

https://www.ijsrtm.com Vol.2 Issue 3 September 2022: 07-11 Published online 11 Sep 2022

E-ISSN: 2583-7141

International Journal of Scientific Research in Technology & Management



Tongue Peerless Pattern Recognition for Procreating Biometric Regime using Prewitt & Emboss Extraction

Arun Pratap Singh
Dept. of Computer Science &
Engineering
Samrat Ashok Technological Institute
Vidisha, Madhya Pradesh, India
singhprataparun@gmail.com

Sanjay Kumar Sharma
Computer Science & Engineering
Truba Institute of Engineering &
Information Technology
Bhopal, Madhya Pradesh, India
sanjaysharmaemail@gmail.com

Manish Manoria

Dept. of Computer Science &

Engineering

Technocrat Intitute of Technology

Bhopal, Madhya Pradesh, India
manishmanoria@gmail.com

Amit Saxena
Computer Science & Engineering
Rabindranath Tagore University
Bhopal, Madhya Pradesh, India
amit.saxena78@gmail.com

Sunil Joshi

Dept. of Computer Science &

Engineering

Samrat Ashok Technological Institute

Vidisha, Madhya Pradesh, India
sunil.joshi05@gmail.com

Utkarsh Dubey
Computer Science & Engineering
University Institute of Technology
Bhopal, Madhya Pradesh, India
utkarshdubey7@gmail.com

Abstract -- In this digital world, it is required to be secured from various identity frauds that has been threatening to the society severely. Human can be identified on the basis of physiological parameters that can be a central dogma in the field of biometric authentication system. There are various biometric parameters such as fingerprint, Iris, knuckle, palm and now tongue. Tongue has labyrinthine patterns that is unique and cannot be forged easily. Tongue is a genetic independent and no two tongues have similar features. There is very fewer researches have been done in this field or it is in preliminarily stage. Tongue is a new and auxiliary biometric unit that can provide alginate impression which will become useful for forensic identification. It has been medically proved that tongue has unique features and it may vary according to the gender. The application of tongue biometric becomes useful in banking sectors, forensic examination and many more. It has morphological characteristics and can be observed from digital photography. Here the system proposed a reconciliation method for implementing tongue biometric using Prewitt Edge Detection and Emboss Kernel filtration. Prewitt is a tool that can explore predominant features of tongue and embossing highlighted the textures effectively for better recognition rate.

Keywords— Tongue Biometric, Labyrinthine Patters, Prewitt Edge Detection, Emboss, Kernel Method, Physiological Parameters.

I. INTRODUCTION

Tongue has most common characteristic i.e. fissures but it is not morphologically same for every tongue. These fissures are located at the central region of the tongue. It can be in U shape or V shape and mostly female may pertain V shape predominantly. It is a surface feature based distinctiveness that can be pertained by dentist and feeding into the database for creating templates to future matching.



Fig. 1. Tongue Textures

Biometric refers to the identification system that is used to authenticate people on the basis of behavioral and physical characteristics. It requires a scanning devices such as digital camera that converts it into digital information in the form of texture or pattern [1]. This will pertain higher sentive information that provides high assurance biometric system. The geographical shape of tongue may constant but the physiological shape or patterns does not varry spacious. It is very difficult to manipulate the patterns as compare to the

other biometic authentication system. It has unquie patterns and two people do have same patterns even identical twins cannot have similar features.

II. RELATED WORKS

A. Literature Survey

Zhi Liu et al. [2] proposed a framework which is based learning methodology manifold for sequence representation of tongue image for recognition. It is a lowdimensional embedded manifold learning that obtains tongue image space from the sequences by LPP. It has been observed that there is non-linear space present over tongue and it can be observed from manifold structure further more training can probe the image and extract the crucial information from tongue image and verify the non-rigid organ patterns effectively. But proper training can achieve the objective of the system that requires large amount of dataset that increases the space complexity and cost of the system. Rahaila NaaZ et al. [3] proposed a framework that intended to use scale invariant points for phase extraction for obtaining non-rigid human tongue. System elaborated the applications of tongue biometric in the field of nuclear installation as well as banking and industrial sectors. Here the system uses existing technology for public use and demonstrated how it works and beneficial for various sectors. David Zhang et al. [4] proposed a framework which is based on image processing tactics and extracted tongue image using Gaussian filter. Here system collected 134 tongue samples from different people and pertain the accuracy as 93.3 %. System focuses on tongue shape extraction that feasible to obtain the actual texture of the tongue instead of other areas. Meo Vincent C. Caya et al. [5] proposed a framework which is based on Binary Robust Independent Elementary Features. System uses SIFT and BRIEF algorithm for enrolling and recognizing tongue print integrated with Raspberry Pi that equipped with 8 mega pixel camera. Here the system pertained the precision as SIFT 0.82 0.71 0.98 0.009927 BRIEF 0.85 0.78 0.98 0.78.

