Implementation of Fusion using MATLAB

J. Ravi[1] M. Gowri Sri Durga[2] MD. Shabeena Begum[3] Y. D. R. C. Kartheek[4] T. Raju[5]
[1,2,3,4,5]Department of Electronics and Communication Engineering
[1,2,3,4,5]Sagi Ramakrishnam Raju Engineering College, Andhra Pradesh, India

Abstract— In the present of technological development, medical imaging plays an important role in many applications of medical diagnosis and therapy. This requires more accurate images with much more details and information for correct medical diagnosis and therapy. Medical image fusion is one of the solutions for obtaining both high spatial and high spectral information in a single image. Multimodal medical image fusion provides a remarkable improvement in the fused image quality. This paper covers the following items, the basic definition of the image fusion process, applications, advantages, and disadvantages of fusion procedures. Through this, a hybrid imaging combinations are suggested for better Image visualization for different human organs. This paper ends with some novel trends in the medical image fusion topic.

Keywords: Image Fusion, Multi Focus Image Fusion, Medical Image Fusion

I. INTRODUCTION

Image processing is a method to convert an image into digital form and perform some operations on it, in order to get an enhanced image or to extract some useful information from it. It is a type of signal dispensation in which input is image, like video frame or photo graph and output may be image or characteristics associated with that image. Usually Image Processing system includes treating images as two dimensional signals while applying already set signal processing methods to them.

- It is among rapidly growing technologies today, with its applications in various aspects of a business. Image Processing forms core research area within engineering and computer science disciplines too[2].

Image processing basically includes the following three steps:

- Importing the image with optical scanner or by digital photography.
- Analyzing and manipulating the image which includes data compression and image enhancement and spotting patterns that are not to human eyes like satellite photographs.
- Output is the last stage in which result can be altered image or report that is based on image analysis.

A. Purpose of Image processing:

The purpose of image processing is divided into 5 groups. They are:

1) Visualization - Observe the objects that are not visible.
2) Image sharpening and restoration - To create a better image.
3) Image retrieval - Seek for the image of interest.
4) Measurement of pattern – Measures various objects in an image.
5) Image Recognition – Distinguish the objects in an image.

Image Fusion is the Process that combines information from multiple images of the same scene [9]. The Result of Image Fusion is a new image that retains the most desirable information and characteristics of each input image [3]. The main application of image fusion is merging the gray level high resolution panchromatic image and the color low resolution Multi spectral image. It has been found that the standard fusion methods perform well spatially but usually introduce spectral distortion. To overcome this problem numerous multi state transform based fusion schemes have been proposed. In image Fusion is the process of combining relevant information from two or more images into a single image. The resulting image will be more enhanced that any of the input images.

The Concept of image fusion has been used in wide variety of applications like medicine, remote sensing, machine vision, automatic change detection and biometrics etc. [6]. With the emergence of various image capturing devices; it is not possible to obtain an image with all the information. Image Fusion helps to obtain an image with all the information. Image fusion is a concept of combining multiple images into composite products, through which more information than that of individual input images can be revealed.

B. Block Diagram of Image Processing:

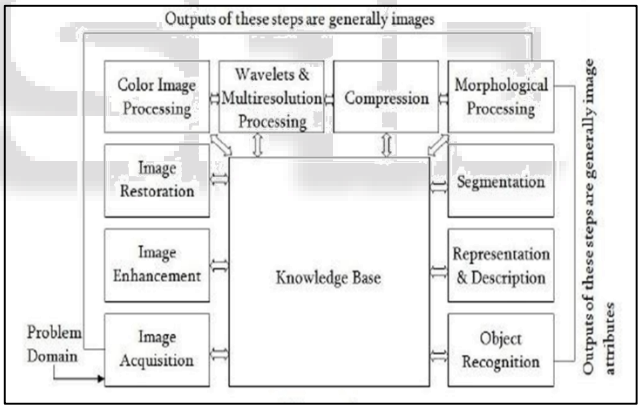


Fig. 1: Fundamental steps of image processing

C. Types:

The two types of methods used for Image Processing are Analog and Digital Image Processing. Analog or visual techniques of image processing can be used for the hard copies like print outs and photographs. Image analysts use various fundamentals of interpretation while using these visual techniques. The image processing is not just confined to area that has to be studied but on knowledge of analyst. Association is another important tool in image processing through visual techniques. So analysts apply a combination of personal knowledge and collateral data to image processing.

