Detection And Reduction Of Impulse Noise Using Fuzzy Technique

Shilpa Sanu Routray[#1], Sigma Nayak[*2], Utpal Chandra De[#3]

[#1,*2]*M.TECH (IT), Pg Department Of Statistic, Utkal University*

[#3]*Assistant Prof, School Of Computer Application,*

Kiit University, Bhubaneswar

Abstract **-** *Reflection processing is today's era, which is a method to improve unrefined images established from different shutter and sensors located on satellites, space props along with air craft's otherwise general pictures is use in everyday life for a variety of application. There is always an adequate probability and possibility of introduction of noise into the digital image during accession and / or broadcast of image. An elementary and vital trouble on icon processing is to successfully diminish noise from digital picture while charging its feature whole over the last several decades a enormous quantity of noise reduction method are built-up, most are meet for gray scale image. Since the result of the algorithm hang on the eminence of given picture so that in each picture processing algorithm value of an image plays a necessary responsibility. Therefore, numerous skills are used for image enhancement. Without having prior knowledge of noise; several of them are applied universal techniques to all the metaphors and called it as image enhancement algorithms. Our center of attention is on fuzzy image de-noising techniques for this paper. Particularly, we build up a latest fuzzy impulse noise detection and reduction method for RGB color image. Applied filtering technique for noisy pixel, expose by fuzzy method, when it protects the sharp edges and color.*

Keywords —*Impulse Noise, Color Model, Fuzzy Logic*

I. INTRODUCTION

Noise is an indiscriminate deviation of image intensity and visible as a part of grains in the picture. Multiple factor might be dependable for beginning of noise in the picture. In reality noise is classified in to two types:

- Blur noise
- Impulse noise

Blur noise is again divided in to two parts:

- Gaussian Noise
- Motion Blur

Impulse noise is also separated in to two category:

- Salt and Pepper noise
- Random Valued noise

Some common varieties of noise that arise into the images are:

- preservative noise
- Multiplicative noise
- Shot noise
- White noise

In an image processing Reduction of impulse noise is a very energetic research area. In this exertion we will represent a latest, quicker and an expert noise reduction process for ruined image through impulse noise. In favour of transparency we have to give the definition of impulse noise first. Afterwards we introduce reduction of impulse noise method for an RGB color image with fuzzy techniques.

Now-a-days to eliminate noise from digital image; there are so many methods are available. The main purpose of the research is to use an appropriate technique to reduce the impulse noise and enhance the image.

Filtering method is emphasized for all types of de-noising scheme used for noise removal. Filters used for image noise removal can be dividing in to 2 categories:

- Linear filters
- Non linear filters

Some linear filters are:

- Mean filter
- Median filter
- Weighted median filter
- Trimmed Mean Filter
- Trimmed Weighted Mean Filter
- Linear mead median filter

Some non linear filters are:

- Adaptive Median Filter
- Progressive Switching Median Filter
- Tri-State Median Filter
- Novel Impulse Noise Detection

A massive amount of fuzzy based reduction techniques be founded more than several years ago by; E.g.

- The histogram adaptive fuzzy filter (HAF)
- The fuzzy impulse noise detection and reduction method (FIDRM)

- The adaptive fuzzy switching method (AFSF)
- The fuzzy similarity-based filter (FSB)
- The fuzzy impulse noise reduction method (FRINRM)
- Fuzzy random impulse noise reduction method (FRINRM) and so on.

For detection of image with impulse noise these fuzzy filters are mostly introduce and also monochrome images (2D images) are complementary for those filters. Other than we are able to apply those filters into special color module like Red, Green, and Blue individually. Several nonlinear vector-based approaches are developed for these problems

Here, we recommend one more color filtering process. As in most of other applications, we are using red-green-blue (RGB) color space as crucial color space. The planned process was expanded to diminish impulse noise from color images.

Now we are going to the surroundings of this paper which contains impulse noise description, color model, fuzzy logic, in RGB color image detection of impulse noise, de-noising method.

