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Image Fusion Techniques and Fuzzy Logic Methods Using Virtual Instrumentation

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Abstract— The fundamentals of image process were laid over fifty years past, vital development occurred principally within the last twenty five years with the entrance of personal computers and today's issues area unit already very subtle and fast. This paper deals with the study of the employment of fuzzy logic ways and image fusion for image processing in LabVIEW.In this we developed a fuzzy edge detector and image fusion using various transformation.The tools for quality management is applicable in biomedical image processing field, jewelry field,satellite field.

Index Terms— DWT, Image Denoising, fuzzy logic, labVIEW.

I. INTRODUCTION

Using methods based on the properties of fuzzy logic and fuzzy sets in the computer image processing is not in the spotlight. It is certainly possible to accept that this topic based on fuzzy decision making can be at least an interesting alternative, especially where some the other methods may fail or give problematic results[7].In the literature can be found the fundamentals of fuzzy logic and fuzzy sets. In this paper implemented a fuzzy based edged detector to improve the resolution of the image[5].

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[1,3]. The 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. Many methods exist to perform image fusion. The very basic one is the high pass filtering technique. The techniques are based on Discrete Wavelet Transform, uniform rational filter bank, and Laplacian pyramid.

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II. WAVELET TRANSFORM

The wavelet expansion set is not unique. A wavelet system is a set of building blocks to construct or represents a signal or function. It is a two dimensional expansion set, usually a basis, for some class one or higher dimensional signals. The wavelet expansion gives a time frequency localization of the signal. Wavelet systems are generated from a single scaling function by scaling and translation. And the coefficients after transformation are processed[6].

Image denoising algorithm consists of few steps; consider an input signal x (t) and noisy signal n (t). Add these components to get noisy data y (t) i.e.

$$Y(t) = x(t) + n(t). \qquad (1)$$

Here the noise can be Gaussian, Poisson's, speckle and salt and pepper, then apply wavelet transform to get w (t).

$$Y(t) \text{ --------------}\rightarrow w(t) \qquad (2)$$

Modify the wavelet coefficient w (t) using a different threshold algorithm and take inverse wavelet transform to get denoising images x (t).

$$W(t) \text{ -----------}\rightarrow x(t) \qquad (3)$$

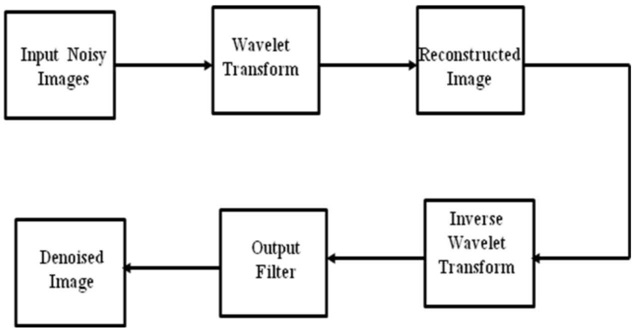


Fig 1: Block diagram of Image denoising using wavelet transform

A. Image Fusion using Wavelet Transform

Image fusion is the process that combines information from multiple images of the same scene. The result of image fusion is a new image that retains the most desirable information and characteristics of each input image. The main application of image fusion is merging the gray-level high-resolution panchromatic image and the colored low-resolution multispectral image. It has been found that the standard fusion methods perform well spatially but usually introduce spectral distortion[7,1].

To overcome this problem, numerous multiscale transform based fusion schemes have been proposed., we focus on the fusion methods based on the discrete wavelet transform (DWT),the most popular tool for image processing. Due to

the numerous multiscale transform, different fusion rules have been proposed for different purpose and applications
.

B. Wavelet Based Image Fusion Algorithm

Wavelets are localized waves .They have finite energy. They are suited for analyses of transient signal. They are finite duration oscillatory functions with zero average value. The irregularity and good localization properties make them better basis for analysis of signals with discontinuities[1,8].
The steps involved in wavelet based image fusion algorithm are as follows :

1. Read the two input images, I1 and I2 to be fused.
2. Perform independent wavelet decomposition of the two images.
3. Apply pixel based algorithm for approximations which involves fusion based on taking the maximum valued pixels from approximations of source images I1and I2.
4. Based on the maximum valued pixels between the approximations, a binary decision the map is generated gives the decision rule for fusion of approximation coefficients in the two source images I1and I2.
5. The final fused transform corresponding to approximations through the maximum selection pixel the rule is obtained.
6. Concatenation of fused approximations and details gives the new coefficient matrix.
7. Apply inverse wavelet transform to reconstruct the resultant fused image and display the result.

