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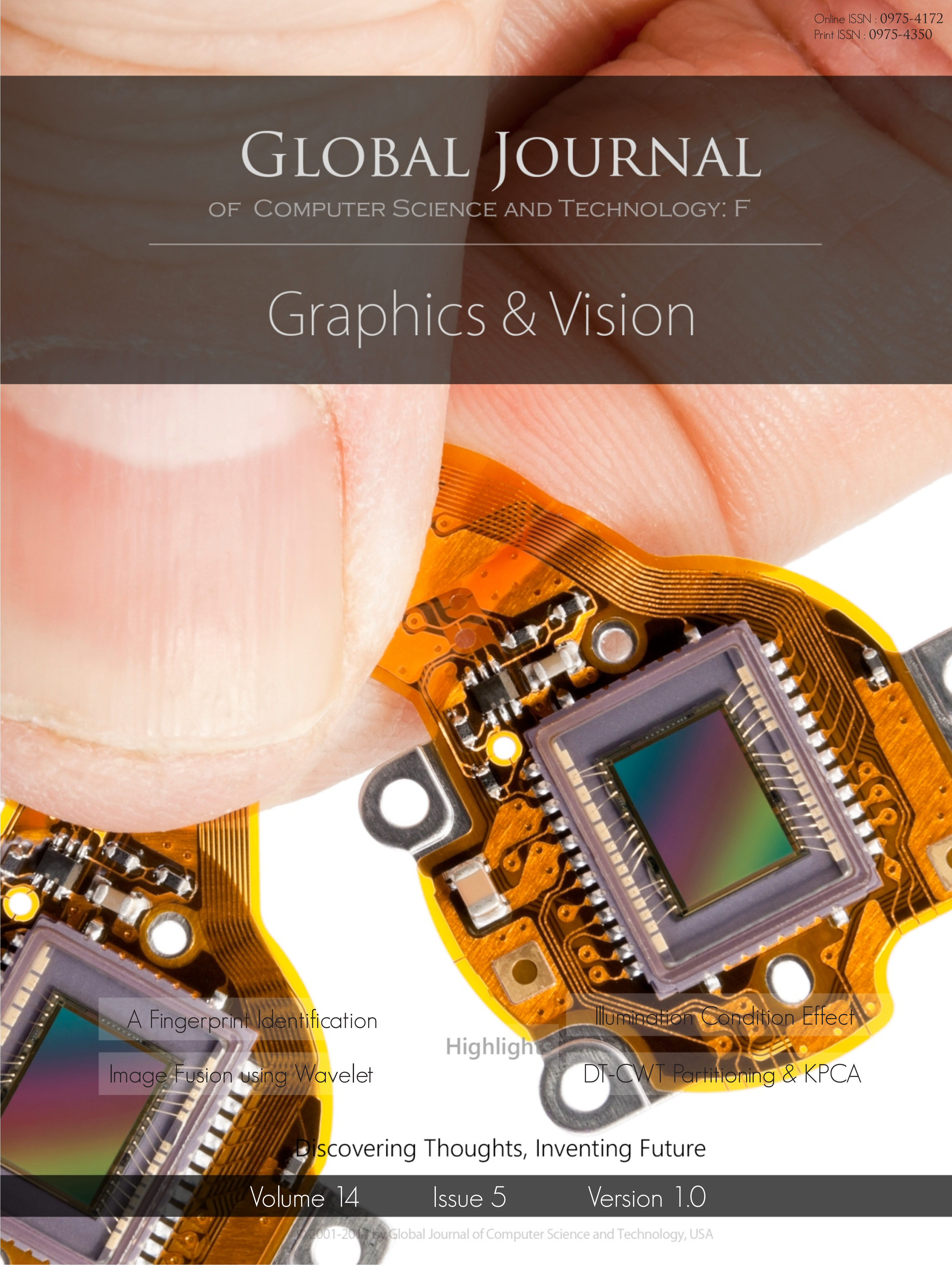

Highlights

A Fingerprint Identification

Image Fusion using Wavelet

Illumination Condition Effect

DT-CWT Partitioning & KPCA

Discovering Thoughts, Inventing Future

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A Fingerprint Identification Approach using Neural Networks

By P. Sreenivasa Moorthy
Research Scholar JJT University, India

Abstract- Today, because of the vulnerability of standard authentication system, law-breaking has accumulated within the past few years. Identity authentication that relies on biometric feature like face, iris, voice, hand pure mathematics, handwriting, retina, fingerprints will considerably decrease the fraud, so that they square measure being replaced by identity verification mechanisms. Among bioscience, fingerprint systems are one amongst most generally researched and used. it\'s fashionable due to their easy accessibility. Moreover in this work the system modified to an adaptive system i.e intelligent by using neural networks.

Keywords: *AFPR, biometric security, gabor filter, neural networks, etc.*

GJCST-F Classification: *F.1.1*

AFINGERPRINTIDENTIFICATIONAPPROACHUSINGNEURALNETWORKS

Strictly as per the compliance and regulations of:

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I. Introduction

Humans have used body characteristics such as face, voce, finger prints, Iris, etc. to recognize each other. Automatic recognition of these characteristics called a biometrics; now days it has become an active research area in pattern recognition. Over a decade's fingerprint is one of the oldest forms of biometric identification because of their uniqueness, consistency, the intrinsic ease in acquisition, distincti-veness, persistence and high matching accuracy rate. As we know, No two people have the same set of fingerprints even identical twins fingerprints. Finger ridge patterns do not change throughout the life of an individual. This property makes fingerprint an excellent biometric identifier and also can be used as forensic evidence. It has received more and more attention during the last period due to the need for society in a wide range of applications. Among the biometric features, the fingerprint is considered one of the most practical ones. Fingerprint recognition requires a minimal effort from the user and provides relatively good performance. Fingerprint recognition refers to the automated method of verifying a match between two human fingerprints. Fingerprints are one of many forms of biometrics used to identify individuals and verify their identity.

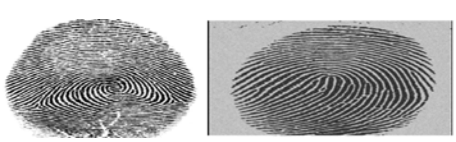

Figure 1.1 : Sample Finger Prints

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Basically Skin of human fingertips consists of ridges and valleys and they mixing together form the distinctive patterns. A fingerprint is the composition of many ridges and furrows. Fingerprints mostly are not distinguished by their ridges and furrows but are distinguished by Minutia which are some abnormal points on the ridges. Minutia is divided in to two parts such as: termination and bifurcation. Termination is also called ending and bifurcation is also called branch. Again minutia consists of ridges and furrows valley is also referred as follows..

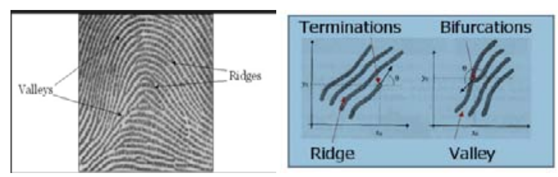


Figure 1.2 : Images Showing Ridges and Valleys with Termination and Bifurcations

The human fingerprint is comprised of various types of ridge patterns, traditionally classified according to The decades-old Henry system: left loop, right loop, arch, whorl, and tented arch.

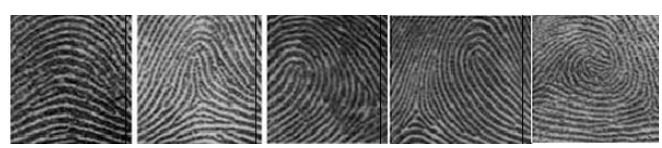


Figure 1.3 : left loop, right loop, arch, whorl, and tented arch of a Fingerprint

Fingerprint recognition system has been successful for many application areas such as computer login, bank account recovery and cheque processing. But the fingerprint recognition system still faces with defect in accuracy rate. The primary objectives of the proposed system will perform more accuracy rate.

II. Literature Survey

Dayashanka Singh et al. (2010) projected a completely unique technique of fingerprint matching supported embedded Hidden Andrei Markov Model (HMM) that\'s used for modeling the fingerprint's orientation field. This HMM primarily based fingerprint matching approach exploitation solely orientation angle parameters. It includes 2 kinds of random finite method. One may be a Mark off process of finite state that describes the transfer from one state to another; the opposite describes the chances between states and observation knowledge. what\'s necessary to statistically characterize a HMM may be a state transition likelihood matrix, Associate in Nursing initial state likelihood distribution, and a group of likelihood density functions related to the observations for every state. Usually a HMM may be a 1-D structure appropriate for analyzing 1-D random signals. The embedded HMM includes 3 super states that represent 3 elements of a finger print from the highest to bottom. Every super state consists of 5 sub states (embedded states) horizontally. The performance is nice and strong. it\'s less sensitive to the noise and distortions of a fingerprint image than the traditional approaches during which the dependent parameters embody a lot of fingerprint details. Still this approach skipped the processes of cutting the ridge image and choosing trivia which can facilitate any noise reduction.

Qijun Zhao et al. (2009) projected pore matching technique that with success avoids the dependency of pore matching on point matching. Such dependency limits the pore matching performance and impairs the effectiveness of the fusion of point and pore match scores, so as to match the pores on 2 fingerprint pictures,{they square measure| they\'re} 1st pair-wise compared and initial correspondences between them are established supported their native options. The initial pore correspondences square measure then refined by exploitation the RANSAC (Random Sample Consensus) algorithmic program to convey the ultimate pore matching results. A pore match score is finally calculated for the 2 fingerprint pictures supported each the initial and final pore correspondences. Thus, the fusion of the point and pore match scores more practical in raising the fingerprint recognition accuracy. However this technique is its complexness in describing the pores.

Min et al. (2008) developed a brand new technique during which they used Fingerprint Recognition System which mixes each the options extraction by applying a applied mathematics and pure mathematics approach system illustrates the process by considering elementary geometric terms, applied mathematics computation and conjointly it checks all of the options for input fingerprint image to attain higher accuracy share and to provide the connected info of input image properly from info. This technique takes less time for recognition of input image but by exploitation non-minutiae primarily based algorithmic program this technique will any be improved with a lot of authentications and fewer area memory usage.

III. Methodology

A Number of different techniques are used for automatic classification of fingerprint. These classifications based on:

- Singular Point
- Syntactic or Grammar Based
- Mathematical Model

The most natural topology for analysing fingerprint images is the topology of curves created by the ridge and valley structures. This necessitates the use of the analysis of properties of the curves or curve features. The approach presented in this paper is combination of biometric and Gabor filter.

Fingerprint sensing

There are two primary methods of capturing a fingerprint image:

1. Inked (off-line) and
2. Live scan

The most popular technology to obtain a live-scan fingerprint image is based on optical frustrated total internal reflection (FTIR) concept. The ridges are in contact with the platen, while the valleys of the finger are not in contact with the platen.The laser light source illuminates the glass at a certain angle and the camera is placed such that it can capture the laser light reflected from the glass. The light touched by the ridges is randomly scattered while the light corresponding to valleys suffers total internal reflection. Consequently, the image formed on the plane of the CCD corresponding to ridges is dark and those corresponding to valleys are bright. More recently, capacitance-based solid state live-scan fingerprint sensors are gaining popularity since they are very small in size and inexpensive in the near future.

a) Capacitance-based fingerprint sensor

Essentially consists of an array of electrodes. The fingerprint skin acts as the other electrode, forming a miniature capacitor. The capacitance due to the ridges is higher than those formed by valleys. This differential capacitance is the basis of operation of a capacitance-based solid state sensor.

b) Feature Extraction:

A feature extractor finds the ridge endings and ridge bifurcations from the input the overall flowchart of a typical process is depicted in Figure 3. It mainly consists of three components.

