Tuijin Jishu/Journal of Propulsion Technology
ISSN: 1001-4055
Vol. 44 No. 5 (2023)

Projection of Dactylogram by Using Fuzzy Relation

[1]S. Kavitha
Research Scholar
Department of Mathematics
Vels Institute of Science, Technology and Advanced Studies
Chennai, India
kavithakavi.s1011@gmail.com

[2,*]K. Selvakumari
Professor
Department of Mathematics
Vels Institute of Science, Technology and Advanced Studies
Chennai, India
selvafeb6@gmail.com

Abstract— Dactylograms (or fingerprints) have a unique sort of skin that covers the palm of the hand, the soles of the feet, and other parts of the body. This category of skin is known as "friction skin," and it aids in the identification of an individual. It cannot cross other lines. Even identical twins do not have the same dactylogram. In this paper, we analyse three generation dactylogram with the help of fuzzy relation.

Keywords—dactylogram, fuzzy relation, generation, membership function.

I. Introduction

Lotfi A. Zadeh (1965) [13] is a father of "Fuzzy set theory". Fuzzy is a mathematical field that is critical for dealing with ambiguity and imperfect knowledge in real-life scenarios. It's a crisp set variation with membership values in the [0, 1] range for elements. [4, 5, 6, 9, 14]. In the nineteenth century, dactylograms were employed in forensic investigations to identify people. Fingerprint patterns are recognised by Marcello Malpighi (1685). Purkjne deduces that there are eight primary fingerprint patterns (1823). The UK's Home Ministry Office confirmed in 1893 that no two people had the same fingerprints. Edmond Locard (1980) wrote twelve points which make a fingerprint unique from "Galton details" called ridge characteristics. Later, they begin to employ crime investigation and security proposals. There are three frequent patterns in dactylograms. (i.e.) arches (arch, tented), loops (ulnar, radial) and whorls (plain, central pocket or peacock eye, double loops, accidental). [8, 10].

It begins to develop in the third month of baby womb and reaches full maturity in the sixth month. Everyone has an impression of all of their fingers; but each finger (hand and foot) is unique. Nowadays, everyone uses dactylograms in a variety of ways to retain personal information and details. [7]. Dactylogram is a life time pattern and does not change till death. It is made up of two layers: the epidermis on top and the dermis on the bottom. Suppose the skin has been wounded, scraped or burned, etc. But it cannot be changing the pattern. Because the inner layer have the same pattern as the outer layer. The dermis is divided into two layers: papillary and reticular. The papillary layer is involved in sensory perception and temperature regulation, as well as nutrient supply to the skin. The papillary layer is a dermis layer that lies beneath the epidermis. The dermis's is an inner layer of the skin. Blood veins and connective tissue support the skin in the reticular dermis. The reticular dermis also contains hair follicles, oil and sweat glands, and other structures. [1].

Biometric play's main role in system scanner it stores many persons fingerprint with its additional details such as name, date of birth, identification number, etc. It used in airport security, building access, cars, blood banks, schools, government, industries, automatic teller machine, financial services, health care, border control, citizen id, forensic science (corpse identification, criminal identification, terrorist identification, parenthood determination and missing children), driver's license, credit cards, computer login in, electronic data access, locker, document encryption, automated medical diagnosis, etc. They also recognized other like physiological (face, hand, iris or eye, retina, DNA (deoxyribo nucleic acid), ear, gait) and behavioural (keystroke, signature, voice). [2, 3, 12].

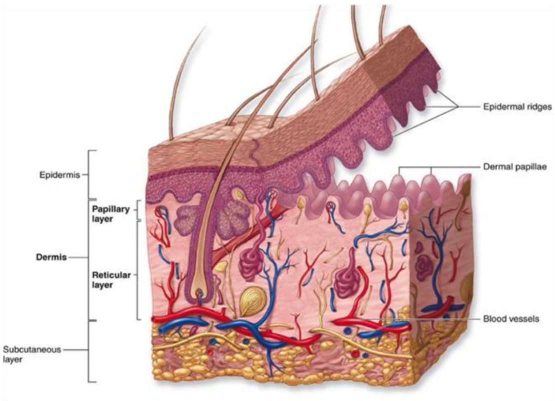


Fig. 1. Fingerprint inner skin.

