Classification of Images into Clusters by Its Properties (CICP)

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Abstract-The Quality of the given image is identified by its Features and properties. In this paper Image Classification of Images into Clusters by its Properties (CICP) we analyze the different Features and Properties of various types of images. The images are of good visible, moderate visible and blur for visibility. The basic properties such as Entropy, Contrast, Skewness, Brightness, Kurtosis, Visibility and Spatial Frequencies are calculated for the given images. These property values are extracted for Weibull, Contrast, Intensity and Fractal images. Image Classification is made based on the properties which are unique for particular type of images.

Index Terms- Brightness, Moments, Standard Deviation, Spatial Frequency, Visibility.

I. INTRODUCTION

Each image has its own features which are used for analysis of the given image. The property of image is called the Feature. Some application require more than one Feature. Feature Space is the group of Feature Vectors. Features can be classified in to Five types : 1.Topological, 2.Intensity, 3.Size and Shape, 4.Texture and 5.Structure or Contextual. Topological represent the components which are connected. Intensity Features include Mode, Median and first few Moments of the image. Size and Shape represent orientation, position and area. Texture features are used to detect regions and image Segmentation. Small texture objects are defined in Structure Feature. Image Classification is the method of grouping images into category based on the type of image.

II. LITERATURE SURVEY

Emilce Moler et. al., [1] proposed a tool with combined Spatial and Frequency domain techniques for finger print identification for Forensic Science. This algorithms helped to find a person who murdered military forces and unknown for fifteen years by the Department of Dactiloscopy of Police. Andreas Markus Loening et. al., [2] described the open source tool Amide's Medical Image Data Examiner (AMIDE) for analyzing multimodal medical images. Program is used to shift, rotate, view, scale, moving and analyze the data and image. Authors also states that the tool runs on Microsoft Windows, UNIX and Macintosh OS X platforms. By using finger print image quality analysis, Eun Kyung Yun et. al., [3] proposed Adaptive Enhancement of finger print images. The extracted minutiae Quality index and Block directional differences are used for enhancement.

Lukasz Kobylinski et. al., [4] introduced Customized image Classification using Associative Classification. Features calculated from texture and color characteristics are classified by spatial proximity features. Authors specify that the proposed method is better than simple rule based classifiers. Masked face priming with High Spatial Frequency and Low Spatial Frequency [5] are analyzed by Vincent de Gardelle et. al.,. Authors identified hybrid prime images results good visibility and used as coarse to fine vision model.Modification in Global Histogram Equalization by using Range Offset [6] is proposed by Haidi Ibrahim. By calculating input image Cumulative Density Function, Intensity mapping Function is constructed. Mean brightness is used to determine the offset of the intensity mapping Function. Author states that the proposed method maintains the Brightness and Histogram partitioning is not required.

Multiwavelet using hard threshold [7] for denoising of Mammographic images is proposed by Kother Mohideen et. al. Subtle detail discriminations and local Contrast are enhanced by preprocessing. Multiwavelet is used for image suppression and satisfy both symmetry and asymmetry. Noise coefficient is modeled by Laplacian random variables. J Quintanilla Dominguez et. al., [8] proposed image segmentation based on K-means, Possibilistic Fuzzy c-means and Fuzzy means Clustering algorithms to identify Microcalcifications of breast images. Microcalcification is an indicator for breast cancer. Different types of tissues and different shapes are enhanced by mathematical morphology to improve contrast between clusters and background.

Muna F Hanoon [9] introduced a method to enhance fingerprint images by using HE and Vector Quantization. contrast limited adaptive histogram equalization with clip limit (CLAHE) is used to enhance the small tiles, wiener filtering for selecting proper image which is enhanced, Thinning and Vector Quantization is used to obtain low bit rate image compression. He Xiaolan et. al., [10] proposed Texture Feature Extraction using Gray Level Coccurence Matrix (GLCM) for Synthetic Aperture Radar (SAR) images. Nonsubsampled Counter Transformation is combined with GLCM for extraction of Mutidirection and Multiscale Texture Features. Support Vector Machine is applied for segmentation of SAR images.

