Dermatoglyphics

Introduction to Fingerprint Identification
Fingerprinting

• A fingerprint is an INDIVIDUAL CHARACTERISTIC
  – no two have yet been found to possess identical ridge characteristics.
Fingerprinting

The foundation for its acceptance in court-

– the probability that two fingerprints could match is such a low probability
– there is an estimated 64 billion different individual prints.
– This is supported by the millions of individuals who have had prints taken over the past 90 years in the FBI central system- no two have ever been found to be identical
Fingerprints

- Fingerprints are a reproduction of friction skin ridges found on the palm of the fingers and thumbs.
- Also found on palms and soles of feet.
- Designed for firmer grasp and resistance to slippage.
Fingerprints

• FINGERPRINTS WILL REMAIN UNCHANGED DURING AN INDIVIDUAL’S LIFETIME
Fingerprints

• Series of lines corresponding to hills (ridges) and valleys (grooves).

• It is the shape and form of skin ridges seen as black lines of an inked fingerprint.
Each skin ridge is populated with a single row of pores—openings for ducts leading from sweat glands

- Perspiration and oils are discharged and deposited on surface of skin.
- When these contact another surface- oils and perspiration are transferred
- Leaves an impression of the finger’s ridge pattern (fingerprint)
- Invisible to the eye and referred to as latent fingerprints
Dermatoglyphics

- Individuality is not determined by general shape or pattern but by a careful study of its ridge characteristics
  - (also called minutiae)

- Identity- number- and relative location of characteristics that impart individuality.
Making the Comparison

1. General ridge patterns are used to narrow down the number of suspects

2. Specific details of the ridges are used to make the final match
Types of Prints

- Arch
- Tentarch
- Right loop
- Left loop
- Double loop
- Right pocket loop
- Left pocket loop
- Whorl
- Mixed figure
Types of Prints

• FINGERPRINTS HAVE GENERAL RIDGE PATTERNS FOR CLASSIFICATION:

• Divided into three classes:
  – LOOP
  – WHORL
  – ARCH

• 60-65% OF POPULATION HAS LOOPS

• 30-35% WHORLS

• AND 5% ARCHES.
Loop

- Loop must have one or more ridges entering from one side of the print, recurring and exiting from the same side.
  - If loop opens toward little finger= ulnar loop
  - Opens from the thumb= radial loop
Type-lines

- Pattern area of the loop is surrounded by two diverging ridges known as type-lines.
Deltas

- The ridge point nearest the type-line divergence is the DELTA.
  - Triangular in shape.
  - ALL LOOPS HAVE ONE DELTA
Core

Core = center of the pattern.
Whorls

- Whorls - 4 distinct groups:
  - Plain
  - Central pocket
  - Double loop
  - Accidental.

- All whorl patterns have type lines and a minimum of two deltas.

- Plain and central pocket loop whirl have at least one ridge that makes a complete circuit.

- Ridge may be spiral, oval or any variant of a circle
Arches

- Arches - least common has 2 patterns - plain arches and tented
- Do not have:
  - type lines
  - deltas
  - or cores
Making the Comparison

• There are as many as 150 individual ridge characteristics on the average fingerprint.
  – a vast majority of prints recovered from crime scenes are partial impressions-showing only a segment of the print.
Making the Comparison

- Expert has to compare small number of ridge characteristics from the recovered print to the known recorded print.
- Criteria of individuality in court requires 8-16 matching characteristics.
- 1973 International Association for Identification concluded “it is the responsibility of the examiner- based upon experience and knowledge to establish positive identification.”
Minutiae

• Minutiae are the details in a fingerprint.

• With the minutiae a fingerprint identification can be made.

• There are big details like starting lines, splitting lines and line fragments.

• But there are also smaller details like pores, incipient ridges, and line shapes.
Minutiae

• **Line-unit**, it exists as only one isle with a pore.

• **Line-fragment**. 2 or more line-units

• **A beginning or ending line.**
Minutiae

• **Bifurcation**, a splitting line.

• **Eye**, two lines splitting and meeting each other shortly after that.

• **Hook**, a short splitting line.
Minutiae

• **Pores**, details in number, shape and size.

• **Line shape**, the lines vary breadth.

• **Scars**, the lines can not recover anymore.

• **Incipient ridges**, between the papillary lines.
Minutiae

- **Creases**, also permanent
- **Warts**, not permanent but also typical.
- **Temporary damages**.
- **Deformation**, the lines deform and fall apart.
IAFIS

Integrated Automated Fingerprint Identification System
Large database of fingerprint collections—using individual characteristics of fingerprints converted into DIGITAL MINUTIAE: ridge endings, and branching.

