iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 7 **Issue:** VIII **Month of publication:** August 2019

DOI: http://doi.org/10.22214/ijraset.2019.8101

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.177
Volume 7 Issue VIII, Aug 2019- Available at www.ijraset.com

Satellite Color Image Enhancement by using Histogram Equalization Techniques

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Abstract: ***Image enhancement is an important pre processing step in any image analysis process .It helps to catalyze the further image analysis like adjusting the image intensities to enhance contrast levels of image. Here in this paper an approach for satellite color image enhancement on HSV color space is introduced .Satellite images are recorded in digital forms and then processed by the computers to extract information. Here local contrast management is given main focus because noise exist on local regions are found over amplified when enhancement is done through global enhancement technique like histogram equalization . The color arrangement and computations are done in HSV color space .The V channel has been extracted for the enhancement process as this channel represents the intensities and there by represents the luminance of an image .At first the image is normalized to stabilize the pixel distribution .The normalized image channel is analyzed with histogram equalization techniques for local contrast enhancement .The result obtained from the experiments prove the superiority of the proposed approach .***

Keywords: Satellite images ,color image enhancement, HSV color space, Histogram equalization Adaptive histogram equalization .

I. INTRODUCTION

Satellite images use to carry a vast amount of information with them. But most of satellite images consists of a noise .From this more amount of information is hamper by the noise. To avoid this problem ,The process of color image Enhancement is introduced. It is a very emerging research topic in the area of color image analysis. There exist so many enhancement algorithms in the literatures the most often used techniques are global histogram equalization or general histogram equalization like histogram equalization .

In the case of satellite Images, A small block of the whole Image concerns a lot, so, local contrast Management should be given more priority here. RGB color space is not able to deal with the satellite color image Analysis properly. Because In RGB R,G,B are all co-related to the color luminance.i.e. we can't separate the color information from luminance . So, in our color image processing, there are various models one of which is the Hue Saturation Value (HSV) model.HSV is used to separate image luminance from color image information (V-channel) .It has the ability to deal with the human vision perceives color making attributes. It is the alternative representations of the RGB color model. By these reasons HSV model is selected for Robust Satellite Color Image Enhancement Approach.

II. HISTOGRAM BASED TECHNIQUES

Satellite color image enhancement by using histogram based techniques are classified in to three types as shown Below

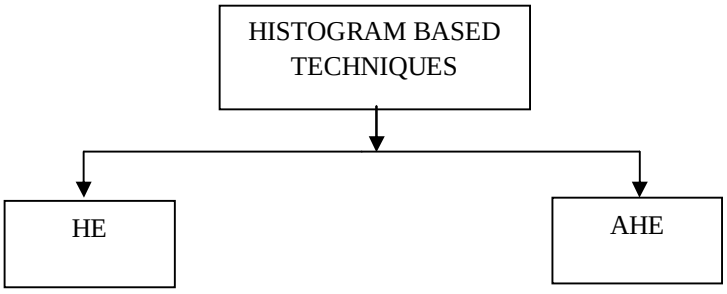

Fig.1. Histogram Based Techniques

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A. Histogram Equalization (HE)

Histogram Equalization (HE) is used as a basic method in the enhancement process by many researchers. It is a technique used for adjusting image intensities to enhance contrast. Let 'f' be the given image represented as mr by mc matrix of integer pixel intensities ranging from 0 to L-1.L is the number of possible intensity values often 256.

There are two ways to think about and implement histogram equalization ,either as image change are palette change. The operation can expressed as p(m(i)) where

i = original image

m= HE mapping operation

P = palette

If we define a new palette as p^1=p(m) & leave image i unchanged then H.E is implemented as palette change. On the Other hand, if palette p remains unchanged and image is modified i^1=m(i) then the implementation is by image change.

For example :letters consider a discrete gray scale image {x} and n_i be the number of occurrences of gray level i.

Probability of an occurrence of pixel of level 'i' in the image is

$P_x(i)=n_i/n$, $0 \le i < L$

Where,

i is the k^{th} intensity level in the interval.

n_i is the number of pixels in the image whose intensity level is i

n is the total number of pixels in the image.

Histogram equalization is an image enhancement technique which enhances the contrast of an image by spreading the intensity values over the entire available dynamic range. This is achieved through a transformation function T(r), which can be defined by the Cumulative Distribution Function (CDF) of a given Probability Density Function (PDF) of gray levels in an image.

1) Continuous Case: This is for intensity levels that are continuous quantities normalized to the range [0, 1].

Let, Pr(r) is the PDF of the intensity levels.

