Matlab Based Application for Image Merging with Predictive Analysis

Randeep Singh Bimbh
UG Student
Department of Computer Engineering
K. C. College of Engineering & Management Studies & Research

Aashish Ambre
UG Student
Department of Computer Engineering
K. C. College of Engineering & Management Studies & Research

Prof. Mandar Ganjapurkar
Professor
Department of Computer Engineering
K. C. College of Engineering & Management Studies & Research

Abstract

Image merging is required in several engineering and scientific fields for creating a complex perception from the sample images. Most of the applications, for such a requirement, uses merging at intensity level. With this technique a good perception of combined objects and scenes is produced, but in certain engineering scenarios, this technique is not sufficient for analysis. The main issue with this technique is incoherent modulation of intensity due to phase properties being lost. Combined amplitude and phase merge is required to compensate those losses. The method proposed in this paper, for image merging, can be used for applications where more precise prediction is required from a combined image phenomenon. By adding pixels, the original property is lost but the frequency domain properties of an image can be used to achieve high quality image along with accurate merging for all intended pixels. This project introduces an effective and simple technique to merge images for overlapped view of set of images with reduced data set for review purpose.

Keywords: Frequency merging, image overlapping, image merging

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I. INTRODUCTION

Structurally, collection of pixels is referred to as Images, where each pixel is portrayed by some typical values relying on the sort and structure of the image; at intensity level they are insufficient for precision management. But in several scenarios cases exist where we need to merge objects in the images with common denominator scene and later separating them distinctively in intensity separable layers. Though intensity information can be found on gray level pixels of an image but here we only perceive and inspect an image which is based on changes in shades of color of intensities and frequencies [1].

One can visualize and single out various objects of the image because of its traits such as its color, shapes and textures. This results in formation of Edges, which are formed due to changes in intensity values and provides us with the illusion of an object. Basically, collection of pixels is referred to as Images, thus it makes it easy to process color/gray level information's.

In Frequency Domain different spectrum of frequencies is generated by the entire object in the image. This paper exhibits the practicality of producing high quality images via merging. To produce an overlapped view of an object or images also to retain the information it is imperative to merge frequencies along with phase [2].

The project described in this paper is not about resolution merging, but it is about object merging or image merging. By performing object merging, the main focus is on merging the objects in the images rather than resolution merge. In this project, merging is being done at pixel level, thus the amount of information that the merged image holds are higher than that of input images. By merging at pixel level we are able to retain the information of input images. The process of image merging can actually take place at different level of information representation in various approaches. These various approaches can be divided into two domains namely, spatial domain and Frequency domain.

This project allows user to merge images in both spatial and frequency domains and gives merged image along with analytical values such as entropy, Standard deviation and fusion factor. The main intention behind this project is to create a technique which can be used in various fields of science where merged images are required for analytical or study purposes. This technique can be used in various fields of science such as body part implantation, fracture prediction, astrology, surveillance, creative editing etc.

In image merging, different datasets are used while processing image digitally in order to improve the quality of data visually and analytically [3]. Image merging or fusion as a technique can be used in various applications also is being used presently in applications where the demand for high fidelity images is more. This paper is more focused on generating high fidelity images rather than merging images. There are many other techniques for merging images like Principal Component, Brovey Transform, HIS, DWT, PCA etc. the technique for fusing multiple images in one-pass can also be found in [4].

II. FUSION METHODS

The basic requirement of any given fusion method is to preserve the data which is valid and useful information from the source images at the same time also reduce the distortions in the resultant image. Along with these, this project focuses on reducing the data required to represent merged images. These methods are divided into basically two domains namely, Spatial and Frequency domain.

A. Spatial Domain

The term Spatial refers to image space itself i.e. for a given application changes or manipulations done on an image are done on an object in space. There are various techniques based on spatial domain, which manipulates the pixels of an image directly. Spatial domain can be used for various functions such as filtering, smoothing, sharping, masking etc. There are various techniques developed to be performed in spatial domain. Some well know techniques are as follows, Principal component analysis(PCA), Intensity hue saturation(IHS), weighted average method, average method, select maximum, Brovery method.

B. Frequency Domain

Every object inside an image generates a unique frequency spectrum, thus a collection of this objects contains complete frequencies of those objects. Thus frequency domain is a space where each pixel value represents the amount of the image. This technique is based on modifying the spectral transform of an image. In frequency domain, the image selected is transformed into is respective frequency representation. It contains high and low frequency components, which when separated from each other gives a transformed image in spatial domain. There are various techniques based on frequency domain. Some well-known frequency domain techniques are as follows, Wavelet Transform, Stationary Wavelet Transform(SWT), FFT, High Pass Filtering, Discrete Wavelet Transform(DWT), Curvelet Transform, HPFA.

