# IMAGE DENOISING WITH 2D FIR FILTER BY USING 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.**

**Keywords: - 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. NOISE TYPES

Types of Noise are following:-

A. Amplifier noise (Gaussian noise)
B. Salt-and-pepper noise
C. Shot noise (Poisson noise)
D. Speckle noise
E. Film grain

A. Amplifier noise (Gaussian noise)

Gaussian noise in digital images are mainly arised during acquisition of image. The standard model of amplifier noise is additive or Gaussian or independent at each pixel and independent of the signal intensity. In color cameras due to more use of amplification in the blue color channel as compared to the green or red channel, there can be more noise in the blue channel .Amplifier noise is a major part of the read noise of an image sensor, that is, of the constant noise level in dark areas of the image. In digital image processing Gaussian noise can be reduced using a spatial filter, though when smoothing an image, an undesirable outcome may result in the blurring of fine-scaled image edges and less details because they also correspond to blocked high frequencies.

B. Salt-and-pepper noise

An image containing with dark pixels in bright regions and bright pixels in dark regions is called salt-and-pepper noise. This type of noise can be caused by dead pixels, analog to digital Conversion errors, bit errors in transmission channel etc. This can be eliminated in large part by using dark frame subtraction and by interpolating around dark/bright pixels. The salt-and-pepper noise is also called shot noise, impulse noise or spike noise that is usually caused by wrong memory allocations ,malfunctioning pixel elements in the camera sensors, or due to timing errors in the process of digitization .

*Common reasons causing Salt and Pepper Noise:*

I. Due to memory cell failure.

II. Due to malfunctioning of camera sensor cells.

III. Due to synchronization errors in image digitizing or transmission.

C. Shot noise (Poisson noise)

When the finite number of particles that carrying energy, such as electrons in an electronic circuit or photons in an optical device and is small enough to give rise to detectable statistical fluctuations in a measurement then the electronic noise thus raised is known as Poisson noise or shot noise.

D. SPECKLE NOISE

Speckle noise is a granular noise that is inherideted in and degrades the quality of the active radar image and synthetic aperture radar images. speckle noise in conventional radar is a results of random fluctuations in the return signal from an object that is no bigger than a single image-processing element. reluctantly increases the mean grey level of a local area. it is caused by coherent processing of backscattered signals from multiple distributed targets.

E. Film grain

Film grain is the random optical texture of processed photographic film due to the presence of small particles of a metallic silver, or dye clouds, developed from silver halide that have received enough photons. While film grain is a function of such particles it is not the same thing as such. It is an optical effect, the magnitude of which depends on both the film stock and the definition at which it is observed. It can be objectionably noticeable in an over enlarged photographic film photograph.

## IV. 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.

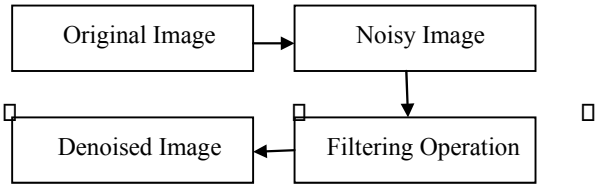


Fig: Framework of image denoising process

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.

## V. 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.

## VI. 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. Differential evolution optimizes a problem by generating a population of random solutions and creates a new solution by combining the existing ones.The differential evolution algorithm is a heuristic global optimization technique based on population which is easy to understand, simple to implement, reliable, and fast.

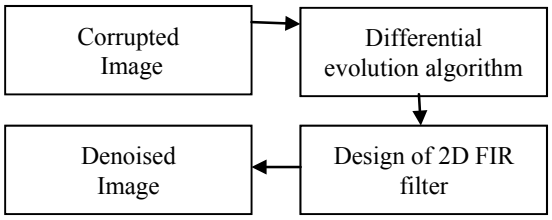


Fig: Steps for Proposed methodology

## VII. RESULT AND CONCLUSION

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 Differential Evolution algorithm and then filter it to the different levels.

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