

## Geographical Image Retrieval Using Spatial Filtering For Image Enhancement Techniques

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### ABSTRACT

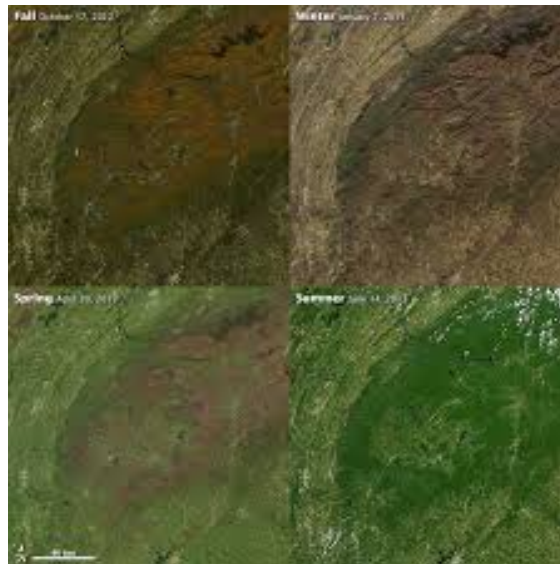
Geographical image retrieval problems are ubiquitous in image processing, weather forecasting and related fields. The image sequences taken from airplane, satellite, radar, unmanned aerial vehicle image that contains noise, blur extraction due to climate changes, night vision, cloud, Airborne, rainy session and unconditional climate. The capture contains information is unknown format. To retrieve the Information present in the image even though if the image contains noise that's this paper proposed a method to give us good informative image on above conditions. Selectively first hypothesis selection filter (HSF) a collection of filtering techniques like linear/nonlinear, Gaussian for the process of removal of noise, blur, salt and pepper images. This will provide the tracker to get normalized image, another one contrast limited adaptive histogram equalization (CLAHE) for night vision images to get better normal image information, Further more Gabor filter (GF) performs the weather forecasting unconditional image analysis and content based image retrieval from the database.

**Keywords:** Hypothesis selection filter (HSF), Contrast limited adaptive histogram equalization (CLAHE), Gabor filter (GF), Spatial Filter (SPF), Linear/Non-linear Selection Filter (L/NLSF), Content based image retrieval (CBIR), Adaptive histogram equalization (AHE).

### 1. INTRODUCTION

Nowadays, we observe a Meta amount of images retrieved from satellite and other sources that are stored in electronic in the sense digital and frequency format. The survey of a geographical image enhancement process has been increasing explosively and analyzing the image research area on weather forecasting community. This paper

classifies the various geographical image retrieval processing likely follows, the hypothesis selection filter serves as a framework for combining the outputs of a number of different user selected filters, each one best suited for a different region of an image. Contrast limited adaptive histogram equalized image has better contrast. The image processing is used to determine the better visual appearance. Now-a-days it's difficult to get good visual image, because captured image contains list of unconditional format due to illumination changes, night vision and unpredictable climate conditions causes noise, blur and salt pepper images. The digital image process gives the better enhancement techniques for types of images to get the desirable information in that one. Some of the filtering techniques produce better enhanced image to user, to get the appropriate information within the image. The advanced hypothesis selection filter (linear/nonlinear, Gaussian, etc.,) and contrast limited adaptive histogram equalization filters are use here to got good visuals. The image enhancement processes like sharpen and highlight the features such as edge, contrast, extraction, boundaries, and reduce the raining artifacts. One of the most difficult progresses in image process is to obtain satisfactory result. The digital image processing plays a vital role in most of the fields like medical, military, microscopic and telescopic imaging. Most of the geographical images are retrieved from the UAV(unmanned aerial vehicle) this going to captures the image with limited range of distance only [1] but the microscope and telescope image enhancement process gives the better enhanced image compare to other image enhancement filters. While using this kind of filters we can easily avoid the noise and identified the exact information within the image. As well as weather forecast image analysis, this type of filter going to give the better resolution image to the tracker. For example an image with different climate conditions (fig.1).

