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DACTYLOGRAPHY: The Scientific Study of Fingerprint

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Abstract: ***Fingerprint analysis has become important because of its reliability and scientific explanation in the courts. Fingerprint has three principles classification, uniqueness and identification. Now there are digital biometric scanner has the ability to access by fingerprint within a minute. This Automated Fingerprint Identification System has made easier to accessible. But the reliability would be little less than other ways to identify fingerprints. Because due to the malfunction of the scanner database can be manipulated or hacked by anyone to access the security. There are various types of fingerprints which needed to know for analyzing it. These types are 1. Patent Fingerprint(visible) 2. Latent Fingerprint(invisible) 3. Plastic/3d; to developing fingerprints there are different methods for different types of fingerprint. Fingerprint experts tend to develop fingerprint in crime scene for solving the crime. Whereas fingerprint become most important physical evidence in matter of solving crime. For developing to analyzing fingerprint expertise would be necessary for establishment. But there are various challenges for forensic experts which are distort prints, smudge prints, contaminated crime scene, database error, partial prints, etc. for the recording of the fingerprint on the wall also be challenging for experts which only can be recorded by photography. Henry classification system would be time consuming to evaluate the recorded fingerprints. Then there is chemical method to develop fingerprint due to the secretion of sweat, oil and other body fluids which make an invisible print. The outermost skin layers have various pores through where body fluid tend to secrets which is responsible for making fingerprints. To make it visible various chemical need to apply so that the secreted body fluid will react with chemical and its visibility will appear. There are some pattern types which tend to administer the individuality such as Arch, Loop and Whorl. Every pattern in itself is unique which can't be match with any other person. Another way is ridge characteristics which is also valuable way to identify fingerprint. Because of its unique characteristics which tend to differ for every person and not only one characteristics but also 14 ridge characteristics are possible to identify through fingerprint. Porescopy and Edgescopy these are other ways to identify fingerprints but it is not practicable in India right now. There are basic two ways to develop latent fingerprints powder method and chemical methods. Through powder method, various powder and brushes will be need to develop fingerprints but it need to be know the surface where fingerprints are found. In chemical method there would be various chemical compound which needed to apply for the development of the latent fingerprints.***

Keywords: Fingerprint, porescopy, edgescopy, patent, latent, arch, loop, whorl

I. INTRODUCTION

Dactylography refers that the scientific study of fingerprints for identification means, which used in Forensic Science and criminal investigation for identifying any individual. Basically, this word came from 'dactylo' meaning 'finger' and 'graphy' meaning 'study or writing'. It is a medico-legal terminology which uses as the fingerprint analysis for identification.

In 1858, Sir William Herschel a German-British Chief Magistrate of India, first used fingerprint as unique identification of individuals on civil contracts for payment authentication and identify prisoners. Herschel wrote the famous 'Hooghly Letter' to jail authority that every prisoner should be enrolled by recording fingerprints. He believed that fingerprints are unique and permanent. He used to record his own fingerprints to prove it. He is the first person who use fingerprint practically in Calcutta.

In 1888, Sir Francis Galton a British anthropologist and cousin of Charles Darwin, began his observations on fingerprints. He published his book 'fingerprint' whereas he mentioning about the individuality and permanency of fingerprint in 1892. Galton has identified unique characteristic of fingerprints which officially become minutiae and refers as Galton's details. Further he invented fingerprint classification system. In 1897, Sir Edward Richard Henry the Inspector General of Police in Bengal with the help of Sub-Inspector Azizul Haque and Hem Chandra Bose first forensic science laboratory in the world established in Calcutta, India. With the assistance of Azizul Haque and Hem Chandra Bose, Sir Henry invented Henry classification system of fingerprint. He was the first person who took fingerprint into practice legally. Later, this Henry classification system become standard for other countries when the fingerprint bureau established in Scotland Yard, 1901.

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There are lot of importance of fingerprint in Forensic Science and criminal investigation. Fingerprints are unique characteristics which is helpful to identify individuals, that's why it become more important to establish any suspiciousness for the matter of crime. The reliability of the fingerprints is valuable and reliable tool for law enforcement which is being used for more than a Century. The most important significance of the fingerprints is admissibility as a scientific evidence in the courts.

