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Significance of Forensic Science Technologies in Collection of Evidences: An Analysis

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ABSTRACT

With the emerging science and technology, the patterns of committing crime are also developing. To tackle these new patterns of crimes the Indian Courts with the help of forensic science in India came up with different innovative investigative strategies to bring justice through criminal justice system. Whether it is inquest report or a report of post-mortem, every report concerns with use of these advanced technologies deduced under the forensic science. There are few advanced technologies which are being used widely in India are Virtopsy, DNA Test, Forensic Dactylography and Forensic Podiatry, etc. These forensic tools are evident to the criminal justice system as they provide precise evidences in order to hold the accused guilty. Apart from these, Mobile forensic and Computer forensic are the one such tools which now-a-days are advantageous to the cyber-crime in this dot com era. As in one hand these tests are like a boon to the criminal justice system to proof the crimes committed by the accused extracting the hidden information from them resulting in speedy trial, on the other hand even though the Court allows, the journey between the moment when power shifts to the police to the getting opinion from the expertise, that leads coercion and violation of right to self-incrimination as well as intrusion to the person's mental privacy which includes Deception Detection Tests like Narco-Analysis test, Polygraph test and Brain Mapping test. These tests are one such innovative strategies of collecting evidence which always remains in debate due to its constitutional validity. In this paper, the author made an attempt to give analysis on the significance of these emerging technologies and the way it conducted by the experts which makes it reliable to collect it as evidence and admissible in the criminal justice system.

I. INTRODUCTION

In 21st century almost in all the cases where the deceased person indicates sudden, suspicious or unnatural cause of death a legal enquiry is done which is also termed as 'inquest'. There are four kinds of inquests, i.e. inquest of police[2], inquest of magistrate[3], inquest of coroner[4], inquest

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[2] Held under section 174 of the Code of Criminal Procedure, 1973.

[3] Held under section 176 of the Code of Criminal Procedure, 1973.

[4] In the 19th century, the Coroner's inquest was very prominently used at Calcutta (now Kolkata) and Bombay (now Mumbai) under the Coroner's Act, 1871; however, it was abolished in Kolkata way back and was

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of medical examiner's system[5]. However, in India solely two types of inquest are used i.e. police and magistrate's inquest. When any dead body found unidentified, it is the duty of the police officer ranking below a superintendent or police chief of a police station to inform the nearest magistrate about such matter and prepare an inquest report which will include the details of the dead body found during the investigation.[6] But in case where the police found some doubts concerning the cause of the demise of the deceased person, the police officer forwards the dead body to the medical examiners for postmortem examination.[7] Even in the cases of rape and other cognizable offences the victim or the dead body of the deceased is sent to the medical examiner for medical examination by the sub-inspector of police along with the statement recorded in the vernacular.[8]

II. VIRTOPSY

'Dead man tells no tales'; this is one of the old sayings which is been proven wrong at present due to inventions in the field of forensic science. A corpse when investigated by the medical experts, it helps to establish its identity, time and cause of death, linkage through its clues to the real culprit. An older form of autopsy begins with an outer examination of the body where the experts try to look thoroughly in to any wounds, markings or trace evidences can be found and after that the dead body is dissected in a Y incision from the shoulders to chest followed down to the pubis.[9] Herophilus known as the foremost person to execute methodical anatomy of the human body due to which he was often regarded as the father of the anatomy.[10] He carried out the first known autopsies in the history of the human anatomy in order to characterize the course of disease. As a result, he made phenomenal discoveries of the human body with respect to

discontinued in Mumbai since July 29th, 1999. At that time, a coroner may be a doctor or a lawyer or both holding the position of Officer Rank of First Class Magistrate appointed by State Government. Under Coroner's Act, a coroner had the power to inquire all death cases where the cause of death is suspicious or unnatural or even occurred in the jail. After examination of the body, he was empowered to decide whether the deceased body required to send for autopsy or to hand over to its legal heirs.

[5] The medical examiner's system is prevalent in the countries like USA, Canada and Japan where the inquest is done by the medical examiners having knowledge of forensic pathology. In India this system is not followed. However, this system is considered as superior to all other types of inquest systems, as the forensic pathologist has both medical and scientific knowledge with little amount of legal background.

[6] The Code of Criminal Procedure, 1973, Sec. 174.

[7] B V Subramanyam, Modi's Medical Jurisprudence and Toxicology, 4 (Lexis Nexis Butterworths, New Delhi, 22nd ed., 2001).

[8] Ibid.

[9] Anupama Singh, Autopsy, Forensic's Blog, https://forensicfield.blog/autopsy/, last visited on Jun. 8, 2022.

