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Research Paper

Development of Latent Fingerprint using Non-Conventional powders

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Abstract
This study explores the effectiveness of non-conventional powders-Hindu sacred ash (vibhuti), sandalwood powder, tooth powder, and wheat flour-for developing latent fingerprints on non-porous surfaces such as glass and metal. A total of 80 latent fingerprints were collected from volunteers aged 18–25 and analyzed for ridge clarity, core and delta visibility, and minutiae count. The results demonstrate that Hindu sacred ash provided the highest clarity and contrast, producing well-defined ridge details across both surfaces. Sandalwood and tooth powder showed moderate effectiveness, with better performance on glass than metal. Wheat flour, due to its poor adherence and light coloration, was the least effective across all samples. The findings support the use of culturally accessible, low-cost, and non-toxic materials like Hindu sacred ash as viable alternatives to conventional forensic powders, especially in resource-limited settings.

Key words: *Latent fingerprints, Non- Conventional powders, Non-Porous surface, Ridge clarity, Core, Delta, Minutiae.*

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I. INTRODUCTION

A fingerprint is a completely unique sample of ridges and valleys shaped at the pores and skin of a person's fingertips, used for identity and authentication, and stays unchanged all through life (Innovatrics. com, n.d.). Distribution is a very important part of the fingerprint identification system (AFIS) (Neha Chaudhary, 2020). Finger-marks are a completely unique figuring out function of human beings. Due to their particular and everlasting characters, they're used for civil and criminal investigations. They are one of the oldest and universally popular bodily proof which facilitates with inside the individualization of a person. These fingermarks may be effortlessly recovered from the crime scene that can offer an immediate hyperlink to the suspect (Patil, 2022). Latent fingerprints left at a criminal offense scene may be evolved and as compared to regarded fingerprints to discover suspects or hyperlink them to the scene (Aratek. 2024). Latent finger print improvement on diverse surfaces includes the usage of strategies to make invisible prints visible with techniques various primarily based totally at the floor type , together with chemical, powder and fuming techniques. Improvement is vital in forensic investigations as it lets in investigators to visualise and examine latent (hidden) fingerprints that are particular to every individual, helping in figuring out suspects and linking them to crime scenes.

1.1. Types of fingerprints

1.1.1. Patent prints- are seen prints that arise whilst a foreign substance at the pores and skin of a finger comes in touch with the easy floor of some other object.

1.1.2. Latent prints- are fingerprint impressions secreted in a floor or an item and are commonly invisible to the bare eye. These prints are the end result of perspiration that is derived from sweat pores determined with inside the ridges of fingers.

1.1.3. Plastic prints- are visible, inspired prints that arise when finger touches a soft, malleable floor ensuing in an indentation. Some surfaces that could comprise this kind of fingerprint are the ones which might be freshly painted or coated, or the ones that comprise wax, gum, blood or another substance that will melt when handheld after which hold the finger ridge impressions (Mihsra, 2016).

II. METHODOLOGY

2.1 Aim:

To analysis the Effectiveness of a Non-Conventional powder method for the enhancement and visualization of latent fingerprints on non-porous surfaces.

2.2 Objectives:

1. To evaluate the effectiveness of the non-conventional powder method (Hindu sacred ash) in developing latent fingerprints on non-porous surfaces like glass, metal.
2. To evaluate the effectiveness of the non-conventional powder method (Tooth powder) in developing latent fingerprints on non-porous surfaces like glass, metal.
3. To evaluate the effectiveness of the non-conventional powder method (Sandalwood powder) in developing latent fingerprints on non-porous surfaces like glass, metal.
4. To evaluate the effectiveness of the non-conventional powder method (Wheat Flour) in developing latent fingerprints on non-porous surfaces like glass, metal.
5. To identify the most effective non-conventional powder for the development of latent fingerprints.
6. To identify the least effective non-conventional powder for the development of latent fingerprints

2.3.Sample collection:

After taking informed consent from all the participants, the data collection procedure was started. The latent fingerprint are collected from selected population.

2.4. Tools and techniques:

Latent Fingerprints are collected using glass and metal, feather brush and non- conventional powders. Fingerprints are taken the glass and metal after dust the surface which has the latent fingerprint with a feather brush. Take once the fingerprint is clear develop. Adjust lighting to avoid glare. Use a smartphone camera with micro mode. Capture high-resolution images.

