Robust Palm-Print Feature for Human Identification

S.Adebayo Daramola, Olujimi Ajayi, Tiwalade Odu

Abstract— Palm-print is a unique biometric trait commonly uses to distinguish people. Identification of people with aid of machine is needed to solve insecurity challenges in our society. Human palm-print is a good raw material for machine based identification systems. These systems require strong predominate feature from palm-print for successful operation. In this work, a discriminate feature that can be used to differentiate people accurately is extracted from palm-print image. Edge detected palm-print image is sliced into smaller image blocks through centre points thereafter robust feature vector is generated from these smaller image blocks. The new feature was experimental using feature plot and it is shown clearly that this feature will deliver excellent classification result.

Index Terms— Centre points, City block distance, Image blocks, Palm-print.

I. INTRODUCTION

Palm is one of the major parts of human hand. Hand image can be captured using camera or scanner. Palm-print is among stable physiological traits uses to identify people. Palm-print contains different unique curves and lines pattern called principle lines, wrinkles and ridges. Palm region contains these pattern is usually cropped for features extraction. Many times palm-print features had been combined with other biometric trait for human identification. In [1] palm-print was combined with face image. Also multimodal identification system was proposed using Electrocardiogram (ECG) and palm-print in [2]. In [3][4] hand-geometry and palm-print features from same hand image were used for identification. Applications of palm-print for human identification include access control to building, facilities and attendance purpose.

A complete palm-print identification system involves the following processes: collection of hand images, cropping of palm region of interest, feature extraction and classification. In this work emphasis is on feature extraction algorithm. Extraction of robust feature from palm-print region of interest has positive impact on the overall performance of the whole system. Several feature extraction techniques have been proposed by researchers for human identification. Some of these methods involve extraction of texture pattern from palm image region of interest.

In [5] textural feature was extracted from palm-print using 2D Gabor filters. Also in [6] Phase feature was extracted from palm-print images using Discrete Fourier Transforms. Some techniques involve decomposition of palm print image region of interest into sub-images before feature extraction was carried out. In [7] it is reported that palm print image was decomposed into sixteen sub-bands using wavelet transforms thereafter texture feature in form of energy and entropy were extracted from each of the sub-band. In [8] feature vector was formed from sub-images of palm print using combination of Fourier Transform, Discrete Cosine Transform, Gabor Transform and Local Binary Pattern whereas in [9] palm-print image was segmented into many zones thereafter Discrete Cosine Transform was applied on each zone to extract features from principal lines. In [10] palm-print region of interest was decomposed into smaller image blocks using Biorthogonal, Symlet and Discrete Meyer wavelet transforms. And energy vector of twenty seven length was computed from each of the blocks.

Different forms of features have been generated in previous works. These features include, orientation, density map, energy and phase [11][12][13][14]. In [15] features like, sobel code, canny edge and phase congruency features were extracted from palm-print region of interest. Minutiae points were extracted from ridges pattern of palm-print image to form feature vector in [16]. To solve the problem of misclassification created by weak palm-print features therefore in this work a robust feature different from previous ones is extracted from smaller image blocks. The extracted feature is established by calculating the city block distance of pixels position created by principal lines, wrinkles and ridges in each of the distinctive block. The rest of the paper is organized as follows: Section 2 describes input image and pre-processing. Section 3 presents the feature extraction steps, and section 4 describes feature test result and finally, conclusion is presented in section 5.

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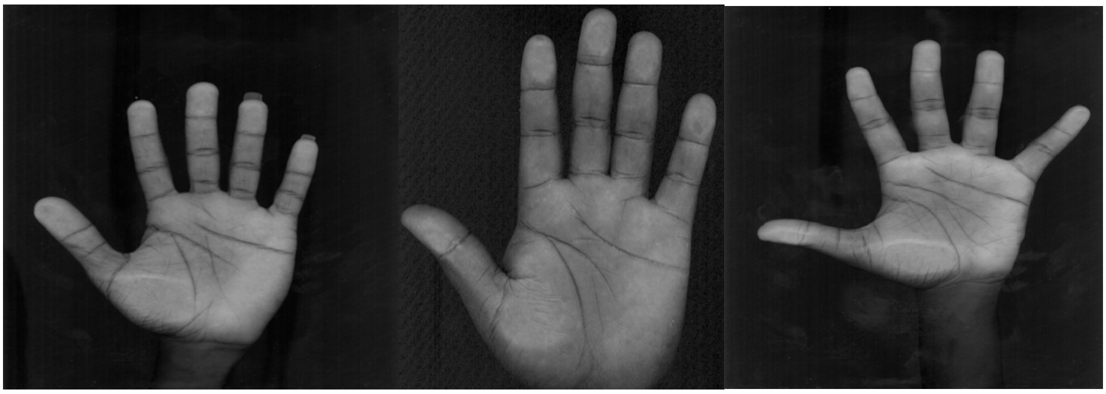

Fig.1 Examples of input hand images

II. INPUT PALM-PRINT IMAGE

Input data to the proposed feature extraction algorithm are obtained from the hand images. Input hand images are captured by scanner to obtain 8 bits gray-level image at resolution of 300dot per inch. Samples of gray-level input hand images obtained from three persons are shown in fig.1.