III. IMPLEMENTATION

As depicted in the figure 3, the input is a set of images that are to be merged.

A. Image merging phase:

Here, the input images are merged in both spatial as well as frequency domain. Once the images are taken as input, the value for number of images is recorded. These images are then aligned in a way that the number of samples will be equal for all images.

These images are normalized where correlated changes in the brightness level in the selected region of interest takes place to bring the modal greyscale value to its 'normal' parenchyma to a standardize reference value [5]. In this particular case the images values are normalized to 0-1. These steps are performed in both the domains.

Initialization*:*

Set the value for number of images/layers 'n'
Align the images or layers so that number of samples is same.
Normalize the image values i(x,y) to 0-1
While all pixels(x,y) in the image are not seen **do**
ADD corresponding intensities of all n images

$$\mathrm{Re}\,sult(x,y) = i_1(x,y) + \ldots\ldots + i_n(x,y)$$

Fig. 1**:** Spatial Domain Merging Algorithm

In spatial domain, corresponding intensities of all the pixels for all images are added to perform image merging [6].

While in frequency domain, after normalization, the maximum frequency is identified and used for setting the threshold T. The corresponding densities of all the pixels for all images are added. For this, FFT is used. Hence for the image FFT can be found using this formula.

$$\mathrm{I(u,v)} = \sum_{x}\sum_{y} \mathrm{i(x,y)[cos(\theta) - jsin(\theta)]}$$

After addition all the frequencies below threshold T are removed which provides data reduction. Inverse FFT is taken to obtain the merged image.

Initialization:

Set the value for number of images/layers 'n'
Align the images or layers so that number of samples is same.
Normalize the image values i(x,y) to 0-1
Identify the highest frequency (Max.Frequency) from frequency spectrum of the input image.
Set threshold T=Max.Frequency * x
Where 0<x<1
While all pixels(x,y) in the images are not seen **do**
ADD corresponding density of frequencies of all n images

$$Result(u,v) = a_1 FFT(i_1(x,y)) + \ldots\ldots + a_n FFT(i_n(x,y))$$

Remove all frequencies below threshold 'T' to achieve data reduction.
Take inverse FFT to visualize the merged image.

Fig. 2: Frequency Domain Merging Algorithm

B. Analysis Phase:

1) Entropy

Image Entropy is the value that measure the content of information in the merged image [7].

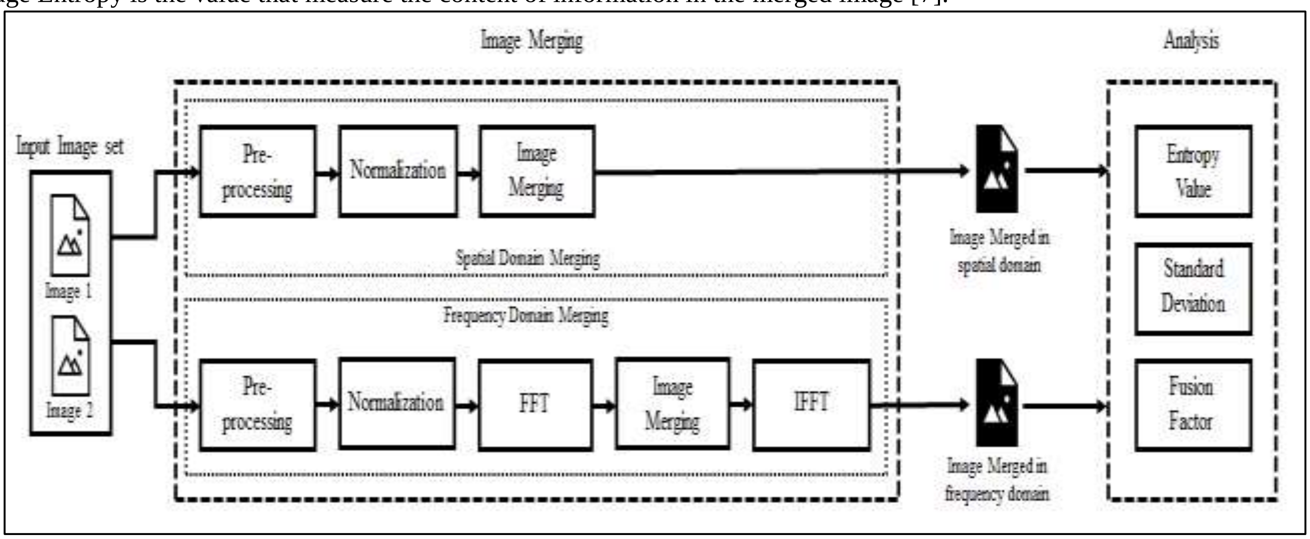

Fig. 3: Architecture of the proposed system

Higher the information content in image higher the entropy value. It can be measured with this eq. [8]

