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Palm Print Recognition and Authentication using Digital Image Processing

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Abstract: This paper presents a broad analytical and comparative study for different methods used for solving the palm print recognition and authentication using different image processing techniques. From contact to contactless techniques here this paper compares all techniques and comes with our conclusion by doing comparative analysis. Palm print recognition has been burning topics in the field of authentication and validation for many years. Different problems related to palm print recognition have been addressed. Palm print has been broadly applied in security and, especially, verification. In continuous evaluation different palm print recognition and algorithmic methods have been proposed and accomplished recognition execution. Different methods require different prior knowledge, in this paper we compare all of them and produce better one based on our survey. And this paper also proposed a novel approach for contactless palm print recognition and authentication.

***Index Terms* – Digital Image Processing, Recognition, Palm Print.**

I. INTRODUCTION

Palm Print naturally can be divide in three categories based on their natural curves formed based on hand gestures and wrinkles. The inner surface of the palm generally contains three flexion creases [1], secondary creases and ridges. The flexion creases are also called principal lines and the secondary creases are called wrinkles. The flexion and the major secondary creases[2] are formed between the third and fifth months of pregnancy and superficial lines appear after we born. Although the three major flexions are genetically dependent, most of other creases are not. Even identical twins have different palm prints. These non-genetically deterministic and complex patterns are very useful in personal identification. Human beings were interested in palm lines for fortune telling long time ago. Scientists know that palm lines are associated with some genetic diseases including Down syndrome, Aarskog syndrome, Cohen syndrome and fetal alcohol syndrome. Scientists and for- tune tellers name the lines and regions in palm differently.

Palm print recognition alludes to the cycle of deciding if two palm prints are from the equivalent individual dependent on line examples of the palm. Palm print is alluded to the chief lines, wrinkles and edges show up on the palm. There are three chief lines on an average palm, named as heart line, headline, and life line, individually[3]. These lines are clear and they barely change for the duration of the life of an individual. Wrinkles are lines that is slenderer than the chief lines and are more unpredictable. The lines other than chief lines, just as wrinkles are known as edges, and they exist everywhere on the palm.

The dermal example of a palm print is totally figured upon entering the world like the fingerprints and the example that is framed would not change over a lifetime subsequently it could be utilized as a device for individual recognizable proof. Nonetheless, there are troublesome issues related when applying the palm prints as the recognizable proof device due to the accompanying viewpoints, for example, the areas of the explicit examples which are to be grouped or coordinated will in general be broadly spread out along these lines bigger measure of handling information than the fingerprints[6] would be required and the challenges in getting information accurately from the districts through the info gadget. In addition, there might be issues influencing the development or the area of explicit examples created from the incomplete harms in the areas of those explicit examples because of the states of the hand a utilization, anyway chief lines, wrinkles[3,4], edges and particulars point which is found in palm print may give viable methods for individual ID

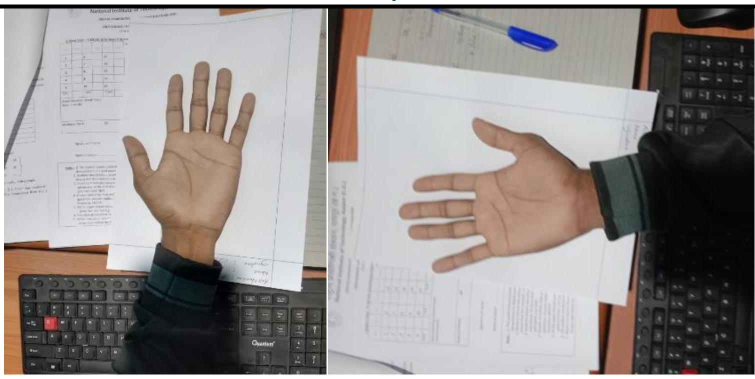

Fig. 1 : sample of palm taken from normal android phone

Moreover, the unique mark will in general have serious measure of data in a restricted area in this manner it could be fashioned halfway and individuals like manufacturing plant workers may have their fingerprints eradicated due to the idea of their work. Palmprint [5,6] might be more made sure about than fingerprints since they are more averse to be deleted or changed and they have a solid propensity against the fabrications because of the wide dispersions of recognizable areas in distinguishing the information.