2.5. Data analysis:

The latent fingerprint were collected to identify the commonly 8 minutiae's and fixed point's core and delta. **2.6.**

Limitation:

1. Non-traditional powders frequently have coarse particle sizes, main to doubtful or smudged ridge details.
2. Natural powders like wheat flour can clump because of moisture with inside the surroundings or the print that could difficult to understand ridge detail.
3. Powders like sacred ash and Tooth powder may also go away in the back of a residue or stain, which can harm the proof or avoid in addition analysis.

2.7. Procedure:

1. Students elderly 18–25 who gave knowledgeable consent had been selected.
2. Each donor contributed 10 natural (uncontaminated) latent fingerprints.
3. Non-porous surfaces (glass and metal) had been used for fingerprint collection.
4. Surfaces had been wiped clean and dealt with gloves to keep away from contamination.
5. Non-traditional powders (Hindu sacred ash, enamel powder, sandalwood powder, and wheat flour) had been used.
6. A feather brush changed into used to dirt the powder lightly over the fingerprint area.
7. High-decision pix had been captured the use of a phone with macro mode.
8. Developed fingerprints had been analyzed to become aware of ridge traits and remember trivialities points (including middle and delta).

III. Observation & Results

3.1. Observation:

Table 1: Fingerprints were developed using Non-Conventional powders on Glass & Metal surface

surface	Powder type	Degree of visibility	Core & delta visibility	Minutiae range
Glass	Hindu sacred ash	High	Mostly visible	7-8
Glass	Sandalwood powder	Moderate	Mostly visible	6-7
Glass	Tooth powder	Moderate to low	Some not visible	6-7
Glass	Wheat flour	Low	Poorly visible	0-3
Metal	Hindu sacred ash	High	Mostly visible	7-8
Metal	Sandalwood powder	Moderate	Mostly visible	7-8
Metal	Tooth powder	Moderate to low	Some not visible	6-7
Metal	Wheat flour	Low	Poorly visible	0-3

Image 1*: Image shows developed latent fingerprints on glass samples GH1-GH10 using Hindu sacred ash.*

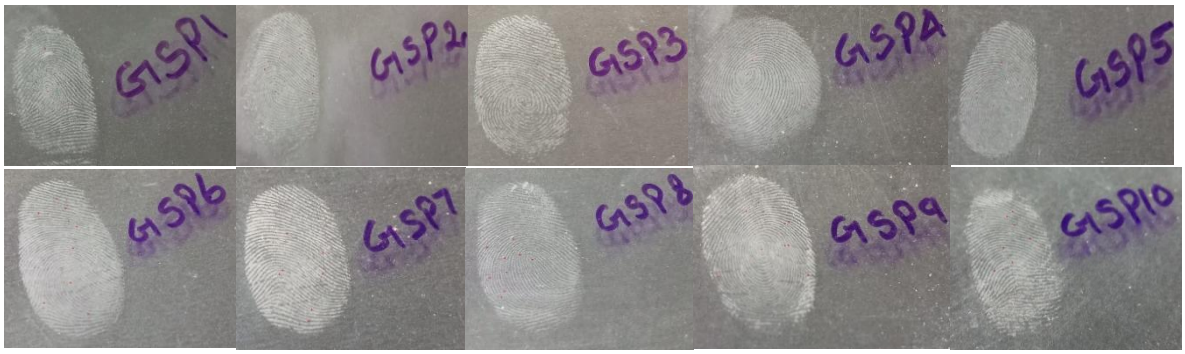


Image 2: *Image shows developed latent fingerprints on glass samples GSP1-GSP10 using Sandalwood powder.*

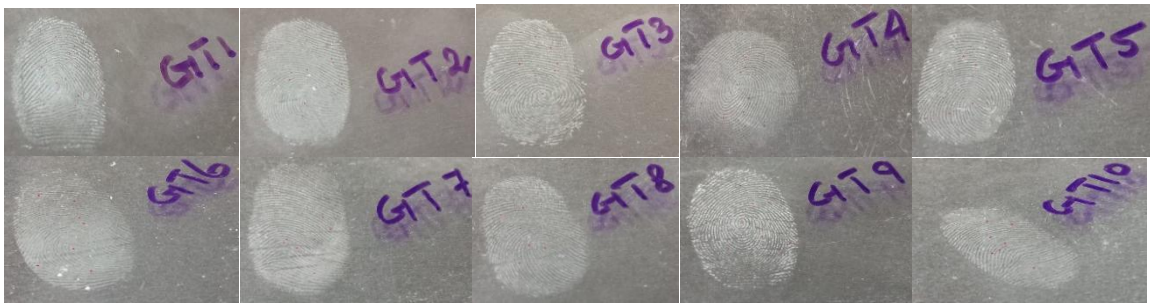


Image 3: *Image shows developed latent fingerprints on glass samples GT1-GT10 using Tooth Powder.*