D. Applications:

1) Intelligent Transportation Systems– This technique can be used in Automatic number plate recognition and Traffic sign recognition.

2) Remote Sensing– For this application, sensors capture the pictures of the earth's surface in remote sensing satellites or multi – spectral scanner which is mounted on an aircraft. These pictures are processed by transmitting it to the Earth station. Techniques used to interpret the objects and regions are used in flood control, city planning, resource mobilization, agricultural production monitoring, etc.
3) Moving object tracking– This application enables to measure motion parameters and acquire visual record of the moving object. The different types of approach to track an object are:
– Motion based tracking
– Recognition based tracking
4) Defense surveillance– Aerial surveillance methods are used to continuously keep an eye on the land and oceans. This application is also used to locate the types and formation of naval vessels of the ocean surface. The important duty is to divide the various objects present in the water body part of the image. The different parameters such as length, breadth, area, perimeter, compactness are set up to classify each of divided objects. It is important to recognize the distribution of these objects in different directions that are east, west, north, south, northeast, northwest, southeast and south west to explain all possible formations of the vessels. We can interpret the entire oceanic scenario from the spatial distribution of these objects.
5) Biomedical Imaging techniques– For medical diagnosis, different types of imaging tools such as X- ray, Ultrasound, computer aided tomography (CT) etc are used. The diagrams of X- ray, MRI, and computer aided tomography (CT) are given below.

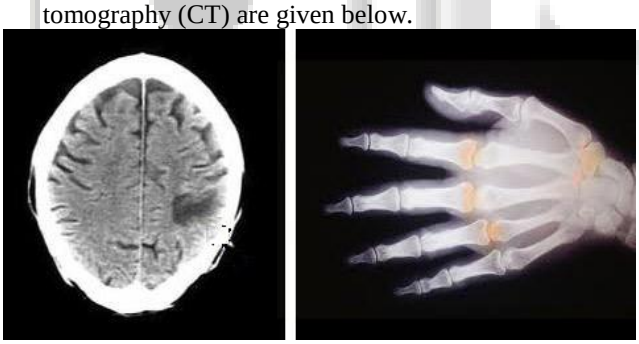


Fig. 2: Representational Image of X- ray, MRI, And Computer Aided Tomography (CT)

Some of the applications of Biomedical imaging applications are as follows:

– Heart disease identification– The important diagnostic features such as size of the heart and its shape are required to know in order to classify the heart diseases. To improve the diagnosis of heart diseases, image analysis techniques are employed to radiographic images.
– Lung disease identification– In X- rays, the regions that appear dark contain air while region that appears lighter are solid tissues. Bones are more radio opaque than tissues. The ribs, the heart, thoracic spine, and the diaphragm that separates the chest cavity from the abdominal cavity are clearly seen on the X-ray film.
– Digital mammograms – This is used to detect the breast tumour. Mammograms can be analyzed using Image processing techniques such as segmentation, shape analysis, contrast enhancement, feature extraction, etc.
6) Automatic Visual Inspection System– This application improves the quality and productivity of the product in the industries.
– Automatic inspection of incandescent lamp filaments – This involves examination of the bulb manufacturing process. Due to no uniformity in the pitch of the wiring in the lamp, the filament of the bulb gets fused within a short duration. In this application, a binary image slice of the filament is created from which the silhouette of the filament is fabricated. Silhouettes are analyzed to recognize the non uniformity in the pitch of the wiring in the lamp. This system is being used by the General Electric Corporation.
– Automatic surface inspection systems – In metal industries it is essential to detect the flaws on the surfaces. For instance, it is essential to detect any kind of aberration on the rolled metal surface in the hot or cold rolling mills in a steel plant. Image processing techniques such as texture identification, edge detection, fractal analysis etc. are used for the detection.