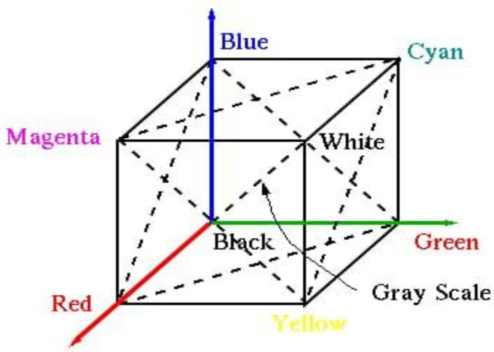
II. SURROUNDINGS

A. COLOR MODEL

It is a structure for generating a complete series of colors from a tiny place of crucial colors. Color models are classified in to two types:

- Additive
- Subtractive

In other words an arithmetical replica which is describes the system colors can be constituted as a vector of figures. RGB (Red, Green, and Blue) are three values of color module. For detecting, constituting and showing images in thermionic system, like small screen and computers; some are used in the RGB color replica; it is use in predictable photography, where the three mechanism of the image are constituted as three ideals of these three color mechanism. In this proposed a color picture where image filtering technique Red-Green-Blue (RGB) color gap is worn as crucial color space, revealed in the fig:



R-G-B color model

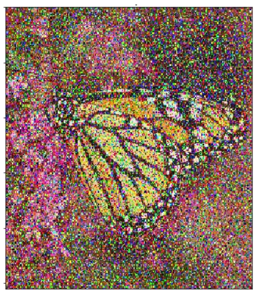
III. IMPULSE NOISE

Impulse noise usually called as salt and pepper. This noise is commonly originated through the acquirement or else broadcast of digital picture by detector or contact channels. The pixels in an image of the impulse noise are unusual color or intensity distinct from their neighboring pixels. Salt and pepper mortification are cause by quick and unexpected disorder in the image indication. In general, this sort of noise will merely influence a minute amount of image pixels. When observed, the image contains black and white dots, therefore the expression was salt and pepper noise. Individual sources contain spots of dust within the camera and damaged CCD (Charge-coupled device) elements. A picture which contains salt-and-pepper noise will include gloomy pixels in intense areas and vice versa. This kind of noise can be caused by quiet pixels, it known as impulsive noise. If S_i indicate the contribution noisy picture and U_i denotes a unique noise-free image at pixel situation i, after that we can convey the accidental cost of impulse noise as:

$$S_i = \begin{cases} u_i \text{ , with } 1\text{-}\delta \text{ probability} \\ n_i \text{ , with } \delta \text{ probability} \end{cases}$$

E.g. of impulse noise:

(A)Original



(B) noisy

A. FUZZY LOGIC:

Fuzzy logic is a proposal to enumerating base on "degrees of truth" moderately than the usual "true or false" (1 or 0) Boolean logic on which the contemporary computer is based. Fuzzy logic is theoretically easy to understand. Fuzzy reasoning constructs this understanding into the procedure rather than stapling it on the end. Fuzzy logic cans replica nonlinear functions of random density. We can generate a fuzzy system to match any set of input-output data.

To become aware of noise from image along with to it filters barely noisy pixels with no disturbing of the color and edging serration we used the fuzzy logic theory.

Reflection processing with fuzzy logic comprise of the subsequent essential stages:

- Image fuzzification
- Membership value modification

- Image De- fuzzyfication

B. IN RGB COLOR IMAGE IMPULSE NOISE DETECTION

For the color image here we approachable fresh fuzzy impulse noise detection process. The anticipated fuzzy noise detection process is executed in every color constituent independently in contrast to the vector based perspective. The proposal of the ruling the color components in detection phase are different:

1) toward the connecting pixels in the equal color module

2) on the way to the matching color module of the two extra color group.

We are utilizing the RGB color space which revenue that every pixel of color *picture S_i holds three 2-D color parts.

$$F_i = (F_i^R, F_i^G, F_i^B)$$

Let us reflect on a 3×3 descending window which has 8 adjacent symbolized as F_1 to F_8 shown in fig:

	-1	0	1
-1	$F_{1(NW)}$	$F_{2(N)}$	$F_{3(NE)}$
0	$F_{4(W)}$	$F_i i = [0,0]$	$F_{5(E)}$
1	$F_{6(SW)}$	$F_{7(S)}$	$F_{8(SE)}$

Fig a 3×3 descending window

In this above 3 X 3 descending window $F_i i = [0,0]$ is the test pixel which is processed.

The steps of this algorithm give an absolute difference in the values, which are converted to fuzzy values to determine the level of similarity. In other words, if there is a similarity of pixels, the similarity will be "BIG" or "SMALL." To update it with a fuzzy value, you attach a similarity to the membership function by adding the difference in absolute values. Here you need to calculate absolute values and convert absolute values to fuzzy values that are used with member functions. I will briefly explain below.