A. Pre-processing

The input hand images had to pass through series of pre-processing steps to get palm-print region of interest. The region of interest contains majorly three principal lines, wrinkles and ridges. Principal lines are called the heart line, the head line and the life line, Fig.2 shows three examples of rectangular palm-print region of interest cropped automatically from input hand images. Further pre-processing was done on the cropped images. The cropped images were passed to Canny edge detection algorithm to obtain binary edge detected images as shown in Fig.3.

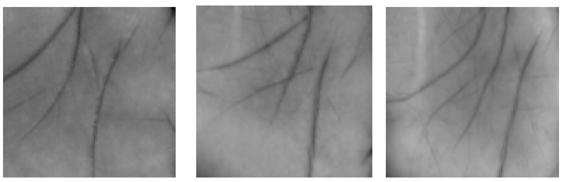

Fig. 2 Examples of palm-print region of interest

Fig. 3 Examples of edge detected palm-print images

III. FEATURE EXTRACTION

The edge detected palm-print image obtained from the pre-processing stage reveals pattern map of the palm print region of interest. This image serve as the input to the robust feature extraction algorithm proposed in this work. To extract feature from this image a reference point is determined which is equivalent to centre points of the image. Larger image blocks are sliced horizontally through the reference point to obtain a smaller image blocks thereafter feature best describe the image is extracted. The steps taken to extract feature from the edge detected image are stated as follows:

1. Obtain two image block1 and block2 as shown in Fig.4
(i) Calculate centre point of first edge detected palm-print image in Fig3.
(ii) Perform horizontal splitting on the image through centre point.
2. Obtain four smaller image blocks: block1a, block1b, block2a and block2b as shown in Fig. 5.
(i) Calculate centre point of each of the images: block 1 and block 2.
(ii) Perform horizontal splitting on image block1 and block2 through their centre point.
3. Obtain eight image blocks: block 1a1, block1a2, block1b1, block1b2, block2a1, block2a2, block2b1 and block2b2 as shown in Fig. 7.
(i) Calculate centre point of each of images block 1a, block 1b, block 2a and block 2b.

Fig.4. Output of first splitting

Fig.5 Output of second splitting

(ii) Perform horizontal splitting on the image block 1a, block 1b, block 2a and block 2b through their centre points.
4. Obtain sixteen smaller image blocks: B1, B2, B3, B4,B5,B6,B7,B8,B9,B10,B11,B12,B13,B14,B15 and B16 as shown in Fig. 8.
(i) Calculate centre point of each of the images block1a1, block1a2, block1b1, block1b2, block2a1, block2a2, block2b1 and block2b2.
(ii) Perform horizontal splitting on the image block1a1, block1a2, block1b1, block1b2, block2a1, block2a2, block2b1 and block2b2 through their centre points.

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5. Obtain feature using the sixteen horizontal image blocks.
(i) Calculate city-block distance of the pixels in each of the smaller image block.

IV. FEATURE TEST

The robustness of the proposed feature is demonstrated by showing the graphical representation of the feature. The intra-variation between palm-print of the same person and inter variation of palm-print three persons is shown in Fig.8 and Fig.9 respectively.

Fig.6. Output from third splitting

Fig.7. Output from fourth splitting

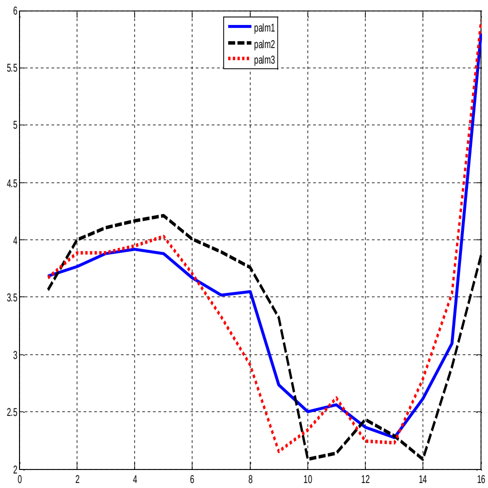

Fig.8. Intra variation feature plot.

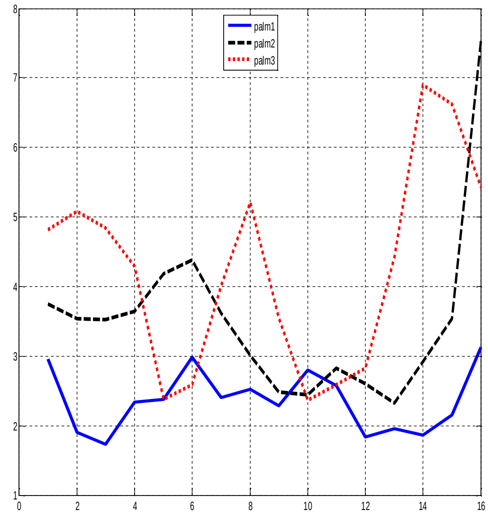

Fig.9. Inter variation feature plot

V.CONCLUSION

Effectiveness of any biometric recognition system majorly depends on the extracted feature use to represent the users. In this work, robust feature is extracted from human palm-print image Region of Interest (ROI). ROI image is converted to edge detected image and divided into smaller image blocks thereafter a robust feature is extracted from these blocks. The extracted feature is able to capture detail information from principal lines, wrinkles and ridges on palm-print region of interest. The test result shows the ability of the extracted feature to reduce intra person variation and widen inter-persons variation.

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