to pursue his dream of playing soccer. This case, though not directly related to forensic psychology, exemplifies the profound impact psychological intervention can have on individuals, particularly in overcoming trauma and adversity. It highlights the importance of psychological support in all areas of healthcare and its potential to transform lives.

## **Can you tell us about your recent work and any notable achievements?**

My recent study on the psychometric profiling of larceny offenders earned the Best Paper award at an international conference. The research focused on identifying the psychological factors driving individuals to repeatedly engage in petty crimes, such as pickpocketing, with the goal of developing rehabilitation strategies to prevent recidivism and help offenders reintegrate into society.

## **What are your views on the formal recognition of forensic psychology in India?**

I advocate for the professionalization and formal recognition of forensic psychology in India. Psychologists have historically struggled for recognition, and I see a parallel in the current efforts to define and regulate the field of forensic psychology. I envision a future where specialized licensing and accreditation systems are established, much like in other branches of medicine, to ensure the professional integrity and recognition of forensic psychologists. This would not only enhance the credibility of the field but also attract more professionals to specialize in forensic psychology.

## **What are your thoughts on the future of forensic psychology in India?**

I remain optimistic about the future of forensic psychology in India. I believe that increased focus from academic institutions and policymakers will lead to better guidelines and frameworks for the practice. My work continues to bridge the gap between psychological research and practical application, ensuring that forensic psychology plays a vital role in the criminal justice system and beyond. My career stands as a testament to the power of psychological insight in understanding and addressing the complexities of human behavior within the legal context.

### **About the Interviewee**

Dr. Paliwal holds a B.Sc. (2007), Certificate in Guidance (2009), M.Sc. in Psychology (2009), Ph.D. in Psychology (2012), and SLET in Psychology. With over 11 years of experience, Dr. Paliwal teaches Human Development, Military Psychology, and Behavioural Science. Her focus includes Clinical, Community, and Neuropsychology. She has 32 publications, 3 projects, and is affiliated with the APA and other major organizations. Her awards include the Best Paper Award (2015), Bharat Gaurav Award (2017), and Young Scientist Award.



*Interviewed by Ms. Sanjana T S  
Drafted by Ms V Deexitha*



# FROM SKIN CELLS TO COURTROOMS: THE JOURNEY OF TOUCH DNA IN FORENSICS

Author: Ms. Sneha K

Forensic Science uses scientific techniques or knowledge to examine evidence that might be used in court to investigate crimes. The need for quick and effective crime and crime detection methods is expanding in tandem with the alarming increase in global crime rates. There are situations when the investigators may be without any biological evidence, physical evidence, or other clear proof. It is common knowledge that DNA testing has been essential in connecting a suspect to a particular crime. When this happens, DNA traces from the suspect that were transferred to the objects at the crime scene can help with the investigation of the case. Touch DNA, also known as Contact Trace DNA, is retrieved from skin epithelial cells that are transferred to surfaces whenever a person makes contact with any surface.

The Locard's exchange concept states that whenever a suspect comes into contact with a crime scene, evidence is transferred from the scene to the suspect and vice versa. Each day, a person sheds a number of skin cells. As a result, when committing a crime, the offender may place a significant amount of cells on evidence such as a murder weapon, victim's clothing, a questioned document etc. If these materials are gathered and DNA taken, it might be possible to connect the criminal to the scene of the crime.

Thanks to modern technology, a criminal can be identified and apprehended just by picking something up or touching anything. The analysis of "touch" DNA samples is no longer the exception; rather, it has become standard practice in the field of the forensic DNA analyst. The number of touch DNA evidence items that have been sent to the lab for examination has increased significantly over the past few years, along with the number of academic articles that discuss touch DNA and DNA transfer (both primary and secondary).



The process of obtaining DNA profiles from skin cells that has been left behind on touch or in contact of skin with crime scene objects is known as "touch DNA" analysis. Searching for evidence that a suspect left behind during the commission of the crime is a useful rule to follow when analysing DNA from most crime scenes. There is a recommended sequence of collection for "best evidence". It is best to start by looking for blood. Second, by looking for objects like cigarettes, bottles, or gum that may have come into contact with saliva. Last but not the least, it is suggested to take into consideration "touch DNA" if blood and/or saliva contact items are not available. Touch DNA is the least favoured DNA source.

Touch DNA is the least favoured DNA source since it requires a person to touch something for a limited amount of time or touch it frequently in order to leave behind enough skin cells to produce a useful DNA profile. Since they are anticipated to have been worn by just one person and to have come into prolonged contact with the skin, hats, masks, and shirt collars are accepted as touch DNA sources. Touch DNA regularly fails to identify objects that have been hurled through windows, jewellery boxes, drawer handles, or padlocks because they have not had enough time to come into touch with the skin to leave behind sufficient skin cells. Furthermore, touch DNA is not appropriate for objects that are anticipated to have been used by many people (such as public door handles) since the ensuing combination profiles are useless.

Even though there are certain drawbacks, touch DNA analysis is still being used for personal identification when no other evidences are found. Forensic laboratories all over the world have been using different Touch DNA sampling procedures for more than a decade. Tens of thousands of skin cells are shed by humans every day, and these cells can be spread to surfaces that come into contact with our skin. Touch DNA testing might be able to connect the offender to the crime scene if the touched object is gathered as potential evidence.

A forensic investigator's first crucial step is to locate the target surfaces that may have traces of suspect DNA on them. Touch DNA must be sought out from all possible evidence, which varies depending on the type of crime. In order to identify touch DNA on target surfaces, non-destructive approaches including exposing surfaces to various light sources and fingerprinting methods can be used. Following the identification of possible evidence items that may contain contact DNA samples, samples are collected using a variety of techniques, including swabbing, cutting, scraping, tape lifting etc.



For the purpose of finding touch DNA on casework materials, a fluorescent dye that makes cellular material on surfaces visible offers a targeted sample approach. For the evaluation of relatively large goods, however, the current application of such dye is not practical. In order to put this strategy into practice, an effective dye application mechanism must be created. A spray system should ideally be created to enable quick, efficient dye application to vast surface areas without coming into contact with the item.

Right now, several fluorescent dyes have been developed and used to visualize touch DNA samples for easier analysis. Dyes with directly come in contact with the nucleus or the mitochondria of the cells are preferred since they provide even more accurate results. The ideal tool should be affordable, easily accessible, portable, and straightforward to use both at crime scenes and in evidence recovery labs.

It is safe to say that Touch DNA technology has great potential in forensics, having helped to solve many previously unsolved cases. However, before testing for Touch DNA, investigators must consider the potential value of DNA as evidence and take into account factors such as relationship between the victim and the suspect, as well as the possibility of “innocent transfer” of DNA. Furthermore, research is needed to give more validation to touch DNA analysis, considering the fact that it is a relatively newer field in the field of Forensic Science.

## About the Author



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# FUNDAMENTALS AND SCOPE OF FORENSIC PSYCHOLOGY IN INDIA

Author: Dr. Vismitha Paliwal

Forensic psychology is a field that bridges the gap between psychology and the justice system. It involves the application of psychological principles and methods to understand and address issues related to law and criminal behaviour. In India, forensic psychology is gaining prominence as an essential aspect of both criminal investigations and legal proceedings. This article delves into the fundamentals of forensic psychology and explores its scope within the Indian context.

Forensic psychology encompasses various domains including criminal behaviour analysis, victimology, the psychology of testimony, and rehabilitation of offenders. The primary objectives of forensic psychologists are to comprehend the psychological aspects of criminal behaviour, assess the mental state of individuals involved in legal cases, and provide expert testimony in courts.

Understanding why individuals commit crimes is a core aspect of forensic psychology. This involves studying the motives, personality traits, and environmental factors that contribute to criminal behaviour. Techniques such as criminal profiling are used to predict and identify potential offenders.

Victimology focuses on the psychological impact of crime on victims. Forensic psychologists work to understand the trauma experienced by victims, provide therapeutic support, and offer expert insights during trials to elucidate the psychological damage suffered.

Forensic psychologists evaluate the reliability and credibility of witness testimonies. They assess factors like memory, perception, and suggestibility that can influence the accuracy of testimonies.



Beyond understanding criminal behaviour, forensic psychology also involves the rehabilitation of offenders. Psychologists design and implement intervention programs aimed at reducing recidivism and aiding the reintegration of offenders into society.

In India, the scope of forensic psychology is expanding as the legal system increasingly recognizes the value of psychological expertise in addressing complex criminal cases. Several factors contribute to the growing importance and application of forensic psychology in the country. Recent legal reforms have highlighted the need for scientific approaches in criminal investigations and trials. The Indian legal system has started to incorporate psychological assessments to ensure fair and just outcomes. Forensic psychologists are called upon to provide expert testimony in cases involving mental health issues, competency evaluations, and criminal responsibility. Law enforcement agencies in India are adopting forensic psychological techniques to aid in criminal investigations. Criminal profiling, behavioural analysis, and psychological autopsies are used to understand the mind-set of offenders, which can be crucial in solving complex cases.



With the rising demand for forensic psychology, educational institutions in India are introducing specialized courses and training programs. Universities and colleges offer postgraduate degrees and diplomas in forensic psychology, equipping students with the knowledge and skills required to pursue careers in this field. Indian scholars and practitioners are contributing to the global body of knowledge through research on topics such as criminal behaviour patterns, victimology, and the effectiveness of rehabilitation programs.

Forensic psychologists also work closely with law enforcement agencies, including the police and the Central Bureau of Investigation (CBI), to provide insights that can enhance investigative processes. Their expertise is particularly valuable in cases involving serial crimes, sexual offenses, and juvenile delinquency. Specially in cases where mental health issues intersect with legal matters, forensic psychologists play a critical role. They conduct assessments to determine the mental state of defendants, the impact of mental illness on criminal behaviour, and the suitability of individuals to stand trial.

However, Forensic psychologists in India are still not included when it comes to contributing to policy-making processes. Their research and expert opinions inform policies related to criminal justice, mental health, and victim support services is not sought to a significant extent.

Advocacy efforts by forensic psychologists help in raising awareness about the psychological aspects of crime and the importance of mental health which is yet to be recognized by policy makers and more is still to come.

Hence, we may opine that Forensic psychology in India is evolving into a vital discipline that significantly contributes to the legal and criminal justice systems. By integrating psychological principles with legal processes, forensic psychologists provide invaluable insights that aid in the understanding, prevention, and resolution of criminal behavior. As the field continues to grow, it promises to enhance the effectiveness of the justice system and promote a more scientifically informed approach to addressing crime and its consequences in India.

## **About the Author**



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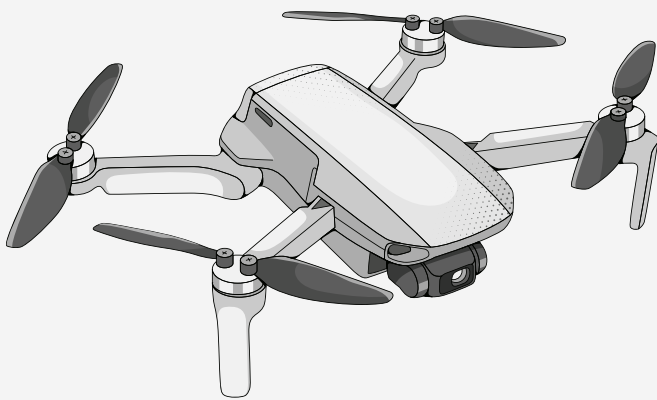
# DRONE FORENSICS: A COMPREHENSIVE ANALYSIS



Author: Vikram K. Hankare

## Introduction

The advent of unmanned aerial vehicles (UAVs), commonly known as drones, has revolutionized numerous sectors, from agriculture and entertainment to surveillance and delivery services. However, this technological advancement also poses significant security and privacy concerns. Drones can be used for malicious purposes such as espionage, smuggling, and unauthorized surveillance, making it imperative for law enforcement agencies to develop robust forensic capabilities to investigate and mitigate these threats.



Drone forensics is a specialized area within digital forensics that focuses on the extraction and analysis of data from drones and their associated components, such as remote controllers, onboard sensors, and storage devices. This article aims to provide a detailed overview of drone forensics, including the types of evidence that can be collected, the tools and techniques employed, and the legal and ethical considerations involved.

## Technological Background

To understand drone forensics, it is essential to comprehend the technological components and functionalities of drones. A typical drone system consists of several key elements:

1. **Airframe:** The physical structure of the drone, including the body, propellers, and landing gear.
2. **Flight Controller:** The onboard computer that controls the drone's flight dynamics and stability.
3. **Sensors:** Devices such as GPS, accelerometers, gyroscopes, and cameras that provide data for navigation and environmental awareness.
4. **Communication System:** The radio frequency (RF) modules that enable communication between the drone and the remote controller.
5. **Power System:** Batteries and power management components that supply energy to the drone.
6. **Storage Devices:** Memory cards and onboard storage used to record flight data and multimedia files.

These components generate and store various types of data that can be crucial for forensic investigations.

## Types of Data in Drone Forensics

Drone forensics involves the extraction and analysis of several types of data, including:

1. **Flight Logs:** Records of flight parameters such as altitude, speed, GPS coordinates, and timestamps.
2. **Multimedia Files:** Photos and videos captured by the drone's cameras.

3. **Telemetry Data:** Information transmitted between the drone and the remote controller, including control inputs and sensor readings.
4. **Configuration Files:** Settings and parameters related to the drone's operation and user preferences.
5. **Network Data:** Logs of communication between the drone and external devices, such as Wi-Fi or cellular networks.
6. **Firmware and Software:** The code and applications running on the drone and its peripherals.

### **Forensic Methodologies**

The process of drone forensics involves several key steps, including identification, collection, preservation, analysis, and presentation of evidence. These steps are analogous to those in traditional digital forensics but are tailored to the specific characteristics of drone technology.

#### **Identification**

The first step in a forensic investigation is to identify the presence of a drone and its associated components at a crime scene. This may involve visual inspection, witness statements, or the use of RF detection equipment to locate the drone and its controller.

#### **Collection**

Once identified, the drone and its components must be carefully collected to preserve the integrity of the evidence. This includes removing batteries to prevent accidental activation, securing storage devices, and documenting the scene with photographs and notes.

#### **Preservation**

To ensure that the evidence remains unaltered, it is crucial to follow proper preservation protocols. This may involve using Faraday bags to block wireless signals, creating forensic images of digital storage devices, and maintaining a chain of custody log.

### **Analysis**

The analysis phase involves extracting and interpreting data from the drone and its components. This requires specialized tools and software to decode flight logs, recover deleted files, and analyze multimedia content. Commonly used tools in drone forensics include:

1. **OpenDroneMap:** An open-source tool for processing aerial imagery and generating geospatial data.
2. **Autopsy:** A digital forensics platform that supports the analysis of various types of data, including multimedia and file systems.
3. **UAV Explorer:** A tool specifically designed for analyzing flight logs and telemetry data from drones.

### **Presentation**

The final step is to present the findings in a clear and concise manner, suitable for legal proceedings. This involves creating detailed reports, visualizations, and expert testimony to explain the evidence and its implications.

### **Case Studies**

To illustrate the practical applications of drone forensics, we will examine several case studies where drones were used in criminal activities and how forensic investigations helped resolve these cases.

**Case Study 1: Smuggling Contraband into Prisons** In many countries, drones have been used to smuggle contraband such as drugs, weapons, and mobile phones into prisons. Forensic investigators can analyze flight logs to determine the launch and landing locations, identify the operators, and trace the contraband's origin and destination.

**Case Study 2: Illegal Surveillance** Drones equipped with high-resolution cameras have been used for unauthorized surveillance

of private properties and sensitive installations. By examining the multimedia files and telemetry data, investigators can establish the duration and extent of the surveillance and identify the individuals responsible.

### Case Study 3: Wildlife Poaching

In regions where wildlife poaching is rampant, drones have been deployed for illegal hunting and tracking of endangered species. Forensic analysis of the drones' GPS data and camera footage can help track poachers' movements and gather evidence for prosecution.

### Legal and Ethical Considerations

The use of drones for both legitimate and illicit purposes raises several legal and ethical issues that must be addressed in forensic investigations.

#### Privacy Concerns

The ability of drones to capture detailed imagery and video raises significant privacy concerns. Investigators must ensure that their methods comply with legal standards for surveillance and evidence collection to avoid infringing on individuals' privacy rights.

#### Regulatory Compliance

Different countries have varying regulations governing drone operations, including restrictions on flight altitudes, no-fly zones, and licensing requirements. Forensic investigators must be familiar with these regulations to ensure that their actions are lawful and admissible in court.

#### Data Protection

The handling of digital evidence from drones involves sensitive personal and location data. It is essential to implement robust data protection measures to safeguard this information and prevent unauthorized access or disclosure.

### Challenges in Drone Forensics

Drone forensics presents several unique challenges that complicate the investigation process.

#### Rapid Technological Advancements

The rapid pace of technological advancements in drone technology means that forensic investigators must continuously update their skills and tools to keep up with new developments. This includes staying informed about new models, software updates, and emerging threats.

#### Data Overload

Drones can generate vast amounts of data during their operation, including high-resolution videos, detailed flight logs, and extensive telemetry data. Managing and analyzing this data can be time-consuming and require significant computational resources.

#### Anti-Forensic Techniques

Malicious actors may employ anti-forensic techniques to hinder investigations, such as encrypting data, deleting logs, or using jammers to disrupt communication signals.

Investigators must be prepared to counter these tactics and recover as much evidence as possible.

#### Future Directions

The field of drone forensics is still in its infancy, and several areas warrant further research and development.

#### Enhanced Analytical Tools

There is a need for more advanced analytical tools that can automate the extraction and analysis of drone data, reducing the manual effort required and improving the accuracy and efficiency of investigations.

#### Integration with Other Forensic Disciplines

Drone forensics should be integrated with other



forensic disciplines, such as digital forensics, cyber forensics, and geospatial analysis, to provide a comprehensive approach to investigations.



