



# American Journal of Biometrics & Biostatistics

## Research Article

# Experimental Analysis of Toe Print Class Distribution in Caucasian and Lepers -

Obaje Samuel Enemakwu\*

*Department of Computer Engineering, Federal Polytechnic, Offa, Nigeria*

**\*Address for Correspondence:** Obaje Samuel Enemakwu, Department of Computer Engineering, Federal Polytechnic, Offa, Nigeria, Tel: +234-080-358-596-39; 234-080-785-643-34; ORCID: <https://orcid.org/0000-0003-1611-5809>; E-mail: [samuelobaje99@gmail.com](mailto:samuelobaje99@gmail.com); [obajese@yahoo.com](mailto:obajese@yahoo.com)

**Submitted:** 03 December 2019; **Approved:** 18 December 2019; **Published:** 20 December 2019

**Cite this article:** Enemakwu OS. Experimental Analysis of Toe Print Class Distribution in Caucasian and Lepers . American J Biom Biostat. 2019;3(1): 009-012.

**Copyright:** © 2019 Enemakwu OS. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

**ABSTRACT**

Toe print could suffice for the fingerprint for leprosy victims that do not have good fingerprints to identify them or vote with. Classification of the toe print or fingerprint into various categories is necessary to reduce the overall matching time to a minimal level. 1183 good toe prints were collected from 140 individual lepers from 9 colonies. The 140 individual toe prints were supposed to be actually 1400, but due to the bad toes on some individual lepers, the amount became what it we have now (1183). The toe prints were scanned at a 600 dpi resolution and saved using the Bitmap image compression algorithm for the experiment. The images were opened one after the other on a 21-inch screen for classification using the fingerprint classification description as a working formula. On the toe prints were found: double loop, left loop, right loop, whorl, arch and tented, just like that found on fingerprint. The Lepers toe print loop population is 63.5%, and is the highest in population, followed by whorls with population of 21.3%, the lepers arch was 10.8% and the tented arch is 4.4%, arch's group is the least. Toe print has features like the fingerprint that can be used for personal identification of an individual.

**Keywords:** Leprosy; Purdah; Arch; Tented arch; Classification; Toe print

**INTRODUCTION**

Popular techniques toe printing is the process of obtaining, for identification purposes, an impression of the papillar ridge of the toes. Although previous literatures have not really gone into the study of the toe print, it is evident that the toe, just like the fingers, has a ridge that could be studied [1-3].

The first extensive collection of fingerprint records was probably made at the end of the 19<sup>th</sup> century by Sir Francis Galton, an English scientist studying heredity [2-4]. After extended investigation, he concluded that the two basic facts on which fingerprint identification rests were one, that the ridge arrangement on each finger of each person was different, and two, that the ridge arrangement remained constant throughout one's life. These facts could have been traced back to other findings in the past, but they could not have come out with such a very solid conclusion. The toes by observation also have similar characteristics to the fingerprint, so that they can also be used for personal identification. The classification of the toe print is as shown in the (Figure 1).

The fingers can be identified by the name of the position, for example, the smallest and thickest finger that stands apart from the other four is called the thumb, followed by the index, then the middle finger, the ring, and finally the small finger.

The FBI (USA) has White fingerprint distribution databases on the internet. The distribution shows the information by percentage of the three main classes of fingerprints according to the categories. This will allow for an undebt fingerprint analysis and will also increase the speed of the storage/retrieval process for the bulky fingerprint database [7].

The percentage was found to be constant for any random selection of the fingerprint depending on any place or position in the United

States. What I mean is that, if a particular state is to be examined, the percentage of the test will be identical to any other state in the same USA for Caucasian fingerprint pictures [8,9].

The distribution of fingerprints of Caucasian as reported by the FBI (USA) indicates that loops are 65.5 percent that is left loop 33.8 percent and right loop 31.7 percent (no double loop records available to me), whorl is 27.9 per cent, and arches are 6.6 percent, that is 3.7 percent for arches and 2.9 percent for arches (Table 1).

