A SURVEY ON VARIETAL NOISE AND FILTERS ON IMAGES

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Abstract

Images are available in large numbers which are tend to get affected by various factors like noise(i.e) defects in the image which includes bad light, false exposure and improper maintenance etc. So these images are to be preserved properly for the future reference. Images may have various noises like salt, salt and pepper, speckle etc., and for these noises we use filters like Total Variation Filter, Max, Min, Arithmetic mean etc. In the proposed work we use various noises and various filters for the clear image and perform the enhancement of these images.

Keywords:
Total Variation filter,Max, Min, LOG, Arithmetic Mean, Salt, Speckle, Salt and Pepper

1. Introduction

Images include documents of various periods which are affected by folding marks, age, and improper maintenance. [1].

Noise occurs in image which comes during acquisition and transformation of these images. [2]

Figure 1 example of an image s(x,y) and noise $\eta(x,y)$ is added to image which is degraded by w(x,y). which have a restoration process g(x,y) produces acquired image z(x,y).

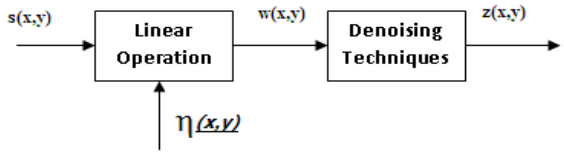

Figure 1. Restoration and denoising Concept

Salt Noise

Salt noise are sparse light disturbances, pixels in the image are very different in color or intensity unlike their surrounding pixels. Salt can be caused by sharp and sudden disturbance in the image signal. The salt noise is a disturbance which occurs on the image and these types of images tend to provide a salt like appearance on the image. The salt noise when added to the image provides white dots scattered all over the image.

Salt and Pepper noise

The term impulse noise is also used for this type of noise. Other terms are spike noise, random noise or independent noise. Black and white dots appear in the image as a result of this noise and hence salt and pepper noise. The salt and pepper is an expansion of salt noise because in salt noise we have only white dots but when using pepper noise we also add black dots to the image [2]

Speckle noise

This noise can be modelled by random value multiplications with pixel values of the image and can be expressed as

$$K = J + m*J \quad (1)$$

Where, K is distribution image with speckle noise, J is the image which is given add input and m is the image with noise. This noise deteriorates the quality various images. The random values are chosen depending upon the equation which is given. The speckle noise when chosen has random multiplied values.

Gaussian noise

Gaussian noise [3] is periodically distributed image which matches each pixel with the original and noise image which shows the Distribution using a bell shaped probability function. In Gaussian noise the noise is scattered and distributed among the image where as these scattered image are clustered among the particular area and this image is chosen for further enhancement.

The Gaussian image is a distributed noise which when scattered produces a high impact of noise and when clustered it reduces the impact of noise on the image which is to be enhanced.

Poisson noise

This noise deals with electromagnetic rays such as X-Rays etc. In this the rays are passed through the image and the images are gathered by these rays. In this noise the fluctuations vary on these images because of the electromagnetic waves formed on the images. The images provide a higher impact when the rays pass on the higher beam. The amount of rays provides the effect on the images. This noise obeys the Poisson distribution and is given as

$$j(f_{(ip)}) = t = \lambda^t f^{e^{-\lambda}}/t! \quad (1)$$

2. FILTERING TECHNIQUES

Various filtering and noise techniques are available and these filtering techniques are both linear and non-linear. The linear deals with the values and the non linear deals with the pixel positions of the images.

2.1 Total Variation Regularization:

The Total Variation Regularization technique is used for performing denoising of the images and these images are helpful in removal of noises from the original images. The TVR method not only denoises the image but help for smoothening of the images in particular.

The Total Variation deals not only for denoising of images but also for stabilization of these images to make the user to view the images in a clear manner.

The data fidelity D measures

$$E(b|c) = \frac{1}{2}\sum_{s\epsilon S}(b(r) - c(r))^2 \forall b\epsilon\Omega \quad (2)$$

Where b is a image defined on Ω. The value of the image b at site s is denoted by b(r).[1]

The equation provides a denoising technique on the image with the noise and these images tend to provide the smoothening of the image. Once the image is denoised the process of smoothening is the important step in the smoothening process. The denoising of images is done during the preprocessing of images because during the preprocessing process the images are denoised and the smoothening process is done to have a clear image.