1. Orientation field estimation,
2. Ridge extraction, and
3. Minutiae extraction and post processing.

c) Classification Algorithm

The fingerprint classifications start with the orientation of input image followed by the Ridge Extraction. This image is used for Minutia Point extraction to train neural network by thinning

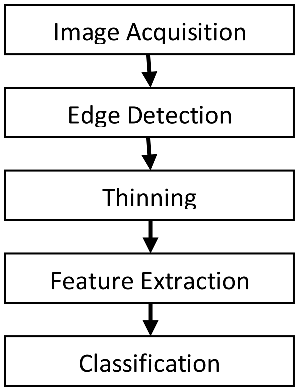


Figure 1.4 : Fingerprint Identification

i. *Image Acquisition*

In any vision system the first stage is the image acquisition stage which is hardware dependent. A number of methods are used to acquire fingerprints. Among them, the inked impression method remains the most popular one. Inkless fingerprint scanners are also present eliminating the intermediate digitization process. In this process we generally use minutiae extraction algorithm achieved by Binarization method.

ii. *Edge Detection*

An edge is the boundary between two regions with relatively distinct gray level properties. The set of pixels obtained from the edge detection algorithm seldom characterizes a boundary completely because of noise, breaks in the boundary and other effects that introduce spurious intensity discontinuities. Thus, edge detection algorithms typically are followed by linking and other boundary detection procedures designed to assemble edge pixels into meaningful boundaries.

a. *Histogram equalization*

Histogram equalization is a technique for adjusting image intensities to enhance contrast. Let f be a given image represented as a mr by mc matrix of integer pixel intensities ranging from 0 to L− 1. L is the number of possible intensity values, often 256. Let p denote the normalized histogram of f with a bin for each possible intensity. So

$$P_n = \frac{number\_of\_pixels\_with\_\text{int}\,ensty\_n}{total\_number\_of\_pixels}$$

n=0,1,........L-1

The histogram equalized image g will be defined by

$$g_{i,j} = floor\left((L-1)\sum_{n=0}^{f_{i,j}} p_n\right)$$

Where floor () rounds down to the nearest integer. This is equivalent to transforming the pixel intensities, k, of f by the function

$$T(k) = floor\left((L-1)\sum_{n=0}^{k} P_n\right)$$

b. *Image Segmentation*

There are two regions that describe any fingerprint image; namely the foreground region and the background region. The foreground regions are the regions containing the ridges and valleys. As shown in Fig. 4, the ridges are the raised and dark regions of a fingerprint image while the valleys are the low and white regions between the ridges. The foreground regions

$$V(k) = \frac{1}{W^2}\sum_{i-1}^{W}\sum_{j=1}^{W}\left(I(i,j) - M(k)\right)^2$$

$$M(k) = \frac{1}{W^2}\sum_{a=1}^{W}\sum_{b=1}^{W} J(a,b)$$

The background region possess very low grey-level variance value while the for ground region possess very high grey-level variance values. A block processing approach is adopted in this research for obtained the grey-level variance values .the approach in this research for obtaining the grey-level variance values. The approach firstly divides the imaged into block of size W*W and the varianceV(k) for each of the pixel in block K in obtained for I(i,j) and J(a,b) are the grey-level value for pixel i,jabd (a,b) respect in block k.

c. *Binarization*

The image obtained for the Gabor filters stage is binarised and thinned to make it more suitable for feature extraction. the method of image binarization sets the threshold (T) for making each cluster in the image as tight as possible, thereby minimizing their overlap to determine the actuial value of T.

The following operations are performed on set of presume treshold values:

1. The pixel is separated into two clusters according to the threshold.
2. The mean of each cluster are determined.
3. The difference of the means is squared.
4. The product of the number of pixels in one cluster and the number in the other is determined. The success of these operations depends on the difference between the means of the clusters. The optimal threshold is the one that minimizes the within-class variance. the within-class variance of each of the cluster is then calculated as the weighted sum of the variance for

$$\sigma^2_{within}(T) = n_B(T)\sigma^2_B(T) + n_0(T)\sigma^2_0(T)$$

$$n_B(T) = \sum_{i=0}^{T-1} p(i)$$

$$n_0(T)=\sum_{i=T}^{N-1} p(i)$$

$\sigma_B^2(T)$ = the Variance of the pixel in the background (below) threshold

$\sigma_o^2(T)$ = the variance of the pixels in the foreground (above) threshold.

p(i) is the pixel value at location I, N is the intensity level and [0,N-1] is the range of intensity levels, the between class variance ,which is the difference between the within class variance and the total variance of the combine distribution is then denoted from

$$\sigma_{between}^2(T)=\sigma^2-\sigma_{within}^2(T)$$

$$=n_B(T)[A]+n_0(T)[B]$$

$$A=(\mu_{\mathbf{B}}(T)-\mu)^2 \quad B=(\mu_0(T)-\mu)^2$$

where σ^2 is the combined variance, $\mu_g(T)$ is the combine means for cluster T in the background threshold , $\mu_0(T)$ is the combine mean for cluster T in the foreground threshold and μ is the combined mean for the two threshold. The between class variance is simply the weighted valence of the cluster means themselves around the overall mean. Substituting $\mu=\sigma^2(T)=n_B(T)n_0(T)[\mu_B(T)-\mu_0(T)]^2$ in

$$n_B(T)[A]+n_0(T)[B]$$

$$\sigma_{between}^2(T)=n_B(T)n_0(T)[\mu_B(T)-\mu_{0.}(T)]^2$$

using the following sample recurrence relations, the between the classes variance is successfully updated by manipulating each threshold using the constant P value as follows:

$$n_B(T+1)=n_B(T)+p$$

$$n_0(T+1)=n_0(T)-p$$

$$\mu_B(T+1)=\frac{\mu_0(T)n_B(T)+p^T}{n_B(T+1)}$$

$$\mu_0(T+1)=\frac{\mu_0(T)n_0(T)-p^T}{n_0(T+1)}$$

iii. *Thinning*

Thinning algorithms can be divided into two broad classes namely iterative and non-iterative. Although non-iterative algorithms can be faster than iterative algorithms they do not always produce accurate results. Like other morphological operators, the behavior of the thinning operation is determined by a structuring element. The binary structuring elements used for thinning are of the extended type described under the hit-and-miss transform (*i.e.* they can contain both ones and zeros). The thinning operation is related to the hit-and-miss transform and can be expressed quite simply in terms of it. The thinning of an image I by a structuring element J is:

$$thin(I,J)=I-hit-and-miss(I,J)$$

Where the subtraction is a logical subtraction defined by

$$X-Y=X\cap NOT\ \mathrm{Y}$$

iv. *Feature Extraction*

Extraction of appropriate features is one of the most important tasks for a recognition system. We are using back propagation algorithm to do this feature extraction. Feature Extraction can be performed by following techniques.

1. Gauss Network Method.
2. Gradient Method.
3. Numerical Method.
4. Directive Adaptive methods.

Feature extraction is concerned with the quantification of texture characteristics in terms of a collection of descriptors or quantitative feature measurements often referred to as a feature vector. It is desirable to obtain representations for fingerprints which are scale, translation, and rotation invariant. Scale invariance is not a significant problem since most fingerprint images could be scaled as per the dpi specification of the sensors. The present implementation of feature extraction assumes that the fingerprints are vertically oriented. In reality, the fingerprints in our database are not exactly vertically oriented; the fingerprints may be oriented up to away from the assumed vertical orientation. This image rotation is partially handled by a cyclic rotation of the feature values in the Finger Code in the matching stage. The feature data can be extracted from thinned fingerprint image, which generally includes the type (endpoint or bifurcation), absolute coordinates and direction of the feature point. Using the template shown in Figure 1, and the value of Cn and Sn are calculated (Cn is the cross number and Sn is the sum of 8 neighborhood pixels):

If $C_n=1$ and $S_n=1$ Point P is an endpoint. If $C_n=2$ and $S_n=2,3\_or\_4$ it is continuous. If $C_n=3$ and $S_n=3$ it is a bifurcation. Once type of feature points is determined, the relate parameters can be calculated. The attribute of endpoint included abscissa, ordinate and ridge angle .Bifurcation attribute includes abscissa ordinate, angle between the three branches and ridges angle.

$$C_n = \frac{1}{2}\sum_{i=1}^{8} | P_{i-1}P_i | \; S_n = \sum_{i=1}^{8} P_i$$

Estimate the block direction for each block of the fingerprint image with WxW in size (W is 16 pixels by default). The algorithm is:

1. Calculate the gradient values along x-direction (gx) and y-direction (gy) for each pixel of the block. Two Sobel filters are used to fulfill the task.
2. For each block, use following formula to get the Least Square approximation of the block direction. After finished with the estimation of each block direction, those blocks without significant information on ridges and furrows are discarded based on the following formulas:
   80(gx2+gy2)
3. For each block, if its certainty level E is below a threshold, then the block is regarded as a background block

tg2ß = 2 $\sum\sum(g_x * g_y)/\sum\sum(g_x^2 - g_y^2)$ for all the pixels in each block. The formula is easy to understand by regarding gradient values along x-direction and y-direction as cosine value and sine value. So the tangent valueof the block direction is estimated nearly the same as the way illustrated by the following formula.

$$tg2\theta = 2\sin\theta\cos\theta/(\cos^2\theta - \sin^2\theta)$$

v. *Classification*

RBF Neural Network classifier has an ability to learn from their experience is the key element in the problem solving strategy of a pattern recognition task. A neural networks system can be seen as an information processing system composed of a large number of interconnected processing elements. Each processing element also called node, neuron calculates its activity locally on the basis of the activities of the cells to which it is connected. The strengths of its connections are changed according to some transfer function that explicitly determines the cell's output, given its input. The learning algorithm determines the performance of the neural networks system. It should be noted that this network configuration is designed to accept the weight values that are obtained by projecting a test images into image-space.

a. *Parameter Estimation of RBF Neural Networks*

Two important parameters are associated with each RBF unit, the center *Ci* and the width *σi*

b. *Center estimation*

Each center should well represent each subclass because the classification is actually based on the distances between the input samples and the centers of each subclass. In our experiment, the mean value of the training samples in every subclass is chosen as the RBF center as follows

$$C_i = \frac{1}{n^i}\sum_{j=1}^{n^1} P_j^i$$

Where P_j^i is the *j* th sample in the *i* th subclass and *ni* is the number of training samples in the *i* th subclass.

c. *Width estimation*

The width of an RBF unit describes the properties of a subclass because the widt of a Gaussian function represents the standard deviation of the function controlling the amount of overlap of Gaussian function. Our goal is to select the width that minimizes the overlaps between different classes so as to preserve local properties as well as maximize the generalization ability of the network. In our experiment, the following method for width estimation is applied

$$d_{med}(i) = med\{d(j,i)\}, \quad \text{i,j=1,2,............u,}$$

$$i \neq j \;\; \text{k}, \;\; \text{l=1,2,.......s}, \;\; k \neq l$$

$$d(i,j) = \left\| C_j^l - C_i^k \right\|$$

Where *k Ci* is the center of the *i* th cluster belonging to the *k* th class and *dmed* (i) is the median distance from the *i* th cluster to the centers belonging to other classes. The width *σi* of the *i* th cluster is estimated as follows

$$\sigma_i = \frac{d_{med}(i)}{\sqrt{|\ln \eta|}}$$

Where η is a factor that controls the overlap of this cluster with other clusters belonging to different classes. By selecting the proper factor η, a suitable overlaps between different classes can be guaranteed.

$$E = \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{\mu}\left(t_i^j - y^j(P_i)\right)^2$$

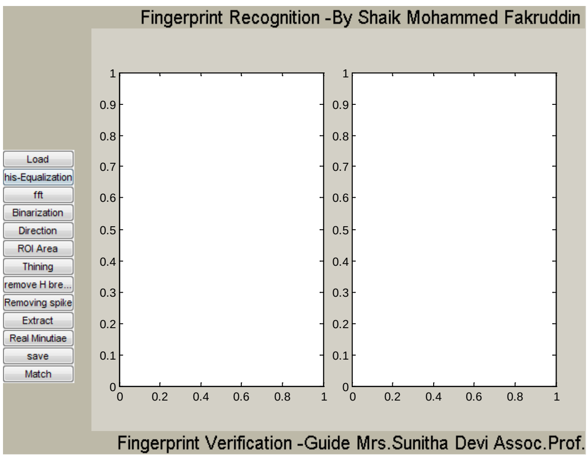
where t_i^j is the target value for output unit *j* when the ith training sample Pi is fed to the network, $y^j(P_j) = \sum_{k=1}^{s} w(j,k)R_k$ *Rk* is the *k* th output of the RBF unit, s is the number of RBF units generated according to the clustering algorithm and *n* is the total number of training samples. The linear least square [11] can solve this problem. Let α and β be the number of input and output neurons respectively, $R \in Rs\times n$ the RBF unit matrix, and $G = (G1, G2, \ldots, Gn)T \in Rs\times n$ the target matrix consisting of "1's" and "0's" with exactly one per column that identifies the processing unit to which a given exemplar belongs. To find an optimal weight matrix $W^* \in Rs \times n$, the Eq. (6) is minimized as follows.