A typical Palmprint recognition system consists of five parts: Palmprint scanner, preprocessing, feature extraction, matcher and database. The Palmprint scanner collects Palmprint images. Preprocessing sets up a coordinate system to align Palmprint images and to segment a part of Palmprint image for feature extraction. Feature extraction obtains effective features from the preprocessed palmprints. A matcher compares two Palmprint features and a database stores registered templates.

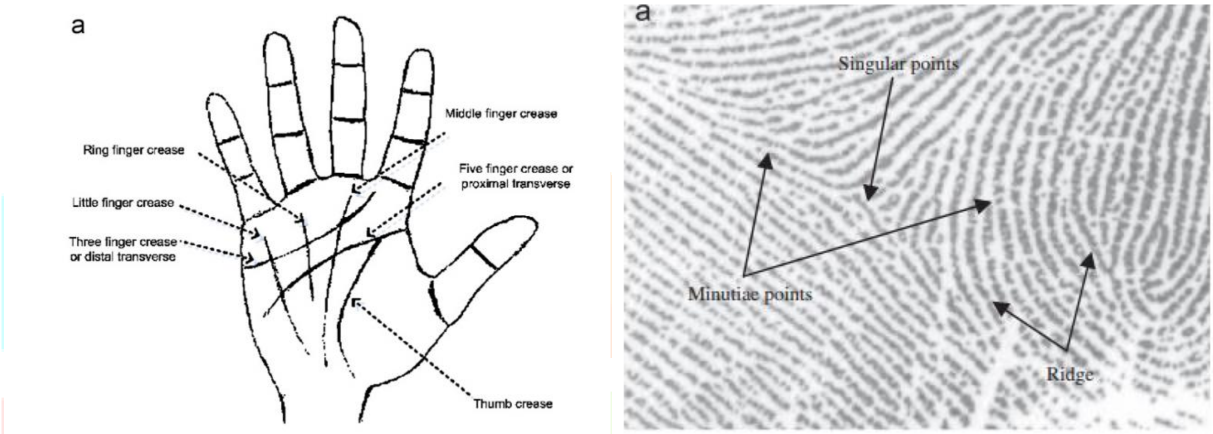

Fig. 2*:Definitions of palm lines and regions*

II. PALMPRINT SCANNERS AND PREPROCESSING

2.1 Palmprint scanners

There are many types of Palmprint scanners have been used so fur for scanning purpose many of them are like CCD- based Palmprint scanners, digital scanners video camera to collect Palmprint images. CCD based scanners for Palmprint scanning gives most accurate and good quality image for input and database maintain purpose and also it aligns properly because it has guidance for where to paced and how to place the palm over scanner. For CCD [9,10] based scanner it requires suitable set of lenses camera and sensors.

2.2 Preprocessing

This part is done to align various Palmprint images and to segment the center for features extraction. Preprocessing algorithms haves mostly fives steps like in first binarizing [11] the palm images and in second extracting the contours of figures or hand in third steps detecting key points or targeted points now in finally extracting the central parts. the first and second steps in algorithms are mostly similar and from third steps in preprocessing it have different approaches for different needs and used like in most of them it has tangent, bisector and figure based to distinguished the different fingers. In the tangent based procedure two boundaries have been considered one from ring figure and last figure and other from point finger and middle finger. these two lines create intersections as two key points for coordinate system. tangent base approach has many advantages as it deepens on very short boundary nearer to bottom of fingers. In bisector based approach [12] start and end point of midpoint and the center of gravity of figure boundary construct a line using these two points.

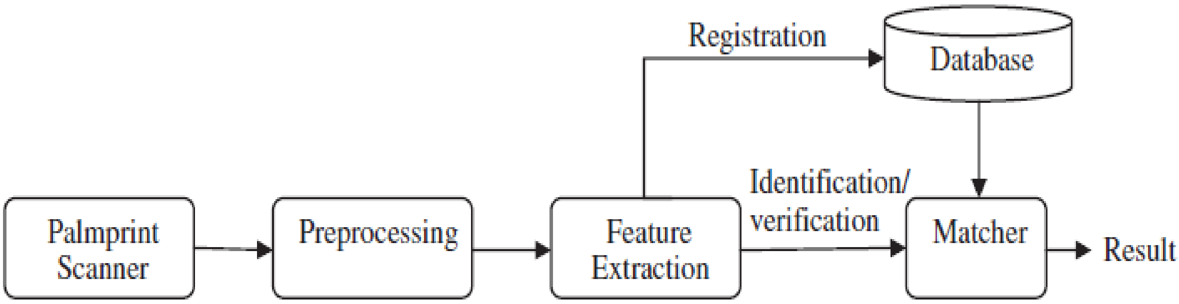

Fig. 3: An illustration of a typical palm print recognition system

III. VERIFICATION ALGORITHMS

There are mainly two task can be done for matching after features get extracted for recognition are verification and identification.one must be accurate and other must be fast. Some algorithms for comparison purpose are listed here .

