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A COMPETENT WAY OF EXAMINING THE FOETUS FROM MRI IMAGES USING ANISOTROPIC DIFFUSION AND GEOMETRIC MATHEMATICAL MORPHOLOGY

D. Napoleon[#1], U.Lakshmi Priya[#2].V.Mageshwari[#3]

#1 Assistant Professor, Department of Computer Science, School of Computer Science and Engineering, Bharathiar University, India, Coimbatore-641046

#2,3 Research Scholars, Department of Computer Science, School of Computer Science and Engineering, Bharathiar University, India, Coimbatore-641046

ABSTRACT

Images are the optical counter part of an object. The availability of large and progressively growing visual data has been a breakthrough in digital fields. In the midst of digital imaging a hallmark trend is on the rise in medical field where the human anatomy is analysed for the diseases using digital images. Thereby Image processing plays a vital role in the enhancement of the medical images to acquire a lucid picture of the disease. Extraction of geometric information from binary and gray scale images is done by means of mathematical morphological tool. The basic effect is Dilation which gradually enlarges the boundaries of regions of foreground pixel too identify the structural element in the image. The boundaries and structural element of the regions is largely with Gamma correction which mainly concentrates on the overall brightness of the image. Gamma correction is a form of power law function that defines the correlation between a pixel's numerical value and its actual luminance. Where, noise has been reduced without affecting the edges using anisotropic diffusion. This research work mainly focuses on Dilation, Gamma correction and anisotropic diffusion which gives best one for MRI images where the foetus gets the enhanced view of its early stage to analyse the growth of the baby. Various iterations are derived to check the lucidity of the MRI image.

Keywords: Dilation, Gamma correction, Anisotropic Diffusion,

1. INTRODUCTION

Images are the visual illustration of the scene or an object. With modern technology it's easier to visualize the anatomical structures for providing better treatment to the patients. Image processing plays a vital role in the enhancement of the medical images which gives more minute information about the image for the amend analysis. MRI images have a great impact in the medical field for diagnosing diseases in many specialities. MRI gives different information about structures in the body than can be seen with an X-ray, ultrasound, or computed tomography (CT) scan. The major problem in medical images is due the coherent nature of the wave transmitting which produced noise. These noises corrupt the quality of the image due which the retrieval of the information from the medical images is difficult and the might lead to erroneous diagnosis. The medical electronic devices always have noises in their image, different noises can affect different devices like Speckle noise corrupts the ultrasound images , Poisson noise affects the x-ray images. Morphological operators are best suited for extracting of the selective structure in the image. Dilation is one of the Mathematical morphology

which is mainly used in the in increasing the boundary regions of an image. The pixels in the boundary region are being added to get a thicker boundary. Gamma correction mainly corresponds to the luminance of the image.

2.LITERATURE REVIEW

Bogdan smolka et al. (2002) in this paper the problem of edge preserving smoothing is proposed and evaluated. The combined method of forward and backward anisotropic diffusion with incorporated time dependent cooling process is used in this algorithm. This method is able to resourcefully remove the noise in the image and also preserves the edges in the image. [2].

Julio Martin-Herrero et al. (2007) this paper reviews recent advances in anisotropic diffusion for multivalued images, analyzes their application to hyperspectral images, and proposes a new diffusion method which takes advantage of the recent improvements and conforms to the specificities of hyper spectral remote sensing. Some examples are provided using both a noisy image and a clean image with added noise [3].

Umamaheswari et al. (2012) presented hybrid method to improve the image quality of Digital Imaging and Communications in Medicine (DICOM) images. The idea of image enhancement technique is to improve the quality of an image for early diagnosis and anisotropic filter is used in noise reduction . This suggests the use of contrast enhancement methods as an attempt to modify the intensity distribution of the image and to reduce the multiplicative noise. The performance of the proposed study is compared with the existing traditional algorithm and real time medical diagnosis image [4].

Qasima Abbas Kazmi et al. (2013) The given Approach is to generalize the diffusion process further into forward-and-backward process. Further the Forward and Backward diffusion process could again be used in Enhancement of the resolution of the given image. A single image is being used for enhancement of resolution of that image by using interpolation and a forward-and-backward nonlinear diffusion post-processing provides suppression of ringing. Process is found to be very productive in distinguishing those medical images which gives similar images for two or more dangerous diseases.[5]

3. METHODOLOGY

Digital image processing application takes an image as input and produce either an image or description of images of the objects that are present in the image as output. Fig 1 describes the system architecture of the work.

