International Journal of Research in Advent Technology, Vol.4, No.8, August 2016
E-ISSN: 2321-9637
Available online at www.ijrat.org

Multimodal Face Recognition Using Minimum Average Correlation Energy Filter

Roshna N.R.[1], Naveen S.[2]
M-tech Student, Department of ECE,LBS Institute of Technology for Women Poojapura, Trivandrum , India[1]
Assistant professor, Department of ECE,LBS Institute of Technologyfor WomanPoojapura ,Trivandrum,,India[2]
Email: roshnanr91@gmail.com[1] *,nsnair11176@gmail.com*[2]

Abstract-Face is the most suitable biometric for surveillance application, since it doesn't requires cooperationof the object.Most of the face images captured by surveillance cameras are non-ideal, because they are affected by many factors such as pose, illumination, expression, occlusion, distance, weather,etc .This leads to the performance of face recognition. This paper introduces a bimodal face recognition algorithm using hybrid correlation filters. Here, the bimodal refers to the depth and texture of each face image.Here wavelet based fusion is used to fuse the texture and depth image of person. Result of the fusion is used to synthesize Hybrid Minimum Average Correlation Energy(HMACE) filter. So recognitionusing both depth and texture of images are possible using the same filter. This approach requires less memory space. Here, the experiment is carried out by testing different pose, illumination and expression variation of different subjects using this filter.

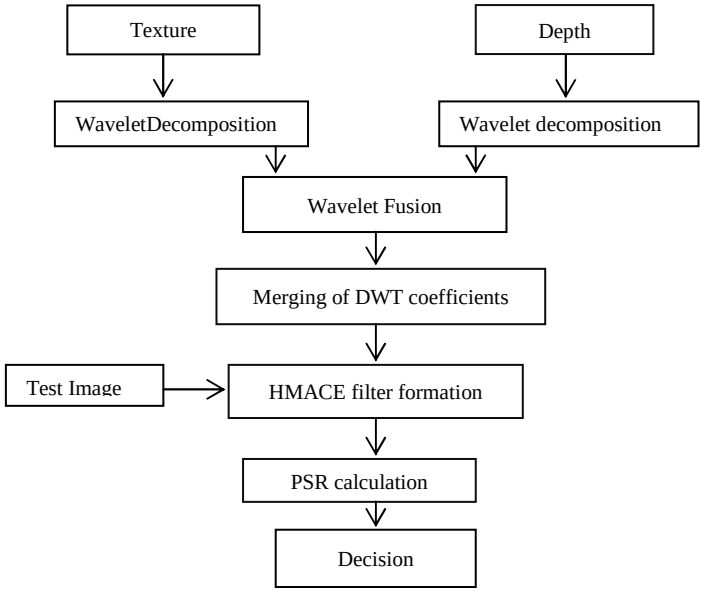
Index Terms-Wavelet fusion; correlation filter ;MACE ;depth ;texture

1. INTRODUCTION

Face recognition is one of the most commonly used biometric authentication technique. It is an interesting and successful application of pattern recognition and image analysis. Machine recognition is gradually becoming very important due to its commercial and law enforcement applications, which includes forensic identification, access control, border surveillance and human interactions along with the availability of low cost recording devices. There are various biometric authentication techniques for human recognition like figure print recognition, speech recognition, iris recognition, signature recognition etc. These recognition techniques differ from face recognition because they requires the active participation of person. So face recognition is more advantageous compared to other biometrics. Face recognition is a pattern recognition problem so it is broadly classified into feature based recognition and correlation Pattern recognition(CPR). The most commonly used filters in CPR is minimum average correlation energy filters(MACE).The robustness and accuracy of this filter is effective for face recognition application. Wavelet based fusion technique is used to fuse the face image of bothinfrared(IR) and visible spectrum of face images because of its localization and multiresolution property. Recognition of images in each spectrum can be possible using HMACE filters. Using this filter the storage space can be reduced. Using this type of correlation filter, we can find out the accuracy face recognition by calculating the true acceptance ratio and false rejection ratio.

2. METHODOLOGY

Our aim is to facilitate multimodal face recognition using wavelet based Multi-resolution image fusion approach. The methodology can be divided primarily into three steps.