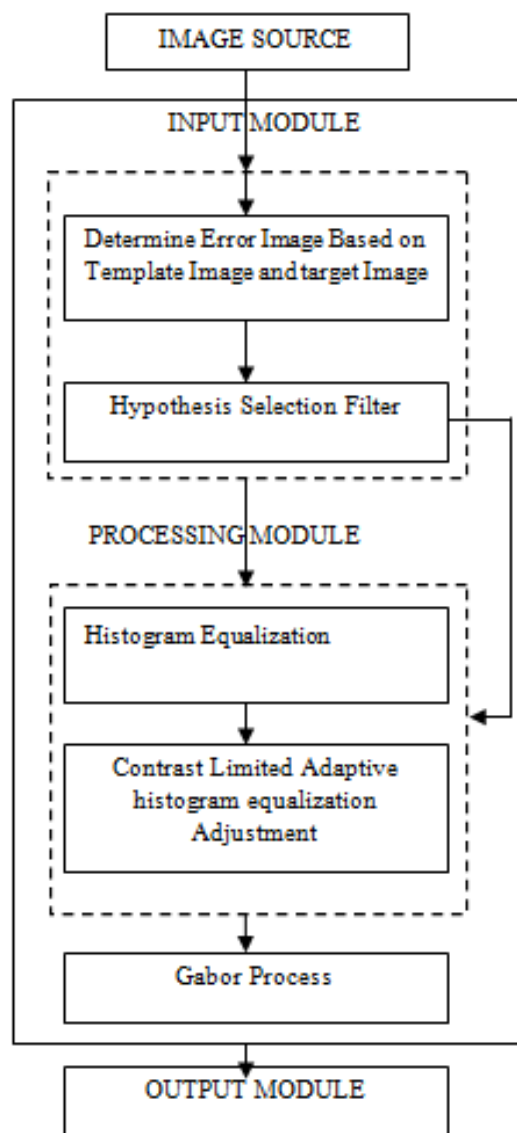


**Fig.1 GEOGRAPHICAL IMAGE FOR VARIOUS CLIMATE CONDITIONS-  
spring, winter, fall, summer.**

**2. IMAGE ENHANCEMENT BY USING HYPOTHESIS SELECTION FILTERS**

The Hypothesis Selection Filter (HSF) is a new image enhancement approach for combining or collection of filtering method that the outputs of distinct filters, combination of each filter which is chosen to improve the particular type of content in an image. Our main aim is to combine the filter outputs and to obtain an overall best quality results over the filtering techniques in (fig2).

**IMAGE ENHANCEMENT PROCESSING**



**Fig.2 Show the image enhancement module flow processing.**

## 2.1 Spatial domain

Which operate directly on PEL. PEL is the smallest element of an image that stores a value proportional to the light object/subject at that particular location. Spatial filter has two major filtering methods named linear and non-linear spatial filter. This filter has been from frequency domain. This filter can be classified into,

1. Preserve low frequency.
2. Preserve high frequency.
3. Preserve frequencies within the band.
4. Reject frequencies within the band.

Some of the image enhancement techniques are,

**Table.1 The spatial domain has following types of filters:**

| Enhancement Technique          | Advantages   | Disadvantages   |
|--------------------------------|--|---|
| Histogram Specification        | Uniform histogram, optimal cost.   | HS can't easily adopt the local information of the image and brightness of the given image. |
| Dynamic Histogram Equalization | Obtain the image details. This ensures the moderate contrast enhancement in a whole image portion. | DHE won't get proper Brightness.  |
| Edge Adaptive Hybrid Filters   | sharp edges  | Low density image and it require more time.   |
| Adaptive Median Filter         | Good in low noise density and easy to implement.   | Not in high density images.   |
| Effective Median Filter        | Better than adaptive median filters when the noise density up to 50%.                              | Not suitable for high density noises.   |

### 2.1.1 Linear filter:

Linear filters are used to remove some types of noise. Here linear spatial filter generally done by blurring the image. They have poor performance in removing signal dependent noise. The output of an image weighted sum of the input pixels. It has two major linear spatial filters:

1. Correlation.
2. Convolution.

#### 2.1.1.1 Correlation:

This is often used to find the similarity matching between the images or some part of an image (pattern matching).

The correlation filter process can be represented by the following equation [19]:

$$x(a,b)=y(a,b)*z(a,b)=\sum_{s=-s/2}^{s/2} \sum_{t=-t/2}^{t/2} x(S,t)z(a+S,b+t)$$

equ(1)

**2.1.1.2 Convolution:**

Similar to correlation but the mask is flipped both directions (horizontally and vertically). If  $y(a, b)$  is symmetric (i.e.,  $y(a, b)=y(-a, -b)$ ) if this condition is proven then Convolution=Correlation. The convolution filter process can be represented by following equation [19]:

$$x(a,b)=y(a,b)*z(a,b)=\sum_{s=-s/2}^{s/2} \sum_{t=-t/2}^{t/2} y(S,t)z(a-S,b-t)$$

