Fuzzy Logic based Adaptive Noise Filter for Real Time Image Processing Applications

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Abstact

In this paper we implement a new technique for detection and removal of impulse noise from the grayscale digital images. Proposed method consist of of three steps, in the first step, center pixel of the window is tested whether impulse noise is present or not, detected pixel has impulse noise when it lies outside from the trimming range by using fuzzy reasoning. In the second step, we replace the noisy pixels by using median filters. In third stage we create a histogram if the image and again remove the noise by using soft thresholding.The results of the proposed technique for the removal and detection of impulse noise from the gray scale images is very good rather than exiting technique in terms of PSNR values.

Keywords: Median filter, Soft thresholding, Fuzzy logic,histogram.

INTRODUCTION: Whenever an image is converted from one form to another such as, digitizing, scanning ,transmitting, storing, etc., some of the degradation occurs at the output. Hence, the output image suffer from a special kind of noise "salt & paper. Salt & paper significantly degrades the image quality. An image denoising is used to remove the additive noise. the goal of image denoising is to estimate the original image from the noisy image. Denoising is one of the important task and pre-processing step in digital image processing.there are many median filters are available for impulse noise reduction although these methods have been improved, but the quality of denoising image is still not satisfactory[1]. but this method is too time-consuming.Most of these algorithms provide suitable and good results at smaller percent of noise levels and find difficulty with higher level noises, also this method is too time-consuming and isn't suitable for real applications[6].we implement the new technique is better than the exiting technique. This approach has been adopted to remove noise from 'TV signal and to reduce interlaced scan related artifacts at the receiver side. Moreover. an algorithm for image quality enhancement has been developed which tunes locally the contrast and the brightness of the picture with respect to the global image characteristics.The proposed technique can work in low time and have better results in PSNR metric. It introduces the artifacts and blurring of the images. So it is a challenge for the researchers to remove the impulsive noise from the gray scale images while retaining the important signal features and explore the possibilities of various denoising technique for gray scale images.

2. **FUZZY LOGIC BASED ALGORITHMS FOR IMAGE PROCESSING** As far as noise is concerned the proposed filters have been designed to reduce respectively impulsive and Gaussian noise. The first one uses three cascaded fuzzy processes, which analyze the four directions into a (3x3) or (3x2) or (4x4) window centered on the pixel to be processed. The complete fuzzy

system is tuned in order to preserve the motion information and one pixel wide edges. The output of the last fuzzy stage provides an evaluation of the pixel noisiness. on the ground of which a median filter is weighted. Conceding the Gaussian noise. the classic temporal recursive average filter has been optimized with a fuzzy motion detector. This one uses fuzzy rules operating on a measure of the spatial and temporal pixel correlation in the vertical and diagonal directions of the (3x3) or (3x2) or (4x4) window. The motion detector selects the direction where the pixels are more correlated temporally and spatially: these information are used to compute the new pixel value resulting from the weighted average of the original pixel and the other window points in the selected direction. Here again motion information is unaffected by filtering. The same fuzzy motion detector has been used for the scanning rate up conversion. In this case. if the pixel is still. no interpolation is performed. otherwise a weighted average between a three point vertical median filter output and the selected direction pixels is used. A better image quality can be obtained by adding a fuzzy filter to adjust locally the luminance dynamic range and enhance picture details (Fuzzy- Contrast Luminance Controller or FCLC). This filter allows to recover details that are attenuated by dynamic range mismatches between the original and the displayed image. The filter is composed by two fuzzy processes respectively modifying the luminance range and enhancing the high frequency.

implementation

The implementation of the improved median filtering algorithm is used to reduce noise in the image. The simple idea is to examine the pixel values in the selected window of the input signal and replace the noisy and distorted or blurred pixels with the median/effective median. The program works by using a moving fixed 3 × 3 window of pixel neighborhoods. Then use the 3×2 and 4×4 window to remove the noise from the edges of the image also create the histogram of image.The proposed algorithm achieves very good results then the exiting algorithm.

