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Recent Advancements in the Visualization of Latent Fingerprints by Different Methods

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Abstract:

Fingerprints are the mean of identification assigned to every individual. They are most unique in nature that's why they are used in Personal Identification. Their recognition and Evaluation has always been a big task for the investigators as they are found in different conditions. Sometimes, fingerprints are visible clearly but in most of the cases, found in invisible form. These forms of fingerprints are needed to develop by various mean so that they can be matched with the Database and linked with the perpetrator.

Keywords: Fingerprints, Cyanoacrylate, Ninhydrin, Magnetic powder, SPR, Nanotechnology, Turmeric powder, Sensor based Method, PTC Method and Instrumental Analysis

1. INTRODUCTION: Fingerprints are present on every finger of both the hands. They are developed during the intrauterine life. These impressions are created with the help of papillary ridges. Once the fingerprints are formed in intrauterine life, they are not subjected to change in the life of the individual and become permanent. The use of fingerprints for the purpose of identification called Dactyloscopy. The anatomy of skin performs a major role in formation and understanding of these patterns. When person under any epidermal burns, abrasions etc the new layer starts forming in place of the earlier one, but never change. The burning of 3^0 would results into the destruction of the pattern permanently. This Science came into existence by the outstanding contribution of Sir Henry and William Hershel who discuss the permanency and uniqueness of the fingerprints.

Fig 1: Structure of Skin

https://www.chegg.com/flashcards/the-integumentary-system-chapter-5-4eddf30b-4513-49ea-95a5-42202d16b63a/deck

Fig 2: Picture of Human Fingerprints

https://andragogytheory.com/2015/09/24/law-enforcement-technology-fingerprint-identification/

There are 4 major classifications of the fingerprints such as Loops, Whorls, and Arches & Composites. The Loops are found in the major group of population and contributes 65% in the world population. Least commonly found patterns are composites which are approx. 5% in population.

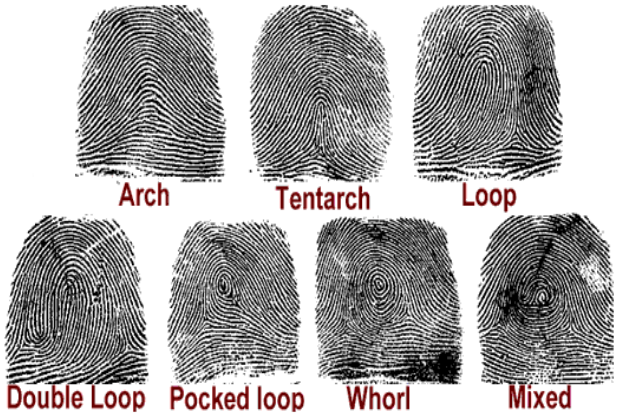

Fig 3: Type of Fingerprint patterns

http://www.spphs.com/history/fingerprints/images/fingerprints1.png

When any investigator visits at the scene of occurrence, 3 types of Fingerprints can be found like Visible, Latent and Plastic prints.[1]

1.1Development of Latent Fingerprints: Majority of fingerprints development powders have inorganic substances which can be toxic in nature like mercury, cadmium, lead, copper etc.

1.1.1 Luminescent Powders: Fingerprints powders have the compounds that give fluorescence and Phosphorescence when they are brought in contact laser light, UV light etc. this type of powders are useful on the surfaces which are generally multicolored. When we come in discussion with laser examination of fingerprints it includes a number of option available to develop fingerprints like Acridine Yellow, coumarin 6, crystal violet, Acridine orange, mercocyanine 540, Rhodamine B and 6G.

1.1.2 Powder Method: these are usually the ferromagnetic granules or powders which are used with the help of the magnetic applicator. This method was applied with great accuracy on the Leather, Human Skin and Walls as well. Lead powder can also be used when hyphenated with Autoelectronography and X-ray electronography.

1.1.3 Small Particle Reagent Method: This method works on the principle that when prints adhere on any surface, their fatty acid reacts with the small particle reagents and imparts results. Its reagent includes: Molybdenum disulfide, Photo Flo 200 and Distilled water. [2]

1.1.4 Fuming Methods: it includes a variety of categories of Iodine fuming:

1. Iodine fuming Gun Method
2. Iodine fuming Cabinet Method
3. Iodine fuming dusting Metho
4. Iodine Solution Method

1.1.5 Cyanoacrylate Method: This is a chemical method for development of Latent Fingerprints. It is used on wood, rubbers, glass etc. it is chemically known as Alkyl 2-cyanoacrylate.

