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I mage Classification

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Abstract:- **Digital image processing is a n method to perform some operations on digital images using the computer algorithms. Processing of images varies from one application to another, i.e. starting from image preprocessing (enhancement, restoration), segmentation, compression, rendering etc., on different types of images . Performance of image processing algorithms strongly depends on the type of the input image and its quality. This paper provides an algorithm to classify the images based on their hom ogeneity such as more homogeneous images, less ho mogeneous image, non homogeneous images and complex images, using the Interquartile Range (IQR). Performance is e valuated by experimental results obtained on various images taken fro m the standard database set.**

Keywords:-- **Interquartile range; classificatio n; Homogenous; Texture; blocks; Histogram;**

I. INTRODUCTION

Performance of image processing algorithms strongly depends on the type and quality of the in put image. Most of the algorithms exists in literature yield different results for the different images because of their hom ogeneity. Homogeneous region [7][8] is a region defined by a higher similarity among the units that compose it than with units belonging to other regions. Regions homogeneity can be determined based on the gray level, color, texture, shape and model etc. Homogeneity is one of the important parameter in image segmentation applications which influences the informa tion required to segment the images based on the homogeneous reg ions. Performance of the segmentation [1][2][4][5][6] algorithms depends on the this homogeneity factor. B.K. Mohan and S. N. Ladha[10] proposed an method to classify satellite images based on object and pixel classification approach. In this method the various features such as compactness, average texture,, area, perimeter, spectral mean vector and others. In the liter ature less work is mentioned in the proposed area. This m otivates us to develop an algorithm to classify the images based on homogeneity. There are various algorithms exist in the literature to classify the images. Robert M Haralick at.el[11]. proposed a methodology to classify the images based on the te xtural properties such as autocorrelation function[12], power spectra[13], first and second Markov meshes[14] of blocks of i mage data. In this method statistical features of texture is consider. T he accuracy of the classification is range of 80 – 90 percent. This paper describes proposed method for classifying the images into different classes.

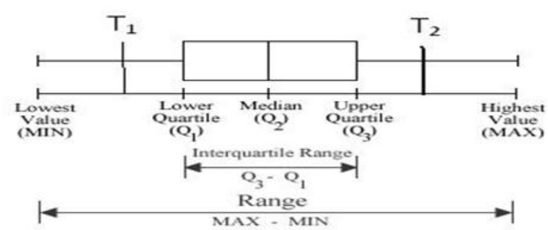

Figure.1: Distribution of IQR and outlier Interquartile range (IQR)

In the proposed method IQR[9] is employed for classifying the image as more homogeneous images, less homogeneous image, non homogeneous images and complex images. Any data that is not satisfying some common patterns belongs to different group compared to the rest of the data. Interquartile range (IQR) is one such statistical feature used to find such type of data (outlier). IQR measures the unevenness by dividing the set of data into quartiles.

In IQR ordered data set is divided into equal sub groups. These groups are called first quartile Q1 which is the median value of the first half (group) of the ordered data set, second quartile Q2 is the middle value in the given data set and third quartile Q3 denotes the median value in the second half (group) of the ordered data set. Difference of quartile Q3 and Q1 is called the interquartile range.

IQR is used as an measure of variability of the data set if the extreme values are not known exactly. It gives the information about the arrangement of data in relation to the median value. Small IQR denotes that data

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is clustered around the median and large IQR denotes that data is more distributed.

There is no standard rule for identifying the outlier data from the set of observed data. This is completely based on the applications. General rule for identifying isolated datasets called outliers from the IQR is defined as

- if data is greater than quartile Q3 or
- if data less than quartile Then data is to be an outlier

Figure.1 shows an example of the distribution of IQR and the thresholds t1 and t2.

II. METHODOLOGY

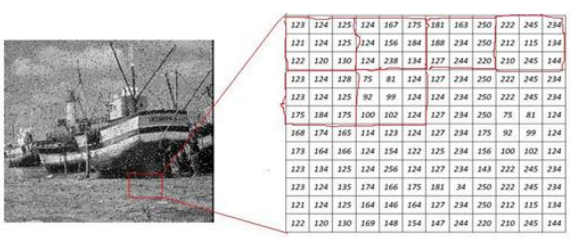
In the proposed method image classification is performed in the following steps.