The steps of the proposed algorithm is described as bellow

1. Read the gray scale image.
2. Add the "salt pepper" noise to the image.
3. 3*3 median filters is used to remove the noise from the gray scale noisy image.
4. 3*2 median filters by using fuzzy logic is used to remove the noise from the edges of the image.
5. 4*4 median filter is used by using fuzzy logic to improve the quality of the gray scale image.Also create histogram of the image.
6. Again create histogram of the previous image by using thresholding concept to remove the remaining noise from the gray scale image.

Figure (a).original gray scale lena image.Figure (b).lena image corrupted by 40% impulse noise. Figure (c).this image represent the filter outputs of the 3x3 matrix scanning fuzzy logic based. Figure (d). after apply the 3x2 and 4x4 matrix scanning fuzzy logic based. Figure (e) represent the better quality image and remaining noise is filtered by using the soft thresholding concept.

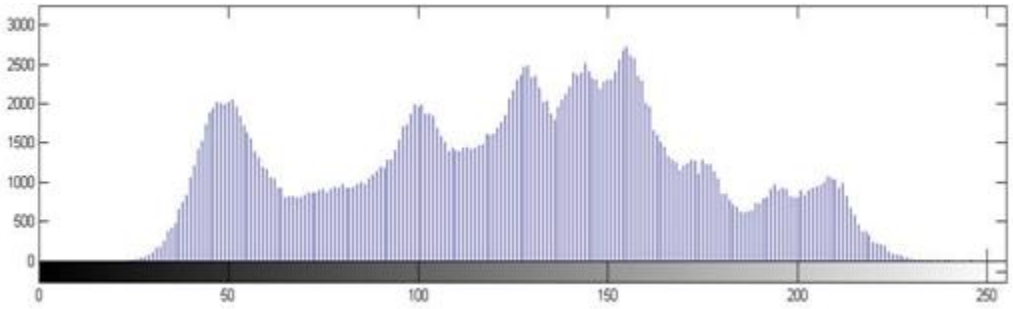

Figure (d.1).This is the histogram of the figure(d).After apply the 3x2 and 4x4 matrix scanning fuzzy logic based on the figure(d) and create histogram of the image.

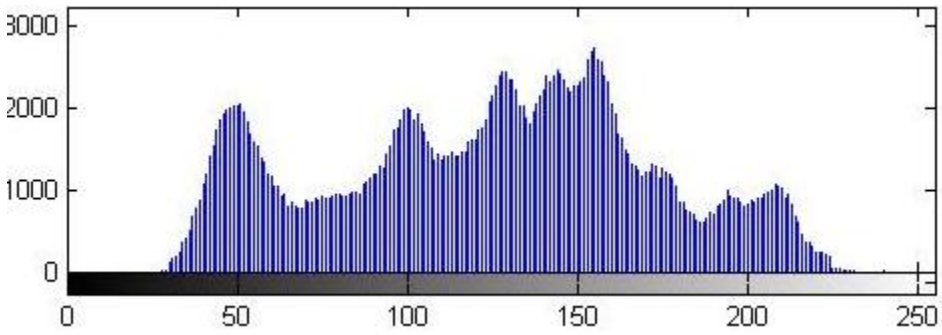

Figure (d.2).This is the histogram of the figure(e) by using the soft thresholding concept and create histogram of the image.

RESULTS: In order to test the performance rate of this proposed algorithm experiments are performed at different noise levels ranging from 5% to 40% on lena image. The lena image is 8-bit grayscale image. Impulse noise of different percentages ranging from 5% to 40% is added to lena image. the adaptive median filter which is based on the fuzzy logic is applied to the corrupted images by impulse noise. The performance of the proposed algorithms was evaluated in terms of the visual quality, the peak-signal-to-noise-ratio (PSNR) and the stability of the performance of filters on different types of images. The experiment was carried out to study the performance of the detection schemes in identifying the noisy pixels in the Lena image at different impulse noise ratios.

$$PSNR=10\log10(R^2/MSE)$$

$$MSE = \frac{1}{MN}\sum_{i=1}^{M}\sum_{j=1}^{N}\left[Y(i,j)-\hat{Y}(i,j)\right]^2$$

We analysis this method with PSNR (Pick Signal Noise Ratio) metric and visual comparison, the results show this method is very good for noise reduction and image restoration in high level noisy images.