Then, the required transformation on the input levels to obtain the output level S is:

$$S = T(r) = \int_0^r P_r(w)dw \quad (1)$$

where w is a dummy variable of integration. Then, it can be shown that the PDF of the output levels is uniform, i.e.,

$$P_s = \begin{cases} 1, for 0 \le s \le 1 \\ 0, otherwise \end{cases} \quad (2)$$

The above transformation generates an image whose intensity levels are equally likely and also, it covers the entire range [0, 1].

This intensity level equalization process results in an image with increased dynamic range with a tendency to have higher contrast.

2) Discrete Case: In the case of discrete quantities, we deal with summations and hence, the equalization transformation becomes:

$$S_k = T(r_k) = \sum_{j=1}^{k} P_r(r_j)$$

$$= \sum_{j=1}^{k} n_j / n \quad , \text{for k =1, 2, 3,..., L} \quad (3)$$

where S_k is the intensity value of the output image corresponding to value rk in the input image.

This method is also applied for color images by applying the same method separately to the red, green &blue components of the RGB green &blue components of the RGB colors values of images. However by applying the some on red, green, blue components of image may yield dramatic changes inn the images "color balance".

Since the relative distribution of the color channels as a result of applying the algorithm. However image is first converted Into another color space ,lob color space (or) HSL /HSV color space in particular , then the algorithm can be applied to Luminance (or) value channel without resulting in changes to the Hue and saturation of the image .

B. Adaptive Histogram Equalization(AHE)

Adaptive histogram equalization is a image processing technique use to improve contrast in images .Adaptive method computers several histograms, each corresponding to a distinct section of the image ,and uses them to redistribute the image ,the uses them to redistribute the lightness values of the images .It is therefore suitable for improving the local contrast & enhancing the definitions of edges in each region of image.AHE has a tendency to over amplify noise in relatively homogeneous region of an image . A variant of AHE called contrast limit adaptive histogram equalization .

In this when ever the image contains regions that are significantly lighter (or) darker than the most of the image ,the contrast in those regions will improved by transforming each pixel with a transformation function derived from a neighborhood region .The transformation function is proportional to the CDF of pixel values in neighborhood.

C. Contrast Stretching

Contrast stretching is used to increase the dynamic range of the gray levels in the image .For example, in an 8-bit system the image display can show a maximum of 256 gray levels .If the number of gray levels in the recorded image spread over a lesser range ,the images can be enhanced by expanding the number of gray levels to a wider range. This process is called contrast stretching. The resulting image displays enhanced contrast between the features of interest.

D. Proposed Work

RGB color, the input image is undergoes conversion to HSV color space. The value channel (V-channel) extracted fro the HSV converted image. The V channel has been chosen as this represents the luminance of the image. Another important face is that H-channel(Hue-channel) should not be affected during the enhancement process as otherwise color information may be misjudge. The extracted V-channel has been normalized between 0&1 to bring stability to the pixel distribution. The normalized V-channel has been undergone local contrast management by BSB-CLAHE(Binary search based-CLAHE).The old V-channel has been replaced by the enhance V channel to obtain the enhanced HSV image .The HSV image is converted back it RGB color space to obtained the final enhanced image of the original input color image.

