Gray Scale Image Enhancement in Vector Valued Image Processing by Parallel Level Sets

B. Sugasini[1], B. S. E. Zoraida[1]
[1, 2] Department of Computer Science
[1, 2] Bharathidasan University, Tiruchirappalli – 620023

Abstract- *Vector valued image processing can be implemented in many fields like Computer – Aided Design, Multimedia image reconstruction, Medical and Virtual Reality applications. From the Literature review, it is found out Vector valued image processing has been done only in color images. This image processing may be used to enhance the images without any distortions but it is difficult to enhance the medical image which is in gray scale. In this paper, Vector valued image processing, an image is segmented and the pixels are arranged in groups using Gradient Vector Flow (GVF) technique. Here, Active Surface method is used to crop a local structure tensor of an image which in turn enables the circulation of the Gradient Vector Flow equation. Our proposed system provides improved enhancement approach that can be proved using Peak Signal-to-Noise Ratio (PSNR) and Structural Similarity Index (SSIM) values.*

Keywords- Demosaicking, Denoising, Gray images, Parallel level sets, Vector processing.

I. INTRODUCTION

The principal objective of image enhancement is to process a given image so that the result is more suitable than the original image for a specific application. It accentuates or sharpens image features such as Edges, Boundaries, or Contrast to make a graphic display more helpful for display and analysis.

The enhancement doesn't increase the inherent information content of the data, but it increases the dynamic range of the chosen features so that they can be detected easily.

Image enhancement is analyzed by following authors as follows: **L. I. Rudin, et al., 1992 [1]** proposes the mathematical algorithm is undemanding and pretty fast. The outcome show to be modern for extremely strident images.

The technique is noninvasive, squashy jagged boundaries in an image. The method might be construe as an initial rung of stirring all stage position of the image usual to itself with rapidity identical to the warp of the stage position separated by the substance of the rise of the image.

S. R. Arridge et al., 1997 [2] analyze a circulation method used for multi-spectral images which fit in together spatial plagiaristic and feature-space sorting. **A Ayache et al., 2005 [8]** introduce a fresh scheme for anisotropic circulation of ultrasound images was established.

It applies the restricted coefficient of deviation and a forceful circulation tensor to strain reverberate realistic images. The LCV is calculating in the vicinity and evaluated to the universal coefficient of deviation. In standardized areas pretentious by spoil is lock to GCV.

The residue of this paper is planned as follows:
Sec. 2 introduces color image enhancement.
Sec. 3 presents gray scale image enhancement.
Sec. 4 describes performance of the system.

II. COLOR BASED IMAGE PROCESSING

Like in the container of scalar-valued metaphors, trouble because demising, in painting, demosaicking, or declaring in favor of vector esteemed images can be transmit addicted to the appearance of a converse trouble by appearing for a least of the valuable

$$\boldsymbol{\Phi(z)} \stackrel{\text{def}}{=} \frac{\mathbf{1}}{\mathbf{2}} \parallel \boldsymbol{Az - g} \parallel^{\mathbf{2}} + \propto \boldsymbol{R(z)} \qquad (1)$$

Where g is the experimental data, $z = (z_k)k = 1, \ldots, k : \Omega \subset \mathbb{R}^N \to \mathbb{R}^k$ the vector-valued image, $\mathcal{R}$ is blame competent and $\propto$ the operation restriction among devotion of the data fit and a-priori in order of the clarification.

For some preferences of R, an explanation of equation (1) is the stationary point (in time) of the partial differential equation (PDE)

$$\boldsymbol{\partial_t \Phi = -D\Phi_z = -A^*(Az - g) + \propto div[k\nabla z]} \qquad (2)$$

Wherever the diffusivity K is in common a spatially changeable N.K× N.K template depending on the image z, i.e.

$$\boldsymbol{k} = \begin{bmatrix} \boldsymbol{k_1} & \cdots & \boldsymbol{T_{1,k}} \\ \vdots & \ddots & \vdots \\ \boldsymbol{T_{k,1}} & \cdots & \boldsymbol{k_k} \end{bmatrix}$$

And the disagreement and slope are definite component-wise. Furthermore, use the NXN sub-matrices k_i is called **within-channel diffusivities** and $T_{i,j}$are known as **cross-diffusivities**.