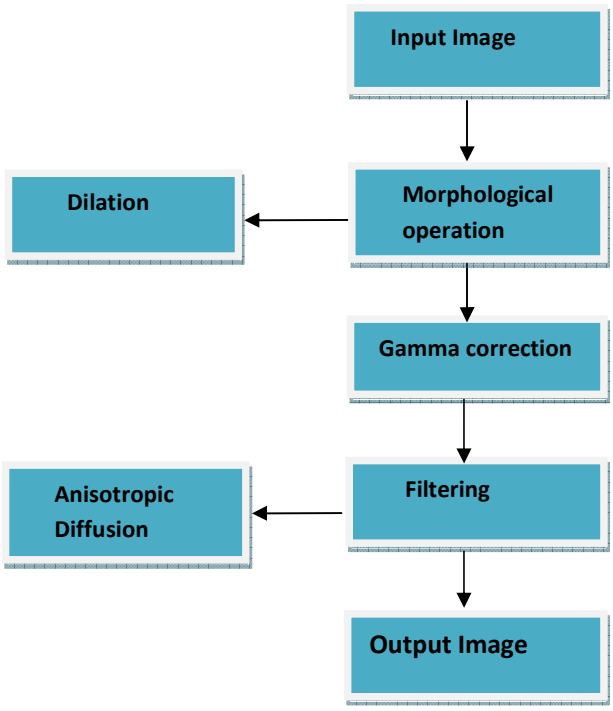


Fig 1. System Architecture

3.1. DILATION

The most basic morphological operation is dilation and erosion. In this paper, the dilation method is used which adds pixel to the boundaries of objects in an image. A dilation of an image I by the structure element H is given by the set operation

$$I \oplus H = \{(p+q) \mid p \in I, q \in H\}$$

Step wise Procedure for Dilation

Uses equivalent formula $I \oplus H = \bigcup_{p \in I} H_p$

Output: Image $I' = I + H$

1. Start with all-zero image I'

2. Loop over all $q = H$

3. Compute shifted image I_q

4. Update $I' = I' \vee I_q$

3.2. GAMMA CORRECTION

Gamma is defined by $V_{out} = V_{in}^{gamma}$, where V_{out} is the output luminance value and V_{in} is the input/actual luminance value. This formula causes the blue line above to curve. When gamma<1, the line arches upward, whereas the opposite occurs with gamma>1.

3.3. ANISOTROPIC DIFFUSION

Perona and Malik propose a nonlinear diffusion method for avoiding the blurring and localization problems of linear diffusion filtering [326, 328]. They apply an inhomogeneous process that reduces the diffusivity at those locations which have a larger likelihood to be edges. This likelihood is measured by |∇u|2. The Perona–Malik filter is based on the equation

$$\partial \text{ tu} = \text{div } (g(|\nabla u|2) \nabla u). \quad (1.31)$$

and it uses diffusivities such as

$$g(s2) = 1 \; 1 + s2/\lambda \; 2 \; (\lambda > 0). \quad (1.32)$$

Although Perona and Malik name their filter anisotropic, it should be noted that in our terminology it would be regarded as an isotropic model, since it utilizes a scalar-valued diffusivity and not a diffusion tensor.

Anisotropic diffusion filter is another denoising technique which is equally gaining popularity. Anisotropic diffusion was initially introduced by and has been improved by several manners. Problems faced by the initial Anisotropic diffusion filter and its variants are;

(i) they cause blocky effects in images

(ii) they destroy structural and spatial neighbourhood information and

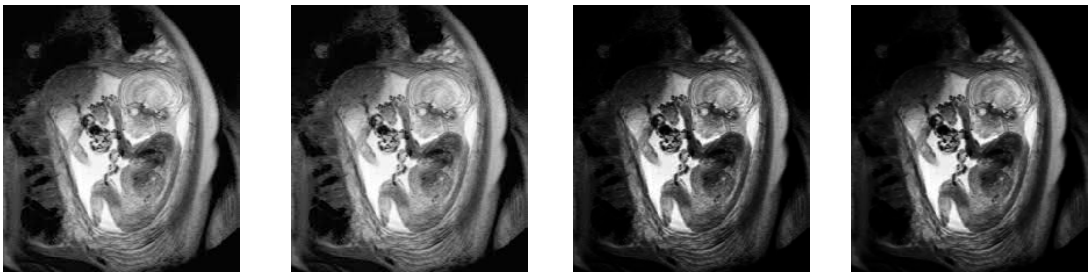
(iii) they are slow in reaching a convergence stage.

