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UNIVERSAL FILTER

REVIEW OF VARIOUS TEHCNIQUES USED TO TACKLE NOISE ALONG WITH DISTINCT PERFORMANCE COMPARISON OF FILTERING TECHNIQUES

[1]Pooja devi-Student, [2]Taqdir-Assistant Professor, [3]Shagun Mahajan-Student
[1]CSE Department, Gndu Gurdarpur Campus, India
[2]CSE Department, Gndu Gurdaspur Campus, India
[3]CSE Department, Gndu Gurdaspur Campus, India

Abstract: The graphical user interface is the need of the hour which is provided with the help of image processing techniques. The image processing techniques enhance the representation of data. Image may has to be transferred from one point to another using some medium. The problem start to appear if the medium is corrupted. This will cause the noise within the image. The proposed work provide state of the comparison between the various noise handling mechanism within the image. The comprehensive comparison table is also provided that indicates which filtering mechanism provide best possible solution.

Keyword: Graphical user interface, Noise, Medium, Noise Handling Mechanism, filtering mechanism

INTRODUCTION

The image processing is utilized in almost every area. This is due to the fact that information representations become impressive by the use of image processing. The problem starts to occur during transmission of image. The representation of image also suffers from rise in temperature. [1]All of these problems can be tackled using filtering mechanism. The legion of methods of handling the noise is devised but desired level of applicability is yet not achieved. The noise handling mechanisms are described in this section.

NOISE MODEL

The noise model discussed is going to handle distinct noises such as Impulse Noise, Shot Noise, and Gaussian Noise etc. The noise handling mechanisms required in order understand type of noise present and then utilize appropriate noise handling mechanism in order to eliminate the noise from the image.[2] The noise generally introduced within the image when intensity of pixels within the image crosses threshold values. These threshold values will be 0 and 255. The threshold values are listed in terms of following equation

Y_{ij} = 0 to 255 with probability p
X_{ij} with probability i-p

If p is the total noise density then salt and pepper noise will has noise density of p/2. The salt and pepper noise is present if pixel value lies at 0 or 255. These are the gray scale levels. In case of random impulse noise any value from the gray scale levels can be chosen. This level can distort the image which is required to be rectified. [3], [4] The gray scale levels of noisy pixel can be specified by the use of following equations.

$Y_{ij} = N_{ij}$ with probability p
X_{ij} with probability i-p

Where N_{ij} is the gray level values of noisy pixels. The type of noise which can be handled through the filtering mechanism are listed as follows

Adaptive Noise

The adaptive noise is also known as adaptive gray scale white Gaussian noise which can distort the image by altering the distribution of pixels.[5], [6] Mathematically it can be represented as

$G(x,y)=f(x,y)+n(x,y)$

Where n(x,y) indicates the noise present over the distribution f. By combining noisy and normal distribution overall image is formulated.

Multiplicative Noise or speckle noise

This type of noise is generally present within the medical image.[7] The multiplicative noise is represented with the help of following equations

G(x,y)=f(x,y)*n(x,y)

Impulse Noise

This type of noise appears within the image when pixel intensity value lies between 0-10 and 240-255 range. In order to overcome this problem generally median filter is utilized. [8], [9]

IMAGE DENOSING TECHNIQUES

There exists legion of work which is done toward the image de noising. The de noising of image is accomplished through the filtering mechanism. The filtering mechanism however is not full proofed. The denoising mechanism introduces clarity by removing corrupted pixels or smoothen the pixels.[10], [11]

Spatial filters

This filter is traditional mechanism of removing the noise from the image. The spatial noise is further divided into following categories

- **Linear Filter**
  Linear filters are used to handle the noise within the image which is linearly described. In case noise is not uniformly distributed then edges or sharply described parts can be destroyed by the use of linear filter. The linear filters are further divided into following parts[12], [13]
- **Mean Filter**
  This filter is also known as sliding window spatial filter. The centre of the window is simply replaced by the mean value of the pixels obtained through the average of pixels obtained. [11], [14]
  Wiener Filter
  This filter is utilized only if signal is smooth. This filter required information about spectra of noises. The noise handling mechanism implemented in this case requires linear structure.
- **Non Linear Filters**
  The linear filters rectify the pixels which has low pass associated with them. This means that they handle the pixels occupying high end frequency regions in the spectrum. The non linear filters on the other hand handle the pixels occupying low end of the spectrum. This means that they handle high end pixels or high pass filters. The simplest filter in this case is median filters.[13]
- **Median Filters**
  The median filter is generally used in order to handle salt and pepper noise. The median filter calculates the median of the neighbouring pixels. The median is replaced by the corrupted pixel. The noise in this way is removed and handled efficiently. [15]
  The median is calculated using the following equations
  If n(total number of pixels) is even
  $$X_{Med} = 2x_i\left(\frac{n}{2}\right) + 2x_i\left(\frac{n}{2}\right) + 1$$
  If n(total number of pixels) is odd
  $$X_{med} = \frac{2x_i(n+1)}{2}$$
- **Spatial Median Filter**
  It is also noise removal mechanism. It is used by calculating the depth value of a particular pixel and depth value of set of pixels. The spatial depth is calculated using the following equation
  $$S_{Depth} = 1 - \frac{1}{N-1} \left\| \sum X - X_i \right/ \left\| X - X_i \right\|$$

COMPARISON OF VARIOUS FILTERING TECHNIQUES

The following table shows the comparison of various filtering mechanism on the image

Filtering Mechanism	Effect
Median Filter	Applied on image with salt and pepper noise and its is under non linear filter.
Mean Filter	It is sliding window filtering technique which is under linear filtering scheme. It cannot be used in order to tackle complex image noise pattern
Wavelet Filtering	It is used in order to handle noises which lie in abnormal spectrum ranges. In other words mix noise can be handled using this scheme

Adaptive Filtering	Requires less computation time and it appear under linear filtering scheme
Weiner Filtering	Inverse noise handling mechanism and smoothening appear under this filtering mechanism
Anisotropic Filtering	It is used in order to preserve the edges of the image

Table 1: Showing Comparison of various Filtering techniques[16]

CONCLUSION

The image filtering mechanism is described in order to evaluate each technique to determine which filter is better in distinct situations. Adaptive filtering out of available techniques has least computation time associated with it. So the filtering can be merged together by using pros and cons of distinct techniques to form a filter to handle different type of noise.

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