[10] Noel Si-Yang Bay & Boon-Huat Bay, Greek anatomist herophilus: the father of anatomy, Vol. 43, Issue 4, Anatomy & cell biology, 280-283, Dec. 2010.

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angiology[11], neurology[12], gastroenterology[13], gynecology[14] or andrology[15], ophthalmology[16], etc. However, after that for almost 1800 years the dissection of the human body was abandoned till mid-16th century. Later on, in 1752 when Murder Act was enacted in England, the surgeons are allowed to dissect the bodies of the executed criminal for committing crime instead of publicly hanging them on a gibbet. In 1800, as a part of the medical education William Osler was credited for teaching autopsy.[17] The derivation of 'autopsy' refers to the doctor scrutinizing a corpse, and the combination of the expressions "autos" and "psia" meaning "own" and "view" respectively.[18]

With the advancement in the technology, the forensic pathologists as well as anatomists found a new helping hand for examination of corpses, i.e. 'Virtopsy'. It is a mixture of two words 'virtual' and 'autopsy'. The team of Michael Thali in his project for the first time coined the term 'virtopsy', where the expression virtual is deduced from the Latish word 'virtus' elucidated as 'useful, efficient and good' and 'autopsy' meaning 'to see with ones own eyes'.[19] Virtopsy is a new procedure of autopsy which comprises of the intramural inspection of the corpses by implementing Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) and that is even unaccompanied by dissecting the body or parts of the body by reconstructing three dimensional perspective of the anatomized corpse.[20] Being a scalpel free and non-invasive imaging technique, it can be digitally stored for decades. Moreover, since this technology does not require any mutilation of the body, hence it can be accepted widely due to certain religious customs where incisions are not recommended after death. Virtopsy can be used to determine the number of cases related to timing of death, identification of an individual including age and gender, death of a person in case of drug abuse, road traffic accidents, hanging and manual strangulations, death due to burns, death due to drowning, gunshot wounds, etc. Virtopsy found very advantageous in the realm of forensic science to the forensic experts due to its easy

[11] Angiology is the study of cardio-vascular system.
[12] Neurology is the study of nervous system.
[13] Gastroenterology is the study of digestive system.
[14] Gynecology is the study of female reproductive system.
[15] Andrology is the study of male reproductive system.
[16] Ophthalmology is the study of parts of the eyes.
[17] Yogish P & Asha Yogish, Virtopsy: New phase in forensic odontology, Vol. 02, Issue 06, International Journal of Dental and Health Sciences, 1548-1555, 2015.
[18] Ademir Franco, Paulo Henrique Couto Souza, et al., Virtual autopsy in forensic sciences and its applications in the forensic odontology, Vol. 27, Issue 1, Revista Odonto Ciencia ,5-9, Mar., 2012.
[19] Michael J Thali, Christian Jackowski, et al, VIRTOPSY- the Swiss virtual autopsy approach, Vol. 9, Issue 2, Leg Med (Tokyo), 100-104, Mar., 2007.
[20] C. Pomara, V. Fineschi, et al., Virtopsy versus digital autopsy: virtual autopsy, Vol. 114, Issue 8, Radiol Med., 1367-1382, Aug., 2009.

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accessibility, 3D illustration, and digital re-examinations of the body even after liberation of the crime scene and rotting or burial of the corpses.[21]

III. DNA TEST

DNA stands for Deoxyribo nucleic acid which acts as a genetic blueprint in the human body. It is a key to determine the identification of criminals based on their scientific configuration unless the instances of monozygotic twins. The samples of DNA can be collected from blood traces, saliva, urine, skin tissues, semen and even sweat. The color of skin, type of hair, nails, shape of tongue, eyes, etc. all these characteristics of a human being can be decided from DNA. Thus, DNA test is one of the widely used techniques to apprehend a suspect. In every living thing, a cell acts as a basic building block, which stores genetic information in the form of DNA. From a bacterium to a living human organism, every organism on human earth has either eukaryotic cell[22] or prokaryotic cell[23] containing chromosomes in the nucleus. These chromosomes are made up of two complimentary strands[24] of DNA which carries the genetic information used in the development, functioning and reproduction of all organisms. And hence this technique can be used extensively to solve both the civil and criminal cases related to inheritance, parentage dispute, rape, murder, assassination, kidnapping, etc. In order to test identity, the two basic techniques used with the help of DNA are DNA fingerprinting and DNA profiling which also includes DNA typing.