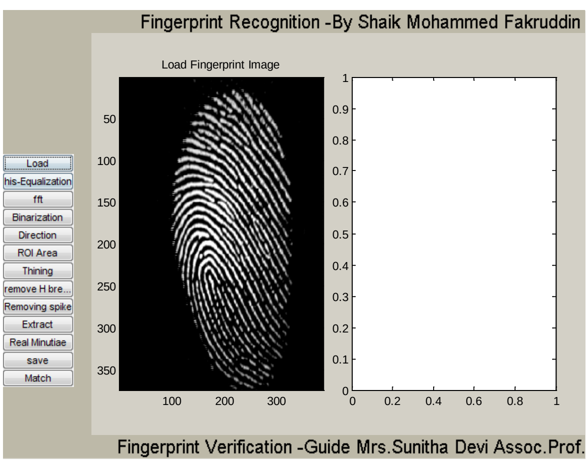
$$W^* = \left(GR^+\right)^T$$

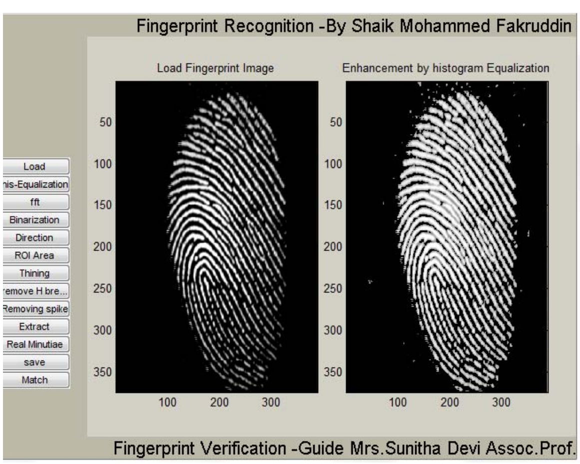
Where R^+ is the pseudo inverse of R and is given by

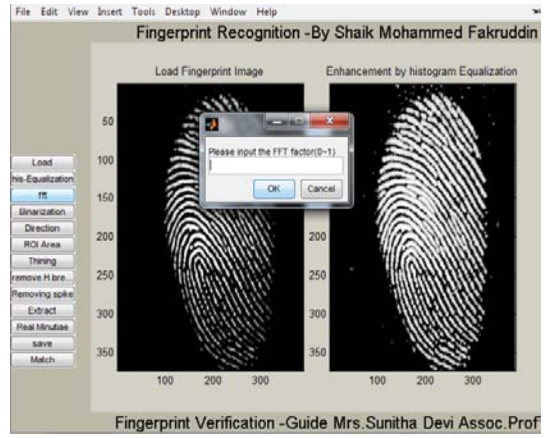
$$R^+ = \left(R^T R\right)^{-1} R^T$$

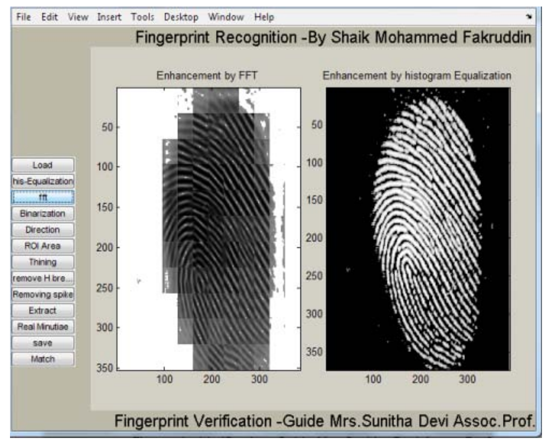
IV. Functional System

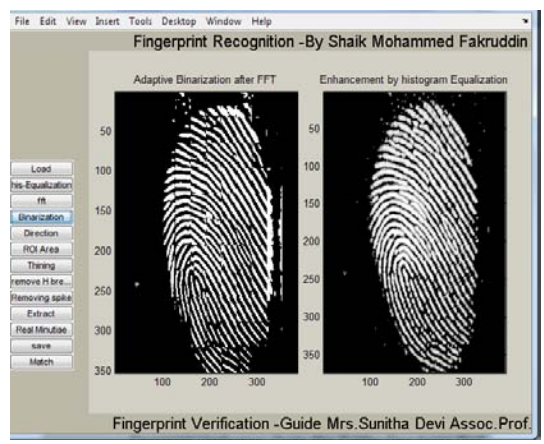


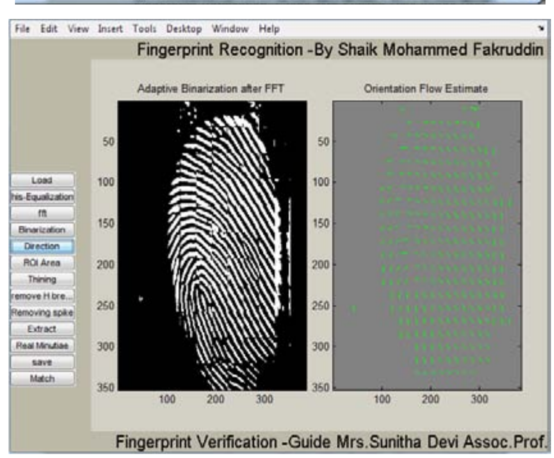


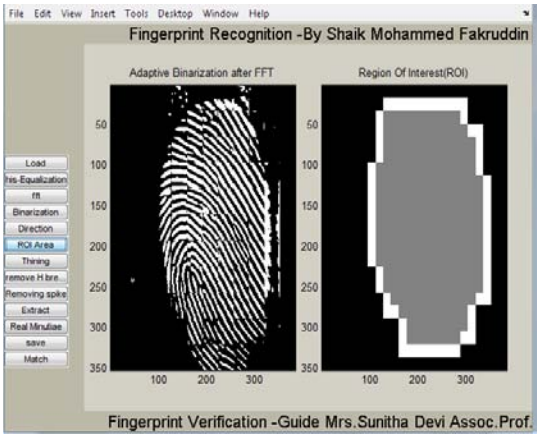


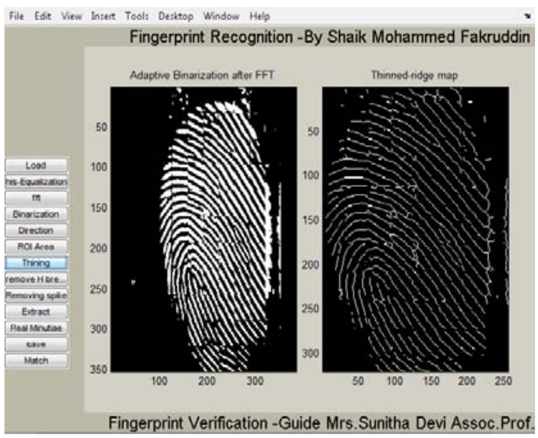


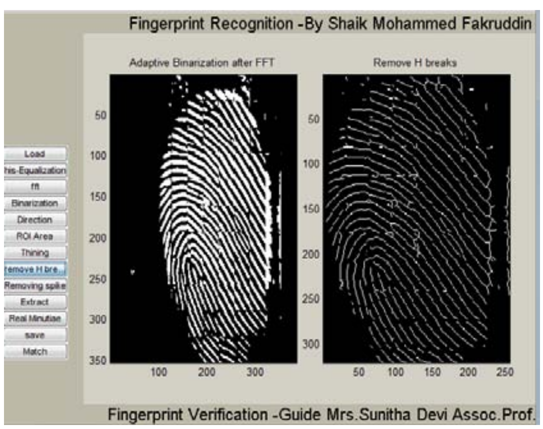


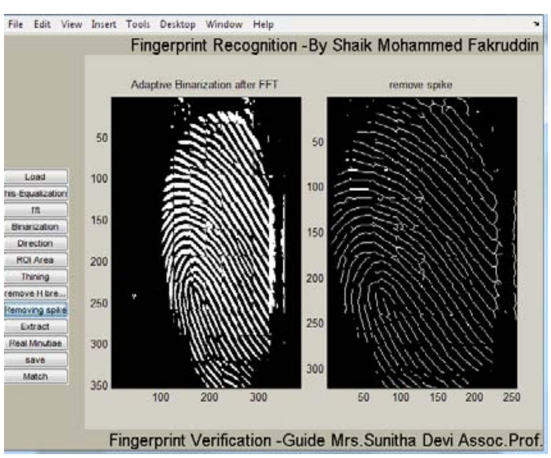


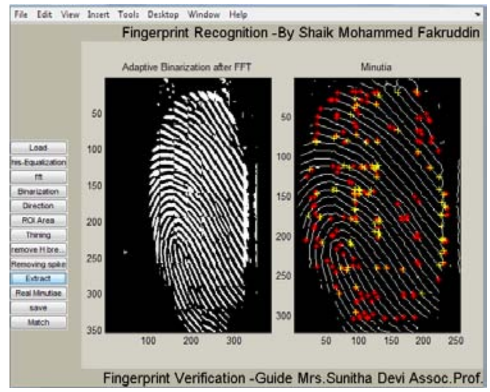


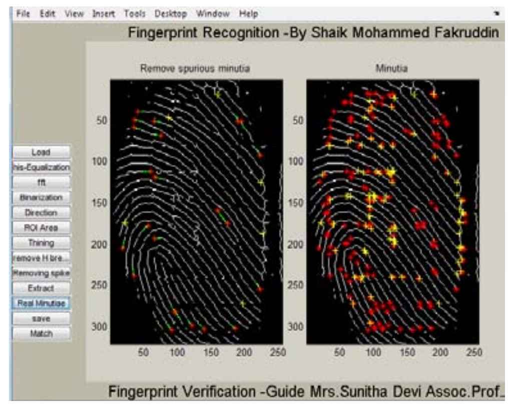












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Illumination Condition Effect on Object Tracking: A Review

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Abstract- Illumination is an important concept in computer science application. A good tracker should perform well in a large number of videos involving illumination changes, occlusion, clutter, camera motion, low contrast, specularities and at least six more aspects. By using the review approach, our tracker is able to adapt to irregular illumination variations and abrupt changes of brightness. In static environment segmentation of object is not complex. In dynamic environment due to dynamic environmental conditions such as waving tree branches, shadows and illumination changes in the wind object segmentation is a difficult and major problem that needs to be handled well for a robust surveillance system. In this paper, we survey various tracking algorithms under changing lighting condition.

Keywords: object detection, object tracking, point tracking, kernel tracking, and silhouette tracking.

GJCST-F Classification: I.4.8

ILLUMINATIONCONDITIONEFFECTONOBJECTTRACKINGAREVIEW

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Kalpesh R Ranipa α & Dr. Kiritkumar Bhatt σ

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I. Introduction

Variation in the visualation of an object mostly arises due to changes in illumination and pose [2]. However, existing approaches has limitations on illumination conditions and objects [1][3], or are computationally intense due to iterative optimization procedures used for obtaining the solution [4]. Moving Object detecting and tracking are very important in any vision based surveillance system. There are Various approaches to object detection have been proposed for surveillance, including feature-based object detection, template-based object detection and background subtraction[6] or inter-frame difference-based detection .Most algorithms for object detection and tracking are designed for daytime visual surveillance[5].

Every object tracking method should have an object detection mechanism either in each frame or when the object first time appears in the video. A most of approach for object detection is to use information in a single frame. However, some of object detection methods make use of the temporal information computed from a of frames sequence to reduce the false detections in video frames. This temporal information is usually in the form of frame differencing, which shows information in form of changing regions in consecutive frames. [7] Tracking involves registering the movements of the segmented object from initial frame to the last frame in a video.

The goal of this paper is estimation for improved object tracking and recognition.