The objectives of this review paper is to know about the fingerprint analysis and its impression types, characteristics, methods for developing, implementation. Now these days' modern technology has come to all forensic laboratory for fingerprint analysis. Detecting fingerprints is one of the most important aspect for crime scene investigation faced by forensic experts. Whereas various challenges also arise like distorted prints, contaminated crime scene, partial prints, database error, etc. Why fingerprint analysis is important? How fingerprint play a crucial role to solve crime?

II. LITERATURE REVIEW

1) Holder, Robinson, Laub, U.S. Department of Justice, National Institute of Justice, The FINGERPRINT: a review literature chapter 5 Henry Classification System, it consists of various values which are different for every finger and the pattern of the finger. This values need to be evaluated which furtherance classify all the fingerprints. But there is various classification system like Battley Single-Fingerprint System which considers more easy to classify the fingerprints, whereas Henry Classification System more time consuming for evaluation. Henry Classification System need to be further explain so that it will be easily accessible.

2) Lee and Gaensslen, Advances in Fingerprint Technology, second edition, Automated Fingerprint Identification and Imaging System, chapter-8; it's been more than a Century that fingerprints is using for authentication in almost everywhere. For fingerprint identification there are various method one of them is Automated Fingerprint Identification system which refers fingerprint identification by fingerprint scanner manufacture by Digital Biometrics. Now these days, everywhere fingerprint scanner installed for identification of any individual without any documentation. But there are some challenges can be arising due to the malfunction of the scanner. And this scanner can be use against the law like by hacking the scanner intruders can access the database so security at the risk.

3) Houck, Forensic Fingerprints (2013), Sources of fingerprint residue; fingerprint residue made due to the sweat, water, oil release from skin layer. There are various skin layers which are responsible for the fingerprint residue. Through the pores of our hand these body fluids release. To detect fingerprint and developing it chemical method need to use for latent fingerprint. There are various chemicals for invisible fingerprint to become visible different chemical would be use. But chemical method for developing fingerprint need expertise. Not everyone can develop the fingerprints. It would be challenging task for forensic expert for developing latent fingerprint through chemical methods.

4) Galton, FINGERPRINTS, chapter 5 Patterns: their outlines and cores; whereas the patterns on the thumb and fingers are important to identify any individual. This refers as the principle of individuality, identification and uniqueness. According to Galton's classification there are various pattern types which are observable on fingerprints. And these pattern types are unique in every individual which has to be match for identification. Galton has further explained about the classification in his book whereas various pattern and ridges and outlines are marked with diagraph for more detailed understanding. He has explained about every pattern found on fingerprint separately. Arch, Loop and Whorl are the pattern types which used to identify individuals. These pattern types also have some basic sub-category to indicate accurate pattern.

III. RESULTS

After the reviewed literature fingerprint analysis has to be evaluated correctly without any error which is necessary for solving the crime. There are three ways that fingerprint can be analyzed which are mentioned below;

A. Pattern Identification

Pattern identification the top first way to identify any fingerprint. This method is very much accessible and less time consuming. Basically in the pattern identification there are so many things to know where as Type lines (outermost area), Core (centermost area), Delta (tri-radial point) should be known.

These Core, Delta and Type lines are important for pattern identification. But there are only three types of pattern can be found on fingerprint which are;

a. Loop b. Whorl c. Arch. These are the basic pattern types which make easier to identify any individual. Because every person got different pattern types which established the individuality and uniqueness.

B. Ridge Characteristics

Ridge characteristics are another conventional way to identify fingerprint. Generally, in forensic science there should be total 14 ridge characteristics for the questioned fingerprint. But in India there should be at least 8 ridge characteristics to identify any fingerprint. There are various ridge characteristics as follows Bifurcation, Dot or Island, Trifurcation, Enclosure, Short Ridge, Cross Over, Bridge, Ridge Ending and Hook or Spur. These characteristics are identifiable on fingerprint of any individual. Ridge characteristics would be more reliable than pattern identification. Because of its more characteristics which explain and administer the individual accurately. Ridge Tracing to identify the characteristics for fingerprint analysis. Whereas there are ridge counting which tend to focus on the numbers of characteristics found on the fingerprint. Then three type is also there for Whorl to identify differences while ridge tracing "Inner 'I' Type", "Outer 'O' Type", "Meeting 'M' Type".