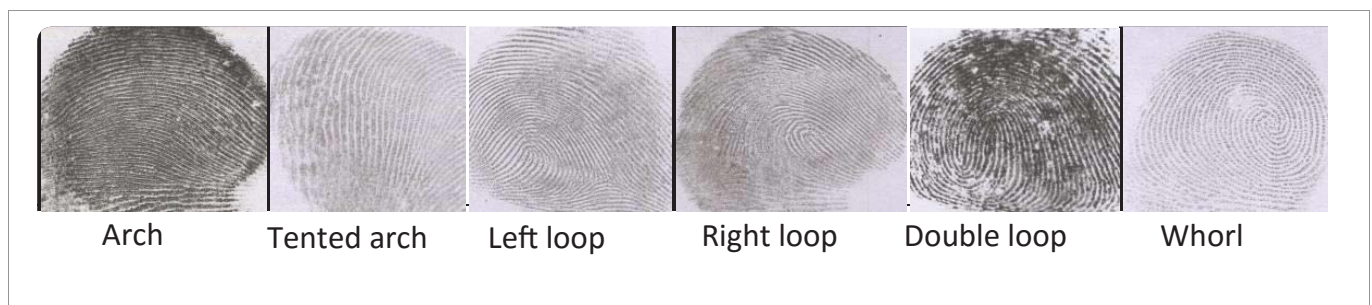
This percentage relationship has been observed to be stable for more than a decade now. For this purpose, if fingerprint images are obtained in mass within a locality, it is appropriate to make the distribution of proper records, and more so, to compare them with the regular FBI (USA) records, so that the analysis may be complete. This report is an analysis of the distribution of toe print data collected during the research sponsored by TET Fund.

**PROBLEM STATEMENT**

Available biometric modes do have problems due to racial considerations, lack of availability of databases in Africa. As it was, the toe print has little or no database available online for researchers to study with. The existing biometric mode, such as fingerprint, has an online database available for research and study purposes. Such systems are distinguished by population distribution, category identification, etc. When we do toe print coverage, it is important to expand the study beyond data collection alone, and therefore classification and distribution is necessary. It is important to compare the distribution thus acquired with the current distribution on a similar subject, fingerprint, for clarification.

**Toe print data acquisition employed**

The process used in the acquisition of toe print data is the ink-



**Figure 1:** Sample toe print classification [5-6].

dabbed method. In this case, all the toes whose prints are to be taken would be pressed against the stained surface of the plate at the same time. The stained toes are then dabbed to the space created for it within the card template that has already been designed as shown in the figure 2. The toe print is better taken with the individual seated on the chair, while the “personnel” should be squatting in front of him and the rolled platen placed on the floor in front of him. A towel must be used to wash the palm before the staining is finished. Figure 3 is a picture taken during one of our toe capturing sessions.

**Toe print class distribution analysis:** 1183 successful toe prints were obtained for the study from 140 individual lepers from 9 colonies. In fact, the (10%) individual toe prints were supposed to be (100%), but because of the bad toes on some individual lepers, the number became what we have now 92%). 35 large toes among the data collected were found to be in bad condition, apart from 25 index toes, 10 middle toes and 17 fourth toes (Table 2).

## COMPARISON OF CAUCASIAN FINGERPRINT DISTRIBUTION AND THE LEPERS

### Toe Print Distribution

The Caucasian fingerprint distribution as found on the FBI (USA) website was downloaded and compared to the lepers toe print distribution. The reason for the comparison is to prove the earlier suggestion that toe prints can conveniently replace fingerprints for voting purposes in those who do not have fingerprints. The Caucasian fingerprint loop population is roughly 65.5 percent and the Lepers toe print loop population is 73.5 percent. Whorls population is 27.9 percent Caucasian fingerprint and 10.8 percent, second in population of lepers toe print. The tent arch is 2.9 percent for the Caucasian fingerprint and 6.33 percent for the Lepers toe print, the lowest in both distributions. Arch is (9.3 percent) for the leper toe print and (3.7 percent) for the Caucasian fingerprint. The percentage by comparison of Caucasian (USA) fingerprint distribution and lepers toe print distribution (9 colonies in Nigeria) were shows in (Table 3).