### Standardization and Best Practices

The development of standardized protocols and best practices for drone forensics will help ensure consistency and reliability in investigations. This includes guidelines for evidence collection, preservation, analysis, and reporting.

### Conclusion

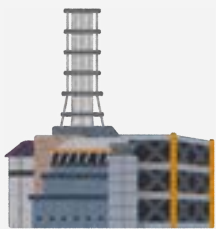
Drone forensics is a vital and rapidly evolving field that addresses the challenges posed by the increasing use of drones in criminal activities. By understanding the technological aspects, forensic methodologies, and legal implications, investigators can effectively collect and analyze evidence from drones to support law enforcement efforts. As technology continues to advance, ongoing research and development will be essential to keep pace with new threats and ensure that forensic practices remain robust and reliable.

## About the Author



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# NUCLEAR FORENSICS: THE SCIENCE BEHIND TRACING RADIOACTIVE FINGERPRINTS



Author: Harsha Chowdhury

## Introduction:

In a world where nuclear technology is constantly evolving and proliferating, advanced systems for tracking, tracing, and identifying radioactive materials are more important than ever. Nuclear forensics is a field that combines the precision of nuclear physics with the investigative capabilities of forensic science. This field has become an essential instrument in global efforts to combat nuclear terrorism, monitor non-proliferation treaties, and solve radioactive mysteries. But what precisely is nuclear forensics, and how does it operate?

## What is Nuclear Forensics?

Nuclear forensics is a scientific discipline that examines nuclear or radioactive materials to establish their origin, history, and intended purpose. It's similar to traditional forensics, but instead of fingerprints and DNA, experts investigate atomic structures and isotopic compositions. This field has arisen as a critical component of nuclear security, helping to deter and investigate illicit nuclear material trafficking.

Dr. Elena Rodriguez, a leading nuclear forensics expert at the International Atomic Energy Agency (IAEA), explains that "every piece of nuclear material has a unique signature - a combination of chemical, physical, and isotopic characteristics that can tell us where it came from, how it was made, and sometimes even who handled it." "Our job is to decode these atomic fingerprints."

## The Tools used in nuclear forensics:

Nuclear forensics employs a wide array of

sophisticated analytical techniques, each providing a piece of the puzzle:

**1. Mass Spectrometry:** This technique separates atoms based on their mass, allowing scientists to identify and quantify different isotopes in a sample. It's particularly useful for determining the enrichment level of uranium or the isotopic composition of plutonium.

**2. Gamma-Ray Spectroscopy:** By measuring the energy of gamma rays emitted by a radioactive sample, scientists can identify specific radionuclides present.

**3. Electron Microscopy:** This allows for the examination of a material's physical structure at the microscopic level, revealing clues about its production process.

**4. X-ray Fluorescence:** This non-destructive technique provides information about the elemental composition of a sample.

**5. Radiochemical Separation:** Used to isolate specific elements or isotopes for more detailed analysis.

**6. Alpha Spectroscopy:** This method measures the energy of alpha particles emitted by a sample, helping to identify certain radioactive isotopes.

Dr. Yuki Tanaka, a researcher at Japan's Nuclear Material Control Center, adds, "We're constantly developing new techniques and refining existing ones. The goal is to extract as much information as possible from even the tiniest samples."

## The Process of Nuclear Forensics:

The nuclear forensics process typically follows these steps:

**1. Sample Collection:** Proper collection and preservation of evidence is crucial. This might involve gathering dust samples from a smuggler's warehouse or carefully extracting material from a seized nuclear device.

**2. Non-Destructive Analysis:** Initial examinations are performed using techniques that don't alter the sample, such as gamma-ray spectroscopy or X-ray fluorescence.

**3. Destructive Analysis:** More detailed examinations may require breaking down the sample, using techniques like mass spectrometry or radiochemical separation.

**4. Data Interpretation:** Scientists analyze the results, often comparing them to databases of known nuclear materials.

**5. Attribution:** Based on the analysis, experts attempt to determine the origin and history of the material.

## Key Aspects of Nuclear Forensics:

### 1. Material Analysis:

Nuclear forensics aims to study nuclear materials in detail. This includes analyzing their chemical, physical, and isotopic compositions. Each of these qualities can reveal important information about a sample origin or history. Dr. Rodriguez explains, "The chemical composition can tell us about the manufacturing process. The physical structure may provide information about how the substance was stored or moved. And the isotopic composition is like a fingerprint; it can be quite unique to a single source or manufacturing facility."

### 2. Trace Element Detection:

One of the most effective techniques in nuclear forensics is the capacity to detect and analyze trace elements, which are minute amounts of compounds found in a sample.

These trace components can reveal important information about where and how a substance was manufactured.

"It's like finding a grain of sand from a specific beach in a bucket of sand from all over the world," according to Dr. Tanaka. "These trace elements may be contaminants added during the manufacturing process or purposeful additions. Either way, they can be extremely enlightening."

### 3. Age Dating:

Determining the age of nuclear materials is another critical aspect of nuclear forensics. This involves measuring the ratios of radioactive parent isotopes to their decay products.

Professor Marcus Whitfield, a nuclear chemist at the University of Cambridge, explains, "Radioactive decay occurs at a known rate. By measuring the ratio of a radioactive isotope to its decay products, we can calculate how long ago the material was last purified. This 'clock' starts ticking as soon as the material is separated from its ore or reprocessed, giving us valuable information about its history."



#### 4. Signature Matching:

Once scientists have gathered data about a sample, they compare it to databases of known nuclear materials. This process, known as signature matching, can help identify potential sources or production facilities.

"It's a bit like matching a bullet to a specific gun," says Dr. Rodriguez. "We compare the characteristics of our sample to known signatures from different facilities around the world. While it's not always possible to pinpoint an exact source, we can often narrow it down significantly."

#### 5. Interdisciplinary Approach:

Nuclear forensics is inherently interdisciplinary, combining elements of nuclear physics, radiochemistry, materials science, and traditional forensic techniques.

This diverse approach allows for a comprehensive analysis of nuclear materials.

Dr. Tanaka notes, "We often work in teams that include physicists, chemists, materials scientists, and even data analysts. Each brings a unique perspective and set of skills to the table."

### **Applications of Nuclear Forensics:**

The field of nuclear forensics has several crucial applications in ensuring global security:

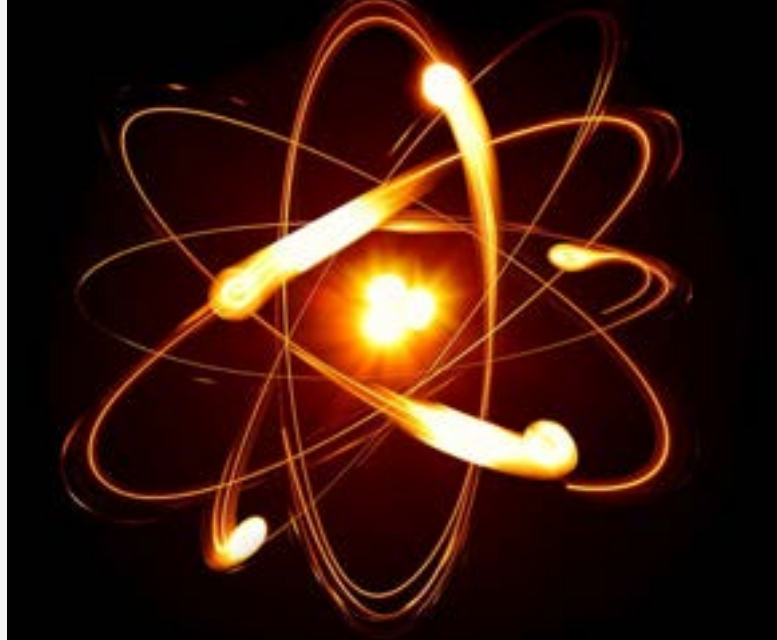
#### **1. Investigating Illicit Trafficking:**

One of the primary applications of nuclear forensics is in combating the illicit trafficking of nuclear materials. When authorities intercept smuggled radioactive substances, nuclear forensics can help trace the material back to its source.

"This not only helps in prosecuting the smugglers but also in identifying and addressing security vulnerabilities in the nuclear fuel cycle," explains Dr. Rodriguez.

#### **2. Attributing Radioactive Contamination:**

In cases of environmental contamination with radioactive materials, nuclear forensics can help identify the source. This is crucial for both cleanup efforts and holding responsible parties accountable



Professor Whitfield recalls a case from 2006: "When polonium-210 was used to poison Alexander Litvinenko in London, nuclear forensic techniques were crucial in tracing the material and building the case against the perpetrators."

#### **3. Verifying Treaty Compliance:**

Nuclear forensics plays a vital role in verifying compliance with international nuclear treaties. By analyzing environmental samples or materials declared by states, experts can help ensure that countries are adhering to their non-proliferation commitments.

#### **4. Nuclear Terrorism Prevention:**

Perhaps the most critical application of nuclear forensics is in preventing and investigating potential acts of nuclear terrorism. The ability to trace nuclear materials serves as a deterrent and provides crucial intelligence in the event of a threat.

"The very existence of these capabilities acts as a deterrent," says Dr. Rodriguez. "Potential bad actors know that if they attempt to acquire or use nuclear materials, we have ways to trace it back to them."

### **Challenges and Future Directions:**

Despite its power, nuclear forensics faces several challenges:

**1. Speed of Analysis:** In crisis situations, there's often pressure to produce results quickly. Researchers are continuously working to develop faster analytical techniques without sacrificing accuracy.

**2. Sample Size:** Sometimes, only minute quantities of material are available for analysis. Improving the sensitivity of detection methods is an ongoing area of research.

**3. Database Maintenance:** Keeping reference databases up-to-date and comprehensive is a constant challenge, requiring international cooperation and regular contributions from nuclear facilities worldwide.

**4. Emerging Technologies:** As new nuclear technologies develop, forensics techniques must evolve to keep pace. This includes dealing with novel nuclear fuels, advanced reactors, and new enrichment technologies.

### **Future Scope:**

**1. Artificial Intelligence:** Machine learning algorithms are being developed to assist in data interpretation and signature matching, potentially speeding up the analysis process.

**2. Portable Technologies:** Researchers are working on miniaturizing some analytical techniques, allowing for more on-site analysis in the field.

**3. International Cooperation:** Efforts are underway to strengthen international networks for sharing data and expertise in nuclear forensics.

**4. Advanced Modeling:** Improved computer models are being developed to better understand how nuclear materials change over time and under different conditions, enhancing our ability to interpret forensic data.

### **Conclusion:**

Nuclear forensics stands as a testament to human ingenuity in the face of one of the most serious security challenges of our time. By decoding the atomic and subatomic secrets hidden within nuclear materials, scientists are providing crucial tools for maintaining global security and the peaceful use of nuclear technology.

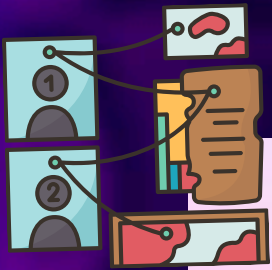
As Dr. Rodriguez reflects, "Every atom tells a story. Our job is to listen to those stories and use them to make the world a safer place." In a world where nuclear technology continues to evolve, the field of nuclear forensics remains a critical safeguard, ensuring that the power of the atom remains a force for good rather than a threat to global peace and security.

As we look to the future, the continued development and application of nuclear forensics will play a vital role in shaping international nuclear policy, enhancing global security, and fostering the responsible use of nuclear technology for the benefit of all humanity.

## **About the Author**



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# Forensic Puzzle Quest



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# AARTI'S COMPREHENSIVE JOURNEY IN FORENSIC SCIENCE



An interview with Ms. Aarti Jyotiram Kamble

*Aarti's journey into the world of forensic science began at the esteemed International Institute of Forensic Science under Mumbai University, where she pursued her bachelor's and master's degrees, graduating in 2020. Her early career saw her joining International Forensic Sciences Private Limited, where she spent four fruitful years, ultimately rising to the position of Head of the Department. However, her ambitions and passion for forensic science led her to venture out independently, establishing her own firm, National Forensic Consortium - India.*

## **Can you tell us about your initial career aspirations and how you ended up in forensic science?**

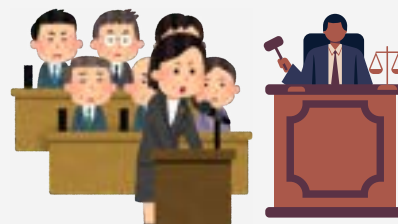
Initially, I did not envision a career in forensic science. My original aspiration was to enter the medical field. However, lower-than-expected marks in entrance exams shifted my path. A family doctor suggested I consider forensic science, a field I had not previously contemplated. During my academic years, I developed a profound interest in forensic science and recognized its critical role in the criminal justice system. The prospect of helping victims and playing a part in delivering justice became a compelling motivator, transforming what was initially a fallback option into a lifelong passion.

## **How has the field of forensic science evolved throughout your career?**

When I first entered forensic science, opportunities were limited, and even educators advised against pursuing the profession. However, the field has evolved significantly. New roles, such as forensic scientific assistants, have emerged, and recent legislative developments, including a new bill passed on July 1st, have expanded opportunities for graduates. The establishment of the National Forensic Science University and various private colleges has further broadened the scope, making forensic science a more viable and rewarding career choice.

## **Can you describe a defining moment in your career?**

One of the most defining moments in my career was serving as an expert witness in the Bombay High Court. Despite my extensive experience, this case was particularly challenging due to the intense scrutiny and the large number of questions I faced. Over three consecutive days, from 11 a.m. to 5 p.m., I answered 179 questions—a significant contrast to the typically brief questioning faced by government experts. This experience highlighted the biases and challenges encountered by private experts. Nevertheless, my testimony played a crucial role in the case's judgment, marking a major achievement and a pivotal moment in my career.



## **Can you describe a defining moment in your career?**

When I first entered forensic science, opportunities were limited, and even educators advised against pursuing the profession. However, the field has evolved significantly. New roles, such as forensic scientific assistants, have emerged, and recent legislative developments, including a new bill passed on July 1st, have expanded opportunities for graduates. The establishment of the National Forensic Science University and various private colleges has further broadened the scope, making forensic science a more viable and rewarding career choice.



### **Can you tell us about the types of cases your laboratory handles and some notable examples?**

My laboratory handles diverse cases like document examination, signature verification, and cybercrime investigations using both traditional techniques and advanced technologies. A notable case involved a large-scale gold fraud worth 40 lakhs, demonstrating the complexity of our work. We prioritize cases based on urgency and client needs, with a team of seven experts specializing in various areas. This structured approach, along with clear deadlines and assignments, helps us manage a high volume of work efficiently.

### **How do you stay updated in the field of forensic science, and how has your background influenced your focus?**

Staying updated with the latest developments in forensic science is crucial for me. I regularly attend conferences and publish research papers, especially on topics like cyber investigations and document examination. Although my academic background is in forensic toxicology, limited opportunities in the private sector for this specialization led me to focus on areas where I could make a significant impact.

### **What motivates you in your work as a forensic scientist?**

The satisfaction of helping clients achieve justice is a significant motivator for me. I find great fulfillment in knowing that my work can bring justice to victims and make a meaningful impact on their lives. This drive goes beyond professional success, reflecting my deep commitment to the ethical and moral responsibilities of my role.

### **What advice do you have for those aspiring to enter forensic science?**

I advise aspiring forensic scientists to carefully consider the realities of the field. Unlike the often-glamorized portrayals in media, real-world forensic science demands genuine passion and dedication. This career path may not offer immediate financial rewards, but for those truly committed, it can be highly rewarding in other ways.

### **How do you balance your professional and personal life?**

Balancing professional and personal life can be challenging, but I manage with the support of my family. Being unmarried allows me to focus more on my work, and my family helps with day-to-day tasks, enabling me to dedicate more time to my profession. However, I acknowledge that this balance may shift in the future, especially after marriage.

### **What are your future goals for your company?**

My goal is to expand National Forensic Consortium across India and make it a household name in forensic services, known for its quality and expertise. This vision drives my current efforts and future plans.

### **How would you summarize your journey in forensic science?**

My journey in forensic science is marked by determination, passion, and a deep commitment to justice. My experiences highlight the importance of perseverance, continuous learning, and ethical integrity in this challenging yet rewarding field.

#### **About the Interviewee**

An experienced and court-qualified forensic expert, she has handled over 1,000 legal cases and provided testimony in various courts, including the Bombay High Court. She works as a forensic consultant and advisor in civil and criminal cases across India. Initially a senior forensic expert with reputed firms,



Her work covers government, defense, and corporate sectors. Renowned for her dedication to quality, she also speaks on forensic case management, investigation, expert witness procedures, and advanced technologies. Currently she is the Director at National Forensic Consortium, India.

*Interviewed by Ms. Sanskriti Verma  
Drafted by Ms V Deexitha*

# CYBERSECURITY REGULATION IN INDIA

Author: P Ravi Kumar

The word digitalization became most popular to all and global dependency on Artificial Intelligence is more in the recent past. Initially, internet was developed as information sharing tool. The manual intervention was minimised and replaced with computers in all private and government offices and the time passes by it became more transactional with e-business, e-commerce, e-governance, and e-procurement etc. As the number of internet users are increased, and the need for cyber laws are also increased. As the world witnessed the fastest growth in the information technology and transactions in electronic platform in recent past. The world also affected by cyber threats and cybercrimes. Majority of the people are affected by cybercrimes, such as online banking frauds, credit card frauds, virus attacks, phishing attacks, online share trading frauds, email hijack, hacking, pornography etc are becoming common, and it creates the necessity of enacting the cyber laws. Almost all public and private companies extensively depend upon their computer networks and keep their valuable data in electronic form. Government forms including Income Tax returns, company laws form etc. are now filed in electronic form. Consumers are increasingly using credit/debit cards for shopping. Most people are using email, phones, and SMS messages for communication. Even in non-cyber crime cases, important evidence is found in computers/cell phones, for instance, in the cases of murder, divorce, kidnapping, abduction, tax evasion, organised crime, terrorist operations, counterfeit currency etc.

