

## **Fingerprint Pattern Recognition Using Distance Method Algorithm**

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**Abstract.** Biometrics is a popular approach for data security, for instance using fingerprint for pattern recognition. There are a lot of algorithms for the purpose such as Distance Method. Here, a blue circle will identify the Reference Point or Core Point. Furthermore, the Centre of Gravity will be defined on the fingerprint to provide an axis for alignment with the Core Point. Then, by taking that as the x axis, the mean x and y distances from the core point can be used to scale the print.

The distribution of the scaled distances from the Core Point then can be used as a fingerprint template and store it as a template master in a system database for next recognition. When someone wants to enter into the system, the machine will compare his fingerprint with the template. If the system finds the acceptance rate close to 1 and rejection rate nearby 0, the user will be allowed entering into the system; otherwise the system will reject him, even though he is the real member of the system.

**Keywords:** *biometrics, distance method, fingerprint, algorithm.*

### **1. Introduction**

The increasing of society care to security threat has born new ways to protect software, hardware, building and even network system from outside party attacks. One of the security ways is by using biometric system. Such system use human body which always can be brought and not possible to leave it at home or loss during the trip. The technology becomes a popular identification and verification tool. Types of existing biometric are fingerprint, iris, eye retina, hand, gait, face and voice or face.

Fingerprint is a typical pattern in the form of lines network arise considering sweat, oil and amino acid in the above palm husk and human foot/feet. Everyone's fingerprint pattern has unique character so that differ one to another. Equally, there is no human being having the same fingerprint, though both people of twin. The pattern formed when we were

still in obstetric, formed below husk coat named papillae dermal. If papillae still reside in husk, fingerprint will be always there. Although injure or burnt, as case of Azahari, bomb maker expert, his fingerprint can be analyzed because his finger arms still intact.

Fingerprint test is the highest identification way to determine someone's identity. Thus, in contrary, DNA test needn't be conducted. DNA test must be done if only body, especially hand finger and foot/feet go to pieces. Nature characteristics had by fingerprint such as:

- 1) Perennial nature that is the fingerprint at human being husk for a lifetime.
- 2) Immutability of someone's fingerprint never changed, except getting serious accident.
- 3) Individuality, fingerprint pattern is unique and differs to each and everyone.

From third the nature of this, fingerprint can be used as an identification system which able to be used in information technology application, for example:

1. Access System Security that is accessing to step a forbidden or limited selected room.
2. Authentication System, that is for data access which in character secret and limited, for example data on banking, military and diplomatic.

There are some criteria which must have by a biometric among others:

1. High consumer acceptance
2. Easy to be used
3. Quick ROI (Return of Investment)
4. Spread over to every level costumers
5. A very little confusing on users
6. Standard quality of performance
7. Proper mathematical calculation
8. Can become the part of routines.

Therefore, it is important to introduce a distance method as a way on fingerprint pattern recognition. At least three benefits will be gained. Firstly, to announce mathematician realizing that the security area requires a lot of idea from mathematician to make the world more secure and trustful. Secondly, the paper will give motivation to the author to do more research in biometrics, particularly on pattern recognition. Lastly, it might be a useful knowledge for the readers. However, the paper does not propose a new recognition method.

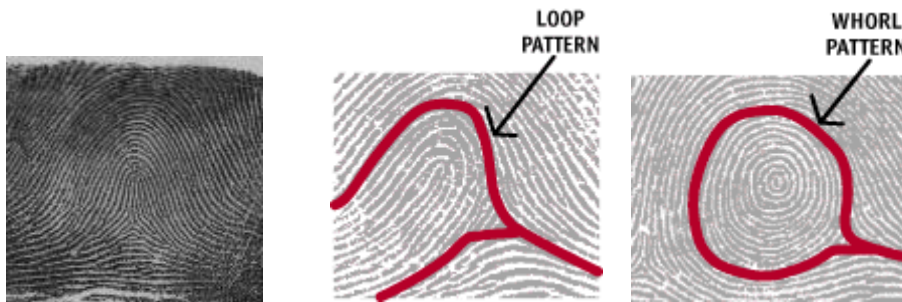
### **3. Discussion**

Biometric technology offers authentication by biological system. The system can recognize the consumers more precise. There are some methods, for instance scanning fingerprint, scanning retina and DNA scanning. Last two methods still in research level, while scanning fingerprint in this time have been used widely and together with smartcard used for authentication and identification. In North America, a man called E. Henry in year 1901 succeeded in advance use fingerprint to identify cessation of worker to overcome paying of double fee.