III. FUZZY LOGIC APPROACH

Fuzzy Logic is a means of dealing with information in the same way that humans of animals do. Fuzzy Logic is built around the concept of reasoning in degrees, rather than in boolean (0 or 1) expressions like computers do. Variables are defined in terms of fuzzy sets. Rules are specified by logically combining fuzzy sets[5].
The combination of fuzzy sets defined for input and output variables, together with a set of fuzzy rules that relate one or more input fuzzy sets to an ouput fuzzy set, which built a fuzzy system. Fuzzy systems represent well-defined static deterministic functions Therefore reaction of a fuzzy system to inputs is anything but fuzzy. Inputs are presented to the system as specific values, and the fuzzy system produces a specific output value[5]. The operation of a fuzzy system is thus analogous to that of conventional systems. Adaptive fuzzy rules and fuzzy membership functions are specified depending on the type of filtration.

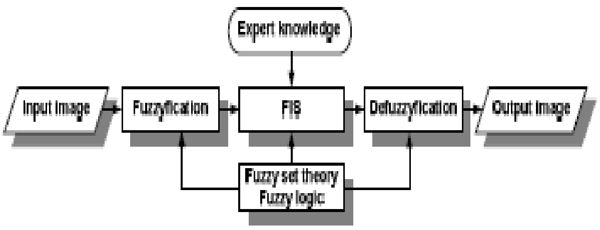


Fig 2. The general structure of the fuzzy image processing

IV. PROPOSED METHODOLOGY

In existing methods of the image edge detection require the images to be in enough contrast. These methods tends to give erroneous results in identification of edges are formed by the points with the low resolution gray scale. The proposed system utilizes the fuzzy logic technique in identifying the edges .To percept the important places in the images it is necessary to find the edges of the image, where the sudden change in the brightness values to be noticed. The fuzzy systems can very well adapt even in the lower contrast conditions. In this paper we divide the image into regions by using of the floating matrix 3×3 pixels. The image data are transformed from the plane of brightness values (gray levels) in the plane belonging to fuzzy sets (Fuzzification) according to fuzzy rules. In our case, we will examine the discretized image of size M×N image function f(x) then can be written for example in the form f(m, n), where m = 1, 2, ... M and n = 1, 2, ... N. For our case we define four rules, which consider the brightness value of eight neighboring pixels around the examined pixel (i, j), as shown in Fig. 3.

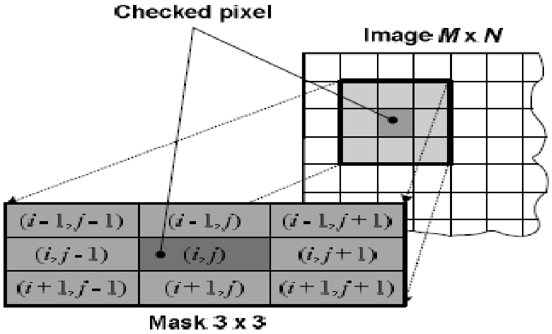


Fig 3. Mask 3×3 pixels in fuzzy edge detection methodology

A. Steps involved in Fuzzy logic based edge detection.

Algorithm for the implementation of this fuzzyfication system for search of edge pixels in the image can be described as follows[5,7]:
1. Input is a grayscaled image M × N, each element (pixel) is described by the value of image function.f(m, n) = f_{mn}, where $f_{mn} \in$ <0, 255>, m = 1, 2, … M, n = 1, 2, …M.
2. Create the auxiliary array A (size M × N, at the end will mention the output image) and initially is setting to a constant value A(m, n) ← 255 for all m = 1, 2, …M and n = 1, 2, …N.
3. Set a counter j ← 2.
4. Set a counter i ← 2.
5. Find values f(i, j) = f_{ij} of all pixels in the neighborhood 3×3 and verify the validity of rules in Fig. 4. In case of validity set **A**(i, j) ← 0.
6. Repeat for all i = 2, …M - 1 from the step 5.
7. Repeat for all j = 2, … N - 1 from the step 4.
8. Finally array **A** now contains the output image.
The input image is quantized into 8-bit grayscale, so the value of imaging, i. e. brightness, takes values in the interval <0, 255>. Brightness can associate with linguistic terms “Black”, “White”, “Edge”, or “Edge point” respectively. Membership function for fuzzy set elements of the input image has the shape of a triangle, as shown in Fig. 2A. It is evident that the pixels considered as “Black” may acquire brightness values in the interval (60, 90), pixels considered as “White” brightness values interval (80, 170). So it is no easy to set the exact threshold level and is therefore highly advisable to use methods of fuzzy logic[7]. Fig 3 shows an example of the desired shape of the output image membership function, it is evident that the edge points are located in a relatively narrow interval of the values (here, for example, brightness values around 140). The algorithm uses two vague (fuzzy) values: “white” and “black”, by which classify ambiguous brightness values of all pixels around the surveyed central pixel.