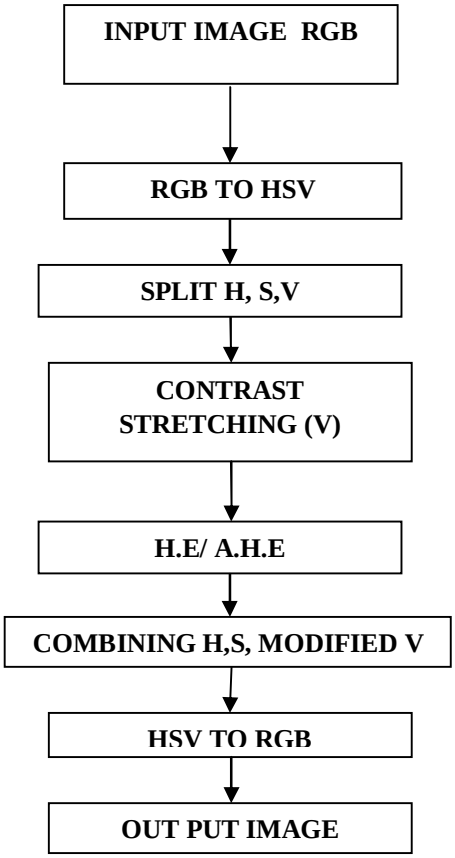


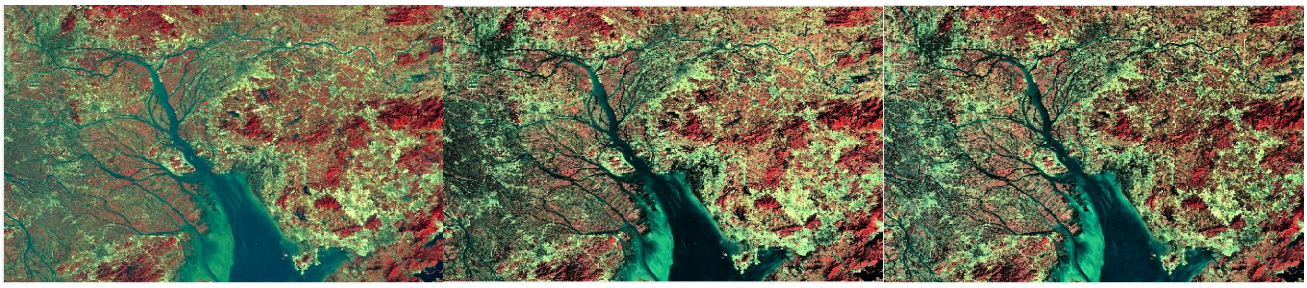
Fig .2.Block diagram of proposed work

III. RESULTS

The work has been done in the MATLAB software with various images taken from the internet source. First the different Histogram based on technique mentioned in the previous section are applied to image and then the performance of Histogram based techniques are analyzed. There is no doubt that the image processing is a source of most important source of the scientific impact if any sciences team. Our proposal scheme aims to achieve a good balance among the missing elements of the Satellite image. In this paper we have used algorithm on HSV color. The novel algorithm had been implemented in MATLAB. Tested our algorithm for many different low contrast satellite images into a great extent.

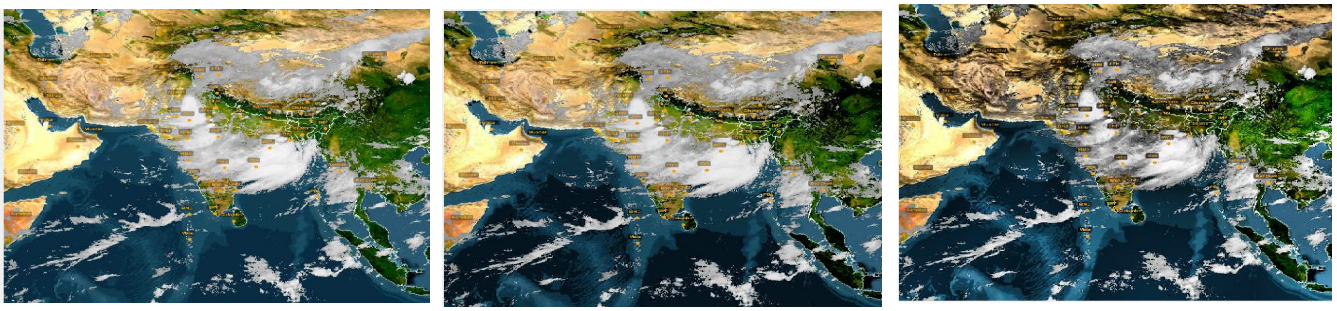
A. Satellite Image (A)

Satellite Image (A) Result Of H.E Result Of A.H.E



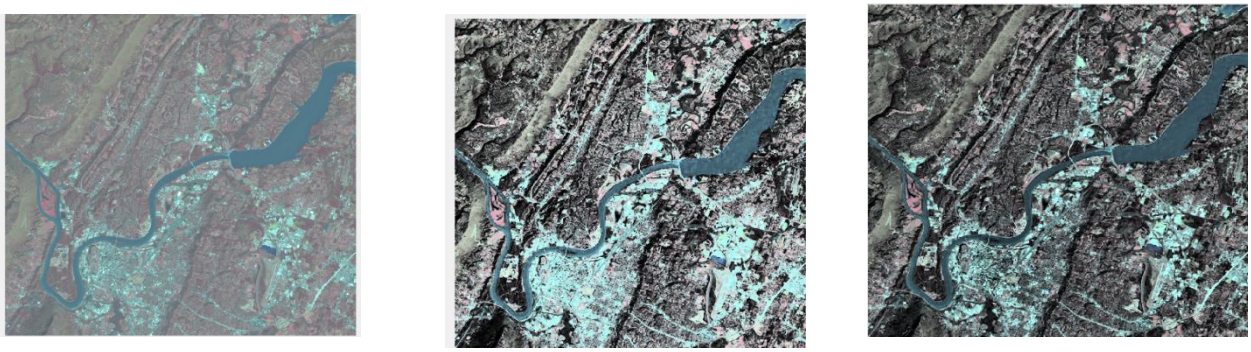
B. Satellite Image (B)

