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Image Fusion : Implementation of Fuzzy Logic Algorithm at Pixel level

Priti yadav[a] , Dr. Sudhir Agrawal[b]

[a]PG Scholar, CSED, [b]Dean, CSED

Buddha Institute of Technology, Gorakhpur, Uttar Pradesh, India

Abstract- *A comprehensive study in the area of image fusion is presented in this paper. This paper includes image fusion, its basic stages, level of fusion, main advantages and disadvantages of fusion process. At the present time, no- one want to carry large information. Everyone want to get all information related to the object using less data and the other reason is that the large data generates a huge information about the object. Hence, image fusion process works on this principle. It is basically proposed to convert various input pictures into single new picture as output. Using these advantages, this process is used in medical field remote sensing, and also in computer vision technology. It discusses in detail the pixel level image fusion method using Fuzzy logic algorithm. In this algorithm, the crucial task to obtain the fused image without blurring. It is observed that fusion using Fuzzy logic algorithm provides better result when number of membership function is large.*

***Keywords*:** *Image fusion, pixel level IF, feature level IF, decision level IF, fuzzy logic algorithm.*

1. Introduction

Image fusion is used to collect all the necessary data from several images, and convert it into single image of higher quality. This single image is more instructive and error free from any single source image, and it contains all the useful information. In other words, we can say image fusion is a process to take out information obtained in several zones. It is a part of data fusion. Image fusion is a sub-part of image processing.

The motive of image fusion is to decrease the number of data and to assemble pictures that are also relevant and penetrable for the human and machine's point of view.

The main goal of image fusion (IF) is to integrate important multiple data into single new picture which contains all important data with the good quality. The quality of image depends on the particular application.

Areas where image fusion is used-

1. In remote sensing.
2. In medical imaging.
3. In military.
4. In security.
5. In surveillance areas.
6. To achieve high quality of images.
7. In visible and infrared images.

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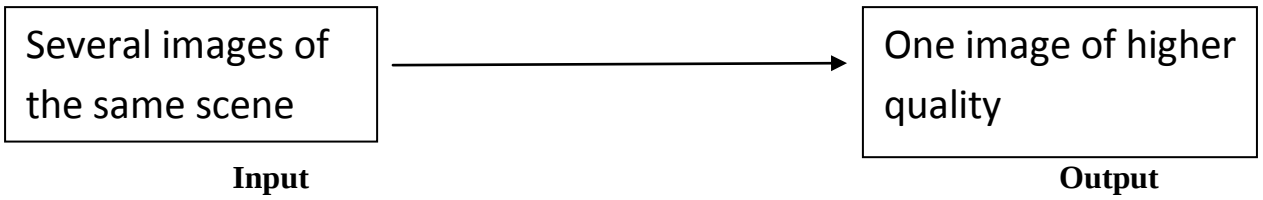
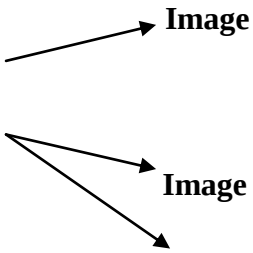


Fig. 1: - Image fusion



Acquisition

The fusion process can be performed into three basic stages-

Registration

(i) Image Acquisition- In image acquisition process, we have to acquire pictures from several image sensors.

(ii) Image Registration- Image Registration is used to establish a point among several pictures from the same scene or different scene.

(iii) Image Fusion- It is the method of changing several pictures of the similar scene into one picture of higher quality.

Before applying image fusion algorithm to the input pictures, image registration is used to establish a point among the pixels in the input pictures.

Advantages of image fusion-

(a) Fused image is accurate in color.

(b) High resolution used at multi-scale images.

(c) Low in cost.

(d) Best for identification and recognition.

(e) It can provide improved fused images in fog.

Disadvantages of image fusion-

(a) Not easily visible at night.

(b) More source energy is needed for the good visualization of mages.

(c) Huge chances of data loss.

(d) Proper maintenance is necessary.