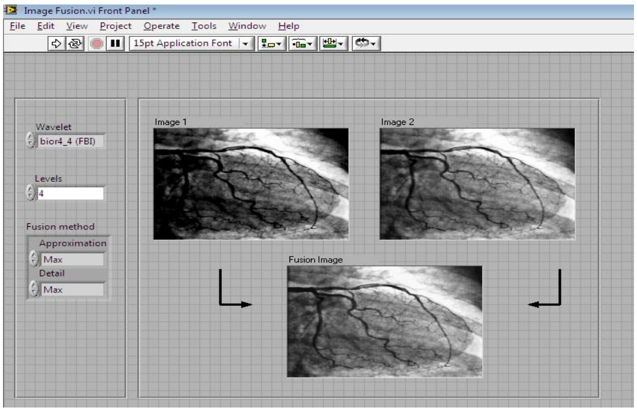
The auxiliary array **A**, which will form as a resulting output image with founded edge points, first fill with value "most white" (in our case 255) and during the classification (i. e. identification of the FIS system – according to the pixels marked as "edge point" are filled with value "most black" (in our case 0).

Fuzzy rules for our case are relatively simple and allow us to get acquainted with the principle of applying fuzzy logic in image processing. Each of the fuzzy rules are created in the form of a conditional language expression of the logical implication IF *X* THEN *Y*, where *X* and *Y* are fuzzy statements, and *X* is a fuzzy condition and *Y* is a fuzzy consequence. The aim is to identify pixels that are logically edge points of the investigated image.

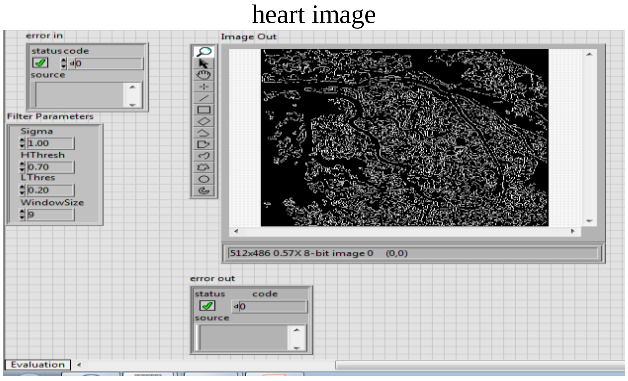
The described method analyzes the brightness values of all pixels in the 8-neighborhood of the image center pixel (*i*, *j*), and if conditions are met, the center pixel is considered as the edge pixel and marked. Fuzzy image processing is a summary of all the approaches to understanding, representation and processing of images, their segments and features as fuzzy sets. Representation and processing depends on the selected fuzzy technique and solved the problem. Fuzzy image processing has three main stages: coding of image data (image Fuzzification), modification of membership values to fuzzy sets (fuzzy recognition system, FIS – Fuzzy inference system) and the results decoding (image Defuzzification),The main power of fuzzy image processing is mainly in the intermediate step, a change of membership function values.

V. RESULTS AND DISCUSSION

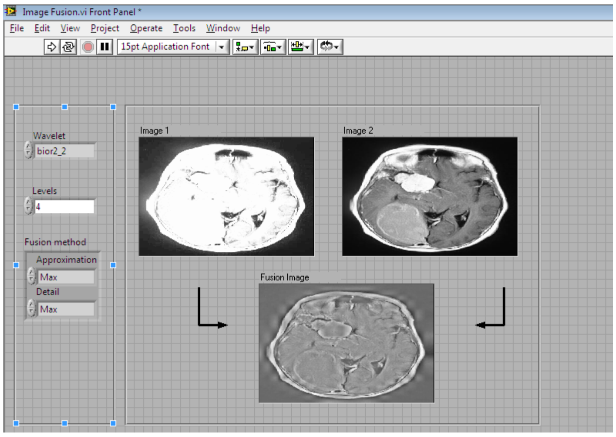
In proposed fuzzy edge detection algorithm was simulated using virtual instrumentation a system having dual core processor and 2G B of RAM. The performance of proposed method is compared with the sobel and prewitt and canny operator[2].