2.2 Non-local Means Method

Non-local means is technique in which the image denoising is carried out which groups all the pixels in the image and smoothen the image based on the pixels and the main pixel is chosen and the target pixel is smoothened based on the amount of noise present on these images.

The image is choosen which is the default image and these images when applied with the NL method provides a clear indication of the images. Once the image is selected the pixels are taken into consideration and these pixels combine to form a linking of values which indeed is essential.

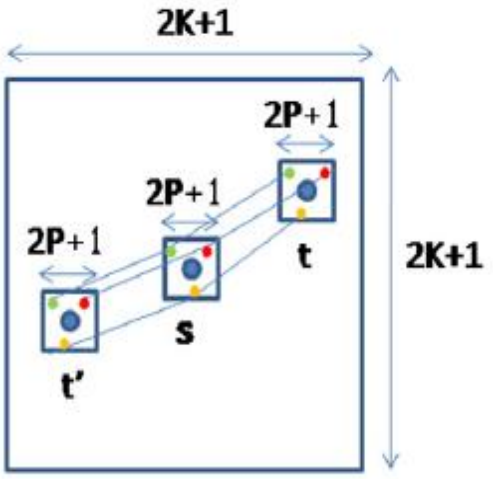

Figure 2. NL means approach: two patches Δ of size 2P+1 the similarity measure between patches is computed from all pairs of points at the same location within patches.

Once the patches are selected these patches are clustered among the pixel. These patches tend to form a pattern among themselves. Once the patches combined to form the clustering variable the window selects the image. The selection of image based on the patch provided is the important step in NL Means.

As the steps are carried out these patches are important in selection of the images.

3. Current Work

The current work deals study of various noises along with various filters in relation with Total Variation Regularization and Non Local Means method.

3.1 Arithmetic Mean filter

Arithmetic Mean filer is the most important filtering technique in which the Bcd is the sub window which is rectangular in nature. This technique calculates the images and the value is set to the restored image a in which (c,d) is the centered image. The filter techniques takes the matrix values a[0,0] …Once the matrix value is finalized these images takes the center value of the pixel from which the surrounding pixels are taken and evaluated. Once the values are gathered the values is stored in the midpoint. The midpoint is the restored value of the image f at any point (c,d) is simply the Arithmetic Mean computed using the pixels in the region defined by S_{xy}.[5]

3.2 Laplacian of Gaussian

The laplacian of Gaussian image deals with the graylevel and the density of these images in which the input images is taken and it is converted into a grayscale image for which the LOG filter is used and the enhancement is performed. The grayscale image is the black and white image when converted provides a clear view of the image which has a higher gray level of the image.[6]

$$\mathrm{LOG}(a,b) = -\frac{1}{\pi\sigma^4}\left[1-\frac{a^2+b^2}{2\sigma^2}\right]\frac{e^{-a^2}+b^2}{2\sigma^2} \quad (3)$$

The LOG filter deals with only the gray level images with higher density of images. The Equation takes two values a,b in which the lambda and sigma values are taken from the pixel values a,b.

3.3 Max/Min Filters

The filters max and min are the rank order matrices which are related to morphological operations. The maximum filters are denoted by white dots and the minimum filters are denoted by black dots. The maximum filters give the max values for the pixel representation of the images. The minimum filters give the min values for the pixel representation of the image. These filters are also called as mean filters which calculates the intensity values using the mean and median value of the pixel positions.[5]

The max is the value which is derived from the pixels with the highest density whereas min is the value which is derived from the pixels with the lower density. Once the values are gathered the best among the two image is known.

3.4 Frost Filter

Frost filter invented by frost which takes the weighted values for the pixel window. These waited values are substituted for the image co-ordinates. These co-ordinates are taken from the pixel position of the images.

The outcome of the pixel value varies depending upon the co-ordinate value. The value changes with regard to the position of

pixels in the image. These pixels make a change in the value.

