Fingerprint Identification

Classifying fingerprints

Before computerization replaced manual filing systems in large fingerprint operations, manual fingerprint classification systems were used to categorize fingerprints based on general ridge formations (such as the presence or absence of circular patterns in various fingers), thus permitting filing and retrieval of paper records in large collections based on friction ridge patterns independent of name, birth date and other biographic data that persons may misrepresent.

The most popular ten-print classification systems include the Roscher system, the Vucetich system, and the Henry Classification System. Of these systems, the Roscher system was developed in Germany and implemented in Germany and Japan, the Vucetich system was developed in Argentina and implemented throughout South America, and the Henry system was developed in India and implemented in most English-speaking countries.

In the Henry system of classification, there are three basic fingerprint patterns: Arch, Loop and Whorl. There are also more complex classification systems that further break down patterns to plain arches or tented arches. Loops may be radial or ulnar, depending on the side of the hand the tail points towards. Whorls also have sub-group classifications including plain whorls, accidental whorls, double loop whorls, and central pocket loop whorls.

Arch

Whorl

Loop
Fingerprints explained in Detail

Identification by fingerprints relies on pattern matching followed by the detection of certain ridge characteristics, also so known as Galton details, Points of identity, or Minutiae *, and the comparison of the relative positions of these minutiae points with a reference print, usually an inked impression of a suspect's print. There are three basic ridge characteristics, the ridge ending, the bifurcation and the dot (or island).

Identification points consist of bifurcations, ending ridges, dots, ridges and islands. A single rolled fingerprint may have as many as 100 or more identification points that can be used for identification purposes. **There is no exact size requirement as the number of points found on a fingerprint impression depend on the location of the print.** As an example the area immediately surrounding a delta will probably contain more points per square millimeter than the area near the tip of the finger which tends to not have that many points.

In image 1 we see part of a fully rolled fingerprint. Notice that the edges are cut-off so you can safely assume that this is not a fully rolled impression. If you take a look at image 2 you can see that I have sectioned out the centre portion of this impression and labeled 10 points of identification. That was not all the points found but simply the ones that could be mapped easily without cluttering up the image.

In image 1 and image 2 are both taken from the same image. In real life you would have impressions made at separate times and subject to different pressure distortions. Secondly, these images are relatively clean and clear where many of the actually crime scene prints are anything but clear. Last you have to consider that this is an easy comparison because you are blessed with having a core pattern and a delta when in some cases you may have a latent that could be a fingertip, palm or even foot impression.
**Basic and composite ridge characteristics (minutiae)**

<table>
<thead>
<tr>
<th>Minutiae</th>
<th>Example</th>
<th>Minutiae</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>ridge ending</td>
<td><img src="image" alt="ridge ending example" /></td>
<td>bridge</td>
<td><img src="image" alt="bridge example" /></td>
</tr>
<tr>
<td>bifurcation</td>
<td><img src="image" alt="bifurcation example" /></td>
<td>double bifurcation</td>
<td><img src="image" alt="double bifurcation example" /></td>
</tr>
<tr>
<td>dot</td>
<td><img src="image" alt="dot example" /></td>
<td>trifurcation</td>
<td><img src="image" alt="trifurcation example" /></td>
</tr>
<tr>
<td>island (short ridge)</td>
<td><img src="image" alt="island example" /></td>
<td>opposed bifurcations</td>
<td><img src="image" alt="opposed bifurcations example" /></td>
</tr>
<tr>
<td>lake (enclosure)</td>
<td><img src="image" alt="lake example" /></td>
<td>ridge crossing</td>
<td><img src="image" alt="ridge crossing example" /></td>
</tr>
<tr>
<td>hook (spur)</td>
<td><img src="image" alt="hook example" /></td>
<td>opposed bifurcation/ridge ending</td>
<td><img src="image" alt="opposed bifurcation/ridge ending example" /></td>
</tr>
</tbody>
</table>

**Minutiae**, in *fingerprinting* terms, are the points of interest in a fingerprint, such as bifurcations (a ridge splitting into two) and ridge endings. Examples are:

- ridge endings - a ridge that ends abruptly
- ridge bifurcation - a single ridge that divides into two ridges
- short ridges, island or independent ridge - a ridge that commences, travels a short distance and then ends
- ridge enclosures - a single ridge that bifurcates and reunites shortly afterward to continue as a single ridge
- spur - a bifurcation with a short ridge branching off a longer ridge
- crossover or bridge - a short ridge that runs between two parallel ridges

**Minutiae** also refers to any small or otherwise incidental detail.
Timeline

The first known use of fingerprinting was in 9th century China, where merchants applied their fingerprints to documents authenticating a record of debt. In 14th century Persia government officials would use their fingerprint in much the same way we use signatures today. A list of significant modern dates documenting the use of fingerprints for positive identification are as follows:

- 1823: Jan Evangelista Purkyně, a professor of anatomy at the University of Breslau, published his thesis discussing 9 fingerprint patterns, but he did not mention the use of fingerprints to identify persons. [citation needed]
- 1880: Dr Henry Faulds published his first paper on the subject in the scientific journal Nature in 1880. Returning to the UK in 1886, he offered the concept to the Metropolitan Police in London but it was dismissed. [12]
- 1892: Juan Vucetich, an Argentine police officer who had been studying Galton pattern types for a year, made the first criminal fingerprint identification. He successfully proved Francisca Rojas guilty of murder after showing that the bloody fingerprint found at the crime scene was hers, and could only be hers.
- 1897: The world's first Fingerprint Bureau opened in Calcutta (Kolkata), India after the Council of the Governor General approved a committee report (on 12 June 1897) that fingerprints should be used for classification of criminal records. Working in the Calcutta Anthropometric Bureau (before it became the Fingerprint Bureau) were Azizul Haque and Hem Chandra Bose. Haque and Bose were the Indian fingerprint experts credited with primary development of the fingerprint classification system eventually named after their supervisor, Sir Edward Richard Henry. [14][15]
- 1901: The first United Kingdom Fingerprint Bureau was founded in Scotland Yard. The Henry Classification System, devised by Sir Edward Richard Henry with the help of Haque and Bose was accepted in England and Wales.
- 1902: Dr. Henry P. DeForrest used fingerprinting in the New York Civil Service.
- 1906: New York City Police Department Deputy Commissioner Joseph A. Fauot introduced fingerprinting of criminals to the United States.