Mrunmayee Godbole et al. [6] proposed a review report over human tongue biometric system and their uniqueness. It has been observed that it is a powerful biometric tool for dealing with the identity fraud. The privacy and feature are very much difficult to reverse-engineered. It a reliable and genetic independent and stable over time and physical protection environment it has. It is mandatory to create a database for template matching.

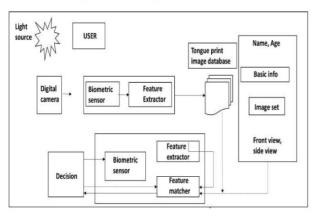


Fig. 2. Biometric Tongueprint System Setup [6]

Swapna B.V. et al. [7] derived a survey over tongue based authentication. There are various researches have been done in this field and it differs gender wise as per the various papers. It featured various advantages and certain disadvantages too. As per the article it shows that it is a unique idea to filter the legitimate user biologically but it is difficult to attain the tongue image. Yang Xin et al. [8] derived a technique based on appearance manifold learning methodology. This method has been used for representing the human tongue appearance by manifold learning as low dimensional embedding system that recorded the sequence of measurements using NMM. This paper devoted to create a platform for tongue based verification in the field of internet of medical things. Here the system recorded the accuracy as 87.5%.

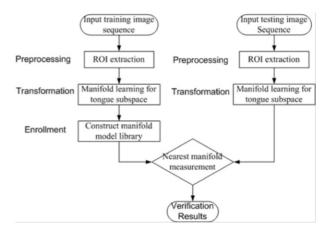


Fig. 3. Framework Flowchart [8]

III. PROPOSED WORK & IMPLEMENTATION

The objective of the paper is to propose a tongue biometric system which is based on Prewitt Edge Detection algorithm and Emboss filtration technique. Proposed system is able to identify the legitimate user as well as illegitimate one effectively. System is able to extract the tongue textures sharply using Prewitt and Emboss that create enrolling templates for verification. Here the only tongue is a region of interest where various features present and these features are recorded as templates and stored in the database for further verification while authentication.



Fig. 4. Proposed Architecture

A. Prewitt Operator

Prewitt is an edge detection technique for extracting edges horizontally as well as vertically and compute its magnitude once the extraction has been done. Prewitt is a modern technique where sharp texture can be achieved presicely and various keypoints can be recorded by the help of that. Tongue has various surface gaps that are required to record as patterns and Prewitt is very much capable to extract the shape of textures effectively. Prewitt is a first order derivative where kernel is masking horizontally as well as vertically. The combination of both horizontal edges and vertical edges may pertains the overall tongue textures edges sharply. Here the edges are computing by the differences among the corresponding pixel intensities. There are two kernels in Prewitt where one is working for horizontal tracing and another one is for vertical.

a. Horizontal Kernel

1	0	-1
1	0	-1
1	0	-1

In horizontal kernel mask, the direction is towards leftward that means calculation is to be performed leftward from right to left. And derivative is as follows-

$$\frac{\partial f}{\partial x} = \frac{f(x, y + K_y) - f(x, y)}{-K_y}$$

$$\frac{\partial f}{\partial x} = f(x, y) - f(x, y + 1)$$

$$(y_3 = y_2 + K_v, y_2 = y, x_3 = x, K_v = 1)$$

Sensitive to horizontal edges and first order derivation is computed in given direction.

b. Vertical Kernel

1	1	1
0	0	0
-1	-1	-1

In vertical kernel mask, the direction is towards upward that means calculation is to be performed upward from right to left. And derivative is as follows-

$$\frac{\partial f}{\partial y} = \frac{f(x + K_x, y) - f(x, y)}{-K_x}$$

$$\frac{\partial f}{\partial y} = f(x+1,y) - f(x,y)$$

$$(x_2 = x + K_x, x_1 = x, y_1 = y_2 = y, K_x = 1)$$

Sensitive to vertical edges and first order derivation is computed in given direction.

