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Image Fusion of Fingerprints using Fractal Representation and Dual Tree Complex Wavelet Transform

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Abstract: ***The popular Biometric used to validate a person's fingerprint is remarkable and permanent all through the individual life. Fingerprint Recognition or fingerprint confirmation alludes to the mechanized strategies for checking a match between two human fingerprints. Fingerprints are broadly utilized as a part of everyday life for over 100 years because of its attainability, uniqueness, perpetual quality, precision, unwavering quality, and acceptability. There are numerous ways to detect the fingerprint. One of the way is by image fusion. Image fusion has standout amongst the most critical systems in digital image processing, which incorporates the improvement of software to make the coordination of numerous arrangements of information for a similar area.***

In this paper fractal analysis and dual tree complex wavelet transform has been utilized for development of fingerprints digital image's quality, particularly fine subtle elements and edges, utilizing edge location and afterward decide the difference by utilizing ten distinct threshold.

Keywords: Image fusion, fractal dimension based image fusion, complex dual tree wavelet transform.

I. INTRODUCTION

Biometrics is the mathematical analysis of the biological characteristics of a human and its objective is to decide its identity accurately. Biometrics depends on what we are, and consequently avoids duplication, theft, forgetting or loss. The characteristics utilized must be universal (common to all individuals), unique (to have the capacity to separate two individuals) and permanent (time invariant for every individual) [1] Biometric methods can be classified into three categories: Morphological analysis: fingerprints, iris of the eye, hand shape, facial features, venous network of the retina, and analysis of the veins. Analysis of biological traces: DNA, blood, saliva, urine, odor, thermographs. Behavioral analysis: speech recognition, keystroke dynamics, signature dynamics, how to walk. Fingerprint recognition has been known since 1880, because of Alphonse Bertillon's examination on the identification of recidivists. And afterward, a few examinations have been explained; so there are several types of algorithms, for example, HMFA (Histogram-Partitioning, Median-Filtering Fingerprint Recognition Algorithm), an algorithm based on Gaussian filters to minimize the noise existing on the image to be treated [2]; Other examinations have concentrated on enhancing the comparison stage to guarantee rapid authentication [3][5]. There are also algorithms [4] based on the recognition of the iris, the geometry of the hand, the face's geometry and so on, utilizing generic algorithms.

II. FINGERPRINT RECOGNITION

A fingerprint is comprised of an arrangement of locally parallel lines shaping a unique pattern for each individual (Figure 1). We can recognize streaks (which are the lines in contact with a surface) what's more, valleys (these are the spaces between two streaks).

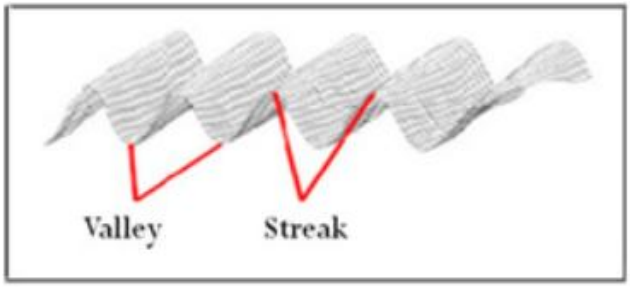

Fig. 1. Valleys and streaks in a fingerprint

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Each fingerprint has a set of global singular points (centers and deltas) and local (minutiae). The centers relate to places of convergence of the streaks while the deltas compare to places of divergence (Figure 2).