2.1. Image Processing

While carrying multiresolution wavelet fusion, both images have respective features

alignedproperly.Some feature points are selected from test images and affine transform is used to align corresponding facial features and ready for wavelet fusion.
(2)Resultant image matrix conversion in single column vector.

2.2. Wavelet Fusion

Mainly image fusion is done to combine the complementary information present in both IR and Visible spectrum to produce a new image that contain the information content of both spectrums. The popular method of image fusion is multiresolution analysis because it has a property to combine the information at different resolution level, wavelet analysis provides a way to combine the information in the form of extracted coefficients at different resolutions which ensures better fusion result. To get the desired quality of fused image the process of merging of coefficients is used in an appropriate way. Here simple averaging scheme is used.
Wavelet fusion subdivided into 2 steps,

2.2.1.Wavelet decomposition
Multi-level 2D wavelet decomposition is carried out using a suitable wavelet basis function. One level wavelet decomposition means decompose the image into four parts. Here 5 level decomposition is used.Less than 5level introduces blocking effect and distortion around the edges while fusion.

2.2.2. Merging of DWT coefficients
It is required to merge the coefficients in such a manner that information of both imaging modalities can be extracted. Simple DWT averaging scheme is used to fuse the DWT coefficients. So DWT coefficients of fused image are DWT coefficients of IR and CCD face images and then inverse Wavelet transform is applied to get image.

2.3. Hybrid correlation filter formation

"Hybrid" means information present in both the spectrum. Hybrid filter is tested for both real and imposterimages. The overall classification is done on the basis of Peak to Side Lobe Ratio value.

2.3.1. Minimum average correlation energy filters.
MACE filters are obtained by forcing the average cross-correlation plane energy to minimum for the training images with hard constraints at the origin of the plane to yield specific value. It implies that resulting filter gives cross-correlation plane which resembles delta function. But in practice we do not get the exact delta function but resulting peaks are very sharp and provide a good measure fordiscrimination between authentic and impostor images.
Steps to perform MACE filter is,
(1)Computation of 2D image of ith training image.

(3)Frequency domain representation of test image by performing 2D-FT of test image

(4)Representation of 2D filters with column vector.

$$h = D^{-1}X(X^{+}D^{-1}X)^{-1}u$$

MACE filter in frequency domain is shown in above equation.

X is **PxN**matrix of Fourier transforms of training images. P-number of pixels diagonal matrix of average power spectrum of training image pre-specified value at the origin of correlation plane.

3. EXPERIMENTATION

HMACE filter corresponding to 5 different subjects are created.10 IR and 10 CCD images are used to create 10 fused images. These images are zero padded to ensure proper correlation. Finally using these padded images, the correlation filter isformulated. Similarly image fusion is carried out for all 5 subjects to formulate 5 different HMACE filter. Eachfilter is tested against 40 true class images and 40 false class images. Corresponding PSR value plots are drawn and accordingly suitable thresholds areselected. Correct classification corresponds to the case when the PSR value of test image exceeds the pre- calculated threshold. Percentage accuracy is calculated as the ratio of correct classification to the total number of test images for a particular subject. Here initially the training images of 5 different subject with 10 samples for each undergoes wavelet fusion and this fused image is used to synthesis 5 different HMACE filter. By correlating the fused image with each of HMACE filter to form a matrix of size 50 by 5.From this obtained matrix calculate the PSR value of each elements. Then find the mean and standard deviation of each of the samples.
Apply a test image into the filter and seta threshold value to check whether the test image is correctly recognized or not. If it is correctly recognized then find its accuracy. Thus we get the percentage accuracy of true acceptance ratio and true rejection ratio for each HMACE.To find the false rejection and acceptance ratio total accuracy is subtracted by each of the corresponding filters accuracy.

The obtained threshold value for the first person (HMACE-1) is 8.3 and 7.81.Its true acceptance ratio is 80% and false rejection ratio is 87.92%.In the case of second person (HMACE-2) threshold value is 4.54 and 4.06.Its true acceptance ratio is 70% and false rejection ratio is 14.16%.Similarly for other HMACE filters threshold values and acceptance and rejection ratios in percentages is tabulated in Table 1.