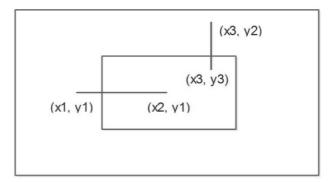


Fig. 5. Horizontal & Vertical Coordinates

$$\begin{array}{cccc}
a_0 & a_1 & a_2 \\
a_7 & [i,j] & a_3 \\
a_6 & a_5 & a_4
\end{array}$$

The partial derivatives $\frac{\partial f}{\partial x} \frac{\partial f}{\partial y}$ can be computed by –

$$M_x = (a_2 + ca_3 + a_4) - (a_0 + ca_7 + a_6)$$

 $M_y = (a_6 + ca_5 + a_4) - (a_0 + ca_1 + a_2)$

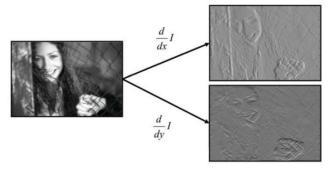


Fig. 6. Prewitt Edge Horizontal & Vertical Derivative

B. Emboss Filtration

Emboss is a digital image processing filtration technique that can highlight object according to the dark and light boundaries Low contrast area would be replaced by gray levels. It is a directional difference filtration technique using convolutional mask.

$$\begin{bmatrix} 0 & +1 & 0 \\ 0 & 0 & 0 \\ 0 & -1 & 0 \end{bmatrix} \begin{bmatrix} +1 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & -1 \end{bmatrix}$$
$$\begin{bmatrix} 0 & 0 & 0 \\ +1 & 0 & -1 \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} 0 & 0 & +1 \\ 0 & 0 & 0 \\ -1 & 0 & 0 \end{bmatrix}$$



Fig. 7. Emboss Tongue Textures

C.Flow Chart

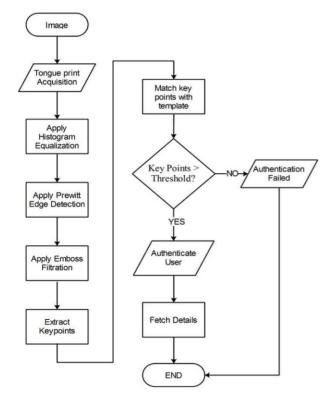


Fig. 8. Flow Chart of Proposed System

As per the flow chart, first of all a tongue image acquisition is pertained for image pre-processings such as histogram equalization. Once the pre-processing has been completed prewitt edge operator is to be applied for extracting edges of textures and later embossing the extracted edges that enhances the image predominantly. Then Keypoints are to be extracted and these keypoints compare with stored templates and if keypoints are greater than the threshold value that means a legitimate user is trying to get access and system will authenticate that user otherwise system will deny the authentication.

D. Prewitt Kernel & Emboss Algorithm

Input: 2D input matrix

Output: Prewitt & Emboss Derivatives

Step 1: Acquire 2D input matrix

Step 2: Apply histogram equalization

$$P_{n} = \frac{number\ of\ Pixel\ Intensity\ n}{Total\ number\ of\ pixels}\ n = 0,1 \dots L - 1$$

$$g_{i,j} = floor\ ((L-1)\sum_{n=0}^{f(i,j)} P_{n}$$

$$T(k) = floor\ ((L-1)\sum_{n=0}^{k} P_{n}$$

Transformation comes from intensities f and g as continuous random variables X, Y

$$Y = T(X) = (L-1) \int_0^X px(x) dx$$

Step 3: Apply Prewitt Operator

 G_x & G_y are gradient mask kernels derived from horizontally and vertically resp.

$$G_x = \begin{bmatrix} +1 & 0 & -1 \\ +1 & 0 & -1 \\ +1 & 0 & -1 \end{bmatrix} * A, \quad G_y = \begin{bmatrix} +1 & +1 & +1 \\ 0 & 0 & 0 \\ -1 & -1 & -1 \end{bmatrix} * A$$

Gradient absolute magnitude can be computed by combining both the derivates that have been calculated horizontally and vertically.

$$G = \sqrt{G_x^2 + G_y^2}$$

Step 4: Apply Emboss kernel filtration by using kernels

$$\begin{bmatrix} 0 & +1 & 0 \\ 0 & 0 & 0 \\ 0 & -1 & 0 \end{bmatrix} \begin{bmatrix} +1 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & -1 \end{bmatrix} \begin{bmatrix} 0 & 0 & 0 \\ +1 & 0 & -1 \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} 0 & 0 & +1 \\ 0 & 0 & 0 \\ -1 & 0 & 0 \end{bmatrix}$$

Step 5: Extract Keypoints where crossover present and defines as K

Step 6: **if** (K > T) **then** // T is the threshold value that relies the boundary value where an authentic user must have greater keypoints than threshold

Authenticate User;

else

Authentication Denied;

end else

end if

Step 7: End

So, the algorithm covers all the mathematical computations of terminology that has been applied. This method is based on kernel masking and finally system acquired features in the form of keypoints that have been computed from crossovers very much similar to the fingerprint crossovers and ridges.