3.1. Line-based approaches

Line-based approaches either develop edge detectors or use existing edge detection methods to extract palm lines. These lines are either matched directly or represented in other formats for matching. Wu et al. use Canny edge operator[14] to detect palm lines. The orientations of the edge points are passed into four membership functions representing four directions. For each direction, the authors compute

ER,i= _(x,y)∈R(Mag(x, y)× _i(x, y))2, where _i represents one of the membership functions; Mag represents the magnitude of the lines and R is a local region. The feature value, ER,i is normalized. Finally, Euclidean distances used for matching. Wu et al. designed two masks to compute the vertical first- order derivative and the second-order derivative of Palmprint images. The directional first-order and second-order derivatives can be obtained by rotating the two standard marks. They use the zero- crossings of the first-order derivatives to identify the edge points and corresponding directions. The magnitude of the corresponding second-order derivative is considered as the magnitude of the lines. They retain only the positive magnitude because palm lines are valleys. The weighted sum of the local directional magnitude is regarded as an element in the feature vector. This feature is normalized by its maximum and minimum components. As with, Euclidean distance[15] is used for matching. Wu etal. Propose another algorithm, which use Sobel masks to compute the magnitude of palm lines . These magnitudes are projected along both x and y directions to form histograms. These histograms are considered as input s of Hidden Markov Models(HMMs)[16]. Boles et al. use Sobel masks and thresholds to construct binary edge images and then employ Hough transform to extract the parameters of the six lines with highest densities in the accumulator array for matching. Kung et al. formed a feature vector based on a low-resolution edge map. The feature vector is passed into decision-based neural networks. This was the first paper to report an on-line palmprint recognition method.

3.2. Subspace-based approaches

Subspace-based approaches also called appearance-based approach in the literature of face recognition. They use principal component analysis (PCA), linear discriminant analysis (LDA)[18] and independent component analysis (ICA). The subspace coefficients are regarded as features. Various distance measures and classifiers are used to compare the features. In addition to applying PCA, LDA and ICA directly to palmprint images, researchers also employ wavelets, Gabor, discrete cosine transform (DCT) and kernels in their methods. The architecture of subspace approach. Some researchers have developed new subspace approaches and examined them on palmprints. Generally speaking, subspace-based approaches do not make use of any prior knowledge of palmprints.

Fig. 4:The architecture of subspace approach

3.3. Statistical approaches

Statistical approaches are either local or global statistical approaches. Local statistical approaches transform images into another domain and then divide the transformed images into several small regions. Local statistics such as means and variances of each small region are calculated and regarded as features. Gabor, wavelets and Fourier transforms have been applied. The small regions are commonly square but some are elliptical and circular. To our knowledge, no one has yet investigated high order statistics for these approaches. In addition to directly describing the local region by statistics, Wang et al. use histograms of local binary pattern as features. Global statistical approaches compute global statistical features directly from the whole transformed images. Moments, centers of gravity and density have been regarded as the global statistical features.