## The First Cyber Crime in India:

"Yahoo Vs Akash Arora" this case occurred in 1999. Popularly known as Yahoo.com case. In this case the defendant Akash Arora was accused of using of domain name "yahooindia.com"

The journey of IT enactments in India:

We have enacted The Information Technology Act, 2000 and framed few rules time to time to curb the cybercrimes in India. let us discuss in brief about the enactments and rules.

## A. The information Technology Act, 2000

India's first ever landmark cybersecurity law was the Information Technology Act, 2000 which come in to force on October 17, 2000. The main purpose of the Act to provide legal recognition to electronic commerce and to facilitate filing of electronic records with the Government. The IT Act of 2000 was enacted by the parliament of India and administered by the Indian Computer Emergency Responses Team (CERT-In) to guide Indian cybersecurity legislation, institute data protection policies, and govern cybercrime. Hence, the need of new enactments to give legal sanction or validity to activities in the cyberspace. For instance, to make email id as legal right or legal validity in our country and sanction to mail.





Different kinds of Offences and punishments in I T Act, 2000 (Chapter XI)

1. Tampering with computer source documents: Whoever intentionally destroys, alters, conceals, by using computer source or network called Tampering with computer source documents and it is punishable offence with imprisonment up to 3 years, or with fine which may extend up to ₹ 2 lakhs or with both. (Section 65)

2. Hacking with a computer system: Whoever access the system without authorization or unauthorized access to computer system with guilty intention or steal the information is called hacking and it is a punishable offense with imprisonment up to 3 years, or with a fine which may extend up to ₹ 2 lakhs, or with both. (Section 66)

3. Publishing of information that is obscene in electronic form: Whoever publishes or transmits or causes to be published in the electronic and shall be punished on first conviction with imprisonment of either description for a term. It is a punishable offense with imprisonment up to 5 years and with a fine which may extend to ₹ 1 lakh and in the event of a subsequent or second conviction punishable with imprisonment of either description for a term which may extend to 10 years and with fine which may extend to ₹ 2 lakhs.

4. Breach of confidentiality: Imposition of penalty on breach of confidentiality and privacy and shall be punished with imprisonment for a term which may extend to 2 years, or with fine which may extend to ₹1 lakh, or with both. (Section 72)

5. Offences committed outside India: Offences committed outside India are also punishable in this Act which involves a computer, computer system or computer network located in India. (Section 75)

6. Other Provisions: Power to investigate offences: Notwithstanding anything contained in the Code of Criminal Procedure, 1973, vested with the police officer not below the rank of DSP shall investigate any offence under this I T Act, 2000 (Section 78).

7. Punishable in The Indian Penal Code, 1860: Capturing of any such image must be consensual but its dissemination is non consensual is punishable in section 354C. Circulation of any obscene object is punishable in section 292.

B. Information Technology (Amendment) Act 2008. The Information Technology (Amendment) Act 2008 was passed in October 2008 and came in to affect the following years as substantial addition to the IT Act of 2000.

### **The IT Amendment Act 2008, includes the following responsibilities:**

Upgrade forensics and cybersecurity measures and preventing unlawful or unauthorized use of a monitors. Securing e-payments and e-transactions. To establish a legal framework for digital signature, recognizing, and regulating intermediaries. Violation of the Act may impose penalties and imprisonment up to 3 years and while penalties for more serious offences and cybercrimes may reach imprisonment of up to 10 years.

C. Information Technology Rules, 2011 As per I T Rules, 2011 other sectors like Banking, Insurance, Telecom, and health care, also include data privacy provisions as part of their as part of their separate statutes.

D. In 2013, the Department of Electronics and Information Technology released the National Cyber Security Policy 2013 as a security framework for public and private organizations to better protect themselves security framework for public and private organizations to better protect themselves from cyber-attacks.

### **Main Goals of NCSP 2013:**

a) Creating a resilient and safe Cyberspace for individuals, organizations, and the government.

b) Monitoring, safeguarding cyber infrastructure and information, reducing vulnerabilities, and strengthening defences against cyber-attacks.

c) Creating framework, capabilities, and vulnerability management strategies for minimizing, faster prevention, or responding to cyber incidents and cyber threats.

d) Encourages organizations to develop cybersecurity policies that align with strategic goals, business workflows, and general best practices.

e) Simultaneously create institutional structures, people, processes, technology, and cooperation to minimize the damage caused by cybercrime

f) National Cyber Security Strategy, 2020: On February 25th, 2021, the Ministry of Electronics and Information Technology introduced the Information Technology (Guidelines for intermediaries and Digital media Ethics Code) Rules, 2021, as a replacement for IT Rules, 2011. This amendment aiming to allow ordinary users of digital platforms to seek compensation for their grievances.

g) Important Amendments to Major Acts with reference to IT Act, 2000 After enacting the I T Act, 2000, the amendments done to Indian Penal Code,1860 the word "Electronic record" substituted to the word "Records". Necessary amendments done to The Indian Evidence Act, 1872 the words "Digital Signature and electronic records" substituted to the words "records and signatures". Necessary amendments done to The Banker's Books of Evidence Act 1891 the following clause shall be substituted, namely: "bankers' books" include ledgers, daybooks, cashbooks, account-books, and all other books used in the ordinary business of a bank whether kept in the written form or as printouts of data stored in a floppy, disc, tape, or any other form of electro-magnetic data storage device.



h) Precautions to be taken to curb the cybercrimes:

1. Updated anti-virus software to be installed in the system to protect from malware and other online threats.
2. Log off or lock computer when the computer is not in use.

3. Go offline when you do not need internet.
4. Use PIN or Passcode to log in computer system, mobile or tab.
5. Don't share sensitive information like PIN, date of birth, Adhaar or PAN number with unauthorized persons or companies.
6. Don't click on suspicious links in email or WhatsApp.
7. Don't open unknown or suspicious mails.
8. Don't install suspicious software or apps in system or mobile.
9. Don't compromise the password credentials.

### Conclusion:

It is not possible to eradicate the cybercrime from the society, but we can control the crimes with bit awareness and with certain precautions. We must depend on information technology. Steganography, trojan horse, scavenging (AND EVEN Dos or DDOs) are all technologies and per se not crimes, but falling into the wrong hands with a guilty intent who are out to exploit them or misuse them, they come into the fold of cyber-crime and become punishable offences. We must connect the globe with internet, but with certain precautions we can curb the cybercrimes. We should be vigilant and report the crimes time to time to the competent authority and create wide awareness among the public to control the cybercrimes



## About the Author



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 Felicitated by International Human Rights Commission as a Best Banker, Lifetime Achievement Award by Maharashtra Patrakar Sangh.

# REVOLUTIONIZING INDIAN LAW: INTRODUCTION TO BNS, BNSS AND BSA 2023

Author: Anuja Gaikhe



The Union Government of India nominated three bills on 11th August 2023 to remodel the Criminal Justice system. The three Bills were: the Bharatiya Nyaya Sanhita Bill, 2023 (BNS), the Bharatiya Nagarik Suraksha Sanhita Bill, 2023 (BNSS), and the Bharatiya Sakshya Bill, 2023 (BSB), replacing the Indian Penal Code, 1860 (IPC), the Code of Criminal Procedure, 1973 (CrPC), and the Indian Evidence Act, 1872 respectively.

Subsequently, the three Bills were referred to the Parliamentary Standing Committee on Home Affairs for review and recommendations. After three months of debate, the committee headed by Bharatiya Janata Party's member of Parliament Brijlal released three reports on the BNS, the BNSS and the BSB recommending changes, along with dissent notes by various panel members.

One of the major dissents of the opposition members of the committee was related to the naming of the three Bills in Hindi. They alleged that the vernacular title of the Bills violated Article 348 (language to be used in the Supreme Court and in the high courts and for Acts, Bills, etc.) of the Indian Constitution which states that the official language for the courts and Bills would be English. However, the parliamentary committee approved the Hindi titles of the three Bills.

According to the recommendations, the three Bills were withdrawn from the Parliament on December 12. Soon after, revised versions of the three Bills were introduced. The revised Bills are now referred to as the Bharatiya Nyaya (Second) Sanhita Bill, 2023 (BNS II), the Bharatiya Nagarik Suraksha (Second) Sanhita Bill, 2023 (BNSS II), and the Bharatiya Sakshya (Second) Bill, 2023 (BSB II). These bills took effect from 1st July 2024.

Ever since India gained its independence from colonial rule, the three criminal laws have seen revisions time and again. However, this time, these criminal laws needed serious changes. Amit Shah, the Union Home Minister expressed that the new sanhitas demonstrated the laws framed by Indians for Indians. It is interesting to note that as per some legal experts, while the new laws will be bringing important changes, they actually don't "overhaul" the ones already existing.

The new laws aim to **replace colonial-era punishments** with a justice-focused approach, integrating **technological advancements** in police investigations and court procedures.

## **BHARATIYA NYAYA SANHITA (BNS) 2023**

Indian Penal Code 1860 is replaced by Bharatiya Nyaya Sanhita comprising of 20 chapters and 358 sections compared to 23 chapters and 511 sections in IPC. Many of the old redundant offences have been removed and some new offences have been introduced. Further, definitions scattered from section 6 to section 52 of IPC have also been brought under two sections viz. Section 2 on 'definitions' and Section 3 on 'general explanations' under Chapter I of BNS.

Offences against women and children have been organized together in Chapter V from sections 63 to 99. Rape is defined under Section 63 BNS. Sexual Intercourse by employing deceitful means is a new offence introduced in Section 69 of the BNS. However, adultery has been removed as an offence. Sections 73 to 78 describe Sexual assault, Sexual harassment, Voyeurism, stalking and related offences. The BNS has raised the age of sexual consent for married women from 15 to 18 years. Section 377 IPC dealing with Unnatural Sexual offences has not been retained

Offences against children also includes **Hiring, employing or engaging a child to commit a crime** as a new offence in section 95 BNS. BNS also includes Procurement of a child for sexual exploitation as a new offence. The word 'minor girl' in similar laws in IPC has been replaced by a gender-neutral term 'child' in BNS.

**Offences affecting the Human Body** includes offences affecting life, hurt, assault, kidnapping and other offences from Section 98 to 144 in Chapter VI of BNS. Murder is defined under section 99 of BNS. The BNS also introduces new offences, encompassing organised crime, terrorism, petty organized crime, mob lynching and group-based murder or grievous hurt on specific grounds.

Punishments have been rationalized for various offences. The terms of imprisonment for 33 offences have been enhanced and mandatory minimum punishment introduced in 23 offences. As per Section 103 of the BNS, whoever commits murder shall be punished with death or imprisonment for life which means imprisonment for the remainder of a person's natural life and shall also be liable to fine. Fines were very low in IPC from Rs. 10 to Rs.1000 which has been increased in 83 offences to 1000/-, 2500/-, 5000/-,10,000/- etc. The BNS has introduced community service as a form of punishment for six offences but the BNS does not offer any explanation or clarification of what constitutes 'community service'.

Other significant changes have been made in BNS where new offences have been included. Certain words have been replaced such as 'unsound mind' with 'mental illness' and including the definition of 'transgender'.

The BNS represents a significant step forward in reforming the criminal justice system of India. There have been significant changes following the requirements for today's perspective. However, it is observed to lack clear explanations for certain aspects and other minor loopholes. Despite its progressive features, the success of BNS will be determined by successful implementation and ongoing evaluation to ensure that it satisfies society's changing demands.

Aside from training and enlightenment of law enforcement agencies, judges, and legal practitioners, enough resources and infrastructure are required to implement the new legal framework.



## **BHARATIYA NAGARIK SURAKSHA SANHITA (BNSS) 2023**

The Bharatiya Nagarik Suraksha Sanhita, 2023 (BNSS) bill, aimed at replacing the Code of Criminal Procedure, 1973 (CrPC), was introduced in the Lok Sabha on August 11, 2023. It consists of 39 chapters and 531 sections. Despite its intent to shed colonial legacies, BNSS retains much of the CrPC's provisions.

A notable change is the introduction of electronic communication for trials, inquiries, and other legal proceedings, utilizing 'electronic communication' or 'audio-video electronic' means. In Section 2, the BNSS defines 'Audio-Video Electronic' as using any communication device for video conferencing, recording identification, search and seizure processes, and evidence transmission. 'Electronic Communication' is defined as the transmission of written, verbal, pictorial information, or video content via electronic devices like phones, computers, and cameras.

Specific changes in BNSS include the ability to record the identification of arrested individuals, issue summons in encrypted electronic forms, and read charges to accused individuals through electronic means. Search and seizure processes can now be recorded using audio-video devices, preferably cell phones, and conditional nuisance removal orders can be notified electronically.

In cognizable cases, police officers will now record information electronically, and statements from individuals familiar with case facts will be recorded via audio-video means. Police must inform victims or informants of the progress of the investigation within 90 days using electronic communication.

Documents like police reports, FIRs, and confessions can be served to the accused and victims electronically, and searches conducted by police officers must be recorded by audio-video means and forwarded to the magistrate. The jurisdiction for offences involving letters and electronic communication is now extended to any court where such communications were sent or received. Evidence for prosecution can be recorded using audio-video means.

Section 176 BNSS mandates forensic teams to visit crime scenes and collect samples, recording the entire procedure via videography for crimes punishable by over seven years. Unlike the CrPC, BNSS allows magistrates to obtain specimens of signatures or handwriting from individuals without arrest, with reasons documented in writing and expands this to include finger impressions and voice samples. The integration of electronic communication and audio-visual means in judicial processes aligns with the Digital India initiative, promising to enhance the justice system's efficiency and modernization.

### **BHARATIYA SAKSHYA ADHINIYAM (BSA) 2023**

The Bharatiya Sakshya Adhinyam, 2023 aims to replace the Indian Evidence Act, 1872, which has long been the primary legislation concerning law related to evidence in all proceedings before the Court. The BSA 2023 consists of 11 Chapters and 170 sections. The BSA aims to simplify and streamline how evidence is presented and interpreted in courts, aligning with contemporary technological advancements.

Expert opinions on the areas stated in Section 45 of the IEA have become increasingly significant over time as a result of the advancement of modern sciences and their deep integration with the entire process of dispensing justice. Even while expert testimony is not regarded as conclusive proof in and of itself, it is important in proceedings and supports the Court in reaching conclusions, assuming that they are consistent with other direct evidence. The BSA defines Expert opinion under Section 39 but adds the phrase "or any other field" to emphasize its significance.

The BSA, 2023 introduces several critical updates to ensure a more efficient and transparent judicial process. Among the notable changes is the inclusion of electronic and digital records within the definition of documents, reflecting the increasing reliance on digital communications. The definition of 'document' in section 2(d) BSA has been expanded including electronic and digital records, expansion of means of recording information and ways information can be otherwise recorded. This update expands the scope of evidence to include statements given electronically and digital records, addressing the contemporary reality of information storage and communication.

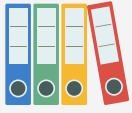
Additionally, the BSA refines the provisions related to confessions, broadening the factors that affect their admissibility, such as explicitly including "coercion" alongside inducement, threat, or promise. It also consolidates multiple sections dealing with confessions into a single, streamlined provision, enhancing clarity and comprehensiveness.

Other significant changes include the expansion of the definition of secondary evidence to encompass oral and written admissions and the testimony of experts skilled in examining complex documents. This broadens the types of admissible evidence, accommodating the diverse nature of modern documentation.

## **About the Author**



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# EMERGING TECHNOLOGIES IN DOCUMENT ANALYSIS



Author: Pooja Tamang



The field of questioned document examination is experiencing a technological revolution, with emerging technologies offering new possibilities for analysing and authenticating documents. This article explores some of the most promising advancements in document analysis, highlighting their potential to transform forensic practices.

## 3D Imaging in Document Examination:

Three-dimensional imaging techniques are providing document examiners with unprecedented levels of detail. Confocal microscopy, for instance, allows for the examination of paper topography and ink distribution at a microscopic level. This technology has proven particularly useful in detecting subtle alterations and erasures that might be invisible to the naked eye or traditional imaging methods. Additionally, 3D scanners are being employed to create highly detailed digital replicas of documents, enabling non-destructive analysis and preservation of fragile or historically significant items.



## Hyperspectral Imaging:

Hyperspectral imaging is emerging as a powerful tool for revealing hidden information in documents. This technology captures and analyses a wide range of electromagnetic wavelengths, far beyond what is visible to the human eye. Researchers have successfully used hyperspectral imaging to uncover obliterated text, detect forged signatures, and differentiate between inks that appear identical under normal light. The non-destructive nature of this technique makes it particularly valuable for examining historical documents and artworks.

## Artificial Intelligence in Document Analysis:

The integration of artificial intelligence (AI) and machine learning into document examination is rapidly advancing the field. AI algorithms are being developed to automate various aspects of document analysis, from handwriting comparison to ink dating. For example, deep learning models have shown promising results in writer identification, achieving accuracy rates that rival those of human experts. AI is also being applied to the detection of digitally manipulated documents, with neural networks trained to identify subtle inconsistencies that might indicate tampering.

## Quantum Dots for Security Features:

Quantum dots, nanoscale semiconductor particles with unique optical properties, are emerging as a novel tool for document security. When incorporated into inks or paper, these particles can create highly specific and difficult-to-replicate spectral signatures. Researchers have demonstrated the potential of quantum dots in creating advanced anti-counterfeiting features for passports, banknotes, and other sensitive documents. The use of quantum dots offers a level of security that surpasses many traditional methods, as their optical properties can be precisely tuned and are extremely difficult to reproduce without specialized knowledge and equipment.



## Chemical Imaging Techniques:

Advancements in chemical imaging are providing new insights into document composition and age. Techniques such as Raman spectroscopy and Fourier-transform infrared spectroscopy (FTIR) allow for the non-destructive chemical analysis of inks and paper.