Faulty component identification – This application identifies the faulty components in electronic or electromechanical systems. Higher amount of thermal energy is generated by these faulty components. The Infra-red images are produced from the distribution of thermal energies in the assembly. The faulty components can be identified by analyzing the Infra-red images.

E. Fusion of two images:

1) Image fusion

The image fusion process is defined as gathering all the important information from multiple images, and their inclusion into fewer images, usually a single one. This single image is more informative and accurate than any single source image, and it consists of all the necessary information. The purpose of image fusion is not only to reduce the amount of data but also to construct images that are more appropriate and understandable for the human and machine perception. In computer vision, Multisensor Image fusion is the process of combining relevant information from two or more images into a single image. The resulting image will be more informative than any of the input images.

– In remote sensing applications, the increasing availability of space borne sensors gives a motivation for different image fusion algorithms. Several situations in image processing require high spatial and high spectral resolution in a single image. Most of the available equipment is not capable of providing such data convincingly. Image fusion techniques allow the integration of different information sources. The fused image can have complementary spatial and spectral resolution characteristics. However, the standard image fusion techniques can distort the spectral information of the multispectral data while merging.
– In satellite imaging, two types of images are available. The panchromatic image acquired by satellites is transmitted with the maximum resolution available and

the multispectral data are transmitted with coarser resolution. This will usually be two or four times lower. At the receiver station, the panchromatic image is merged with the multispectral data to convey more information.

– Many methods exist to perform image fusion. The very basic one is the high pass filtering technique. Later techniques are based on Discrete Wavelet Transform, uniform rational filter bank, and Laplacian pyramid.

F. Multi-Focus Image Fusion

Multi-focus image fusion is used to collect useful and necessary information from input images with different focus depths in order to create an output image that ideally has all information from input images. In visual sensor network (VSN), sensors are cameras which record images and video sequences. In many applications of VSN, a camera can't give a perfect illustration including all details of the scene. This is because of the limited depth of focus exists in the optical lens of cameras. Therefore, just the object located in the focal length of camera is focused and cleared and the other parts of image are blurred. VSN has an ability to capture images with different depth of focuses in the scene using several cameras. Due to the large amount of data generated by camera compared to other sensors such as pressure and temperature sensors and some limitation such as limited band width, energy consumption and processing time, it is essential to process the local input images to decrease the amount of transmission data. The aforementioned reasons emphasize the necessary of multi-focus images fusion. Multi-focus image fusion is a process which combines the input multi-focus images into a single image including all important information of the input images and it's more accurate explanation of the scene than every single input image.

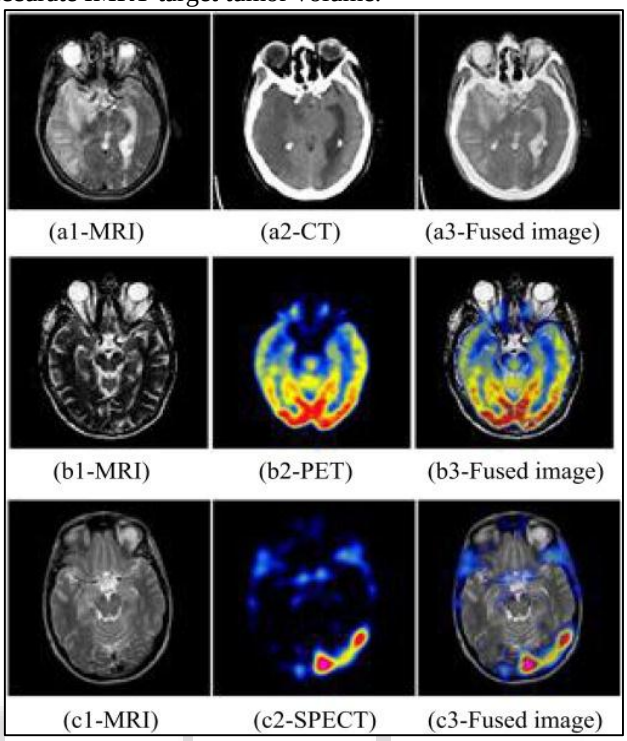
1) Why Image Fusion

Multi sensor data fusion has become a discipline which demands more general formal solutions to a number of application cases. Several situations in image processing require both high spatial and high spectral information in a single image. This is important in remote sensing. However, the instruments are not capable of providing such information either by design or because of observational constraints. One possible solution for this is data fusion.