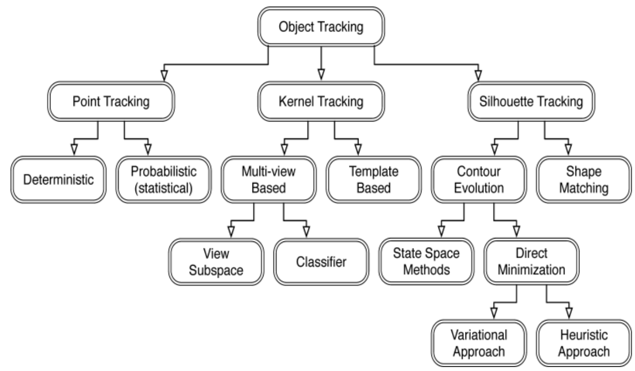

Figure 1 : Object tracking classification [8]

Object tracking algorithm can be categorized into three steps shown in Fig.1 [8]. These are point tracking, kernel tracking and silhouette tracking [8]. In point tracking, detected object in consecutive frames are represented by a set of points and kalman filter is widely used in the point based feature tracking [9]. Point tracking is complicated in the presence of occlusion, entries and exists of an object. Kernel tracking is associate with the object shape and appearance. These algorithms differ from the others based on the method used to estimate the object motion and the numbers of the objects tracked [8]. Kernel based object tracking is usually represented with rectangular or elliptical shape of kernel. Silhouette tracking methods provide an accurate shape of the objects [9], where object boundary shows sharp changes in image intensities. Advantages of the silhouettes are their flexibility to recognize and handle a variety of object shapes.

The object tracking also defined as a serial process of object representation, feature selection, object detection and object tracking. [43] [8] The object can be defined as a set of points or single point. Object is represented as primitive geometric shapes like circle, ellipse, rectangle , object contour, object silhouette, skeletal model, articulated shape models, etc. The combined defined with the appearance representations for tracking purpose. Most of appearance representations are probability densities of object appearance, active appearance model, multiview appearance model and templates. In feature selection

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is another most important steps in object tracking. Some of the commonly used features are edges, gradient, texture, color, optical flow etc. Every object tracking method requires an object detection mechanism in every frame. Some commonly used object detection methods are: point detectors, segmentation, background subtraction etc. After object detection the tracker's task is to detect and generate the object trajectory over time by locating object position in each frame of the video.

Object tracking can be complex due to the loss of information, complex object motion/shapes, noise in the image, illumination changes into scene and partial occulation object. Kernel tracking is associate with the object shape and appearance. These algorithms differ from the others based on the algorithm used to estimate the object motion and the numbers of the objects tracked [8]. Kernel based object tracking is usually represented with rectangular or elliptical shape of kernel. Silhouette tracking methods provide an accurate shape of the objects [9], where object boundary shows sharp changes in image intensities. Advantages of the silhouettes are their flexibility to handle a variety of object shapes. Object tracking can be complex due to the loss of information, complex object motion/shapes, noise in the image, illumination changes into scene and partial and full occlusion into scene [8]. Illumination is an important concept in visual arts. Illumination problem is defined as the degree of visibility of the object or change in appearance of the object with different lighting condition [10]. The placement of the light sources can make a difference in the type of any object that is being presented. Multiple light source can produces the illumination effect. Another major challenge is the occlusion effect. It is also defined as hidden (occluded) object. In dynamic scenes, the moving objects exhibit many spatial configurations relative to other objects. A relative depth ordering on the objects and the scene background structures is imposed along the lines of sight when observed from a view point. Such a depth ordering leads to the partial or complete viewing obstruction of some of the object of interest by others and the phenomenon is also known as occlusion [11].

II. Relate Work

Illumination effect on object tracking has been the major challenge till date and various researchers have proposed the effective algorithms for the same.

There are several techniques that attempt to pre-compensate for illumination variations between frames caused by changes in the strength or position of light sources in the scene. Some of the earliest attempts to deal with illumination changes used intensity normalization [32-34], Most of the algorithms handle luminance intensity, which is one scalar value per each pixel [35-41].

Few reviews exist for surveying the performance of application independent trackers. The work of 2006 of Yilmaz et al. [8] still provides a good frame of reference for reviewing the literature, describing methodologies on tracking, features and data association for general purposes.

Fuat corun and A. Enis Cetin have proposed method using 2D-Cepstrum characteristics method for object tracking under illumination variations of the target. They also explain object tracking algorithm bsed on the co-difference and covariance matrix based [12].The covariance of feature vectors describing the target is called covariance matrix [13]. Co-difference tracking method describes the co- difference matrix to model the moving objects or target. In these two methods, the aim is to assign this region as the moving target and find the region in a given Image frame having the minimum distance from the target matrix at that frame. The first stage of these algorithms is to find the feature images and vectors and then co-variance matrix and co-difference matrix is finding out by using the feature vectors. After first stage, to estimate the distance matrix and target location of the object. This operation is repeated for each frame. Then this algorithm is analyzed by using 2DCepstrum [14] analysis. 2D-Cepstrum is an amplitude invariant feature extraction method. So, cepstrum domain coefficient of a region remains unchanged under the light intensity variations. This property of cestrum provides robustness to illumination variation at the target region.

Co-difference method is applied to video.it is applied to video sequence in which the intensity of the target region varies and experimentally this method provides better result than the ordinary covariance tracking method.

Ashwani Kumar et al., have proposed method to improvement in colour based a moving object tracking for corporate world and employed. The parameter of object consideration are object position, speed, size, object size scale and the appearance effect of the object. The target parameter update based on condition to the perfect tracking of an object [15]. This method is used for non-rigid deformation of targets, partial occlusion and cluttered background. Disadvantage of this method is that it does not consider colour histogram in target regions.

Zhou Dan et al., have proposed method based on surf for higher tolerance of illumination changes, which help in outdoor object tracking [16].this method is robust for difficult and complex environments. Disadvantage of it increases the complexity of the algorithm and reduce efficiency of tracking.

Kai Du et al., have improved algorithm based on SIFT feature matching and MeanShift method for used in object initialization in tracking, which uses weight coefficient of Bhattacharyya coefficient in each video sequence block.

Rama Chellappa et al. have proposed a method for object detection and tracking using multiple smart cameras [18]. They use the method of background modelling (background Subtraction) for moving object detection and tracking. In this study, a test image can be subtracted from the template and pixel with large difference can be marked as moving objects. Gaussian distribution functions are used to remove the global changes into the scene such as illumination or camera jitter. Also, the mixer of Gaussian (MOG) model handles periodic background disturbance and can be used to keep the tack of global changes in the scene. This will reduce the effects of illumination into the Scene. Multiple smart cameras are arranged in the proper direction and the numbers of cameras are connected in the distributed network. In detection and tracking, ground place can be used as a strong constraint for designing efficient and robust estimators for moving objects.

The algorithms are optimized for sensor networks that contain a small number of cameras. The geometric constraints induced by the imaging devices to derive distributed algorithms for target detection, tracking and recognition which are efficiently used.

Object detection and tracking under changing lighting (illumination) conditions studied by Wagas Hassan et al. [19] is based on orientation of the edge. Tracking based on the energy or magnitude of the edges can also suffer from changes in illumination. A change in illumination can causes the magnitude of an edge to change which can result in false tracking outputs. In this paper, author has considered adaptive edge orientation based technique. Adaptive edge orientation method considers the orientation of the edge rather than the intensity and there is no dependency on colour features. Such method will gives the better results where lighting is not consistent.

Under lighting Conditions, edges are more stable than both edge magnitude and colour. This algorithm is also applied to the highly variable lighting video sequence and provides the better results.

Francois Bardet et al., have proposed a method for illumination invariance where multi-objects are jointly tracked through a Markov chain Monte-carlo Particle Filter (MCMC PF) [20]. To allow the object to enter or leave the scene khan et al. [21] extended their Markov chain Monte-Carlo particle Filter (MCMC PF) method to track the variable number of objects. This extended method is reversible Jump Markov Chain Monte-carlo (RJ MCMC) [25] sampler. Reversible Jump Markov chain Monte-Carlo Particle Filter has become a popular algorithm for real-time tracking. RJMCMCPF samplers allow the object classification as well as detect the object shapes. An experiment has been performed by the authors on pedestrian tracking and highway vehicle tracking. In pedestrian tracking, more than ten objects are tracked under variable sunlight condition. Also, highway vehicles are tracked and classify simultaneously with time evolving sunlight.

RJ MCMC PF sampler algorithm overcomes the problem of Isard et al. [24]. They have proposed a method using SIRPF (Sequential Importance Resampling Particle Filter) and a Monocular multi-Object Tracker (MOT) which has the limitation of tracking the maximum three objects.

Online tracking methods under the various outdoor lighting variations with moving cameras are studied by Yanli Liu and Xavier Granier [22]. To design the algorithm, they have assumed a strong correlation in lighting over large spatial and temporal extents. With such an assumption, they combine the information of previous frame with the current frame for estimating the relative variations of sunlight and skylight. Sunlight and skylight are estimated via a sparse set of planar feature-points extracted from each frame. The most of algorithm achieves nearly real-time processing with an un-optimized Matlab implementation.

This approach does not require any prior knowledge of 3D scene and works with moving view point. Also algorithm provides a user with an augmented reality experience with its general purpose camera. Without knowledge of lighting direction, algorithm cannot deal with indoor scenes.

Moving object tracking approach defined by Oksam Chae et al. [45] is based on the parametric edge of the object. Image information lies on the edge of different objects. Edge information is less sensitive to noise and is more consistent than the pixel values in the video sequence. Also edge-based methods show more robustness as compared to pixel intensity based methods and less sensitive to illumination variation than intensity features. Object boundary shows sharp changes in image intensities. Segment based edge pixels representation is fast compare to all the pixels in the image. This representation helps to incorporate a fast, efficient and flexible edge tracking algorithm.

Tianzhu Zhang et al. have proposed a robust visual tracking algorithm using multi-task sparse learning [26]. This algorithm handles the particles (target Candidates) [27] independently. First stage of this algorithm given by the authors is to define or formulate the object tracking in particle filter framework as a multi-task tracking. They have also uses the particle filter to track the target object. Then the particles are randomly sampled according to Gaussian distribution. These particles are represented as a linear combination of updated dictionary template. As particles are densely sampled around the target stage, their representation will be sparse. This is more robust representation for particles. This convex optimization problem can be solving using accelerated proximal gradient method. This algorithm improves the tracking performance and overall computational complexity.

III. Evaluation Parameter

Basic types of evaluation parameter used in object tracking for algorithm [7][8][42][43]:

1. Deviation: the track's location deviated from the ground truth.
2. True positive: tracker identifies a target which is a target.
3. False positive: tracker identifies a target which is not a target
4. True negative: tracker not misses to identify and locate the target.
5. False negative: tracker misses to identify and locate the target.

IV. Conclusions

In this paper, we present a literature survey of object tracking approaches and also give a brief review of related topics. We devides the basic approach in three categories such as point tracking, kernel tracking and silhouette tracking. Moreover, we describe the degree of applicability and qualitative comparison of the tracking algorithms.

After the literature survey, we came to the conclusion that in order to track object under illumination condition, the features extracted from frames must be invariant to illumination. We expect that this survey on moving object tracking in video with rich theoretical details of the tracking methods along with bibliography contents will give valuable contribution to research works on object tracking and encourage new research.

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Pose Invariant Face Recognition using DT-CWT Partitioning and KPCA

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Abstract- In this paper the suitability of Dual Tree Complex Wavelet Transform for pose invariant Face Recognition is studied and a feature extraction frame work is proposed. This proposed framework will aid in design of Face Recognition system to address the challenging issue like Pose Variation. In contrast to the discrete wavelet Transform (DWT) the design of Dual Tree Complex Wavelet Transform is rugged to shift Invariance and poses good directional properties. These features of DT-CWT motivated to study their suitability for Face Feature Extraction, as the features of face are oriented in different directions. In this proposed frame work the Image is decomposed using DT-CWT and the features are extracted from low frequency band using Kernel Principal Component analysis (KPCA). To show the performance, the proposed method is tested on ORL Database. Satisfactory results are obtained using proposed method compared to existing state of art.

Keywords: dual tree complex wavelet transform, KPCA, and euclidian classifier.

GJCST-F Classification: I.4.8 I.7.5

POSEINVARIANTFACERECOGNITIONUSINGDT-CWTPARTITIONINGANDKPCA

Strictly as per the compliance and regulations of:

Pose Invariant Face Recognition using DT- CWT Partitioning and KPCA

K. Punnam Chandar [α] & Dr. T. Satyasavithri [σ]

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Keywords: dual tree complex wavelet transform, KPCA, and euclidian classifier.