Image 4: *Image shows developed latent fingerprints on glass samples GWF1-GWF10 using Hindu sacred ash.*

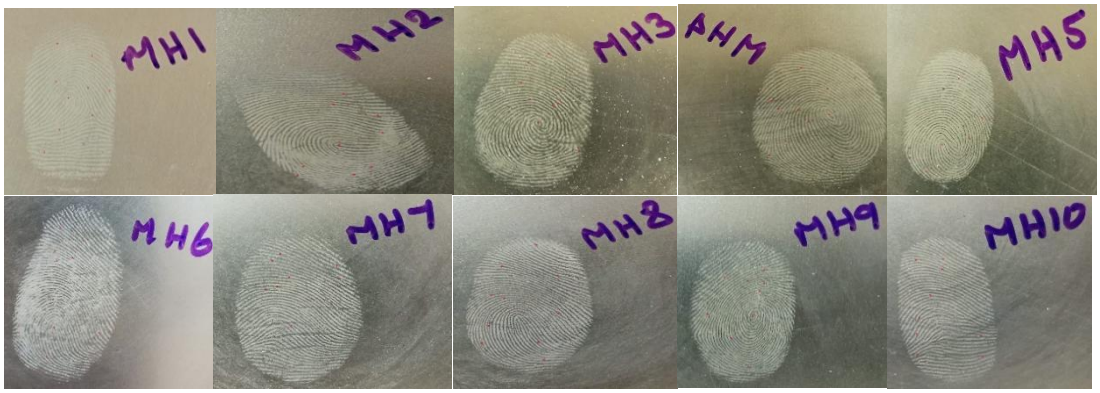


Image 5: *Image shows developed latent fingerprints on metal samples MH1-MH10 using Hindu sacred ash.*

Image 6: *Image shows developed latent fingerprints on metal samples GSP1-GSP10 using Sandalwood powder.*

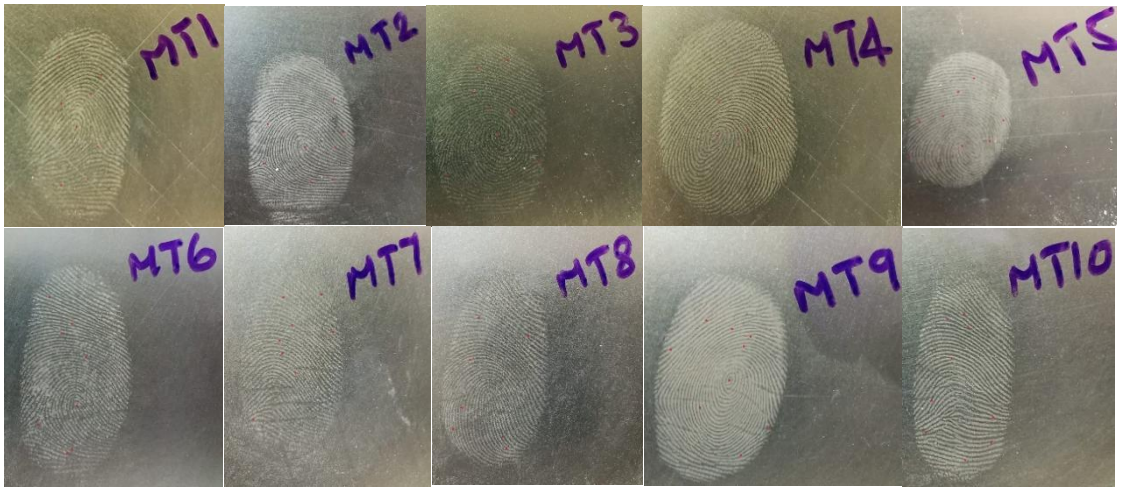
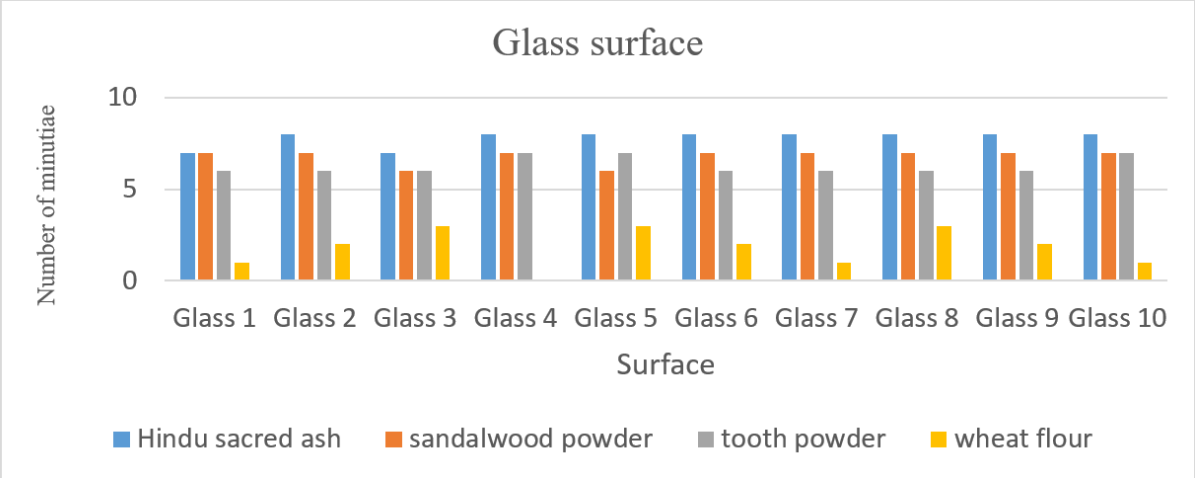