These methods can reveal the chemical composition of writing materials, aiding in the differentiation of inks and the detection of alterations. Moreover, recent research has shown promise in using chemical imaging for more accurate document dating, by analysing the degradation of certain compounds over time.

### **Portable and Rapid Analysis Devices:**

The development of portable and rapid analysis devices is transforming on-site document examination. Handheld spectroscopic devices, for instance, allow forensic experts to conduct preliminary analyses at crime scenes or in the field. These devices can quickly identify ink types, detect inconsistencies, and provide real-time data to investigators. Similarly, portable digital microscopes with advanced imaging capabilities are enabling detailed examinations outside of traditional laboratory settings, increasing the efficiency and speed of forensic investigations.

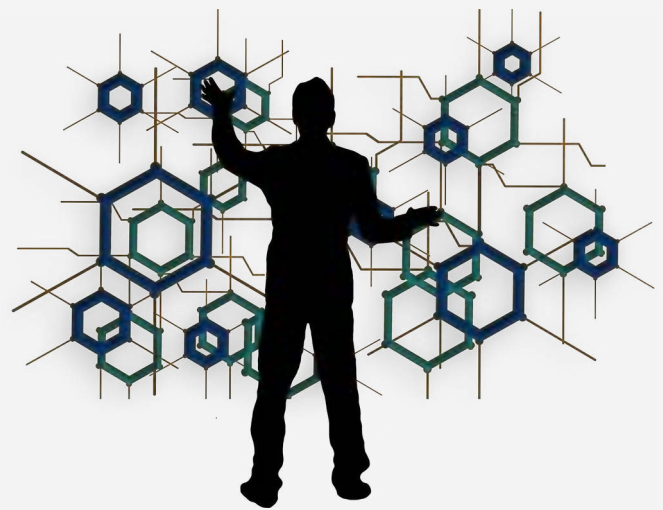
### **Blockchain for Document Authentication:**

Blockchain technology is being explored as a means of enhancing document security and authentication. By creating an immutable and transparent record of a document's creation, modification, and verification history, blockchain can provide a robust system for establishing document provenance and detecting unauthorized alterations. Researchers have proposed blockchain-based frameworks for secure document management in various sectors, including legal, financial, and governmental institutions.



### **Advanced Pattern Recognition Algorithms:**

Sophisticated pattern recognition algorithms are enhancing the ability to detect subtle features in questioned documents. These algorithms can identify minute patterns in handwriting, printing processes, and paper manufacturing that may be imperceptible to human examiners. For example, recent advancements have enabled the automated detection of "phantom signatures" - faint impressions left on documents from writing on overlying pages. Such technologies are particularly valuable in cases involving complex document sets or when traditional methods yield inconclusive results.



### **Challenges and Future Directions:**

While these emerging technologies offer exciting possibilities, their integration into forensic practice faces several challenges. Issues of cost, training, and standardization need to be addressed to ensure widespread adoption and acceptance in legal contexts. Additionally, as these technologies become more sophisticated, there is an increasing need for interdisciplinary collaboration between document examiners, chemists, computer scientists, and legal professionals.

The rapid pace of technological advancement also raises questions about the long-term preservation and analysis of digital documents. As new file formats and encryption methods emerge, forensic experts must continually update their skills and tools to effectively examine digital records.





### **Conclusion:**

The field of questioned document examination is on the cusp of a technological revolution. Emerging technologies such as 3D imaging, hyperspectral analysis, AI, quantum dots, advanced chemical imaging techniques, portable devices, blockchain, and sophisticated pattern recognition algorithms are expanding the capabilities of document examiners. As these technologies continue to evolve, they promise to enhance the accuracy, efficiency, and scope of document analysis, potentially revolutionizing forensic document examination and its applications in legal and historical contexts. However, the successful implementation of these technologies will require ongoing research, interdisciplinary collaboration, and careful consideration of ethical and legal implications.

## **About the Author**



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# ADVANCEMENTS IN FORENSIC SCIENCE: ENHANCING LATENT FINGERPRINT DETECTION WITH NANOPARTICLE-BASED POWDERS

Author: Aanchal Sakarkar, Surbhi Athiya

## Introduction

Latent fingerprints play a crucial role in forensic investigations for identifying individuals. However, traditional fingerprint powders have limitations in sensitivity and surface applicability. These powders often struggle to reveal prints on challenging surfaces, such as non-porous, wet, or multi-coloured backgrounds. Additionally, conventional powders can sometimes damage the prints or leave residues that interfere with subsequent forensic analyses. The integration of nanotechnology into fingerprint powder development addresses these limitations, providing improved detection and clarity of latent prints. Nanotechnology involves manipulating materials on an atomic or molecular scale, resulting in particles with unique physical and chemical properties. By utilizing nanoparticles in fingerprint powders, forensic scientists can achieve greater accuracy in fingerprint detection and analysis, ultimately leading to more reliable identification in criminal investigations. This shift towards nanoparticle-based powders represents a significant advancement in forensic methodologies, making it possible to uncover latent fingerprints that were previously difficult or impossible to detect.

## Nanoparticles in Fingerprint Powder

Nanoparticles are particles with dimensions between 1 and 100 nanometres. Their unique optical, electrical, and chemical properties make them suitable for various forensic applications.

Nanoparticle-based fingerprint powders can adhere more efficiently to the residues left in latent fingerprints, including sweat and sebaceous materials, resulting in clearer and more detailed prints.

## Advantages of Nanoparticle Fingerprint Powders

**Enhanced Sensitivity:** Nanoparticles have a high surface area-to-volume ratio, which increases their interaction with fingerprint residues. This results in better visualization of latent prints, even on challenging surfaces like plastics and metals. The high reactivity and large surface area of nanoparticles allow them to interact more intimately with the minute traces left by fingerprints, revealing details that traditional powders might miss.

**Versatility:** These powders can be tailored to adhere to different types of residues and surfaces. For instance, silver nanoparticles have been shown to produce high-quality fingerprints on non-porous surfaces. This adaptability means that a single nanoparticle formulation can be effective across a wide range of surfaces, from glass and metal to plastics and ceramics.

**Fluorescent Properties:** Certain nanoparticles can be engineered to exhibit fluorescence under specific lighting conditions, aiding in the detection of prints on multi-coloured or patterned backgrounds.

Fluorescent nanoparticles can produce high-contrast images of latent prints, making it easier to discern the fine details of ridge patterns against complex backgrounds.

**Non-Toxicity:** Many nanoparticles used in fingerprint powders, such as silica and titanium dioxide, are non-toxic and safer for forensic personnel to handle. The non-toxic nature of these materials ensures that they can be used safely in various environments, including those involving sensitive evidence or human contact

**Improved Longevity:** Nanoparticles are more stable over time compared to traditional powders. This means that fingerprint powders containing nanoparticles can have a longer shelf life, retaining their effectiveness for longer periods. The enhanced stability of nanoparticle powders reduces the need for frequent replenishment and ensures consistent performance across different batches.

### Recent Developments

Recent studies have focused on the synthesis of various nanoparticles for fingerprint powder. For example, carbon-based nanoparticles such as graphene oxide and carbon dots have been explored for their excellent adhesion properties and fluorescence capabilities. These materials not only adhere well to fingerprint residues but also provide bright and stable fluorescence, enhancing the visibility of prints.

Metal oxides like zinc oxide and titanium dioxide have been investigated for their stability and non-toxicity. These nanoparticles are known for their robustness and environmental compatibility, making them ideal for forensic applications. Zinc oxide, in particular, has been found to provide strong adhesion to fingerprint residues, producing clear and distinct prints even on challenging surfaces.

Gold nanoparticles have also been used due to their strong optical properties and biocompatibility,

allowing for detailed fingerprint imaging and analysis.

The unique optical properties of gold nanoparticles enable the development of highly sensitive detection techniques, such as surface-enhanced Raman scattering (SERS), which can provide detailed molecular information about the residues in latent prints.

Recent advancements also include the development of hybrid nanoparticles that combine the properties of different materials to enhance their performance.

For instance, researchers have created composite nanoparticles that integrate the high surface area of carbon-based materials with the stability and fluorescence of metal oxides, resulting in powders that offer superior sensitivity and versatility.

These hybrid nanoparticles can be customized to target specific fingerprint residues, improving the detection of prints under various environmental conditions.

### Application Techniques

Applying nanoparticle fingerprint powders involves techniques similar to those used for traditional powders. However, the finer particle size of nanoparticles necessitates careful handling to prevent inhalation and ensure even distribution. Methods such as brushing, dusting,





and spraying have been optimized for nanoparticle powders, with modifications to equipment and protocols to accommodate their unique properties.

### **Case Studies and Applications**

Case studies show that nanoparticle fingerprint powders are effective in forensic investigations. Graphene oxide powders successfully visualized latent prints on surfaces exposed to harsh conditions, while zinc oxide nanoparticles recovered clear fingerprints from non-porous materials at crime scenes.

### **Conclusion**

The development of fingerprint powders using nanoparticles represents a significant advancement in forensic science. These advanced powders offer remarkable improvements in sensitivity, enabling the detection of even the faintest and most degraded fingerprints. Their versatility allows for effective application across a wide range of surfaces, including those that traditional powders struggle with, such as porous materials. Enhanced detection capabilities, including fluorescence and chemical reaction specificity, contribute to better visibility and detail of fingerprint impressions. As ongoing research continues to refine these nanoparticle-based powders, their applications are expected to become increasingly sophisticated, providing forensic experts with even more powerful tools for evidence recovery and analysis. This progress will ultimately bolster the pursuit of justice by improving the accuracy and reliability of forensic investigations.

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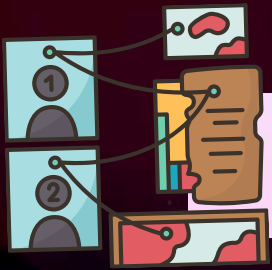
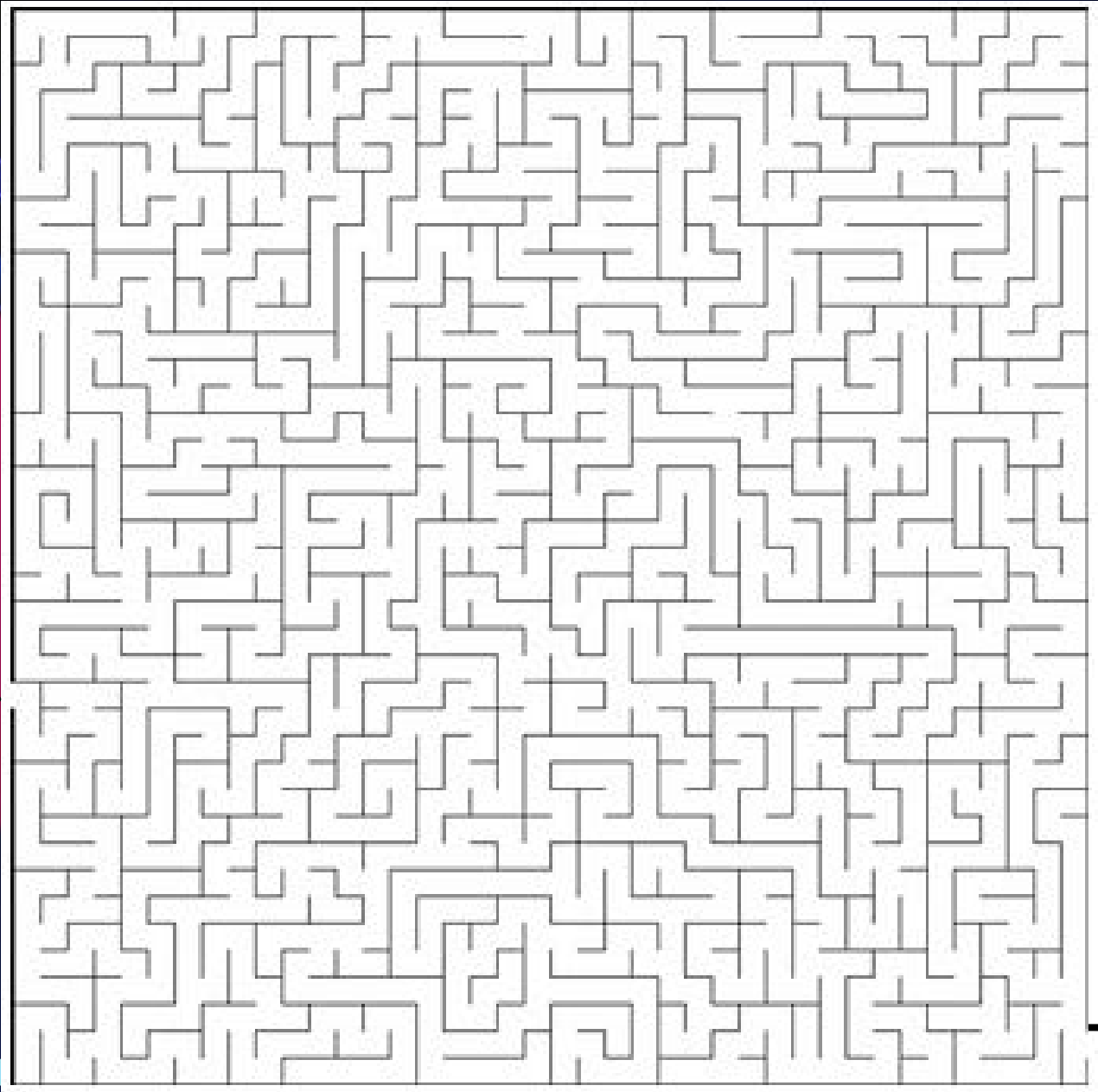
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# CRIME LABYRINTH

START



# REFLECTING ON THE LEGACY OF PROFESSOR P. CHANDRA SEKHARAN

An interview with Prof. Dr. Om Prakash Jasuja

*Dr. Om Prakash Jasuja is presently work as Professor & Head, Dept. of Forensic Science, RIMT University, Mandi Gobindgarh. Former Professor of Forensic science, Dean, Faculty of Physical sciences, Punjabi University Patiala India. Nominated by Ministry of Home Affairs, Government of India, to be a Member of the Forensic Science Advisory Committee (F-SAC) of the Directorate of Forensic Science, Government of India, New Delhi.*

## **P. C Sekaran, a less popular pioneer in the field of Forensic Science in India. What draws you to an initial memory of PC Sekaran?**

Professor Sekharan was a silent worker who, despite not actively seeking fame, garnered immense respect and recognition. Coming from a pure sciences background, he adeptly applied his knowledge to forensic investigations. One notable example was his study of skull sutures to establish individuality, which showcased his keen interest and innovation in forensic science. His involvement in high-profile cases, such as the Rajiv Gandhi assassination case, earned him the prestigious Padma Award, highlighting his expertise and dedication.

## **Have you had an opportunity to work with him?**

My relationship with Professor Sekharan transcended mere professional collaboration. In the scientific community, it's about more than just working together on research and publications; it's about meeting and engaging with influential figures. I remember back in 1986 when Professor Sekharan was the director of a prestigious laboratory, and I was starting my career as a lecturer. He founded the Indian Society of Forensic Science, which was dedicated to publishing journals and organizing major conferences. My early publications appeared in his journal, and I even received invitations to various conferences, even as a student. It was through this connection that our paths first crossed, marking the beginning of a significant journey together in the field of forensic science.

## **Share your fond memories with P.C. Sekaran.**

I fondly recall attending conferences in Chennai and the Indo-Pacific Academy of Forensic Science, where I gained invaluable exposure. In Ooty, Professor Sekharan organized another significant conference, and I was fortunate to be with him at all three events. During a European Academy of Forensic Science meeting in Turkey in 2003, I expressed my interest in forensic facial reconstruction training. Professor Iscan, a co-author of the influential book 'Human Skeleton in Forensic Medicine,' kindly invited me to stay with him. This provided a unique opportunity for deep discussions and collaborative work, which greatly enriched my career in forensic science. Prof. Iscan expressed his desire to visit India, which was made possible three times through the efforts of Professor Jasuja and the Indian government. On his third visit, facilitated by Dr. M. S. Rao, the Ex-Director cum Chief Forensic Scientist at the Directorate of Forensic Science in Delhi, preparations were underway for a conference. The importance of inviting a foreign dignitary was emphasized, with the Indian government generously covering expenses. I suggested Professor Iscan for this honor, with his agreement on the condition that he meet P. Chandhra Sekharan. Professor Iscan was familiar with Sekharan's work, having reviewed and published his papers in the same journal, and even showed me these papers as editor. Determined to fulfill Professor Iscan's request, I approached Dr. M. S. Rao about inviting P. Chandhra Sekharan. To my delight, he agreed, and the meeting was scheduled at the Haryana Forensic Science Laboratory in Maduban Karnal

Reflecting on my interactions with Professor Sekharan, I cherish the memories of our discussions on forensic anthropology, a field we both deeply cared about. Even though sophisticated mobile phones were not available then to capture photographs or videos of our encounters, one memorable event stands out—the meeting between Professor Iscan and P. Chandhra Sekharan. It was a significant moment in the realm of forensic science, marked by their evident mutual respect and admiration for each other's work. Despite Professor Sekharan's fame, which he earned through hard work and dedication rather than seeking it actively, our discussions were always grounded in our shared passion for advancing the field. I also maintained contact with one of Professor Sekharan's PhD students, who completed their degree under his guidance.

**We are all aware of the Rajiv Gandhi Assassination case findings, apart from that. What do you believe was the most significant contribution to their field?**

While the Rajiv Gandhi assassination case is widely recognized, I believe Professor Sekharan's most significant contribution was his leadership in forensic investigations. "The Rajiv Gandhi case marked India's first instance of suicide bombing, necessitating expertise in explosives, human psychology, and other specialized fields," I explained. "Being based in Tamil Nadu, his laboratory played a crucial role, and as director, he had to lead the investigative team. Gathering information is one aspect, but effectively interpreting and presenting it requires strong leadership, which he demonstrated exceptionally well."