IV. RESULT ANALYSIS

Here the system has been tested with 150 data sample of different people where 75 samples are from male and 75 from female users, age between 20 to 45. Where 148 samples are recorded as correct recognition and 2 as incorrect. So, as per the total number of samples, the recorded accuracy is 98.66% which is bit higher than the previous works.

TABLE I. RESULT OBTAINED

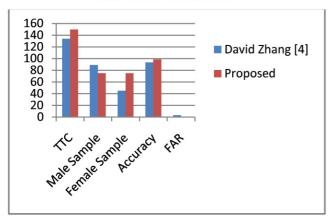
	Proposed
Total Correct Recognition (CR)	148
Total Incorrect Recognition (IR)	2
Total Testing Class (TTC)	150
Accuracy	98.66 %
False Acceptance Rate (FAR)	0.01 %

Fig. 9. Console Result

TABLE II. RESULT COMPARISON

Terms & Parameters	David Zhang [4]	Proposed
Total Testing Class	134	150
Male Samples	89	75
Female Samples	45	75
Accuracy	93.3 %	98.66 %
FAR	2.9 %	0.01 %

GRAPH I. RESULT COMPARISON



V. CONCLUSION & FUTURE SCOPE

The system which has been proposed in this paper is able to identify the legitimate users by tongue biometric prints with high level of accuracy. System uses Prewitt Edge Detection Algorithm for extracting edges sharply and Emboss Filtration kernel for enhancing the texture for better authentication system. System also uses a pre-processing technique i.e. histogram equalization for adjusting the contrast value for better visibility. System is capable enough to classify the illegitimate users and denied for the same. The false acceptance rate is bit low i.e. 0.01 % and accuracy has been recorded as 98.66 % which is bit higher than the previous work. There are various applications of this system in the field of banking, forensic department and many more. In future certain new approaches can be applied and accuracy can be enhanced with less processing time and that can work with poor image also.

REFERENCES

- [1] Jeddy N, Radhika T, Nithya S. Tongue prints in biometric authentication: A pilot study. J Oral Maxillofac Pathol 2017;21:176-9
- [2] Liu, Z., Wang, H., Jiang, W., & Zhuang, H. (2011). Tongue verification with manifold learning. 2011 Seventh International Conference on Natural Computation.
- [3] Naaz, R., Yadav, S., & Diwakar, M. (2012). Tongue Image Extraction Technique from Face and Its Application in Public Use System (Banking). 2012 International Conference on Communication Systems and Network Technologies.
- [4] Zhang D., Liu Z., Yan J., Shi P. (2007) Tongue-Print: A Novel Biometrics Pattern. In: Lee SW., Li S.Z. (eds) Advances in Biometrics. ICB 2007. Lecture Notes in Computer Science, vol 4642. Springer, Berlin, Heidelberg.
- [5] Caya, M. V. C., Durias, J. P. H., Linsangan, N. B., & Chung, W.-Y. (2017). Recognition of tongue print biometrie using binary robust independent elementary features. 2017IEEE 9th International Conference on Humanoid, Nanotechnology, Information Technology, Communication and Control, Environment and Management (HNICEM).
- [6] Mrunmayee Godbole1, Bindiya Narang2, Sangeeta Palaskar3, Swati Patil4, Anirudha R Bartake2, Tongue Scanning As a Biometric Tool: A Review Article, International Journal of Health Sciences and Research Vol.10; Issue: 4; April 2020.
- [7] Venkatesh, Swapna & Kamath, Vignesh & Hasbullah, Norhaswani & Mutalib, Noor & Nazeri, Muhammad & Putera, Ahnaf & Tharmaseelan, Mayasimiriti & Paula, Jordana & Yi, Sofia. (2019). A Preliminary Study of Tongue Prints for Biometric Authentication. Shiraz E-Medical Journal. In Press. 10.5812/semj.96173.
- [8] Xin, Y., Cao, Y., Liu, Z., Chen, Y., Cui, L., Zhu, Y., ... Wang, M. (2018). Automatic Tongue Verification Based on Appearance Manifold Learning in Image Sequences for the Internet of Medical Things Platform. IEEE Access, 1–1.
- [9] Suryadevara, S., Naaz, R., Shweta, Kapoor, S., & Sharma, A. (2011). Visual cryptography improvises the security of tongue as a biometric in banking system. 2011 2nd International Conference on Computer and Communication Technology (ICCCT-2011).