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Class-based soleprint population distribution

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Abstract
If victims of leprosy, accidents, or natural causes have fingerprints, they can be used for personal recognition and voting in our society. The Soleprint is an impression of the friction ridges on the whole or a portion of the sole. When a Soleprint is exposed to the identification procedure, the matching time is drastically reduced if the Soleprints are stored in en-class groups. 280 Soleprint impressions were obtained using the ink dab process for this experiment, scanned at a 600 dpi scale, and saved using the Bitmap image compression algorithm. The photographs were opened on a 21-inch panel for classification, with the fingerprint classification definition serving as a functioning algorithm. The following soleprints were discovered: double loop, left loop, right loop, and whorl. Instead of the twisted U, the Arch and Tented Arch seen on the soleprint is inverted to shape a "U." whorl was discovered to be the largest proportion of the human population, accounting for 41.43 percent. Loop comes in second with 37.14 percent, and arch (inverted) comes in last with 21.43 percent. Soleprint has characteristics similar to fingerprints and can be used to identify a person.

Keywords: Leprosy, purdah, arch, tented arch, inverted, classification, sole print

1. Introduction
The Caucasian fingerprint databases in the United States have demographic distribution dependent on class as a feature of the study. There are no such analyses for any African database. There is no such thing as a soleprint archive in Africa or anywhere else. Now that the soleprint database has been developed, research must be performed to discover all required characteristics such as population distribution, classification, and so on. The features would have more significance if applied to the established Caucasian fingerprint distribution. A friction ridge is an elevated part of the epidermis on the palmer (Palm), digits (Fingers and toes), or plantar (sole) skin that is made up of one or more associated ridge units of friction ridge skin [1-2]. These are often referred to as "dermal ridges" or "dermal papillae." As a result, a soleprint is described as "an impression of the friction ridges of all or some part of the sole." The soleprint was also considered in this work. It is a point on the sole adjacent to the big toe, at the flat space behind the toes. It has features similar to those on the fingerprint and could be used for identification purposes (Fig. 1). The soleprint impression could be achieved using standard inking techniques.

Fig 1: Complete soleprints showing regions of interest

2. Literature review

Fingerprints have three simple patterns: arches, rings, and whorls. As seen in figs. 2(a) to 2(c), they are classified into eight types: spiral, tented arch, left loop, right loop, double loop, central pocket loop, whorl, and unintended (h) [3-5].

1. The arch pattern is the most basic. The ridges join on one side, grow to form a wave in the middle and leave on the opposite side smoothly.

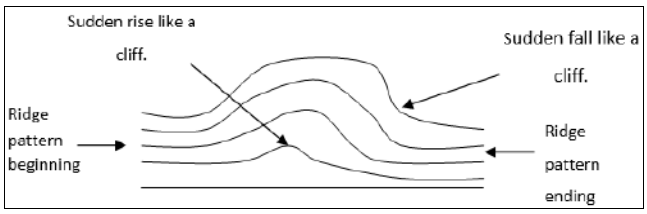

Fig 2(a): Arch

2. The tented arch is a variant of the simple arch. Ridges in the middle are thrown upward more abruptly.

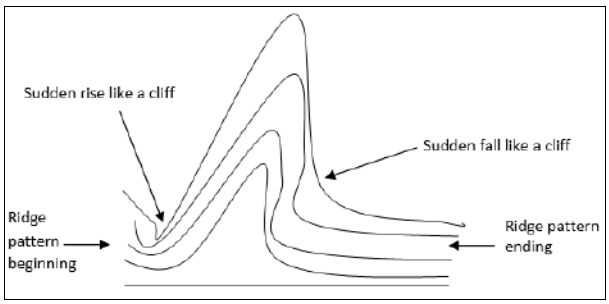

Fig 2(b): Tented arch

3. The left loop. The ridge Patterns join from the left, create a circle, and exit from the left, leaving a delta to the finger's right.