I. Introduction

Biometrics comprises methods for unambiguously recognizing individuals based upon physical and behavioral attributes. Face recognition is one of the biometric systems that takes image or video of a person and compares it with images in database to grant access to secure areas. Many researchers showed that the features extracted from face images aid in designing robust security/authentication systems. Successful face recognition system [1] is proposed utilizing Eigen face approach. This method is conventional, considers frontal and clear faces for implementing the system, but in real time faces may not be frontal and device intrinsic capture (illumination variation) properties pose difficulties in the process of detection. Thus in security and other computer vision applications, pose and variation in illuminations plays a critical role.

Conventional Face feature extraction suffers mainly from

a. Pose and expression variation ,
b. Resolution variation and
c. Illumination problems

In this paper pose problem is addressed using Complex Wavelets [9-10][13] and KPCA to extract Multi scale features towards secure Face Recognition system.

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To aid the process of recognition, nearest neighborhood classifier [16] is used; this method finds an image to the class whose features are closest to it with respect to the Euclidean norm.

This work uses Dual tree Complex wavelet [15] transform mainly to reduce the computation complexity. In the ORL face database [7] all the images are of size 112 X92, we worked on approximation details of first level decomposition using DT-CWT. The size in first level decomposition reduces to 56 X46.

Figure 1 : Different poses of a subject from ORL face database

In this paper we used Kernel Principal Component Analysis (KPCA) as feature extraction method [1, 2, 3]. For comparing results Eigenface approach is used for low dimensional representation of faces by applying Principal Component Analysis (PCA). The system functions by projecting face images onto a feature space that spans the significant variations among known face images. The significant features are known as “eigenfaces” because they are eigenvectors (principal components) [1].

The performance of the proposed algorithm is verified on available databases on the internet, such as ORL face database [7]. ORL face database consists of 400 images of 40 individuals; each subject has 10 images in different poses.

This paper is organized into six sections in section II we discussed Dual Tree Complex Wavelet Transform, in section III Feature Extraction and classifier, in section IV proposed face recognition system, in section V, experimental results & discussions, and conclusion in the last section.

II. Dual Tree Compex Wavelet Transform

The defects in DWT can be eliminated by using an expansive wavelet transform in place of a critically-

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sampled one. (An expansive transform is one that converts an N-point signal into M coefficients with M > N).DT-CWT provides N multi scales, can be implemented using separable efficient Filter Banks.

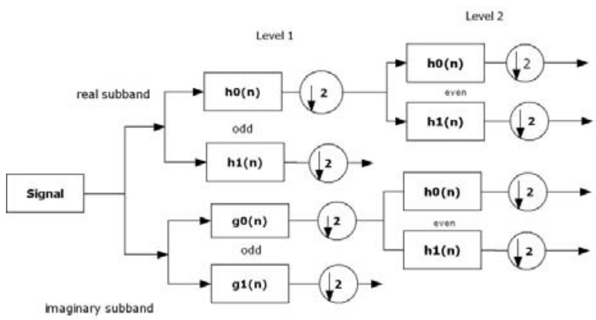

Figure 2 : Dual Tree Complex Wavelet Transform working principle for 1D signal

Here two sets of Filter banks are used, consists of low pass and high pass filters. Down sample the input signal by 2 through a filter of H (Z) transfer function and again through G (z) filter. The filters should be Hilbert transform pairs

$$y_g(t) = \mathrm{H}\{y_h(t)\} \tag{1}$$

The filters in the upper and lower DWTs should not be the same, the filters used in the first stage of the dual-tree complex DWT [4] should be different from the filters used in the remaining stages. The sub band signals of the upper DWT can be interpreted as the real part of a complex wavelet transform, and sub band signals of the lower DWT can be interpreted as the imaginary part. Equivalently, for specially designed sets of filters, the wavelet associated with the upper DWT can be an approximate Hilbert transform of the wavelet associated with the lower DWT. Then designed, the dual-tree complex DWT is nearly shift-invariant and strong directional in contrast with the critically-sampled DWT. The designed filter complex wavelet should be analytic and it is

$$\psi_c(t) := \psi_h(t) + j\psi_g(t) \tag{2}$$

The wavelet coefficients w are stored as a cell array. For j = 1..J, k = 1..2, d = 1..3, w{j}{k}{d} are the wavelet coefficients produced at scale j with an orientation d. The dual-tree complex DWT outperforms well compared to the critically-sampled DWT for applications like image de-noising and enhancement. DT-CWT for image provides six (d=1…..6) directional high frequency sub bands and two (d=1, 2) low frequency sub bands as shown in fig 5.

The 2-D wavelet is defined as

$$y(x,y) = y(x)y(y) \tag{3}$$

where $y(x)$ is complex analytic wavelet, given as

$$y(x) = y_r(x) + jy_i(y) \tag{4}$$

similarly

$$y(x,y) = y_r(x)y_r(y) - y_i(x)y_i(y) + j\left[y_r(x)y_i(y) + y_i(x)y_r(y)\right]$$

ψ_r is real and even and is imaginary and odd.

The complex-wavelet coefficient is defined as

$$d_c(k,l) = d_r(k,l) + jd_i(k,l) \tag{6}$$

And its magnitude is

$$|d_c(k,l)| = \sqrt{|d_r(k,l)|^2 + |d_i(k,l)|^2} \tag{7}$$

When $|d_c(k,l)| > 0$

And phase is given as

$$d_c(k,l) = \arctan q \tag{8}$$

Where $\theta = \dfrac{d_i(k,l)}{d_c(k,l)}$

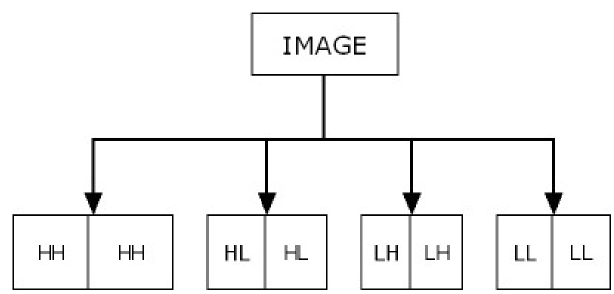

Figure 3 : Decomposition of DT-CWT for 2D image

Key features of DT-CWT are

1. Better directionality
2. Anti- aliasing effect
3. Good shift-invariant
4. Geometry of the image features retained from phase
5. Better robustness for smooth varying
6. Low computation compared with DWT, 3 times that of maximally decimated DWT.

III. Feature Extraction and Classifier

a) Principal Component Analysis

A 2-D facial image can be represented as 1-D vector by concatenating each row (or column) into a long thin vector. Let's suppose we have *M* vectors of size *N* (= rows of image $\times$ columns of image) representing a set of sampled images. *pj*'s represent the pixel values.

xi = [p1 : : : pN]T ; i = 1, ... , M

The images are mean centered by subtracting the mean image from each image vector. Let m represent the mean image.

$$m = \frac{1}{M}\sum_{i=1}^{M} x_i \qquad (9)$$

And let w_i be defined as mean centered image

$$w_i = x_i - m$$

Our goal is to find a set of *ei*'s which have the largest possible projection onto each of the *wi*'s. We wish to find a set of M orthonormal vectors ei for which the quantity

$$\lambda_i = \frac{1}{M}\sum_{n=1}^{M}(e_i^T w_n)^2 \qquad (10)$$

is maximized with the or thonormality constraint

$$e_l^T e_k = \delta_{lk}$$

It has been shown that the *ei*'s and ¸*λi*'s are given by the eigenvectors and eigen values of the covariance matrix

$$C = WW^T \qquad (11)$$

where *W* is a matrix composed of the column vectors *wi* placed side by side. The eigenvectors corresponding to nonzero eigenvalues of the covariance matrix produce an orthonormal basis for the subspace within which most image data can be represented with a small amount of error. The eigenvectors are sorted from high to low according to their corresponding eigenvalues. The eigenvector associated with the largest eigenvalue is one that reflects the greatest variance in the image. That is, the smallest eigenvalue is associated with the eigenvector that finds the least variance. They decrease in exponential fashion, meaning that the roughly 90% of the total variance is contained in the first5% to 10% of the dimensions.

A facial image can be projected onto *M' (M)* dimensions by computing Ω = *[v1, v2 , , , VM']T*

b) Kernel Principle Component Analysis

Kernel Principal Component Analysis is another technique used for dimensionality reduction when the data lie on the non-linear manifold .In KPCA data X are first mapped into a high dimensional space F via non linear mapping Φ [3]. Assuming that the mapped data are centered, i.e., $\sum_{i=1}^{M}\Phi(x_i)=0$, where is M the number of input data (the centering method in F can be found in [10] and [13]). Kernel PCA diagonalizes the estimate of the covariance matrix of the mapped data $\Phi(x_i)$ defined as,

$$F = \frac{1}{M}\sum_{i=1}^{M}\Phi(x_i).\Phi(x_i)\ .$$

Polynomial, Exponential and Sigmoid functions are most widely used non linear functions. In this paper we considered only polynomial functions. If the new data set is 'K'. PCA is now performed in this K.

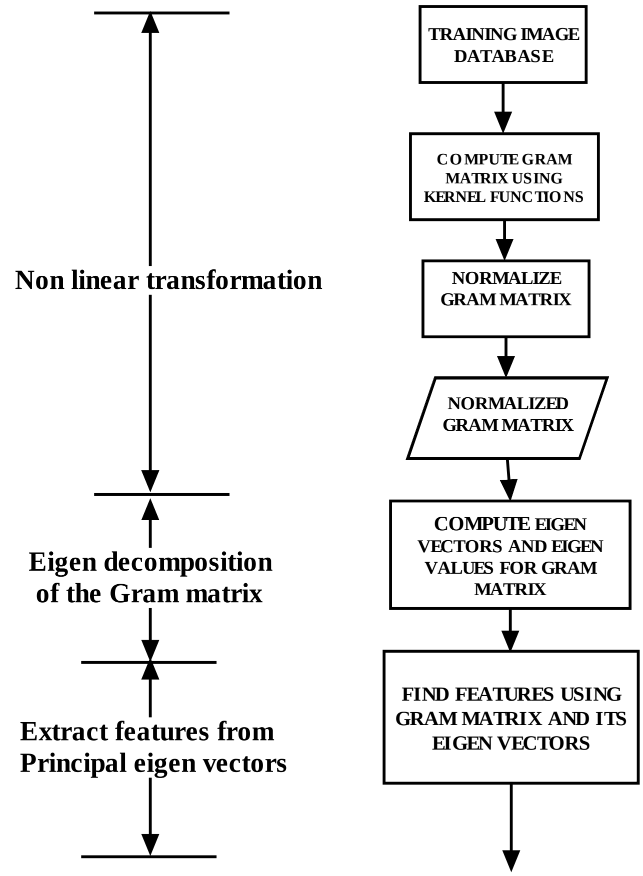

Figure 4 : Feature extraction using KPCA

Typical kernel functions are

(a) The radial basis function (RBF), defined as

$$K(x, y) = \exp\left(\frac{\|x-y\|^2}{P_0^2}\right) \qquad (4)$$

Where P0 is a user-defined parameter that specifies the rate of decay of k(x, y) toward zero, as y moves away from x and

(b) The polynomial function, defined as

$$K(x, y) = \left(x^T y + P_1\right)^{P2} \qquad (5)$$

Where P1and P2 are user defined parameters. The following Table.1 gives the effect of kernel parameters on recognition rate for given number of features.

We used (1, 2) as kernel parameters P_1, P_2 for polynomial kernel function. In the paper [3] by Kwang in Kim et.al they used (1, 4) as kernel parameters. Any P2 from 1 to 4 is considerable.

c) Classifier

In this work we have used nearest neighborhood classifier [16] to recognize the image. This classifier comes under minimum distance classifiers. It is also called as Euclidean classifier. In this method the minimum the distance from test feature vectors to train feature vectors the correct the image is. If Xi, Yj represents test and train image features then

$$\|X_i - Y_i\| \equiv \sqrt{(X_i - Y_i)^T (X_i - Y_i)} < \|X_i - Y_j\| \quad (12)$$

*Where||. || represents Euclidean norm

Because of its simplicity, it finds an image to the class whose features are closest to it with respect to the Euclidean norm.