II. Preliminaries

A. Linear Membership Function

A fuzzy set $\tilde{L}$ is specified by a function $\mu_{\tilde{L}}$: E → [0, 1], where [0, 1] is a set of all interval or membership function, E will beuniverse. [11]. Then,

$$\mu_{\tilde{L}}(x) = \begin{cases} 0 & , \quad 0 < x \\ \frac{x}{(t-s)\times 5} & , \quad s < x < t \\ \frac{x}{(v-u)\times 5} & , \quad u < x < v \\ 1 & , \quad \text{Otherwise} \end{cases}$$

where s = 0.2, t = 0.4, u = 0.7 and v =0.9. This is called as linear membership function.

B. Union of Fuzzy Relation

For any fuzzy relation $\tilde{L}_1$ and $\tilde{L}_2$. Let union of fuzzy relation $\tilde{L}_1 \cup \tilde{L}_2$ is denoted by $\mu_{\tilde{L}_1\cup\tilde{L}_2}(x,y)$. [4, 6, 9]

(i.e.) $\mu_{\tilde{L}_1\cup\tilde{L}_2}(x,y) = \max\{\mu_{\tilde{L}_1}(x,y), \mu_{\tilde{L}_2}(x,y)\}$

(or)

$$\mu_{\tilde{L}_1\cup\tilde{L}_2}(x,y) = \mu_{\tilde{L}_1}(x,y) \cup \mu_{\tilde{L}_2}(x,y) \text{ for all } x \in X, y \in Y.$$

is also called as maximum of relation.

C. Intersection of Fuzzy Relation

The intersection of fuzzy relation $\tilde{L}_1 \cap \tilde{L}_2$ is denoted by $\mu_{\tilde{L}_1\cap\tilde{L}_2}(x,y)$. [4, 6, 9]

(i.e.) $\mu_{\tilde{L}_1\cap\tilde{L}_2}(x,y) = \min\{\mu_{\tilde{L}_1}(x,y), \mu_{\tilde{L}_2}(x,y)\}$

(or)

$\mu_{\tilde{L}_1\cap\tilde{L}_2}(x,y) = \mu_{\tilde{L}_1}(x,y) \cap \mu_{\tilde{L}_2}(x,y)$ for all $x \in X$, $y \in Y$.

where $\tilde{L}_1$ and $\tilde{L}_2$ is a fuzzy relation. This is called as minimum of relation.

D. Properties of Fuzzy Relation

Let $\tilde{L}_1, \tilde{L}_2$ and $\tilde{L}_3$ be any fuzzy relation. Then, the combination of maximum and minimum relation is known as properties of fuzzy relation. [4, 6, 14]. Define

(i) $\tilde{L}_1 \cup (\tilde{L}_2 \cup \tilde{L}_3) = (\tilde{L}_1 \cup \tilde{L}_2) \cup \tilde{L}_3$

(ii) $\tilde{L}_1 \cap (\tilde{L}_2 \cap \tilde{L}_3) = (\tilde{L}_1 \cap \tilde{L}_2) \cap \tilde{L}_3$

(iii) $\tilde{L}_1 \cap (\tilde{L}_2 \cup \tilde{L}_3) = (\tilde{L}_1 \cap \tilde{L}_2) \cup (\tilde{L}_1 \cap \tilde{L}_3)$

(iv) $\tilde{L}_1 \cup (\tilde{L}_2 \cap \tilde{L}_3) = (\tilde{L}_1 \cup \tilde{L}_2) \cap (\tilde{L}_1 \cup \tilde{L}_3)$

For example,

$\mu_{\tilde{L}_1}(x_1, y_1) = 0.8$, $\mu_{\tilde{L}_2}(x_1, y_1) = 0.8$, $\mu_{\tilde{L}_3}(x_1, y_1) = 0.3$

(i) $\tilde{L}_1 \cup (\tilde{L}_2 \cup \tilde{L}_3) = (\tilde{L}_1 \cup \tilde{L}_2) \cup \tilde{L}_3$