Currently, the techniques used by forensic experts includes Restriction Fragment Length Polymorphism (RFLP)[25], typing of Variable Number of Tandem Repeat (VNTR) Loci, amplification of the number of target DNA molecules by the Polymerase Chain Reaction (PCR) and subsequent typing of specified genetic markers.[26] In the year 1984, Sir Alec Jeffreys introduced the foremost application of DNA profiling test which embraced the exposure of a multi-locused RFLP pattern.[27] However he declared his discoveries in the year 1985. Even,

[21] Raj Kumar Badam & Triekan Sownetha, et al., Virtopsy: Touch-free autopsy, Vol. 9, Issue 1, Journal of Forensic Dental Sciences, 42, Apr., 2017.

[22] Eukaryotic cells are found in protists, fungi, plants, animals and human beings.

[23] Prokaryotic cells found in bacteria and archaea which consists of a single cell.

[24] DNA consists of four nitrogenous bases known as Adenine, Thymine, Cytosine and Guanine. These nitrogenous bases are arranged in a regular structure with phosphoric acid. Thus, it forms a polymer of nucleotides, which are the units strung together to form a DNA strand. The backbone of a DNA strand is formed by a sugar base component and a phosphate group. The DNA molecule is composed of two strands coiled in a double spiral which looks like helix in structure.

[25] It is a commonest method used for DNA typing.

[26] Sinisa Franjic, Legal aspects of Forensics, Vol. 4, Issue 1, Forensic Science Today, 009-017, Apr., 2018.

[27] Norah Rudin and Keith Inman, Forensic Science Timeline, Jul. 2002, http://plaza.ufl.edu/jhefner/forensic_Timeline.pdf, last visited on Jul. 9, 2025.

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Rapid DNA is one of the new forensic technologies which are applied to portray the entire automated operation of incubated DNA profile without intervention of any human from a reference sample such as buccal swab.

Almost in ever criminal cases, the DNA test is widely used. The DNA profiles found on victim's rape kit from the semen stain can lead to a potential suspect.[28] According to the INTERPOL data, currently INTERPOL's DNA database which is created in 2002 contains more than 2,47,000 profiles contributed by almost 84 member countries.[29] However, the rise in the steady expansion on the use of DNA database has raised various questions with respect to human rights and their privacy. Recently, in July 2019, India launched 'The DNA Technology (Use and Application) Regulation Bill, 2019' in the lower House of the Parliament of India (Lok Sabha), with an objective to set up DNA database in the country same as UK. So far, in various police investigations, DNA profiling was used widely and the reports made by the experts from the evidences collected are used in the Indian Legal System but still India didn't have its any databases of its own. After passing this Bill in the Lok Sabha, India came among 89th countries that use DNA databases. However, this DNA Bill of 2019, much like its predecessor has been received widespread criticism.[30] Undoubtedly, a national DNA databank can help tremendously in the criminal matters irrespective of ethical concerns but the question still arises is at what cost the fundamental right of privacy can be infringed for the sake of the greater good in the society. A national DNA database can help in solving the cases of missing persons. In India, 11 states accounted for 80% of the missing children in the year 2019, i.e. about 73,138 children where the number of girls is comparatively higher than the boys.[31] A huge amount of DNA database can help in solving cases within short span of time but these data can reveal a person's ethnicity, caste and even skin color that it can be easily used to link inappropriate manner with particular caste or community based criminal activities. An alarming concern which is raised on the bill is the scope of caste based and minority-based profiling as these databases can be misused for criminal activities.

[28] Henry C. Lee & Elaine M. Pagliaro, Forensic Evidence and Crime Scene Investigation, Vol. 1, Issue 2, Jounal of Forensic Investigation, 01-05, Sep., 2013.

[29] https://www.interpol.int/en/How-we-work/Forensics/DNA, last visited on Jul. 10, 2025.

[30] Sadhana Swaminathan, establishing a National DNA Database in India, YL Cube (Jun. 4, 2025, 2.40 PM), https://ylcube.com/l/blog-posts/blogs-collection-0/2022/06/04/establishing-national-dna-database-india/, last visited on Jun. 20, 2025.

[31] Pavithra K M, Data: Number of 'Missing Children' cases increases to 1.2 lakh in 2019, Factly (Nov. 6, 2020), https://factly.in/data-number-of-missing-children-cases-increase-to-1-2-lakh-in-2019/, last visited on Jun. 15, 2025.

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IV. FORENSIC DACTYLOGRAPHY AND FORENSIC PODIATRY

The Dactylography is nothing but the scientific study of fingerprints of human beings which found to have the same unique identifications like DNA. The fingerprints consist of three main patterns termed as arches, loops and whorls. These minute details of fingerprint patterns are unique because of its shape, size, number and arrangements in the human beings. Even in the Biometrics, the use of fingerprints is widely used as neither the fingerprint changes after getting old nor the deep or basal layer is dissipated after deliberately changing it by plastic surgeries.