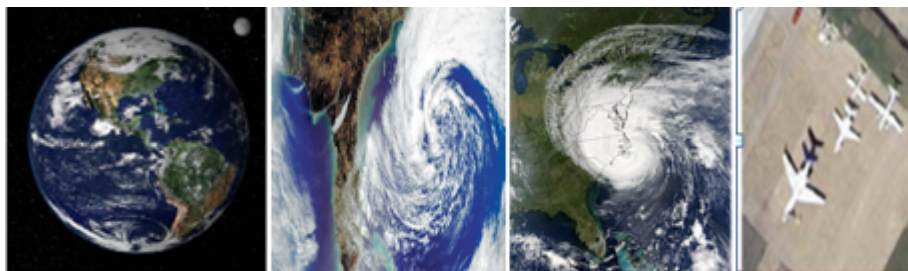
equ(2)

**2.1.2 Non-linear filter:**

Non-linear filters such as,

1. Median filter
2. Min filter
3. Max filter
4. Mean filter

These process of filters are been developed to overcome the limitations and shortcomings of linear filter (fig.3 A, B, C, D). Non-linear filters exhibit better performance when compare to linear filters. They are discussed below (table.2),



**Fig.3 (A)**



**Fig.3 (B)**



Fig.3 (C)

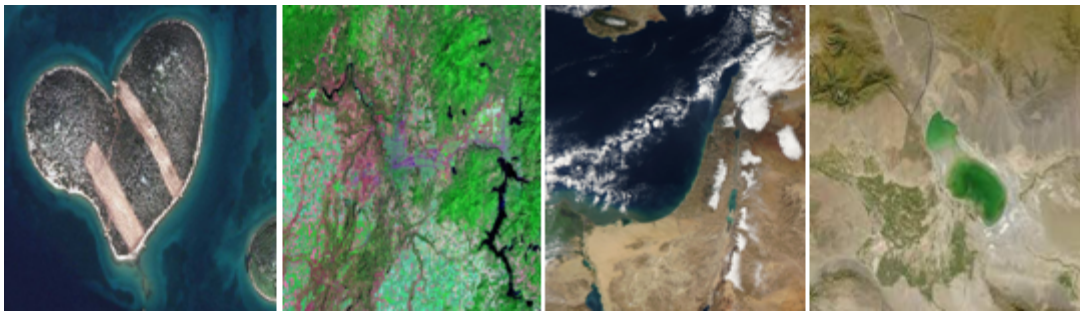


Fig.3 (D)

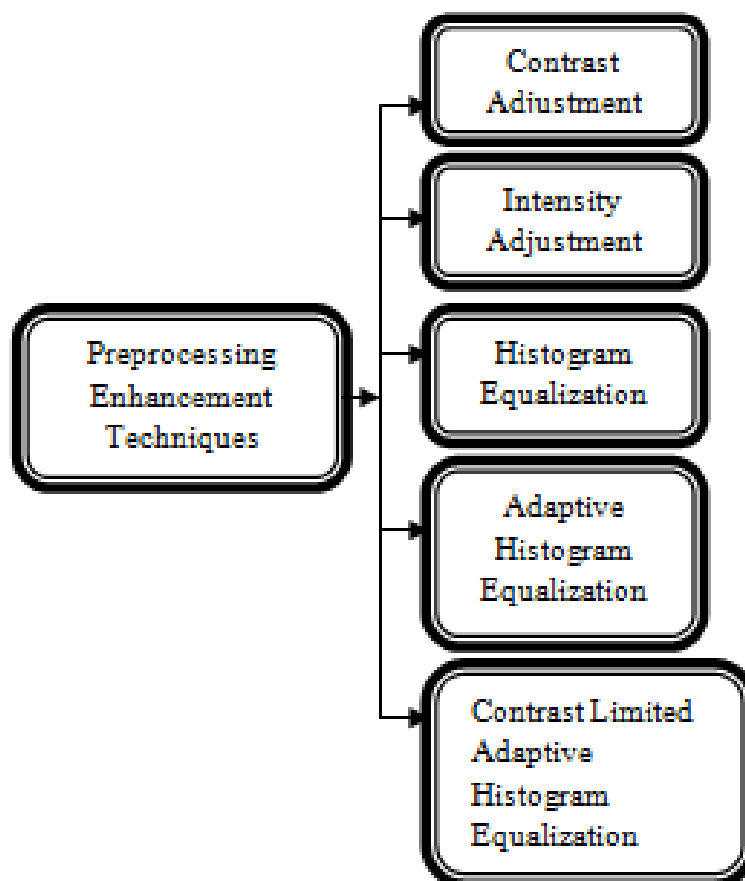
**Fig.3 shows that the examples of Non-linear filters. (A), (B), (C) and (D) show the various land set of geographical images captured by UAV or Satellite.**