IV. Proposed Face Recognition System

First aspect of this work is to use Dual Tree Complex Wavelet transform [9, 10, 13] where multiscale analysis is possible. The decomposition level of the wavelet transform is decided by the imagery details which we need. In this work first level decomposition is satisfactory to preserve the details. The Second and important aspect of this work is to extract the features from the LL_{NEW} using KPCA.

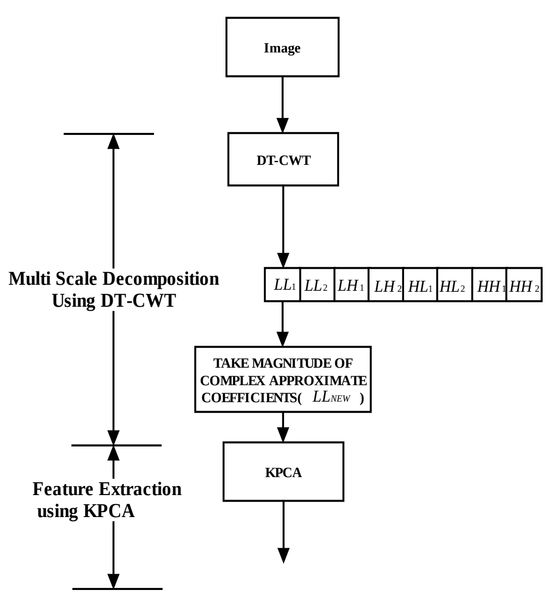

Figure 5 : DT-CWT Multiscale Feature Extraction (Proposed Algorithm)

The general procedure of the proposed technique is as follows. As a first step we divide database into testing and training database. Each database consists of 200 images of 40 subjects and 5 different poses. As next step Approximation details of all train images in database including test image are calculated using DT-CWT. The approximation coefficients of first level decomposition are complex numbers. Then we formed new database LL_{NEW} with magnitudes of these complex numbers.

Now the LL_{NEW} is processed using KPCA to extract the features Fig.2 shows all the steps of the proposed algorithm and feature Extraction.

Third aspect of this work which is the decision making step to find suitable image. After extracting features for all train images and test image, nearest neighborhood classifier is used to recognize the correct image from database. Face recognition system with proposed algorithm rugged to pose variation is shown in Fig.7.

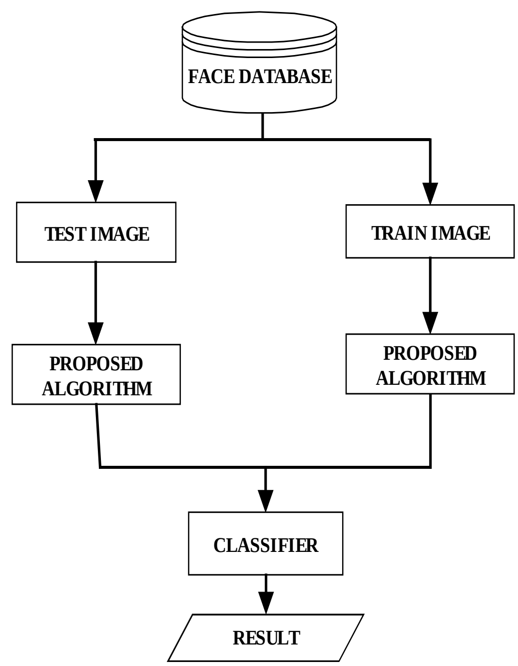

Figure 6 : Block diagram of face recognition system

V. Experimental Results & Discussions

a) Database

In this work experimentation is carried ORL face databases [7]. The ORL database consists of 400 images of 40 individuals in different poses. Sample images from ORL database are shown in below figure.7, ,Which shows 10 different poses of 5 subjects.

Figure 7 : ORL Face Database

b) Experimental Results

For evaluating the performance of the proposed algorithm we have used ORL database. Recognition rate was calculated on this database and results are shown in Table 1. The Results are also plotted in figure 7.It is observed from figure that as the number of features increasing the recognition rate is also increasing.

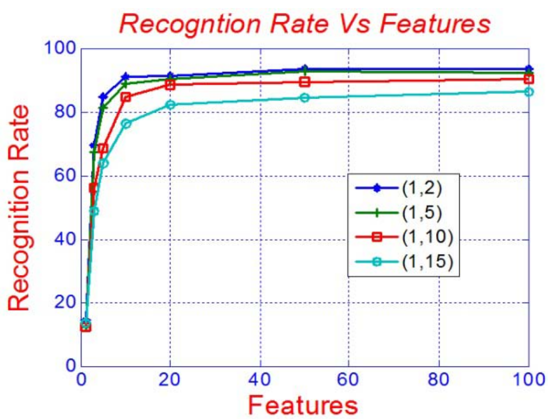

Figure 8 : Recognition Rate vs. Features for ORL face database

Table 1 : Recognition Rate Calculation On ORL Database using DT-CWT and KPCA

Recognition Rate Calculation by Using Various Kernel Parameters					
Features	*Database*	*(1, 2)*	*(1, 5)*	*(1, 10)*	*(1 , 15)*
1	ORL	14.5	12.5	12.5	13.5
3	ORL	69.5	67.5	56.0	49.0
5	ORL	85.0	81.5	68.5	64.0
10	ORL	91.0	89.0	85.0	76.5
20	ORL	91.5	90.5	88.5	82.5
50	ORL	93.5	93.0	89.5	84.5
100	ORL	93.5	92.5	90.5	86.5

VI. Conclussion

In this paper we proposed a novel approach for face recognition for pose variant case by extracting the multi scale features by using DT-CWT, KPCA, the algorithm follows top-down approach which process the image data in each level. In next step, the wavelet decomposition is applied to the entire database to reduce memory occupation. Here only the Low frequency information is used in the identification of the face and the mapping from input space of data to high dimensionality feature space is done by KPCA method along with nearest-neighbor distance classifier which can speed up the recognition process.

Experimentation is carried on openly available challenging face database. The experimental results show that as the feature space increases, the performance increases but the same time computational cost of the algorithm increases. The recognition rate is improved on ORL database. We are working out to find best suitable classifier to enhance the performance again, which is our future work remains.

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Image Fusion using Wavelet Transform: A Review

By Vinay Sahu & Dinesh Sahu
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Abstract- An Image fusion is the development of amalgamating two or more image of common characteristic to form a single image which acquires all the essential features of original image. Nowadays lots of work is going to be done on the field of image fusion and also used in various application such as medical imaging and multi spectra sensor image fusing etc. For fusing the image various techniques has been proposed by different author such as wavelet transform, IHS and PCA based methods etc. In this paper literature of the image fusion with wavelet transform is discussed with its merits and demerits.

Keywords: image fusion, medical image, PCA, wavelet transform.

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Strictly as per the compliance and regulations of:

Image Fusion using Wavelet Transform: A Review

Vinay Sahu [α] & Dinesh Sahu [σ]

Abstract- An Image fusion is the development of amalgamating two or more image of common characteristic to form a single image which acquires all the essential features of original image. Nowadays lots of work is going to be done on the field of image fusion and also used in various application such as medical imaging and multi spectra sensor image fusing etc. For fusing the image various techniques has been proposed by different author such as wavelet transform, IHS and PCA based methods etc. In this paper literature of the image fusion with wavelet transform is discussed with its merits and demerits.

Keywords: image fusion, medical image, PCA, wavelet transform.

I. Introduction

Fusion imaging is one of the most contemporary, precise and useful diagnostic techniques in medical imaging today. The new skill has made a clear difference in patient care by compressing the time between diagnosis and treatment. Image fusion is the progression by which two or more images are combined into a single image retaining the important features from each of the original images. Image fusion mingles absolutely registered images from numerous sources to fabricate a high quality fused image with spatial and spectral information [1]. So many image fusion methods have been developed from the past to now such as: the Brovey, the HIS, DCT, DWT, DT CWT and PCA methods etc. These methods functions under spatial domain & have proved to be flourishing in computer vision, robotics, satellite and medical image fusion applications. Now-a-days, Medical image fusion has become a new promising research field. For medical diagnosis, MRI (Magnetic resonance image) and CT (Computed tomography) images are very important. MRI image provides better information about soft tissue and CT image provides detail information about dense structure such as bones. These two images provide complementary information. The main purpose of medical image fusion is to obtain a high resolution image with as much details as possible for the sake of diagnosis. So if these two images of the same organ are fused then the fused image contains as much information as possible for diagnosis of that organ [2]. Researchers have made lot of work on the fusion of MRI &CT images using wavelet transform. Jean Morlet in 1982 introduced the idea of the wavelet transform. Three types of wavelets used in the image fusion are Orthogonal, Bi-orthogonal and A-trous (Non-orthogonal).The image fusion method based on wavelet transform has good spatial & spectral eminence but has limited directivity to deal with the images having curved shapes. The image fusion is classified into three level first pixel level second feature level and third decision level.

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a) Pixel Level Fusion

It produces a fused image in which information content related with each pixel is concluded from a set of pixels in source images. Fusion at this level can be carry out either in spatial or in frequency domain. However, pixel level fusion may conduct to contrast reduction [4].

b) Attribute Level Fusion

Attribute level fusion requires the extraction of salient characteristics which are depending on their surroundings such as pixel intensities, edges or textures. These analogous attribute from the input images are fused. This fusion level can be used as a means of creating supplementary amalgamated attributes. The fused image can also be used for classification or detection [5].

c) Decision Level Fusion

Decision level is a superior level of fusion. Input images are processed independently for information mining. The obtained information is then united applying decision rules to emphasize widespread interpretation [6].

The advantage of multi-sensor image fusion comprise [3]:

i. Improved reliability – The fusion of different measurements can diminish noise and consequently develop the steadfastness of the measured quantity.
ii. Robust system performance – Redundancy in various measurements can help in systems stoutness. In case one or more sensors fail or the performance of a meticulous sensor deteriorates the system can depend on the other sensors.
iii. Compact representation of information – Fusion leads to condensed representations. For example, in remote sensing, instead of storing

imagery from numerous spectral bands, it is moderately more proficient to store the fused information.

iv. Extended range of operation – Multiple sensors that function under different operating conditions can be deployed to expand the effective range of operation. For example, different sensors can be used for day/night operation.

v. Extended spatial and temporal coverage – Joint information from sensors that diverge in spatial resolution can increase the spatial coverage. The identical is true for the secular dimension.

vi. Reduced uncertainty – Joint information from several sensors can diminish the vagueness associated with the sensing or decision process.

The steps carries out for processing the image fusion is shown by figure 1.

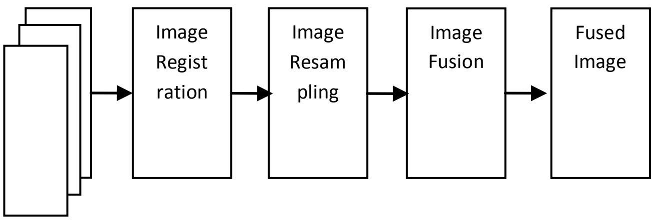

Figure 1 : Steps used to fuse the images

In this paper study of different image techniques with their merits and demerits is discuss below. The remaining part of this work is arranged in this manner: section second give description of different technique to fuse two or more images. Section third presents the literature of previous work done and last section gives conclusion about the paper.

II. Image Fusion Techniques

Image fusion is one of the significant processes to acquire essential features from the common images and to extract these features so many techniques has been developed such as DCT, DWT, DT CWT, IHS and PCA based fusion etc. In this paper some of them is describing with their merits and demerits.

a) Brovey Transform

Brovey transform (BT) [7] also known as color regularized fusion is based on the chromaticity transform and the perception of intensity modulation. This method is an unsophisticated to amalgamate data from different sensors which can safeguard the comparative spectral contributions of each pixel but reinstate its complete brightness with the high spatial resolution image. As applied to three MS bands each of the three spectral components (as RGB components) is multiplied by the ratio of a high-resolution co-registered image to the intensity component I of the MS data.

b) IHS based Fusion

It is one of the mainly used popular methods by many researchers for blending Panchromatic and Multispectral images. In IHS fusion method the IHS (Intensity, Hue and Saturation) space are converted from the Red, Green and Blue (RGB) space of the Multispectral image. The intensity factor I is replaced by the PAN. Then the reverse transform is applied to get RGB image as an output [8].