$$E = -\sum_{L=0}^{L-1} P_1 Log_2 P_1$$

where: L represents no. of gray level, P_1 is the ratio between the no. of pixels with gray values l and total no. of pixels. Entropy E, a scalar value representing the entropy of grayscale image. Entropy is a statistical measure of randomness that can be used to characterize the texture of the input image. Entropy is defined, where p contains the histogram counts returned from imhist.

2) Fusion Factor

For two input images A, B and the fused image F, fusion factor is given by eq. [8]

$$\mathrm{FF} = \mathrm{I_{AF}} + \mathrm{I_{BF}}$$

where: I_{AF} and I_{BF} are mutual information between source images and the fused image. Higher values of fusion factor [9] FF indicates that fused image contains moderately good amount of information present in both the images. However, a high value of FF does not imply that the information from both images is symmetrically fused.

3) Standard Deviation

Standard deviation of m x n image is given by Eq.

$$\mathrm{SD} = \left(\frac{1}{\mathrm{mxn}} \sum_{1}^{\mathrm{m}} \sum_{1}^{\mathrm{n}} (\mathrm{f(n,m)} - \mu)^2 \right)^{1/2}$$

where: f (n, m) & μ represents the pixel and the mean values of fused image respectively. Higher values of standard deviation indicate high quality of fused image [8].

These analytical results are used to identify the quality of merged images in both domains which can help in deciding the better results.

IV. RESULTS

This system is developed to merge images by retaining high fidelity with much less loss of information from the source image.

