An Intricate Information and Visual Treat for the Craft Rainfall Predication by region based segregation and Characteristic Segmentation of Clouds from Remote Sensing Images Using Multi-Kernel Fuzzy C-Means Algorithm (MKFCM)

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***Abstract*--- The drastic growth and rich development of the technology in the computer era, craft the prediction of nature calamity becomes quite comfortable. On such a note the field of image processing plays a promising role along with current technology in various applications. The visual treat which is to be considered as the outcome of the processed images gives intricate information about the relevance. One such mania is the rainfall prediction which is one of the traditional process in which the formation of the clouds are to be encountered. The prime objective of the paper focuses on an approach for cloud segmentation from remote sensing images in order to encounter the prediction of the rainfalls in the particular regions. The replication of objects existing in and around is termed as image which is produced without any physical contact is broadly focused as Remote Sensing Images. Where, the weather forecasting is encountered by considering the RSI images in order to predict the rainfall. The objective of segmentation is to perform the operation which will segregate the regions based on the characteristics without the knowledge of what they really are. Therefore the Multi-Kernel Fuzzy C-Means Algorithm (MKFCM) is performed with the Remote sensing images so as to get hold of an effective segmentation of the clouds which helps to acquire the prediction of rainfall.**

***Keywords* –Remote Sensing Image, Segmentation, Multi-Kernel Fuzzy C Means Algorithm.**

I. INTRODUCTION

Broad term Remote Sensing can be described as the collection and interpretation of information about an object and area without being in physical contact with the object. The development and deployment of manned and unmanned satellites has enhanced the collection of remotely sensed data and offers an in expensive way to obtain over large areas. Remote Sensing Image is utilized to assess most type of land cover changes in which primarily that involves the variation in climate. Image processing leads as a promising role in the effects of the natural disasters with the growth and development of the technologies.

Computer vision based systems which utilize the digital technology by associating the image and video processing techniques plays a very important role to effectively replace conventional weather forecasting systems. The prediction of the climate can be determined by segmenting the clouds and analyzing the detected clouds. Clouds are commonly encountered phenomena that are difficult to simulate because they are complex in shape and interact with light in a complex fashion. On the other simulation are easy to detect, everyone knows what clouds look like. The important phenomena in weather are clouds in which it also important for meteorological casting, forecasting and understanding. On such aspect from the Remote Sensing image the clouds are segmented by using Multi-kernel Fuzzy C-Means Algorithm (MKFCM) in which effective cloud detection is performed.

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II. RESEARCH METHODOLOGY

The goal of segmentation is to divide the image into homogeneous regions. Here, the system architecture of our proposed work shown in the fig-1.