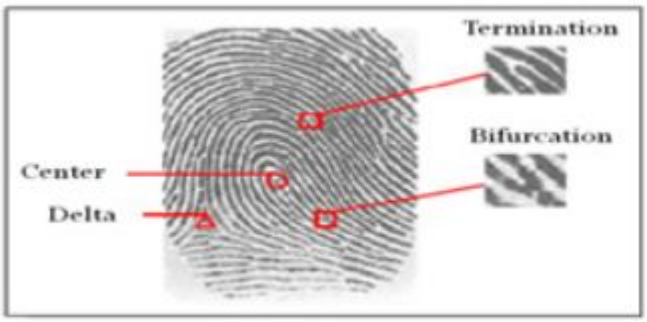
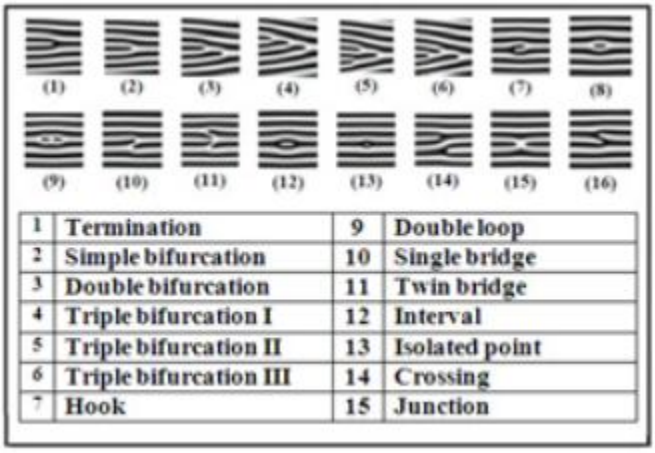


Fig. 2. Local and Global singular points in a fingerprint

A study (Figure 3) demonstrated the presence of sixteen unique types of minutiae, however when all is said in done the algorithms are just worried about the bifurcations and terminations which make it conceivable to acquire alternate types by combination [6].



1	Termination	9	Double loop
2	Simple bifurcation	10	Single bridge
3	Double bifurcation	11	Twin bridge
4	Triple bifurcation I	12	Interval
5	Triple bifurcation II	13	Isolated point
6	Triple bifurcation III	14	Crossing
7	Hook	15	Junction

Fig. 3. Different types of minutiae [6]

A programmed fingerprint recognition framework is a chain of capacities that, from the image of a candidate's finger, must choose whether the candidate is permitted access or not. The fingerprint recognition algorithm under inquiry comprises of three basic parts: preprocessing of the fingerprint image to enhance its quality, the extraction of the valuable data what's more, a filtering of the outcomes previously the comparison.

III. LITERATURE SURVEY

Nunsong W., et al., 2015, proposed a method which is derived from two assumptions: (i) increasing the precision of box-counts by using unequally triangle box partition, and (ii) weighting the box-counts in proportion to the size of triangle-box partition. Based on these assumptions, on each grid a square box is divided into four asymmetric triangle-box patterns. Each pattern is calculated the box-counts by a weighted box-counting technique.

Singh S., et al., 2015, proposes a Finger prints detection method in which the input to image is based on fusion mechanism. Daubechies Wavelet transformation is applied on them. Various fusion rules are applied on wavelet coefficients like mean, add, maximum, minimum. Quality of fingerprints are being tested using parameters are PSNR, Average Difference, Entropy, Chi-Square.

Chakraborty S., et al, 2011, presents a fingerprint matching system which uses eight directional Gabor filter bank, a popular method for enhancing poor quality image, to capture global and local information available in the fingerprints.

Shehnaz M. et al, 2015, Fingerprint identification is very popular among the identification in biometric security systems. The identification process comprises of image enhancement, feature extraction and pattern classification. The adjustment of grey scale values improves the intensity values of the image. A region mask is generated which provides a stable sampling window to extract features.

Ali M., at al, 2016 there are various types of applications for fingerprint recognition which is used for different purposes .fingerprint is one of the challenging pattern Recognition problem. The Fingerprint Recognition system is divided into four stages. First is Acquisition stage to capture the fingerprint image, the second is Pre-processing stage to enhancement, linearization, thinning fingerprint image. Han C.C., et al, 2003, applied four directions of Sobel operators to extract the feature points of ROI of palm print, and then applied a complex morphology operator to extract the features of palm print image.

