REMOVAL OF HIGH DENSITY IMPULSE NOISE USING MODIFIED K-MEAN ALGORITHM FOR DIGITAL IMAGE

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ABSTRACT

Image filtering tries to remove the noise from an image while maintaining its perceived visual quality and Noise can be consistent noise, , salt and pepper noise ,Gaussian noise, gamma noise. The objective of filtering is to remove the impulses so that the noise free image is recovered fully with minimum signal distortion. The best-known and most frequently used non-linear digital filters, based on order statistics are median filters. Median filters are known of having capability to remove impulse noise without damaging the edges. Median filters have the capability to remove impulse noise as well as preserve the image edges. The effective removal of impulse often leads to images with blurred as well as distorted features. At high noise densities, their performance becomes poor. We can use clustering algorithm to prepare clusters of high intensity and low intensity pixels in different groups. After this we can use a filtering algorithm to significantly improve their filtering performance and enhance the output images.

Keywords: Impulse Noise, MATLAB, Modified K-Mean Algorithm,Type-2 Fuzzy Logic.

I. INTRODUCTION

Impulse Noise:

Impulse noise is a class of acoustic noise which comprises unwanted, practically instantaneous (thus impulse-like) sharp sounds ,like clicks and pops. Noises of the type are usually caused by electromagnetic interference, scratches on the recording disks, and bad synchronization in digital recording and communication. High levels of such a noise (200 + Decibels) may impair internal organs, while 180 Decibels are sufficient to damage human ears.

An impulse noise filter can be deployed to improve the quality of noisy signals, in order to obtain robustness in pattern recognition and adaptive control systems. A typical filter is deployed to eliminate impulse noise is the median filter, at the expense of signal degradation. Thus it is quite common, in order to obtain better performing impulse noise filters, to use model-based systems that realize the properties of the noise and source signal (in time or frequency), in order to eliminate only impulse destroyed samples.

Image restoration:

The objective of image restoration is to "compensate for" or "undo" defects which impair an image. impairment comes in many forms such as noise ,motion blur, and camera misfocus. In cases like motion blur, it is possible to appear with a sufficient estimate of the actual blurring function and "undo" the blur to restore the original image. In cases where the image is distorted by noise, the superior we may hope to do is to compensate for the impairment it caused. In this project, we will introduce and implement various of the methods used in the image processing world to restore images.

1.1 Modified K-Means

This paper introduces a data grouping approach using modified K-Means algorithm based on the enhancement of the sensitivity of initial center of clusters. This algorithm divides the whole space into different segments and calculates the frequency of data point in each segment. The segment which manifests maximum frequency of data point will have the maximum probability to contain the centroid of cluster or group. The number of cluster's centroid (k) will be provided by the user in the same way like the traditional K-mean algorithm and the number of division will be k*k (`k' vertically as well as `k' horizontally). If the maximum frequency of data point is same in different segments and the upper bound of segment extend across the threshold `k' then merging of different segments become compulsory and then take the highest k segment for calculating the initial centroid of clusters. In this paper we also describe a threshold distance for each group's centroid to compare the distance between data point and cluster's centroid with this threshold distance through which we can minimize the computational attempt during calculation of distance between data point and group's centroid. It is manifested that how the modified k-mean algorithm will reduce the complexity & the attempt of numerical calculation, maintaining the easiness of executing the k-mean algorithm. It allocates the data point to their appropriate class or cluster more effectively.

We have introduced a modified k-means algorithm which removes the problem of generation of empty groups (with some exceptions). Here, the fundamental structure of the original k-means is preserved along with all its essential characteristics. A new center vector computation strategy make possible for us to redefine the clustering process and to reach our goal. The newly modified algorithm is found to work much satisfactorily, with some conditional exceptions which are very rare in habitual practice.

Modified approach K-mean algorithm:

The K-mean algorithm is a well liked & widely accepted clustering algorithm and has its application & uses in image segmentation ,data mining, , bioinformatics and many other fields. This algorithm does well with small datasets. In this paper we presented an algorithm that does well with large datasets. Modified k-mean algorithm avoids getting into locally optimal solution in some measure, up to some extent , and minimizess the adoption of cluster -error criterion.

Algorithm: Modified approach (S, k), S={x1,x2,…,xn }

Input: The number of clusters k1 (k1> k) and a dataset containing n objects(Xij+).

Output: A set of k clusters (Cij) that minimize the Cluster - error criterion.

Algorithm

1. Calculate the distance between each & every data point and all other data- points in the set D

2. Notice & detect the closest pair of data points from the set D and create a data-point set Am (1<= p <= k+1) which has these two data- points, Delete these two data points from the set D

3. Notice & detect the data point in D that is closest to the data point set Ap, Add it to Ap and remove it from D

4. Repeat step 4 until the number of data points in Am reaches (n/k)

5. If p<k+1, then p = p+1, Notice & detect another pair of data points from D between which the distance is the shortest, form another data-point set Ap and delete them from D, Go to step 4.