Table.2

| <i>MEAN</i>  | <i>MAX</i>   | <i>MIN</i>   | <i>MEDIAN</i>  |
|--|--|--|--|
| Among spatial filter this is one of the simple one.    | Max is also known as 100 <sup>th</sup> percentile filter.  | Min is also known as 0 <sup>th</sup> percentile filter.  | Very effective preservation in image detail and removal of impulsive noise, blur salt and pepper images. |
| Mean is uses a filter window which is normally square. | This is going to replaces the value of PEL by the maximum intensity level of the neighborhood of that PEL. | This is going to replaces the value of PEL by the minimum intensity level of the neighborhood of that PEL. | Order statics filters are more commonly used in non linear filters.                                      |

|  |   |  |  |
|--|---|--|--|
| Filter window replace the center value in the window with the average mean of all the pixels values in the window. | Max finds the brightest point of an input image.                                      | Min finds the darkest point of an input image.   | Median is lowers the Intensity variation between one and other pixels. |
| The main drawback of this filter: blurs image and detail lost.   | Due to low intensity value this removes the salt and pepper noise of our input image. | Due to high intensity values this remove the salt and pepper noise of our input image. | The main drawback in this computational complexity.                    |

**3. IMAGE ENHANCEMENT BY USING PREPROCESSING ENHANCEMENT TECHNIQUES**



**Fig.4 Show the classes of preprocessing image enhancement methods.**

### 3.1 Contrast Adjustment:

The contrast of an image is based on the distribution of pixels. A low contrast image exhibits small differences between the light and dark PEL values. The histogram of a low contrast image is narrow domain because of the absolute PEL intensities [2] [16] [17].

### 3.2 Intensity Adjustment:

Most of the image enhancement techniques are used to improve an image as well as satisfy the human perception. Where image improve is sometimes defined objectively-to increase the signal to noise ratio, And sometimes defined subjectively-to make a certain features easier to see by modifying the color or intensities [2]. Here some basic intensity adjustment functions Image negative, threshold, logger transformative, power-law transformative, piecewise-smoothing transformative functions.

### 3.3 Histogram Equalization:

Histogram equalization [2] [16] provides the global description of the appearance of an image and this provide useful information to the contrast enhancement often tried to enhance an image [7]. This have special requirements on the operators are,

1. The output of an image should use all the available gray level and
2. The output of an image has approximate same number of pixels of the each grey level.

The close contrast values are used when the usable data value of the image represent. Through this adjustment the intensity enhancement can be better distributed on histogram equalization. Very poor dynamic range of an image can be enhanced and visual artifacts get introduced [16] [17]. Then probability density function is one going to enhance an image. It express as follows [2],

$$pdf = p(r_k) = r_k/x \quad \text{equ(3)}$$

PDF  $f(x)$  this random variable taken on the given value, the output pixels from the histogram equalization operation are equal to the cdf of the image [2],

$$pdf(x) = \sum_{k=0}^{L-1} p(r_k) \quad \text{equ(4)}$$

$$p(s_k) = \sum_{k=0}^{L-1} p(r_k) \quad \text{equ(5)}$$



**AHE Vs CLAE**

**Table.3**

|  |   |
|--|---|
| Adaptive Histogram Equalization (AHE)  | Contrast Limited Adaptive Histogram Equalization(CLAHE)   |
| The AHE differs from ordinary histogram equalization with respect to compute some slot histograms.   | CLAHE based on the on the adaptive histogram equalization methods and remove some threshold value then CLAHE applied. |
| Adaptive histogram equalization-adaptive method each one has corresponding to a distinct region of an image and it uses them to redistribute the lightning values of given input/output image. | While performing the contrast enhance on given input image this CLAHE going to apply all region of an output image.   |
| This AHE improve the local contrast of an image. An AHE selects the each center PEL to the neighborhood.   | Contrast limit is controlled and CLAHE has the good contrast image enhancement performance.                           |
| AHE consists of local neighborhood of specific region of an image and mapping of PEL center values.  | Result is the homogeneous contrast region can be controlled and noise amplification also avoided.                     |