Figure 4-6 shows that toe print can be used incase of people that does not have fingerprint . the experimental analysis from the graphs shows that the percentage error left loop is 2.4% while the accuracy is 97.6%, percentage error for right loop is 0.4% while the accuracy is 99.6%, percentage error for double loop is 5.2% while the accuracy is 94.6%, percentage error for whorl is 17.1% while the accuracy is 82.9%, percentage error for Arch is 5.6% while the accuracy is 94.1% and percentage error for Tented arch is 3.4% while the accuracy is 96.6%.

## CONCLUSION

By observation, population distribution for both the Caucasian fingerprint (USA) and the Lepers toe print (9 Leprosy Colonies in

**Table 1:** Percentage fingerprint distribution of Caucasian (USA).

Percentage fingerprint distribution of Caucasian (USA)	
Class	Percentage%
Left loop	33.8
Right loop	31.7
Whorl	27.9
Arch	3.7
Tented arch	2.9



Figure 2: Toe print card template.



Figure 3: Toe print Capture process.

**Table 2:** Toe print distribution

Lepers toe print distribution	
Class	Number
Left loop	428
Right loop	380
Double loop	62
Whorl	128
Arch	110
Tented arch	75

**Table 3:** Percentage by comparison of Caucasian (USA) fingerprint distribution and lepers toe print distribution (9 Colonies in Nigeria)

Class	Caucasian%	Lepers%
Left loop	33.8	36.2
Right loop	31.7	32.13
Double loop	Not revealed	5.24
Whorl	27.9	10.8
Arch	3.7	9.3
Tented arch	2.9	6.33

Nigeria) tends to follow the same trend. In other words, correlations between Caucasian fingerprints and lepers are the highest in the population and tend to form 2/3 of all databases collected. The whorl is second in population; the third is the arch, while the tent arch is the smallest. All groups of fingerprints and minutiae points used by

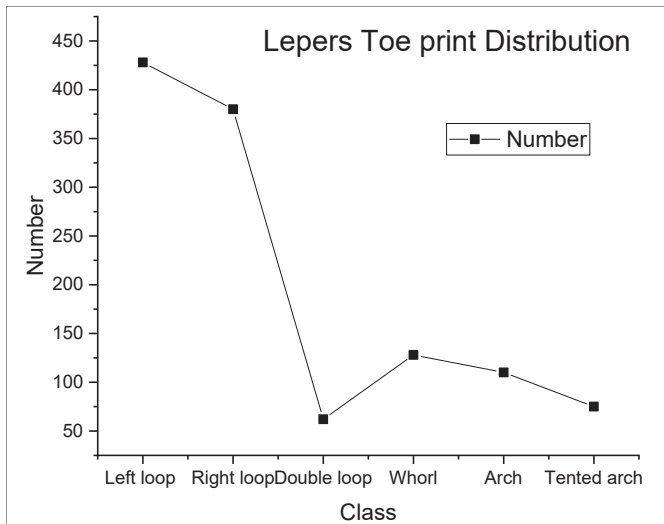


Figure 4: Toe print chart.

