

## Palm Print Recognition Using Wavelet Transforms

B. Padmavathy<sup>1</sup>, Loganathan R<sup>2</sup>, Chaithra S<sup>3</sup>

<sup>1</sup>Asst. Professor, Department of CSE, Sri Ventakeshwara College of Engineering, Bengaluru, India

<sup>2</sup>Professor and Head, Department of ISE, Sri Ventakeshwara College of Engineering, Bengaluru, India

<sup>3</sup>Asst. Professor, Department of CSE, Sri Ventakeshwara College of Engineering, Bengaluru, India

**Abstract**— Palmprint recognition is a biometric technology that has gained popularity in recent years due to its great accuracy and reliability in identifying people based on the distinctive patterns seen in their hands' palms. Wavelet transform is a signal and image processing mathematical tool that has been applied to palmprint recognition to extract features from palmprint images, which are subsequently used for recognition. The wavelet transform technique for palmprint recognition begins with the collection of a high-resolution image of the palmprint, which is then preprocessed to eliminate any noise or artefacts. The image is then subjected to the wavelet transform, which divides it into a series of sub-bands with varying sizes and resolutions. Features unique to the individual's Palmprint are derived from each sub-band. To identify the individual, the retrieved traits are compared to the features contained in the database. Since palmprints are unique to each individual and do not vary considerably over time, Palmprint recognition using wavelet transform is a non-intrusive technology with excellent accuracy and reliability. Overall, using wavelet transform is a promising biometric approach with applications in security and access control, forensic investigation, and healthcare.

**Keywords**— Biometrics, Palmprint features, resolution.

### I. Introduction

Palmprint recognition is a biometric technology used to identify people based on the distinctive patterns found in their hands' palms. The wavelet transform is a mathematical method used in signal and image processing that analyses signals and images at various sizes and resolutions. Palmprint recognition using wavelet transform is a technique that extracts features from a Palmprint image and then uses them for recognition. Palmprint recognition using wavelet transform typically entails the following steps: Image capture: Using a digital camera or scanner, a high-resolution image of the Palmprint is captured. Preprocessing: The image is preprocessed in order to remove any noise or artefacts that may be present. Feature extraction: The preprocessed image is subjected to the Wavelet transform in order to extract features

that are unique to each individual's Palmprint(Fig.1). The wavelet transform divides the image into subbands of varying sizes and resolutions, and characteristics are retrieved from each subband. Wavelet transform Palmprint identification has various advantages over other biometric approaches. It is a non-intrusive technique that requires no physical touch with the person being recognised. However, there are several drawbacks to using this strategy. Palmprint images can be influenced by elements like as illumination, orientation, and scale, which can impair the recognition system's accuracy. Furthermore, the processing time necessary for feature extraction and matching might be lengthy, making real-time applications difficult. It is also extremely accurate and

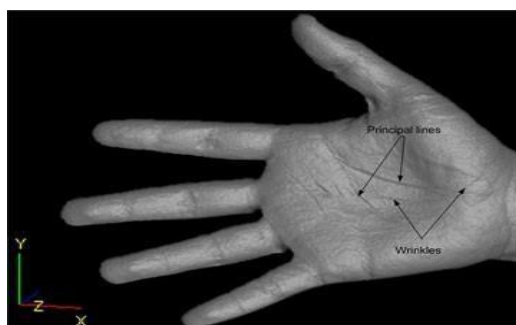


Fig.1 Image of Palm

dependable because palm prints are unique to each individual and do not vary greatly over time. Feature matching: To identify the individual, the extracted features are matched to the features contained in the database. Feature matching: To identify the individual, the extracted features are matched to the features contained in the database. Feature matching. Overall, wavelet transform palm print recognition is a promising biometric identification technology with good

accuracy and reliability. It has the potential to become a widely used technology in a variety of applications, including security and access control, forensic investigation, and healthcare, with continuous study and improvement. Palm print recognition is a biometric technique that uses the distinctive patterns seen in the palm of a person's hand to identify them. The wavelet transform is a mathematical method for signal and image processing that divides a signal or image into distinct sizes and resolutions.