Now-a-days with the invention of Biosensors, forensic experts are capable of tracing the nanoscopic marks or clues of body fluids originated in the fingerprints to recognize the doubtful person and to analyze fingerprints. These data can be used to detect age, medications, gender as well as even lifestyle of the subject. However, these biosensors can also be utilized to detect other body fluids found in the crime scene.[32] At present there are various tools are invented in order to analyze the fingerprints. Micro-X-Ray Florescence is one of the novel techniques utilized to recognize dactylogram by quickly unfolding the fundamental configuration of a specimen by illuminating it with a sheer beam of X-rays without interfering the sample.[33] Magnetic Fingerprinting and Automated Fingerprint Identification (AFIS) are one of the newest inventions through which police officers as well as crime scene investigators can rapidly and readily differentiate a dactylogram in a homicide scene with a comprehensive virtual database and that is even without contamination of the evidence. The automatic fingerprint identification system is an international fingerprint database which is run by INTERPOL. According to the INTERPOL data, this system comprises over 220,000 dactylogram inscriptions and more than 17,000 crime site traces.[34] In 2019, above 1,600 identifications are furnished by INTERPOL in consequence of high sharing and juxtaposition of fingerprint particulars by member countries.[35]

The recent advancement in the sector of forensic science have made the invention of the new field 'Forensic Podiatry', this is the study of the footprints of an individual found at the crime scene. The footprints are the indentations or image abandoned by the perpetrator of the crime, walking or running.[36] In the early 1970s, is field of forensic science is introduced in the

[32] Kimmy Gustafson, 9 Modern Forensic Science Technologies, The Forensic Science Education Blog, https://www.forensicscolleges.com/blog/resources/10-modern-forensic-science-technologies#:~:text=Forensic%20scientists%20can%20now%20use,found%20at%20a%20crime%20scene., last visited on Jun. 28, 2025.

[33] https://forensicsdigest.com/8-new-forensic-science-tools-and-technology/, last visited on Jun. 30, 2025.

[34] https://www.interpol.int/en/How-we-work/Forensics/Fingerprints, last visited on Jul. 10, 2025.

[35] Ibid.

[36] Vijay Panchal & Rakesh Mia, Detection of Footprint Impressions at the Scene of Crime- A Review, Vol. 15, Issue 4, Journal of Forensic Sciences and Criminal Investigation, Mar., 2022.

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countries like Canada and UK. This technique includes the identification of human footprints; footwear and gait[37] patterns accumulated from the place of the crime or captured from any CCTV footages. Now-a-days, gait analysis is extensively used in the Indian reform system to identify the suspects from the present evidences. Based on the individual characteristics of the heel and the toe region, the analysis of bare footprints includes ridges, flat footings, extra or missing toe, cuts, pits, humps, creases, deformities and various other features which may link the culprit with the crime scene. The Podiatrist Hayden Kelly was the first to discovered, introduced and made admissible Forensic Gait Analysis as the evidence in the law enforcement system in the year 2000 at Old Bailey Central Criminal Court, London, UK. However, in India the study of footprints is still perceived as rudimentary science.[38] Though, the naked-eye footmarks are frequently observed and accepted in the Indian legal system which provides sometimes positive evidences. In 1862, for the first time the foot-impression is used as evidence in the criminal investigation for murder of women by Jessie McLachlan for which he was subsequently convicted. The footprint can act as important physical evidence found in the crime scenes but still it is ignored considering unimportant even in the initial stage of the investigation.

V. COMPUTER FORENSICS

Computer Forensics synonymize with computer crimes, cyber-crimes, e-crimes, net crimes or even electronic crimes. It handles all sorts of crime evidences legally found on the computer and relates digital storage devices, which includes hard disks, files, and concerned software. These computer crimes basically include identity thefts, hacking, spams, and financial frauds. The computer forensics helps in search of the criminals' using computers and internet in committing most traditional crimes such as theft, blackmail, pornography, forgery, embezzlement, fraud, money laundering, which today are still committed in the wider scale. In India the incidence of computer crime is relatively lower than any other developed countries, and the reason being that the computerization is yet in its developing stage. Besides that, the crime is high tech crime, and in order to commit such one must be skilled and professional in this field. However, in about one decade, the official figures of computer crime have gone sky high. There are number of different crimes has been registered under Information Technology Act, 2000 which includes tampering of computer documents, hacking, obscene publications or transmission in electronic media, unauthorized access or attempt to access the protected computers, breach of privacy, sharing of confidential reports, digital signatures, etc., according

[37] Gait means the style of walking of a person.

[38] Arya Ajith, Using Forensic Podiatry in Investigation, Legal Desire (Oct., 2020), https://legaldesire.com/using-forensic-podiatry-in-investigation/, last visited on Jul. 6, 2025.