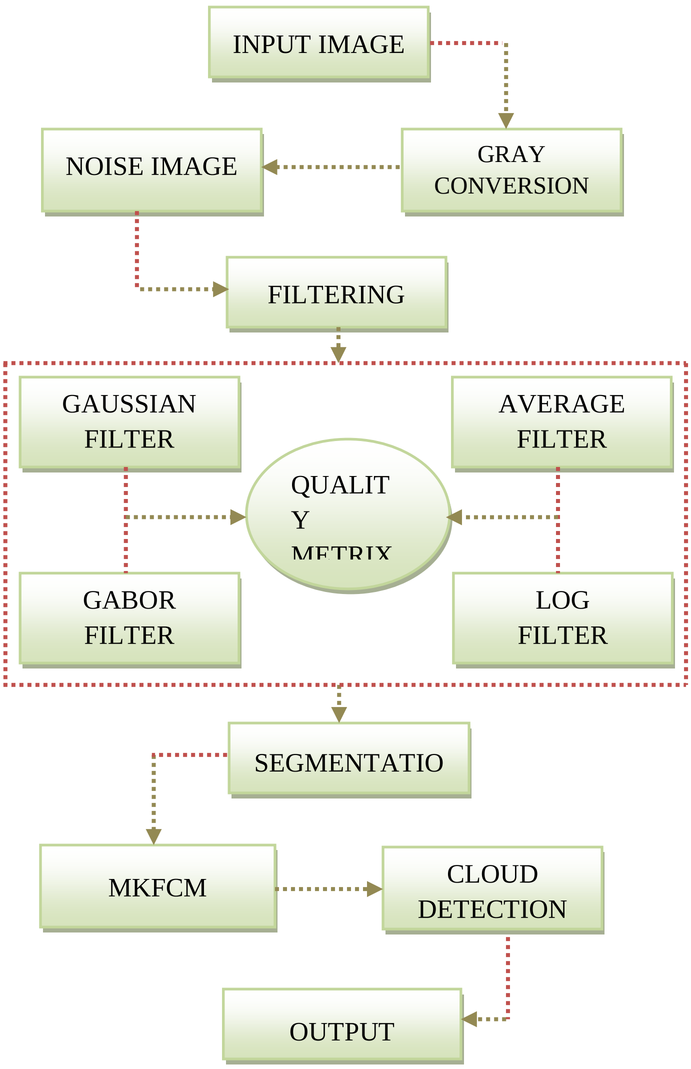

Fig 1: System Architecture

III. NOISE TYPES

The medical images are often degraded by some random errors – this degradation is usually called noise. Noise can occur during image capture, transmission, or processing, and may be dependent on, or independent of, the image content. Noise can be viewed in numerous ways. Some of the frequent noises that are encountered in image processing are categorized based on the criteria of distributions, correlation, nature and source. There are various types of noise in image that can corrupt images. Some of the noises are Gaussian noise, speckle noise and salt and pepper.

A. Salt & Pepper Noise

It represents itself as randomly occurring white and black pixels. An effective noise reduction method for this type of noise involves the usage of a median filter. Salt and pepper noise creeps into images in situations where quick transients, such as faulty switching, take place. The image after distortion from salt and pepper noise looks like the image attached. This type of noise contains random occurrences of both black & white intensity values, and often caused by threshold of noise image. Salt & Pepper distribution noise can be expressed by

$$P(x) = \begin{cases} p1, & x = A \\ p2, & x = B \\ 0, & otherwise \end{cases}$$

Where P1, P2 are the Probabilities Density Function (PDF) p(x) is distribution salt and pepper noise in image and A, B are the array size image. In this paper salt & pepper noise in image is randomly occurred in white and black pixels of an image. The main challenge in removing salt & pepper noise from image is due to the fact that image data as well as the noise, share the same small set of values, which complicates the process of detecting and removing the noise.

IV. FILTERING

Filtering in visual processing is a process that cleans up appearances and allows for selective highlighting of specific information. A number of techniques are available and the best options can depend on the medical images and how it will be used. In all the visual processing may require filtering to yield a usable and attractive end result. This can be a routine part of the editing process used to prepare video frames for distribution.

A. Gaussian Filter

The Gaussian filter is arrived at by setting the weights equal to the ordinates of an appropriate Gaussian, or normal, probability density function. The Gaussian filter is particularly convenient because the standard deviation of the appropriate Gaussian distribution can be specified in terms of the 50% frequency response of the filter. Gaussian filters have the properties of having no overshoot to a step function input while minimizing the rise and fall time. This behavior is closely connected to the fact that the Gaussian

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filter has the minimum possible group delay. The one-dimensional Gaussian filter has an impulse response given by

$$g(x) = \sqrt{\frac{a}{\pi}} . e^{-a.x^2}$$

These equations can also be expressed with the standard deviation as parameter

$$g(x) = \frac{1}{\sqrt{2\pi}.\sigma} . e^{-\frac{x^2}{2\sigma^2}}$$

By writing a as a function of σ with the two equations for $g(x)$ and as a function of σ_f with the two equations for $\hat{g}(f)$ it can be shown that the product of the standard deviation.

B. Average Filter

A moving average filter smoothes data by replacing each data point with the average of the neighboring data points defined within the span. This process is equivalent to low pass filtering with the response of the smoothing given by the difference equation

$$Y_s (i) = \frac{1}{2N+1}(y (i) +N) + y (i+N-1) + ... +y (i-N))$$

Where Y_s (i) is the smoothed value for the ith data point, N is the number of neighboring data points on either side of Y_s (i) and 2N+1 is the span. By comparing with the Gaussian filter, the average filter works effectively for the color video frames.

C. Gabor Filter

The Gabor filter served as excellent band-pass filters for one-dimensional signals such as speech. A complex Gabor filter is defined as the product of a Gaussian kernel times a complex sinusoid such as

$$g(t) = ke^{j\theta} w(at)s(t)$$

Where

$$w(t) = e^{-\pi t^2}$$

$$s(t) = e^{j(2\pi f_0 t)}$$

$$e^{j\theta} s(t) e^{j(2\pi f_0 t + \theta)} = (\sin(2\pi f_0 t + \theta), j\cos(2\pi f_0 t + \theta))$$