Left hand side

$\mu_{\tilde{L}_1 \cup (\tilde{L}_2 \cup \tilde{L}_3)}(x_1, y_1)$

$= \max\{\mu_{\tilde{L}_1}(x_1, y_1), \max\{\mu_{\tilde{L}_2}(x_1, y_1), \mu_{\tilde{L}_3}(x_1, y_1)\}\}$

$= \max\{0.8, \max\{0.8, 0.3\}\}$

$= \max\{0.8, 0.8\}$

$= 0.8$

Right hand side

$\mu_{(\tilde{L}_1 \cup \tilde{L}_2) \cup \tilde{L}_3}(x_1, y_1)$

$= \max\{\max\{\mu_{\tilde{L}_1}(x_1, y_1), \mu_{\tilde{L}_2}(x_1, y_1)\}, \mu_{\tilde{L}_3}(x_1, y_1)\}$

$= \max\{\max\{0.8, 0.8\}, 0.3\}$

$= \max\{0.8, 0.3\}$

$= 0.8$

$\therefore$ Left hand side = Right hand side

(ii) $\tilde{L}_1 \cap (\tilde{L}_2 \cap \tilde{L}_3) = (\tilde{L}_1 \cap \tilde{L}_2) \cap \tilde{L}_3$

Left hand side

$\mu_{\tilde{L}_1 \cap (\tilde{L}_2 \cap \tilde{L}_3)}(x_1, y_1)$

$= \min\{\mu_{\tilde{L}_1}(x_1, y_1), \min\{\mu_{\tilde{L}_2}(x_1, y_1), \mu_{\tilde{L}_3}(x_1, y_1)\}\}$

$= \min\{0.8, \min\{0.8, 0.3\}\}$

$= \min\{0.8, 0.3\}$

$= 0.3$

Right hand side

$\mu_{(\tilde{L}_1 \cap \tilde{L}_2) \cap \tilde{L}_3}(x_1, y_1)$

$= \min\{\min\{\mu_{\tilde{L}_1}(x_1, y_1), \mu_{\tilde{L}_2}(x_1, y_1)\}, \mu_{\tilde{L}_3}(x_1, y_1)\}$

Tuijin Jishu/Journal of Propulsion Technology
ISSN: 1001-4055
Vol. 44 No. 5 (2023)

= min {min {0.8, 0.8}, 0.3}

= min {0.8, 0.3}

= 0.3

∴ Left hand side = Right hand side

(iii) $\tilde{L}_1 \cap (\tilde{L}_2 \cup \tilde{L}_3) = (\tilde{L}_1 \cap \tilde{L}_2) \cup (\tilde{L}_1 \cap \tilde{L}_3)$

Left hand side

$\mu_{\tilde{L}_1 \cap (\tilde{L}_2 \cup \tilde{L}_3)}(x_1, y_1)$

= min $\{\mu_{\tilde{L}_1}(x_1,y_1)$, max$\{\mu_{\tilde{L}_2}(x_1,y_1)\}$, $\mu_{\tilde{L}_3}(x_1,y_1)\}\}$

= min {0.8, max {0.8, 0.3}}

= min {0.8, 0.8}

= 0.8

Right hand side

$\mu_{(\tilde{L}_1 \cap \tilde{L}_2) \cup (\tilde{L}_1 \cap \tilde{L}_3)}(x_1, y_1)$

= max {min $\{\mu_{\tilde{L}_1}(x_1,y_1)$, $\mu_{\tilde{L}_2}(x_1,y_1)\}$, min $\{\mu_{\tilde{L}_1}(x_1,y_1)$,

$\mu_{\tilde{L}_3}(x_1,y_1)\}\}$

= max {min {0.8, 0.8}, min {0.8, 0.3}}

= max {0.8, 0.3}

= 0.8

∴ Left hand side = Right hand side

(iv) $\tilde{L}_1 \cup (\tilde{L}_2 \cap \tilde{L}_3) = (\tilde{L}_1 \cup \tilde{L}_2) \cap (\tilde{L}_1 \cup \tilde{L}_3)$