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to the National Crime Bureau Data.

The Computer Crimes are classified into three categories firstly, internet crimes, secondly, computer frauds, and thirdly, computer crimes. The computer crimes include hacking, logical and time bombs, e-mail bombing, induction of virus or worm, introduction of Trojan horse, child pornography, blocking of services, defamation, false propaganda, espionage, disruption of financial services, tax evasions human trafficking drug trading, etc. In all of these the most severe crime is grouped under organized crime which includes child pornography, obscene films circulations, smuggling of drugs and human trafficking. Internet and computers promote them with vehemence.

Computer forensic investigations involve high computer technologies. Computer technologists have to know not only but he has to understand the mechanizations of the computer forensics criminal and to tackle his depredations and evidences thereof to pin him with the crimes. There are number of tools used by computer forensics like steganography[39], X-ways Forensics[40], SANS[41] Investigative Forensic Toolkit (SIFT)[42], EnCase[43], Computer Online Forensic Evidence Ext (COFEE)[44], Bulk Extractor[45], Registry Recon[46], Forensic Toolkit (FTK)[47], etc. A relatively new technology which has been introduced in the Computer Forensics is the use of Computerized Facial Recognition paired by administration of automated biometrical software. It is proposed by the Bureau of Law Enforcement throughout the globe in order to single out an

[39] Steganography is the process of searching pornography images and incriminating evidence is often hidden in other innocuous images. Computer forensics scientist can fight this by the hashing the file and comparing it to the hash of the original image. The images appear different if it contains steganographic writing/images.

[40] X-Ways forensics is an advanced work environment for computer forensic examiners. X-ways forensics is more efficient to use after a while, often run faster, finds deleted files X-Ways forensics is fully portable.

[41] SANS stands for SysAdmin, Audit, Network and Security Institute

[42] SANS Investigative Forensic Toolkit (SIFT) is a multi-purpose forensic operating system which comes with all the necessary tools used in the digital forensic process. It comes for free of charge and contains free open-source forensic tools.

[43] EnCase OS another popular multi-purpose forensic platform with many nice tools for several areas of the digital forensic process. This tool can rapidly gather data from various devices. EnCase can be utilized to examine Active, Latent and Archival data without altering the evidence. It also produces a report based on the evidence.

[44] Computer Online Forensic Evidence Ext (COFEE) is a tool kit developed by Microsoft to gather evidence from windows system. It can be installed on a USB pen drive or external hard disk. Just plug in the USB device in the target computer and it starts a live analysis. It comes with 150 different tools with a GUI based interface to command the tools. It is fast and can perform the whole analysis in as few 20 minutes.

[45] Bulk Extractor is another important and popular digital forensic tool. It scans the disk images, file or directory of files to extract useful information. It is faster than other available similar kinds of tools. It is basically used by Intelligence/law enforcement agencies to solve cyber-crimes.

[46] Registry Recon extracts the registry information from the evidence and then rebuilds the registry representation. It can rebuild registries from both current and previous windows installations.

[47] Forensic Toolkit (FTK) is able to make forensic copies and "hash" the evidence. FTK is easy to use and provides an investigator with the ability to view Active, Latent and Archival data without altering the evidence.

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individual of undivided attention after identifying a personality by collating and scrutinizing samples and configuration of the subject's ocular attributes and lineation. This system is known as the INTERPOL Face Recognition System (IFRS) which controls the facial resemblance of humankind conceded from over 179 countries thus making it novel criminal database worldwide.[48] According to the data of INTERPOL, since the INTERPOL's facial recognition system has been launched, by the culmination of 2016 verging from 1,500 terrorists, criminal, absconders, targeted personality or unaccounted or lost living souls have been elucidated.[49]

VI. MOBILE FORENSICS

Mobile Forensics also known as cell phone forensics is a branch of digital forensics. It is concerned with the crimes involving a cell phone which helps to recover digital evidence or data from a cell phone. Cell phone forensics helps to preserve and recover the evidence or data from the device observing scientific principles and legal formalities, without, compromising the original evidence in the device. Cell phone forensic experts often use a cell phone or PDA synchronization software to 'back up' device data to a forensic computer for imaging. Often, they process the evidence from the computer's hard drive of an individual with uncertainty. The recent advancements in the technology have given mushroom growth of telecommunication worldwide. In India, telecommunication was introduced in the year 1882 and almost after 100 years on 15th August, 1995 for the first time on the non-commercial basis first mobile telephone service started as well as internet was introduced. However, with the advent of internet and privatization of the telecommunication networks India became very soon the second largest country with the telecommunication network in the world. Now-a-days, telecommunication has become a part of a life of every Indian citizen. In this *dot com* era a person is looked with surprise if he is not a mobile user.[50] The use of internet has become so necessary in order to be updated in this modern era. The social sites and the messenger apps used in the phones in order to connect with friends, relatives and with the world are more concerned with ensuring the customer data privacy and burying them into the protected area of the cell phone in encrypted data.[51] Therefore, in order to curb up this situations, a new discipline has been came forward and introduced in the field of forensic science, i.e. 'Mobile Forensics'. The term mobile forensic refers to the seizure, acquisition and analyze evidence stored on mobile devices for use in