The anisotropic filter is non-optimal for medical images with spatially varying noise levels, such as images reconstructed from sensitivity-encoded data and intensity in homogeneity- corrected images

4. RESULT

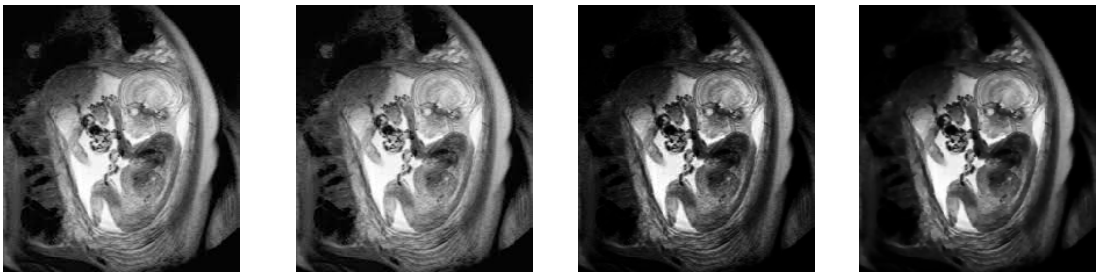
The following shows the experimental results of the work done. MRI image of foetus is taken as input and it is processed in mat lab 2010

Iteration 1



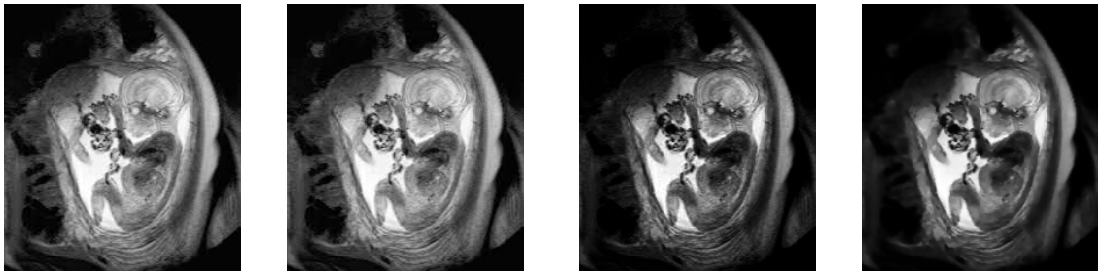
(A) Input Image (B)Dilated Image (C)Gamma Image (D)Anisotropic Image

Iteration 3



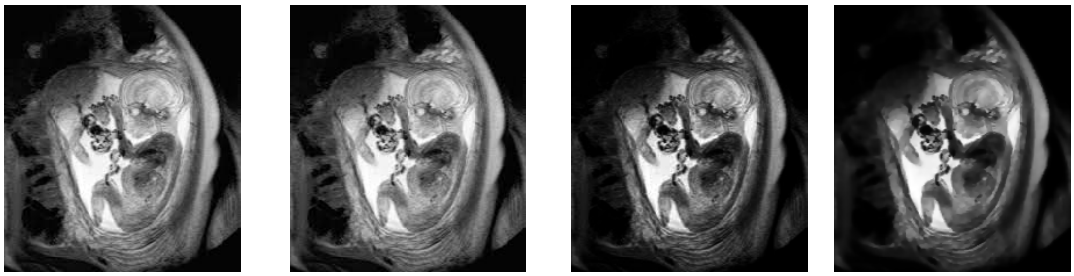
(A) Input Image (B)Dilated Image (C)Gamma Image (D)Anisotropic Image

Iteration 5



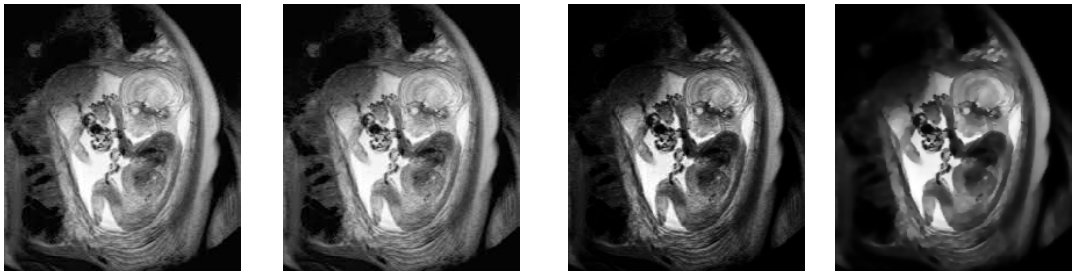
(A) Input Image (B)Dilated Image (C)Gamma Image (D)Anisotropic Image