(e) Due to rain or fog visualization is not cleared.

Due to major demand at this time, the scientists will become more dynamic in presenting extra advantageous image fusion techniques. The quantity of research- based papers published in this field enriches rapidly since 2004 and reaches to the peak at 2020. There are some major reasons behind its enrichment. These are -

(1) Cost effective and accurate image capturing technique makes it so popular.

(2) The pattern of sensors with good level and special feature, leads image fusion a powerful techniques.

(3) The evolution of signal processing and analyzing concept like sparse representation and multi- scale decomposition which provides facility to improve the performance of image fusion again and again.

(4) Obtaining inter-related images in different aspects like in remote sensing and medical imaging. For making use of these interrelated images, several fusion methods have been developed.

In the place of earlier research, the aim of this research paper is to submerge appropriate image fusion methods and implementation initiated latterly and show new visions to the recent evolution of image fusion technique and implementation. This paper contains a brief description of pixel level image fusion method using Fuzzy logic algorithm.

There are three categories in image fusion process- Pixel level, Feature level and Decision level [3].

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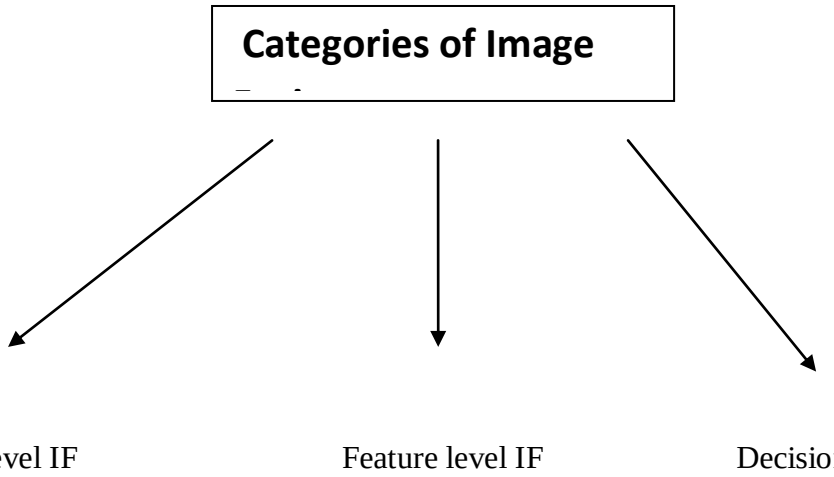

Fig. 2: Levels of image fusion

(a) Image fusion at Pixel level- It is used by many scientists. This fusion method is used to combine the original information in the source images. As the result, the fused image becomes much informative in the field of visual perception and computer processing.

