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An Hardware Implementation of Palm Recognition using 1-D DWT

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Abstract **- The VLSI design of palm recognition system using discrete wavelet transform is presented in this paper. The designed hardware is customized to a given error tolerance as comparable requirement. The results of the proposed system exhibits high speed for bit parallel design and increases precision of digit serial implementation and supports both segmented and desegmented DWT parameters.**

Keywords: *DWT, Lifting Scheme, on-chip architecture, Splitter, Palm recognition.*

I. INTRODUCTION

Biometrics based personal identification is getting wide acceptance in the networked society, replacing passwords and keys due to its reliability, uniqueness and the ever increasing demand of security. Common modalities adopted are fingerprint and face recognition but for face authentication researchers are still working with the problem of pose and illumination invariance where as fingerprint does not have a good psychological effect on the user because of its wide use in crime investigations. Biometric modality should have the traits like uniqueness, accuracy, richness, ease of acquisition, reliability and fast above all user acceptance. These are sometimes referred to as the "seven pillars of biometrics". Palm print based personal identification is a new biometric modality which is getting wide acceptance and has all the necessary traits to make it a part of our daily life. The Palm print identification has a number of advantages where it has a unique identification of the people. This method of identification is accomplished by comparing fingerprints from every individual against a database of known fingerprints. If the sample fingerprints characteristics match fingerprints in the database, it is considered a positive match. Mainly the extracted features from a hand image are classified in to two categories.

a) Geometrical features, including features such as area of the palm, length and width of fingers, etc.
b) Palm-print features including principal line, wrinkles, crease and delta point on the palm.

The inner surface of the palm normally contains three flexion creases, 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 are formed between the 3rd and 5th 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. There are three different methods to extract the features of the palm. (a) Texture based, (b) Line based and (c) Appearance based methods. The Palm-print is rich in information and has been analyzed for discriminating features like principal lines [1], [2], appearance base[3], and texture base[4], [5], [6]

The Discrete Wavelet Transform (DWT) brought groundbreaking influence in the area of signal analysis. Mallat, a pioneer in the field, established the idea that the wavelet transform, performed in a multi-scale manner, is effective for analyzing the meaning of the content in images. The DWT decomposes the image into sub-images, details and an approximation. We label the resulting sub-images from an octave (a single iteration of the DWT) as LL (the approximation), LH (horizontal details), HL (vertical details), and HH (diagonal details), according to the filters used to generate the sub-image. For example, HL means that we used a highpass filter along the rows, and a low pass filter along the columns. Then the DWT can be applied again and again, producing four more sub-images (with each successive iteration) that are 1/4 the size of the original image. The image can be reconstructed by undoing the transform. The channel with the low pass filter contains the slow changing aspects and the rapidly changing parts are preserved in the high-pass filter's channel [10].

II. METHODOLOGY

The proposed block diagram is as shown in Figure1, which describes the identification of Palm. The feature of input palm image extracted using Kadir and Brady algorithm. The splitter splits the data in to segmented and desegmented signal using lifting scheme of DWT. This signal compares with database images if it match the output of match is yes, otherwise no.

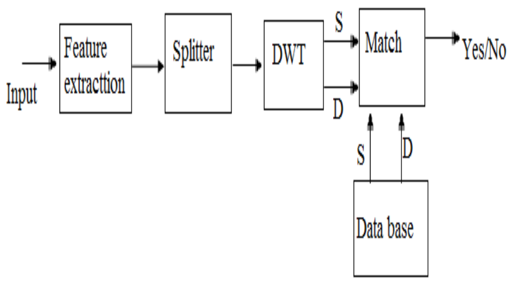

Figure 1 Block diagram.

The lifting scheme is a technique for both designing wavelet and performing the Discrete wavelet transform. The Lifting scheme uses spatial domain to construct a wavelet and has three steps: split, predict and update as shown in Figure2. Using split phase the input stream divided in to odd and even sample is called lazy wavelet transform. The lifting scheme applies for constructing bi-orthogonal wavelets, symmetrical extension can always be used to calculate the lifting scheme.

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Splitting Step,

$$e_i = x_{(2i+1)} \qquad (1)$$

$$o_i = x_{2i} \qquad (2)$$

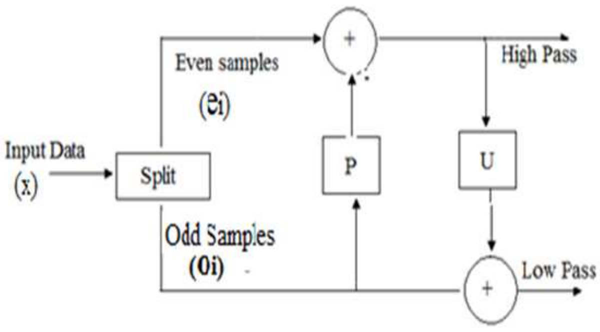

Figure 2 Lifting Scheme.

