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Image Enhancement of Low Resolution Satellite Image Based on Texture & Morphological Features

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Abstract-**In a modern and industrial world, image processing plays a vital role to make the applications more smart compare to the present systems. Image Enhancement, a major term in image processing industry, which is more innovative and crucial task in digital image processing domain. The main intention of the digital image processing and enhancement scheme is to portrait the visual inspection of the image in better contrast with proper sharpness and brightness. The Satellite Image Processing scheme is most essential image processing task, which illustrates the processing of converting complex and blurred view of images into better clarified view to the user. The term morphological feature analysis illustrates the processing of extracting the features of satellite images as well as enhancing the clarity of the respective image in better manner. The proposed approach of satellite image processing clearly demonstrates the process of textural and morphological features of respective image and provides better visual clarity to understand the input image with proper level of accuracy. In the proposed approach, some classification schemes are taken care for processing the image with better clarity, such as Support Vector Machine [SVM], Artificial Neural Network [ANN] and so on. For all the entire work clearly demonstrates the process of manipulating the satellite image processing to provide better quality of images with more contrast as well as accuracy in result.**

Keywords- Digital Image Processing, Satellite Images, Feature Extraction, Morphological Analysis, Image Enhancement.

I. Introduction

Image Processing, a major domain in Information Technology industry, which deals the processing of digital images as well as providing different kinds of solutions to corresponding users. The processing of contrast analysis, feature extraction, resolution checking as well as enhancement of satellite images requires more concentration in this image processing industry. Specifically, the image enhancement schemes are supervised to change the band-intensities as well as reduce the noisy pixels, which save the specific required data of image. Linear-Contrast Manipulation, Edge Smoothing, Transformation, Histogram Feature Evaluation, Filtration Schemes, Decomposition and composition schemes and so on. Many classical techniques are available to process the satellite images such as: Transformation schemes like Fourier-Transformation, Wavelet-Decomposition, Domain Image Processing and many more. The major objective of all these quoted image processing techniques are improving the visual quality of the respective input image as well as enhancing the clarity level within defined and reduced timings. The proposed approach is also guaranteed those things to achieve more clarity of the satellite image by means of applying the feature analysis scheme over digital image processing domain to improve the view of satellite images with low-level of toughness as well as achieving high level of accuracy. The proposed approach constitutes a data preparation phase just

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before the feature extraction. It attempts to improve the quality of the image while retaining the computational burden in low levels.

II. LITERATURE REVIEW

[1] H. Demirel, C. Ozcinar, and G. Anbarjafaripresentedon the discrete wavelet transform (DWT) & SVD.It used for the decomposes the input image into the four frequency subbands by using DWT and the singular value matrix of the low sub band images & then it reconstruct the enhanced image by applying inverse DWT

[2] A. R. Gillespie, A. B. Kahle, and R. E. Walker,
presented on conventional enhancements for the color display of multispectral images arebased on independent contrast modifications or stretches of three input images. The two different enhancements are "de-correlation stretch" based on principal-component (pc) analysis & the stretch of hue saturation –intensity transformed data

[3] M. Pesaresiet al, presented on new global human settlement layer (GHSL) derived from HR & VHR optical remotely sensed data. The automatic image information retrieval process respect to two basic perspectives as accuracy measurements & consistency analysis

[4] M. Pesaresiet al, presented on design and test new technologies able to generate global fine scale information about the physical characteristics of human settlement

[5] S. Ferriet al, presented on methodology applied for production of the European human settlement layer derived from 2.5m resolution multi spectral remote sensing images & the results showed for the cities of Torino and Athens that prove strength of this specific approach in built up estimation & five scale mapping of urban areas