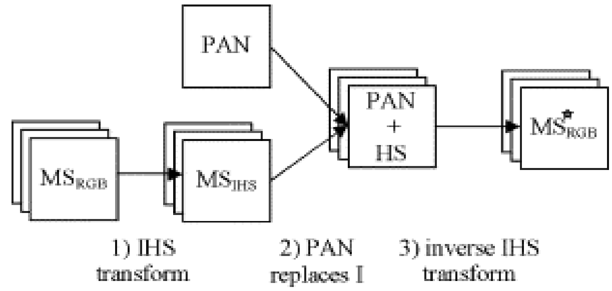

Figure 2 : IHS fusion principle

The standard fusion method of IHS technique is as follows:

i. Read the PAN and MS images as inputs
ii. Resize the MS image based on the PAN size
iii. Transform the RGB components to the IHS components
iv. Modify the PAN image with respect to the MS image by using histogram matching of PAN image with Intensity level of MS image
v. Intensity component replaced by the PAN
vi. Reverse transform will obtain high resolution MS image

In IHS fusion, he the transformation of RGB to IHS will be based on the following formulas.

$$\begin{bmatrix} I \\ v1 \\ v2 \end{bmatrix} = \begin{bmatrix} \frac{1}{3} & \frac{1}{3} & \frac{1}{3} \\ \frac{-\sqrt{2}}{6} & \frac{-\sqrt{2}}{6} & \frac{2\sqrt{2}}{6} \\ \frac{1}{\sqrt{2}} & \frac{-1}{\sqrt{2}} & 0 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix}$$

$$\begin{bmatrix} R \\ G \\ B \end{bmatrix} = \begin{bmatrix} 1 & \frac{-1}{\sqrt{2}} & \frac{-1}{\sqrt{2}} \\ 1 & \frac{-1}{\sqrt{2}} & \frac{-1}{\sqrt{2}} \\ 1 & \sqrt{2} & 0 \end{bmatrix} \begin{bmatrix} I \\ v1 \\ v2 \end{bmatrix} \quad (1)$$

where v1 and v2 are considered as x and y axes and I (Intensity) as the z axis. The H (Hue) and S (Saturation) can be represented as

$$H = \tan^{-1}\frac{v1}{v2} \quad \text{and} \quad S = \sqrt{v1^2 + v2^2} \quad (2)$$

The representation of RGB – HIS conversion by

$$I = \frac{R+G+B}{3}$$

$$H = \begin{cases} \cos^{-1}(a) & if\ G \geq R \\ 2\pi - \cos^{-1} a & if\ G \leq R \end{cases} \quad (3)$$

$$S = 1 - \frac{3\min(R,G,B)}{R+G+B} \tag{4}$$

The above two conversion systems are differed based on the saturation. The saturation value is same where the pixels are identical in (1) and (2) that build a saturation barrel in IHHS space. In the conversion system, (3) and (4), we can locate the identical saturation value of the pixels where the saturation is proportional to the intensity values.

c) Principal Component Analysis (PCA)

It is a mathematical tool from applied linear algebra. It is a simple parametric method for extracting relevant information from confusing data sets. PCA is a useful statistical technique that has found application in fields such as face recognition and image compression, and is a common technique for finding patterns in data of high dimensions The origin of PCA lie in multivariate data analysis, it has a wide range of other application PCA has been called, 'one of the most important results from applied linear algebra and perhaps its most common use is as the first step in trying to analyses large sets. In general, PCA uses a vector space transform to reduce the dimensionality of large data sets. Using mathematical projection, the original data set, which may have involved many variables, can often be interpreted in just a few variables.

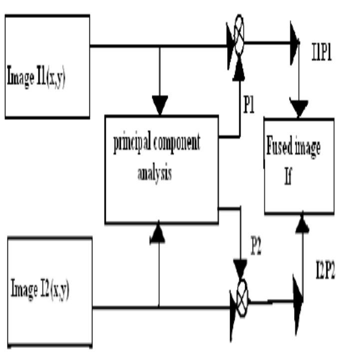

Figure 3 : Image fusion development using PCA

d) Select Maximum/Minimum Method

A selection process if performed here wherein, for every corresponding pixels in the input images, the pixel with maximum/minimum intensity is selected, respectively, and is put in as the resultant pixel of the fused image. The wavelet-based image fusion methods can be performed in two ways replacement and selection method. Figure 4 gives the general flow diagram for Selection method [9].

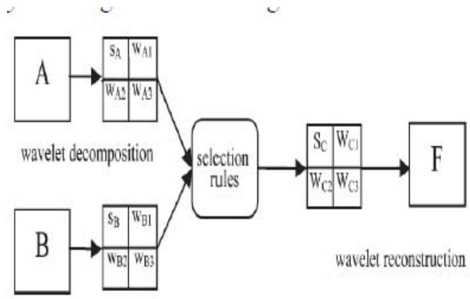

Figure 4 : Fusion of image using selection method

e) Discrete Wavelet Transform (DWT)

The discrete wavelet transform [10] is a spatial-frequency domain disintegration that presents a bendable multi-resolution analysis of an image. In 1-D, the mean of the wavelet transform is corresponding to the signal as a superposition of wavelets. If a isolated signal is correspond to by f(t) its wavelet decomposition is then

$$f(t) = \sum_{m,n} C_{m,n}\varphi_{m,n}(t) \tag{5}$$

where m and n are integers. This guarantees that the signal is decomposed into normalized wavelets at octave scales. For an recursive wavelet transform supplementary coefficients a $_{m,n}$ are mandatory at every scale. At each am, n and am-1,n illustrate the approximations of the function 'f ' at resolution 2m and at the coarser resolution 2m-1 correspondingly while the coefficients cm ,n illustrate the difference among one approximation and the other. In order to obtain the coefficients cm ,n and am, n at each scale and position, a scaling function is needed that is similarly defined to equation (6). The convolution of the scaling function with the signal is implemented at each scale through the iterative filtering of the signal with a low pass FIR filter hn. The approximation coefficients am,n at each scale can be obtained using the following recursive relation:

$$a_{m,n} = \sum_k h_{2n-k} a_{m-1}, k \tag{6}$$

Where the top level a0,n is the sampled signal itself. In addition, by using a related high pass FIR filter gn the wavelet coefficients can be obtained by:

$$c_{m,n} = \sum_k g_{2n-k} a_{m-1}, k \tag{7}$$

To renovate the original signal the examination filters can be selected from a bi-orthogonal set which have a correlated set of synthesis filters. These synthesis filters ĥ and ĝ can be used to absolutely renovate the signal using the renovation formula:

$$a_{m-1,l}(f) = \sum_n [\hat{h}_{2n-1} a_{m,n}(f) + \hat{g}_{2n-1} C_{m,n}(f)] \tag{8}$$

Equations (7) and (8) are implemented by filtering and subsequent down sampling. Conversely equation (6) is implemented by an initial up sampling and a subsequent filtering. A single stage wavelet synthesis and analysis in one dimension is shown in figure(5).

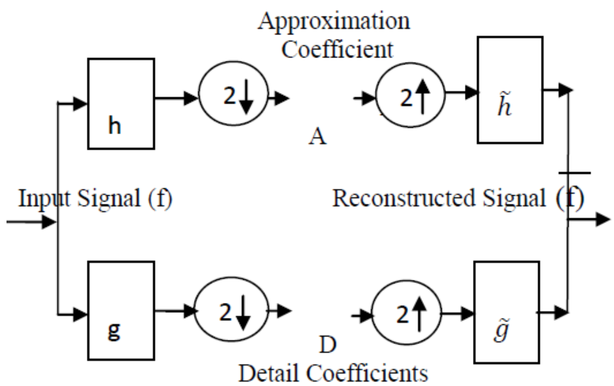

Figure 5 : 1-D wavelet analysis and synthesis filter

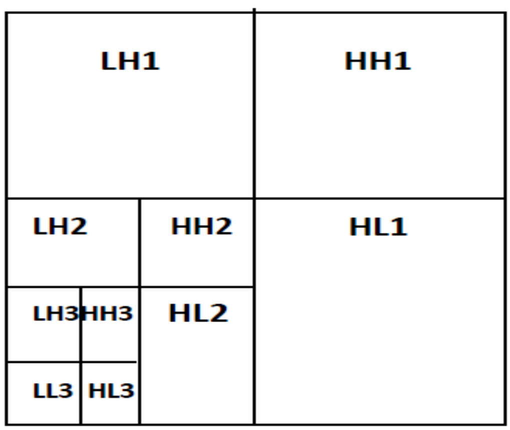

Figure 6 : Wavelet decomposition at Level-3

The fusion process of two images using the DWT is shown in. figure (7). The two images used were from a multi-focus set, i.e. two registered images of same scene each with a different camera focus. This figure demonstrates that the coefficients of each transform have considerably different magnitudes within the regions of diverse focus. A straightforward “maximum selection” was used to produce the combined coefficient map. This effectively retains the coefficients of “in focus” regions within the image. This inverse wavelet transform is then applied to the combined coefficient map to produce the fused image which in this case shown an image retaining the focus from the two input images.

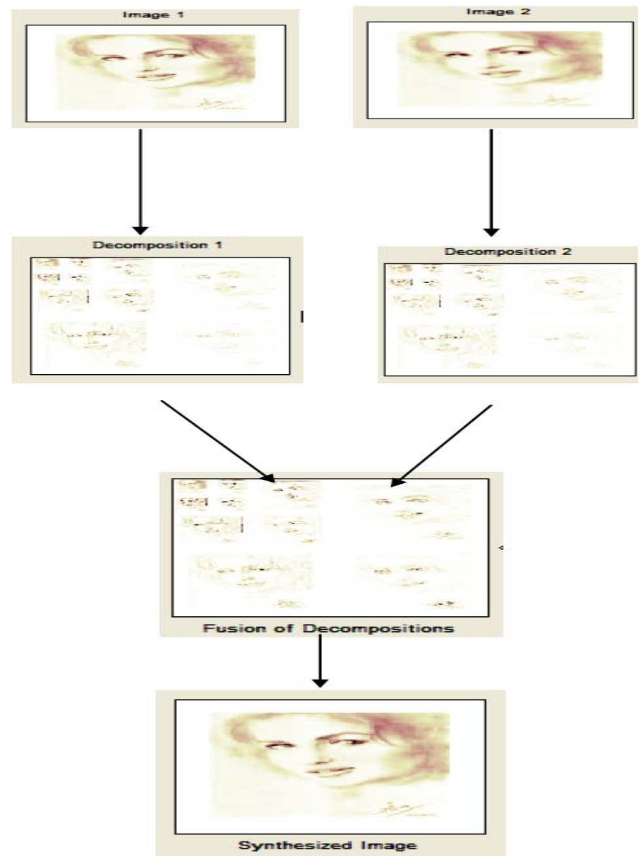

Figure 7 : Image fusion using DWT of two Katrina image

f) Dual Tree Complex Wavelet Transform

In this method, fusion is executed using the masks to remove information from the decomposed structure of DT-CWT [11]. Figure 8 demonstrates the complex transform of a signal using two split DWT decompositions: Tree a and Tree b.

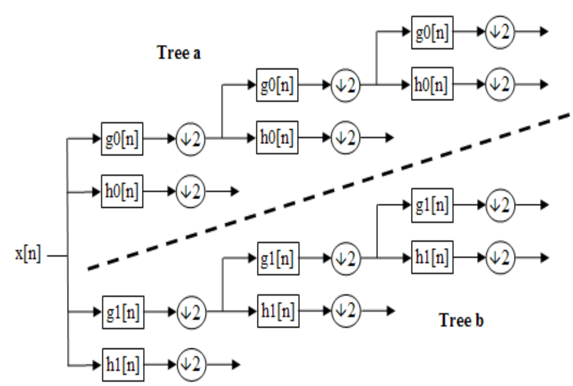

Figure 8 : DT-CWT Structure

It can be observed that the DT-CWT structure, involves both real and complex coefficients. It is known that DT-CWT is relevant to visual sensitivity. Fusion procedure involves the formation of a fused pyramid using the DT-CWT coefficients which are obtained from the decomposed pyramids of the source images. The fused image is obtained through conventional inverse dual tree complex wavelet transform or reconstruction process. This results show a significant reduction of distortion.