If any of the sub-matrices is of the form c .I where c is a scalar and I the uniqueness medium to facilitate indicate the entire template c as well.

The extraordinary holder while all sub-matrices are multiples of the uniqueness matrixes is called **isotropic**, or else **anisotropic**. In this paper all circulation equations will be **isotropic**.

There is need to differentiate two other singular cases. If the sub-matrices $K_{i,}T_{i,j}$ depend on the image itself, i.e. $K_i = K_i(z), T_{i,j} = T_{i,j}(z)$, this is a non-linear circulation, or else linear. Once more, all circulation equations considered in this work will be non-linear.

Lastly, if any cross-diffusivity $T_{i,j}$ is non-zero it is call as cross guide circulation, or else channel-wise circulation. This'll be a key point later on.

Significant to note is, to flush after the exchange is presently channel-wise, the structure of PDEs can be coupled if the diffusivities K_i depend on other channels$j \neq i$.

Here, figure 1 below shows the Color image and its three Color channels (Red, Blue and Green).

Figure 1: The Color image and its Color (R,G,B) channels

III. GRAY BASED IMAGE ENHANCEMENT

Aiming at existing medical image enhancement method is unable to prominent part and detailed information and will be interfered by noise easily when medical image contrast is increased; this work proposed enhancement algorithms combining the histogram equalization with image details preservation and bi-dimensional empirical mode decomposition.

First, through the GVF with image details preservation to increase the overall image contrast; and then based on bi-dimensional empirical mode decomposition, the medical image has been decomposed into the image information with different frequency, with various levels improvement of the information, to perform image enhancement.

Figure 2 below shows the gray images and its three color channels (Red, Blue and Green).

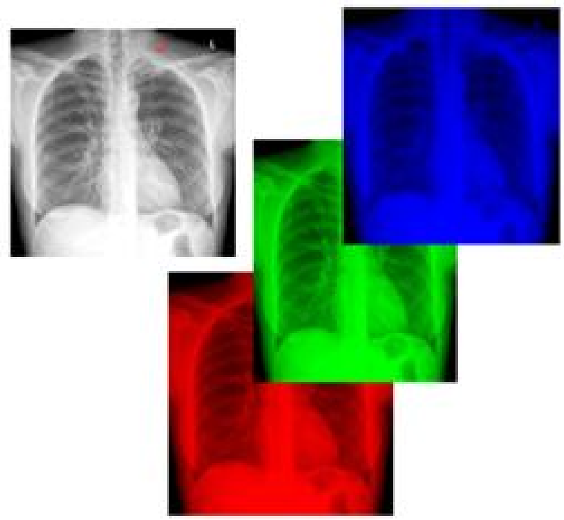

Figure 2: The Gray image and its Color (R, G, B) channels

In this analyze it is possible to import retinal gray images to identify the diseases with improved accurate rate. It can be measured using PSNR and SSIM values. The PSNR (in dB) and SSIM are defined as follows

$$\boldsymbol{PSNR} = \mathbf{10}.\log_{10}\frac{\boldsymbol{MAX_I^2}}{\boldsymbol{MSE}}$$

$$= \mathbf{20}.\log_{10}\frac{\boldsymbol{MAX_i}}{\sqrt{\boldsymbol{MSE}}}$$

$$= \mathbf{20}.\log_{10}(\boldsymbol{MAX_I}) - \mathbf{10}.\log_{10}(\boldsymbol{MSE})$$

The measure between two windows x and y of common size NxN is:

$$\boldsymbol{SSIM(X,y)} = \frac{(2\mu_x\mu_y + c_1)(2\sigma_{xy} + c_2)}{(\mu_x^2 + \mu_y^2 + c_1)(\sigma_x^2 + \sigma_y^2 + c_2)}$$

Figure 3 below illustrates the process of gray scale image enhancement.