Left hand side

$\mu_{\tilde{L}_1 \cup (\tilde{L}_2 \cap \tilde{L}_3)}(x_1, y_1)$

= max $\{\mu_{\tilde{L}_1}(x_1,y_1)$, min $\{\mu_{\tilde{L}_2}(x_1,y_1)$, $\mu_{\tilde{L}_3}(x_1,y_1)\}\}$

= max {min {0.8, 0.8}, 0.3}

= max {0.8, 0.3}

= 0.8

Right hand side

$\mu_{(\tilde{L}_1 \cup \tilde{L}_2) \cap (\tilde{L}_1 \cup \tilde{L}_3)}(x_1, y_1)$

= min {max $\{\mu_{\tilde{L}_1}(x_1,y_1)$, $\mu_{\tilde{L}_2}(x_1,y_1)\}\}$, max

$\{\mu_{\tilde{L}_1}(x_1,y_1)$, $\mu_{\tilde{L}_3}(x_1,y_1)\}$

= min {max {0.8, 0.8}, max {0.8, 0.3}}

= min {0.8, 0.8}

= 0.8

∴ Left hand side = Right hand side

Tuijin Jishu/Journal of Propulsion Technology
ISSN: 1001-4055
Vol. 44 No. 5 (2023)

E. Projection of Fuzzy Relation

Let $\tilde{L}$ be a fuzzy relation on $X \times Y$. Then the first projection is maximum of each row and second projection is maximum of each column. Finally, maximum of first projection and second projection must be equal. Then it's called as global projection. [4]

First Projection

$$\tilde{L}^{(1)} = \underset{y}{\vee} \mu_{\tilde{L}}(x, y)$$

Second Projection

$$\tilde{L}^{(2)} = \underset{x}{\vee} \mu_{\tilde{L}}(x, y)$$

Global Projection

$$\tilde{L}^{(G)} = \underset{yx}{\vee\vee} \mu_{\tilde{L}}(x, y) = \underset{xy}{\vee\vee} \mu_{\tilde{L}}(x, y)$$

where $\vee$ is maximum relation. Suppose $\tilde{L}^{(G)} = 1$, if projection is ordinary and $\tilde{L}^{(G)} < 1$, if projection is below ordinary.

For Example,

		y_1	y_2	y_3	$\tilde{L}^{(1)}$
$\mu_{\tilde{L}}(x, y) =$	x_1	0.0	0.8	0.7	0.8
	x_2	0.1	0.2	0.6	0.6
	x_3	0.8	0.3	0.3	0.8
	$\tilde{L}^{(2)}$	0.8	0.8	0.7	0.8

First Projection

$$\mu_{\tilde{L}^{(1)}}(x_1, y_j) = \underset{x}{\vee} [\mu_{\tilde{L}^{(1)}}(x_1, y_1), \mu_{\tilde{L}^{(1)}}(x_1, y_2), \mu_{\tilde{L}^{(1)}}(x_1, y_3)]$$

$$= \underset{x}{\vee} [0.0, 0.8, 0.7]$$

$$= 0.8$$

Second Projection

$$\mu_{\tilde{L}^{(1)}}(x_i, y_1) = \underset{x}{\vee} [\mu_{\tilde{L}^{(1)}}(x_1, y_1), \mu_{\tilde{L}^{(1)}}(x_2, y_1), \mu_{\tilde{L}^{(1)}}(x_3, y_1)]$$

$$= \underset{x}{\vee} [0.0, 0.1, 0.8]$$

$$= 0.8$$

Global Projection

$$\mu_{\tilde{L}^{(G)}}(x_i, y_j) = \underset{xy}{\vee\vee} [\mu_{\tilde{L}^{(2)}}(x_i, y_1), \mu_{\tilde{L}^{(2)}}(x_i, y_2), \mu_{\tilde{L}^{(2)}}(x_i, y_3)]$$

$$= \underset{\text{y}}{\vee} [0.8, 0.8, 0.7]$$

(∵ Maximum values of second projection)

