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Parametric Evaluation of Fused Image

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Abstract:This paper is used to implement feature level fusion for the extracted images of the different biometric features. The biometric features used here are face and iris. SVD is a fusion technology based on Singular Valued Decomposition method applied at feature level for recognise pattern. There are many objective methods to check the quality of fused image like Mean Square Error (MSE), Peak Signal to Noise Ratio (PSNR), Normalized Cross-Correlation (NCC) and Normalized Absolute Error (NAC). Self created face database and CASIA iris database is used for experimental results. The simulation process is done by MATLAB 7.0

Keywords: *Face Recognition, Iris Recognition, Feature level fusion, Singular Valued Decomposition(SVD), Mean Square Error (MSE) , Peak Signal to Noise Ratio (PSNR) , Normalized Cross-Correlation (NCC) and Normalized Absolute Error (NAC) .*

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I. Introduction:

Now a day's verification is becoming a security mainstay in the modern distributed systems environment. With the proliferation of large-scale computer networks (e.g., Internet), the increasing number of applications making use of such networks (e.g., e-commerce, e-learning), and the growing concern for identity theft problems, the design of appropriate personal authentication systems is becoming more and more important. Systems that have the ability to authenticate persons (i) accurately, (ii) rapidly, (iii) reliably, (iv) without invading privacy rights, (v) cost effectively, (vi) in a user-friendly manner, and (vii) without drastic changes to the existing infrastructures are desired. Note that some of these requirements conflict with the others.

The traditional human identification systems rely on three key elements: 1) attribute identifiers (e.g., Social Security Number, driver's license number, and account number), 2) biographical identifiers (e.g., address, profession, education, and marital status), and 3) biometric identifiers (e.g., fingerprint, iris, face, voice and gait). It is rather easy for an individual to falsify attribute and biographical identifiers; however, biometric identifiers depend on intrinsic physiological characteristics that are difficult to make incorrect or alter.

Fusion can be described as the process of combining two or more different entities to form a new entity. Therefore, Image fusion is the process of combining two or more distinct images to form a new single image which will be better and more informative than every other input image. With the progress in technology, we can now obtain information from images of different sources to produce a new high quality image which also contains spatial and spectral information.

II. Previous Work:

[1].PCA based Image Fusion of Face And Iris Biometric Features(S. Anu H Nair, P. Aruna CES department Annamalai University) - In this paper author explain how to implement feature level fusion for the extracted images of the different biometric features. The biometric features used here are face and iris. Discrete Wavelet Transform (DWT) and Discrete Cosine Transform (DCT) are used for feature extraction of face and iris independently and compared. The features of face and iris are fused by PCA fusion technique. The feature extraction of face and iris are very complex and non linear. These images are first decomposed for feature extraction and later the extracted images are fused. The performance of DCT and DWT are evaluated using PSNR and DWT analyzed and DWT the best feature extraction technique. The fused image can be further used for watermarking and authentication purposes.

[2]. Research on Face and Iris Feature Recognition based on 2ddct and Kernel Fisher Discriminant Analysis-

In this paper, a new approach to the fusion and recognition of face and iris image based on wavelet features and Kernel Fisher Discriminate Analysis (KFDA) is developed. Firstly, the dimension is reduced, the noise is eliminated, the storage space is saved and the efficiency is improved by Discrete Wavelet Transform (DWT) to face and iris image. Secondly, face and iris features are extracted and fusion by KFDA. Finally, Nearest Neighbor classifier is selected to perform recognition.

[3]A Review: Analysis of SVD based image Fusion Method by Mr.Indeevar Thakur (Department of ECE, Chandigarh engineering collage, Landren) - in this paper author explain different types of Image fusion techniques based on Singular Value Decomposition (SVD) technique. Basically, Image fusion can be described as a technique which is used to generate a single good quality image from one or more images. Image fusion can be applied at many levels viz. pixel level, feature level, signal level and decision level. Image fusion can be applied in many areas like recognition of patterns, to enhance visual features, detection of objects, area surveillance etc.