The palm print recognition using wavelet transform technique entails extracting features from palm print images using wavelet transform, which are subsequently used for recognition. The wavelet transform palm print recognition procedure begins with the collection of a high-resolution image of the palm print. After that, the image is preprocessed to remove any noise or artefacts. The wavelet transform is applied to the preprocessed image, dividing it into a series of sub-bands with varying sizes and resolutions. The features that are unique to the individual's palm print are then retrieved from each sub-band. To identify the individual, the retrieved traits are compared to the features contained in the database.

## II. Daubechies Wavelet Transform

Daubechies wavelet transform, sometimes referred to as the Discrete, is a mathematical technique for signal processing and analysis. A signal is divided into many frequency components with varying time resolutions using this particular type of wavelet transform. Ingrid Daubechies first proposed the Daubechies wavelet transform in 1988, and it has since grown to be one of the most used wavelet transforms.

In order to analyse signals, the Daubechies wavelets employs a group of mathematical operations known as wavelets. These wavelets are created by scaling and translating the mother wavelet, a single fundamental function. The scaling and translating process allows the wavelets to analyse signals at different resolutions and frequencies. The Daubechies wavelets has the ability to capture both local and global aspects of a signal, which makes it helpful for a variety of applications like denoising, data analysis, and

image and audio compression.

Digital images and audio signals are examples of discrete-time signals that can be transformed using the Daubechies wavelet algorithm. The signal is divided into several frequency components through a series of filtering and subsampling operations during the transformation process. A set of coefficients that can be used to rebuild the original signal or study its attributes is the transformation's output.

Here are some of the mathematical functions that explains how the features are extracted using the Daubechies wavelet transform :

1. Compute the coefficients of the scaling function:

$$c_j = 1/\sqrt{2} * \sum(x_n * h_n(n - 2j))$$

where  $x_n$  is the input signal,  $h_n$  is the low-pass filter (scaling function), and  $j$  is the current level of the transform.

2. Compute the coefficients of the wavelet function:  $d_j = 1/\sqrt{2} * \sum(x_n * g_n(n - 2j))$

where  $g_n$  is the high-pass filter (wavelet function).

3. Downsample the coefficients:

$$c_{j+1} = \text{down sample}(c_j) \quad d_{j+1} = \text{down sample}(d_j)$$

where down sample is an operation that selects every other sample from the input signal.

Thus, the Daubechies wavelet transform is an effective signal processing tool that has been extensively applied in a number of disciplines, including engineering, physics, and computer science.

## III. Block Diagram

Palm print recognition is a biometric identification technology that involves extracting and analysing the unique features of a person's palm print to identify them. One of the popular methods used for palm print recognition is the wavelet transform technique. The wavelet transform is a mathematical tool that analyses signals and images at different scales and resolutions. It decomposes the image into multiple levels of detail, each containing different frequencies and orientations of image features. The wavelet transform provides a robust and efficient method for feature extraction from palm prints.

The self-explanatory block diagram of the used methodology is put forth in Fig2. The systems are designed with the following steps:

- Palm print Image Acquisition

- Image Pre-Processing
- Wavelet Transforme
- Feature Extraction
- Recognition

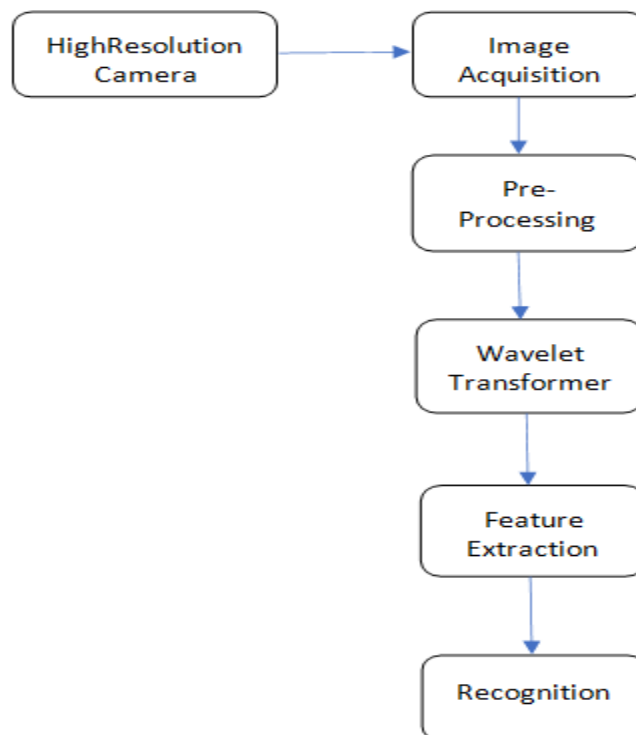


Fig.2: Block Diagram of Proposed System

#### Image Acquisition:

Image acquisition for palm print recognition typically involves capturing a digital image of the palm surface using a specialized camera or scanner. The goal of the image acquisition process is to obtain a high-quality image of the palm surface that can be used for subsequent processing and analysis.