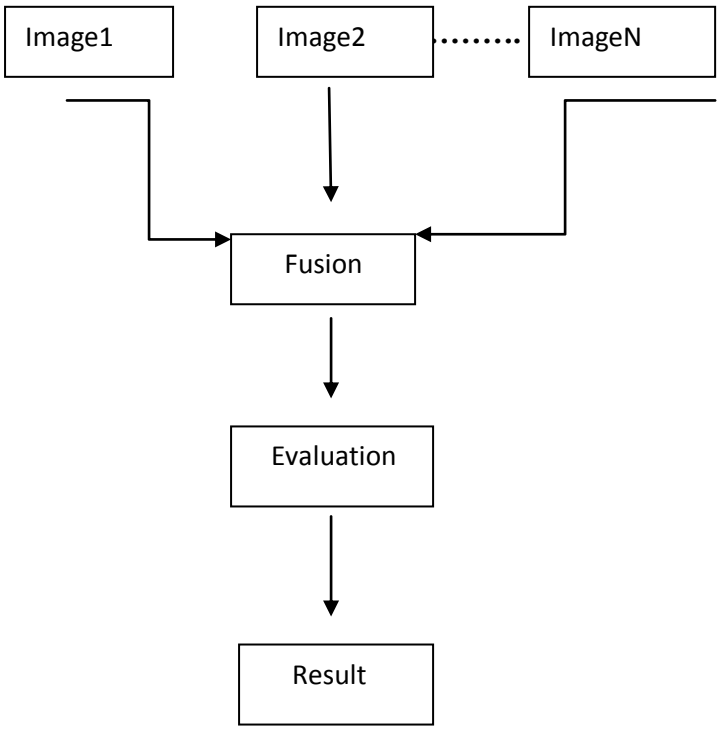

Fig. 3: - Flow chart of image fusion at Pixel level

This technique is mostly used in medical imaging, remote sensing, and night vision but it is not possible to design a common technique for every image fusion. The pixel level image fusion method can be used in three main categories-

(i) image transform (ii) fusion of the coefficients (iii) inverse transform [3].

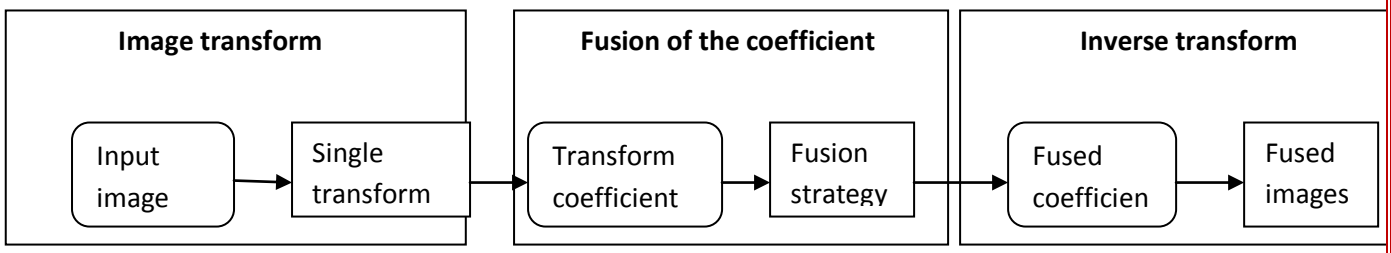

Fig.4: - Main stages of image fusion method at pixel level

(b) Image fusion at feature level - In this fusion method salient feature of images are calculated. Images are fused using joint segmentation. This joint segmentation is used to extract the segments from the images to be fused. On the basis of salient feature, a particular segment is selected and placed in the fused image. This level of image fusion is one level higher than pixel level image fusion and also better to incorporate the feature information in the process of fusion.