III. METHODOLOGY

Block Diagram

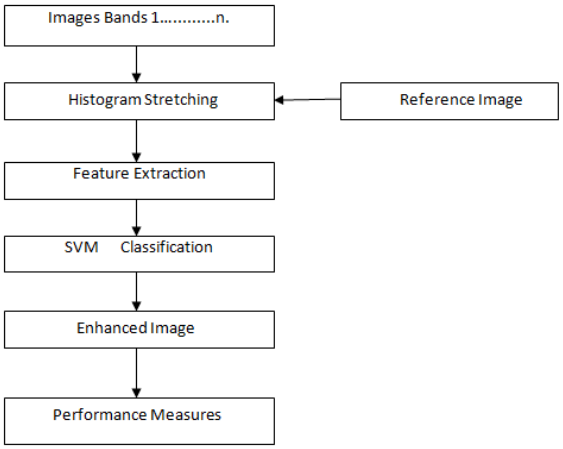

Fig. 1Block diagram of proposed work

The main objective of the proposed system is to provide good quality and better view of satellite images, which is not clear and illuted in nature. This is done by using the following procedures. Initially the input of three band images is processed by reprocessing technique such as converting the input imageinto gray scale manner as well as resizes the pixels into base nature like 256X256. The next step of processing is based on histogram based feature analysis, which is performed individually for all bands of the input image. In this stage a new replication is produced as well as which is made by thepowerful classification technique called Support Vector Machine [SVM]. The next stage of processing is to adjusting the pixels and improves the contrast of the input image to make it so perfect for the future processing. The next step is to extract the color features of the images based on Red, Green and Blue [RGB]. The next step is to measure the performance and accuracy level of the input image with balanced pixel manipulations. Finally, the process ends with SSL [Soil Sealing Layer], which is used for the data set and it is from European areas and it is useful to provide the information of degree of soil sealing in spatial resolution.

A. Pre-processing

The aim of pre-processing is an improvement of the image data that suppresses unwanted distortions or enhance some image features important for further processing. Following steps are used for pre-processing the input color image.

1. Image Resizing

The captured retina images are in RGB color space. In the pre-processing step, the input image is first resized into the size of 256 x 256 pixels. All images in database having different size, therefore we are doing image resizing to convert all image to fixed size

2. Gray Scale Conversion

The resized image is then converted into a gray scale image which has the grey level intensity ranging from 0 to 255.

3. Contrast Enhancement

The aim of contrast enhancement is to improve the contrast of an image. Basically, the idea behind enhancement techniques is to bring out detail that is obscured, or simply to highlight certain features of interest in an image There is various method of contrast -enhancement techniques but in proposed method adaptive histogram equalization technique is used. Histogram equalization (HE) is a simple and widely used image contrast enhancement technique. The basic disadvantage of histogram equalization is it changes the brightness of the image. In order to overcome this drawback, various HE methods have been proposed. These methods preserve the brightness on the output image but, do not have a natural look.

In order to overcome this problem, in proposed method adaptive histogram equalization technique is used. Adaptive Histogram Equalizer splits the image into small rectangular areas called tiles and enhances the contrast of these areas by adjusting their local histograms. This method is also called as Contrast Limited Adaptive Histogram Equalization (CLAHE). This method has the ability to control the level of contrast enhancement in the output image. The process of adjusting intensity values can be done automatically by the "histeq" function. "histeq" performs histogram equalization, which involves transforming the intensity values histogram. In this proposed method we use "adapthisteq" to adjust the contrast in a grayscale image. "Adapthisteq" produces an output image having values evenly distributed throughout the range.

4. Denoising

It is the process of removing the noise from image. In proposed method Wiener filter is used to remove noise from the image. The goal of the Weiner filter is to filter out the noise present in an image which posses corrupted signal in it. This filtering technique uses statistical approach to filter the noise from each pixel of an image. This filtering technique uses different angle in an image to modify the corrupted signal in it. It removes the additive noise and inverts the blurring simultaneously. It reduces the overall mean square error in image

B. Image Segmentation

After image enhancement, the next process is the image segmentation and the very first step in image analysis is image segmentation where the image is subdivided into different parts or object. Basically the image is subdivided until we segregate the interested object from their background. Generally there are two approaches for segmentation algorithms, one is based on the discontinuity of gray level values and the other is based on the similarity of gray level values and for this different approaches like Thresholding, region growing, region splitting and merging can be used. Segmentation can also be done using edge detection. Edge detector detect the discontinuities in color, gray level, texture etc. canny, sober are edge detection operator which are basically used for detecting an edge. Another approach is a region growing method used for segmentation.

In proposed method contrast thresholding is used for segmentation purpose. Contrast thresholding is a simple, yet effective, way of partitioning an image into a foreground and background. This image analysis technique is a type of image segmentation that isolates objects by converting grayscale images into binary images. To find lesions, all regional minima are identified. A regional minimum is defined as a group of connected pixels with same intensity, such that all its adjacent pixels have strictly higher intensities. Only minima with a contrast superior to a threshold 0.1 are retained. After that area opening is done to remove small objects from binary image and small holes get filled.