G. Medical Image Fusion

Image fusion has become a common term used within medical diagnostics and treatment. The term is used when multiple images of a patient are registered and overlaid or merged to provide additional information. Fused images may be created from multiple images from the same imaging modality, or by combining information from multiple modalities, such as magnetic resonance image (MRI), computed tomography (CT), Positron emission Tomography (PET), and Single Photon Emission Tomography(SPET). In radiation and radiation oncology, these images serves different purposes. For Example, CT images are used more often to ascertain difference in density while MRI images are typical used to diagnose brain tumors.

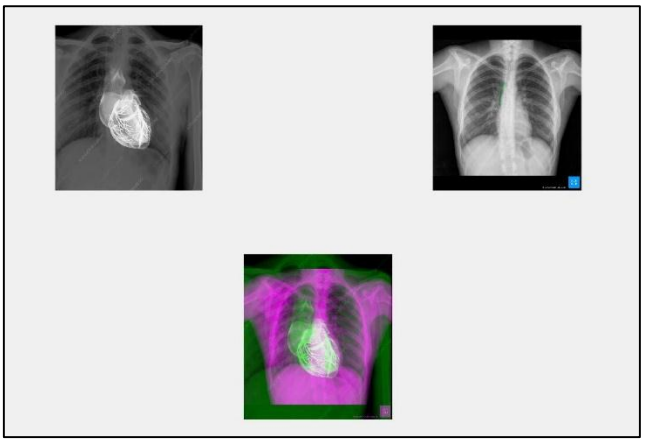
For accurate diagnosis radiologist must integrate information from multiple images formats. Fused automatically consistent images are especially beneficial in diagnosing and treating cancer with the advent of these new technologies radiation oncologists can take full advantage of intensity modulated radiation therapy. Being able to overlay diagnostic images into radiation planning images results in more accurate IMRT target tumor volume.



II. EXPERIMENTAL RESULTS

A graphical user interface(GUI) is a pictorial interface to a program. A good GUI can make programs easier to use by providing them with a consistent appearance. The GUI should behave in an understandable and predictable manner.

A. Results for fusion of two images:



III. CONCLUSION

We presented project on image fusion based on applications of medical diagnosis and therapy. Our main contribution is that we develop a better image than the applied input images. By this we can identify the each and every part of the image. In medical field this is used to identify the problems. The Image Fusion quality has been assessed based on optical image sets with respect to a perfect image. The efficiency of

the fusion can be better assessed if the same could be performed on many more multi variant images. The same could not be done due to lack of such set of test sample multi variate images. The ImFuse Toolkit now looks into considering only two input images to be fused. An option to load and fuse more than two images at the same time can also be easily incorporated into the project. An option could be provided to the user on to select the number of input images available.

IV. FUTURE SCOPE

A wide research is being done in the Image processing technique.

1) Cancer Imaging – Different tools such as PET, MRI, and Computer aided Detection helps to diagnose and be aware of the tumour.
2) Brain Imaging – Focuses on the normal and abnormal development of brain, brain ageing and common disease states.
3) Image processing – This research incorporates structural and functional MRI in neurology, analysis of bone shape and structure, development of functional imaging tools in oncology, and PET image processing software development.
4) Imaging Technology – Development in image technology have formed the requirement to establish whether new technologies are effective and cost beneficial. This technology works under the following areas:

– Magnetic resonance imaging of the knee.
– Computer aided detection in mammography.
– Endoscopic ultrasound in staging the oesophageal cancer.
– Magnetic resonance imaging in low back pain.

5) Development of automated software- Analyzes the retinal images to show early sign of diabetic retinopathy.
6) Development of instrumentation – Concentrates on development of scanning laser ophthalmoscope.