Image 7: *Image shows developed latent fingerprints on metal samples GT1-GT10 using Tooth powder.*

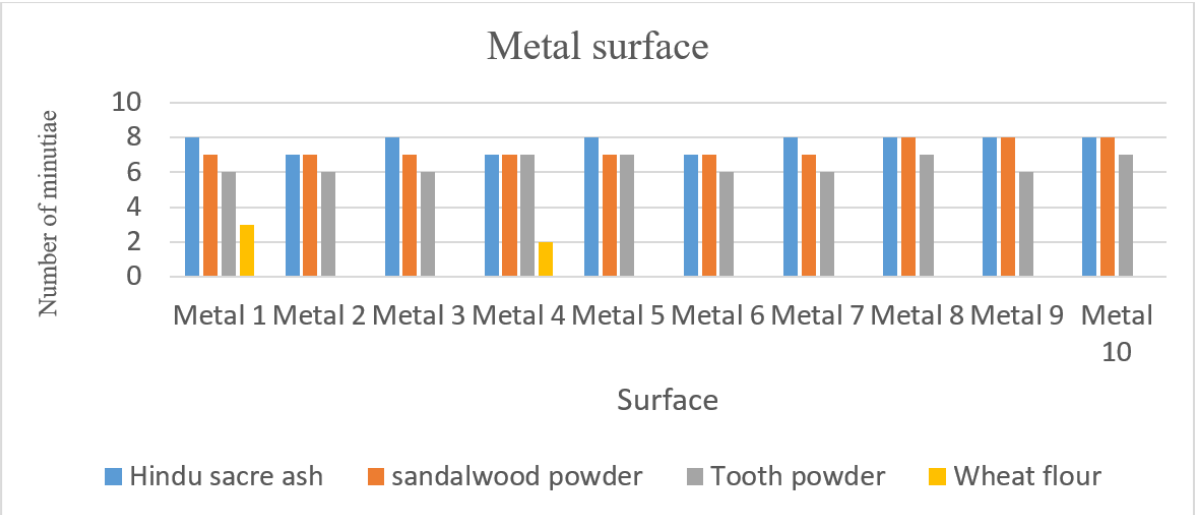
Image 8*: Image shows developed latent fingerprints on metal samples GWF1-GWF10 using Wheat flour.*

Comparison of Non-conventional powder in glass surface
Graph compares cleaning effectiveness of four powders on glass surfaces, showing Hindu sacred ash consistently highest, wheat flour lowest.



Graph 9- *Compare effectiveness of non-conventional powders on glass surfaces*

Comparison of Non-conventional powders in metal surface
Graph compares cleaning effectiveness of four powders on metal surfaces, showing Hindu sacred ash consistently highest, wheat flour lowest.



Graph 10- *Compare effectiveness of non-conventional powders on metal surfaces*

3.2. Results:
The effectiveness of non-traditional powders-Hindu sacred ash (vibhuti), sandalwood powder, enamel powder, and wheat flour-changed into evaluated for growing latent fingerprints on non- porous surfaces, especially glass and metal. The fingerprints had been assessed primarily based totally on clarity, ridge element, assessment, and simplicity of development.