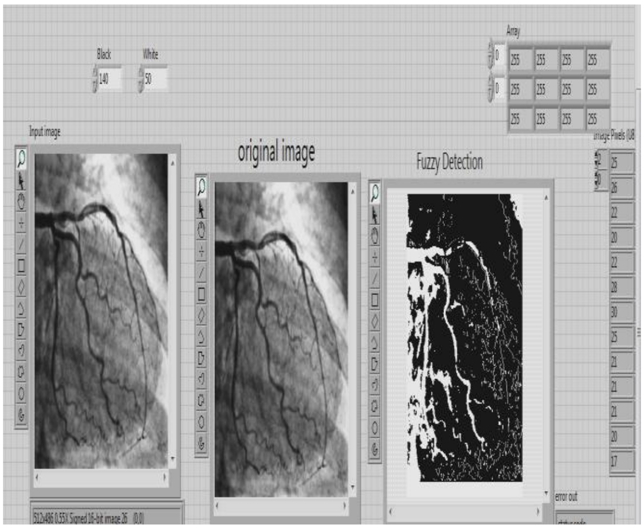
(a) Image fusion using bior4 wavelet transformation in heart image



(b) canny edge detection without fuzzy logic



(c) Image fusion using bior4 wavelet transformation in brain image



(d) fuzzy edge detection in heart image

In this we implemented an image fusion using wavelet for various transformation like bior4 etc.In this image fusion,the input consists of two images ,one image having high resolution and another image having low resolution,comparing the two input images,the output having high resolution and high pixel values.But in fuzzy based edge detection rules are based on 3*3 images.In the fuzzy logic edge detection ,we framing 9 rules appart from this 8 rules are taken in an account,the 9th rule taken as edges.Based upon the two techniques image resolution is improved.

VI. CONCLUSION

The goal of this paper to present examples of the use of fuzzy logic in image processing to find of edge points in the image and a simple application of image fusion by the identification of the subject properties in the image. In this paper we developed the image fusion using wavelet transformation and modeling of fuzzy edge detector to improve the pixel value and resolution implemented by LabVIEW platform. The test results suggest that the use of fuzzy methods can bring new quality to the image processing solutions.

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REFERENCES

[1] Laure J Chipman & Timothy M Orr, (1995) "Wavelets And Image Fusion", Proceedings Of SPIE, Vol. 2569, No. 208, Pp248-251.

[2] CANNY, J.A.Computational Approach To Edge Detection. IEEE Transactions On Pattern Analysis And Machine Intelligence. 1986, P. 679-698, [Cit. 2011-11-05]. ISSN 0162-8828

[3] SONKA, M., V. HLAVAC And R. BOYLE. *Image Processing, Analysis, And Machine Vision*. Toronto: Thomson Learning, 2008 [Cit. 2011-11-05].

[4] Krista Amolins & Yun Zhang, Peter Dare, (2007) "Wavelet Based Image Fusion Techniques – An Introduction, Review And Comparison", ISPRS Journal Of Photogrammetry & Remote Sensing, Vol. 62, No. 4, Pp249–263.

[5] CINTULA, P. From Fuzzy Logic To Fuzzy Mathematics. FJFI CVUT Praha, 2004 [Cit. 2011-11-05].

[6] Gonzales C. Rafael, Woods E. Richard, "Digital Image Processing", 1998, Second Edition, Prentice Hall Publications, Pp.519-560

[7] *Jaroslav VLACH* FUZZY LOGICMETHODS AND IMAGE FUSION IN ADIGITAL IMAGE PROCESSING**,** DIGITAL IMAGE PROCESSING AND COMPUTER GRAPHICS VOLUME: 10 | NUMBER: 1 | 2012 | MARCH

[8] Maruthi R & Sankarasubramanian K, (2008) "Pixel Level Multifocus Image Fusion Based On Fuzzy Logic Approach", Asian Journal Of Information Technology, Vol 7, No.4, Pp168-171..

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