The Figure 3 shows the steps for performing a two-level DWT on an image. The 1-D DWT is first performed on the rows of the image producing low-frequency L1 and high-frequency H1 components. After performing a 1-D DWT again on the columns of and the first level of decomposition is completed, and LL1, HL1, LH1 and HH1are obtained. This process can be recursively applied on to produce the LL2, HL2, LH2 and HH2 sub bands.

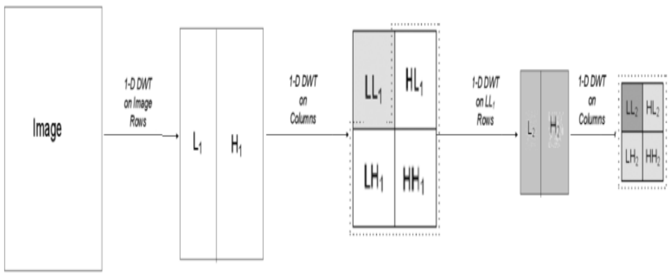

Figure 3 The two-level wavelet decomposition.

The DWT was originally implemented via convolution based methods, in which low-pass and high-pass FIR filters are employed. In 1998, *Daubechies and Sweldens* [7] showed that DWT can be decomposed into a finite sequence of lifting steps, which provides several advantages including lower computation and memory requirements and easier boundary management [11]. When lifting is used, the 9/7 filter can be expressed using the following steps:

$$P(z)=\begin{bmatrix}1 & \alpha(1+z-1)\\ 0 & 1\end{bmatrix}\begin{bmatrix}1 & 0\\ \beta(1+z) & 1\end{bmatrix}\begin{bmatrix}1 & \gamma(1+z-1)\\ 0 & 1\end{bmatrix}$$

$$\times\begin{bmatrix}1 & 0\\ \delta(1+z) & 1\end{bmatrix}\begin{bmatrix}\varsigma & 0\\ 0 & \frac{1}{\varsigma}\end{bmatrix} \qquad (3)$$

where α=-1.586134342, β=-0.05298011854, γ=0.8829110762, δ = 0.4435068522 and ζ=1.149604398.

The flipping structure described Hung et al[8] for lifting based 1-D DWT Although the flipping structure shares the same computational complexity with the traditional lifting scheme, it reduces the critical path considerably by flipping computation units with the inverses of multiplier coefficients. Constants C0,C1...,C5 are given by

C0 =1/α = -0.6304636206
C1 =1/(αβ)=0.7437502472
C2 =1/(βγ) = -0.6680671710
C3 =1/(γδ) =0.6384438531
C4 =(αβδ)/ζ =2.065244244
C5=αβγδζ=2.42102115

Assuming truncation, for addition z= *x*+*y* and multiplication z = *x* x *y* , worst case error E_z of z is given by

$$Z = X + Y : E_z = E_x + E_y + \max(0, 2^{-FBz} - 2^{-FBz'}) \qquad (4)$$

$$Z = X \times Y : E_z = \max(y)\, E_x + \max(x) E_y + E_x E_y + \max(0, 2^{-FBz} - 2^{-FBz'}) \qquad (5)$$

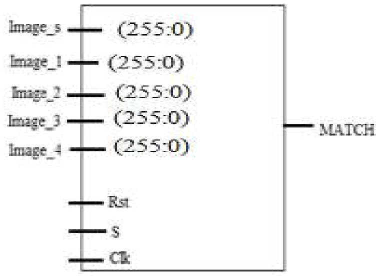

Figure 4 Main module.

The name of main module is 'Match', within this DWT of module is also obtained and images are compared. Once the DWT obtained for scanned image, it will be compared with the data base images. Each scanned image is compared with four Segmented and desegmented data base images, if it matches with all , then match output will be one else it will be zero.

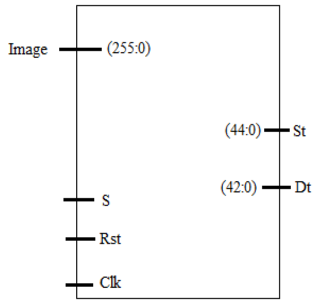

Figure 5 DWT Module.

Here *St* is segmented and *Dt* is desegmented scanned images. The Scanned image is continuously compared with database images for every positive edge clock, The reset and set high and low (its checking for both high and low). The segmented and desegmented signal of input palm image check for all four database images to produce the match output.

III. SIMULATION RESULT

The result shows the DWT based palm print identification which compared with four database palm images with the input palm for every positive edge clock, The reset and set as high and low (its checking for both high and low). The segmented and desegmented signal of input palm image check all with all four database images.

