Image Denoising with 2D FIR Filter by using hybrid Differential Evolution Algorithm

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Abstract— The digital image processing deals with development of digital system that performs operations on a digital image and there manipulation through a digital computer. It's a subfield of systems and signals but focusing particularly on images. DIP focuses on development of a computer system which is capable to perform processing on an image. This system involves input of digital image, its processing through algorithm and a processed image as an output. Image noise is random variation of color or brightness information in images, and is usually an aspect of electronic noise. Electronic noise can be produced by the sensor, circuitry of a scanner , digital camera or dust particles. Filters are used to remove noise from digital images while keeping the details of image preserved is a necessary part of image processing to enhance the quality of the image many filters are used for the removal of noise. 2D FIR filter can be used for denoising the noisy images. Emphasis is made on denoising of Gaussian noised images through 2D FIR in the paper. At the first stage, we present a 2D finite impulse response filter design using differential evolution algorithm. At the second stage, to demonstrate the robustness of the filter algorithm it was implemented for the Gaussian noise for the noisy images. The proposed approach will show improvements in filter design.

Key words: digital image, image processing, Gaussian noise, 2D FIR filter, Denoising

I. INTRODUCTION

Images are corrupted by random and unnecessary variations in intensity values called noise due to non perfect camera acquisition or environmental conditions. Different factors may be responsible for introduction of noise in the image insufficient light levels and sensor temperature may introduces noise in the image,the image may also corrupted due to interference in the transmission channel, the noise in the image can also be introduced if dust particles are present on the scanner screen. Filtering in an image processing is a basic function that is used to perform many task such as noise reduction.

Image denoising still remains a fact of risk because noise removal can result loss of details And can causes blurring of the images.Noise modeling in images is differs accordingly as change in capturing instruments, data transmitting media, image Quantization and discrete sources of radiation. Different algorithms are used depending on the type of noise model.

Image denoising is a process of correction and modification in image so that the resultant image is well suited for further analysis by human or machine.The principal objective of image Denoising is the modification of the image attributes so that it becomes suitable for the observer.in this process image attributes are modified for improvisation in image quality.

II. NOISE MODELS

The main source of noise in digital images arises during image digitization or during image transmission. The performance of image sensor is affected by variety of reasons such as environmental condition during image acquisition or by the quality of the sensing element. For example, during images capturing with CCD camera, sensor temperature and light levels are major factors that affects the amount of noise in the image. Images are corrupted while transmission of images. The principal reason of noise is due to interference in the channel which is used for the image transmission. We can model a noisy image as follows:

$$A(x,y) = B(x,y) + C(x,y)$$

Where B(x ,y) is the original image pixel value and C(x ,y) is the noise in the image and A(x ,y) is the resulting noise image.

III. IMAGE DENOISING

Image denoising is an image processing task which holds its importance as a process as well as a component of other processes. There are many ways to denoise an image or a set of data . A good image denoising model removes noise from the image preserving its details and edges.

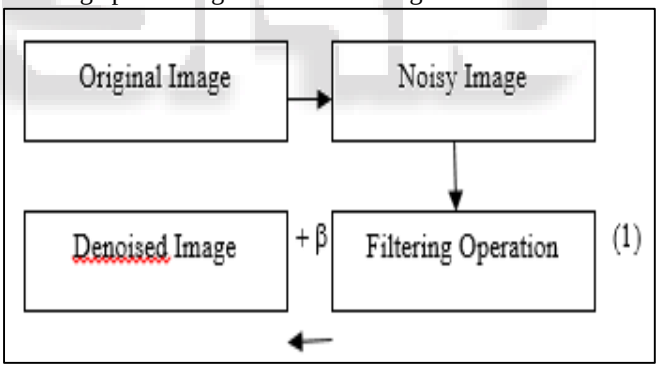

Fig 1: Framework of image denoising process

The above figure explains simple process if denoising. An image is feeded to the computer system. The system should have required algorithms to detect the type of noise in the image. Afterwards the algorithm determines the corrupted pixels in the image and following the procedure heals the affected area by changing the pixel intensity or by method as such required. The procedure of image correction is also termed as image filtering. After this procedure a denoised image is obtained. It should be noted that the processed image should not loose any of its characteristics ir details but since its not always possible so the loss of quality should be minimized.

IV. LITERATURE REVIEW

K Freeman, M Reicher (2015) detailed study about a different method for image denoising and how it is importance for image processing. The domains discussed

here is the spatial domain by which we can enhance the image for visualization and further processing[11].

SerdarKockanata, NurhanKarabogab(2015) proposed that In order to demonstrate the efficiency and the perfor-mance of

The 2D-ABC adaptive filter algorithm, it was firstly ap-plied to the 2D-ANC setup for image noise filtering[7].

Kotha Srinivasa Reddya, Subhendu Kumar Sahooa (2015) presented that approach for the design of low complexity, low power FIR filter with reduced delay using evolutionary algorithm. DE algorithm was used as the evolutionary algorithm for optimizing filter design[8].

Jingyu Hua • Wangkun Kuang • Zheng Gao •Limin Meng • Zhijiang Xu (2014) proposed a denoising method through the 2-D FIR filtering approach, where coefficients are generated by the DEPSO algorithm. Training the system with noisy and noiseless images, the generated filters helps to yield better visual quality than the conventional lowpass filtering approach.

Serdar Kockanat, Nurhan Karaboga, Turker Koza (2012) suggested the methodology that The artificial bee colony algorithm has been applied to design 2D FIR digital filters for the noise elimination on the noisy images.