[4] Low Quality Image Information Enhancement Using SVD Fusion Technique by Gagandeep Kour, Sharad P. Singh (Department of Electrical & Electronics Engineering, Arni University, Kathgarh, Himachal Pardesh)- In this Images fusion technique based on Singular Value Decomposition (SVD) has been done on the blurred images with different level of blurring. Five different set of images were taken and on these images SVD based fusion implemented on the images. The content of the image were calculated with respect to reference image on the blurred

image and fused image. PSNR value for highest blurred image come out to be for blurred and fused image 13.27 dB and 12.61 dB respectively.

III. Proposed Method:

We select Face and Iris biometrics because face and iris is most reliable and accurate biometric of human biometric. Performing DWT (Discrete wavelet transformation) for feature extraction as it provides higher compression ratio & also provide good localization than other fusion techniques. Most of the image information is retained in the low-frequency component [LL], it is considered as the approximate amount of the original image. For each low-frequency component, LL can be done by DWT once again, and the dimension will be reduced further. Afterword's taking SVD's of both face and iris images i.e coefficients U,V,S(encrypted) are combined, encryption ratio will set according requirement of application and finally formation of fused image is done.

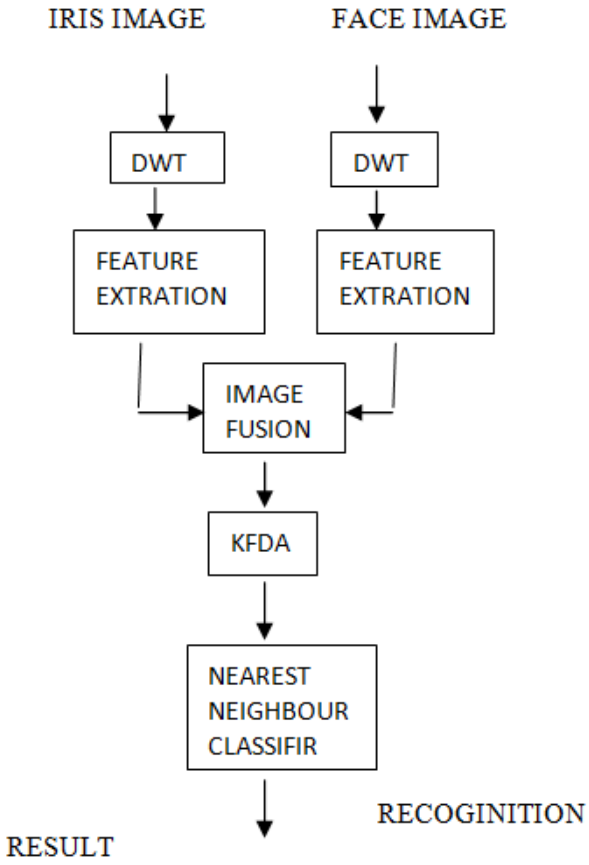

FIG.1 BLOCK DIAGRAM OF FACE AND IRIS FUSION MODEL

The techniques that are used mostly for image fusion are Intensity-Hue-Saturation (IHS), high pass filtering, principal component analysis (PCA), different arithmetic combinations, multi resolution analysis based methods (pyramid algorithm and wavelet transform),Artificial Neural Networks (ANN),Singular Value Decomposition (SVD) etc.

SVD (Singular Valued Decomposition):

SVD is a method to identify and order the dimensions along which data points have the most variations. With SVD we can find the best approximation of the original data points with minimum dimensions. It takes a high dimensional, highly variable set of data points and reduces them to a lower dimensional space that can present the substructure of the original data more accurately. It also orders this data from most variation to the least variation. It is based on a theorem of linear algebra that says that we can break a rectangular matrix A into the product of three matrices known as an orthogonal matrix (U), a diagonal matrix (S), and the transpose of an orthogonal matrix (V).Thus according to the theorem:

$$A = USV$$

Nowadays, SVD is becoming very popular technique for image fusion due to many factors like Conceptuality, stability and it is also a robust and reliable orthogonal decomposition technique. A huge advantage of SVD is that it can also adjust the variations that are present in the local statistics of an image.