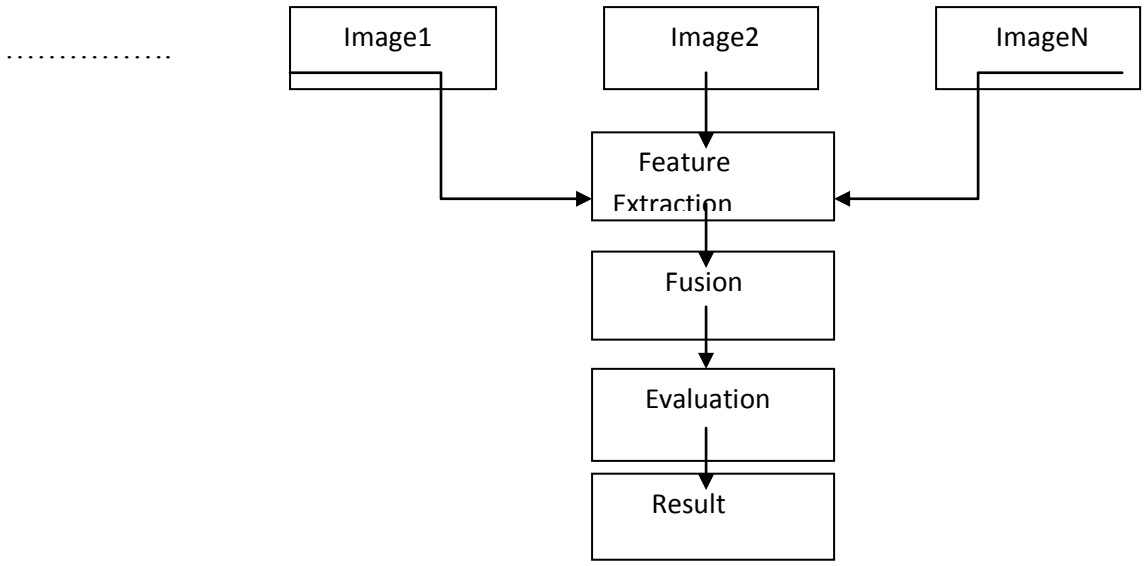

Fig.5: - Flow chart of image fusion at Feature level

(c) Image fusion at Decision level- This fusion method is a combination of several algorithms to get the final fused images. It combines data from higher level of abstraction and merge the results from multiple algorithms. In this level of fusion, the fused images are more clear and accurate as compare to other level of image fusion.

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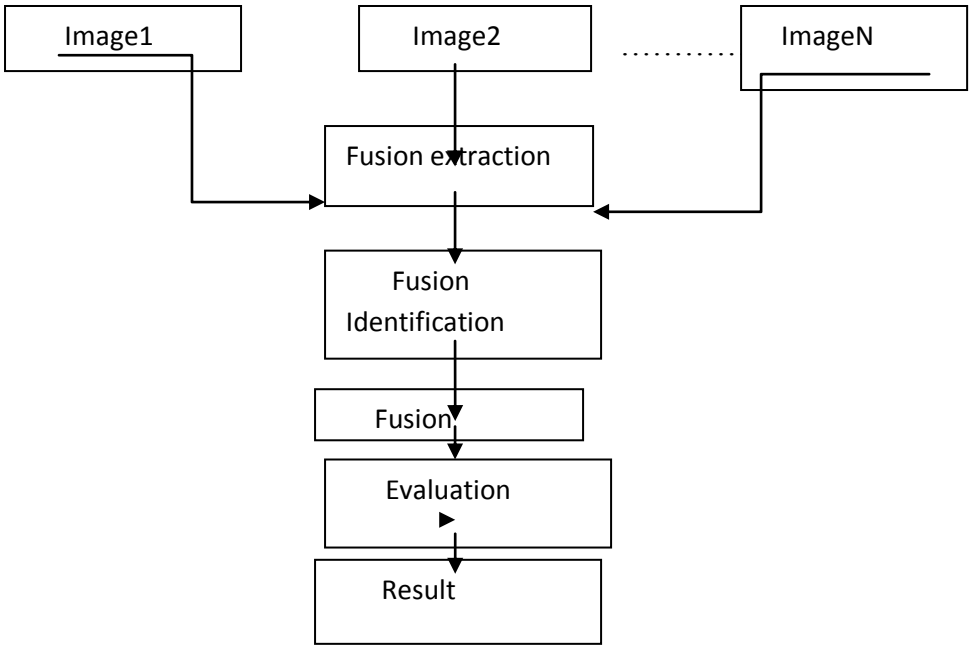

Fig. 6- Flow chart of image fusion at decision level

Fuzzy logic fusion algorithm at Pixel level image fusion - This algorithm is also known as Fuzzy interface method. It is not a common method. This algorithm combines various fuzzy techniques which operate, recognize, and characterize the images with its components and features as fuzzy sets. This method is generally depends on membership functions and also describes the degree of membership of element. To convert input into output, Fuzzy Inference System (FIS) is used. The block diagram of FIS is shown below-

