

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

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**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







### 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 precisely 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-

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

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

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

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.

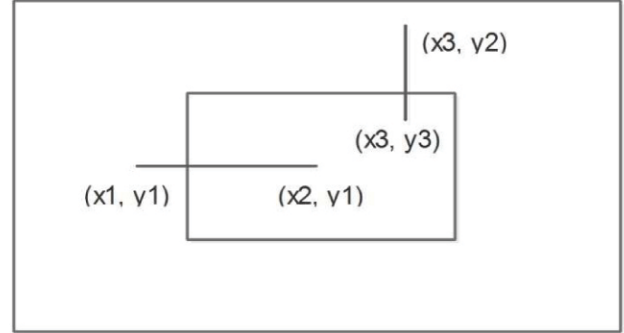


Fig. 5. Horizontal & Vertical Coordinates

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

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

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

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

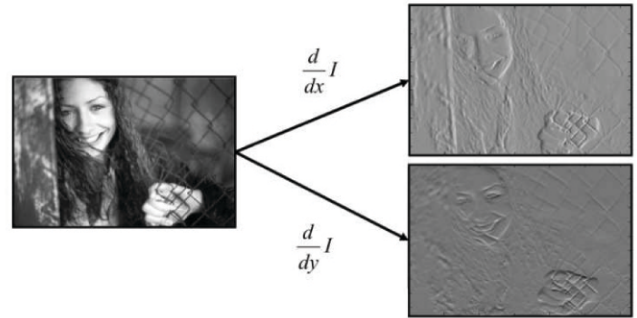


Fig. 6. Prewitt Edge Horizontal & Vertical Derivative

### 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

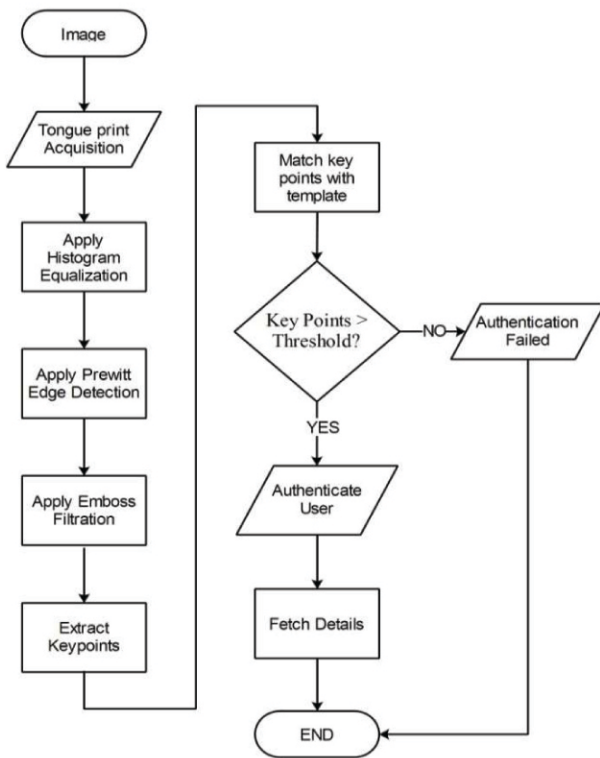


Fig. 8. Flow Chart of Proposed System

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

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

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

$$T(k) = \text{floor} \left( (L - 1) \sum_{n=0}^k P_n \right)$$

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

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

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 derivatives 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 %   |

$$\text{Accuracy} = \frac{TTC - IR}{TTC} * 100 \%$$

```

[143] '143.jpg' 'CR' [1]
[144] '144.jpg' 'CR' [1]
[145] '145.jpg' 'CR' [1]
[146] '146.jpg' 'CR' [1]
[147] '147.jpg' 'CR' [1]
[148] '148.jpg' 'CR' [1]
[149] '149.jpg' 'CR' [1]
[150] '150.jpg' 'CR' [1]

Total Correct Identification = [148]
Total Incorrect Identification = [2]
Total Testing Class = [150]
Accuracy = [98.6667]

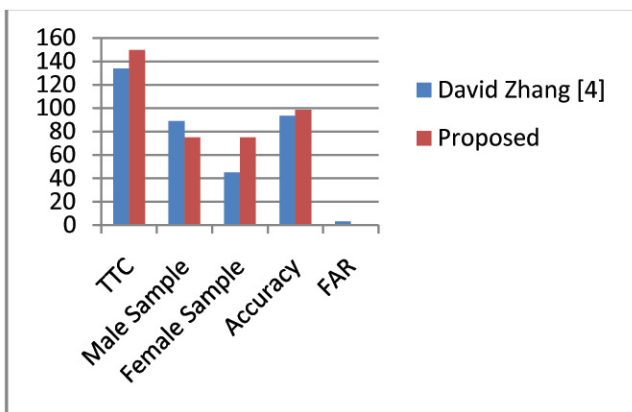
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Fig. 9. Console Result

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.

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