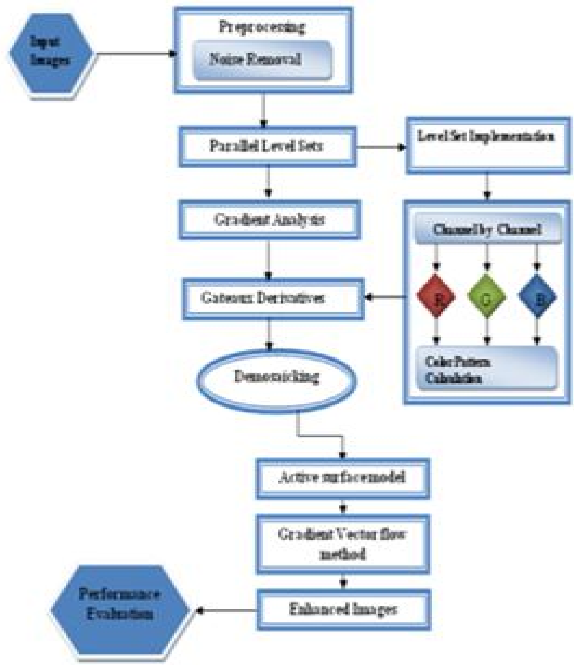

Figure 2: Gray based image enhancement

IV. EXPERIMENTAL RESULTS

In this experimental results show the rate for PSNR and SSIM results. PSNR is commercial word designed for the relation amid the most possible power of a signal and the power of corrupting noise that affects the fidelity of its representation.

SSIM index is a method for measuring the similarity between two images. The SSIM index is a full reference metric; in other words, the measuring of image quality based on an initial uncompressed or distortion-free image as reference.

And also shows the comparison table of color and gray scale images with their PSNR rate and SSIM value (Table 1) and the graph illustrates the performance evaluation and quality result (Figure 4 & Figure 5) in between them is shown below

Table 1: Comparison of PSNR rate & SSIM in both color and gray scale images

Approaches	PSNR Rate	SSIM
Image enhancement in color images	12.1115	0.01645
Image enhancement in gray scale images	4.28657	0.01068

The below graph shows the PSNR rate between Color and Gray images.

