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A Novel Approach for Image Enhancement Using Morphological Operators

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Abstract
Image Enhancement through De-noising is one of the most important applications of Digital Image Processing and is still a challenging problem. Images are often received in defective conditions due to usage of Poor image sensors, poor data acquisition process and transmission errors etc., which creates problems for the subsequent process to understand such images. The present paper gives the detail of various noise effects on the images and also discusses the methods to remove the noise by using Gaussian filter and to enhance the image quality using bilateral filtering method. The Experimental results performed on a set of standard test images for a wide range of noise corruption levels. The present paper also discusses the enhancement of the text images. The work is implemented on the MATLAB environment. The various results are shown in the simulation result section.

Keywords
RGB (red, green, blue), Image enhancement, noise, MATLAB, spatial domain etc.

I. Introduction

Image De-noising and Enhancement are the key research fields in Image Processing as they are useful in several applications such as Feature Detection, Medical Image Processing, Remote Sensing, Machine vision etc., which improves the image clarity and visual perception of human beings. They modifies images to improve them (enhancement, restoration), extract information (analysis, recognition), and change their structure. It improves the clarity of the Image for Human Perception. Edge Enhancement, Sharpen (create more contrast between neighboring pixels), Soften (blend the edges of neighboring pixels), Blur removing (blend together pixels of the image), Raising Contrast, Medical Imaging (CT scan and MRI images) are some of the Image Processing functions. Grayscale images are distinct from one-bit black-and white images, which in the context of computer imaging are images with only the two colors, black, and white (also called bi-level or binary images). Grayscale images have many shades of gray in between 0 and 255. A 640 x 480 grayscale image requires over 300 KB of storage. Linear and Non Linear Filtering Techniques are used for Image De-noising and Enhancement.

On the other hand, image denoising from natural and unnatural images is still a challenging problem in image processing. Indeed, wavelets transform based approaches have efficient noise reduction ability in photographic images and promising results are reported in these references. Recently, multiple wavelets basis image denoising methods are also reported with remarkable performance. However, still these approaches have problems on a heavy noisy network. Additionally, wavelet based approaches are computationally expensive and are not suitable for non-natural images.

A. Different Types of Noises

There are several noises that may degrade the quality of an image

- Amplifier noise (Gaussian noise)
- Salt-and-pepper noise
- Quantization noise (uniform noise)

In our proposed work we have considered the effect of Gaussian noise and we have proposed a method to denoise the noisy image using Gaussian filter. The proposed work also considers the enhancement of the image using bilateral filtering method.

II. Related Work

Morphology is a set theory approach, developed by J.Serra and G. Matheron, process the digital image based on geometrical shape i.e. by applying a structuring element. It has various applications in bio-medical imaging, Geo-science, Remote sensing, Quality control, Document processing and Data analysis. The value of each pixel in the output image is based on a comparison of the corresponding pixel in the input image with its neighbors. The extraction and enhancement of shape information from images is one of the important tasks of mathematical morphology. Basic operations of morphology are dilation and erosion. More complicated morphological operators can be designed by means of combining Erosions and Dilations. Dilation adds pixels to the boundaries of objects in an image.

Monedero et al [7] proposed a spatially variant erosions/ dilations and openings/closings approach. Structuring elements (SE) can locally adapt their shape and orientation across the direction of the structures in the image. The process of extracting shape and orientation of the SE at each pixel from the image is under study. This method is useful in the enhancement of anisotropic features such as coherent, flow like structures. A general method based on fuzzy implication and inclusion grade operators have been discussed by Yee Yee Htun et al.

III. Proposed Formulation

For the purposes of image analysis and pattern recognition there is always a need to transform an image into another better represented form. During the past five decades image-processing techniques have been developed tremendously and mathematical morphology in particular has been continuously developing because it is receiving a great deal of attention because it provides a quantitative description of geometric structure and shape and also a mathematical description of algebra, topology, probability, and integral geometry. It is mathematical in the sense that the analysis is based on set theory, topology, lattice algebra, function, and so on.