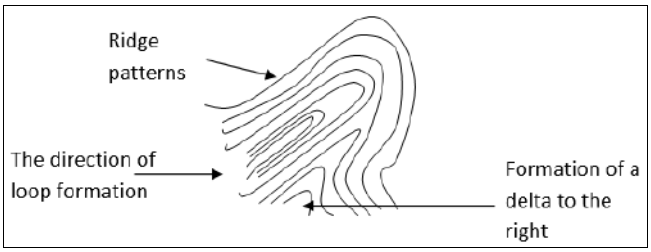

Fig 2(c): Left loop

4. The right loop is analogous to but opposed to the left circle. After creating the circle, the ridge patterns join from the right and exit from the right, leaving a delta to the west.

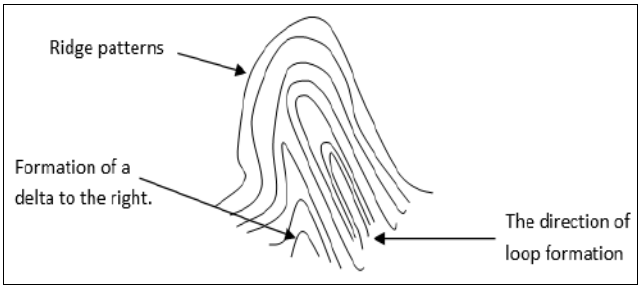

Fig 2(d): Right loop

5. Twin loop (Double loop)

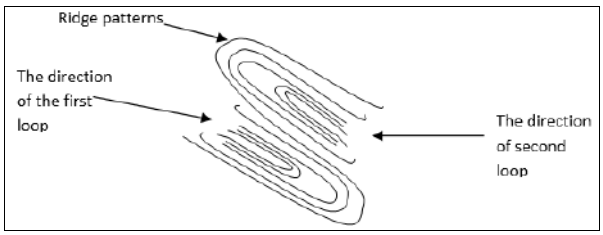

Fig 2(e): Twin loop

As the name suggests, it comprises both the right and left loops on a single finger. Two distinct loops are created in this situation, one to the left and one to the right. It may or may not have a delta.

6. The central pocket loop is a whorl shape variant. Some ridges have a circle pattern that re-curves and circles a whorl in the middle.

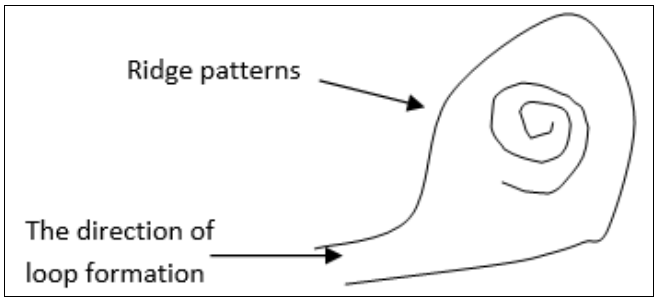

Fig 2(f): Centre pocket loop

7. The Whorl The ridge pattern that shapes the whorl starts in the centre and circles around to the edge. A cluster of concentric, continuous circles is visualized when tracing the forming phase. The delta is also located on the whorl's lower edge.