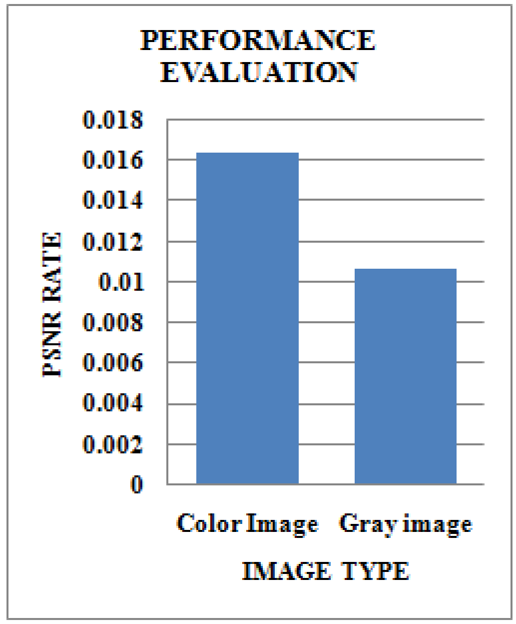

Figure 4: Graph – PSNR Rate between Color and Gray Scale images

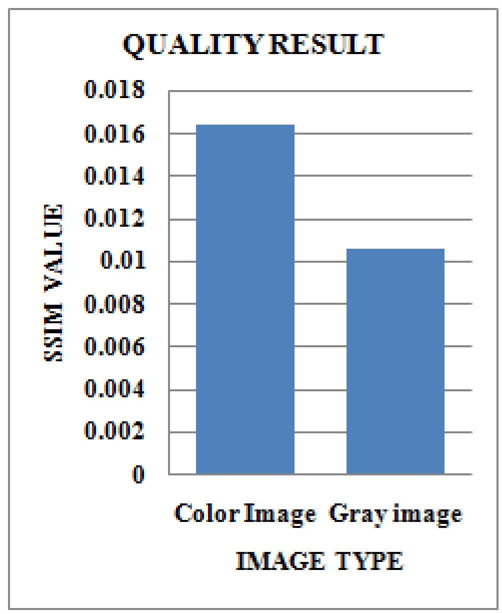

Figure 5: Graph – SSIM Rate between Color and Gray Scale images

V. CONCLUSION

In this paper, gray scale image enhancement is carried out. Existing gray scale image enhancement technique is not efficient because of noise occurrence. In the proposed work GVF technique is applied, so that particular part of an image can be enhance according to the user choice. Parallel level sets technique is applied to the entire image to separate each color space (Red, Blue and Green). Color pattern is applied to the predicted color variance of the image by the parallel level sets. After these operations improved enhanced image with the reduced level noise and efficient image structure is obtained. These results are proved using PSNR and SSIM measurements.

ACKNOWLEDGMENT

I am grateful to **Dr. B. Smitha Evelin Zoraida** for her whole heartily encouragement and constant guidance throughout this work for making it a successful one.

REFERENCES

[1] L. I. Rudin, S. Osher, and E. Fatemi, "Nonlinear Total Variation Based Noise Removal Algorithms," Physica D: Nonlinear Phenomena, vol. 60, no. 14, pp. 259–268, 1992.

[2] S. R. Arridge and A. Simmons, "Multi-Spectral Probabilistic Circulation Using Bayesian Classification," in Scale-Space Theory in Computer Vision : Proc. First Intl. conf., Scale-Space, Utrecht, The Netherlands, B. ter Haar Romeny, L. Florak, J. Koenderink, and M. Viergever, Eds. Berlin: Springer, pp. 224–235, 1997.

[3] P. Blomgren and T. F. Chan, "Color TV: Total Variation Methods for Restoration of Vector-Valued Images," IEEE Transactions on Image Processing, vol. 7, no. 3, pp. 304–309, 1998.

[4] B. K. Gunturk, Y. Altunbasak, and R. M. Mersereau, "Color Plane Interpolation using Alternating Projections." IEEE Transactions on Image Processing, vol. 11, no. 9, pp. 997–1013, Jan. 2002.

[5] D. L. Bailey, D. W. Townsend, P. E. Valk, and M. N. Maisey, Positron Emission Tomography - Basic Sciences. London: Springer, 2005.

[6] K. Deckelnick, G. Dziuk, and C. M. Elliott, "Computation of Geometric Partial Differential Equations and Mean Curvature Flow," Acta Numerica, vol. 14, pp. 139–232, May 2005.

[7] B. K. Gunturk, J. Glotzbach, Y. Altunbasak, R. W. Schafer, and R. M. Mersereau, "Demosaicking: Color Filter Array Interpolation," IEEE Signal Processing Magazine, pp. 44–54, 2005.

[8] C Tauber, H Batatia, A Ayache, "A robust active contour initialization and gradient vector flow for ultrasound image segmentation", cvl.iis.u-tokyo.ac.jp, pp. 16-18 MVA, 2005.

[9] D. Cremers, M. Rousson, and R. Deriche, "A Review of Statistical Approaches to Level Set Segmentation: Integrating Color, Texture, Motion and Shape," International Journal of Computer Vision, vol. 72, no. 2, pp. 195–215, Aug. 2006.

[10] D. W. Townsend, "Multimodality Imaging of Structure and Function," Physics in Medicine and Biology, vol. 53, no. 4, pp. R1–R39, 2008.