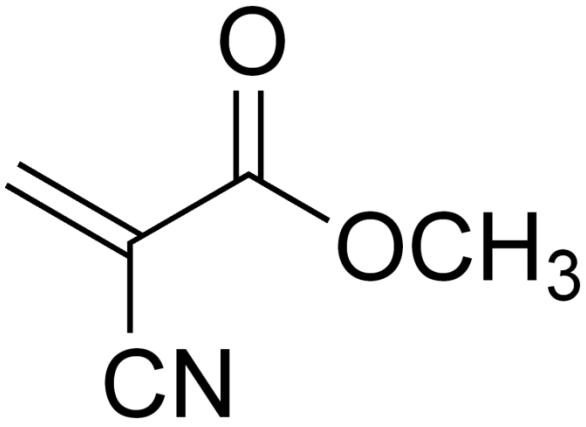

Fig 4: structure of Cynaoacrylate

https://commons.wikimedia.org/wiki/File:Cyanoacrylate_structure.png

There are several such as Rhodamine and Gentian violet are used to improve the quality of the fingerprints developed by Cyanoacrylate. [3]

1.1.6 Ninhydrin Method: Amino Acids are the constituent of the finger marks; the Ninhydrin reacts with these amino acids to form a Purple coloured complex. This is suitable method for the print development on Paper. There are some other chemicals which can be used in place of Ninhydrin such as NBD-fluoride, NBD-Chloride, o-phthaladehyde etc. certain Analogues are also used like Benzo|e|ninhydrin, 2, 2-dihydroxy-5-chloro-6-methoxyindane-1,3-dione and benzo|f|ninhydrin etc.

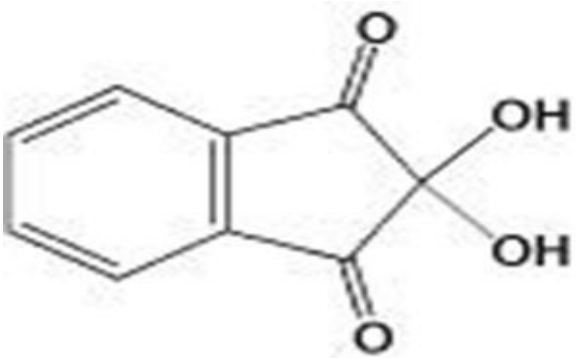

Fig 5: Structure of Ninhydrin

https://bio-gallery.blogspot.com/2013_02_01_archive.html

1.1.7 Nanotechnology in Fingerprints: Nano-tech is new and emerging science in Forensic Science. It is setting its roots in forensic and specifically in Fingerprints Science. This technique is the application of use of metal and its ions in the visualization of Fingerprints. The ordinary particle used is in the range of 1 to 10 micrometers, which are much larger than nanoparticles. There are several advantages of using it; it is based on quantum phenomenon. Most commonly used particles are made up of metal oxide, metal sulfide particles etc. [4]

1.1.8 Turmeric Method: As a huge number of materials are available for the development of fingerprints, there is a recent addition of Turmeric (Curcuma longa) in the list. Turmeric is a perennial plant that comes under the herbaceous category in the family Zingiberaceae. The underground part of this plant bears turmeric. This is also known as Curcumin because it is present in the turmeric as a constituent. Curcumin is responsible for its yellow colour and chemically called 1,7-bis(4-hydroxy-3-methoxy-phenyl)-hepta-1,6-diene-3,5-dione. This method can be applied for porous and non-porous surfaces. It is not a suitable choice for the prints present on skin. [5]

1.1.9 Optical Method: This is sensor based technology which generates the topographic picture of the fingerprints by means of chromatic aberration of light. This new approach of technology also useful to determine the age of fingerprints on large number of surfaces. When taking the factors affecting into consideration, so sweat, UV light category of substrate etc can give unsatisfactory results.

1.1.10 Phase Transfer Catalyst [PTC] Method: There are various cases in the modern time of world where adhesive tape can also be used in crime commission, so it was required to develop a method that can be used to lift the marks from tapes. This was made possible by the introduction of Phase transfer catalysts method which uses tetrabutylammonium iodide. One more advantage it provides, it is accommodating the prints which are old in nature i.e. upto 11 days old.

1.1.11 Electrochemical Method: The fingerprints were also visualized by using Polyaniline on the marks. This method is suitable for old as well as fresh fingerprints which are on stainless steel.

1.1.12 Camphor Fuming Method: When fingerprint is developed it is necessary to choose a cost effective, low overlapping method and which is non-abrasive in nature. This camphor fuming technique is following all the required conditions that can be ideal for an investigator. This is comparatively better than Cyanoacrylate and silver nitrate method.

1.1.13 Instrumental Analysis: there are diversity of chromatography techniques and its hyphenation with others techniques such as MS. Along with this. Many other instruments are also available for fingerprints analysis.

Types of chromatography which can be used are given below:

1. TLC
2. LC-MS
3. GC-MS
4. IR Spectrophotometry
5. CE-MS
6. Matrix-assisted laser desorption ionization-MS. [6]

2. DISCUSSION: As fingerprints mostly establish in latent form rather than others. For its development, a cost effective, reliable and which can give the best results will be used whether it is discovered recently or years ago. The modern technology is giving us the better options for fingerprints visualization like sensor method whereas nature can also be useful for its development as we have turmeric powder. The use of method is purely dependent on the type of fingerprints and its circumstances in which it is found.

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