Zhang et al., 2013, extracted the datum points and the line features from the palm print image. The datum points are defined as the points of palm print registration. Therefore, it detected the principle lines and their endpoints by using the directional projection algorithm. Moreover, the authors have improved template algorithm to extract the ridges and wrinkles as straight lines.

IV. METHODOLOGY

In this segment, the proposed system in details are clarified. Fig.4 demonstrate the proposed work flow.

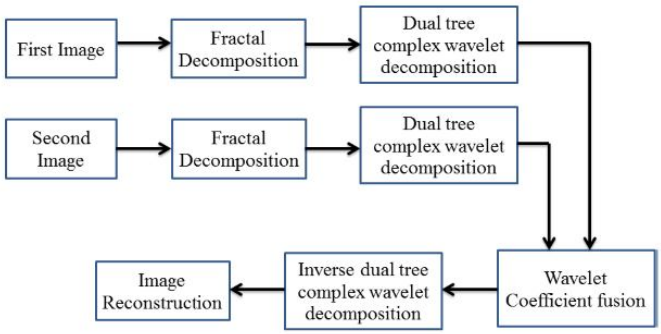


Fig.1. Propsoed System Architecture

A. First Image

From the dataset, first image is selected for input to the framework.

B. Second Image

From the dataset, second image is taken. The first image is compared with the second image for recognition of fingerprints.

C. Preprocessing

The images are firstly preprocessed so that the noises are removed. Various method of preprocessing are:

1) RGB conversion to grey scale.
2) Image resizing to specific sizes.

D. Fractal Decomposition

The fractal decomposition is used for finding fittest chromatographic curves. They are mainly used for finding features of the image. It includes:

1) *Binarization:* Using some of specific threshold values it converts the grey scale image into the binary format. It converts it by selecting each of the pixel from the image and converting it to binarized form.
2) *Thinning:* To get skeleton of the image, thinning is done. It shows the thin line of each of the fingerprints clearly. Stentiford algorithm is used for thinning process.
3) *Minutia:* Extracting of local ridges from the fingerprint images is called as minutia. It captures the minute structure of image.
4) *Bifurcation:* Bifurcation is also called ridge bifurcation. In biometrics and fingerprint scanning, bifurcation refers to the point in a fingerprint where a ridge divides to form two ridges.

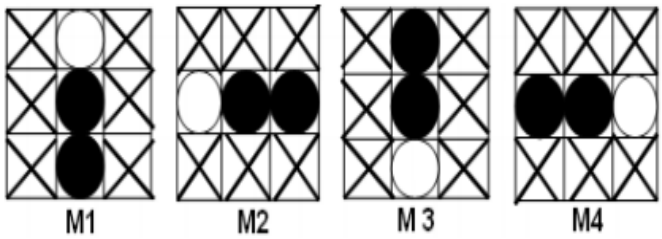


Fig. 5. Shows the thinning mask of the stentiform algorithm

E. Dual Tree Complex Wavelet Transform

It is basically the enhancement of DWT algorithm. It is basically the numerical function which samples the discrete data. The major advantage of this function is that it captures both frequency and location information of each pixels.

V. RESULT

In this section we present the evaluation result obtained from the analysis. The analysis are done on different collection of fingerprint images. These images are trained and applied dual tree complex wavelet decomposition method for better matching.
Table I. shows the system configuration and dataset used.

TABLE I. System Configuration

S.NO	Attributes	Configuration
1	Simulator	MATLAB
2	Version	2013
3	Tool	Image Processing Tool
4	Dataset	Random Data Set taken in different conditions
5	Algorithm Used	dual tree complex wavelet transform