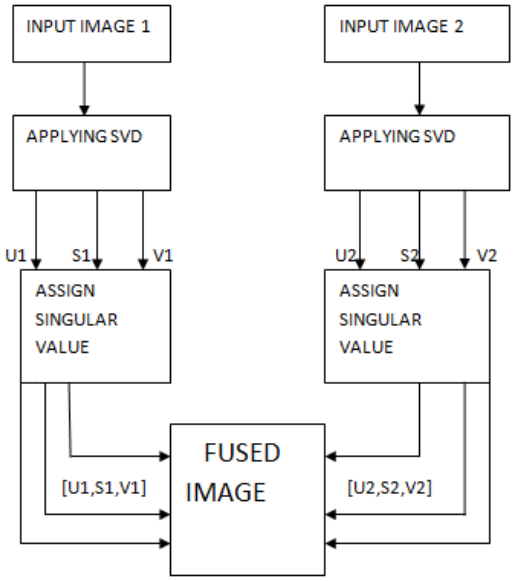

FIG.2 BLOCK DIAGRAM OF SVD

IV. Results and Analysis:

The quality of fused image is evaluated based on following parameters-

1. Mean Squared Error (MSE):

It is the average of the squares of errors. Error is the amount by which the value implied differs from the original value. The image quality decreases as MSE increases.

$$MSE = \frac{1}{mn}\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}\left[I(i,j) - K(i,j)\right]^2$$

2. Peak Signal to Noise Ratio (PSNR):

It is the ratio between the maximum possible power of a signal and the power of noise that affects the fidelity of the output. The image quality increases as PSNR increases.

$PSNR = 20\log_{10}\left(\frac{MAX_I}{\sqrt{MSE}}\right)$ where MAX_I is the maximum possible pixel value of the image.

3. Normalized cross correlation (NCC):

Cross correlation is the measure of similarity of two images. In image processing applications the brightness of the image can vary due to exposure conditions, so images can be first normalized. The image quality increases as NC increases.

4. Normalized absolute error (NAE): It is a metric where the error value is normalized with respect to the expected data. That is, the net sum ratio between the error values and the perfect values is calculated. The net sum of the error value which is the difference between the expected values and the actual obtained values is divided by the net sum of the expected values.

Where m is the height of the Image implying the number or pixel rows, n is the width of the image, implying the number of pixel columns. A(i,j)being the pixel density values of the perfect image. B(i,j) being the pixel density values of the fused image.

We are tacking 10 samples face images and iris image from database and fused them, resulted parametric evolution is as follows-

Image Numbers	Parameters			
	MSE(Mean Square Error)	PSNR(Peak to Signal Noise Ratio)dB	NCC(Normalize Cross-Correlation)	NAE(Normalize Absolute Error)
Image no 1	15.11	12.27	649.94	122.75
Image no 2	15.75	12.09	559.08	134.99
Image no 3	15.93	12.09	831.52	162.54
Image no 4	15.62	12.13	397.37	106.53
Image no 5	15.89	12.05	627.08	128.40
Image no 6	15.92	12.05	574.75	134.98
Image no 7	15.86	12.06	950.21	215.16
Image no 8	15.44	12.18	748.46	163.49
Image no 9	15.78	12.08	739.56	162.11
Image no 10	15.81	12.08	816.91	168.19

FIG.3 RESULTS OF FUSED IMAGE

V. Conclusion:

In this paper, an SVD based fusion approach was implemented, which can be used to fuse two images i.e face and iris image to increase the quality of the output image. This is performed by choosing certain components of SVD (U, S and V) of the input images based on a singular value, and performing fusion of those images. The quality of the images was measured using various image quality measures like PSNR, NCC,NAE and MSE.

The quality of this fused output keep on increasing as the singular value increases and output images of good quality at higher singular values was obtained.

VI. References:

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