[48] https://www.interpol.int/en/How-we-work/Forensics/Facial-Recognition, last visited on Jul. 10, 2025.
[49] Ibid.
[50] Nikhil A. Gupta, Mobile Cell Phones and Cyber Crimes in India: How Safe Are We?, Bharati Law Review, Manupatra, 18- 23, Apr.-Jun., 2014.
[51] Dirk Pawlaszczyk, Mobile Forensics- The End of a Golden Age?, Vol. 15, Issue 4, Journal of Forensic Sciences and Criminal Investigation, Feb. 2022.

court.[52] The mobile forensics is a part of digital forensics where 85% of crime investigation includes electronic evidence. However, it is a matter of concern that whether the crimes committed through cellphones come under the purview of cybercrime. The common cybercrimes committed through mobile phones are Bluebugging[53], Vishing[54], Malware[55], Smishing[56], and Stalking[57].

VII. DECEPTION DETECTION TEST (DDT)

Deception Detection Tests are one such tests conducted by administering certain drugs to the accused leading him to semi-conscious state of mind to gather material information for the cases to which he is suspected. These are psychophysiological tests designed to understand psychological behavior of the person whom it is administered, through their physiological measure. The three types of DDTs which are intensively used are Narco-Analysis test, Polygraph test and Brain Mapping test.

Narco-Analysis Test or Truth Serum Test

The term Narco-Analysis is extracted from the Greekish expression 'narck', connotes 'anesthesia' or 'torpor' and the title was formulated by Sir Horseley.[58] In 1922, it occurred to Robert House, an obstetrician in Dallas, Texas that the technique adopted in early twentieth century by physicians of employing scopolamine in addition to morphine and chloroform to instigate predicament of 'twilight sleep' in the course of accouchement, could be used in the interrogation of suspected criminals.[59] Later on by interviewing few prisoners charged with the criminal offences he concluded that any patient under these drugs cannot lie as the ability to think or reason reduces. This experiment was attracted by wide attention and lead to the origination of idea of truth serum. Hence it is also known as 'Truth Serum Test'. In Narco-Analysis Test the drugs widely used are Sodium Amytal, Pentathlon Sodium and Barbiturates.

[52] Ibid.

[53] Bluebugging allows hacker to tack control over phones through its Bluetooth technology.

[54] Vishing is a tool for committing financial crime by using mobile, where the motive of the hacker is getting easy money.

[55] Malware is a designed program used to perform malicious activities and can be entered in to the cellphones through SMS, file transfer, downloading programs from internet, etc.

[56] Smishing is a security attack in which the user is sent an SMS posing as a lucrative service that indulges them into exposing their personal information like internet banking passwords, credit card details, email ID and passwords, etc. which can be misused later by the criminals.

[57] Stalking is punishable offence under Section 354(D) of Indian Penal Code, 1860.

[58] Nikhil Thakur, Constitutional validity of the Deception Detection Tests (DDTs), iPleaders, (Jan. 6, 2022, 4.56 PM), https://blog.ipleaders.in/constitutional-validity-of-the-deception-detection-tests-ddts/, Last visited on Jan. 6, 2025.

[59] Justice U.L. Bhat, Relevancy, Proof and Evaluation of Evidence in Criminal Cases, 188 (Lexis Nexis, Gurgaon, 1st ed., Reprint 2020).

These medicaments exert oneself on the assumption of hindering the hypothesis of decontamination of the brain, the assumption behind this is that when we produce false statements, our conceptualization are strained by the brain and resolve by the brain what is to be unveiled and what has to be veiled.[60] Narco-Analysis Test is far better than from the police's third-degree tortures in extracting evidences, but since there are no such laws or policies exist hence still it is challenged on the grounds of constitutionality.