A. Binary Morphology

Binary morphology is extremely important for fast, low-level image matching operations. Every commercial 'machine vision' system has it because of its usefulness. Back in the period around 1990, to do fast pattern matching, there are provisions for getting a system from any one of several firms. The basic binary morphology operations are dilation and erosion. In a binary image, to refer the foreground (black) pixels variously as 'black', 'foreground', 'ON' or '1'. To refer the background (white) pixels variously as 'white', 'background', 'OFF' or '0'.

Gaussian Filtering De-Noising

The Gaussian filtering is an important space for the weighted mean filter. It is based on the shape of the Gaussian function to select the right value of linear smoothing filter. It usually uses the Gaussian function of discrete two-dimensional by zero-mean to be smoothing filter. The following equation as below:

$$g(x,y)=\frac{1}{M}\sum f(x,y)\exp\left[-\left((x-i)^2+(y-j)^2\right)/2\sigma^2\right]$$

In our proposed work we have used Mathematical morphological operator for the manipulation of the images. We have considered the above said point in our approach to enhance the captured images. Further we have also considered the power law transformation technique for the result analysis.

IV. Simulation Results

Fig.1: Original Image

Fig. 2 : Noise effected noise

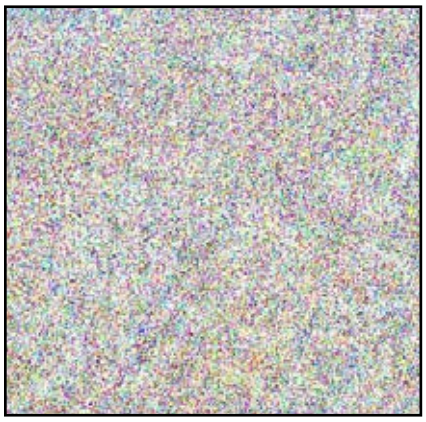

Fig. 3 : Image effected by Gaussian noise

Fig. 4 : Recovered image

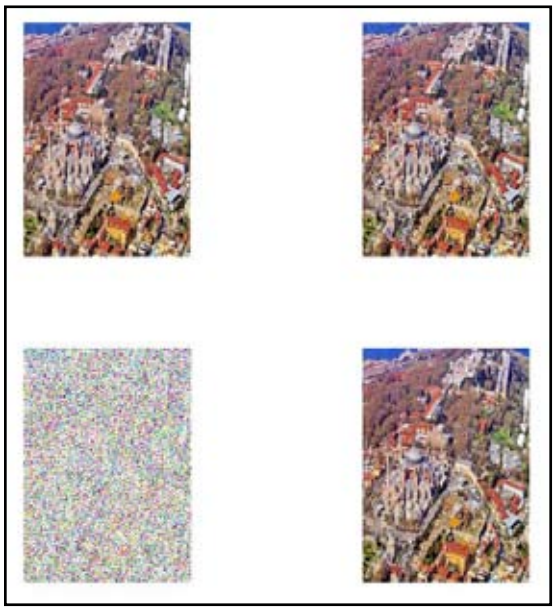

Fig. 5 : Comparing the Four aspects of images

IV. Conclusion and Future Scope

In this paper, we have presented an intelligent approach based on cellular neural network for adaptive noise denoising. Experimental results of proposed intelligent denoising algorithm exhibit high performance. In our proposed work transformation function is defined to enhance the image and algorithm is proposed which is based on morphological operators. The proposed algorithm is implemented in MATLAB. This proposed algorithm is able to overcome the drawbacks of previous methods like thresholding, histogram equalization and fuzzy methods.

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For future prospective the work can be extended using Neural network. The images can be tested with different noise with different parameters. Further the work can be included the part of mathematical calculations including different parameters.

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