= 0.8

$$\mu_{\tilde{L}^{(G)}}(x_i, y_j) = \underset{yx}{\vee\vee}[\mu_{\tilde{L}^{(1)}}(x_1, y_j), \mu_{\tilde{L}^{(1)}}(x_2, y_j), \mu_{\tilde{L}^{(1)}}(x_3, y_j)]$$

$= \underset{x}{\vee}$ [0.8, 0.6, 0.8]

(∵ Maximum values of first projection)

= 0.8

III. Numerical Example

Our intention is to compare the three generation dactylogram from 25 distinct families. First, tag for each generation,

L - Grandfather/Grandmother

F-Father/Mother

N - Male/Female child

Now form a gridline for each dactylogram and imagine a 3x3 matrix to match the descendent. Compare three set of dactylograms: (L, F), (F, N) and (F, L). Hereafter, create a matrix table by using the likens of each cell (compare same cell on both sides).

From the above definition 2.1, we construct the values. If it resembles equally, we assign a value of 1.0, if it does not, we assign a value of 0.0, if it resembles maximum, we assign a value of 0.9, it is medium resembles then assign a value 0.5 and if it resembles minimum, we assign 0.3. This is how we liken each of the nine cells. For liken dactylograms, we create a matrix table.

Equally resemble	=	1
Maximum resembles	=	0.9
Medium resembles	=	0.5
Minimum resembles	=	0.3
Not resembled	=	0

Then we are using the definitions 2.4 and 2.5 to get a better outcome. Definition 2.4, we need to get an equal matrix from the left and right hand side and hereafter, use the equality table to get the maximum for each column and row in definition 2.5. From those values we found the global projection.

Family

Devi (49)	-	Grandfather/Grandmother
Kasturi (31)	-	Father/Mother
Mohammed Rafick (10)	-	Male/Female child

Give the membership values for each compared cell. Hereafter fix the label for matched tables $\tilde{L}_k$ has x_i rows and y_j columns where $i = j = k = 1, 2, 3$.

Tuijin Jishu/Journal of Propulsion Technology
ISSN: 1001-4055
Vol. 44 No. 5 (2023)

TABLE I. MATCHING L AND F

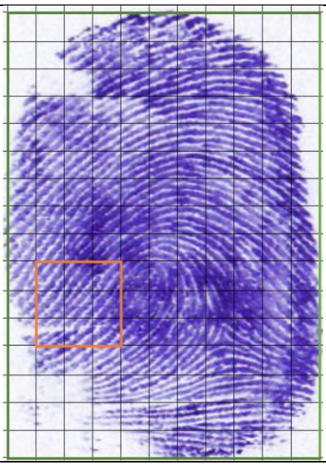
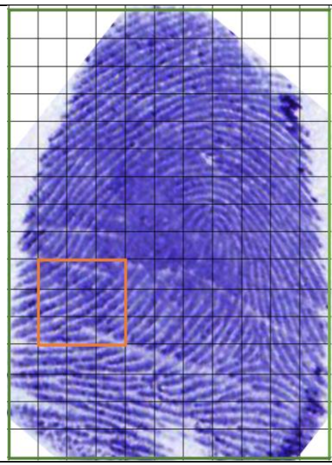
L	F
	

TABLE II. $\tilde{L}_1$

	y_1	y_2	y_3
x_1	0.0	0.0	0.0
x_2	0.3	0.0	0.0
x_3	0.0	0.0	0.3

TABLE III. MATCHING F AND N

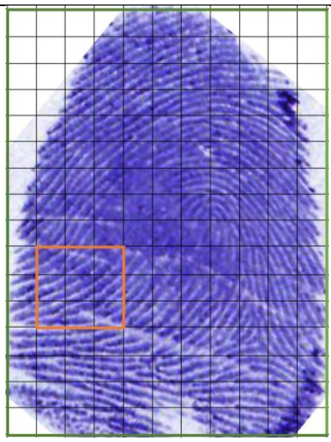
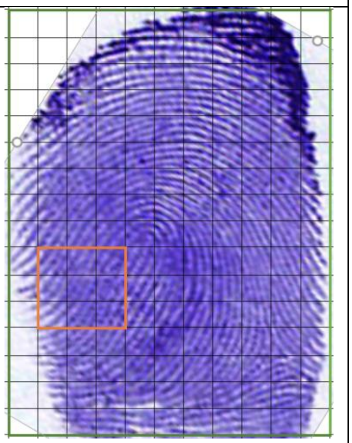
F	N
	