**There sure is a legacy left behind by PC Sekaran. To you, what would that be?**

Professor Sekharan's legacy in forensic science is defined by his proactive approach. "Whenever an intriguing case arose without a solution, requiring research, he would initiate it,". "He was a composed speaker, always mindful of context and adept at delivering pertinent information. His commitment to his work and his capacity to motivate others stand as enduring legacies," I concluded. In commemorating Professor P. Chandra Sekharan, we celebrate a quiet achiever whose contributions have profoundly shaped forensic science. His legacy inspires future generations to uphold his dedication and innovative spirit in advancing the field.



**Both of you belong to the same field of interest, and usually, there is a sense of competitiveness and conflicts in opinions. Has any instance brought you to such a stand?**

When asked about the possibility of competition, I emphasized, "At that time, there were only three universities offering courses in forensic science, so competition was not a factor. Professor Sekharan was primarily focused on case work, with research being an additional pursuit for him, while I was fully dedicated as a full-time researcher. Competition typically arises when individuals are in similar roles or fields, which was not the case for us. Professor Sekharan was a great man who worked on diverse projects, from banknotes to ancient metal idols, showcasing his broad expertise."

**About the Interviewee**

Dr. Om Prakash Jasuja, with over three decades of experience in forensic science and has been recognized for his contributions by the MHA, GoI, nominating him to the Forensic Science Advisory Committee. He has received a National Award from the Technology Innovation, Forecasting and Assessment Council (TIFAC) and was invited to lecture at prestigious institutions worldwide.



Serving as Vice President of the International Association of Forensic Institutes, holding memberships in several forensic science organizations, he has earned numerous accolades, including the "Young Scientist Award" (IAFS, 1995) and "Second Best Paper Presentation Award" at Forensic Science Forum Indian Science Congress, New Delhi (2001).

# DETECTING FORGED DOCUMENTS CREATED USING ARTIFICIAL INTELLIGENCE

Author: Sanskriti Verma

With the rapid advancement of artificial intelligence (AI), the challenge of detecting forged documents generated by these technologies has become increasingly urgent. To address this issue effectively, experts must combine traditional forensic techniques with modern technological innovations, leveraging a multi-faceted approach. One of the foundational methods for detecting AI-generated forgeries is metadata analysis. Metadata, which encompasses information about a document's creation, modification, and the software used, can reveal discrepancies that suggest tampering. For example, inconsistencies in file creation dates or unfamiliar software signatures might indicate that a document has been altered. However, as AI capabilities evolve, these technologies can manipulate or hide metadata, making it less reliable on its own. Therefore, it is often used in conjunction with other methods to provide a more thorough evaluation. Text analysis is another crucial technique for identifying AI-generated documents. While AI models can produce text that appears human-like, they often lack the subtle nuances and complexity of genuine human writing. AI-generated text may display unusual patterns in grammar, syntax, and coherence, which can be detected through advanced natural language processing (NLP) and machine learning algorithms. For instance, recent advancements in models like GPT-4 have

made it increasingly challenging to distinguish between human and AI-generated text due to their improved ability to generate realistic content.

By examining linguistic features and stylistic elements, these models help identify deviations that might indicate AI authorship. Digital watermarking offers another layer of protection against document forgery. This technique embeds invisible markers or signatures within documents that can be used to verify their authenticity. Advanced digital watermarking methods include encrypted watermarks, which enhance the security of documents by providing robust, tamper-resistant verification. These watermarks are particularly effective in ensuring that both textual and graphical content remains intact. When documents include images, image forensics becomes essential. AI-generated images often show specific anomalies such as unnatural textures or inconsistent lighting. Techniques like analyzing pixel-level details, detecting compression artifacts, and examining image metadata help uncover





signs of manipulation. Deep learning methods, including convolutional neural networks (CNNs), are increasingly used to detect these subtle irregularities and verify the authenticity of images. Machine learning models designed to detect AI-generated content have advanced significantly. Generative adversarial networks (GANs) and similar deep learning techniques can produce highly realistic text and images, posing challenges for detection systems.

To counter these challenges, researchers are developing adaptive algorithms that improve their ability to identify sophisticated forgeries. These models analyze features such as coherence, contextual relevance, and stylistic nuances to spot subtle signs of AI generation.

A comprehensive approach to detecting AI-generated forgeries often involves multimodal analysis, which integrates text, image, and metadata analysis. This method allows forensic experts to cross-check findings from different sources, enhancing overall detection accuracy. For example, inconsistencies found in text analysis can be verified through image forensics or metadata examination, providing a more robust framework for identifying potential forgeries.

Despite these technological advancements, human expertise remains a crucial component of forensic analysis. Skilled document analysts provide valuable contextual understanding and interpretative abilities that automated systems may lack. Their expertise in recognizing complex patterns and signs of forgery is essential, especially when dealing

with sophisticated AI-generated content. The collaboration between human experts and technological tools ensures a more thorough and accurate detection process. Looking to the future, the field of document forgery detection will continue to evolve in response to advances in AI technology. Research and development efforts will focus on refining detection techniques, improving machine learning models, and creating new methods to analyze AI-generated content.

As AI technologies continue to advance, staying ahead of emerging forgery techniques and integrating human expertise with technological advancements will be crucial for maintaining the integrity of document verification processes.

In Summary , Detecting AI-created forged documents requires a multi-faceted approach, combining metadata analysis, text and image forensics, digital watermarking, and advanced machine learning. This strategy is essential for identifying AI-driven forgeries. Ongoing research and innovation are crucial for adapting to new techniques and ensuring effective document verification.

## **About the Author**



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# THE IMPACT OF DATA BREACH ON REPUTED COMPANIES

Author: Rakesh Kumar Ray, Rahul Kumar Sinha, Tinganiwar Akhilesh Kumar

## INTRODUCTION

We are in 21st Century where we can find everything Online. We the human beings are adopting the technology in all possible ways to make our lives Comfortable. Even the companies conduct their businesses electronically and trying harder to make us comfortable by making themselves online, but some where there will be always a question mark regarding the security of data, we share with those companies it might be personal or professional data. Information security incidents are increasing continuously. Information leakage is a serious threat to firm operations, such as institution and government agencies. The loss of sensitive data can lead to significant reputational damage and financial losses, and even can destroyed long-term stability of a company. In the digital modern era, data has achieved one of the most crucial components of an organization. A data breach is the intentionally or unintended exposure of confidential information to unauthorized hands. It poses serious threats to enterprises, including significant reputational and financial losses. What if the companies are vulnerability to data breach? A rise of cybercrime in industries has overburdened the organizations with high costs and impacted their revenue to a large scale. Data breach report 2019 of IBM exposed that within 16 geographies, 507 organizations and 17 industries have suffered an average cost of 3.92 million (USD) with an average data breach size of records 25,575. Yahoo reported in 2016, that minimum 500 million accounts had been stolen in a manifest 'state sponsored' data breach in 2014. Whenever a data breach incident happens, various financial problems can beat the organization and infected organization's security.

Researches have proved that 29% of businesses end up losing revenue after facing the incident of data breach out of that 38% enterprises experience a loss of almost 20% or more and are unable to sustain the condition. Organizational Data.

- 1) Finance Companies: Income statements, balance sheets, loan details, bank Account details
- 2) Online Shopping Sites: personal information like Name, Address, mobile number, bank card details,
- 3) Insurance Companies: medical records, bank records
- 4) Job Offering Sites: educational Records

## CLASSIFICATION OF DATA LEAK THREATS

Data leak threats can be classify on the basis of their causes that could be either intentionally or inadvertently on which parties caused the leakage that could be either insider or outsider threats. Mostly intentional leaks caused due to either external hands or malicious insiders. External information breaches are normally performed by hacker break-ins, virus, malware, and social engineering (e.g., phishing). There are also some other attributes like industry sector or the types of occurrences to characterized data leaks. The Report of Identity Theft Resource Center (figure 1), showed that number of major data breach cases keep increasing from 2011 to 2016. Data breach incidents in 2016 is around 40% more than the incidents in 2015. Similarly, incidents of data breach are increasing as 10%, 30%, 32% in the year 2012, 2013, 2014 respectively. Business and medical/healthcare sector leaks take the majority portion of the data leaks.

Data breach by type of occurrence is shown in Figure 1(b), that is on the basis of malicious insider, malicious outsider, data on the move, accidental loss, third party and others, where the 'Other' category involve email/internet exposure or any employee error. In 2016, figure represents, the number of data breaches due to malicious outsider is around 55% of the overall leak incidents.

B. Financial Losses The monetary cost of a Breach is much higher than just replacing any lost are stolen devices investing in existing security and strengthening the buildings physical security. The most obvious consequence of many attacks, is the main target, for example, unauthorized or fraudulent transfers, or ransom payments after a ransomware infection.

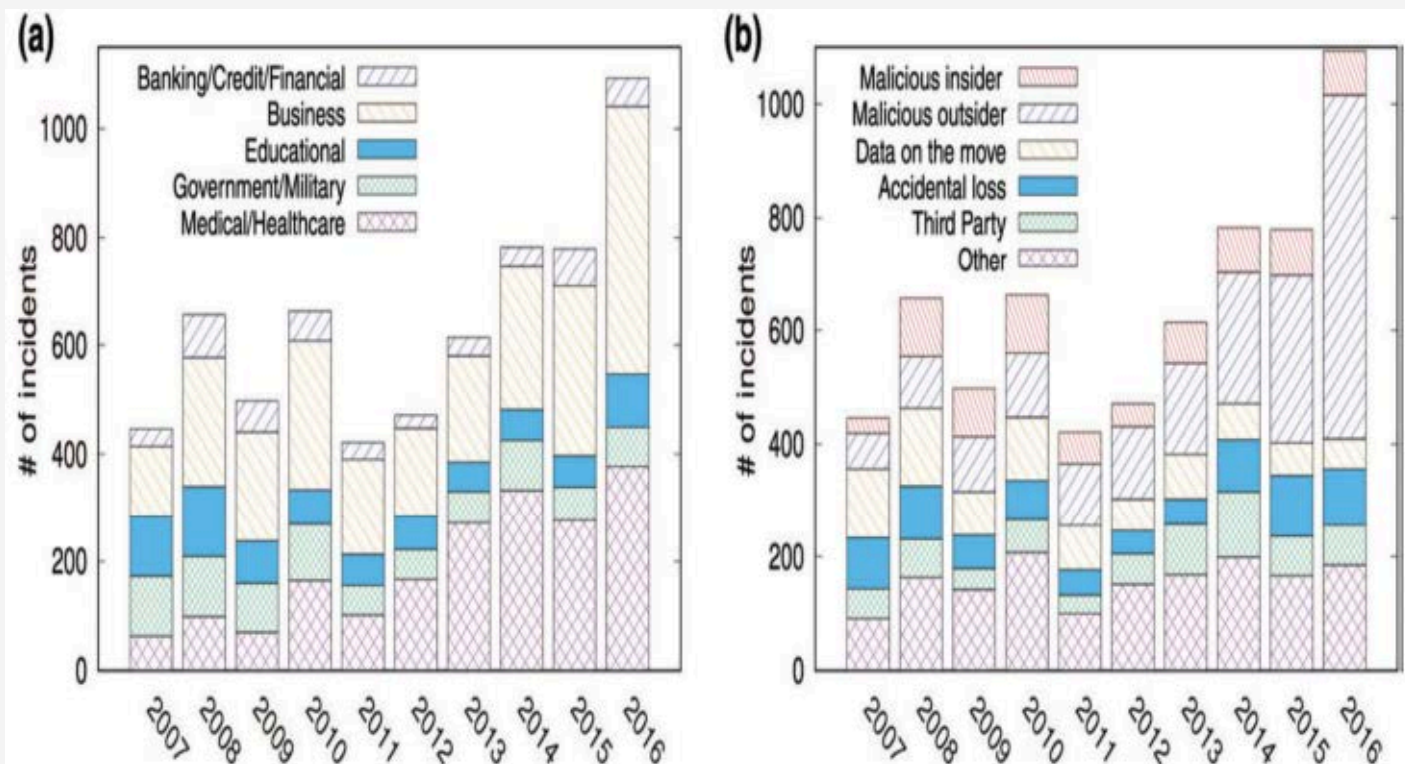


Figure 1 | Statistics representation of data leak incidents in year 2007-2016 (Copyright 2017 Identity Theft Resource Center). (a) Breaches by industry sector and (b) Breaches by type of Occurrence

### DATA BREACH AND IMPACT

A successful Cyber Attack can cause major damage to the companies.

A. Reputation Damage Apart from immediate costs, a cyberattack can also have less obvious long-term consequences related to reputation damage that took years to build. If the website is down for longer periods of time the company may appear unreliable and possibly lose credibility. The crucially loss of trust the company must focus less on growing & more on repairing its reputation. The effect of reputational damage can even impact on your suppliers, or affect relationships you may have with partners, investors and other third parties investor in your business.

Expenses on investigation, post-breach forensics and vulnerability analysis and interpretation may require to engage in costly external auditors and consultants. For some organizations, if their servers are down for some time means they lost business if there is an online store goes offline, customers can't place orders or buy products.

C. Legal Liability The company may be responsible for connecting all the affected customers about breach and have to be prepared for litigation even employees may live the company Data protection and privacy laws require to manage the security of all Data which holds with company. If this data is accidentally or deliberately compromised, and the company is failed to deploy appropriate security measures, then the company must face fine and regulatory sanctions.

Apart from fines and regulatory obligations, enterprises can face civil lawsuits from the business partners and customers who has been affected from data breach. If any organization's information systems are breached and customer personal data is stolen, it may be forced to prove that the incident was not due to negligence and company did everything reasonably possible to maintain its best practice security measures and procedures.



**CASE STUDY**

A. BigBasket Data Breach BigBasket, India's top online grocer has suffered a massive data breach, allegedly sold of personal information of more than 20 million customers on dark web. Cyber has claimed that personal information of as many as 20 million users such as full names, email IDs, password hashes (potentially hashed OTPs), pin, contact numbers (mobile and phone), date of birth, full addresses, location, and IP addresses of where users have logged in from and have been put up for sale for \$40,000 on the dark web.

B. Upstox Data Breach Upstox, second largest stock broker of the country in the terms of strength of customers have been breached by hackers and theft KYC and other data of about 25 lakhs of customers. Ravi Kumar, Upstox's co-founder and CEO, through its website exposed security systems has been upgraded after receiving of emails, claimed unauthorized access into company's database. "These claims proposed that third-party data-warehouse systems may have been compromised some contact information and KYC data.

C. MobiKwik Data Breach The data of around 110 million users of MobiKwik, mobile wallet and payments app is reported to be on sale on a hacker forum on the dark web. The dataset is nearly 8.2TB in size and includes details of Aadhaar cards, KYC documents, mobile phone numbers linked to MobiKwik wallet, credit card details, etc.

D. Domino's Data Breach India's one of the top pizza service Domino's was affected with massive data breach that exposed order details of 18 crore Pizza orders made via the service includes 130TB of employee data files and customer details. The data leak includes the details of some transactions which reveals the order delivery address, the date, the name, phone number & email ID of the customer latitude and longitude coordinates of the address, total number of transactions and the total amount spent on orders transactions in Rupees



**CONCLUSION**

With cybercriminals increasing day to day as they are shifting their interest from stealing money to stealing data, no company can honestly say that their system is 100% safe from vulnerabilities in its systems. Anyone can be targeted by unauthorized exploits and other bulk attack attempts, so the best way to protect your company is to avoid being an easy target. Maintaining cybersecurity is necessary for smooth business operations, and good response and recovery planning can help to minimize the risk.



# VACUTAINERS

Author: AMBATI RAMESH BABU



## INTRODUCTION

Vacutainer is blood collection method. Vacutainer technology was developed in 1947 by JOSEPH KLEINER. Vacutainer tubes may contain additional substances that preserve blood for processing in a medical laboratory. These additives are typically thin film coating applied using an ultra sonic nozzle (type of spray nozzle uses high frequency vibration produced by piezoelectric create capillary waves in liquid film). The additives may include anti coagulants (EDTA, SODIUM CITRATE, HEPARIN). With density between blood cells and blood plasma. When a tube is centrifuged the materials within are separated the density blood cells sinking to the bottom and the plasma or serum accumulating at the top. Tubes contain gel can be easily handled and transported after centrifugation with out the blood cells and serum mixing. When plasma contains blood platelets is required for

analysis a vacutainer that does not contains gel or clotting agent.

## COLOUR CODE:

Colour code has standard protocol universal application across the medical domain.

1. **GOLD/RED /BLACK**=chemistry ,immunology and serology determination it contains activators and gel.

2. **ORANGE/GREY/YELLOW** = STAT serum testing contains thrombin.

3. **GREEN** = it contain sodium heparin useful for plasma determination.

4. **PURPLE** =it contain potassium salts and EDTA useful for complete blood analysis.

5. **GREY** =it contain sodium fluoride useful for glucose determination.

6. **LIGHT BLUE** =reversible anticoagulants having sodium citrate useful prothrombin time and partial thromboplastin time.

7. **DARK BLUE** =having sodium heparin or EDTA useful analysis trace metal analysis and toxicology tests.

8. **RED TUBES** =this are additives free vacutainers used for tests for antibodies chemistry and drugs.

9. **LIGHT YELLOW** =having ACD (acid citrate dextrose ) useful for HLA phenotyping and parental testing.