There are different approaches to image acquisition for palm print recognition, including contact-based and contactless methods(Fig.3.1). Here we are using a contact- based approach where the palm of a person is pressed against a glass surface that contains a digital camera below it with LED illuminated.

Once the image has been acquired, it can be

preprocessed to remove noise and enhance the contrast and clarity of the palm print pattern. The preprocessed image can then be used for feature extraction and comparison with other palm print images in a database for recognition purposes.



Fig.3.1 Image acquisition

#### PRE-PROCESSING AND ROI:

Pre-processing and ROI (Region of Interest) extraction are important steps in palm print recognition systems, as they can greatly affect the accuracy and efficiency of the system. Pre-processing is an essential step in palm print

recognition to enhance the quality of the image and remove noise or distortion, which can negatively impact the accuracy of the system. Here are some common techniques for pre-processing and ROI extraction:

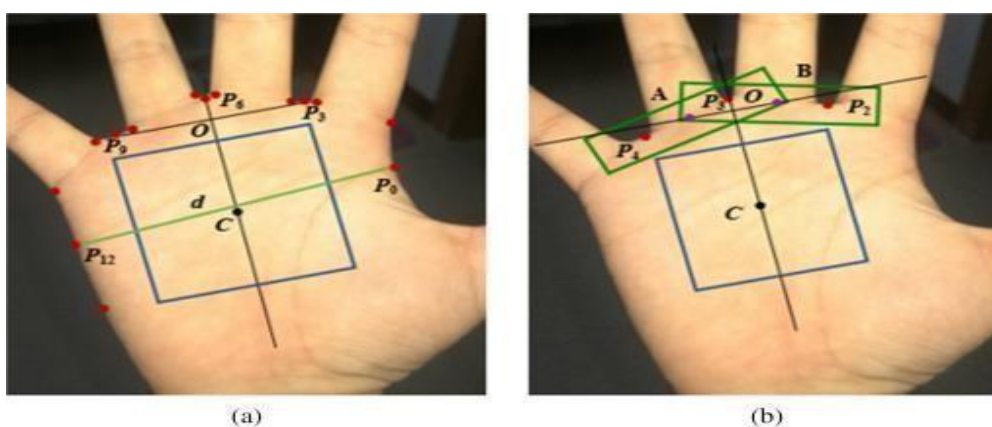
- i. Image enhancement: This involves techniques

- such as contrast stretching, histogram equalization, and filtering to improve the quality of the image and reduce noise. This can be done using techniques such as thresholding or adaptive thresholding.
- ii. Image binarization: This involves converting the image to a binary format, where the background is set to 0 and the palm print is set to 1. This can be done using techniques such as thresholding or adaptive thresholding.
  - iii. Segmentation: This involves separating the palm print from the background and any other objects in the image. This can be done using techniques such as region growing, edge detection, or

morphological operations.

- iv. ROI extraction: This involves identifying the palm print region in the image and extracting it for further processing (Fig 3.2). This can be done using techniques such as template matching or feature-based methods.
- v. Normalization: This involves scaling the extracted ROI to a standard size and orientation to ensure consistency in the feature representation. This can be done using techniques such as geometric normalization or texture normalization.

The illustration of ROI and Pre-processing of a Palm print image is as shown



**Fig 3.2 Image Preprocessing and ROI**

**Wavelet Transformer:**

Wavelet transform is a mathematical tool used for analyzing signals and images at different scales. In palm print recognition, wavelet transform is commonly used for feature extraction, which involves extracting the relevant information from the palm print image that can be used to uniquely identify an individual.