Polygraph or Lie-Detector Test

Polygraph test or Lie Detector Test is also known as Psych-physiological Detection of Deception (PDD) examination or truth verification is a big leap towards the crime handling. During the early years of 20th century psychosomatic disorders, also known as psycho-physiological disorders were studied a good deal by psychologists, psychiatrists and physiologists. "Psychosomatic disorders" are certain disorders of the body or soma, which are due to psychological events, such as welling up of strong emotions. The psychosomatic theorists believe that a close relationship between body and mind exists and the interaction between the two is psycho-physiological interaction. The interaction of emotions and body, when a person tells lies, causes certain changes in the body as seen above, both visible, and invisible. The latter is more subtle and autonomic. They are detected through instruments and the process is called lie detection by the common man; or, "Psycho-physiological Detection of Deception" (PDD) by the psychologists. "Truth Verification" or "Detection of Truth" is also an appropriate name for the process. Although the theory of psychosomatic interaction appears to be a new development, yet historically it is as old as human chinking about mind and matter. There are enough instances where this theory had been applied successfully for medical diagnosis. Now this psychosomatic interaction is extensively used in lie detection of deception or truth verification. The rationale behind the principle is that when a person faces the problem of answering questions relating to a crime in which he is involved; he has to decide what answer he should give. He is worried that a truthful answer would attract punishment. He cannot give truthful answers as that would put his life and liberties in jeopardy. He, therefore, has to coin some lie for self-preservation. This mental conflict brings in certain visible and invisible physiological disturbances. The subtle ones are detected through instrumental recordings, recorded in the forms of graphs. Thus, the emotions and thinking of the subject are visualized from the physiological manifestations. The evaluations of the graphs indicate their truthful or

[60] Indu Rani, Evidentiary Value of Narco-Analysis Test, Vol.9, Issue 5, International Journal of Research in Social Sciences, 2249-2496, May, 2019.

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false nature.

The foremost technical application of this philosophy for crime investigation stem from 1895 when Lombroso carried out research on real criminal suspect and illustrated that there is an alteration in the suspect's arterial pressure and pulse rate when he tells a lie. From 1914 onwards, the experiments were pursued more seriously and intensively to establish that the feeling of guilt in a culprit induces fear of exposure and punishment. The fear, in turn, brings in physiological changes in blood pressure, the pulse rate and the respiration prominently. The experiments also indicated that these reactions are governed by the autonomic nervous system of the body and, therefore, lie, generally, beyond the conscious control of almost all individuals. The polygraph test is based on the theory of hyper-arousal[61] state which can be control or suppress through meditation, yoga or any relaxable exercises.[62]

The initial polygraph or lie detector was, in fact, a product of these early experiments. It was, however, around 1920 that Larson and Keeler, for the first time, independently developed instruments, which came to be known as a polygraph. The instrument could simultaneously record an individual's blood pressure, pulse rate and respiration during interrogation. Keeler further refined the instrument by adding the electro-dermal galvanometer to record the electrical resistance of the skin (GSR). It is this version of the instrument, which constitutes the traditional polygraph.

For successful interrogation under the PDD test, needs highly sensitive instrument. Other than that, to perform this test needs an examiner with qualified and eligible educational background, training and working experience; a subject with good mental and physical health at the time of conducting examination; proper interrogation room; background knowledge of the case; pre-interrogation interview of the subject; equipment like pneumograph[63], sphygmograph[64], electrode[65], plethysmograph[66], etc.

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[61] Hyper arousal state means an abnormal state of increased responsiveness to stimuli that is marked by various physiological and psychological symptoms such as increased levels of alertness and anxiety and elevated heart rate and respiration. This hyper-arousal state is measured on the basis of heart rate, blood pressure rate, respiratory rate, skin conductance and electromyography of the subject. However, this test has been often questioned on the basis of its reliability because this test basically triggers the emotions like nervousness, anxiety, confusion, psychosis, fear, hypoglycemia, depression, or any other kind of emotional behavior.

[62] Suresh Bada Math, Supreme Court judgment on polygraph, narco-analysis & brain-mapping: A boon or a bane, Vol. 134, Issue 1, Indian Journal of Medical Research, 4-7, Jul., 2011.

[63] Pneumograph: It is a corrugated rubber tube. It is tied around the subject's chest. It measures respiratory changes.

[64] Sphygmograph: It is an inflated cuff. It is wrapped around the upper arm. It measures the cardiovascular changes.

[65] Electrode: it is attached to the palm or fingers. It measures the Galvanic (electrodermal) Skin Response (GSR).

[66] Plethysmograph: It is a transducer. It is attached to the thumb. It measures blood volume reflecting the pulse rate.

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Brain Mapping Test

The Brain Mapping Test or P-300 test or Brain printing or profiling is based upon the study of the brains additional electrical activities stimulated by the visual recognition of familiar associative evidence. The created additional electrical activities indicate that the subject has recognized the given object. An instrument Encephalograph has been developed and patented to study these electrical activities. When a culprit a victim or witness is shown an object, a scene or a situation, which is connected with the crime, his brain recognizes the entity. Recognition creates activity in the brain. This activity is recorded by Encephalograph and the trace thus obtained is called Electroencephalogram (EEG). The brain printing can provide useful information if the following basics are met with-

i. There should be a reliable measure to record the brain stimulation this has been achieved through electroencephalograph (EEG).

ii. The existence or absence of the information with the subject. It is indicated by the response of the subject in the electroencephalograph.

iii. Brain printing is based upon the premise that the individual cannot control his train activity. The correctness or otherwise of the premise has not been proved so far.