Divide the image into non overlapping blocks of size (p x p) for an image f (m, n) as shown in Figure. Extract the two statistical features called mean and standard deviation from each block as given in equation 1 and equation 2.

$$\mu=\frac{1}{m\,n}\sum_{i=p-\frac{l-1}{2}}^{p+\frac{l-1}{2}}\sum_{j=q-\frac{l-1}{2}}^{q+\frac{l-1}{2}} y(i,j) \qquad (1)$$

$$\sigma=\frac{1}{m\,n}\sum_{i=p-\frac{l-1}{2}}^{p+\frac{l-1}{2}}\sum_{j=q-\frac{l-1}{2}}^{q+\frac{l-1}{2}} (y(i,j)-\mu)^2 \qquad (2)$$

(a)



(b)

Quartiles

25% of values **Q1** 25% of values **Q2** 25% of values **Q3** 25% of values

Standard deviation (Data set) for the 10 blocks as shown in fig. 2(b)

5, 5, 5, 5, 6, 6, 6, 6, 7, 7, 7, 9

This data set is divided into four quartiles as follows

5 5 5 Q1 5 6 6 Q2 6 6 7 Q3 7 7 9

After extracting the standard deviation from the image, the values are ordered and divided into four equal parts called quartiles Q1, Q2 and Q3 as shown below

The quartile Q1 is the point shows lowest 25% of data i.e., 25th percentile, quartile Q2 is the median of the data set called 50th percentile and the quartile Q3 which is between lowest 75% and highest 25% of data set and is called 75th quartile. Consider the following example for the blocks 12. As the quartile point falls between two values, the mean (average) of these values is the quartile value:

Q1 = (5+5) / 2 = 5
Q2 = (6+6) / 2 = 6
Q3 = (7+7) / 2 = 7 IQR = Q3 - Q1
= 7 - 5
= 2

IQR for given data is 2. This shows that blocks in image are more homogeneous and image will be classified to one of the four classes based on the IQR. i.e., as the IQR reduces regions in the image are more homogeneous. Algorithm for classifying the images into more homogeneous, less homogeneous, non homogeneous and complex images is given in the Table 1

Table 1: Image classification algorithm

	Input: Gay scale image
	Output: Type of the image.
i)	Divide the image into blocks of size $m \times m$
ii)	Find the mean and standard deviation of all the blocks
iii)	Sort the standard deviation of all the blocks in increasing order.
iv)	Find the first and third quartile Q_1 and Q_3 respectively.
v)	Find *IQR* from Q_1 and Q_3 i.e., $IQR = Q_3 - Q_1$
vi)	Select the threshold T_1, T_2 and T_3
vii)	If the IQR is less then T_1 then the image is more homogeneous image else If the IQR is in between then T_1 and T_2 then the image is less homogeneous image else If the IQR is in between then T_2 and T_3 then the image is non homogeneous image else the image is complex image

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Table 2 : Classification Results for the images shown in Figure 3.

Image No	Block size *4 x 4*		Block size *8 x 8*	
	IQR	Classification	IQR	Classification
1	3.810894	Less Homogeneous	3.61831	Less Homogeneous
2	7.471959	Complex	4.494715	Less Homogeneous
3	5.011795	Non- Homogeneous	5.347164	Non- Homogeneous
4	2.362908	More- Homogeneous	1.593328	More- Homogeneous
5	7.213021	Complex	5.506063	Non- Homogeneous
6	4.168257	Less Homogeneous	4.145646	Less Homogeneous
7	8.78608	Complex	3.930229	Less Homogeneous
8	5.10252	Non- Homogeneous	6.707915	Non- Homogeneous
9	4.974744	Less Homogeneous	6.51683	Non- Homogeneous
10	6.610606	Non- Homogeneous	7.572086	Complex
11	3.77982	Less Homogeneous	4.237396	Less Homogeneous
12	1.959454	More- Homogeneous	3.125258	Less Homogeneous
13	6.894591	Non- Homogeneous	7.02117	Non- Homogeneous
14	6.714339	Non- Homogeneous	4.082526	Less Homogeneous
15	3.915565	Less Homogeneous	2.461111	More- Homogeneous
16	2.72257	More- Homogeneous	2.917006	More- Homogeneous
17	3.98166	Less Homogeneous	3.737655	Less Homogeneous
18	5.476115	Non- Homogeneous	5.525647	Non- Homogeneous
19	3.032586	Less Homogeneous	3.263255	Less Homogeneous
20	3.846678	Less Homogeneous	3.636203	Less Homogeneous
21	1.850353	More- Homogeneous	2.030707	More- Homogeneous
22	9.416455	Complex	4.800107	Less Homogeneous
23	3.689186	Less Homogeneous	2.096357	More- Homogeneous
24	1.833417	More- Homogeneous	1.272556	More- Homogeneous
25	8.700524	Complex	5.40111	Non- Homogeneous
26	11.58527	Complex	10.32548	Complex
27	7.70435	Non- Homogeneous	5.701408	Non- Homogeneous
28	7.81298	Non- Homogeneous	8.310441	Complex
29	9.081659	Complex	6.889952	Non- Homogeneous
30	1.990603	More- Homogeneous	1.029315	More- Homogeneous
31	4.617053	Less Homogeneous	4.4521	Less Homogeneous
32	6.978276	Non- Homogeneous	3.376229	Less Homogeneous

III. RESULTS AND CONCLUSION

Proposed method of image classification evaluated by conducting experiments on images. These images of size 256 x 256 are selected from Berkeley segmentation data base set. In the proposed method, we used some of the parameters called block size m x m, thresholds T1, T2 and T3 are selected using brute force method. Experiment is conducted for the block size 4 x 4 and 8 x 8 (3 x 3, 5 x 5 and 9 x 9 are the commonly used window size in most of the image processing applications). 3,5 and 7 are selected as thresholds for T1, T2 and T3 respectively. Table 2 shows image classification for the various images shown in Figure 3. The performance of the method also compared with histogram technique and shows the prominent results. From table 2, it is observed that proposed method gives classification for few images (2,5,7,9,10,14,15) when the block size is different, this is due to number of edges in the images and the selection three thresholds. Proposed method also compared with the histograms shown in figure4 for the block size 4 x 4 and observed that results are identical.