Resulting fused image is obtained by performing inverse transform of combined coefficient map which shows the oriented nature of complex wavelet sub bands. That is each of the clock hands in different directions is taken correctly by the differently oriented sub bands. In the figure 9 shown the area of region of image more in focus has larger magnitude coefficient. i.e by comparing each and every pixel of both images the values of larger magnitude coefficient alone is taken. Maximum scheme is used to produce the combined coefficient map. It thus takes only the larger coefficient from images to produce the combined coefficient map. Resulting fused image is obtained by performing inverse transform of combined coefficient map which shows the oriented nature of complex wavelet sub bands. That is each of the clock hands in different directions is taken correctly by the differently oriented sub bands. Coefficient fusion rule is applied to magnitude of DT-CWT coefficients as they are complex. Experiment results show that this fusion method is remarkably better than the classical discrete wavelet transform.

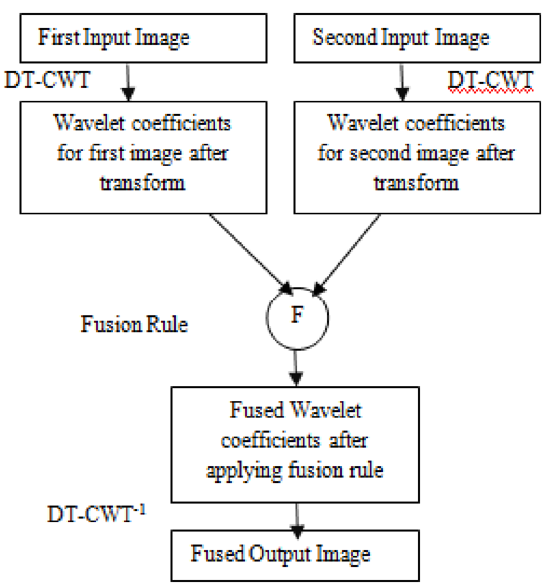

Figure 9 : DT-CWT based fusion

DT-CWT is able to conserve subtle texture regions of brain in MRI images. Ringing effects are reduced and it can retain the edge details more clearly. DT-CWT is better than DWT because of its directional selectivity and shift variant nature.

III. Related Work

Kanisetty Venkata Swathi et al. [12] proposed a new approach of multimodal medical image fusion on Daubechies wavelet transform coefficients. The fusion process starts with comparison of block wise standard deviation values of the coefficients. Here the standard deviation can be used to characterize the local variations within the block. The performance of proposed image fusion method is compared with existing algorithms and evaluated with mutual information between input and output images, entropy, standard deviation, fusion factor metrics.

J. Srikanth et al. [13] presented the wavelet transforms of the input images are properly pooled the new image is achieved by taking the inverse wavelet transform of the fused wavelet coefficients. The suggestion is to progress the image content by fusing images like computer tomography (CT) and magnetic resonance imaging (MRI) images so as to recommend more information to the doctor and clinical treatment planning system. They demonstrate the application of wavelet transformation to multi- modality medical image fusion. This work covers the selection of wavelet function, the use of wavelet based fusion algorithms on medical image fusion of CT and MRI, implementation of fusion rules and the fusion image quality evaluation. The fusion performance is estimated on the basis of the root mean square error.

Ch.Bhanusree et al. [14] analysed the characteristics of the Second Generation Wavelet Transform and put forward an image fusion algorithm high frequency coefficients according to different frequency domain after wavelet. In choosing the low-frequency coefficients, the concept of local area variance was chosen to measuring criteria. In choosing the high frequency coefficients, the window property and local characteristics of pixels were analyzed. Finally, the proposed algorithm in this article was applied to experiments of multi-focus image fusion and complementary image fusion. In this a hardware implementation of a real-time fusion system is proposed. The system is based on Xilinx Spartan 3 EDK FPGA and implements a configurable linear pixel level algorithm which is able to result in color fused images using System C language.

Kanaka Raju Penmetsa et al. [15] proposed a DT-CWT method which is used in de-noising of colour images. CDWT is a form of DWT in which complex coefficients (real and imaginary parts) are generated by using a dual tree of wavelet transform. The experiments on a amount of customary colour images carried out to approximate performance of the proposed method. Outcome shows that the DT-CWT method is better than that of DWT method in terms of image visual eminence. Patil Gaurav Jaywantrao et al. [16] proposed the novel relevance of the shift invariant and directionally discerning Dual Tree complex Wavelet Transform (DT-CWT) to image fusion is now introduced. The flourishing fusion of images acquired from assorted modalities or instruments is of great significance in many applications such as medical imaging, infinitesimal imaging, remote sensing and robotics. With 2D and 3-D imaging and image indulgence becoming widely used; there is a growing need for novel 3-D image fusion algorithms accomplished of combining 2D & 3-D multimodality or multisource images. Such algorithms can be used in areas such as 2D & 3-D e.g. fusion of images in Target tracking system, Synthetic Aperture Radar (SAR) etc. In case of target tracking system the time is the very vital factor. So we take time as a comparison factor to compare unlike methods which we execute. In order to get better the competence of the project, a far time for the fusion to scuttle is being formulated.

Pavithra C et al. [17] presented a method for fusing two dimensional multi-resolution 2-D images using wavelet transform under the combine gradient and smoothness criterion. The usefulness of the method has been illustrated using various experimental image pairs such as the multi- focus images, multi-sensor satellite image and CT and MR images of cross-section of human brain. The results of the proposed method have been compared with that of some widely used wavelet transform based image fusion methods both qualitatively and quantitatively. An experimental result expose that the proposed method produces better fused image than that by the latter. The use of mutually gradient and relative smoothness criterion ensures two fold effects. While the gradient criterion ensure that edges in the images are included in the fused algorithm, the relative smoothness criterion ensures that the areas of uniform intensity are also incorporated in the fused image thus the effect of noise is minimized. It should be noted that the proposed algorithm is domain-independent.

Hasan Demirel et al. [18] Complex Wavelet Transform (CWT) is used in image processing. CWT of an image produces two complex-valued low-frequency sub-band images and six complex valued high-frequency sub-band images. DT-CWT decomposes original image into different sub-band images. Then high frequency sub-band images and original low frequency image are undergoes the interpolation. These two real-valued images are used as the real and imaginary components of the interpolated complex LL image, respectively, for the IDT-CWT operation. This technique does not interpolate the original image but also interpolates high frequency sub-band image resulting from DT-CWT. The final output image is high resolution of the original input image. Quality and PSNR of the super resolved image is also improves in this method. There are some problems with wavelet domain also, it introduces artifacts like aliasing, any wavelet coefficient processing upsets the delicate balance between forward and inverse transform leading to some artifacts in the images. Also constructs lack of directional selectivity substantially make difficult modelling and processing of geometric image features like ridges and edges. One resolution to all these problems in Complex Wavelet Transform (CWT). CWT is only somewhat like magnitude or phase, shift invariant and free from aliasing.

Singh R.et al. [19] proposed a new weighted fusion scheme using Daubechies complex wavelet transform (DCxWT). Shift sensitivity and lack of phase information in real valued wavelet transforms motivated to use DCxWT for multimodal medical image fusion. It was experimentally found that shift invariance and phase information properties improve the performance of image fusion in complex wavelet domain. Therefore, we used DCxWT for fusion of multimodal medical images. To show the effectiveness of the proposed work, we have compared our method with existing DCxWT, dual tree complex wavelet transform (DTCWT), discrete wavelet transform (DWT), non-sub contourlet transform (NSCT) and contourlet transform (CT) based fusion methods using edge strength and mutual information fusion metrics. Comparison results clearly show that the proposed fusion scheme with DCxWT outperforms existing DCxWT, DTCWT, DWT, NSCT and CT based fusion methods.

Bull D.R. et al. [20] presented a new approach to 3-D image fusion using a 3-D separable wavelet transform. Several known 2-D WT fusion schemes have been extended to handle 3-D images and some new image fusion schemes (i.e. fusion by hard and soft thresholding, composite fusion, fusion of the WT maxima graphs) have been proposed. The goal of this paper is to present the new framework for 3-D image fusion using the wavelet transform, rather than to compare the results of the various fusion rules. Wavelet transform fusion diagrams have been introduced as a convenient tool to visually describe different image fusion schemes. A very important advantage of using 3-D WT image fusion over alternative image fusion algorithms is that it may be combined with other 3-D image processing algorithms working in the wavelet domain, such as `smooth versus textured' region segmentation, volume compression, where only a small part of all wavelet coefficients are preserved, and volume rendering, where the volume rendering integral is approximated using multi-resolution spaces. The integration of 3-D WT image fusion in the broader framework of 3-D WT image processing and visualisation is the ultimate goal of the present study.

Ai Deng et al. [21] presented a new algorithm based on discrete wavelet transform (DWT) and canny operator from the perspective of the edge detection. First make original images multi-scale decomposed using DWT, and then acquire the level, vertical as well as diagonal edge information by detecting low-frequency and high-frequency components' edges. Where after carry out a comparison of the energy of each pixel and consistency verification to more accurately determine the edge points and ensure the clarity of the fusion image. The comparison between the

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traditional method and this new method is made from the three aspects: independent factors, united factors and comprehensive evaluation. The experiment proved the usefulness of the method, which is able to keep the edges and obtain better visual effect.

The advantages and disadvantages of the proposed method are described in table 1 below

Table 1

S. No.	Authors	Approaches	Merits	Demerits
1	Kanisetty Venkata Swathi et al.	Daubechies wavelet transform	It is able to manage different images resolution	It consider only wavelet coefficient value
2	J. Srikanth et al.	Wavelet Transform	It reduces the storage cost	Not able to maintain edge information efficiently
3	Ch.Bhanusree et al.	Second Generation Wavelet Transform	It is multi scale dimensionality	It has poor directionality
4	Kanaka Raju Penmetsa et al.	DT-CWT method	Image visual eminence is better	Has limited directionality
5	Patil Gaurav Jaywantrao et al.	Dual Tree complex Wavelet Transform (DT-CWT)	It is more flexible and better image visibility and reduces the time variant	It introduce artifacts like aliasing
6	Pavithra C et al.	wavelet transform using gradient and smoothness criterion	It is able to retain the edge information also minimize the noise	It is domain-independent
7	Hasan Demirel et al.	Complex Wavelet Transform (CWT)	magnitude or phase, shift invariant and free from aliasing	Most expensive and computational intensive
8	Singh R.et al	weighted fusion scheme using Daubechies complex wavelet transform (DCxWT)	It is better to retain the edge the information than the DT-CWT	Not able to achieve the expected performance
9	Bull D.R. et al.	3-D separable wavelet transform	It is able to enhance the quality of 3-D image	Poor selectivity for diagonally
10	Ai Deng et al.	discrete wavelet transform (DWT)	It effectively reduce the noise from image	It is a shift- invariant in nature

IV. Conclusion

To acquire the crucial features or attributes of the images of common features image fusion is widely used technology. The wavelet transform is one of the most efficient approaches to extract the features by the transformation and decomposition process but this method is not efficient to retain the edge information. In this paper literature study of the fusion techniques is described with their shortcoming. In future work, design such algorithm which can efficiently retain the edge information.

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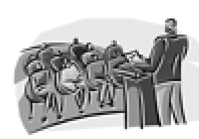

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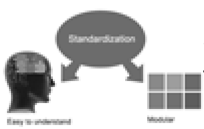

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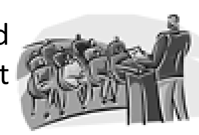

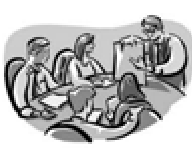

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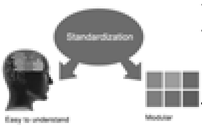

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- In case, the chairperson needs to be replaced then consent of 2/3rd board members are required and they are also required to jointly pass the resolution copy of which should be sent to us. In such case, it will be compulsory to obtain our approval before replacement.
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1. General,

2. Ethical Guidelines,

3. Submission of Manuscripts,

4. Manuscript’s Category,

5. Structure and Format of Manuscript,

6. After Acceptance.

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Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.

- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

Procedures (Methods and Materials):

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

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	A-B	C-D	E-F
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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