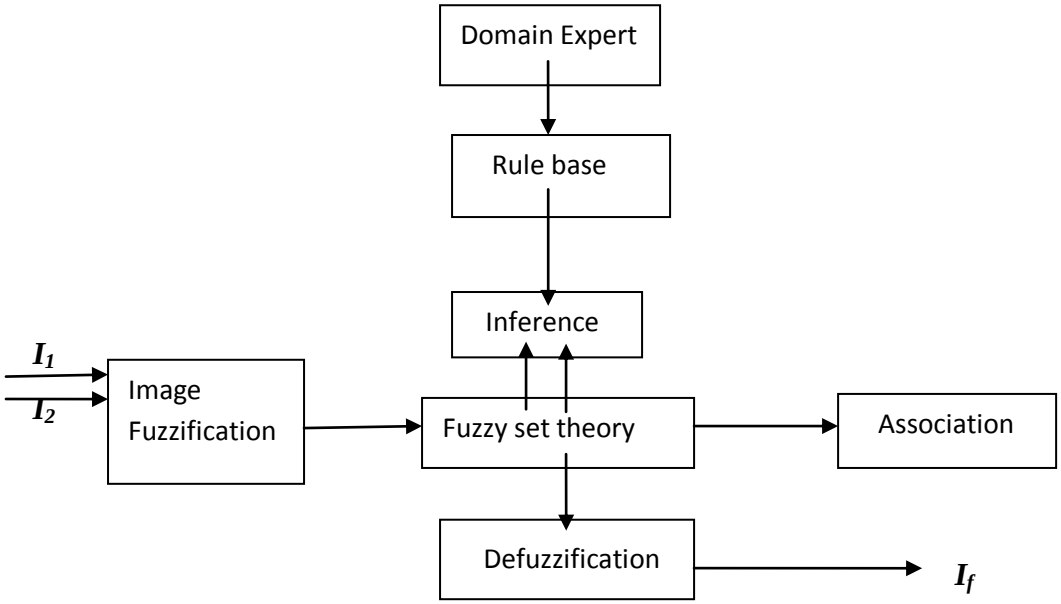

Fig. 7: - Fuzzy Inference Method used for image processing

To get a fused image, must follow the following stages given below-

(a) Evolution of Rule base: After evolution of rule base, it will become to easier to find a collection of fuzzy rules.

(b) Fuzzification of Input: This stage helps to fuzzify the inputs.

(c) Inference: This stage is used to combine the fuzzified inputs to build rule set and find the outcome of the rule.

(d) Association: Merging the outcome to obtain an output.

(e) Defuzzification: This stage is used to obtain the desired output.

Following steps are required in fuzzy algorithm [1]-

(1) Convert the images (I_1,I_2) into column after reading.

(2) Construct a fzy (Fuzzy) file having input images *(I_1,I_2).*

(3) For both the input images determine number and type of element.

(4) Construct rules for input images, which determine the two predecessors to a single number 0- 1.

(5) Apply fuzzification rule on input images which gives element function and resultant image in column format.

(6) To get fused image I_f, change the column into matrix form.

The implementation of this algorithm is very difficult because when the number of membership function increases than number of rules also increases.

FUTURE RESEARCH-

However several image fusion algorithms and methods have developed at this time but there are quiet problems in different areas of applications. Hence, the future trends in different areas are-

- In medical field, capturing human's internal images and designing clinical problems are hard task to diagnosis.
- Miss-registration is a laborious problem in photography area due to moving things.
- How to minimize visual distortion in remote sensing is a big issue?

Conclusion-

The background study and introduction of image fusion process has been presented in this paper. This paper includes discourse on the contribution of fusion in different fields of technology. Image fusion using Fuzzy Logic method maximally combines the useful information related to images. The main goal of image fusion is to increase the information which is clearly visible in the pictures as well as to enhance the authenticity of the related pictures. This fusion process helps to collect exact data and enhance usefulness in application areas such as night vision, medical imaging and remote sensing etc.

Besides the image processing, image fusion is a very challenging method and pixel level image fusion using fuzzy logic algorithm is tough as comparison to other algorithm. This algorithm gives better result with large number of membership function. On the basis of several research papers, this paper wind ups a discourse on the contribution of fusion in different fields of technology varying from remote sensing to medical imaging.