Algorithm A

- For each & every data-point set Am (1<=p<=k) Notice & detect the arithmetic mean of the vectors of data points Cp(1<=p<=k) in Ap.
- Select nearest object of each Cp(1<=p<=k) as initial centroid.
- Calculate the distance of each data-point di (1<=i<=n) to all the centroids cj (1<=j<=k+1) as d(di, cj)
- For each & every data-point di, find the closest or nearest centroid cj and assign di to cluster j
- Set ClusterId[i]=j; // j:Id of the closest cluster(group)
- Set Nearest_Dist[i++]= d(di, cj)
- For each cluster j (1<=j<=k), recompute the centroids
- Repeat

Algorithm B

1. For each data-point di

- Calculate its distance from the centroid of the present nearest cluster(group)
- If this distance is less than or equal to the present nearest distance, the data-point stays in the cluster (group) Else ;
- For every centroid cj (1<=j<=k) Calculate the distance (di, cj); Endfor Assign the data-point di to the cluster (group))with the nearest centroid Cj
- Set ClusterId[i] =j
- Set Nearest_Dist[i] = d (di, cj); Endfor

1.2 Or Modified K -Means Algorithm

Input: a set D of d-dimensional data and an integer K.

Output: K clusters

begin

randomly pick K points ∈ D to be initial means;

while measure M is not stable **do**

begin

calculate distance dkj = ||**x**j – **z**k||2 for each

k, j where 1 ≤ k ≤ K and 1 ≤ j ≤ N, and

determine members of new K subsets based

upon minimum distance to **z**k for 1 ≤ k ≤ K;

calculate new center **z**k for $1 \le k \le K$ using (3);

compute M;

end

end

1.3 Type-2 Fuzzy System

The actual fuzzy logic (FL), Type-1 FL, cannot handle (that is, model and minimize the effects of) uncertainties sounds contradictory because the word fuzzy has the connotation of uncertainty. A user believes that Type-1 FL captures the uncertainties and ambiguity. But, in reality Type-1 FL handles only the ambiguity, not uncertainties, by using precise membership functions (MFs). When the Type-1 MFs have been chosen, all uncertainty disappears because Type-1 MFs are completely precise. Type-2 FL, on the other hand, handles uncertainties hidden in the information/data as well as ambiguity by modeling these using Type-2 MFs. All set theoretic operations, such as union, intersection, and complement for Type-1 fuzzy sets, is similar for Type-2 fuzzy sets. Procedures for how to do this have been gone through and are especially simple for Type-2 fuzzy sets [Karnik'2001].

First, let's remember that FL is all about IF-THEN rules (i.e., IF the sky is blue and the temperature of the day is in between 16 and 24 degree Celsius, THEN it is a lovely day). The IF and THEN parts of a rule are called its antecedent and consequent, and they are modeled as fuzzy sets. Rules are explained by the MFs of these fuzzy sets. In Type-1 FL, the antecedents ie preceding in time or order and consequents are all explained by the MFs of Type-1 fuzzy sets. In Type-2 FL, some or all of the antecedents and consequents are explained by the MFs of Type-2 fuzzy sets.

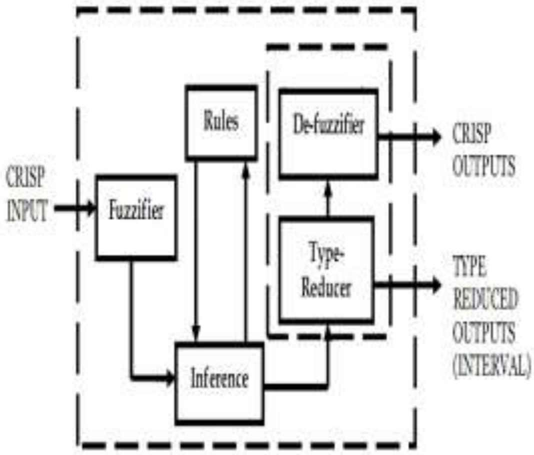

Fig. 1. Block Diagram of Type-2 FIS

The Type-2 fuzzy sets are 3-D, so they can be visualized as 3-D plots. Unfortunately, it is difficult to sketch such plots as it is to sketch the two dimensional plots of a Type-1 MFs. The other way to visualize Type-2 fuzzy sets is to plot their so-called Footprint of Uncertainty (FOU). The Type-2 MFs, MF(x, w), occupy atop two-dimensional x-w plane. It occupy only on the permissible (sometimes called "admissible") values of x and w. This signifies that x is defined over a range of values (its domain)—say, X. Moreover, w is defined over its range of values (its domain)—say, W.