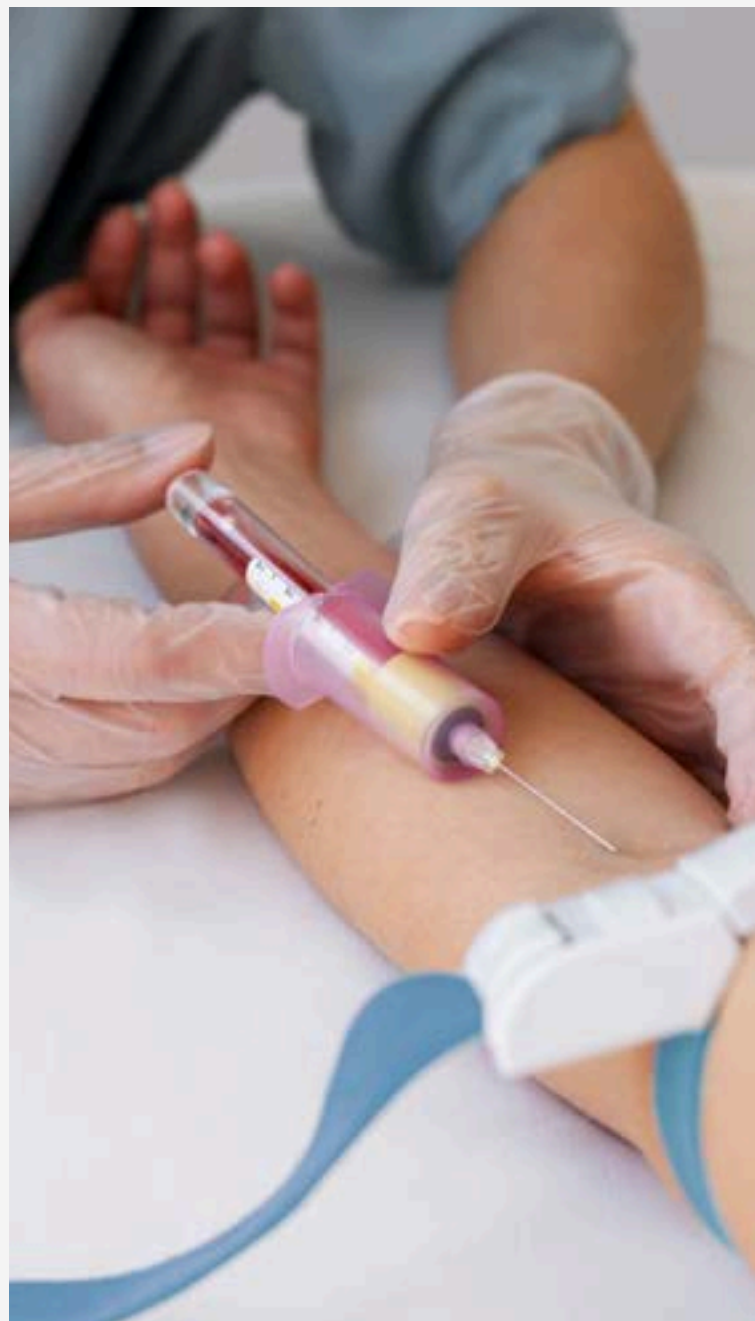
10. **TAN content.** =this tubes are lead free and used to determine lead

## WORKING OF VACUTAINERS :

- First wash the hands and wear apron.
- Clean the part from where the blood was going to collect and tie a band 2-3 inches above from the blood collection part.
- Take vacutainer holder and vacutainer needle the needle has two ends keep plastic side end in to Holder and punch needle in to skin.
- Now take vacutainer colour cap vial and keep inside the holder
- Handle vial carefully will blood was collecting Or blood was filling in to vial .
- The vial present 1ml ,2ml,and 5ml.
- After collecting the blood store in 4 degrees Temperature.

## ADVANTAGES:

- Vacutainers with plastic material light weight ,pressure, unbreakable easy to transport and ensure safety.
- Enter blood collection process is a closed system healthy, safety, medical personnel not contagious source.
- Long shelf life up to 18 months.
- Vacutainer blood collection tubes for the burning products of carbon , hydrogen, oxygen , does not produce toxic gases burning of residues of 0.2 percentage for environmental friendly product.
- By single punch of needle of single person can collect blood 2-4 colour cap of vials for each vial no need of changing the needle.
- Full range of vacuum blood collection to e blood collection can meet all the requirements of lab a needle that is able to complete all testing of samples reduce patient suffering.
- Safety cover colour in the line with internationally standards easy to distinguish the different tube additives.
- Vacutainer is automated blood collection



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# EXPLORING THE ROLE OF MICROFRACTURES IN FORENSIC ANTHROPOLOGY

Author: Dr. Kajol

Forensic anthropology has long been a cornerstone of criminal investigations, particularly in analyzing human skeletal remains. Traditionally, studies have concentrated on macroscopic features such as bone structure, trauma, and pathology. However, the microscopic analysis of bones, especially the examination of microfractures, offers a burgeoning field of study that holds significant potential for forensic applications. This article delves into the lesser-known yet crucial role of microfractures in forensic anthropology, providing insights into how these tiny bone imperfections can unveil hidden clues about a person's life and death.

## Understanding Microfractures

Microfractures are minute cracks in bones that occur due to various factors, including mechanical stress, repetitive strain, and underlying bone health conditions. These fractures are often invisible to the naked eye and require advanced imaging techniques such as scanning electron microscopy (SEM) or micro-computed tomography (micro-CT) to be identified and analyzed.

## Causes and Implications

Microfractures can result from several scenarios, each carrying forensic significance:

**Occupational Stress:** Repetitive movements or heavy physical labor can cause microfractures, providing clues about the individual's occupation or lifestyle. For instance, the presence of microfractures in the metacarpal bones might suggest a history of manual labor.

**Pathological Conditions:** Certain diseases, such as osteoporosis, increase the likelihood of microfractures. Identifying these can help forensic anthropologists infer the health status of an individual before death, contributing to a more comprehensive biological profile.

**Traumatic Events:** High-impact injuries or repeated low-impact trauma can lead to microfractures. By analyzing the pattern and location of these fractures, forensic experts can reconstruct the circumstances leading to an individual's death or injury.

## Methodology

The process of examining microfractures involves several meticulous steps:

**Sample Collection:** Bones are carefully collected and prepared, ensuring minimal damage to preserve microscopic details.

**Imaging Techniques:** SEM and micro-CT scans are employed to capture detailed images of the bone's microstructure. These images are then analyzed to identify and categorize microfractures.

**Data Interpretation:** The location, orientation, and density of microfractures are studied to infer possible causes. Comparative analysis with known cases and reference samples enhances the accuracy of conclusions.

## Case Studies:

Recent forensic cases have demonstrated the practical application of microfracture analysis. For instance, a study on the remains of a

construction worker revealed numerous microfractures in the vertebrae and ribs, consistent with repetitive heavy lifting. In another case, the presence of microfractures in the tibia of an elderly individual suggested undiagnosed osteoporosis, providing a crucial piece of information for the investigation.

### **Future Directions:**

The field of microfracture analysis in forensic anthropology is still in its early stages, with vast potential for growth. Future research could focus on:

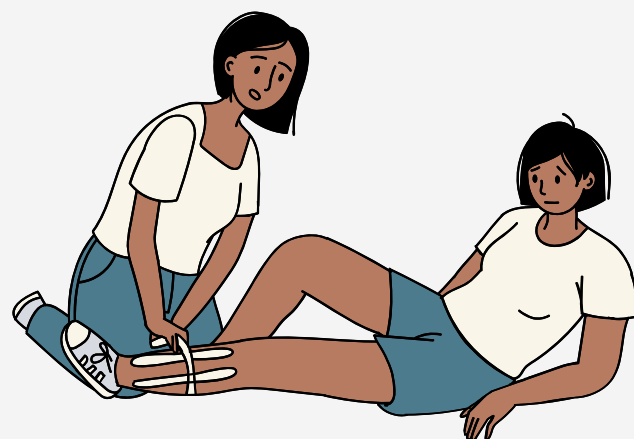
**Standardization of Techniques:** Developing standardized protocols for the identification and interpretation of microfractures to ensure consistency across forensic investigations.

**Database Creation:** Establishing comprehensive databases of microfracture patterns associated with various occupations, activities, and pathological conditions to aid forensic analysis.

**Technological Advancements:** Leveraging advancements in imaging technology to enhance the resolution and accuracy of microfracture detection.

**Interdisciplinary Collaboration:** Collaborating with medical researchers and biomechanical engineers to better understand the mechanisms behind microfracture formation and healing.

**Conclusion:**  
Microfractures, though small and often



overlooked, hold immense forensic value. Their detailed analysis can reveal significant aspects of an individual's life, health, and circumstances surrounding their death. As forensic anthropology continues to evolve, incorporating microfracture analysis into standard practice promises to uncover hidden clues that could be crucial in solving complex forensic cases. This emerging field not only broadens the scope of forensic investigations but also underscores the importance of meticulous, multi-scale analysis in unraveling the mysteries of human skeletal remains.

## **About the Author**



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# POLITICAL FORENSICS: UNVEILING THE NEXUS BETWEEN FORENSICS AND POLITICS

Author: Gaurav Ashok Varade

## Introduction

Political forensics is an emerging interdisciplinary field that applies forensic science techniques to the investigation of political events, actions, and behaviors. The intersection of forensics and politics has gained significant attention in recent years. Political forensics involves the application of forensic techniques and principles to scrutinize political events, decisions, and activities. This field encompasses various aspects such as electoral fraud, political corruption, human rights violations, and political violence. By employing scientific methods, political forensics aims to uncover the truth, support legal proceedings, and promote transparency and accountability in governance. This article explores the conceptual framework, methodologies, applications, and implications of political forensics. We delve into case studies, highlight technological advancements, and discuss the ethical and legal challenges faced by practitioners. The goal is to provide a comprehensive understanding of how forensic science can contribute to transparency, accountability, and justice in the political arena.

## Definition and Scope

Political forensics is the application of forensic science methods to investigate and analyze political events and activities. It includes the examination of physical evidence, digital data, financial records, and other relevant materials to uncover facts and support legal and political processes.

## Historical Development

The use of forensic techniques in political investigations is not new. Historical instances, such as the analysis of the Watergate tapes or the examination of the Kennedy assassination,

demonstrate early applications of forensic science in political contexts. However, the formalization of political forensics as a distinct field is a recent development, driven by advancements in forensic technologies and the increasing complexity of political landscapes.

## 3. Methodologies

### 3.1 Digital Forensics

Digital forensics plays a crucial role in political forensics. This involves the recovery, analysis, and preservation of digital evidence from electronic devices, networks, and online platforms. Techniques such as data mining, metadata analysis, and network forensics are employed to uncover digital footprints related to political activities.

### 3.2 Financial Forensics

Financial forensics investigates the financial transactions and economic behaviors associated with political actors. This includes tracing illicit financial flows, analyzing campaign finances, and uncovering corruption and money laundering activities. Financial forensics often involves collaboration with accounting experts and financial institutions.

### 3.3 Physical and Biological Forensics

Physical and biological forensics are applied in cases of political violence, assassinations, and human rights violations. Techniques such as DNA analysis, ballistics, and forensic pathology are used to analyze crime scenes, identify perpetrators, and determine causes of death.

## 4. Applications

### 4.1 Electoral Fraud

Electoral fraud is a significant concern in many political systems. Political forensics can identify and analyze irregularities in voting patterns, examine the authenticity of ballots, and investigate allegations of voter manipulation. Digital forensics, in particular, is crucial for detecting and addressing cyber-attacks on electoral systems.

### 4.2 Political Corruption

Political forensics helps uncover corruption by investigating financial records, monitoring transactions, and analyzing communication patterns. High-profile cases, such as the Panama Papers and the Petrobras scandal, highlight the importance of forensic techniques in exposing corrupt practices.

### 4.3 Human Rights Violations

In cases of political repression and human rights abuses, forensic science provides critical evidence for legal and humanitarian interventions. Forensic anthropologists, for instance, analyze mass graves to identify victims and document atrocities.

### 4.4 Political Violence and Terrorism

Political forensics is essential in the investigation of acts of political violence and terrorism. This includes the examination of bombings, assassinations, and insurgent activities. Forensic experts collaborate with intelligence agencies to analyze materials, reconstruct events, and identify perpetrators.

## 5. Case Studies

### 5.1 The Watergate Scandal

The Watergate scandal is a landmark case in the history of political forensics. The investigation involved the analysis of audio recordings

### 5.2 The Panama Papers

The Panama Papers investigation revealed extensive corruption and tax evasion involving political figures worldwide. Forensic accountants and digital forensic experts analyzed vast amounts of leaked financial data to trace illicit financial flows and expose the hidden assets of influential individuals.

### 5.3 The Assassination of Rafic Hariri

The assassination of Lebanese Prime Minister Rafic Hariri in 2005 was a high-profile case involving political forensics. Forensic experts analyzed the explosion site, examined the remains, and reconstructed the event to identify the perpetrators. The investigation combined physical, digital, and financial forensics to establish a comprehensive understanding of the assassination.

## 6. Technological Advancements

### 6.1 Artificial Intelligence and Machine Learning

Artificial intelligence (AI) and machine learning (ML) have revolutionized political forensics. AI and ML algorithms analyze large datasets, identify patterns, and predict potential threats. These technologies enhance the efficiency and accuracy of forensic investigations.

### 6.2 Blockchain Technology

Blockchain technology offers transparency and security in political forensics. It ensures the integrity of digital evidence, facilitates secure data sharing, and prevents tampering. Blockchain applications in electoral systems, financial transactions, and digital records are particularly promising.

### 6.3 Biometric Forensics

Biometric forensics involves the use of biometric data, such as fingerprints, facial recognition

recognition, and voice analysis, to identify individuals involved in political activities. Advances in biometric technologies have improved the accuracy and reliability of identification processes.

## 7. Ethical and Legal Challenges

### 7.1 Privacy Concerns

The use of forensic techniques in political investigations raises significant privacy concerns. Balancing the need for transparency and accountability with the protection of individual privacy rights is a critical challenge. Legal frameworks must be developed to regulate the collection, storage, and use of forensic data.

### 7.2 Political Bias and Manipulation

The potential for political bias and manipulation in forensic investigations is a significant concern. Ensuring the independence and impartiality of forensic experts is crucial to maintain the integrity of political forensics. Transparent procedures and oversight mechanisms are necessary to prevent misuse.

### 7.3 International Jurisdiction

Political forensics often involves cross-border investigations, raising complex issues of international jurisdiction and cooperation. Harmonizing legal standards and facilitating collaboration between different jurisdictions are essential for effective political forensics.

## 8. Future Directions

### 8.1 Integrating Multidisciplinary Approaches

The future of political forensics lies in integrating multidisciplinary approaches. Collaboration between forensic scientists, political analysts, legal experts, and technologists will enhance the effectiveness and comprehensiveness of investigations.

### 8.2 Developing Robust Legal Frameworks

Establishing robust legal frameworks is crucial for regulating political forensics. These frameworks should address issues of privacy, data protection, jurisdiction, and accountability to ensure ethical and lawful practices.

### 8.3 Enhancing Public Awareness

Raising public awareness about political forensics is essential for promoting transparency and accountability. Public education campaigns, media engagement, and academic research can contribute to a better understanding of the role and significance of political forensics.

## 9. Conclusion

Political forensics is a burgeoning field that holds great potential for promoting transparency, accountability, and justice in the political arena. By applying forensic science techniques to political investigations, we can uncover the truth, support legal proceedings, and enhance public trust in governance. However, addressing ethical and legal challenges, fostering multidisciplinary collaboration, and developing robust legal frameworks are critical for the future success of political forensics.

## About the Author



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## THE EVOLUTION OF CYBER THREATS: FROM MALWARE TO SOCIAL ENGINEERING

**Introduction:** In the rapidly advancing digital age, the evolution of cyber threats has become an intricate and ever-changing landscape. From the early days of simple viruses and malware to the sophisticated tactics employed by cybercriminals today, the world of cybersecurity has undergone a remarkable transformation. This article aims to shed light on the evolving nature of cyber threats, focusing on the transition from traditional malware attacks to the rise of social engineering as a prominent threat vector.

**The Early Days of Malware:** The history of cyber threats can be traced back to the early days of computing when the primary concern was the development and spread of malware. Viruses, worms, and Trojans were the weapons of choice for hackers looking to exploit vulnerabilities in computer systems. These malicious programs were typically designed to disrupt operations, steal sensitive information, or gain unauthorized access to networks.

**The Rise of Advanced Persistent Threats (APTs):** As organizations bolstered their cybersecurity measures to combat traditional malware, cybercriminals adapted by deploying Advanced Persistent Threats (APTs). APTs are sophisticated, long-term cyberattacks designed to infiltrate a target's network and remain undetected for an extended period. These attacks often involve a combination of malware, social engineering, and other advanced techniques.

**Social Engineering: A New Paradigm in Cyber Threats:** While traditional malware and APTs continue to pose significant threats, the emergence of social engineering represents a paradigm shift in cyber threats. Social engineering relies on manipulating human psychology to trick individuals into divulging sensitive information or taking actions that compromise security. It leverages the inherent trust people place in communication and exploits their willingness to comply with seemingly legitimate requests.

**Phishing Attacks:** One of the most prevalent forms of social engineering is phishing attacks. Cybercriminals use deceptive emails, messages, or websites to trick users into revealing login credentials, financial information, or other sensitive data.

Phishing attacks have become highly sophisticated, with attackers employing convincing replicas of legitimate websites and employing psychological tactics to increase their success rates.

**Spear Phishing and Business Email Compromise:** Spear phishing takes social engineering to a targeted level, tailoring attacks to specific individuals or organizations. Business Email Compromise (BEC) is a variant of spear phishing where attackers compromise email accounts to impersonate executives or trusted contacts, tricking employees into making unauthorized transactions or disclosing sensitive information.

**Ransomware and Extortion:** Ransomware attacks, another offshoot of social engineering, involve encrypting a victim's data and demanding a ransom for its release. Attackers exploit fear and urgency, often threatening to leak sensitive information if the ransom is not paid. Ransomware attacks have become a lucrative business for cybercriminals, affecting individuals, businesses, and even critical infrastructure.