References-

1. Swathy, N., & Elias2, B. (2013). Pixel Level Image Fusion using Fuzzylet Fusion Algorithm. *IJAREEIE* , *2* (Special Issue 1), 3-4.
2. Pixel- and Feature-Level Image Fusion Concepts and Algorithms. (2009). *Multi-Sensor Data Fusion with MATLAB*, 395-448. doi:10.1201/9781439800058-19.
3. Li, S., Kang, X., Fang, L., Hu, J., & Yin, H. (2017). Pixel-level image fusion: A survey of the state of the art. *Information Fusion, 33*, 100-112. doi:10.1016/j.inffus.2016.05.004.
4. Omar, Z., & Stathaki, T. (2014). Image Fusion: An Overview. *2014 5th International Conference on Intelligent Systems, Modelling and Simulation*. doi:10.1109/isms.2014.58.
5. Harpreet Singh, Jyoti Raj and Gulsheen Kaur, "Image Fusion using Fuzzy Logic and Applications", Budapest Hungary, 25-29 July. 2004.
6. G. Bhatnagar, Q. M. J. Wu, and Z. Liu, "Human visual system inspiredmulti-modalmedicalimagefusionframework,"Expert SystemswithApplications,vol.40,no.5,pp.1708–1720,2013.
7. Rahul Ranjan, Harpreet Singh,Thomas Meitzler and Grant R. Gerhart, "Iterative Image Fusion Technique using Fuzzy and Neuro Fuzzy logic and Applications", Annual Meeting of the North American Fuzzy Information Processing Society,NAFIPS 2005.
8. R. Maruthi and K. Sankarasubramanian, "Pixel Level Multifocus Image Fusion Based on Fuzzy Logic Approach", Asian Journal of Information Technology 7(4): 168-171, 2008 ISSN: 1682-3915.
9. Yanfen Guo, Mingyuan Xie, Ling Yang, "An Adaptive Image Fusion Method Based on Local Statistical Feature of Wavelet Coefficients" 978-1-4244-5273-6/9 2009 IEEE
10. Dr. H. B. Kekre, Dr. Dhirendra Mishra and Rakhee Saboo " Review on Image Fusion tecsshniques and performance evaluation parameters" IJEST, April- 2013.
11. M. M. Riaz and A. Ghafoor, "Fuzzy logic and singular value decompositionbasedthroughwallimageenhancement,"RadioengineeringJournal,vol.22,no.1,p.580,2012.
12. L. X. Wang, A Course in Fuzzy Systems and Control, Prentice Hall,NewYork,NY,USA,1997.
13. G.Piella,"Imagefusionforenhancedvisualization:avariational approach,"InternationalJournalofComputerVision,vol.83,no. 1,pp.1–11,2009.
14. S.Li,X.Kang,andJ.Hu,"Imagefusionwithguided filtering," IEEETransactionsonMedicalImaging,vol.22,no.7,pp.2864– 2875,2013.
15. Prakash NK (2011) "Image Fusion Algorithm Based on Biorthogonal wavelet", International Journal of Enterprise Computing and Business Systems, Vol. 1, No. 2, pp1-6.
16. Julien Montagner & Vincent Barra, (2009) "Multilevel Information Fusion: A Mixed Fuzzy Logic/Geometrical Approach with Applications in Brain Image Processing", pp490-513.
17. Zhu Mengyu & Yang Yuliang, (2008) "A New Image Fusion Algorithm Based on Fuzzy Logic", International Conference on Intelligent Computation Technology and Automation, Vol. 2, pp8386.
18. Thomas J. Meitzler, Davis Bednarz, Sohn E.J, Kimberly Lane & Darryl Bryk, (2002) "Fuzzy Logic Based Image Fusion", pp1-9.

19. B. Yang and S. Li, "Pixel-level image fusion with simultaneous orthogonalmatchingpursuit,"InformationFusion,vol.13,no.1, pp.10–19,2012.
20. N.N.Yu,T.S.Qiu,andW.H.Liu,"Medicalimagefusionbased on sparse representation with KSVD," in Proceedings of the WorldCongressonMedicalPhysicsandBiomedicalEngineering, vol.39,pp.550–553,2013.