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C. Contrast Stretching

It is simple enhancement technique that improves the contrast in an image by 'stretching' the range of intensity values it contains to span a desired range of values & it uses a linear function This technique is often used when data in a digital image occupy only a small portion of the available range of digital values Contrast enhancement changing the original values so that more of the available range is used then it increases the contrast between features and their backgrounds

D. Support Vector Machine (SVM)

A Support Vector Machine (SVM) is a supervised machine learning algorithm that can be employed for both classification and regression purposes. SVMs are more commonly used in classification problems. SVMs are based on the idea of finding a hyperplane that best divides a dataset into two classes, as shown in the image below.

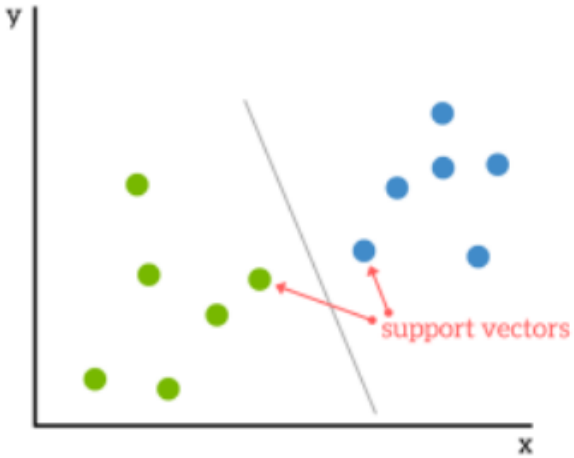

Fig. 2 Support vector machine model

A classifier is a supervised function where the learned (target) attribute is categorical. It is used after the learning process to classify new records (data) by giving them the best target attribute (prediction). In machine learning, support-vector machines (SVMs, also support-vector networks are supervised learning models with associated learning algorithms that analyze data used for classification and regression analysis

IV.RESULTS AND DISCUSSION

In the proposed method database is collected from satellite image. Experimental results are described in this chapter. Programming environment Matlab was used to execute this experiment.

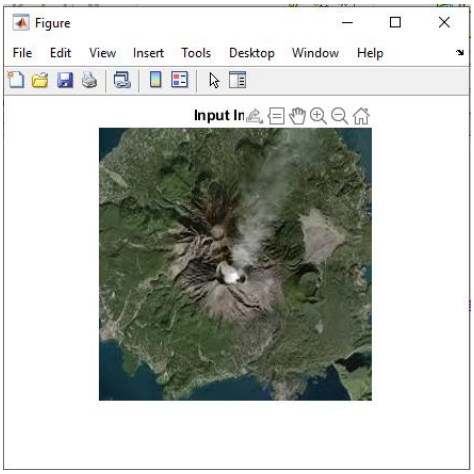

Fig. 3Input Image

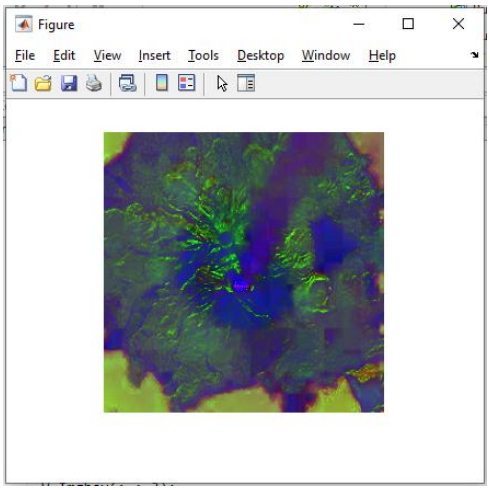

Fig. 4RGB to HSV image

Fig.3 & 4 show the input satellite image and it's converted into HSV format from RGB image.

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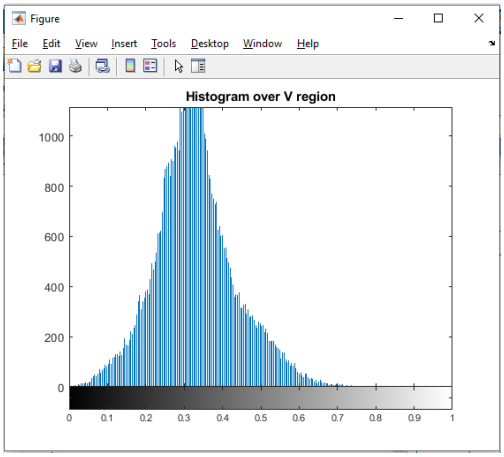