3.2.1. Hindu Sacred Ash:
• **Glass:** Very clean ridges with excessive assessment, powder adhered nicely to fingerprint residues, making ridge styles tremendously seen below ambient lighting.
• **Metal:** Also gave sharp ridge element with desirable adherence.
3.2.2. Sandalwood Powder:
• **Glass:** Provided reasonably clean fingerprints with ridge visibility.
• **Metal:** Fainter prints than on glass.
3.2.3. Tooth Powder:
• **Glass:** Tooth powder offered limited ridge clarity making it is less effective.
• **Metal**: Ridge have been seen however lacked sharp definition.
3.2.4. Wheat Flour:
• **Glass:** Wheat flour failed to develop usable prints due to poor contrast.
• **Metal:** Wheat flour consistently failed to produce useful results due to poor adherence and lack of contrast.
3.2.5. Summary of Effectiveness (Best to Least Effective):
• Hindu sacred ash > Sandalwood Powder > tooth powder > Wheat Flour
3.2. Most effective:
• The most effective non-conventional powder method of latent fingerprint is Hindu sacred ash.
3.3. Least effective:
• The least effective non-conventional powder method of latent fingerprint is Wheat flour.

IV. DISCUSSION:

Non-traditional powders affords a unique and cost-powerful technique to forensic investigation, specifically in resource-restricted settings. In this study, the powders used—Hindu sacred ash (vibhuti), sandalwood powder, enamel powder, and wheat flour—are effortlessly available, culturally relevant, and non-toxic, making them appropriate options to business fingerprint powders.

4.1. Effectiveness on Non-Porous Surfaces:
The overall performance of every powder became evaluated on non-porous surfaces like glass and metal, which can be normally encountered at crime scenes. Non-porous surfaces do not soak up residues, therefore making the fingerprint residue continue to be at surface and less difficult to detect.

4.2. Hindu sacred ash (vibhuti):
The use of Hindu sacred ash for the development of latent fingerprints presents a promising alternative to conventional powders sacred is a fine dry powder composed mainly of burnt plant material & minerals which give it excellent adhesion properties.
4.3. Sandalwood Powder:
Sandalwood powder furnished mild results. Its extraordinarily coarser texture now and again decreased the readability of ridge info.
4.4. Tooth powder:
Tooth powder confirmed properly adherence to latent fingerprint residues. Its moderate moisture-soaking up assets helped in visualizing ridge styles on glass. However, on steel surfaces, the evaluation was difficult because of the powder's mild color, making visualization beneath ordinary lighting fixtures much less distinct.
4.5. Wheat Flour:
Wheat flour, even though effortlessly available, it confirmed the least effectiveness. Its mild color and tendency to clump ended in bad adherence. It provided very little ridge features of print on glass surface while no development was observed on metal surface.
4.6. Challenges and Considerations:
4.6.1 Particle Size and Adherence:
The effectiveness of any powder relies upon on its particle size and its potential to stick to the fingerprint residue. Optimizing those elements for unconventional powders is crucial.

4.6.2. Surface Compatibility:
Different surfaces (e.g., glass, metal, plastic) may also have various stages of compatibility with distinct powders. Research is wanted to decide which powders are handiest on unique surfaces.

4.6.3. Potential for Distorted Images:
The texture of a few powders may also intrude with the readability of the evolved fingerprint, in particular if the powder isn't always nicely removed.

4.7. Factors Affecting Performance:
The effectiveness of those powders relies upon on different factors along with particle size, color contrast, oil absorption capability, and the floor type. Non-traditional powders like teeth powder and sacred ash advantage for their nice consistency and adhering property to fingerprint residues.

V. Conclusion:

5.1. Hindu sacred ash:
The development of latent fingerprints using Hindu sacred ash demonstrates a clear and effective method for fingerprint visualization. This technique is not only cost effective and easily accessible. But also non-toxic and environmentally friendly.

5.2. Sandalwood powder:
The use of sandalwood powder for the development of latent fingerprints shows a moderate level of effectiveness. However, due to its natural, non-toxic properties and cultural availability in certain regions, sandalwood powder can still be considered a viable alternative for fingerprint development.

5.3. Tooth powder:
The development of latent fingerprints using tooth powder shows low to medium effectiveness. While some ridge detail may be visible, the clarity & contrast of the prints are generally poor compared to Hindu sacred ash powders. Therefore, it may only be suitable for preliminary or educational demonstration.

5.4. Wheat flour powder:
The development of latent fingerprints using wheat flour shows low effectiveness. Due to its coarse texture and lack of adhesion to the oily or sweaty residues left by fingerprints, wheat flour does not produce clear or detailed ridge.

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