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IV. CONTACTLESS PALMPRINT IDENTIFICATION SYSTEM

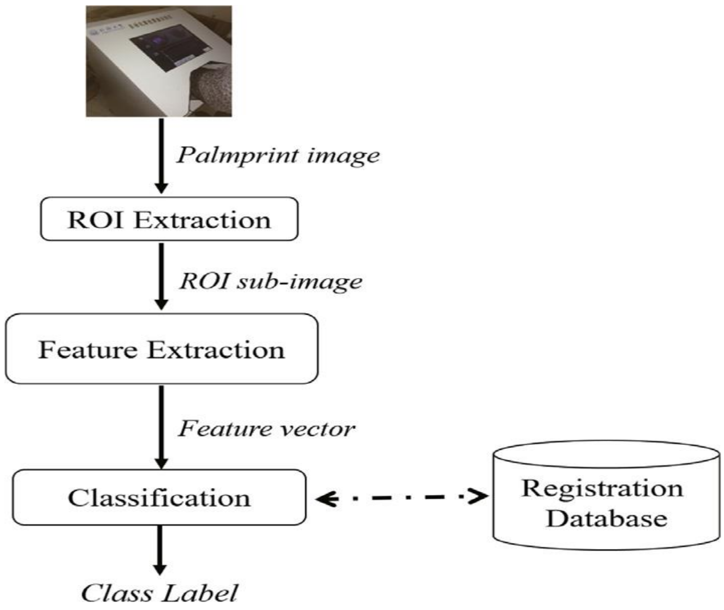


Fig. 5:The overall flowchart of [12] contactless Palmprint identification system.

The pipeline of contactless[12] palmprint identification system is shown in Fig. 3 . It can be seen that when the palmprint image is ready, three major steps are followed, ROI (region of interest) extraction, feature extraction, and classification. In this section, ROI extraction is introduced. In the pipeline of palmprint recognition, ROI extraction is the first influential step. Since global geometric transformations exist between two palm- print images, it is necessary and critical to align palmprint images.

The algorithm of ROI extraction from a contactless palmprint image.

Table 1:algorithm of ROI extraction from a contactless palmprint image

The algorithm of ROI extraction from a contactless palmprint image.
Input: A Palmprint image I . Output: The ROI sub-image R extracted from I . 1. Low-pass filter I using a Gaussian filter and then convert it to a binary image B ; 2. From B , extract boundaries of two finger gaps; 3. Get the tangent line of the gap boundaries and the tangent points are X 1 and X 2 ; 4. X 1 X 2 is taken as the X-axis and the midpoint of X 1 X 2 is taken as the origin O ; 5. A line passing through O and perpendicular to X-axis is the Y-axis; 6. A line being c 1 _ X 1 X 2 _ far away from O and parallel to X-axis intersects the palm contour at passing O 1 and O 2 ; 7. A square region S of side length c 2 _ O 1 O 2 _ , being symmetric with respect to Y-axis and c 2 _ O 1 O 2 _ far away from X-axis is extracted; 8. S is normalized to the size N × N and the result is taken as R .

V. PALMPRINT BASED PATTERN RECOGNITION USING FAST ICA

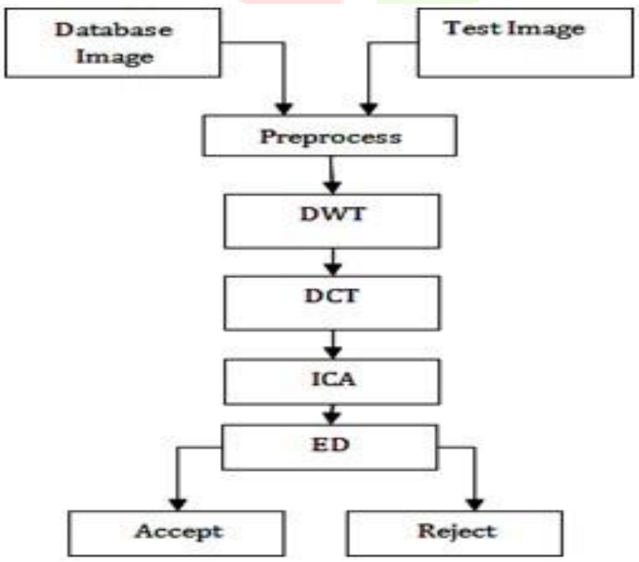


Fig. 6:Fig.4. Architecture of Proposed System [13]

A. Database

The proposed method tested by utilizing Demo_FusionNet-master of palmprint images . Many images of palm are utilized for the framework. The database consists of many palmprint of the distinctive individuals.

B. Preprocessing

The framework used in this paper is utilized preprocess the palmprint as describe below:

• RGB to Gray Scale conversion: It is used to change color image to black and white image. In grayscale the estimation about every pixel is used as one sample .