Fig. 5Histogram plotting over v region

Fig 5 show the histogram plotted over v region because only v region contains information

Then least square fitting method takes place as shown below

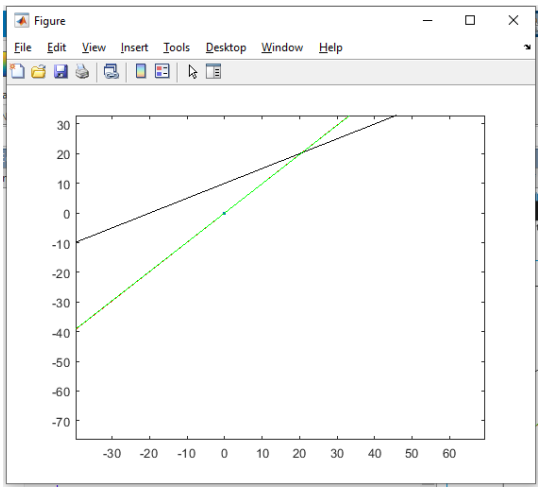

Fig 6 Least square fittingimage

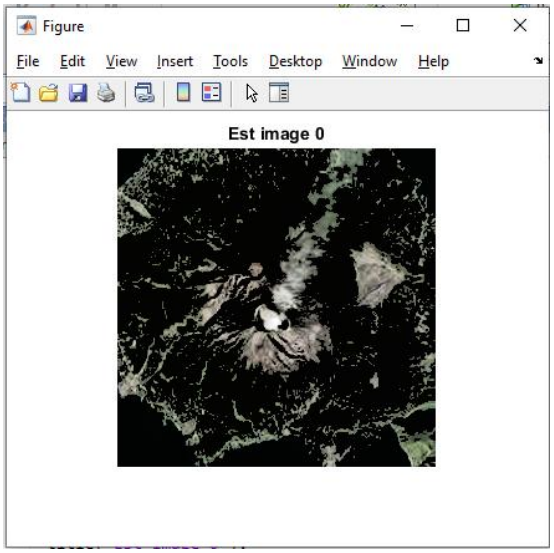

Fig 7 Threshold Zero Image

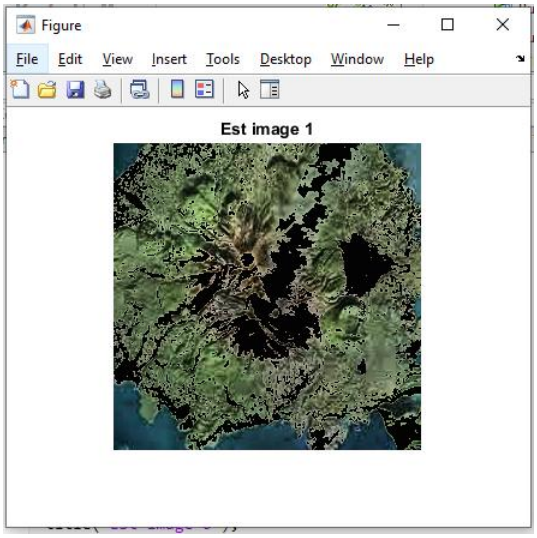

Fig 8 Threshold One Image

Fig 7 & 8show thethreshold zero and one image, Thresholding is a technique, in which the assignment of pixel values in relation to the threshold value provided. In Thresholding, each pixel value is compared with the threshold value. If the pixel value is smaller than the threshold, it is set to 0, otherwise, it is set to a maximum value

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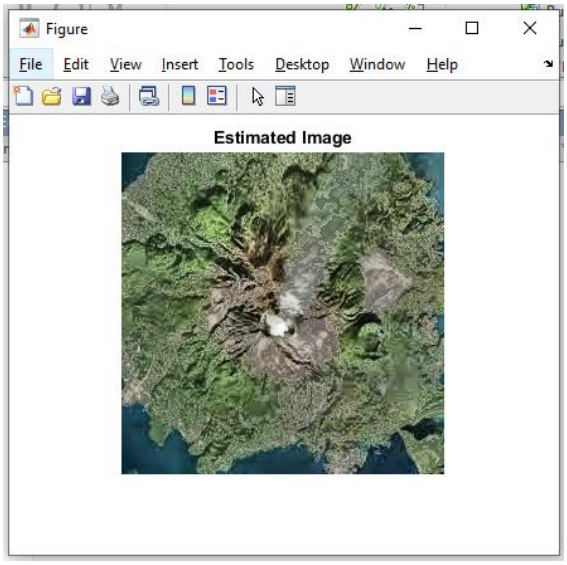