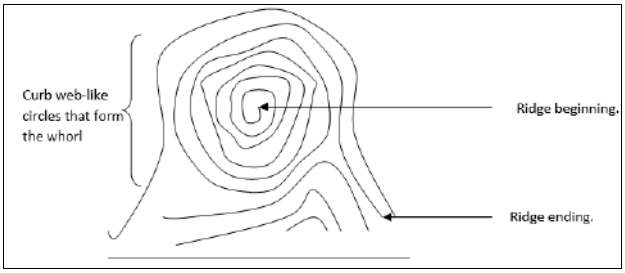

Fig 2(g): Whorl

8. Accidental characterises patterns that do not correspond to any previously defined sequence. It is very uncommon.

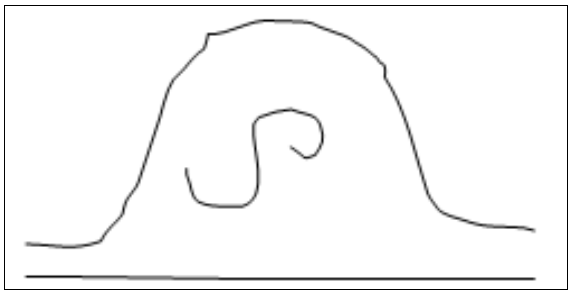

Fig 2(h): Accidental

In classification, two more characteristics of a print, delta and main, are used: the core, which is the approximate centre of the pattern, and the delta, which is the outer, terminal point of the pattern, as seen in fig. 2I

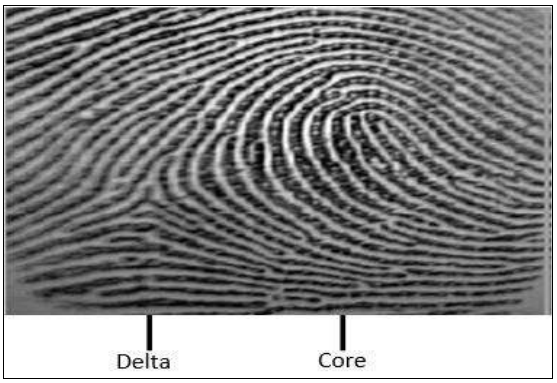

Fig 2(i): The delta and core of a fingerprint pattern

The fingerprint pattern includes additional attributes that can be used to classify the patterns. These minutiae marks, also known as Galton points, are tiny special markings on the fingerprint, such as ridge ends and ridge bifurcations. The traditional fingerprint classification system's purpose is to assign a functioning algorithm to a series of fingerprints, allowing the collection of prints to be identified or located in a register. The formula comprises numerical values given to fingerprint patterns (the value differs from finger to finger). These values are then added to form a numerical summary of the sequence of fingerprints, combined with the sort of pattern appearing in the index fingers and numerical values calculated from the ridge counts of different fingers.

The Henry scheme is one of these systems. This method employs the entire collection of ten finger patterns on both hands to identify an individual. The following describes the revamped Henry method, which is an expansion of the initial Henry system. The new Henry system recognises six previously described classes: arch, tented arch, whorl, left loop, right loop, and double loop.

The soleprint, like the fingerprint, has ridges that are patterned out, as seen in Fig. 2. (j). This experiment aims to look at the accessible classes on the Soleprint by studying the collected impression of Soleprint through the TET Fund-funded research (TET Fund, Tertiary Education Trust Fund, in Nigeria via the National Research Fund program supported my research on the topic "Viability of Soleprint and Toeprint of Lepers for Voting Purposes" in the year 2015).

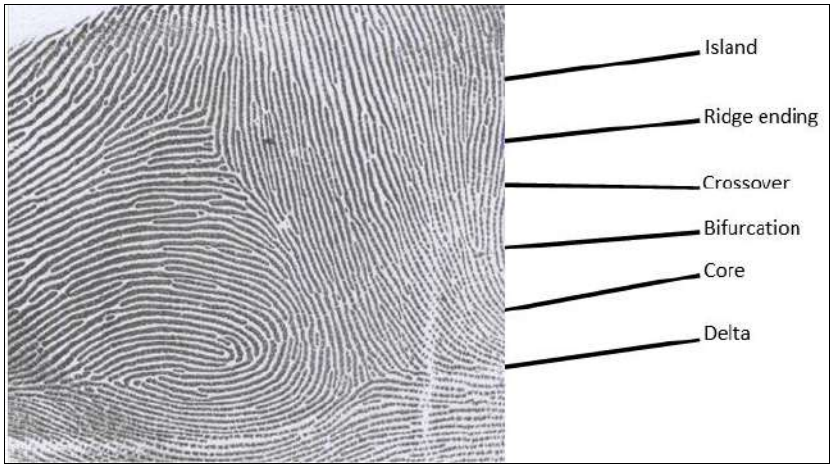

Fig 2(j): Presence of Minutiae in the Soleprint [3-4].