TABLE IV. $\tilde{L}_2$

	y_1	y_2	y_3
x_1	0.0	0.6	0.0
x_2	0.3	0.0	0.0
x_3	0.0	0.3	0.3

Tuijin Jishu/Journal of Propulsion Technology
ISSN: 1001-4055
Vol. 44 No. 5 (2023)

TABLE V. MATCHING N AND L

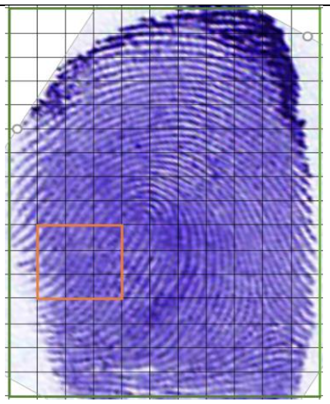
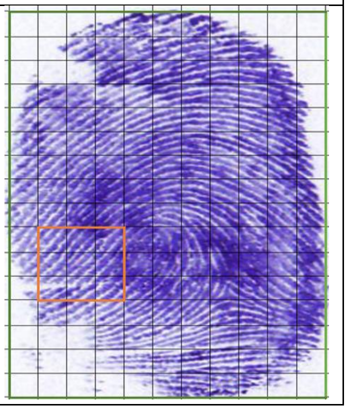
N	L
	

TABLE VI. $\tilde{L}_3$

	y_1	y_2	y_3
x_1	0.0	0.0	0.0
x_2	0.3	0.3	0.3
x_3	0.0	0.3	0.6

Using definition 2.4

(i) $\tilde{L}_1 \cup (\tilde{L}_2 \cup \tilde{L}_3) = (\tilde{L}_1 \cup \tilde{L}_2) \cup \tilde{L}_3$

Left hand side

Calculate $\tilde{L}_1 \cup (\tilde{L}_2 \cup \tilde{L}_3)$, by using definition 2.2.

TABLE VII. $\tilde{L}_2 \cup \tilde{L}_3$

	y_1	y_2	y_3
x_1	0.0	0.6	0.0
x_2	0.3	0.3	0.3
x_3	0.0	0.3	0.6

TABLE VIII. $\tilde{L}_1 \cup (\tilde{L}_2 \cup \tilde{L}_3)$

	y_1	y_2	y_3
x_1	0.0	0.6	0.0
x_2	0.3	0.3	0.3
x_3	0.0	0.3	0.6

Right hand side

Calculate $(\tilde{L}_1 \cup \tilde{L}_2) \cup \tilde{L}_3$,by using definition 2.2.

TABLE IX. $\tilde{L}_1 \cup \tilde{L}_2$

	y_1	y_2	y_3
x_1	0.0	0.6	0.0
x_2	0.3	0.0	0.0
x_3	0.0	0.3	0.3

TABLE X. $(\tilde{L}_1 \cup \tilde{L}_2) \cup \tilde{L}_3$

	y_1	y_2	y_3
x_1	0.0	0.6	0.0
x_2	0.3	0.0	0.0
x_3	0.0	0.3	0.3

Left hand side = Right hand side.

TABLE XI. USING DEFINITION 2.5 AND THE ABOVE RESULTANT TABLE OF (I).

				First Projection
	0.0	0.6	0.0	0.6
	0.3	0.0	0.0	0.3
	0.0	0.3	0.3	0.3
Second Projection	0.3	0.6	0.3	**0.6** **Global Projection**

(i) = 0.3 = sub-normal.