**Conclusion:** Understanding the evolution of cyber threats is crucial for organizations and individuals alike to stay ahead of the ever-changing tactics employed by cybercriminals. From the early days of malware to the rise of social engineering, the landscape of cybersecurity continues to evolve. As technology advances, so too must our defenses, incorporating a holistic approach that addresses not only technical vulnerabilities but also the human element through awareness, education, and robust cybersecurity practices. Only through a comprehensive and adaptive strategy can we effectively navigate the complex and dynamic world of cyber threats.

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# STUDENTS VOICE

## ARTIFICIAL INTELLIGENCE IN CRIME INVESTIGATION

Artificial Intelligence (AI) has become a game-changer in various sectors worldwide, and the criminal justice system is no exception. In India, where the system grapples with a myriad of issues such as case backlogs, inefficiencies, and resource shortages, AI presents a beacon of hope. This article delves into the transformative potential of AI in reshaping the Indian criminal justice landscape, spotlighting its applications in case management, evidence analysis, predictive policing, and judicial decision-making. Furthermore, it scrutinizes the hurdles and ethical dilemmas accompanying the infusion of AI into India's criminal justice system.

**Introduction :** Artificial Intelligence (AI) has emerged as a game-changer across diverse sectors globally, including law enforcement and criminal justice. In India, where the criminal justice system confronts numerous challenges, integrating AI technologies offers a significant opportunity for improvement. This article delves into the current state of the Indian criminal justice system, identifies its deficiencies, and explores how AI can revolutionize its functioning.

**Challenges in the Indian Criminal Justice System :** The Indian criminal justice system grapples with several challenges, ranging from a backlog of cases to inefficiencies in investigation and prosecution. According to the National Crime Records Bureau (NCRB), Indian courts face alarmingly high case pendency, with millions of cases languishing for years, resulting in delayed justice and overcrowded prisons. Moreover, reliance on outdated methods and a lack of modernization contribute to inefficient investigation processes and low conviction rates.

**The Role of AI in Revolutionizing the Indian Criminal Justice System :** Artificial Intelligence holds immense potential to address the myriad challenges plaguing the Indian criminal justice system. Predictive analytics, a primary application of AI, can assist law enforcement agencies in pinpointing crime hotspots and deploying resources effectively. By analyzing historical crime data and patterns, AI algorithms can forecast potential crime locations, enabling proactive policing strategies to prevent offenses.

AI-powered facial recognition technology can expedite suspect identification and criminal tracking.

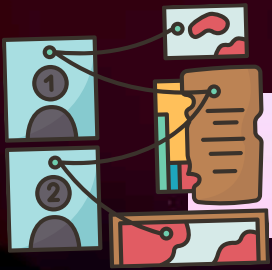
This technology analyzes vast amounts of CCTV footage, matching faces against criminal databases to accelerate investigations and enhance identification accuracy. AI-driven tools such as natural language processing (NLP) and machine learning algorithms can streamline legal research and facilitate faster judicial decision-making. By analyzing legal documents, case files, and judicial precedents, these tools automate routine administrative tasks, enabling legal professionals to focus on more intricate aspects of their work. Additionally, AI can play a pivotal role in enhancing forensic analysis and evidence management. Advanced AI algorithms can analyze forensic evidence, such as DNA samples and fingerprints, with unprecedented speed and accuracy, aiding in crime resolution and securing convictions.

**Ethical and Legal Considerations :** Despite its potential benefits, the integration of AI into the Indian criminal justice system raises ethical and legal concerns. Chief among these is the issue of bias inherent in AI algorithms, which can exacerbate existing disparities in the criminal justice system, particularly against marginalized communities. Moreover, the collection and utilization of personal data for AI applications raise privacy concerns, necessitating robust data protection laws and regulations.

**Conclusion :** Artificial Intelligence holds immense promise in transforming the Indian criminal justice system by addressing its longstanding challenges. From predictive policing to forensic analysis, AI technologies offer innovative solutions to enhance efficiency, accuracy, and fairness in law enforcement and judicial proceedings. However, it is imperative to navigate the ethical and legal implications meticulously to ensure responsible deployment in alignment with constitutional principles.

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# Detective's



START



# Lidar Enhanced Drone Forensic in Metaverse

1. Jalem Amogh Sriram (M.Sc.Cyber Security) 2. Busi Praveen Kumar (B.Sc Forensic Science)

Lidar Enhanced Drone Forensic (LEDF) is an emerging field that uses drones equipped with lidar sensors to collect data for forensic investigations. Lidar is a remote sensing technology that uses lasers to measure distances to objects. This data can be used to create high-resolution 3D maps of crime scenes, accident sites, and other areas of interest.

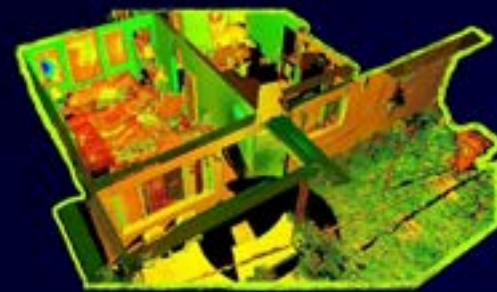
Scanning systems like the lidar Enhanced drone speed up the process of crime scene investigation by creating an accurate 3D representation in virtual world Metaverse of the scene of a crime. Police and forensic can use the 3D world of lidar to take measurements, inspect evidence, and analyze blood splatter or bullet trajectory. 3D scan data is also frequently used in the courtroom. Juries can be taken into a 3D world that's more readily understandable than simple pictures and verbal scene description

Here are some specific examples of how lidar enhanced drone forensics is being used:

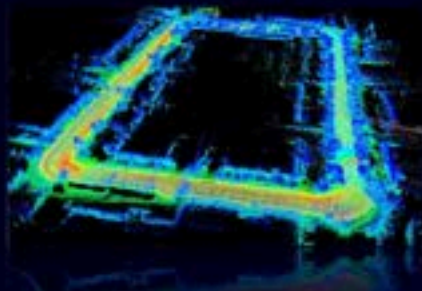
- Accident investigation
- Crime scene investigation
- Border security
- Search and rescue
- Fire investigation
- Wildlife crime monitoring
- Crime scene documentation
- Unearthing Hidden Evidences



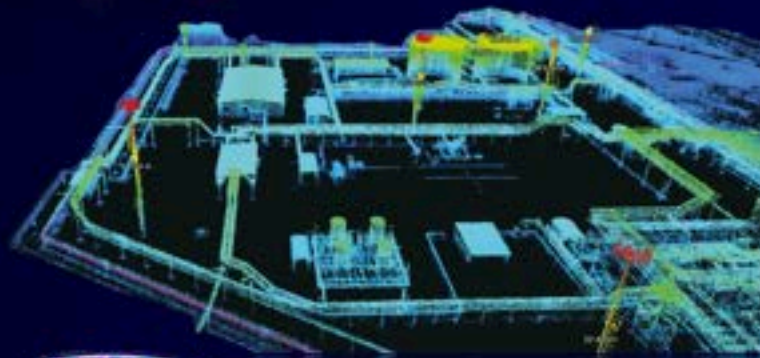
Lidar Drone view of Crime Scene



Lidar Drone view of Arsenic Crime Scene



Lidar Enhanced Drone



Lidar Sensor

Scan here for Virtual Experience



# DECODING AROMAS: CAN E-NOSES REPLICATE THE COMPLEXITY OF HUMAN OLFACTORY SYSTEM?

ALAN JOJO

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## INTRODUCTION

Illicit drug use presents significant challenges for law enforcement and public health, hindering traditional detection methods through time-consuming lab analyses. This poster explores the transformative potential of electronic nose (e-nose) technology in drug detection. The e-nose, mirroring the human olfactory system, employs advanced sensor arrays to analyze volatile organic compounds released by drugs, enabling quick and non-invasive on-site screening. Despite challenges such as sensor drift and standardization, ongoing research is crucial to enhance e-nose performance and reliability in addressing the evolving societal issues associated with substance abuse.

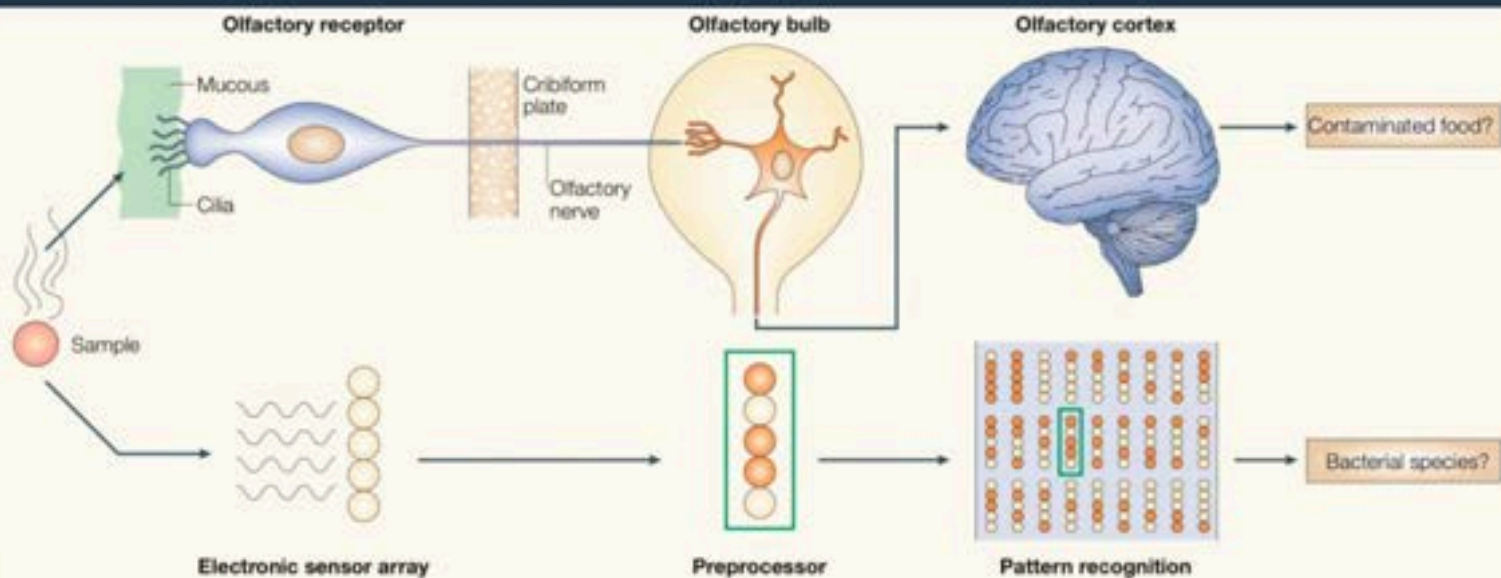
## OBJECTIVE

- Identifying novel drugs
- Assessing their associations
- Classifying molecular structures
- Evaluating efficacy through diverse techniques like mass spectrometry and spectroscopy.

## FEATURES

- High Sensitivity
- Detects various Aromatic compounds
- Qualitative Output
- Real time analysis (On-site Drug Screening)
- Fast
- Cost effective
- Portable

## WORKING PRINCIPLE



## LIMITATIONS

- Technical limitation; Reliability, Sensitivity, Selectivity
- Complexity of hardware and software integration
- Reference data
- Regulatory consideration

## APPLICATIONS

- Security and crime
- Agriculture and environment
- Medicine
- Food industry

## CONCLUSION

It's a developing technology which has its high utilization in various fields. It welcomes the development in optimizing the accuracy and capabilities of the existing systems and integrating them with the latest technologies.

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2. Baeto M. Advances in Electronic-Nose Technologies Developed for Biomedical Applications Alpha D. Wilson 1.
3. The How and Why of Electronic Noses H. Troy Nagle1, Susan S. Schiffman2 and Ricardo Gutierrez-Osuna1 1North
4. A Brief Note on Drug Analysis and Its Importance Elsie Guan\* Department of Pharmacy, New York, USA.



# Can Ants be A Evidence Collector?

ADITYA DEGREE & PG COLLEGE, SURAMPALEM

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## 1. INTRODUCTION

- Forensic myrmecology involves the study of ants in the context of forensic science.
- Particularly in determining the time since death or other relevant aspects of a criminal investigation. Ants, belonging to the Hymenoptera order and Formicidae family, serve as valuable forensic indicators in criminal cases. The use of ants in forensic science is a unique and innovative approach that has gained attention for its potential in helping investigators solve crimes and determine post-mortem intervals. Ants, as highly organized and social insects, can provide valuable information in forensic investigations, especially in cases involving decomposition of human remains.



## 3. ECOLOGICAL CONCEPTS AND FORENSIC EVIDENCE:

Ants, as primary predators in litter habitats, influence post-mortem time calculations and decomposition processes. Their activities on decaying carcasses, including biting, stinging, and blood pattern changes, can be examined as forensic evidence. The implications of ants in forensic investigations and time of death estimation are far-reaching.

## 5. MARKS AND CHARACTERISTICS:

Invasive ant species like *Solenopsis invicta* leave distinctive marks on the skin, ranging from orange-pink to yellow, and create sores. These marks can be identified and analyzed during post-mortem investigations.



## FORENSIC MYRMECOLOGY



## 4. IMPACT ON DECOMPOSITION:

Ants, particularly species like *Solenopsis invicta*, can prevent flies from colonizing carrion. Their actions can slow down the rate of decomposition by consuming the cadaver and keeping other scavengers away.

## 6. ADVANTAGES OF ANTS IN FORENSIC SCIENCE:

Ants, particularly species like *Solenopsis invicta*, can prevent flies from colonizing carrion. Their actions can slow down the rate of decomposition by consuming the cadaver and keeping other scavengers away.

## 7. ROLE IN CADAVER MOVEMENT ANALYSIS:

Ant species native to specific location or regions can be used to determine whether the cadaver was moved after the murder. seasonal variations in ant species like *T.nigerrimum* can also consider in forensic investigation.



## 8. CONCLUSION

In the up coming years, the collaboration between researches, practitioners, and policymakers will be crucial in unlocking the full potential of ants in forensic science.

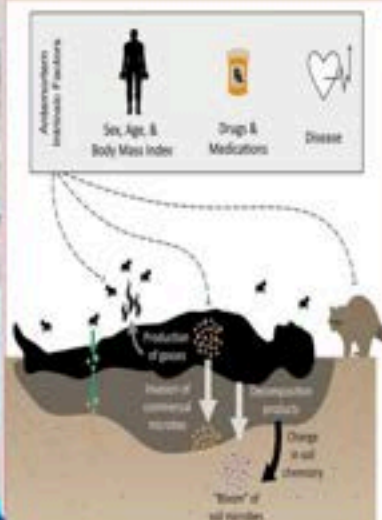
The tiny yet powerful contributions of ants may hold the key to solving complex cases and ensuring justice for these affected by crime

## 9. REFERENCE:

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- Keller, L., & Gordon, D. M. (2009). *The Lives of Ants*. Oxford University Press
- Smith, J., et al. (2018). "Ants as Forensic Indicators: Community Dynamics and Potential for Effort Reduction." *Journal of Forensic Sciences*, 63(2), 500-506

## 2. CONNECTION BETWEEN ANTS AND DECOMPOSITION PROCESS:

The connection between ants and decomposition processes is multifaceted. Ants contribute to the breakdown of organic matter, leave distinctive markings, and influence insect succession at decomposing sites. Understanding the relationship between ants and decomposition is essential for forensic entomologists seeking to use ant-related evidence in estimating postmortem intervals and reconstructing the timeline of events in forensic investigations.





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M.Sc. Chemistry & Toxicology | M.Sc. Digital Forensics & Information Security  
M.Sc. DNA Fingerprinting | M.Sc. Questioned Document & Fingerprints

### Eligibility & Course

- \* Course:- For B.Sc. Forensic Science
- \* Eligibility:- Intermediate (10+2) in Science Stream (M.P.C/Bi.P.C) With 60% Marks
- \* Course:- For B.Sc. Cyber Forensics
- \* Eligibility:- Intermediate (10+2) in Science Stream (M.P.C/Bi.P.C) With 60% Marks
- \* Course:- For M.Sc. Cyber Security and M.Sc. Digital Forensics & Information Security
- \* Eligibility:- B.Sc. Forensic Science or Any Graduate with Computers Science as one of the subject at Graduation level
- \* Course:- For M.Sc. Questioned Document & Fingerprints and M.Sc. Chemistry & Toxicology
- \* Eligibility:- B.Sc. Forensic Science or Any Graduate with Chemistry as one of the subject at Graduation level.
- \* Course:- For M.Sc. DNA Fingerprinting
- \* Eligibility:- B.Sc. Forensic Science or Any Graduate with Biology as one of the subject at Graduation level.

### Employment Areas

- \* Central Forensic Science Laboratories
- \* State Forensic Science Laboratories
- \* Regional Forensic Science Laboratories
- \* Mobile Forensic Science Laboratories
- \* Private Forensic Science Laboratories
- \* Police Departments
- \* Police Training Centers
- \* Police Training Academies
- \* Law Firms
- \* Private Detective Agencies
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- \* Banking Sectors
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### Best Practices

- CISCO Networking Courses
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- Court Visit
- Autopsy Visit
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- Paper Mill Visit
- Expert Lectures
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# Crime Chronicles

## **COUPLE MURDERS DAUGHTERS IN RITUAL SACRIFICE, CLAIM RESURRECTION AS "SATYA YUGA" APPROACHES**

In a deeply troubling case from Madanapalle, Andhra Pradesh, V.Purushotham Naidu and his wife Padmaja have been accused of murdering their two daughters, Alekhya (27) and Sai Divya (22), as part of an occult ritual. The couple believed that by "sacrificing" their daughters, they could bring them back to life in a "purer form," convinced that the transition from the current age of "Kali Yuga" to "Satya Yuga" was imminent. This shocking incident has raised significant legal and ethical questions regarding mental health, the influence of religious beliefs, and the sanctity of human life.