Henry's system comes from pattern of ridge which centrally hand finger pattern of his forefinger. A classic method of ink and furl finger at one particular printing mould card yielding a pattern of the unique ridge for each individual. This matter has earned to be trusted to prove that there is no two individuals have the same pattern of similar ridge. It can not inherit, never changed and only after death can change as deterioration result. In life, pattern of ridge only altered incidentally effect of, body injury, burnt, factious cause or disease.

Identification of fingerprint need differentiation concerning circle form of uninterrupted papillary ridge which followed by mapping concerning sign or unsystematic of similar anatomic ridge. There is seven patterns of papillary ridge i.e. *Loop*, *Arch*, *Whorl*, *Tented Arch*, *Double Loop*, *Central Pocked Loop* and *Accidental*. From seven patterns of papillary ridge there are three patterns which most common like depicted below:

### Arch

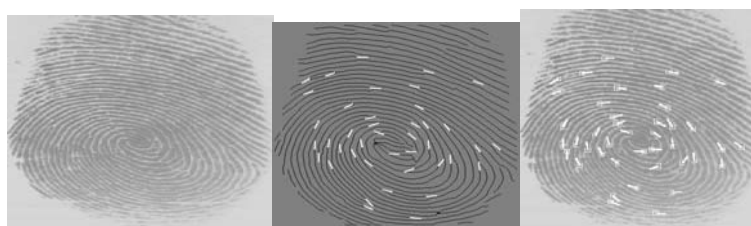


**Picture 1. A few example of papillary ridge pattern**

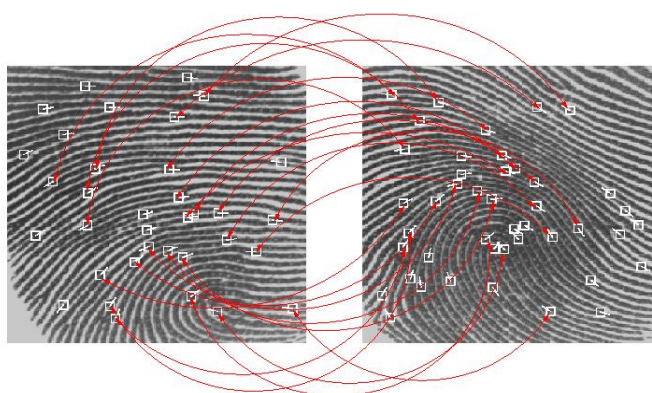
All above patterns can be differentiated by naked eye and can give a binning or index yielding data. A computer can analyze center of diameter change of direction form ridge, tired like eye which can see naturally. Mistake happened if this step is eliminated by a computer fingerprint program or AFIS (Automatic Fingerprint Identification). Moreover,

from all techniques of biometric, fingerprint-based is the oldest method which has been used at many applications. A fingerprint made by a series of wrinkling and ridge at surface of finger. It can be determined by pattern of ridge wrinkling and insignificant detail points. Insignificant points detail is characteristic of local ridge occurred at a particular bifurcation of two ridges and an end ridge.

Fingerprint technique can be placed into two categories: **minutiae-based** and based on correlation. Firstly, minutiae-based technique finds insignificant detail points and then map location which of similar pattern. However, usage of this approach there are some difficulties. That is difficult to tap that insignificant detail points accurately so that fingerprint quality of him become to lower. This method nor consider pattern of ridge dwindle and global cam. Method of correlation-based can defeat some of approach difficulties which is minutiae-based. However, each method has its insufficiency. Its need correct location to a registration and pretended by translation draw and rotation.



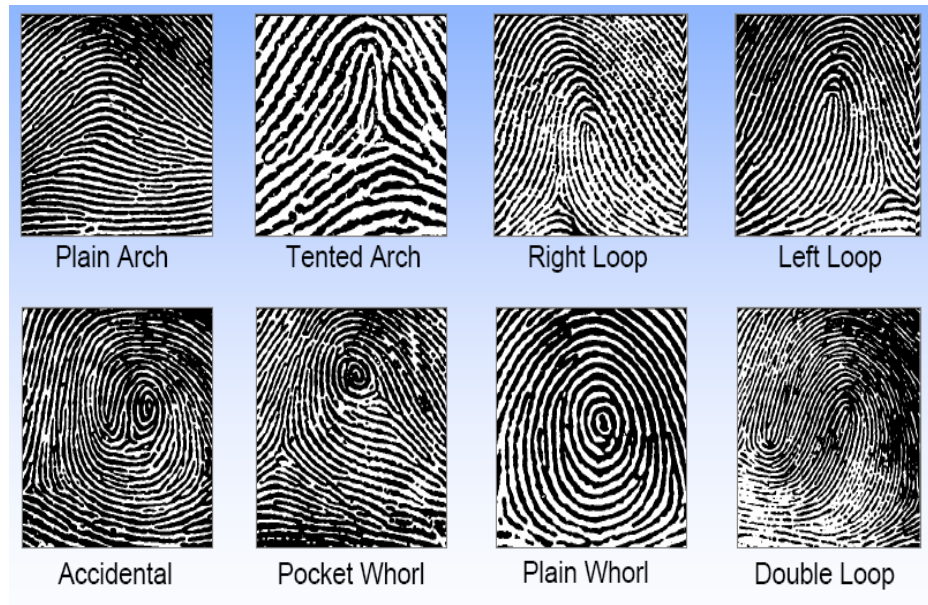
Picture 2. Some extension dots of ridge at fingerprint.