(ii) $\tilde{L}_1 \cap (\tilde{L}_2 \cap \tilde{L}_3) = (\tilde{L}_1 \cap \tilde{L}_2) \cap \tilde{L}_3$

Left hand side

Calculating $\tilde{L}_1 \cap (\tilde{L}_2 \cap \tilde{L}_3)$ by using definition 2.3

TABLE XII. $\tilde{L}_2 \cap \tilde{L}_3$

	y_1	y_2	y_3
x_1	0.0	0.0	0.0
x_2	0.3	0.0	0.0
x_3	0.0	0.3	0.3

TABLE XIII. $\tilde{L}_1 \cap (\tilde{L}_2 \cap \tilde{L}_3)$

	y_1	y_2	y_3
x_1	0.0	0.0	0.0
x_2	0.3	0.0	0.0
x_3	0.0	0.0	0.3

Right hand side

Calculating $(\tilde{L}_1 \cap \tilde{L}_2) \cap \tilde{L}_3$ by using definition 2.3

TABLE XIV. $\tilde{L}_1 \cap \tilde{L}_2$

	y_1	y_2	y_3
x_1	0.0	0.0	0.0
x_2	0.3	0.0	0.0
x_3	0.0	0.0	0.3

TABLE XV. $(\tilde{L}_1 \cap \tilde{L}_2) \cap \tilde{L}_3$

	y_1	y_2	y_3
x_1	0.0	0.0	0.0
x_2	0.3	0.0	0.0
x_3	0.0	0.0	0.3

Left hand side = Right hand side.

TABLE XVI. USING DEFINITION 2.5 AND THE ABOVE RESULTANT TABLE OF (II).

				First Projection	
	0.0	0.0	0.0	0.0	
	0.3	0.0	0.0	0.3	
	0.0	0.3	0.3	0.3	
Second Projection	0.3	0.3	0.3	0.3	Global Projection

(ii) = 0.3 = sub-normal.

(iii) $\tilde{L}_1 \cap (\tilde{L}_2 \cup \tilde{L}_3) = (\tilde{L}_1 \cap \tilde{L}_2) \cup (\tilde{L}_1 \cap \tilde{L}_3)$

Left hand side

Calculating $\tilde{L}_1 \cap (\tilde{L}_2 \cup \tilde{L}_3)$ by using definition 2.2, 2.3.

TABLE XVII. $\tilde{L}_1 \cap (\tilde{L}_2 \cup \tilde{L}_3)$

	y_1	y_2	y_3
x_1	0.0	0.0	0.0
x_2	0.3	0.0	0.0
x_3	0.0	0.0	0.3

Right hand side

Calculating $(\tilde{L}_1 \cap \tilde{L}_2) \cup (\tilde{L}_1 \cap \tilde{L}_3)$ by using definition 2.2, 2.3.

TABLE XVIII. $\tilde{L}_1 \cap \tilde{L}_3$

	y_1	y_2	y_3
x_1	0.0	0.0	0.0
x_2	0.3	0.0	0.0
x_3	0.0	0.0	0.3

TABLE XIX. $(\tilde{L}_1 \cap \tilde{L}_2) \cup (\tilde{L}_1 \cap \tilde{L}_3)$

	y_1	y_2	y_3
x_1	0.0	0.0	0.0
x_2	0.3	0.0	0.0
x_3	0.0	0.0	0.3

Left hand side = Right hand side.

TABLE XX. USING THE ABOVE DEFINITION 2.5 AND RESULTANT TABLE OF (III).

				First Projection	
	0.0	0.0	0.0	0.0	
	0.3	0.0	0.0	0.3	
	0.0	0.0	0.3	0.3	
Second Projection	0.3	0.0	0.3	0.3	Global Projection

(iii) = 0.3 = sub-normal

(iv) $\tilde{L}_1 \cup (\tilde{L}_2 \cap \tilde{L}_3) = (\tilde{L}_1 \cup \tilde{L}_2) \cap (\tilde{L}_1 \cup \tilde{L}_3)$

Left hand side

Calculating $\tilde{L}_1 \cup (\tilde{L}_2 \cap \tilde{L}_3)$ by using definition 2.2, 2.3.