Here k, f_0, θ are filter parameters. It can be thought as the complex Gabor filter as two out of phase filters continently allocated in the real and complex part of a complex function, the real part holds the filter

$$g_r(t) = w(t) sin(2\pi f_0 t + \theta)$$

And the imaginary part holds the filter

$$g_i(t) = w(t)\cos(2\pi f_0 t + \theta)$$

D. Log Filter

The log Filter each channel of input over time using static or time-varying log filter implementations. The log Filter block independently filters each channel of the input signal. Laplacian filters are derivative filters used to find areas of rapid change (edges) in images. Since derivative filters are very sensitive to noise, it is common to smooth the image (e.g., using a Gaussian filter) before applying the Laplacian. This two-step process is calling the Laplacian of Gaussian (LoG) operation.

$$L(x, y) = \nabla^2 f(x, y) = \frac{\partial^2 f(x, y)}{\partial x^2} + \frac{\partial^2 f(x, y)}{\partial y^2}$$

There are different ways to find an approximate discrete convolution kernel that approximates the effect of the Laplacian. A possible kernel is

$$\begin{pmatrix} 0 & 1 & 0 \\ 1 & -4 & 1 \\ 0 & 1 & 0 \end{pmatrix}$$

This is called a negative Laplacian because the central peak is negative. It is just as appropriate to reverse the signs of the elements, using -1s and a +4, to get a positive Laplacian

V. MULTI-KERNEL FUZZY C-MEANS ALGORITHM

The Multiple Kernel fuzzy c-means (MKFC) Algorithm simultaneously finds the best degrees of membership and the optimal kernels weights for a non-negative combination of a set of kernels. The incorporation of multiple kernels and the automatic adjustment of kernel weights render MKFC more immune to unreliable features or kernels.

MKCM Algorithm

Step 1: Let k1 and k2 be kernels over Σ×Σ , Σ ⊆ Rap, and k3 be a kernel over Rp× Rp.

Let function ψ: Σ → Rp.

$$K_k (X_i , X_j) = \varphi_k (X_i)^T \varphi_k (X_j)$$

Step 2: MKFC is to simultaneously find combination weights w, memberships U, and cluster centers V, which minimize the objective function. However, direct

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evaluation of the cluster centers may not be possible because they are in the implicit feature space; similar to FCM, we first fix the weights and cluster centers to find the optimal memberships. For brevity, we use D_{ic} to denote the distance between data x_i and cluster center v_c , $D_{ic}^2 = (\psi(x_i) - v_c)T(\psi(x_i) - v_c)$. Thus, we can be written as

$$J(w,U,V) = \sum_{i=1}^{N}\sum_{c=1}^{c} u_{ik}^{m} D_{ic}^{2}$$

Step 3: Similar to FCM by forming an energy function with Lagrange multiplier **λ** for the constraint $\mathbf{\Sigma^{c}_{c=1}\, up_{c}=1}$

$$J_{\lambda}(U,V) = \sum_{i=1}^{N}\sum_{c=1}^{c} u_{ic}^{m} D_{ic}^{2} + \lambda(\sum_{c=1}^{c} u_{ic} - 1)$$

Step 4: When the weights **w** and cluster centers **V** are fixed, the optimal memberships **U** can be obtained. Now, let us assume that the memberships are fixed. The optimal centers and weights are combined to the kernels. By taking the derivative of J (**w**, **U**, **V**) with respect to V_c and setting it to zero, we have

$$\frac{\partial J(w,U,V)}{\partial V_c} = -2\sum_{i=1}^{N} u_{ic}^{m}\,(\psi(X_i) - V_c) = 0$$

Step 5: Hence, when U are given, the optimal v_c is the following closed form solution represented by the combination weights

$$V_c = \frac{\sum_{i=1}^{N} u_{ic}^{m}\,\psi(X_i)}{\sum_{i=1}^{N} u_{ic}^{m}} = \sum_{i=1}^{N} u_{ic}^{m}\,\psi((X_i)$$

For MKFCM, it still updates $\mathbf{u_{ij}}$ the difference is that the kernel function *k* in these equations is replaced by the combined kernel *k*com.

Step 6: The objective function of the MKFCM with the linearly combined kernel is still the weighted sum of distances between the data and prototypes in the kernel space.

Step 7: Final step is to segment the Cloud.

VI. SEGMENTATION

Segmentation is the process of partitioning a digital image into multiple regions and extracting meaningful regions known as regions of interest (ROI) for the future image analysis. Image segmentation has emerged as an important phase in image-based applications. Thresholding is a very important technique for image processing. It produces uniform regions based on the threshold criterion T. The thresholding operation can be thought of as an operation, such as

$$T=T\{x, y, A(x, y), f(x, y)\}$$

In which the particular region is detected using this segmentation technique along with the thresholding operation. Edge plays a very important role in image processing application in which they provide an outline of the object. In the physical plane, edges correspond to the discontinuities in depth, surface orientation, changes in material properties, and light variations. When an edge is detected, the unnecessary details are removed, while only important structural information is retained.