Picture 3. Similarity ridge on fingerprint

Area of papillary ridge is sometime known as area pattern. Each pattern of papillary ridge results a different area pattern form. Center of draw finger is known as the point core. Fingerprint feature used is fingerprint which enable to identify by analyzing 'fine details' of named fingerprint details with minutiae. Some fingerprints of macro: Arch, Loop Left, Loop

Right, Whorl and Arch Tented. Furthermore, minutiae is *Ridge ending*, *Bifurcation*, *Island*, *Divergence* and *Enclosure*.



**Picture 4. Some fingerprint patterns**

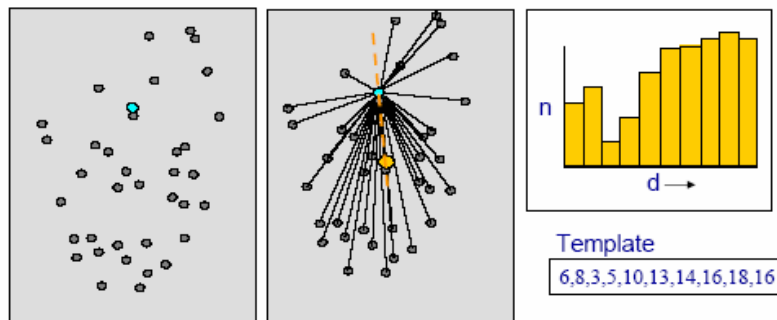
**Minutiae:** The small features of the fingerprint



**Picture 5. Feature of minutiae fingerprint**



**Picture 6. The way to define The Core Point**



**Picture 7. The way to make the scale distance and its template**

Based on the picture 6 and 7, a blue circle identifies the core point. Furthermore, the Centre of Gravity is defined on the fingerprint to provide an axis for alignment with the Core Point. Then, by taking that as the x axis, the mean x and y distances from the core point can be used to scale the print. The distribution of the scaled distances from the Core Point then can be used as a fingerprint template and store it as a template master in a system database for next recognition.

When someone wants to enter into the system, the machine will compare his fingerprint with the template. If the system finds the acceptance rate close to 1 and rejection rate nearby 0, the user will be allowed entering into the system; otherwise the system will reject him, even though he is the real member of the system.

### 3. Accuracy

Calculation of accuracy of fingerprint extraction with system is:

1. False Acceptance Rate (FAR): The fault where someone of user which do not enlist will be held true by system.

$$FAR = \frac{\sum_{n=1}^N FAR(n)}{N} \dots\dots\dots 1$$

2. *False Rejection Rate* (FRR)

The fault when someone which registered in the system was refused by system.

$$FRR = \frac{\sum_{n=1}^N FRR(n)}{N} \dots\dots\dots 2$$

3. *Failure To Enrol* (FTE)

A fault when system fail to enlist a new user ID:

$$FTE = \frac{\sum_{n=1}^N FTE(n)}{N} \dots\dots\dots 3$$

4. *Equal Error Rate* (EER)

That is contiguity dot FAR the highness with FRR the lowness and referred [as] also with number of error in system. Level possibility of fault and inaccuracy of system earn happened because many matters such as: condition of fingerprint finger which is good with quality like the him of clear, dry fingerprint, harsh fingerprint and allergic disease fingerprint husk, mount hygiene of censor glass equipments, finger position at the tim) of detection. All of these can influence levels efficacy of system in recognizing fingerprint correctly.

### 4. Conclusion

The distance method can be used for fingerprint pattern recognition. The algorithm can be implemented to create a template master and restore it in the database system. For next recognition, the user's fingerprint must be compared with the template in the database system.

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