• Median Filter: It is utilized to eliminate noise from palmprint. This filter is use in the framework to protect the boundaries and to evacuate the 'salt and pepper'

C. Haar Wavelet

The Haar wavelet is the simplest type of wavelets. In the discrete form, Haar wavelets are related to a mathematical operation called the Haar transform". It is used over the median filtered palmprint. There are LH, LL, HL and HH bands acquiring by transitory wavelet signals. The LL band with low frequency is used in The huge data present in LL band as contrast with LH, HL, and HH band.

D. Discrete Cosine Transform (DCT)

DCT is a compression technique. Segregates the blocks and converts them to independent blocks further the OCT application over the blocks energy is compressed.

DCT for pixel at location (i, j) is given by equation:

$$"D(i,j) = -\frac{1}{\sqrt{2N}} C(i)C(j)\sum_{x=0}^{N-1}\sum_{y=0}^{N-1} cos\left[\frac{(2x+1)i\pi}{2N}\right] cos\left[\frac{(2y+1)j\pi}{2N}\right]" \quad (1)$$

For 8X8 block it is given as:

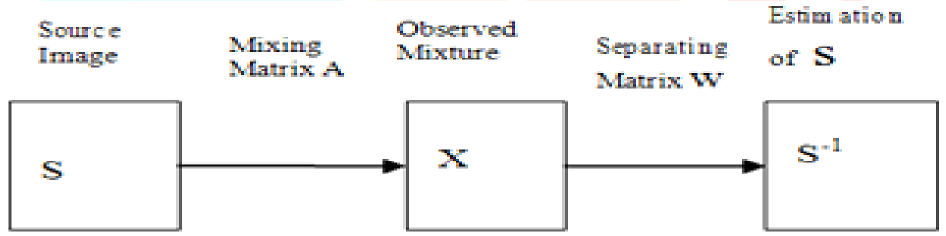
$$"D(i,j) = -\frac{1}{4} C(i)C(j)\sum_{x=0}^{N-1}\sum_{y=0}^{N-1} cos\left[\frac{(2x+1)i\pi}{8}\right] cos\left[\frac{(2y+1)j\pi}{8}\right]" \quad (2)$$

E. Fast Independent Component Analysis

Fast-ICA is utilized to decompose mixed signal into independent signal. The palmprint image consider as mixture of source image and unidentified integration matrix . A sorting out matrix is learnt by ICA to recuperate a group of basis images which are independent .

F. Euclidean Distance (ED)

It is utilized to measure the vectors of extracted feature. It is ascertained by dissimilarity between database feature vectors and test feature vectors.



Feature extraction	Subspace	Classifier
Wavelets: Haar, Daubechies and Symmlet	PCA, LDA, ICA	L_1 measure
		L_2 measure
		Cosine measure
		Probabilistic neural network
Nil	LDA	Euclidean distance
Nil	PCA	Weighted Euclidean distance
DCT	Improved Fishface	Euclidean distance
Nil	Kernel PCA	Maximum a posterior classifier
Wavelet	ICA	Euclidean distance
Nil	PCA, ICA	Euclidean distance
Nil	ICA	Radial basis probabilistic neural network
Nil	Bi-directional PCA	Assembled matrix distance metric
Nil	Kernel PCA+locality preserving projections	Euclidean distance
Gabor filter+boosting algorithm	LDA	Cosine distance
Nil	Winner-take-all network based on ICA	Radial basis probabilistic neural network
Wavelet, DCT, FFT	Kernel PCA	Support vector machine, weighted Euclidean distance, linear Euclidean distance
Nil	Unsupervised discriminant project	Euclidean, cosine measure

Fig. 7: Summary of subspace approach [11]

Feature extraction	Statistical feature	Shape of small regions	Classifier
Sobel filter, morphological operators	Mean	Square and rectangle	Backpropagation neural network
Direction masks	Standard deviation	Square	Cosine similarity
Gabor filter	Mean and standard deviation	Circular	Cosine similarity
Directional line detector, Gabor, Haar wavelet	Mean energy, number of line pixel	Rectangle, segments in elliptical half-ring	L_1 norm
Nil	Zernike moments	Global statistics	Euclidean, L_1 norm
Wavelet	Center of gravity, density, spatial dispersivity and energy	Global statistics	Sum of individual percentage error
M-band wavelet	L_1-norm energy, Variance	Global statistics	Euclidean distance
Nil	Zernike moments	Global statistics	Modular neural network
Otsu binarization	Hu invariant moments	Global statistics	Euclidean distance