REFERENCES

[1] J.Núñez, X.Otazu, O.Fors, A.Prades, V.Palà, and R.Arbiol, Multi resolution-Based Image Fusion with Additive Wavelet Decomposition, IEEE Transactions on Geo science and Remote Sensing, vol.37, no. 3, Pages. 1204-1211, 1999.
[2] Jorge Núñez, Xavier Otazu, Octavi Fors and Albert Prades, Simultaneous Image Fusion And Reconstruction Using Wavelets; Applications to SPOT +LANDSAT Images, Vistasins Astronomy, Volume 41,Issue3,Pages 351-357, 1997.
[3] L.J Chipman, T.M.Orr, L.N.Graham, Wavelets and Image Fusion, Proceedings International Conference on Image Processing, vol.3, Pages 248-251, 1995.
[4] M.Antonini, M.Barlaud, P.Mathieu, and I.Daubechies, Image Coding Using the Wavelet Transform, IEEE Trans on Image Processing, 2(2), Pages 205-220, 1992.
[5] Zhong Zhang and Rick S. Blum, A Categorization of Multi scale-Decomposition-Based Image Fusion Schemes with a Performance Study for A Digital Camera Application, Information Fusion, Pages 135-149, 2001.
[6] Zhong Zhang and RickS. Blum, A Hybrid Image Registration Technique for a Digital Camera Image Fusion Application, Information Fusion, Volume2, Issue2, Pages 135-149, 2001.
[7] L. Yi-bo, X. Hong, and Z. Sen-Yue, "The wrinkle generation method for facial reconstruction based on extraction of partition wrinkle line features and fractal interpolation," in Proc. 4th Int. Conf. Image Graph., Aug. 22–24, pp. 933–937, 2007.
[8] Y. Rener, J. Wei, and C. Ken, "Down sample-based multiple description coding and post-processing of decoding," in Proc. 27th Chinese Control Conf., Jul. 16–18, pp. 253–256, 2008.
[9] H. Demirel, G. Anbarjafari, and S. Izadpanahi, "Improved motion based localized super resolution technique using discrete wavelet transform for low resolution video enhancement," in Proc. 17th Eur. Signal Process. Conf., Glasgow, Scotland, pp. 1097–1101, 2009.
[10] Y. Piao, I. Shin, and H. W. Park, "Image resolution enhancement using inter-sub band correlation in wavelet domain," in Proc. Int. Conf. Image Process., vol. 1, pp. I445–448, 2007.
[11] H. Demirel and G. Anbarjafari, "Satellite image resolution enhancement using complex wavelet transform," IEEE Geoscience and Remote Sensing Letter, vol. 7, no. 1, pp. 123–126, 2010.
[12] C. B. Atkins, C. A.Bouman, and J. P. Allebach, "Optimal image scaling using pixel classification," in Proc. Int. Conf. Image Process., Oct. 7–10, vol. 3, pp. 864–867, 2001.
[13] Image interpolation, " IEEE Trans. Image Process., vol 8, no. 9 W. K. Carey, D. B. Chuang, and S.S.Hemami, "Regularity- preserving, pp. 1295–1297, 1999.
[14] S. Mallat, A Wavelet Tour of Signal Processing, 2nd ed. New York: Academic, 1999.
[15] J. E. Fowler, "The redundant discrete wavelet transform and additive noise", Mississippi State ERC, Mississippi State University, Tech. Rep. MSSU-COE-ERC-04-04, 2004.
[16] X. Li and M. T. Orchard, "New edge-directed interpolation," IEEE Trans. Image Process., vol. 10, no. 10, pp. 1521–1527, 2001.
[17] K. Kinebuchi, D. D. Muresan, and R. G. Baraniuk, "Wavelet based statistical signal processing using hidden Markov models," in Proc. Int. Conf. Acoust., Speech, Signal Process., vol. 3, pp. 7–11, 2009.
[18] S. Zhao, H. Han, and S.Peng, "Wavelet domain HMTbased image super resolution," in Proc. IEEE Int. Conf. Image Process., vol. 2, pp. 933–936, 2003.
[19] A. Temizel and T. Vlachos, "Wavelet domain image resolution enhancement using cycle-spinning," Electron. Lett, vol. 41, no. 3, pp. 119–121, 2005.