TABLE XXI. $\tilde{L}_1 \cup (\tilde{L}_2 \cap \tilde{L}_3)$

	y_1	y_2	y_3
x_1	0.0	0.0	0.0

x_2	0.3	0.0	0.0
x_3	0.0	0.3	0.3

Right hand side

Calculating $(\tilde{L}_1 \cup \tilde{L}_2) \cap (\tilde{L}_1 \cup \tilde{L}_3)$ by using definition 2.2, 2.3.

TABLE XXII. $\tilde{L}_1 \cup \tilde{L}_3$

	y_1	y_2	y_3
x_1	0.0	0.0	0.0
x_2	0.3	0.3	0.3
x_3	0.0	0.3	0.6

TABLE XXIII. $(\tilde{L}_1 \cup \tilde{L}_2) \cap (\tilde{L}_1 \cup \tilde{L}_3)$

	y_1	y_2	y_3
x_1	0.0	0.0	0.0
x_2	0.3	0.0	0.0
x_3	0.0	0.0	0.3

Left hand side = Right hand side.

TABLE XXIV. USING DEFINITION 2.5 AND THE ABOVE RESULTANT TABLE OF (IV)

				First Projection
	0.0	0.0	0.0	0.0
	0.3	0.0	0.0	0.3
	0.0	0.0	0.3	0.3
Second Projection	0.3	0.0	0.3	0.3 **Global Projection**

(iv) = 0.3 = sub-normal.

Result

The projection result from the four comparisons above will be less than 1. As a result, the outcome is not ordinary.

IV. CONCLUSION

Dactylogram is more useful to identify the individual persons and security proposes. The projection of a fuzzy relation and certain fundamental properties of a fuzzy relation, such as the conjunction of max and min, are used in this paper. In furthermore, 25 families three-generation fingerprints have been analyzed. Now we've concluded that generation fingerprints have some similarity.

REFERENCES

[1] C. Chinnappan, and R. Porkodi, "Fingerprint Recognition Technology Using Deep Learning: A Review," International Journal of Creative Research Thoughts, vol. 9, pp. 4647-4663, Jan 2021.

[2] A. K. Jain, A. Ross and S. Prabhakar, "An Introduction to Biometric Recognition", IEEE Transactions on Circuits and Systems for Video Technology, vol. 14, pp. 4-20, 2004.

[3] K. Jain, F. Patrick and A. Arun, Handbook of Biometrics, 1st edition, Springer Science Business Media, 2008.

[4] A. Kaufmann, "Introduction to the Theory of Fuzzy Subsets", United Kingdom Edition, Academic Press, Inc, London, 1973.

[5] S. Kavitha and D. Vidhya, "Fingerprint Matching Based on Fuzzy Astribution", AIP Conference Proceedings, vol. 2277, pp. 090016-1-090016-14, 2020.

[6] J. G. Klir and B. Yuan, Fuzzy Sets and Fuzzy Logic: Theory and Applications, Prentice Hall P T R, New Jersey, 1996.

[7] H. C. Lee and R. E. Gaensslen, Advances in Fingerprint Technology, 2nd edition, CRC Press, London, 2001.

[8] D. Maltoni, D. Maio, A. K. Jain and S. Prabhakar, Handbook of Fingerprint Recognition, 2nd edition, Springer, 2009.

[9] M. Mizumoto and K. Tanaka, Fuzzy sets and their operations, Information and Control, vol. 48, pp. 30-48, 1981.

[10] P. Singh and L. Kaur, Fingerprint Feature Extraction using Ridge and Valleys, International Journal of Engineering Research & Technology, vol. 4, pp. 1330-1334, 2015.

[11] M. Swarup, J. Kim and R. Krishnapuram, "An overview of membership function generation techniques for pattern recognition", International Journal of Approximate Reasoning, vol. 19, pp. 319-417, 1998.

[12] W. Yang, S. Wang, J. Hu, G. Zheng, and C. Valli, "Security and accuracy of fingerprint-based biometrics: A review", Symmetry, vol. 11, pp. 141, 2019.

[13] L. A. Zadeh (1965), "Fuzzy sets", Information and Control, vol. 8, pp. 338-353.

[14] H. J. Zimmermann, Fuzzy Set Theory and its applications, 3rd edition, Kluwer Academic Publishers, London, 1996.