We have to first calculate the absolute value differences of all adjacent pixels from the F_0 pixel:

$\Delta F_x^R = |F_0^R - F_x^R|$, $\Delta F_x^G = |F_0^G - F_x^G|$, $\Delta F_x^B = |F_0^B - F_x^B|$ (1)

Where x = 1 to n^2 - 1 and F_0 is the processed pixel.

After calculating the absolute distinction of values, you should understand that this difference is small or equal. Small is a fuzzy word that preserve to be expressed as a fuzzy group with a partner level. If the difference in absolute values is relatively small, the membership level is high and gradually decreases as the difference increases. After you get a convincing value, it drops faster than the previous value, and eventually becomes zero. Therefore, we use a member function called Ƶmf (Ƶ-membership function) as given below:

$$Ƶmf(k, [a\ b]) = \begin{cases} 1, & \text{if } k \le a \\ 1-2\left(\frac{k-a}{b-a}\right), & \text{if } a \le k \le \frac{a+b}{2} \\ 2\left(\frac{k-a}{b-a}\right), & \text{if } \frac{a+b}{2} \le k \le b \\ 0, & \text{if } k \ge b \end{cases}$$

In the above equation a and b are parameters with the same values as a = 20 and b = 75, but get better results.

C. SIMILARITY CALCULATION OF DEGREE

After calculating the membership level, which is indicated as $Ƶ_1(\Delta F_x^R)$, $Ƶ_1(\Delta F_x^G)$, $Ƶ_1(\Delta F_x^B)$ for x= 1,…. n^2 -1 . This membership degree is worn to locate the comparison of pixel with other adjacent pixels of same color.

The similarity calculation of degree for Red module is specified as:

$$\sigma^R = \prod_{j=1}^{x} Ƶ_1(\Delta F_j^R)$$

The similarity calculation of degree for Green module is specified as

$$\sigma^G = \prod_{j=1}^{x} Ƶ_1(\Delta F_j^G)$$

The similarity calculation of degree for Blue module is specified as

$$\sigma^B = \prod_{j=1}^{x} Ƶ_1(\Delta F_j^B)$$

Use two other pixels of the color component in the same place to calculate the level of similarity with the color component of each pixel and add a function with the parameter values a = 0.01, b = 0.15

$$Ƶ_x^{RG} = Ƶ_2(|Ƶ_1(\Delta F_x^R) - Ƶ_1(\Delta F_x^G)|)$$

$$Ƶ_x^{RB} = Ƶ_2(|\,Ƶ_1(\Delta F_x^R) - Ƶ_1(\Delta F_x^B)|)$$

$$Ƶ_x^{GB} = Ƶ_2(|\,Ƶ_1(\Delta F_x^G) - Ƶ_1(\Delta F_x^B)|)$$

Now calculate the joint similarity for the x pixel by taking T-norm operation

$$\sigma^{RG} = \prod_{j=1}^{x} \sigma^{RG}$$

$$\sigma^{RB} = \prod_{j=1}^{x} \sigma^{RB}$$

$$\sigma^{GB} = \prod_{j=1}^{x} \sigma^{GB}$$

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D. NOISE FREE DEGREE ($Ƞf$) calculation

Calculated of membership degree in fuzzy set Noise – Free (Ƞf) in red module for F_0^R is given by the subsequent law

Fuzzy Rule 1:

IF (($\sigma R ==$ LAR) & ($\sigma G ==$ LAR) & ($\sigma RG ==$ LAR)) | (($\sigma R ==$ LAR) & ($\sigma B ==$ LAR) & ($\sigma RB ==$ LAR)) => (Ƞf (F_0^R) = LAR)

(LAR means large)

By agreement, the following silent color components are detected:

1. Some adjacent ideals of the similar color module are parallel, and
2. Difference linking adjacent pixels of the extra two color mechanism coincides with the current Fuzzy rule consists of four connections i.e. AND (&) and one disjunction i.e. OR (l).