Fig 9 Estimated Image

Fig 9 show the estimated image by using linear stretched method

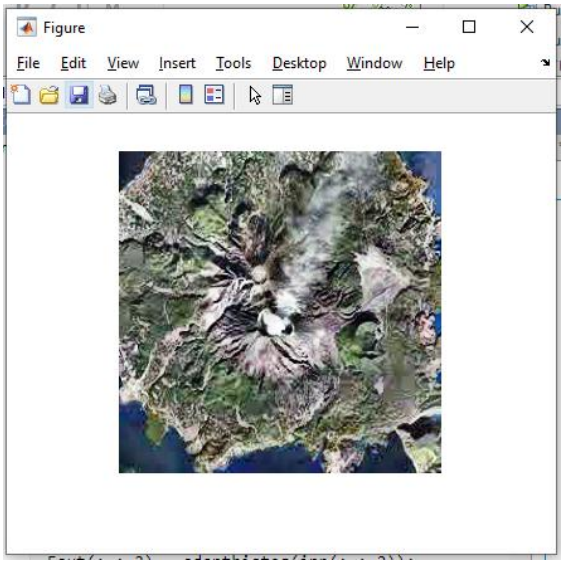

Fig 10 CLAHE Image

Fig 10 show the preprocessing done by using CLAHE method, it is a variant of Adaptive Histogram Equalization. CLAHE was used to prevent the over amplification of noise that adaptive histogramequalization can give.

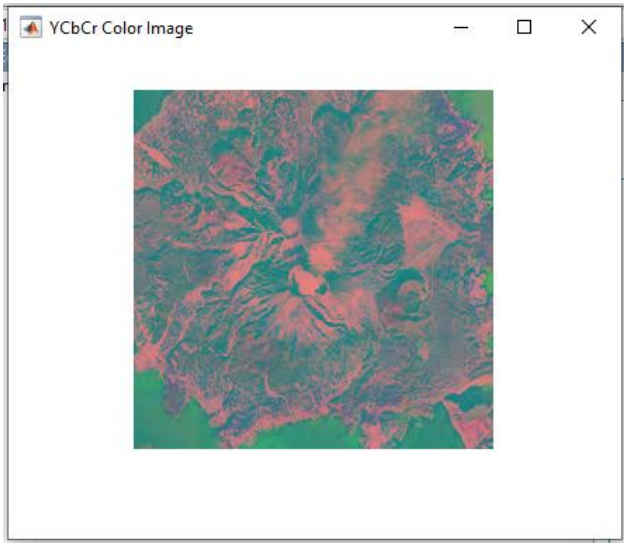

Fig 11 YCbCr Image

Fig 11 show the CLAHE image is converted into YCbCr format and it is suitable to further processing

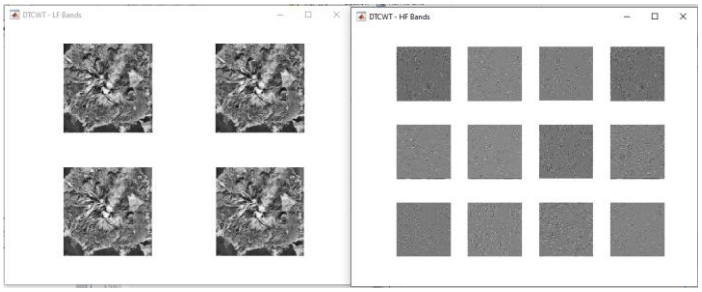

Fig 12 Level of Decomposition

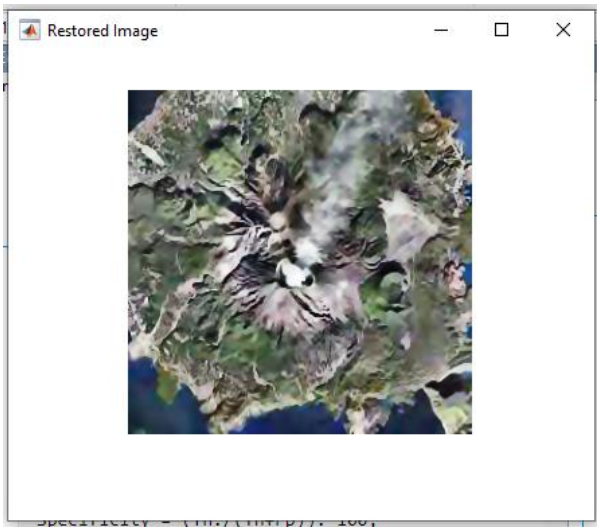

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Fig 13 Restored Image

Fig 12 & 13 show the decomposition method is used to restore the imagethen calculated accuracy,specificity and sensitivity by using performance matrix as follow as