From the Figure 1, the measured (crisp) inputs are first converted into fuzzy sets in the fuzzifier block because it is fuzzy set, not the number, that activates the rules which are defined in terms of fuzzy sets.

There are three types of fuzzifiers possible in an interval Type-2 FLS. When measurements are:

- Perfect, they are modeled as a crisp set;
- Noisy, but the noise is stationary, they are modeled as a Type-1 fuzzy set; and,
- Noisy, but the noise is non-stationary, they are modeled as an interval Type-2 fuzzy set (this latter kind of fuzzification cannot be done in a Type-1 FLS).

After fuzzification of measurements (inputs), the resulting input fuzzy sets are associated element by element by element into fuzzy output sets by the Inference block. This is achieved by first quantifying each rule deploying fuzzy set theory, and by then deploying the mathematics of fuzzy sets to establish the output of each rule, with the aid of an inference mechanism. If there are M rules, the fuzzy input sets to the Inference block will activate only a subset of those rules normally fewer than M rules. So, at the output of the Inference block, there will be one or more than one fired-rule fuzzy output sets.

The fired-rule output fuzzy sets have to be transformed into a number by Output Processing block as shown in the Figure 2. Transformation of an interval Type-2 fuzzy set to a number (usually) requires two steps. In the very first step, an interval Type-2 fuzzy set is reduced to an interval-valued Type-1 fuzzy set called type-reduction. There are many type-reduction methods available [Karnik'2001]. Karnik and Mendel have succeeded to develop an algorithm, known as the KM Algorithm, used for type-reduction. It is very quick algorithm but iterative. The next step of output processing, after type-reduction, is defuzzification. Since a type-reduced set of an interval Type-1 fuzzy set is a limited interval of numbers, the defuzzified value is just the average of the two end-points of this interval. If a type-reduced set of an interval Type-2 fuzzy set is a Type-1 fuzzy set, the defuzzified value can be get by any of the defuzzification method applied to Type-1 FL.

II. RELATED WORKS

An Improved Modified Decision Based Filter to Eliminate High Density Impulse Noise [01], Image filtering makes an effort to eliminate the noise from an image while maintaining its understood visual quality. Noise can be Gaussian noise, consistent noise, gamma noise , salt and pepper noise,. The study totally focuses on the salt and pepper noise by deploying improved modified decision based switching median filter. The salt and pepper noise happens when the pixel value is either 0 or 255.The algorithm will calculate the centre pixel's value i.e. whether or not it is equals to 0 and 255. If centre pixel is lies in between 0 or 255 then find out the different noise free value for the centre pixel. The quality metrics are used to calculate the performance for image enhancement deploying predicted algorithm: bit error rate(BER), root mean square (RMS). The processed pixel is verified weather it is noisy or noise free. If the processing pixel lies between maximum and minimum gray values then it is noise free pixel and remains unaltered. If the processing pixel takes the maximum or minimum gray level then it is considered noisy pixel, which is processed by Improved Decision Based Switching Median Filter deploying global mean for highly corrupted images. Most of the filters fail when the noise density is too high. The improved modified decision based filter works when the noise density is too high. The proposed method maintains in its original edges than available method.

Using Median Filter Systems for Elimination of High Density Noise From Images [04], An Efficient algorithm for median filter for elimination or improvement of gray scale images that square measure highly distorted salt and pepper noise is presented during this paper. Noise in image square measure is represented by the pixel value 0‘s and 255‘s that square measure displays that black and white dot in image. In algorithm , now take an image and choose 3x3 size window and 5x5 size window and processing or center pixel value examine if its value is 0‘s or 255‘s then image is corrupted otherwise noise free image. If image is noisy and processing pixels neighboring pixel value is between 0‘s and 255‘s then we are in the direction to replace pixel value with the median value and if processing pixels neighboring pixel value is 0‘s or 255‘s then we are in the direction to replace pixel value with the mean value. Further we increased the window of size 5x5 and again repeat given process until image is denoised. The presented filter algorithm with 3x3 and 5x5 patch manifests higher parametric values as compared to the standard median filter with 3x3 and 5x5 patch for Lena image. The simulation result manifests higher and much efficient performance of Maximum signal to noise ratio and Mean Square Error and Image enhancement factor.

Elimination of High Density Salt & Pepper Noise Through Super Mean Filter for Natural Images [06], A super-mean filter (SUMF) is suggested to eliminate high density salt & pepper noise from digital images. The suggested filter functions in two phases, in the first phase the noisy pixels are perceived and in the second phase each noisy pixel is replaced by the mean value of noise free pixel of 2×2 matrix. Substantial simulation and experimental results manifests that the suggested filter works well steadily for suppressing the salt & pepper noise. The performance of presented filter is compared with the other already existing filters, standard median filter(SMF), progressive switching median filter (PSMF), centre weighted median filter (CWMF) ,decision based algorithm (DBA), open-close sequence filter (OCSF), modified decision based unsymmetric trimmed median filter (MDBUTMF). The suggested filter manifests better performance as compared to above mentioned filters for noise elimination from different gray scale images.