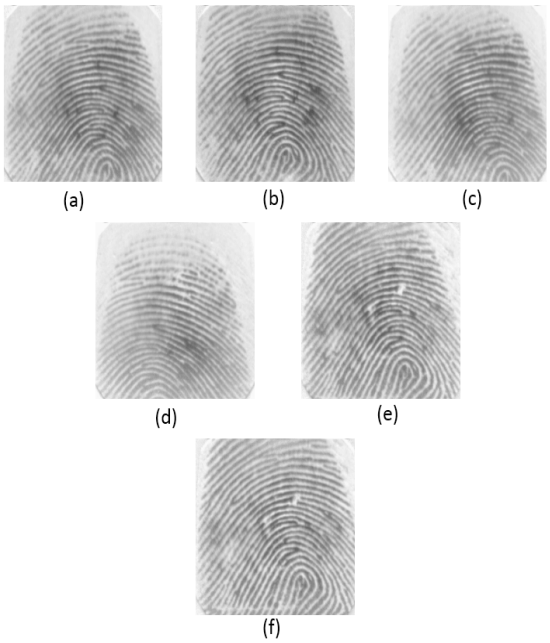


Fig. 6. Shows the sample fingerprint dataset

The step by step execution of proposed system interface is shown below:

STEP 01: Driver class – main GUI

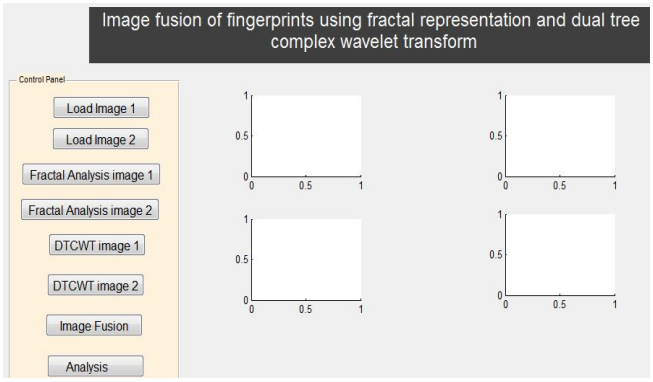


Fig. 7. Main GUI

STEP 02: Load image 1 and 2, for comparison

Fig. 8. Input image 1 and 2

STEP 03: Fractal Analysis

Fig. 9. Fractal analysis of IMG1 and IMG2

Step 04: Dtcwt & Image Fusion

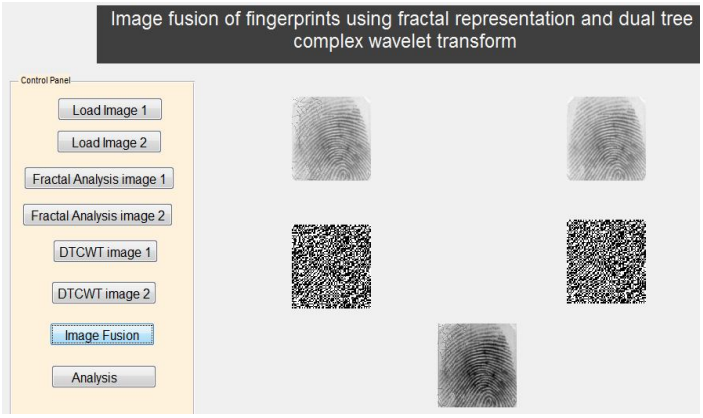


Fig. 10. DTCWT & FUSION of IMG1 and IMG2

Evaluation of Image 2 against fused image obtained from fig. 10 are shown in table II.

TABLE II. Comparison of proposed approach with existing

S. N.	Parameter	Value
1.	MSE	180.4542
2.	PSNR	25.5670
3.	Normalized Cross Correlation	0.9998
4.	RMSE	13.4334
5.	Average Difference	94.4701

VI. CONCLUSION

Fingerprints are broadly utilized as a part of everyday life for over 100 years because of its attainability, uniqueness, perpetual quality, precision, unwavering quality, and acceptability. There are numerous ways to detect the fingerprint. One of the way is by image fusion. In this paper we propose a novel mechanism in contrast with DTCWT algorithm combined with various preprocessing technique such as thinning, binarization helps in recognition of fingerprint efficiently. The proposed method outperforms the existing method.