Pawan Patidar, Manoj Gupta, Sumit Srivastava, Ashok Kumar Nagawat (2010) presented that The performance of the Wiener Filter after denoising Gaussian noise is better than Mean filter and Median filter. The performance of the Median filter after de-noising for all Salt & Pepper noise is better than Mean filter and Wiener filter.

V. PROPOSED METHODOLOGY

Differential evolution is an optimization algorithm to find the optimum solution for a given problem by iteratively trying to improve the solution without sacrificing the system quality requirement. In this firstly some amount of noise is added in to original images then this image is taken as an input image, after that wavelet parameters are initialized and then wavelet transformation are done. After transformation filtering is done. By using differential evolution algorithm 2D FIR filter is designed. By using proposed algorithm i.e hybrid differential evolution algorithm filter coefficient are optimized. On the basis of the optimization criteria denoised image will be obtained.

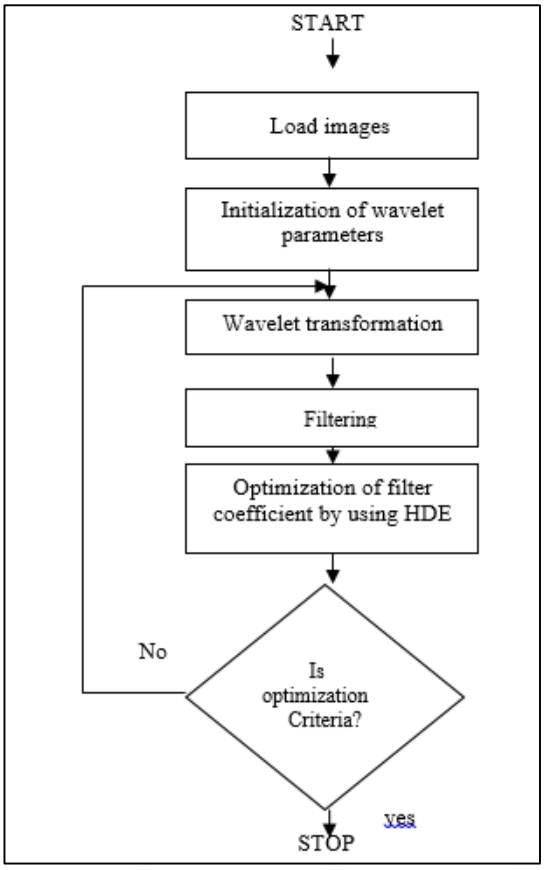

Fig. 2: Steps for Proposed methodology

VI. RESULT AND DISCUSSION

In this paper we tried to show a method for image denoising and how it is importance for image processing. In this paper we tried to show our implemented method for designing of 2D FIR filter using two major steps as 2D Filter Design using Hybrid Differential Evolution algorithm and then filter it to the different levels.

A. Original Noiseless Image:

Fig. 3: Original image

Salt-and-pepper noise is added into the noiseless image and taken as an input image:

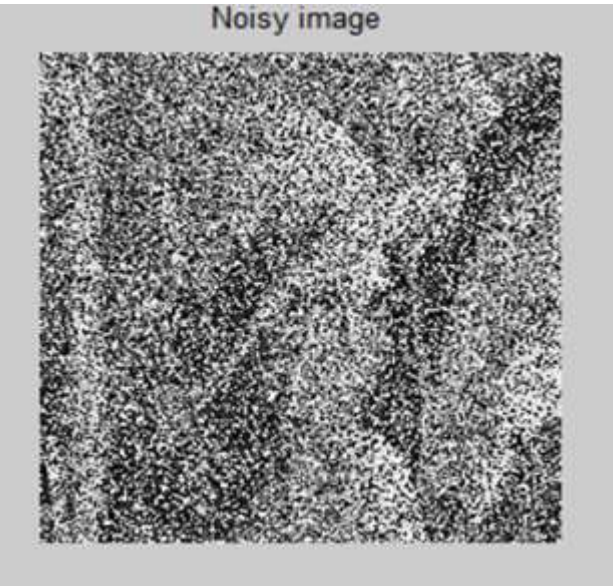

Fig. 4: Noisy image

Denoised image by using universal thresholding:

Fig. 5: Image by universal thresholding

Denoised image using proposed method i.e hybrid differential evolution algorithm:

Fig. 6: Denoised image using HDE

B. Comparison On The Basis Of Noise Levels:

Comparison is done on the basis of noise levels for noisy image, universal thresholding and for hybrid differential evolution algorithm:

S.NO	NOISE LEVEL	PSNR(NOISY IMAGE)	PSNR(UNIVERSAL THRESHOLD IND)	PSNR(HYBRID DIFFERENTIAL EVOLUTION)
1.	0.05	66.6237	69.7652	75.5287
2.	0.1	63.6873	67.8098	74.1633
3.	0.15	61.8795	68.4904	72.8608
4.	0.2	60.6073	70.3631	71.7960
5.	0.25	59.6292	69.3335	70.8144

Table 1: comparison on the basis of noise levels

VII. CONCLUSION

For removing the noise from noisy images, filter is designed by using the hybrid differential evolution algorithm. In the original image the Salt-and-pepper noise can be added for obtaining the noisy images. By applying the filter into the noisy images the noisy pixels can be detected and removed.

Image denoising still remains a fact of risk because noise removal can result loss of details and can causes blurring of the images. Noise modeling in images is differs accordingly as change in capturing instruments, data transmitting media, image Quantization and discrete sources of radiation. Different algorithms are used depending on the type of noise model.

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