Here in this paper we are using Daubechies wavelet transform. As discussed above Daubechies wavelet is more efficient compared to other wavelet transform. Some of which are :

- a. Orthogonality: Daubechies wavelets are orthogonal, meaning that the scaling and wavelet functions are perpendicular to each other. This property ensures that decomposition of a signal into its wavelet coefficients and scaling coefficients is unique.
- b. Compact support: Daubechies wavelets have finite support, which means that the wavelet and scaling functions are zero outside a certain

range. This property makes Daubechies wavelets particularly useful for signal processing applications.

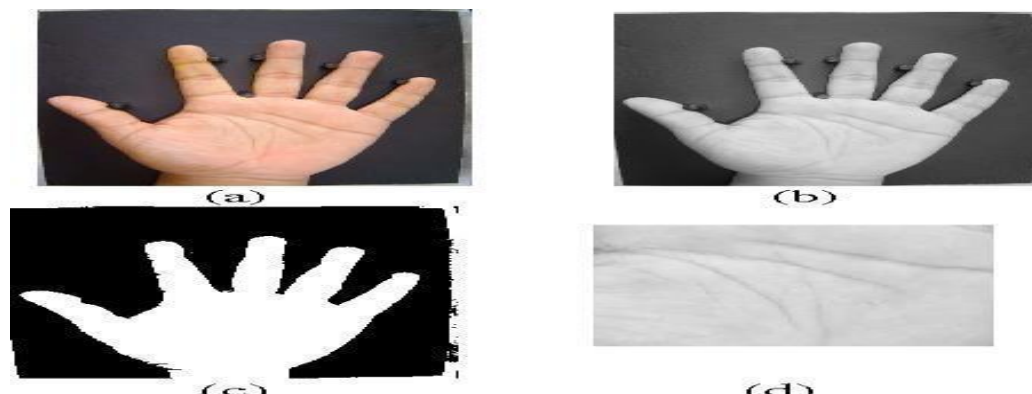
- c. Symmetry: Some Daubechies wavelets are symmetric, which makes them particularly useful for processing real- world signals that have symmetry.
- d. High accuracy: Daubechies wavelets can accurately represent signals with piecewise smoothness, making them a popular choice for image processing and compression.
- e. Efficient implementation: Daubechies wavelets have a fast implementation using the fast wavelet transform (FWT), which makes them computationally efficient for large-scale applications.

The palm print image is first decomposed into a set of wavelet coefficients using the wavelet transform. The coefficients at different scales and orientations represent the texture and structural information of the palm print image (Fig.3.3).

These coefficients are then used to extract features such as texture, lines, and edges, which can be used for palm print recognition.

One of the advantages of using wavelet transform for palm print recognition is that it allows for multi-resolution analysis, which means that the

palm print image can be analysed at different scales to capture both local and global features. Additionally, wavelet transform can effectively handle the noise and distortions that may be present in palm print images, improving the accuracy of the recognition system.



**Fig. 3.3 Wavelet Transform**

**Feature Extraction:**

Feature extraction is an essential step in palm print recognition systems, as it helps to extract relevant information from the palm print image to aid in identification and authentication.

The specific function of feature extraction using wavelet transform in palm print recognition is to identify and extract distinctive features from the palm print that are robust to variations in the image, such as changes in lighting, rotation, and scaling. These features can include ridge patterns, texture, and other characteristics of the palm print that are unique to each individual.

We will then apply the inverse wavelet transform to the modified wavelet coefficients to obtain the masked image. The resulting image will show the palm print in the foreground more prominently, while background noise and unwanted data will be removed or masked. This masked image will be finally sent for recognition.

**Recognition:**

Finally, in the matching step, the extracted features are compared with the features stored in the database. Here we will be using EDCC Library with is built on python.

This library is used to train model to remember a palm print.

The EDCC Library is a Python library that provides a set of functions for encoding and decoding palm

print images using the Enhanced Directional Champfer Correlation (EDCC) algorithm. The EDCC algorithm is a powerful technique for palm print recognition, which utilizes wavelet transform to extract the texture features of a palm print image.

The library provides functions for performing wavelet transform, calculating the EDCC feature vector for a palm print image, and comparing two palm print feature vectors to determine their similarity. The main function of the EDCC Library is to enable the recognition of palm prints by comparing their feature vectors.

Using the EDCC Library can be built using palm print recognition system that can identify individuals based on their palm prints. This can be useful in a variety of applications, such as access control, security systems, and biometric authentication.