2.1 Caucasian fingerprint distribution

The FBI (USA) website contains reports of Caucasian fingerprint distribution. According to the types, the distribution shows the information by a percentage of the three (3) key fingerprint groups. This will allow for indebted fingerprint analysis and a faster storage/retrieval device pace for the large fingerprint database.

The percentage was constant for any random fingerprint collection depending on location or localisation throughout the United States. That is, if a certain state is searched, the percentage in the result would be comparable to every other state in the same USA for Caucasian fingerprint photographs [5-6].

The FBI (USA) fingerprint distribution for Caucasians reveals that loops are 65.5 percent, with left loop 33.8 percent and right loop 31.7 percent (no records for double loop on the details accessible to me), whorls are 27.9 percent. Arches are 6.6 percent, with 3.7 percent for the arch and 2.9 percent for the tented arch.

Table 1: Percentage Fingerprint Distribution of Caucasians (USA).

Class	Percentage %
Left loop	33.8
Right loop	31.7
Whorl	27.9
Arch	3.7
Tented arch	2.9

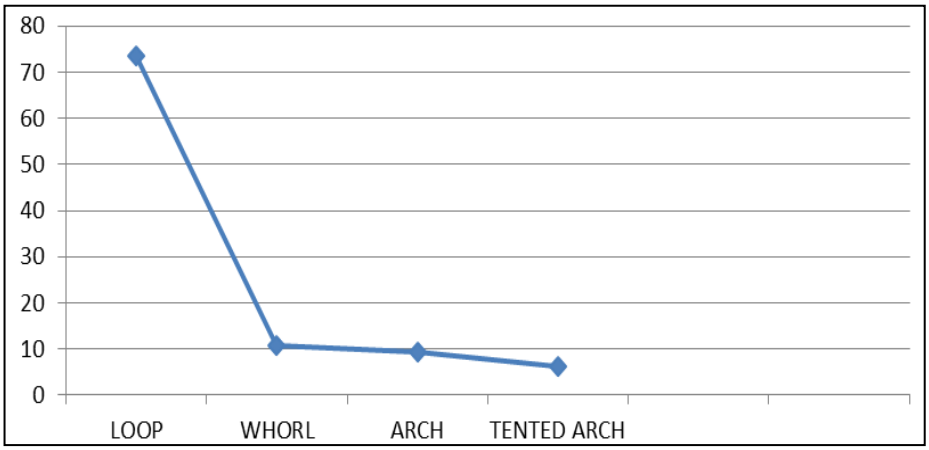

Fig 3: The Caucasian Distribution Plot

This percentage association has been nearly constant for over a decade. As a result, if photographs of fingerprints are obtained in bulk within a locality, it is essential to distribute them for proper records and, most importantly, to match them to the regular FBI (USA) records so that the review is complete. On that point, I would like to present this study on the distribution review of Soleprint data collected during the TET Fund-sponsored project.

2.2 Soleprint data acquisition tactic

Fingerprint data acquisition is usually done on a laptop computer, although the situation is somewhat different in the case of Soleprint and Toeprint [7]. The dabbed ink system was used in this capture operation. The stained platen surface was rubbed against the smooth surface of the sole whose prints were to be taken [8-10]. The stained sole is dabbed onto the card template's back. The single print is best taken with the man seated in a chair, the "personnel" squatting before him, and the rolled platen on the floor in front of him. Until staining, a towel can be used to clean the hand. Figure 4 shows an image of the soleprint capture operation.