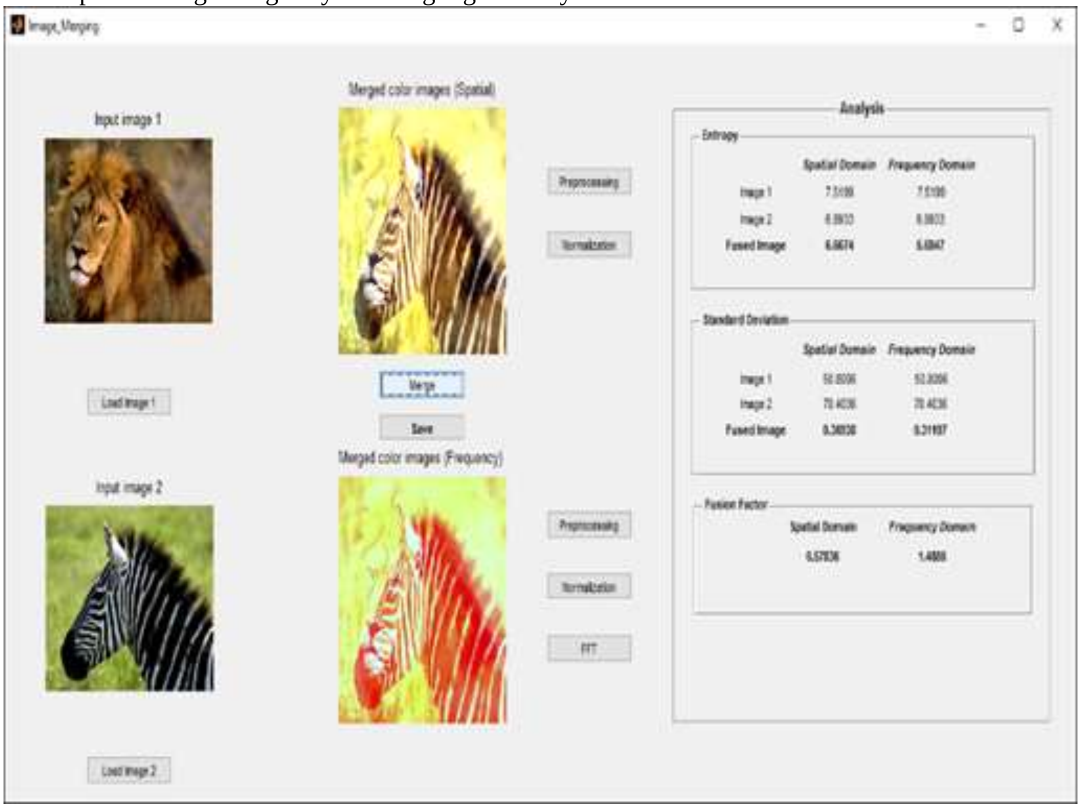

Fig. 4: Application's GUI

The results obtained by merging ten set of images in both spatial as well as frequency domain shows that merging in any domains gives fairly good output when there are no overlapped objects in an image. When there are overlapped objects in an image, the merging in frequency domain gives better output.

Frequency domain image merging keeps the fine details in all input images. Even though image merging itself is a data reduction, due to use of threshold value in frequency domain image merging algorithm it further reduces data load by keeping the frequencies only with higher coefficient value.

V. ADVANTAGES

1) This system provides additional data load reduction. This can be really useful while merging many images on a system with ordinary memory resource.
2) Even with reduction of data, the distortion is much less.
3) A slight change in a prominence coefficient depending on the application domain can provide highly improved results.

VI. FUTURE SCOPE

With this proposed technique, if we increase the number of input images, further compressed result can be achieved.

High frequency coefficients tend to be very small and they can be quantized very effectively without distorting the results to achieve compression [10]. Many image merging applications does not need to preserve all frequency values. Additional feature for changing reduction ratio can certainly increase the area of application in such cases.

 Input Image 1	 Input image 2
 Image merged in spatial domain Entropy: 6.6674 Standard Deviation: 0.36938 Fusion Factor: 0.57836	 Image merged in frequency domain Entropy: 5.6947 Standard Deviation: 0.31197 Fusion Factor: 1.4886

Fig. 5: Sample output with analytical values

VII. Conclusion

This project proposes a simple as well as effective way for merging objects by linear integrating the spectral density in corresponding windows. The merging of images in this proposed system can improve precision which can be very useful in areas like solid fracture prediction, body implant visualization. While merging images the frequency density's linear integral retains accurate details of original images with data reduction.

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References

[1] Gonzalez, Woods, Eddins, Digital Image Processing using MATLAB, 2nd ed., Gatesmark Publication, 2009.
[2] M. Erdogan, H.H. Maras, A. Yilmaz, Ö.T. Özerbil, "Resolution merge of 1:35.000 seale aerial photographs with landsat 7 ETM imagery", The International Archives of the Photogranunetry, Remote Sensing and Spatial Information Seienees, vol. XXXVII. Part B7, Beijing 2008.
[3] Stephen E. Reiehenbach and Jing Li,"Restoration and Reeonstruetion from Overlapping Images for Multi-Image Fusion", IEEE trans. on Geoseienees and Remote Sensing, vol. 39, no. 4, April 2001.
[4] Ken De Loria, "Understanding Relationships: Bringing Clarity to Phase, Frequeney and Time", Internet: http://www.prosoundweb.eomlarticle/understanding_relationships_bringing_clarity_to_phase_frequency_and_time,Aug.15, 2012, [Dec 6 2012].
[5] C Horwood, S J Hogan, P R Goddard, J Rossitor "Image Normalization, a Basic Requirement for Computer-based Automatic Diagnostic Applications." May 2001.

[6] T.R. Gopalakrishnan Nair, Richa Sharma "Accurate Merging of Images for Predictive Analysis using Combined Image" Signal Processing, Image Processing and Pattern Recognition, IEEE, 2013.
[7] Dave O'Brien. (n.d.). Cassini Lossy Compression Software Tests. Citing Sources: [http://www.astro.cornell.edu/research/projects/compression/entropy.html] [March 20, 2016]
[8] Abhinav Krishn, Vikant Bhateja "Medical Image Fusion Using Combination of PCA and Wavelet Analysis" September 2014 DOI: 10.1109
[9] R. Singh and A. Khare, "Fusion of Multimodal Images using Daubechies Complex Wavelet Transform- A Multiresolution Approach," Elsevier-Information Fusion, Vol. 19, pp. 49-60, 2014
[10] G.Rahull, R.Kalpana2, "Bloek-Based Feature Multi Level Multi Foeus Image Fusion on Neural Network", Int. J. of Engineering Research & Teehnology (IJERT), vol. 1(8), October 2012