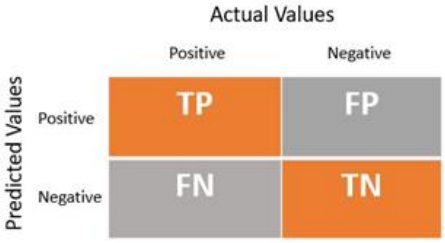

Fig 14 Performance Matrix

$$\text{Accuracy} = \frac{TP+TN}{TP+TN+FP+FN}$$

$$\text{Sensitivity} = \frac{TP}{TP+FN}$$

$$\text{Specificity} = \frac{TN}{TN+FP}$$

TP = True PositiveFP = False Positive

TN = True NegativeFN = False Negative

Table 1. Parameter Result

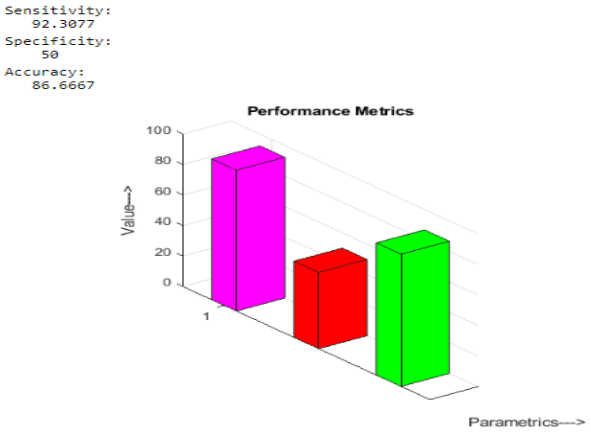

Fig 15 Parameter Evaluation Matrix

Then calculated parameter evaluation such as sensitivity, specificity & accuracy of training images and same performed with testing images.

Training Images	Sensitivity %	Specificity %	Accuracy %
T1	86.66	50	78.94
T2	83.33	33.33	76.19
T3	84.61	75	82.35
T4	76.92	60	72.22
T5	80	66.66	76.19
T6	73.33	40	65

PARAMETER	RESULT
Sensitivity	92.30%
Specificity	50%
Accuracy	86.66%

T7	84.61	50	71.42
T8	83.33	50	72.22
T9	93.75	75	90
T10	87.5	66.66	81.81

Table 2 Training Images Parameter Evaluation

Testing Images	Sensitivity %	Specificity %	Accuracy %
Test1	92.3	66.66	87.5

Test2	86.66	66.66	80.95
Test3	90.9	60	81.25
Test4	92.3	50	86.66
Test5	83.33	66.66	77.77
Test6	86.66	50	78.94
Test7	90.9	50	84.61
Test8	80	33.33	72.22
Test9	91.66	33.33	80
Test10	91.66	33.33	80

Table 3 Testing Images Parameter Evaluation

Average	**Sensitivity %**	**Specificity %**	**Accuracy**
Training Image	83.404	56.66	76.63
Testing Image	88.63	50.99	80.99

Table 4 Average Parameter Evaluation

V.CONCLUSION AND FUTURE WORK

The implemented approach/framework presents image clarity improvement such as enhancing the image as well as enabling the contrast alteration, which assumes a generous part for the enhancing the input satellite image. The Histogram Equalization, Adaptive Histogram Equalization, CLAHE and contrast stretching methods improves the enhancing of image by reducing noise for spatial domain and frequency domain techniques. The performance of the classifiers produced by the Supervised Machine Learning (SML) evaluated with Accuracy- 86.66%, Sensitivity-92.30 %, specificity-50%. For all the entire work is the presentation of a straightforward and generally quick approach that can "accurate" the low determination reference and move it easily in better resolutions and clarity. This Enhanced image results are more suitable for display or further image analysis with various applications.

Further work can be tested with adaptive histogram adjustment by using different reference layers, and use the different classification techniques in machine learning to get the results more accurately.

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