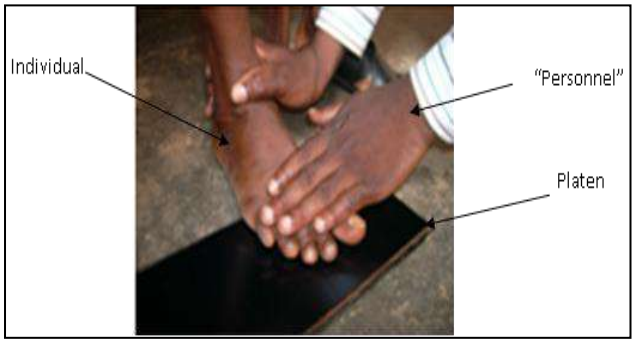

Fig 4: Toeprint Capture process

3. Methodology

For the experiment, 280 soleprints photographs were used. The photos were created using the two feet (left and right) of 140 lepers from nine Nigerian colonies. The soleprint data were gathered using the ink dab process. The captured data was inspected at 600dpi and saved using the Bitmap image processing algorithm. The photographs were saved in a save location with a file size of about 600KB and a resolution of about 400 X 500.

The photographs were then opened one by one to be displayed on a 21-inch display, while manual classification was performed using the experience of fingerprint classifications as a working formula.

4. Experiment/Result

The 280 Soleprints were examined and commented on in the following manner. Whorl has the largest population of 116, accounting for about 41.43 percent of the total population. Loop came in second with a population of 104, or about 37.14 percent, and arch (inverted) came in last with a population of 60, or about 21.43 percent.

Table 1: Population-Based Analysis of Soleprint Collected

Class	Population	Percentage (%)
Whorl	116	41.43
Right Loop	36	12.86
Left Loop	42	15
Double Loop	26	9.29
Arch (Inverted)	25	8.92
Tented Arch (Inverted)	35	12.5
Total	280	100

According to the experiment results, the soleprint is recognised for its uniqueness, and it contains the six (6) classes of the whorl, right loop, left loop, double loop, arch, and tented arch, much like the fingerprint. Both of the arches in the soleprint are reversed. No single soleprint was found to be identical to another. The thesis also shows that the soleprint contains minutiae points that could be used to identify them through real-time applications instantly. In soleprint, the whorl is the most populated among lepers in this geographical area, in contrast to fingerprint, which has the loop as the most populated.

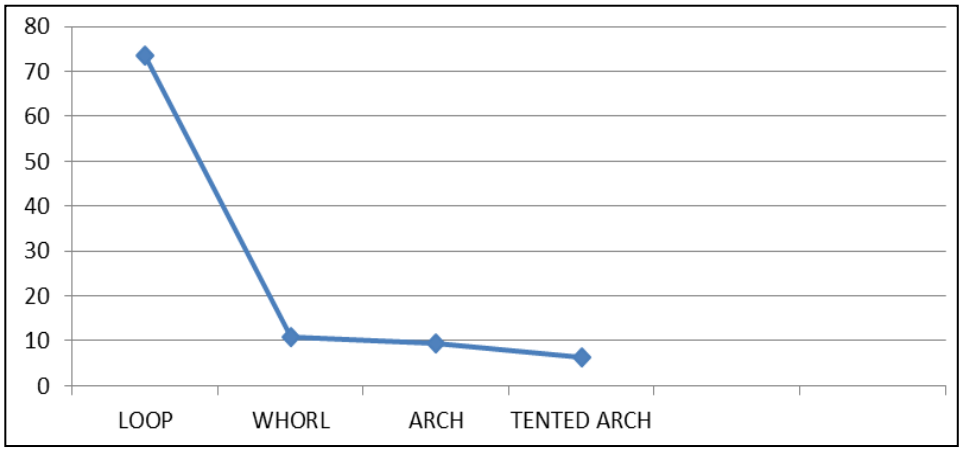

Fig 5: Soleprint chart

5. Conclusion

In the soleprint database, whorl is greater in the community, while the loop is larger in the FBI's Caucasian fingerprint. At this stage, it is necessary to remember that current fingerprint recognition software systems can easily manage soleprint impressions and provide decent results.

6. Acknowledgements

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