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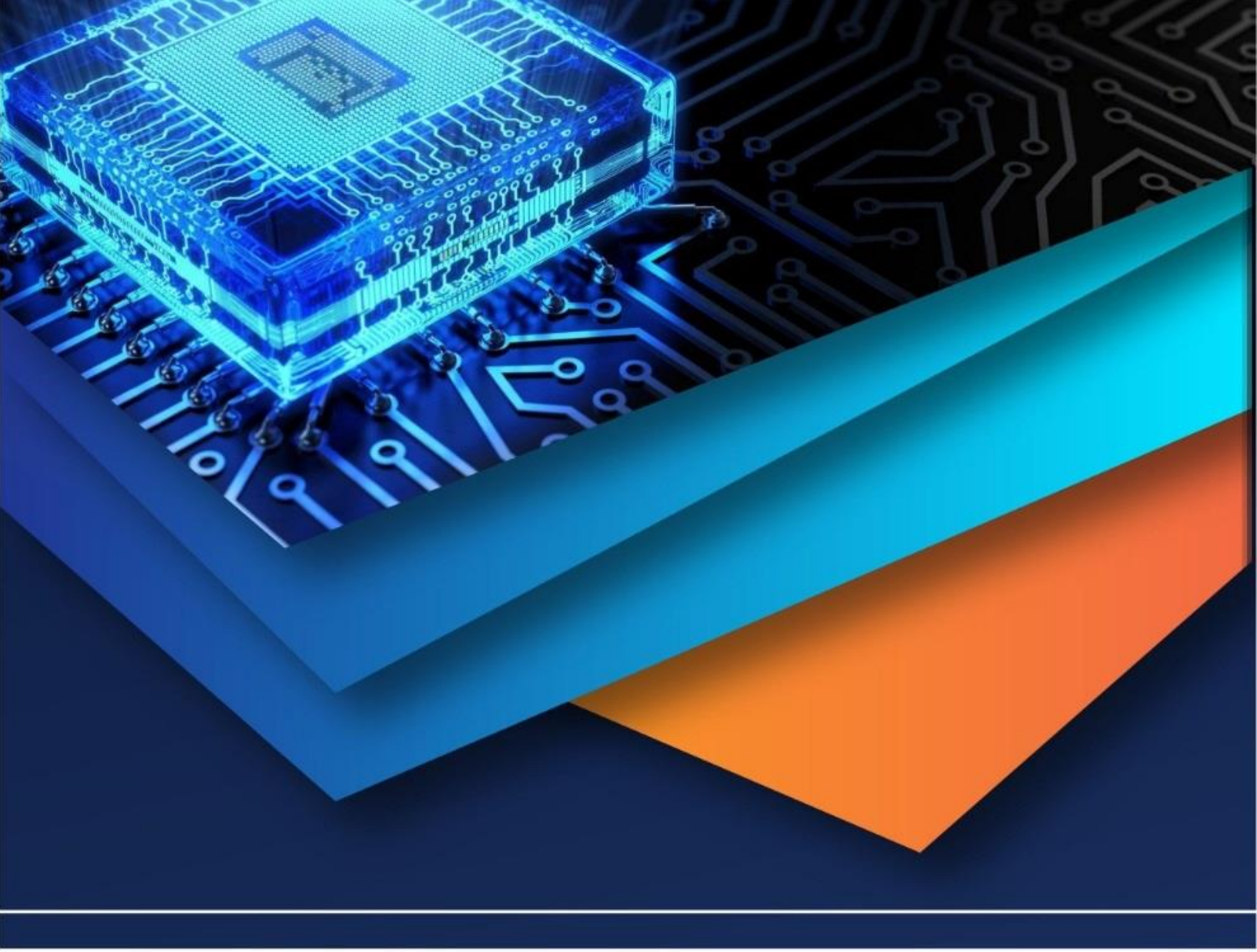

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