Detection performance on the lena image for random variable impulse noise as follow:

percentage	5	10	15	20	25	30	35	40
Existing method(psnr)	35.77	34.61	33.46	32.57	31.74	30	29	28
Proposed method(psnr)	42.60	41.25	39.98	38.57	36.49	.35.59	33.11	32.09
Proposed method(mse)	3.59	4.90	6.98	9.08	14.68	18.08	31.97	40.47

Table 1:comparision of the results of Existing technique with the Proposed method technique filter for the lena image.

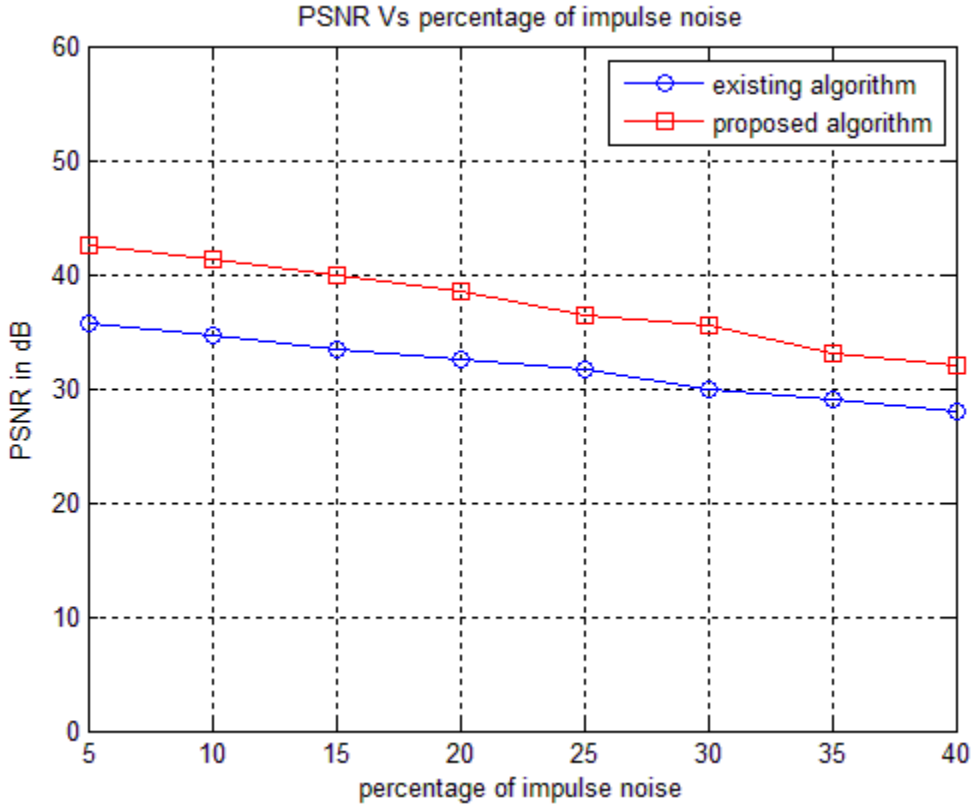

Figure 4.1: Variation of PSNR with respect to the impulse-noise percentage for different values on the Lena image for random-valued impulse noise.

CONCLUSION AND FUTURE SCOPE: It have been concludes that fuzzy logic based on adaptive noise filtering technique gives the better results as compared to the exiting technique. It detects and removes impulse noise in gray scale digital images.We detect noisy pixels by using fuzzy reasoning with lowest uncertainty and we replace noisy pixels with a median filter. After then remaining noise is removed by creating the histogram of that image by using soft thresholding method..We analysis this method with PSNR (Pick Signal Noise Ratio) metric and MSE (mean square error) and visual comparison, the results show this method is very good for noise reduction as compared with the exiting technique.

FUTURE SCOPE:In this thesis, noise detection is mostly covered and for noise filtration median filter is used. Research may be undertaken to devise better filtration techniques.This technique together with a best detection technique can result in optimal restoration of degraded image.As it has been stated that the existing as well as proposed techniques are computationally expensive, investigation may be carried out in this direction. The future plan of the proposed method is to extend it further for removing impulse noise from colour images.

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