**4. IMAGE ENHANCEMENT BY USING GABOR FILTER**

A Gabor filter is smoothing filter. The impulse response of the Gabor filter is defined to used by a multiple harmonic functions by Gaussian function is often used for various and must be in image processing enhancement [9] [10]. The real time implementation of the Gabor filter is challenging one due to the complexity of Gaussian and sinusoid. Here is the formula for 2-D spatial Gabor filter in spatial domain,

$$G(X, Y) = \text{SINU}(X, Y) W_R(X, Y) \tag{6}$$

Where,

SINU(X, Y)=Complex sinusoid (known as the carrier) and

W<sub>R</sub>(X, Y)=2-DGaussian-shaped function (known as the envelope)

In digital image processing the images are taken into PEL or matrix form [10]. The convolution is involved while the matrix or PEL process going to be process, first the input data is in PEL format then enter in to the filter process and stored it in the memory. The smoothing filter is obtained by sinusoid modulation of Gaussian [9]. This smoothing filter locates the texture features in the spatial domains and customized 2-d linear filter for RGB color image segmentation is provide efficient noise reduction and reduced memory usage.

## 5. IMAGE ENHANCEMENT BY USING CONTENT BASED IMAGE RETRIEVAL

Users who do not always know? Either what they want? How to express it in words? So The Content based image processing is a process of retrieving images from [14] a collections of images in a meta data in the image directory because of day by day geographical conditions are vary due to our unconditional weather conditions this image are captured by satellite or UAV. More number of images per day stored in directory this going to retrieved based on the basis of features automatically extracted from the images themselves [12] [13].

1. Colour
2. Texture
3. Shape

In Spatial location also important factor in CBIR besides color and texture [12] [14] [15] for example while enhancement of the two images shares some textural and color features having the different spatial location defined with respect to regions of locations in image as bottom, upper and top. The main objective of the CBIR method is essentially to extract, Meta image databases and some specific number of images are similar to visual and semantic content to bridge the semantic gap that exists in between the representation of low-level features then this high-level semantic content is retrieved by processor. While evaluating the performance of CBIR method the most commonly used measures are used. However, in the research of image enhancement processing a captured image is represented by low-level features like in the content based image retrieval.

The two classes of CBIR as follows (In table.4),

**Table.4**

| NARROW DOMAIN   | BROAD DOMAIN  |
|---|---|
| In narrow domain variance of content is low.  | Here variance of the content is high.   |
| Specific source of knowledge.   | Generic source of knowledge.  |
| Homogeneous semantics.  | Heterogeneous semantics.  |
| Objective content description and likely to ground truth.                             | Subjective content description and unlikely to ground truth.                  |
| This is possibly controlled scene and sensor.   | Unknown.  |
| Narrow domain image retrieval is specific aimed and professional type of application. | Broad domain image retrieval is generic aimed and public type of application. |
| Limited interactivity.  | Pervasive, iterative interactive process.                                     |
| Based on the source of inspiration is object recognition.                             | Source of inspiration is information retrieval based.                         |
| Narrow tailored database-driven and medium size architecture.                         | Broad modular interaction-driven and Large to very large size architecture.   |
| Model-driven, specific invariants tools can be used.                                  | Tools can be the Perceptual, cultural and general invariants are used.        |

$$\text{CBIRE} = \frac{\text{Total Number of relevant images retrieved}}{\text{Precision} * \text{Recall}} \quad \text{---equ(7)}$$

$$\text{CBIRFD} = \frac{\text{Number of relevant image} - \text{Number of Nonrelevant image}}{\text{Scope}} \quad \text{---equ(8)}$$

Also called advanced performance evaluation method, provide the normalized performance of image retrieval process. The advanced performance evaluation of content based retrieval efficiency (CBIRE) [equ(7)] and content based retrieval false determine (CBIRFD) [equ(8)] method provide the effective image retrieval progresses. In CBIR retrieval and stored processes are slightly difficult today because millions of images are stored and retrieved from the different trackers for image normalization purpose.

## CONCLUSION

The concept of image enhancement process over the hypothesis selection filter is a collection of filter process in digital image processing. Advanced hypothesis selection is an processes of enhanced version of filtering techniques, which provide better informative image as well as fast filtering algorithm (mathematical transformation) help us to get an effective result of processing images and contrast limited adaptive histogram equalization give the night visuals has good clarity. Further geographical image analysis methods are used, the Gabor filter for analyzing the weather forecasting captures.

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