**Iv. Conclusion And Future Work**

The application of wavelet transform for palm print recognition is a promising strategy that has shown significant promise in enhancing the accuracy, reliability, and speed of palm print recognition systems. More study in this area is required to advance the technology and make it more practicable for wider use in various security and identity applications. The application of wavelet transform in palm print recognition has been demonstrated in several research, with good

results. The derived characteristics have been demonstrated to be highly discriminative and capable of providing consistent recognition performance. Furthermore, the approach has been tested on numerous databases, with consistent results across diverse datasets.

One of the primary advantages of wavelet transform palm print recognition is its ability to accommodate partial palm prints. This is especially helpful when only a piece of the palm print is accessible for recognition, as in forensic applications. The approach has also been demonstrated to be useful in dealing with differences in illumination, orientation, and scale. Despite its numerous advantages, wavelet transform palm print identification still confronts a number of problems. One of the most difficult tasks is the creation of efficient and stable feature extraction systems capable of handling large-scale datasets. Furthermore, the approach must be optimised for real-time applications with short computation durations.

## II. References

- [1] B. Padmavathy and Arun Kumar, "Palm Stamp Identification using Daubechies 4 and Coiflet Transforms", *International Journal of Recent Issues on Computer Science and Electronics (IJRICSE)*, Vol. 1, 2013, pp. 08-11.
- [2] B. Padmavathy and C. T. Kavitha, "Performance of Wavelet-based Feature Extraction for Palmprint Recognition" *International Conference on VLSI, Communication and Security (ICVCCS'10)*, vol. 1, issue 3, 2010.
- [3] B. Padmavathy and C. T. Kavitha, "Identification of Palmprint using Various Wavelet Energies", *National Conference on Emerging Technologies*, 2010.
- [4] B. Padmavathy and C. T. Kavitha, "A Comparative Analysis using Different Wavelets for Palmprint Recognition", *National Conference on Emerging Technologies*, 2010.
- [5] B. Padmavathy, M. Arun Prasath, M. Ramkumar, S. Manimaran, "Image Watermarking based on Statistical Features in the Low-frequency Domain", *National Conference on Emerging Trends in Computer Applications and Management*, 2011
- [6] B. Padmavathy, Arun Kumar, Leo Karthick, Manikandan, "Palmprint Recognition using Daubechies 4 and Coiflet Transforms", *National Conference on Emerging Trends in Computer Applications and Management*, 2011
- [7] B. Padmavathy, "Removal of High-densi and Pepper Noise through Modified Decision
- [8] P. Dubey, T. Kanumuri, and R. Vyas, "Palmprint recognition using binary wavelet transform and lbp representation," in *Recent Innovations in signal processing and Embedded System*, 2017 *International Conference on. IEEE*, 2017, pp. 201-205.
- [9] C. Gottschlich, "Curved-region-based ridge frequency estimation and curved gabor filters for fingerprint image enhancement," *IEEE Transactions on Image Processing*, vol. 21, no. 4, pp. 2220-2227, 2012.
- [10] M. Tabejamaat and A. Mousavi, "Concavity-orientation coding for palmprint recognition", *Multimedia Tools and Applications*, vol.76, no. 7, pp. 9387-9403, 2017.
- [11] Feng, J., Zhou, J., Xu, Y., & Xu, M. (2014). Palmprint recognition based on wavelet decomposition and principal component analysis. *Journal of Electronic Imaging*, 23(3), 033016.
- [12] M. Tabejamaat and A. Mousavi, "Concavity-orientation coding for palmprint recognition", *Multimedia Tools and Applications*, vol.76, no. 7, pp. 9387-9403, 2017.
- [13] L. Fei, B. Zhang, Y. Xu and L. Yan "Palmprint Recognition Using Neighboring Direction Indicator", *IEEE Transactions On Human Machine Systems*, Vol. 46, No. 6, December 2016
- [14] G.-Y. Chen and W.-F. Xie, "Invariant Pattern Recognition Using Ring Projection 2011 *International Conference on Wavelet Analysis and Pattern Recognition*, Guilin, China, pp. 182-186, 10-13 July, 2011
- [15] Das, A., Bhattacharjee, D., & Bora, P. K. (2017). Palm print recognition using discrete wavelet transform and Gabor filter. *International Journal of Applied Engineering Research*, 12(14), 4635-4