So Fuzzy rule 1 can be written as:

$$Ƞf_{F_0^R} = \sigma^R\, \sigma^{RG}\, \sigma^G + \sigma^R\, \sigma^{RB}\, \sigma^B - (\sigma^R)^2\, \sigma^G\, \sigma^B\, \sigma^{RB}\, \sigma^{RG}$$

The following equation was equivalent for the green and blue mechanism:

$$Ƞf_{F_0^G} = \sigma^G\, \sigma^{RG}\, \sigma^R + \sigma^G\, \sigma^{GB}\, \sigma^B - (\sigma^G)^2\, \sigma^B\, \sigma^R\, \sigma^{GB}\, \sigma^{RG}$$

$$Ƞf_{F_0^B} = \sigma^B\, \sigma^{RB}\, \sigma^R + \sigma^B\, \sigma^{GB}\, \sigma^G - (\sigma^B)^2\, \sigma^R\, \sigma^G\, \sigma^{RB}\, \sigma^{BG}$$

For each color module the fuzzy set noise (Ƞ) can be consequent by the assist of average negation i.e. Ƞ = 1 - Ƞf. Yeager's complement or Surgeon's complement also taken for each color module.

Example of the rule for noise detection is given in the below fig:

(a)Original (b)

(c) (d)

In this fig (a) this flower image with 5% noise with membership degree $Ƞf$ (b) noisy image of red component with membership degree $Ƞf^R$ (c) noisy image of green component with membership degree $Ƞf^G$ (d) noisy image of blue component with membership degree $Ƞf^B$.

E. DE – NOISEING METHOD

To de - noising the impulse noise we can use the consequence of the fuzzy noise detection technique. When some noisy color component is set up, it is filtered in a comparative degree. So it is first balancing and then calculated by extra color mechanism which gives the predictable ideals to calculate the de-noising method.

Red, green and blue mechanism of every pixel is being calculated by allowing for n X n filter window for a fuzzy weight; which is worn to estimate the filter harvest in provisions of weighted standard of the ideals in the window. Computation of the component to be de-noised by involving of the calculation of the weight and its adjacent, grant the noise-free harvest. The calculation used for red mechanism is illustrated here and also similarly applied to green and blue mechanism.

Weight of the centre pixel for red is denoted as ω_0^R in weight calculation and the neighbours denoted by ω_x^R where x = 1 ,…..n^2 - 1. Following fuzzy rules are used to calculate for weight of the pixel.

Fuzzy Rule 2:

IF ($Ƞf_{F_0^R}$) = =large) => (ω_0^R = large)

This fuzzy rule can directly written as follows for the behaviour of ancestor and subsequent

$$Ƞf_{F_0^R} = \omega_0^R$$

No weighting obligation is performed if the constituent to be de – noised, is noise – free i.e. zero assigned for the weight of the neighbour pixels and value of pixel remains unmoved. The following fuzzy rules are used to determine the weight of the neighbours at x positions.

Fuzzy Rule 3:

IF (($\eta f_{F_0^R} \sim=$ LAR) & ($\eta f_{F_x^R}$ == LAR) & ($Z_1(\Delta F_x^G)$ == LAR) & ($\eta f_{F_0^G}$ == LAR)

($\eta f_{F_0^R} \sim=$ LAR) & ($\eta f_{F_x^R}$ == LAR) & ($Z_1(\Delta F_x^G)$) == LAR) & ($\eta f_{F_x^B}$ == LAR)

⇨ (ω_x^R = LAR)

Here Z_1 is the Z-shaped membership function examine in previous through parameters a=20and b=75. T-norm and S-norm are replaced every part of conjunctions and disjunctions there in the law. „ $\eta f_{F_0^R}$ Is not large" was represented the negation which can be given as (1 - $\eta f_{F_0^R}$) is written as „ $\eta_{F_0^R}$ is large". Yager's complement can also use. In the mathematical form the rule can be derived as:

$\omega_x^R = \eta_{F_0^R}\, \eta f_{F_x^R}\, Z_1(\Delta F_x^G)\, \eta f_{F_x^G} + \eta_{F_0^R}\, \eta f_{F_x^R}\, Z_1(\Delta F_x^B)\, \eta f_{F_x^B}$

$- \eta_{F_0^R}\, \eta f_{F_x^R}\, Z_1(\Delta F_x^G)\, \eta f_{F_x^G}\ .\ \eta_{F_0^R}\, \eta f_{F_x^R}\, Z_1(\Delta F_x^B)\, \eta f_{F_x^B}$

Rule said that R component is found if two colors G and B mechanism have parallel and R module is as well parallel with them. The value of F_0^R can be calculated applying the weighted average operation as:

$$F_0^R = \frac{\sum_{x=0}^{n^2-1} \omega_x^R F_x^R}{\sum_{x=0}^{n^2-1} \omega_x^R}$$

For x= {0,……… n^2 - 1} this technique gives good approximation values, but it generates some messy values when ω_x^R =0. It can be happened in two cases:

1) When all color mechanism are noisy which gives no similarities i.e. $\eta f_{F_0^R} = \eta f_{F_0^G} = \eta f_{F_0^B} = 0$.
2) When $Z_1(\Delta F_x^G) = Z_1(\Delta F_x^B) = 0$. It can be happen in the extreme noisy case.