Location and relationship of minutiae in a digitally recorded geometric pattern

A computer can make thousands of fingerprint comparisons in a second.
IAFIS does not make final verification of print identity, but rather flags prints with the closest correlation to the search prints.

IT ALLOWS CRIMINAL INVESTIGATORS TO SPEND LESS TIME DEVELOPING SUSPECT LISTS AND MORE TIME INVESTIGATING SUSPECTS GENERATED BY THE COMPUTER.
IAFIS

- The IAFIS maintains the largest biometric database in the world
  - containing the fingerprints and corresponding criminal history information for more than 47 million subjects in the Criminal Master File

- The fingerprints and corresponding criminal history information are submitted voluntarily by state, local, and federal law enforcement agencies.
1. Latent fingerprint - earlier stated was invisible to the eye since just oils and perspiration.

2. Visible Prints- made by fingers touching a surface after ridges have been in contact with colored material: BLOOD, PAINT, GREASE, INK

3. Plastic Prints - are ridge impressions left in soft material- putty, wax, soap, or dust.
METHODS OF DETECTING FINGERPRINTS

• THE METHOD OF CHOICE WILL DEPEND ON THE SURFACE BEING LIFTED OR TESTED.

• Hard and non-absorbent surfaces (glass, mirror, tile, and painted wood) require different approaches than soft and porous- paper, cloth, or cardboard.

• The most challenging thing an examiner faces is finding the location of latent prints.
Ultraviolet Imaging Systems

• Reflected Ultraviolet Imaging System- locates prints on nonabsorbent surfaces without chemical or powder treatments.

• When UV light strikes the fingerprint, light is reflected back to the viewer- differentiating the print from its background surface.

• UV light is converted into visible light by image intensifier.
Ultraviolet Imaging Systems

Latent fingerprint on Painted Wall.
Illustration of Contrast Effect due to variation of illumination angle.

Depending on what angle the user holds the light, a print can either appear white or black.
Ultraviolet Imaging Systems

Untreated Oily Print on sticky side of Duct (Duck) tape.

35mm Black and White film. Scene Scope excels at detecting prints on surfaces that a forensic light source would find difficult or impossible.
Ultraviolet Imaging Systems

- Hand held Forensic Light Sources
Fingerprint Powders

- Commercially available in a variety of colors and textures
- Lightly applied to nonabsorbent surfaces with camelhair brush will ADHERE TO PERSPIRATION RESIDUES AND BODY OILS.
- Black and gray for photographing on surfaces - produce contrast.
Magnetic Powders

- **Magnetic powders** - Magna Brush - since there are no bristles there is less chance of destroying print.

- Fluorescent powders that fluoresce under ultraviolet light - used when color or pattern of background obscures visibility of the print. (plaid, newsprint, etc).
CHEMICAL METHODS FOR VISUALIZING LATENT PRINTS

- Iodine fuming
  - Iodine is a solid crystal that when heated, turns into a vapor without passing through a liquid phase
    - This transformation is called Sublimation.

- Suspect material is placed in an enclosed cabinet with iodine crystals
- Once heated, vapors fill the chamber and combine with latent print to make it visible.

- Iodine prints are not permanent and begin to fade once fuming is stopped.
  - NECESSARY TO PHOTOGRAPH IMMEDIATELY

- Can be fixed with 1% solution of starch in water applied by spraying; this will turn blue and last for several weeks or longer.
Super Glue Fuming

• Super Glue fuming - works great on nonporous surfaces - metals, leather, plastic bags.
• Created when superglue is placed on cotton and treated with sodium hydroxide.
• Created when heating produces toxic vapors - cyanide.
• Fumes and object contained within an enclosed chamber for up to 6 hrs.
• Produces white latent print.
PRESERVATION OF DEVELOPED PRINTS

• Once visualized, it must be permanently preserved for future comparison and possible use in court as evidence.

• Camera with close-up lens

• Fixed focus to take photographs on 1:1 scale when lens is held exactly flush against the print surface to avoid distortion.

• Photograph print’s relative location with other evidential items.
Permanent Record of Print

- If on small surface- transport without destroying the print
- Protect with cellophane bag
- If large surface (door, wall, etc) objects that have been developed with a powder can best be preserved by "lifting".
  - Done with broad adhesive tape
  - Fingerprint covered with adhesive side and pulled up, the powder will be transferred to the tape.
  - Digital imaging may be used to enhance contrast, enlarge detail and compare individual points on prints to others in question.