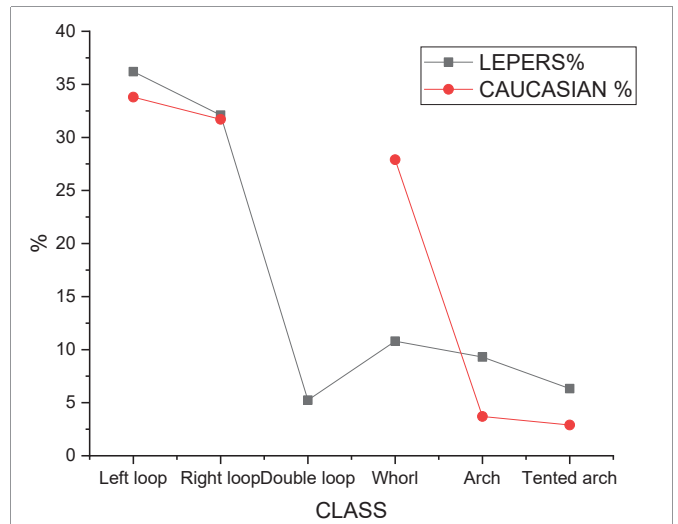


Figure 6: Comparison of Caucasian fingerprint and lepers toe print percentage.

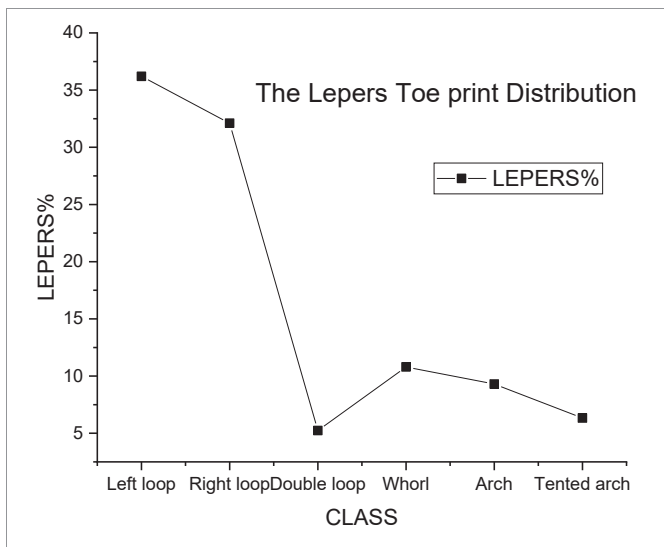


Figure 5: The lepers toe print distribution plot.

expert systems for the classification and recognition of objects are included in the toe print. With this in mind, we would like to conclude that the fingerprint can be conveniently replaced by a toe print for people (lepers and accident victims who have no fingerprints) who do not have a fingerprint as a means of personal identification and, in particular, for voting purposes.

### REFERENCES

1. Ajibade LS, Jimoh IA. Introduction to computer graphics, artificial intelligence and expert systems depet and co, mokola-ibadan. 2016; 1: 33.
2. Collins, Battley H. Single fingerprints, Hm stationary office London. 2012.
3. Clarence G. Fingerprint science: How to roll, classify, and use fingerprints, Ed. By Gerald D. Hunt, Custom. 2015.
4. Lawrence R, Thebaud. Systems and methods with identity verification by comparison and interpretation of skin patterns such as fingerprints. US Patent 5, 909, 501. 2018.
5. Obaje SE, Ibiyemi TS. Development of fingerprint database and analysis. Department of electrical, university of Ilorin. 2003.
6. Obaje SE, Ibiyemi TS. Automatic fingerprint and toe print recognition for personal identification and forensic application. Final report, department of electrical & electronics engineering, University of Ilorin. 2010.
7. Obaje SE. Lepers personal identification using the soleprint in place of fingerprint. Proceedings of the 3<sup>rd</sup> International Conference on Electronics and Computer Technology. Kanyakumari. India. 2011; 3: 471-474. <http://bit.ly/2rOH5Ao>
8. Gaensslen RE, Peter R, Deforest, Henry C Lee. Forensic science, an introduction to criminalistics. McGrawHill, New York. 2013.
9. Maio D, Maltoni R. Cappelli JL, Wayman, AK Jain. FVC2000: Fingerprint verification competition. Proc. 15<sup>th</sup> International Conference Pattern Recognition. Barcelona. 2000. <http://bit.ly/2PZVKAr>