From this experiment it can be concluded that, for a given test input the true acceptance ratio and false rejection ratio is high. That shows high accuracy of face recognition for a particular test face. The true rejection ratio and false acceptance ratio shows the reliability of this correlation filter method for face recognition than the feature based method.

4. CONCLUSION

Multimodal face recognition in IR and Visible light domain based on the formulation of hybrid correlation filter is done. The proposed methodology requires single correlation filter for recognizing both IR as well as CCD images. HMACE filter is extensively tested on both IR and CCD images under sufficient pose and expression variation. Test set contained both true class and false class images. The robustness offilter is demonstrated by its satisfactory performance. The reported results indicate the usability of the proposed algorithm in field of multimodal face recognition.The true acceptance ratio and false rejection ratio shows high accuracy of face recognition for a particular test face .The values of true rejection ratio and false acceptance ratio shows the reliability of this correlation filter method for face recognition than the feature based method. Moreover the proposed methodology results in reduction of approximately half percentage memory space requirement since a single filter isnow required for recognition of IR as well as CCD images.

In future we can use Machine learning tools to formulate a more suitable discriminating quantity like PSR which can enhance the performance of formulated hybrid filters. We can use MACH(Maximum Average Correlation Height)filter other than MACE filter. In future we can improve the design and testing of the correlation filter on expressions also.

	HMACE1	HMACE2	HMACE3	HMACE4	HMACE5
Threshold [Min Max]	[8.30 7.81]	[4.54 4.06]	[7.7 7.2]	[7.7 7.46]	[12.9 12.4]
False acceptance ratio	12.08%	14.6%	5%	9.58%	10%
False rejection ratio	87.92%	85.83%	95%	90.4%	90%
True acceptance ratio	80%	70%	60%	70%	90%
True rejection ratio	20%	30%	40%	30%	10%

Table 1.Recognition accuracy of HMACE filter

5. ACKNOWLEDGEMENT

I would like to express my sincere gratitude and heartfelt indebtedness to Department of ECE, LBS institute of technology for women poojappura for its encouragement in pursuing this work.

6. REFERENCE

[1] Multimodal Face Recognition using Hybrid Correlation Filters AnamikaDubey, Abhishek Sharma Electrical Engineering Department, Indian Institute of Technology Roorkee, India,2011.

[2] A. Mahalanobis, B. V. K. Vijaya Kumar, D. Casasent, ‘‘Minimum average correlation energy filters,’’ Applied Optics, 26, 1987, 3633–3640.

[3] G. Pajares, J. M. de la Cruz, “A wavelet-based image fusion tutorial”, Pattern Recognition Society, Elsevier B.V., 2004.

[4] Martin David Levine, Yingfeng Yu, “Face recognition subject to variations in facial expression, illumination and pose using correlation filters,” Computer Vision an Image Understanding 104, 2006, 1–15

[5] J. Heo, M. Savvides, B.V.K.Vijayakumar,Performance evaluation of face recognition usingvisual and thermal imagery with advanced correlation filters," in proc. IEEE CVPR, 2005.

[6]W. Zhao, R. Chellappa, A. Rosenfeld, "Face Recognition: A Literature Survey," ACMComputing Surveys, 35(4), 2003, 399–458.

[7]A.Mahalanobis, B.V.K. VijayaKumar, S. Song, S.R.F. Sims, J.F. Epperson, "Unconstrainedcorrelation filters," Applied Optics," 33, 1994,3751–3759.

[8] B. V. K. Vijaya Kumar, ''Tutorial survey of composite filter designs for opticalcorrelators,''Applied Optics, 31, 1992, 4773–4801.

[9] AbhijitMahalanobis , B. V. K. Vijaya Kumar, "Correlation Pattern Recognition" CambridgeUniversity Press, February 2006.

[10] J. Heo, M. Savvides, B.V.K. Vijayakumar,Performance evaluation of face recognition usingvisual and thermal imagery with advancedcorrelation filters," in proc. IEEE CVPR, 2005.

[11] Heng Ma1,ChuanyingJia, and ShuangLiu,"Multisource Image Fusion Based on Wavelet Transform", International Journal of InformationTechnology, Vol. 11, No. 7, 2005.