We have to be relevant difference structure of de-noising when these cases come to mind, a weighted vector median (WVM) method can use for the de-noising of image, in which it gives an output of F_{j^*} from Ƞ size vector.

Where $j^* = arg_j$, min $\sum_{x=1}^{N} \omega j ||F_j - F_x||$,wherever ωj indicate weight of the color vector at position j and $||F_j - F_x||$ is Euclidian norm. . The noise free degree ηf_{fj} of each color vector is computed as:

$\eta f_{fj} = \eta f_{fjR}\, \eta f_{fjG}\, \eta f_{fjB}$.

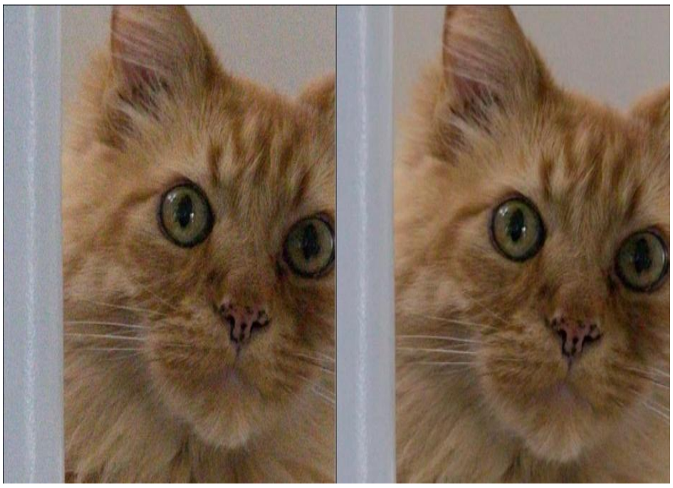
To stay away from the noisy effect for computation of output we can use only those vectors which are noise-free, so it takes all vectors for which $\eta f_{fj} > 0$. If $\eta f_{fj} = 0$ for j= {0, n^2 - 1}, we can't concern WVM and other fuzzy need to use.

IV. EXPERIMENTAL RESULT AND ANALYSIS

If you want to filter with an abnormal impulse noise level, try another image and send the disabled image with a peak noise value (PSNR). Values are scheduled inside the following table (comparisons are provided as input for cats). The PSNR result of another filter is taken from the reference document associated with this filter. In this book, we have an image of a cat and a cat with noisy input signals and a D-noised image.

(a) (b)

Fig: (a) doll picture polluted with 10% impulse noise (b) de-noised image



(a) (b)

Fig: (a) Cat picture polluted with impulse noise (b) de-noised image

We have to compare filtering process with other filters during term of PSNR.

Filters	5%	10%	15%	20%	25%	30%
Noisy image	21.82	18.75	16.98	16.06	15.17	14.14
VMF	22.91	22.65	22.21	21.95	21.66	21.55
ASVMF	24.89	22.64	22.75	21.94	21.91	21.65
FISF	25.35	24.15	22.39	22.99	22.30	21.77
FIDRMC	26.06	24.05	23.66	23.87	23.33	21.75
MEDIAN	23.08	25.33	24.65	22.35	21.90	22.78
HAF	23.09	22.78	22.44	21.99	21.44	20.87
Proposed method	30.70	29.08	27.35	26.06	25.12	24.35

Here Noise filtering techniques using a fuzzy sound detection method. Several filtering methods are available for pixel filtering. The main task is to capture loud pixels in real time and clean up those noisy pixels.

V. CONCLUSIONS

The R-G-B color images may contain complex fuzzy filters. It is based on the use of color information for noise detection. The expected method is different from other methods. We found that 1) impulse noise is reduced by this method. 2) Solid color and sharpness at the edges. In this book, this approach reduces the impulse noise filter, so in the future we will explore the proposed filters to reduce Gaussian noise, shot noise, additive noise, noise multiplication, white noise, and many other types of noise.

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