The brain is a storehouse of all the information a subject possesses. If the subject is involved in a particular activity, he has the information stored in his brain. All the criminals and their associates have information about their criminal acts. Therefore, if we can reach this information in the brain, we can establish their involvement or innocence and also the part played by them in a particular act. Thus, it can provide foolproof evidence against them without external sources such as written or oral evidence. As the brain of the culprit always records the occurrence, therefore the evidence is always available. Recent advances in neuro-sciences have given a ray of hope that the stored information in the brain can be tapped accurately, non-invasively and objectively which can provide clinching evidence in a crime situation. However, the techniques involved need a lot of spadework before they can be provided through brain printing. It will be a big break-through (perhaps the biggest) in scientific criminal investigations. According to its protagonists it is useful specifically in White collar crimes; Burglary and theft cases; Offences against person, including murder and rape cases; Identification of terrorist, saboteurs, spies, arsonist; Identification of potential criminals or crime situations. The advantages of the technique are claimed to be always available evidence, accurate, cost effective, time effective, non-invasive, quick, no subjective element where computer process the details and interpretation and hence no bias, human-right savvy, etc.

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The process of brain printing is simple. It involves sensors which are strapped around the head in the form of a band. Then, a number of pictures like crime-relevant or crime-irrelevant are shown to the subject. The culprit's involvement is indicated by the electrical activity of the brain when crime related pictures are shown. The subject should show no additional brain electrical activities when non-crime related pictures are shown. The innocence of the subject is proved by the absence of the electrical activities when the subject is shown the mixed pack of pictures. Afterwards, the brain activity is picked up by the sensors and recorded in a computer in waveform. The electrical activity changes if the subject recognizes any familiar object, action or word at the screen. The analysis of the changes in the wave pattern indicates whether the subject recognized the particular object, action or wound, relevant to the crime and shown on the TV screen or not. If the subject was the culprit or a partner, he would recognize the item and the fact is found from the waveform. If the subject is innocent the item would not stimulate brain activity and hence no additional electrical activity will take place. In this process, unlike the polygraph method, no questions are asked. Brain printing technique to collect evidence is highly attractive. However, there are many rough corners which need smoothing before it becomes a respectable routine technique in the criminal justice system. In India, Forensic Psychology is making its mark in criminal investigation and trials and thus helping dissemination of justice in a better way. Its tremendous potentiality is bound to make inroads and gets its rightful place in the criminal justice system. There is no doubt that Forensic Psychology is a potent weapon in the fight against crime and handling criminals, to reduce their number, to induce them to follow the path on the tight side of the law. The younger generations are finding it tough to compete, to be one with the Joneses and to lead a satisfied life. Society has lost faith in religion and social values. They are increasingly marching towards crime. They need help to avoid downhill slide Psychology, in general, and Forensic Psychology, in particular, can and has to help to avoid the fall. In India the most common method used in this regarding is termed as Brain Electrical Activation Profile (BEAP) test which is also called as 'P300 Waves Test'.

VIII. Conclusion

The evidences collected from the eye-witnesses are most of the time found incorrect and vague. Even due to certain circumstances and situations the witnesses become hostile. In such situations, in order to prove the crime committed by the criminal the various disciplines of forensic science and its modern scientific technologies as well as tools acts as a gift to the Criminal Justice System. Although as early 19th century, the India has widely accepted the use of forensic evidences in the Indian legal system. Due to various ethical concerns and

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malpractices, the use of these modern scientific technologies are not accepted by the Indian courts rather they are still dependent on the time consuming hear and say evidences as well as evidences collected through eye-witnesses. According to the Technology and Innovation Report 2021[67], the India holds 43rd rank whereas USA holds the 1st rank and UK holds for the 2nd rank statistically on the basis of the readiness for the frontier technologies, which is very low compared to these developing countries. Therefore, it can be very easily concluded that these technologies favor the development of autopsies done by using the different fields of forensic science and lessens the stress of the medical experts and thereby solves the criminal matters with a short span of time.

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[67] Technology and Innovation Report 2021, 137-138, United Nations Conference on Trade and Development (UNCTAD), United Nations, Geneva, https://unctad.org/system/files/official-document/tir2020_en.pdf, last visited on Jun. 6, 2025.

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