VII. PERFORMANCE MEASURES

A. Mean Square Error (MSE)

The simplest of image quality measurement is Mean Square Error (MSE) [7]. The large value of MSE means that image is poor quality. MSE is defined as follow

$$MSE = \frac{1}{MN}\sum_{j=1}^{M}\sum_{k=1}^{N}(x_{j,k} - x'_{j,k})$$

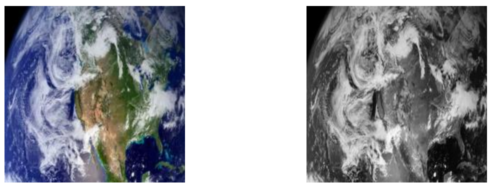
B. Peak Signal to Noise Ratio (PSNR)

The small value of Peak Signal to Noise Ratio (PSNR) means that image is poor quality [8]. In general, a good reconstructed image is one with low MSE and high PSNR. PSNR is defined as follow

$$PSNR = 10log\frac{(2^n - 1)^2}{MSE} = 10log\frac{255^2}{MSE}$$

VIII. RESULT AND DISCUSSION

The proposed work is done using MATLAB.2010 version. The images which are considered as input for the work are



(a) **(b)**

Fig 2: (a) Original Color Image and (B) Gray Scale Image

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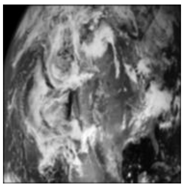
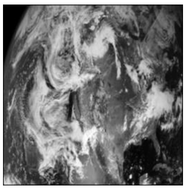
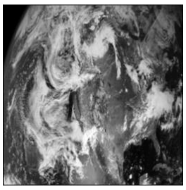
The samples are introduced with a noise (called salt & pepper noise) and filtered using various filters. In which the median filter performed well by comparing with the other filters. The filtered images are



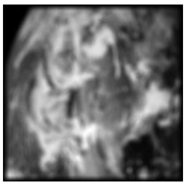
(c)



(d)



(e)



(f)

Fig 3: (c) Average Filter Image, (D) Gaussian Filter Image, (E) Gabor Filter Image, and (F) Log Filter Image.

IMAGES	PSNR	MSE
AVERAGE FILTER	23.07	254.17
GAUSSIAN FILTER	19.12	294.55
GABOR FILTER	24.00	258.34
LOG FILTER	17.73	394.55

Table 1: Filtered images.

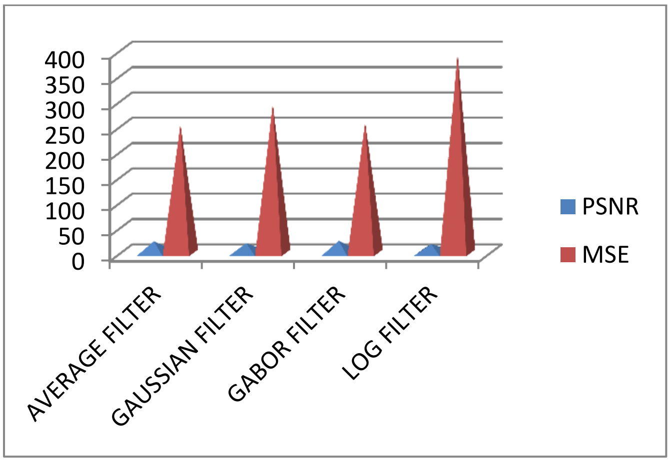


Fig 4: Comparison of filters.

The filtered image is processed under the segmentation technique by using the Multi-Kernel Fuzzy C Means Algorithm to detect the Clouds.

(g) Cloud detection

IX. CONCLUSION

In the nature calamity the environmental change is evolved due to the active participation in the climate change. The weather forecasting is one of the phenomenal processes in which the prediction of the rainfall is by means of the climatic conditions. The hygienic technological process has been utilized in various places for the betterment of the current scenario. One such focusing process is weather forecasting in which usage of the technologies leads to the prediction is quite comfortable. On such environment which withstands its promising role from the past decade is image processing where the Remote Sensing images are processed with various techniques. In this research work Remote Sensing images (RSI) are considered to take part in the effective segmentation of clouds so as to produce the evidence for the prediction of rainfall using Multi-Kernel Fuzzy C-Means Algorithm (MKFCM) algorithm which performs well in segmentation and detect the clouds.

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