Iteration 7



(A) Input Image (B)Dilated Image (C)Gamma Image (D)Anisotropic Image

Iteration 9



(A) Input Image (B)Dilated Image (C)Gamma Image (D)Anisotropic Image

5. PERFORMANCE MEASURE

5.1 Peak signal to noise ratio

The quality of image, sound and video files can be analysed using the PSNR. PSNR calculation of two images, one original and an altered image, describes how far two images are equal.

$$PSNR = 10\log\frac{(2^n-1)^2}{MSE} = 10\log\frac{255^2}{MSE}$$

5.2 Structural Content

Correlation, a familiar concept in image processing, estimates the similarity of the structure of two signals. This measure effectively compares the total weight of an original signal to that of a coded or given. It is therefore a global metric; localized distortions are missed . This measure is also called as structural content. The Structural content is given by Equation and if it is spread at 1, then the decompressed image is of better quality and large value of SC means that the image is of poor quality.

$$SC = \sum_{j=1}^{M}\sum_{k=1}^{N} {x_{j,k}}^2 \Big/ \sum_{j=1}^{M}\sum_{k=1}^{N} {x'_{j,k}}^2$$

5.3 Normalised Absolute Error

It's the numerical difference between the original and reconstructed image. The large the value of NAE means that image is poor quality.NAE is defined as:-

$$NAE = \Sigma_{j=1}^{M}\Sigma_{k=1}^{N}\left|x_{j'}{}^{k} - x_{j'}{}^{k}\right| / \Sigma_{j=1}^{M}\Sigma_{k=1}^{N}\left|x_{j'}{}^{k}\right|$$

QUALITY MEASUREMENT	OUTPUT IMAGE		
	PSNR VALUE	STRUCTURAL CONTENT	NORMALIZED ABSOLUTE ERROR
ITR 1	10.7	0.72	0.48
ITR 3	10.83	0.72	0.479
ITR 5	10.85	0.71	0.474
ITR 7	10.87	0.71	0.471
ITR 9	10.89	0.71	0.468

Table 1. Measurement values of PSNR, SC, NAE

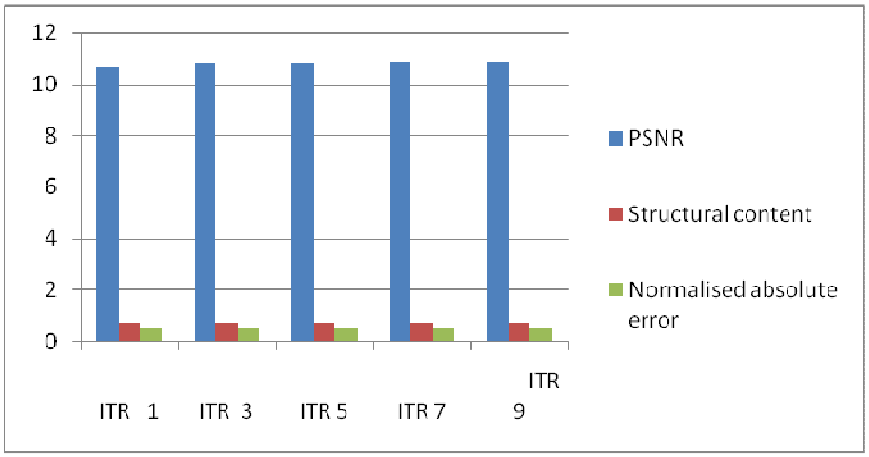


Fig.2. Comparison of PSNR, SC, NAE

VI.CONCLUSION

Medical images are the path way from the diagnosis of any syndrome. It is important that the medical images should be presented in a splendour manner for retrieval of better information. In this work Gamma correction is efficiently used in the improving the luminance of the MRI image of the foetus. The structural growth of the foetus is enhanced using dilation which increases the boundary regions of the foetus while Anisotropic Diffusion is used in the reduction of the noise from the MRI image. The foetus in the image gets a clearer view for diagnosing the foetus growth.

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