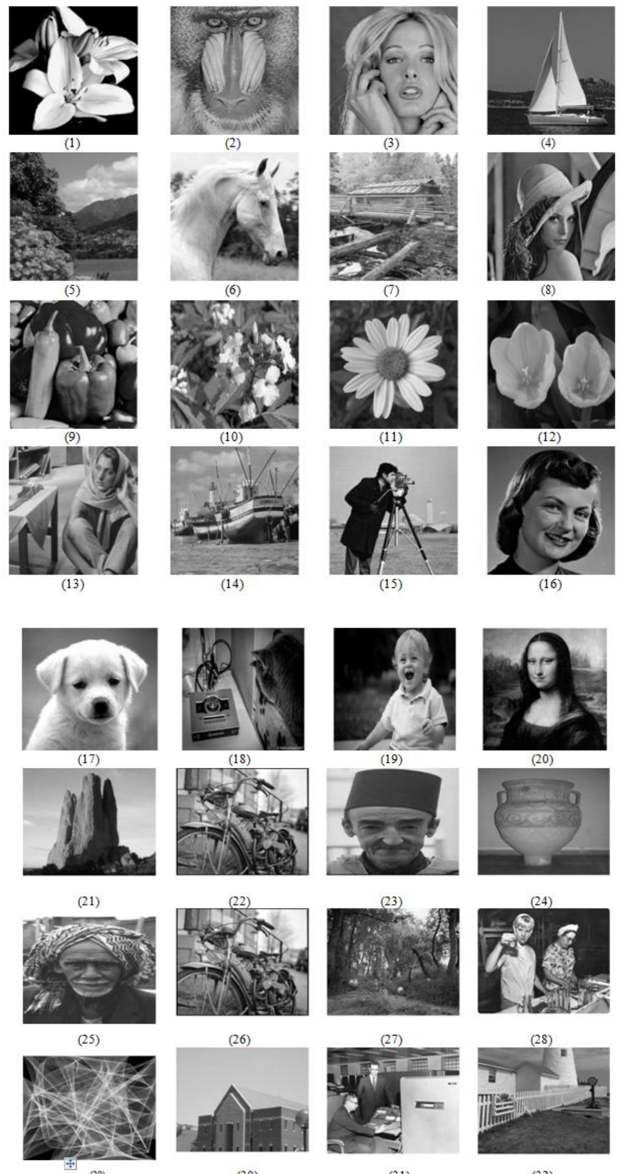
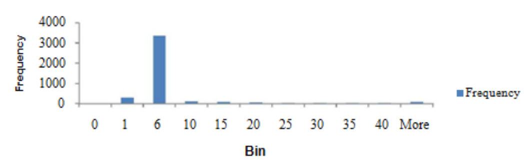


Figure 3: Few of the Images used for testing the developed method



(a)

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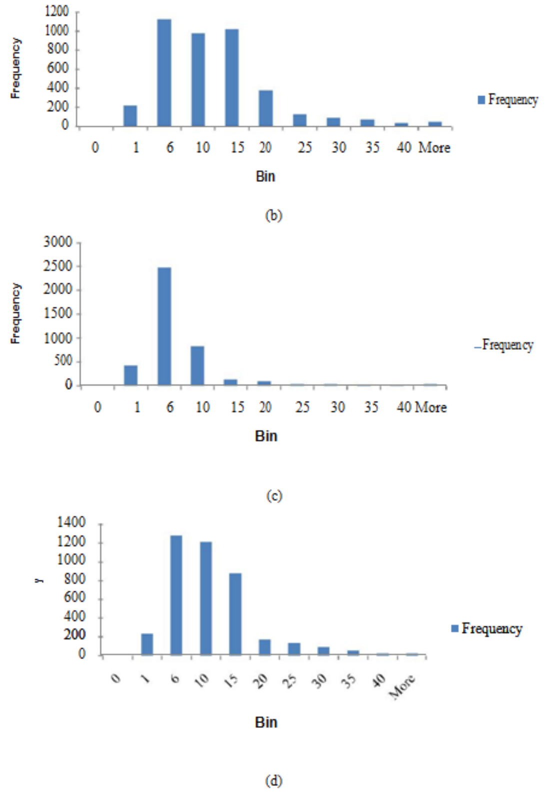

Figure 4: (a) to (d) Histogram for the standard deviations of the images 12, 7, 6, and 13 respectively for 4 x 4 block

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