Satellite Image (B) Result Of H.E Result Of A.H.E



C. Satellite Image (C)

Satellite Image(C) Result Of H.E Result Of A.H.E



D. Satellite Image (D)

Satellite Image (D) Result Of H.E Result Of A.H.E

IV. CONCLUSION

In any image analysis process , image enhancement is always considered as an important preprocessing step. Through image enhancement, the noises or irrelevant information is tried to remove to the maximum possible extent. Contrast management is one of the important tasks during enhancement process .It is of two types: global and local. Global contrast management although possessing low computational complexity , but fails to produce better enhancement results and maximum times enhanced images are found subfreezing from noises .So, local contrast management is needed for better enhancement. In this paper , histogram equalization technique for satellite color images is introduced where local contrast management is given main focus. The enhancement process is done on HSV color space because of its capability to deal with satellite image in a far better way than RGB color space does. Normalization procedure is adopted here to bring stability in the range of pixels distribution of the input color image .The results of the proposed approach are found quite satisfactory and hence establish a good framework for satellite color image enhancement .In future ,the application of the proposed approach will be extended to different emerging areas like medical color image enhancement ,satellite color image enhancement etc.

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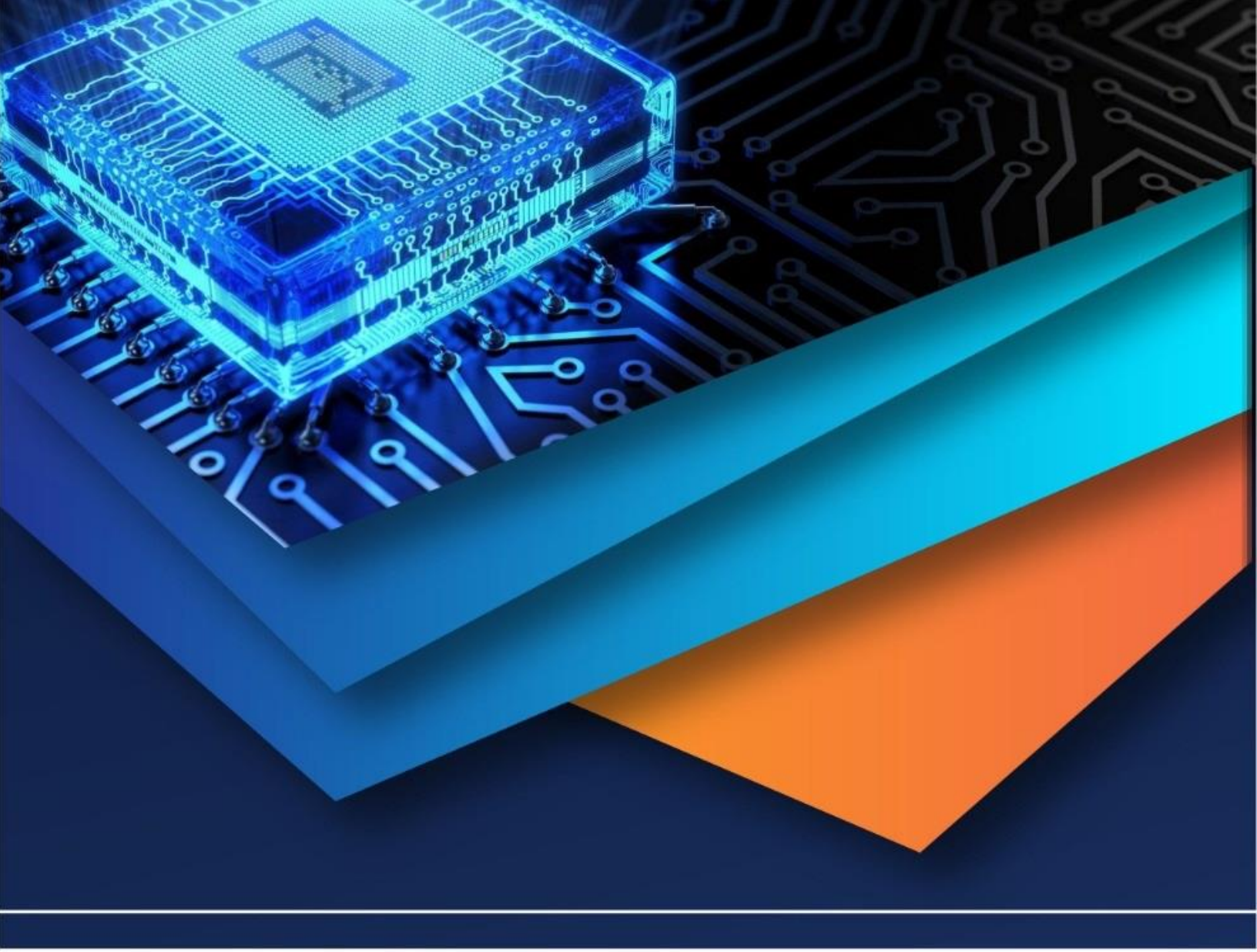

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