C. Porescopy

Porescopy refers the study of pores of friction ridges. This was defined by Locard. Whereas pores on the friction ridges like which is responsible for releasing body fluids and making latent fingerprint. Every person is having pores on their hand which is homogeneous but the position of it and shape of the pores would be differ. In this way it can be possible to identify the fingerprint. Basically porescopy studies about shape, location, size, number and nature (closed or open). In a study it found that shape of pores can be totally different for every individual. Because shapes can be varying such as triangular, round, square, oval, elliptical, kite, flower, etc. this can make it totally unique for every individual. This porescopy is not practicable in India right now.

D. Edgeoscopy

Edgeoscopy refers that a method of fingerprint identification through the edges of individual fingerprint ridges. The unique details and characteristics of fingerprint ridge edge would vary for every individual. These details are straight, irregular, concave, pocket, jable, peaked, angular, convex, etc.

IV. DISCUSSION

After analysis of all the findings development of fingerprint through various methods has significance in forensic science. Basically only invisible print need to be developed whereas there are three methods which can make invisible fingerprint visible. So this Latent prints can be developed by these methods;

A. Physical Method

This is the basic method to develop latent fingerprints with the help of powder and brush. There are various powder and brushes which can be useful to develop fingerprint.

Powder- Black powder (only on white surface), White powder (only on black surface), Fluorescence, Magnetic powder, etc.

Brushes- Glass brush (soft), Ostrich brush (feather), Camel hair (hard), Magnetic brush

But in physical method surface also has some significance which would be porous and non-porous. It need to be known that from which surface fingerprint is going to be developed. Because on the porous surface physical method will not work to develop the fingerprint like, if fingerprints are on the wall then it only can be recorded by photography. Non-porous surface would be good for powder method. There are tape lifting method also available which tend to be destructive in nature but it is practicable. In physical method destructive and unconventional in nature would be some other things also which are corn flour, turmeric powder, vermilion, etc.

B. Chemical Method

Chemical method would be need of expertise in chemistry and lab experience which is more helpful to develop fingerprint. There are various chemicals which are mainly used to develop fingerprint in forensic science. But first we need to know why chemical method will work? Because of body fluids which secrets from various pores those are on our hands. The outermost layer of the skin is responsible for making these latent fingerprints which is invisible. So these certain chemical will allow to see the fingerprints.

1) Iodine Fuming

Iodine fuming can be useful to develop latent fingerprints easily. Iodine crystals will be look like round and grey color balls. Basically it will react with Amino Acid which release from our hand and make fingerprints. The process would be that the sample (latent fingerprint) has to be taken then some Iodine crystals need to put into a Petri dish with the sample and shake the petri dish properly. After sometime brown dirty color latent fingerprint would be visible. But it will not stay longer so we can use starch solution for not disappearance of developed fingerprint. Now after using starch solution it will appear as dark blue in color.

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2) Ninhydrin

Ninhydrin is the chemical method which is used widely for the develop of latent fingerprint on porous surfaces such as paper and cardboard. This compound also reacts with the Amino Acid which secrets from our hand. But this compound alone won't be helpful so we need to make a solution which is 0.5gm of Ninhydrin dissolved in 10 ml of Ethanol. This solution need to apply on the sample (latent fingerprint) then it has to be heated. After applying heat purple color latent fingerprint would be visible.

3) Silver Nitrate

This is another compound which use to develop latent fingerprint. Basically this compound reacts with the chlorides which is in the skin to form silver chloride a gray color. This compound will make appearance of fingerprint when it is exposing to sun or heating it. But visible fingerprint has to be recorded immediately by photography neither it will fill the background fully.

4) Cyanoacrylate

Cyanoacrylate is the compound available in the glue, but it need to be heated which will make appearance of this substance. To develop fingerprint using this substance fevikwik need to be heated then it will release as a gas. This gas will be helpful to develop latent fingerprint. This method is applicable on porous surface. Basically this substance reacts with lipid components of sweat and oil which secrets from our hand.

V. CONCLUSION

Fingerprint is the most important tool for Law Enforcement Officer and forensic science. But now these days' fingerprint become common to access the work, school and any other corporate office. Because of its security purpose which will not be easy to manipulate. Still there are some risks due to the scanner malfunction or hacked the scanner to access the database. There are various ways to analyze fingerprint which are used to identify suspect of any crime in India such as pattern identification and ridge characteristics. To identify any fingerprint using ridge characteristics method there should be minimum 8 characteristics to analyze it. Pattern identification is the basic method to identify any individual's fingerprint.