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The simulation is carried out using ModelSim(R). The Figure 6 shows the simulation result for the authentication and Figure 8 shows for de-authentication of the biometric. The palm database images for matching and no matching is shown in the Figure 7 and Figure 9 respectively. Here segmented data and desegmented data of scanned image and database image are compared; if it is equal then output match is authenticated else the match will be disabled by signal state showing zero.

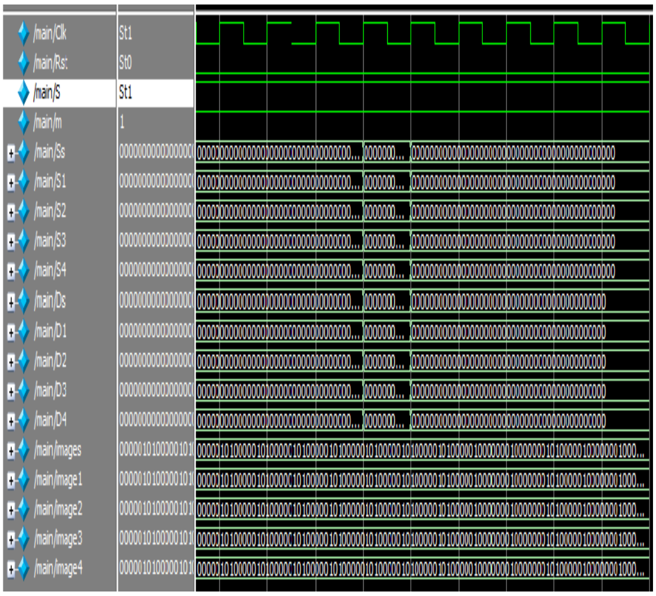

Figure 6. Simulation result for match condition.

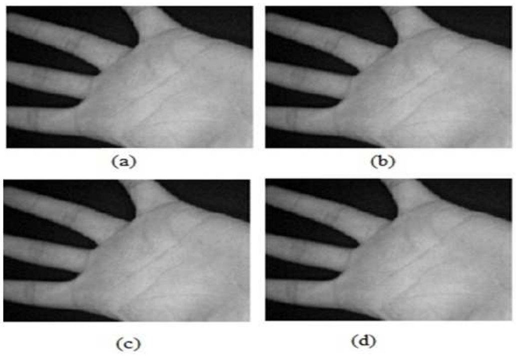

Figure 7. Palm print database images for matching

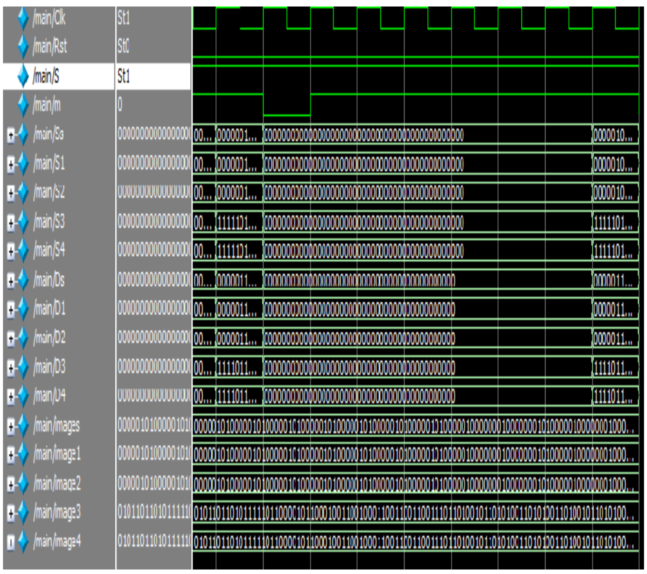

Figure 8.Simulation result for No-match condition .

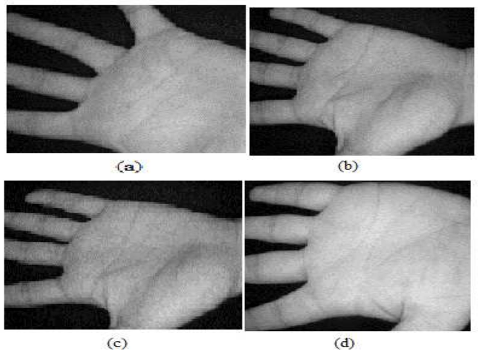

Figure 9 Palm Print Database Images for No Matching.

IV. CONCLUSION

In this paper, a highly configured for self quantized DWT for palm identification is developed for high Recognition rate. The Hardware for palm identification is successfully designed and implemented. The 1D-DWT lifting scheme executed for odd and even values of palm for segmented and desegmented data. The implementation reduces the computation time and resources required.

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