Purushotham, a 55-year-old associate professor of chemistry, and Padmaja, 50, who runs a private coaching institute, reportedly engaged in bizarre rituals that included bludgeoning their daughters with dumbbells and stabbing them with a trident. Neighbors reported hearing strange noises from the house for days leading up to the incident, but the couple dismissed these concerns as part of their religious practices. On the night of the murders, Purushotham informed a friend that his daughters had been sacrificed, prompting the friend to alert the police.

Upon their arrival, law enforcement found the home in disarray, with ritualistic items scattered throughout. When police arrived, they discovered the bodies of the two young women—one in the puja room and the other in a bedroom, both showing signs of brutal violence. Alekhya was bludgeoned with a dumbbell, while Sai Divya was killed with a trident. The couple initially resisted police entry, insisting they were performing rituals. After the police entry, Alekhya was discovered in the puja room with severe head injuries, while Sai Divya was found naked in a pool of blood in her bedroom. The couple's claims that their daughters would return to life by morning only added to the horror of the situation.

The legal implications of this case are profound. Under Section 302 of the Indian Penal Code, the couple could face charges of murder, with aggravating factors such as the brutality of the crime and the abuse of parental trust. Additionally, their actions contravene the Prohibition of Human Sacrifice Act, of 1954, which explicitly forbids such acts. If convicted, they could face severe penalties, including life imprisonment or even the death penalty.

Mental health evaluations have become a crucial aspect of the investigation. Initial assessments suggest that Padmaja may suffer from a chronic psychological disorder, potentially inducing delusions in Purushotham due to their proximity during the lockdown. Reports indicate that Padmaja exhibited erratic behavior, claiming to be the human form of the COVID-19 virus, and insisted that their daughters were manifestations of divine entities. This raises questions about the couple's mental state and their ability to comprehend the gravity of their actions.

The case also highlights issues of domestic and gender-based violence, as the daughters were killed in their own home, a space that should have been a sanctuary. The societal implications of viewing female children as burdens further complicate this tragic narrative.

As the investigation unfolds, it is imperative to address not only the legal ramifications but also the underlying mental health issues and societal attitudes that may have contributed to this horrific event. This case serves as a stark reminder of the need for increased awareness and preventive measures against such acts of violence, ensuring that the sanctity of human life is upheld in all circumstances.



## About the Author



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# PREPARE YOURSELF

## ***NET & FACT QUESTION BANK***

- 1) Inherent signs of forgery in signatures do NOT include .....?
  - A) Defective line quality of strokes
  - B) Indentation marks
  - C) Slow and hesitating strokes
  - D) Freely and speedily written strokes
  
- 2) The best method for analysis of snake poison is .....
  - A) HPLC
  - B) GC
  - C) Colour test
  - D) Immunological technique
  
- 3) Macroscopic crime scene is .....
  - A) Single crime scene
  - B) Comprised of many crime scenes
  - C) Vehicular crime scene
  - D) None of the above
  
- 4) Who first explained the Friction Ridge Skin Pattern with drawings ?
  - A) Sir Francis Galton
  - B) J.C.A. Mayer
  - C) Henry Faulds
  - D) William Herschel
  
- 5) Which of the following statements about fingerprints is NOT true ?
  - A) Fingerprints are unique for every human being.
  - B) Fingerprints are no more similar between two family members than between two strangers.
  - C) Even identical twins do not have identical fingerprints.
  - D) Fingerprint patterns do not change with growth or age.
  
- 6) Metabolite of ethyl alcohol is .....
  - A) Formaldehyde
  - B) Formic acid
  - C) Acetaldehyde
  - D) Acetone

- 7) The type styles of standard type writers can be classified as under .....
- A) Pica with ten letters an inch
  - B) Elite with ten letters an inch
  - C) Pica with eight letters an inch
  - D) Elite with eight letters an inch
- 8) Eruption of permanent maxillary canine tooth in humans happens between .....
- A) 5-6 years
  - B) 11-12 years
  - C) 8-9 years
  - D) 14-15 years
- 9) Following are the primary components of paint except .....
- A) Additive
  - B) Binder
  - C) Solvent
  - D) Pigment
- 10) FT Raman Spectroscopy is useful in the Forensic Analysis of .....
- A) Intermittent pen emphasis & pressure
  - B) Erasures
  - C) Obliterations
  - D) Inks
- 11) When layer of plastic is sandwiched in between two pieces of ordinary glass form ..... glass.
- A) Tempered
  - B) Borosilicate
  - C) Float
  - D) Laminated
- 12) In 1902, Henry (Harry) Jackson became the first person in the United Kingdom to be convicted on fingerprint evidence. What was his crime ?
- A) Burglary
  - B) Blackmail
  - C) Embezzlement
  - D) Kidnapping
- 13) Select the one which belongs to benzodiazepine group ?
- A) Zolpidem
  - B) Ketamine
  - C) Pethidine
  - D) Clonazepam

14) Acromion process is present in .....

- A) Fibula
- B) Pelvis
- C) Scapula
- D) Humerus

15) Culpable Homicide is defined under \_\_\_\_\_.

- A) IPC, 299
- B) IPC, 302
- C) IPC, 300
- D) IPC, 298

16) Which of the following statements is not true?

- A) Plastic fingerprints involve the deposition of material onto a surface.
- B) Latent fingerprints are invisible to the naked eye.
- C) Plastic fingerprints are three dimensional.
- D) Latent fingerprints require development in order to make them visible.

17) Power alcohol consist of .....

- A) Ethanal 99.9 percent
- B) Mixture of ethanol and methanol
- C) Mixture of ethanol and petrol
- D) Pure methanol

18) What is Visible light's wavelength range?

- A) 400 - 700 mm
- B) 400 - 700 nm
- C) 400 - 700 cm
- D) 400 - 800 nm

19) Automotive paint can assist investigator to determine .....

- A) Colour
- B) Model
- C) Manufacturer
- D) All

20) Explosive limit for ethanol is .....

- A) 4.0-4.9 percent
- B) 3.0-19.0 percent
- C) 7.7-8.9 percent
- D) 10.0-16.0 percent

# IS THIS A NEW ADVANCEMENT ?

## **Video Spectral Comparator (VSC 9000): A Device for Forensic Document Analysis**

### *WHAT'S IT ALL ABOUT?*

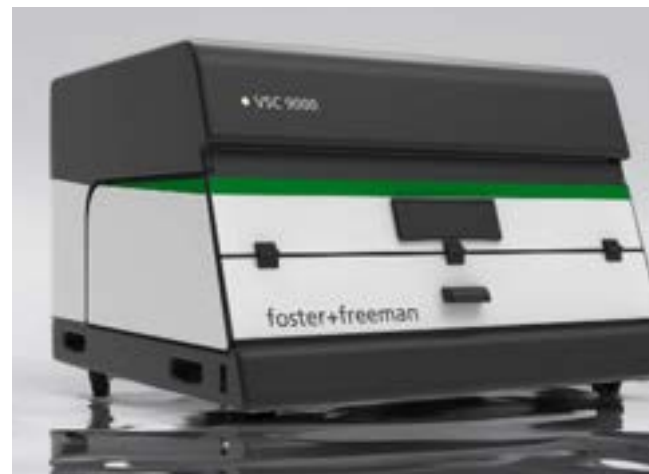
Forensic document examination is a critical field in criminal investigations, involving the analysis of documents to determine their authenticity, origin, and possible alterations. One of the most advanced tools in this domain is the Video Spectral Comparator (VSC 9000). The VSC 9000 is an essential device used by forensic experts to examine various security features and detect forgeries in documents such as passports, ID cards, banknotes, and other important papers.

### *QUICK OVERVIEW*

The VSC 9000 is a sophisticated forensic instrument designed by Foster + Freeman, a leading manufacturer of forensic science equipment. This device combines a range of advanced imaging techniques, including visible, infrared, and ultraviolet light, to analyze the physical and chemical properties of documents. The VSC 9000 enables forensic document examiners to uncover hidden security features, detect alterations, and identify counterfeit documents with a high degree of accuracy.

### *KEY FEATURES*

- **Multispectral Imaging:** The VSC 9000 uses multispectral imaging to examine documents under various wavelengths of light, uncovering hidden details and features not visible under standard lighting conditions. It captures images in ultraviolet (UV), visible, and infrared (IR) spectra, providing a thorough analysis of the document.
- **Hyperspectral Imaging:** Expanding on multispectral imaging, hyperspectral imaging captures a broad range of wavelengths, offering detailed information about the document's material composition. This feature is particularly useful for identifying inks, pigments, and other substances used in document creation.





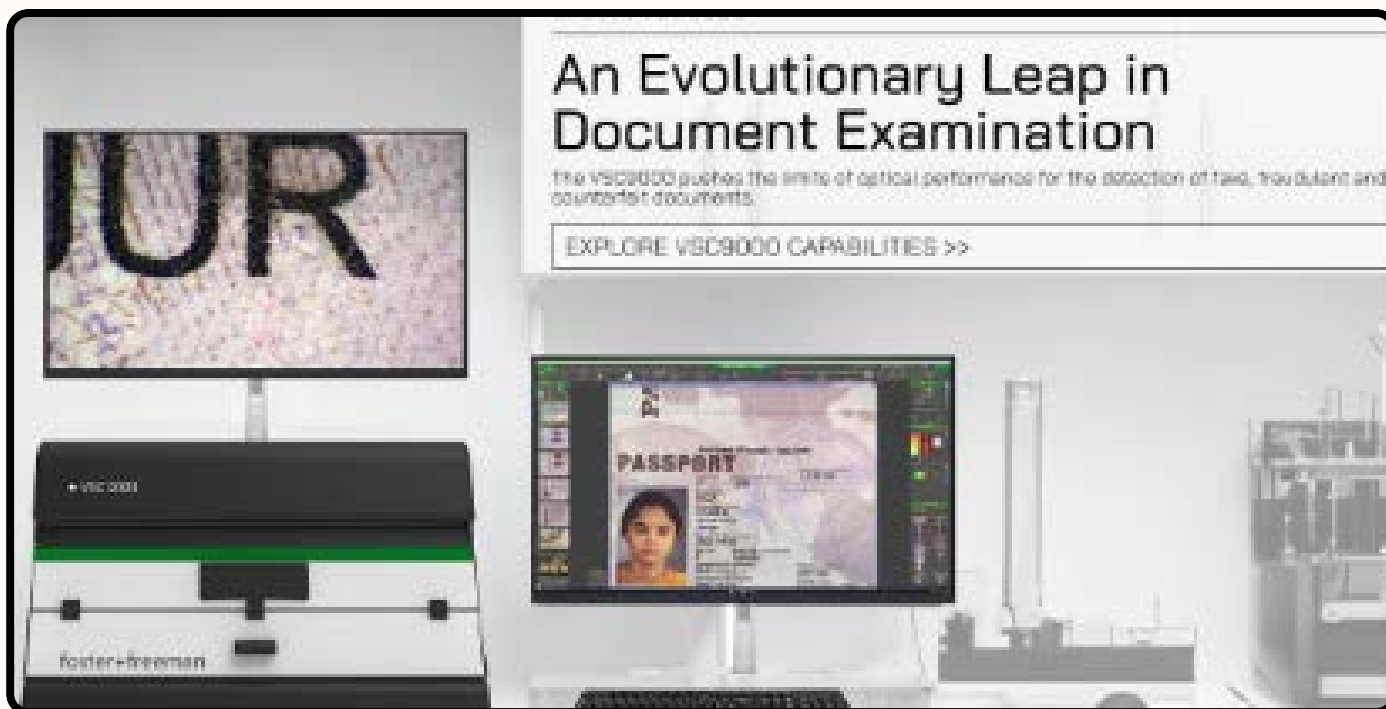


Figure. Video Spectral Comparator (VSC 9000)

- **High-Resolution Imaging:** Equipped with high-resolution cameras, the VSC 9000 can capture intricate details of a document. This capability is crucial for examining fine features like microprinting, security threads, and holograms, which are commonly used as security elements in high-value documents.
- **Image Enhancement and Analysis:** The device includes advanced software for enhancing and analyzing images. This software allows forensic experts to improve the visibility of faint or obscured features, measure dimensions precisely, and compare questioned documents with known samples.
- **Document Examination Modes:** The VSC 9000 provides various examination modes, such as transmitted light, coaxial light, oblique light, and side light. Each mode highlights different document features, facilitating a comprehensive examination.
- **Spectral Comparison:** A key feature of the VSC 9000 is its ability to perform spectral comparisons. By analyzing the spectral characteristics of questioned and known documents, forensic experts can determine if the documents were created using the same materials and methods.
- **Database Integration:** The device can integrate with databases containing information on known security features of various documents. This integration allows for rapid verification and comparison, streamlining the examination process.
- **Authenticating Passports and IDs:** Passports and ID cards often contain numerous security features, such as watermarks, holograms, and microprinting. The VSC 9000 can detect these features and identify any discrepancies, helping to determine the document's authenticity.
- **Detecting Alterations and Forgeries:** Alterations, such as changes to text or images, can be challenging to detect with

## *FORENSIC APPLICATION*

the naked eye. The VSC 9000's advanced imaging capabilities can reveal such modifications by highlighting differences in ink composition or document structure.

- **Analyzing Banknotes and Currency:** Counterfeit currency is a significant concern worldwide. The VSC 9000 can examine the intricate security features of banknotes, such as security threads, color-shifting inks, and microprinting, to identify counterfeits.
- **Examining Legal Documents:** Legal documents, such as contracts and wills, may be subjected to forgery or alterations. The VSC 9000 can help forensic experts verify the authenticity of signatures and detect any changes to the original content.
- **Investigating Art and Historical Documents:** The VSC 9000 is also used in the examination of artworks and historical documents. It can reveal underlying sketches, changes made by the artist, and identify the materials used, providing valuable information about the artwork's history and authenticity.

## *ADVANTAGES*

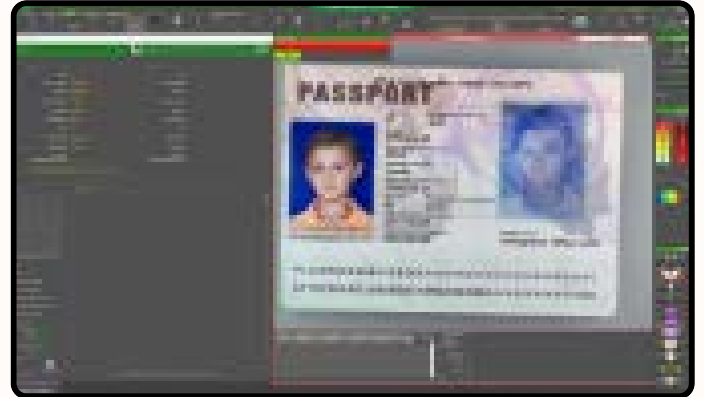
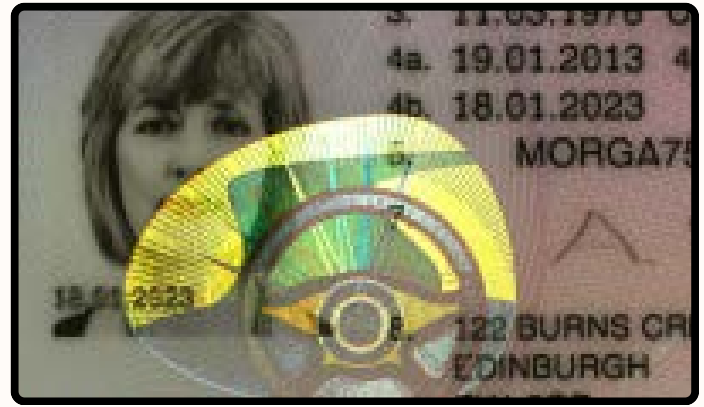
- **Accuracy and Reliability:** The VSC 9000 provides highly accurate and reliable results, making it an invaluable tool in forensic investigations. Its ability to reveal hidden features and detect alterations ensures that forensic experts can make informed decisions based on solid evidence.
- **Non-Destructive Analysis:** One of the key advantages of the VSC 9000 is that

it performs non-destructive analysis. This means that the document being examined is not damaged or altered in any way during the analysis, preserving its integrity for future examinations.

- **Comprehensive Examination:** The combination of multispectral and hyperspectral imaging, high-resolution cameras, and advanced analysis software allows for a comprehensive examination of documents. This multi-faceted approach ensures that all aspects of the document are thoroughly analyzed.
- **Enhanced Efficiency:** The VSC 9000 streamlines the document examination process, reducing the time required for analysis. Its integration with databases and automated features enables quick comparisons and verifications, enhancing the efficiency of forensic investigations.

## *CHALLENGES & CONSIDERATIONS*

- **Cost:** The VSC 9000 is a high-end forensic tool, and its cost can be prohibitive for some forensic laboratories, especially smaller ones with limited budgets.
- **Training:** Operating the VSC 9000 requires specialized training. Forensic experts need to be well-versed in its capabilities and software to effectively use the device and interpret the results.
- **Maintenance:** Like any advanced technological device, the VSC 9000 requires regular maintenance to ensure its optimal performance. This can add to the overall cost and operational requirements.



## CONCLUSION

The Video Spectral Comparator (VSC 9000) is a powerful and versatile forensic document examination device that has revolutionized the field of document analysis. Its advanced imaging capabilities, combined with high-resolution cameras and sophisticated analysis software, make it an indispensable tool for forensic experts. By providing accurate, reliable, and non-destructive analysis, the VSC 9000 plays a crucial role in detecting forgeries, verifying document authenticity, and supporting criminal investigations. Despite its cost and the need for specialized training, the benefits it offers make it a valuable asset for any forensic laboratory committed to ensuring the integrity and authenticity of critical documents.

**VSC®9000**

Ready to find out more?



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# ***Thank You Note***

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***Dr. N. Suguna Reddy***

**Secretary  
Aditya Degree Colleges  
Andhra Pradesh**



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