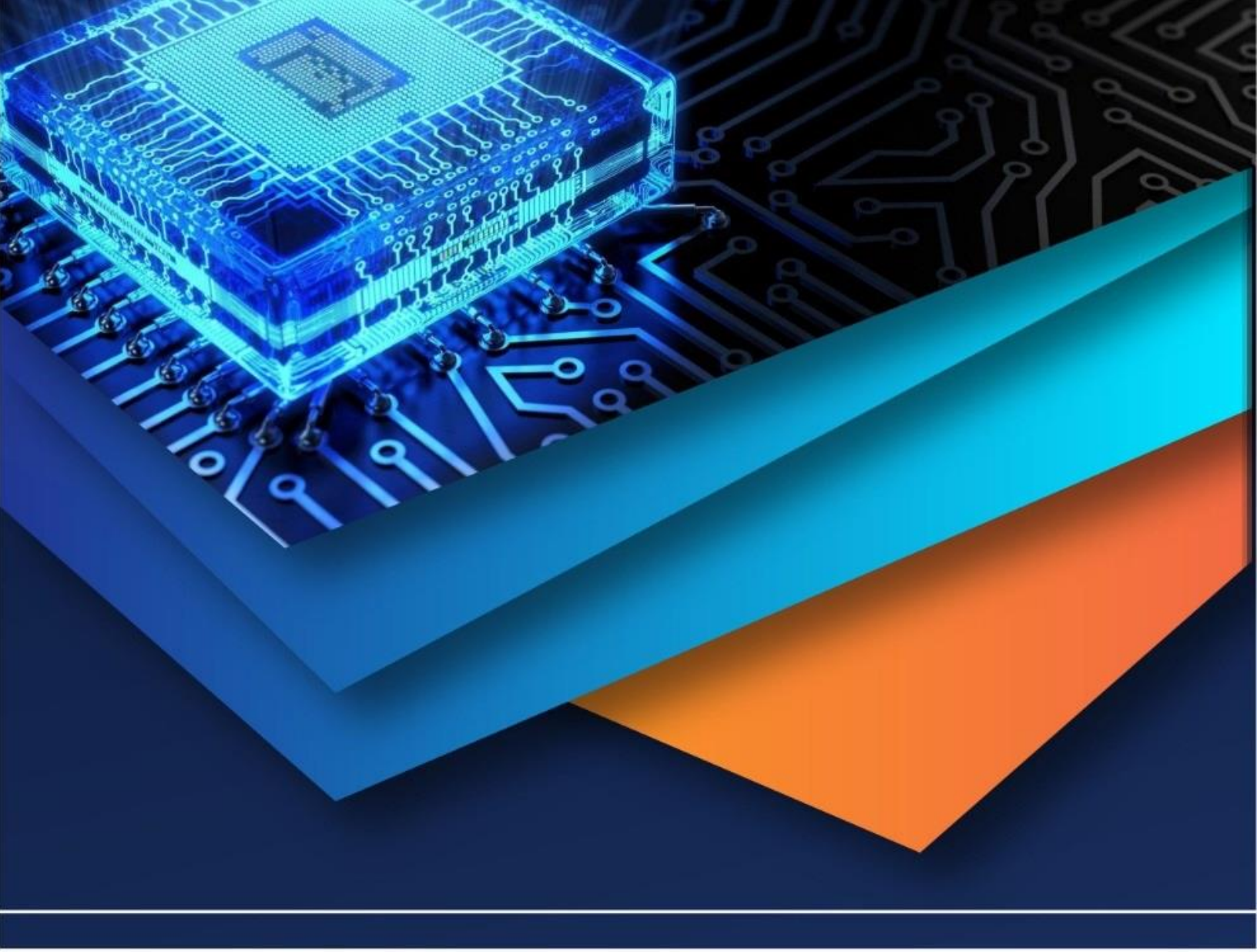
The main focus of this review paper is to understand different types of fingerprint such as patent, latent and plastic or 3D fingerprint. Their characteristics which is helpful to identify the fingerprint. And methods for developing fingerprints which refers different methods for different type of fingerprint impression.

Although there is development in laboratory also happening like recruiting new experts, training and using technology to identify fingerprints like Automated Fingerprint Identification System.

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