3.5 Range Filter

The main usage of range filter is to detect the edges in the images. These images are helpful if there is a folding mark in the image in that case these images use the range filter to perform enhancement in the images.

The range may be higher if the luminance on the image too high. In that case these images are to be preprocessed so that the outcome is not affected. The range is an expansion of rank filter in which the image with higher luminance has a higher rank level and higher visibility.

The visibility mainly depends upon the brightness of the image and the availability of the image which can be from the oldest to the present. Each image has a different impact due to the defects on the image.

3.4 flow diagram

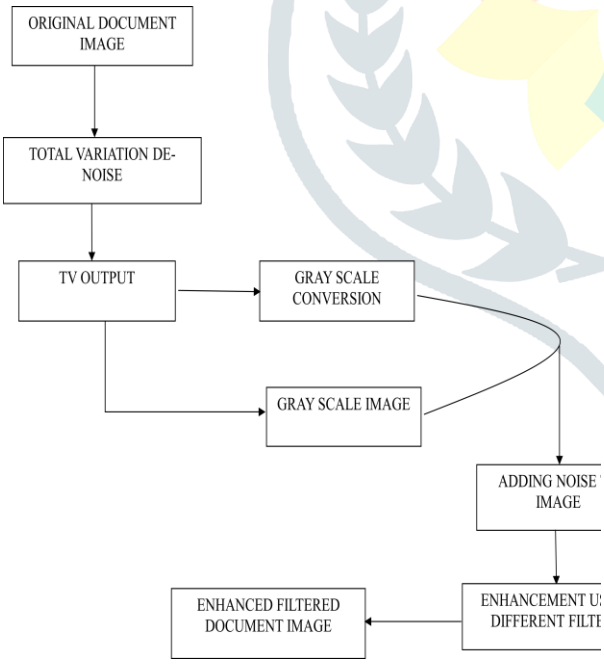

Figure 3. Flow of document Image enhancement

1. The original image is chosen from the available list of images.
2. In order to perform the enhancement the original image is transformed into a grayscale image.
3. After the conversion of grayscale image the noise is added to the images.
4. The images with the noise are enhanced using the available filters.
5. Calculation of the values of the images is carried out to find the quality of the image.
6. Save the image if it is required.

The process is same as that of document image with noise but, the only difference is instead of adding noise the document image is directly enhanced using various filters.

Once the above process is selected and the task is confirmed the steps are carried out provide for the image with noise and without noise images. The image when used in the process provides a step by step enhancement of images.

Once the enhancement is performed the outcome depicts the clear view of the image which is saved for future use.

4. Comparative study

The original image when added with different noises provides various effects on the image which may be good or else bad. When taking into consideration the various noises each noise has a unique effect in which one provides a dot on the image whereas one provides blurring of the images.

Once the noise is added to the image the removal of noise should take place which indeed a tedious task as some of the filters provide enhancement for certain images. Each filter has its own advantages and disadvantages.

Some filters when added on medical images provide a clear view of the enhanced images whereas adding on document images provides a loss on the quality of the image. In order to avoid those loss of quality all the images should be converted into grayscale images which is essential for enhancement of the image.

Once the image is converted we can add noise to the image and make the image addicted to noise and then the concept of filters used to remove the noise from image which is added. In the next case the noisy

image is taken in which the sharpening of images takes place if needed. It is carried out for the purpose of highlighting the edges in the image.

5. Conclusion

The proposed work discuss about the various noises and various filters in the enhancement of images. The comparative study helps to know about different noises how they are added to the image and how these filters help to reduce the amount of noise on the image.

Different filtering techniques are taken into consideration and about the images which are apt for filters because these filters work better on different types of images namely document images, medical images etc.,

In this study we deal with different noises which can be added to the images and how the filtering techniques
are helpful for removal of noise from the image and also about removal of noise from the images which are already in the image.

6. Future Work

In the future we can implement this technique to videos so that the unwanted disturbances in the video can be easily sorted out and a clear video will be made available, mainly of the videos which belong to the olden periods. Once this Total Variation combined with Non Local Method is used on the videos it provides a clear visual to the users.

The videos can be of any quality and any format but these techniques are helpful to provide a clear view of the videos which the normal user expects.

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