Analysis of Improved Edge Preservation Filtering Deploying Gradient & Multiple Selection Based Sorted Switching Median Filter [11], they advise a Sorted Switching Median Filter (i.e. SSMF) for successfully denoising very corrupted images while preserving the image details. The center pixel is measured as ‘‘uncorrupted’’ or ‘‘corrupted’’ noise in the detecting stage. The tarnished pixels that possess more noise-free surroundings will have higher processing priority in the SSMF sorting and filtering stages to rescue the heavily noisy neighbors. Five noise models are considered to assess the presentation of the presented SSMF algorithm. Several extensive simulation results conducted on both grayscale and color images with a wide range (from 10% to 90%) of noise corruption clearly manifest that the proposed SSMF substantially outperforms all other existing median-based filters. General Terms – Denoising, Digital image, Decision based median filter, Impulse noise, SSMF, Noise model, Salt-and-pepper noise, PSNR.

Elimination of High Density Impulse Noise through Modified Non-Linear Filter [03], A New algorithm for the restoration of gray scale and colour images are highly distorted by impulse noise (salt and pepper noise) is presented in this paper. This suggested algorithm menifests better outcomes than the Standard Median Filter (SMF), Decision Based Median Filter (DBMF), Modified Decision Based Median Filter (MDBMF), Progressive Switched Median Filter (PSMF) and Modified Decision Based Unsymmetrical Trimmed Median Filter (MDBUTMF). The presented algorithm replaces the noisy pixel by trimmed median value when other pixel values, 0's and 255's are present in the selected window and when all the pixel values are 0's and 255's then the noise pixel is replaced by lenthening window size and finding trimmed mean based on algorithm. Different gray scale and colour images are verified by deploying the presented algorithm and found to produce better Peak Signal to Noise Ratio (PSNR) and Image Enhancement Factor (IEF).

A Survey on Median Filters for Elimination of High Density Salt & Pepper Noise in Noisy Image [10], Impulse noise in image is exist due to bit errors in transmission or induced during the signal acquisition stage. There are two varieties of impulse noise, similar to salt and pepper noise and random valued noise. Salt and pepper noise can distort the images where the distorted pixel obtains either maximum or minimum gray level. Several non-linear filters have been established as well founded method to eliminate the salt pepper noise without spoiling the edge details. Survey of non-linear Median Filters for the elimination of high density salt pepper noise is shown in this paper. The basic non linear filter i.e. standard median filter (MF) and unlike variants such as adaptive median filters (AMF), and decision based median filters (DBMF) are described in this paper.

III. PROPSED METHODLOLGY

The efficient elimination of impulse noise mainly relies on the detection stage. The detection method of the suggested proposed algorithm efficiently recognizes the location of noisy pixels, so that the false alarm rate and miss detection rate are reduced. Deploying clustering, the high intensity and low intensity noisy pixels are collected separately. The rest of the pixels associated to the noise free group. Modified K-Means (MKM) is one of the best techniques used to group data. In this Suggested , MKM is incorporated in both the detection stages. For noise reduction we use type-2 fuzzy logic. The type-2 fuzzy logic based can be deployed to guide impulse noise removal filters to outstandingly improve their filtering performance and improve enhance their output images.

IV. RESULT ANALYSIS / IMPLEMENTATION

PSNR(db)				
% of Noise	Median Filter		Proposed Filter	
	3x3	5x5	3x3	5x5
50	15.081	20.975	27.568	26.675
60	12.343	17.805	25.848	24.968
70	10.027	13.901	23.345	23.895
75	8.893	11.733	21.326	22.912

80	8.159	10.271	18.629	21.905
85	7.379	8.844	17.805	20.439
90	6.655	7.500	15.837	21.507

V. CONCLUSION

Linear and nonlinear filters have been presented earlier for the elimination of impulse noise; however the eliminaion of impulse noise often brings about blurring which outcomes in edges being distorted and of worse quality. Therefore the requisite to preserve the edges and fine details during filtering is the challenge faced by researchers in present day. Using clustering, the high intensity and low intensity noisy pixels are clusterd separately. The rest of the pixels are associated to the noise free group. Modified K-Means (MKM) is one of the best techniques deployed to cluster data. In this Presented, MKM is incorporated in both the detection stages. For noise minimization we deploy type-2 fuzzy logic. The type-2 fuzzy logic based can be deployed to guide impulse noise removal filters to outstandingly enhance their filtering performance and enhance their output images

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