Fig. 8:Summary of statistical approach [11]

Biometric traits and features	Level of fusion
Hand geometry and palmprint	Feature
Hand geometry and palmprint	Score
Finger+palmprint	Score
Face+palmprint	Score
Gabor+line features+PCA features from palmprints	Score
Gabor+line+Haar wavelet features from palmprints	Score/decision
Hand geometry+palmprint+knuckleprint	Feature
Hand geometry+palmprint	Feature/score
Face+palmprint+claimed identity	Score
Face+palmprint	Feature
Hand geometry+palmprint	Feature/score
Hand geometry+palmprint+finger surface	Score
Palmprint+face	Feature
Fingerprint+hand geometry+palmprint	Score
Palmprint+palm vein	Score
Palmprint+iris	Score

Fig. 9:Summary of Palmprint fusion [11]

Summary of Related work [13]

Researchers	Limitation of research work
D. Zhang et al.	The proposed method unable to identify some noisy images with cuts and bruises on the hand
K. P. Shashikala and K. B. Raja	The implemented method works in combination with Quaternion technique
S. M. Prasad et al.	The proposed technique is not much suitable for large databases
J. Dai et al.	This method user was not allowed to select ROI
R. Cappelli et al.	Combination of minutiae not considered like local frequency or ridge count
Jayshri P. Patil et al.	The proposed method work only on the principle line of palmprint
Zhenhua Guo et al.	The discussed method only for hyper spectral palmprint
Xingpeng Xu and Zhenhua Guo	The described technique work only on multispectral images which are captured under the pre-defined illumination

VI. EXPERIMENTAL RESULTS:

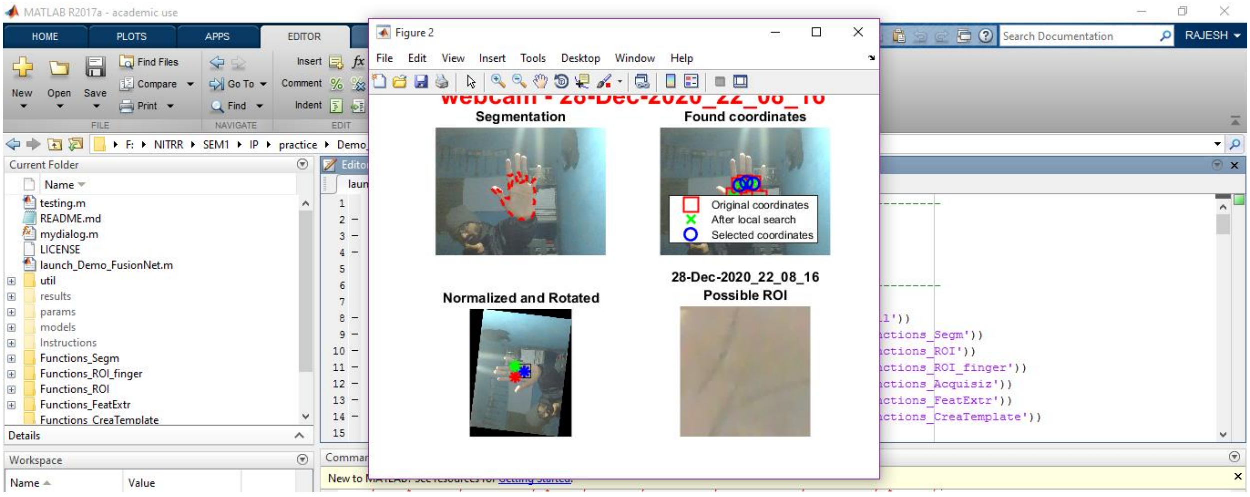


Fig. 10: simulation of working model

VII. RESULTS:

S.No.	Algo Used	Accuracy(based on probability funtion)
1	PalmCode[14]	92.08
2	OLOF[17]	95.02
3	LBP[18]	91.04
4	SIFT+OLOP[16]	86.04
5	SIFT+AlignedCompCode[15]	78.20
6	Proposed algo	92.99

VII. CONCLUSION:

In this paper, we successfully made an attempt towards creating an novel approach for contactless Palmprint recognition technique using low cost and low computational powered devices which worked so efficiently and its accuracy also achieved so better compared to previously implemented ones, and also its recognition is also better compared to the previous ones

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