A Sanchez Romerol et. al., [11] proposed a method for Direct solar irradiance by using Campbell Strokes sunshine recorder. Digital scanned burned cards are used for image processing which are of burn width with 1 min resolution. High temporal sunshine duration is computed and compared with visual determination. Brian Jhonson [12] proposed Spatially Weighted image Fusion by segmenting Higher Spatial Resolution (HSR) Images, extracting Mean Spectral Features from Lower Spatial Resolution (LSR) Images and finding Euclidean distance from the boundary of images.

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Authors used Urban area and Mixed Agricultural area for the case studies and concluded that the proposed method can be used for spatial segmentation resolution is greater than 2:1 for LSR w.r.t. HSR. Najva Izadpanah [13] presented a indexing the image based on Hierarchical Clustering. The essential information is to be approximated in maximum extent of negentropy for classifying data space. Feature vectors with High dimensions are managed by divisive hierarchical Clusters. Authors also states that prerequisite parameter is to be estimated in selecting the model and proposed indexing method results unbalanced structures.

III. PROPOSED METHODOLOGY

The objective of CICP is to obtain the properties of given image and classify into clusters based on its properties. From the Intensity image Properties, multiple attributes are taken to obtain better result. From the Intensity, Weibull, Contrast and Fractal images, the Feature Vectors are derived. Figure 1 represent the Block diagram of proposal of CICP implantation.

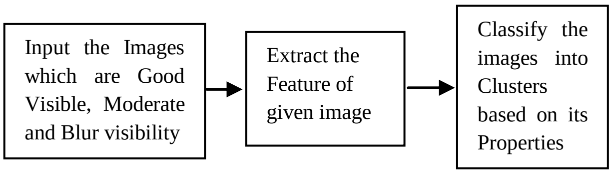

Figure 1. Block diagram of System CICP

IV. FEATURE ANALYSIS

Study of statistical models of a given image is called Feature Analysis. It is used in different image applications like Enhancement, Smoothing, Segmentation etc.,. Some of the basic Features of an image are Brightness, Standard Deviation, Entropy, Skewness, Kurtosis, Visibility, Spatial Frequency and Moments.

A. *Brightness*

It is the inherent quality of a source sending out the light. Brightness is used to track the object and is based on exposure level. It is also defined as overall Darkness or Brightness of an image.

B. *Standard Deviation (SD)*

Standard Deviation is also called Contrast in image processing. Standard Deviation is the difference between minimum and maximum intensity of pixels. It is also called as Contrast or Root Mean Square (RMS). Equation (1) represent the Standard Deviation.

$$SD = \sqrt{\frac{1}{MN}\sum_{i=0}^{N-1}\sum_{j=0}^{M-1}\left(I_{ij} - \bar{I}\right)^2} \qquad (1)$$

where intensity of pixel is represented by I_{ij} for $(i,j)^{th}$ location. M and N represent the dimension of the image. Average intensity is indicated by $\bar{I}$.

C. *Entropy (H)*

Entropy is the disorder or uncertainty and expected value measure of an information. It gives the randomness of texture of an image. It can be defined as the probabilistic behavior of given information. Entropy can be derived by equation (2).

$$H = -\sum P_k \log_2 P_k \quad for\ k = 1\ to\ l \qquad (2)$$

where P_k represent the Probability of k elements(i.e., from 1 to l).

D. *Skewness (g)*

Skewness is the asymmetry measure of Probability distribution. Positive skew value indicates that probability curve has tail on right side. The relationship between Mean and median cannot be identified by Skew. In Unimodal distribution there is only one maximum value and in Multimodal distribution, more than one maximum values for probability distribution. Skewness value may be negative, positive or undefined. Equation (3) can be used to find Skewness.

$$g = \frac{m_3}{m_2^{\frac{3}{2}}} = \frac{\frac{1}{n}\sum_{i=1}^{n}(x_i-\bar{x})^3}{\left[\frac{1}{n}\sum_{i=1}^{n}(x_i-\bar{x})^2\right]^{\frac{3}{2}}} \qquad (3)$$

where m_2 and m_3 are second and third moments representing variation and symmetric estimator respectively. x_i and $\bar{x}$ are Median and Sample Mean.

E. *Kurtosis:*

The shape of random variable probability is obtained by Kurtosis. The value of Kurtosis are -2 to any positive value. The Probability distribution with fatter tails have Positive excess kurtosis value. The distribution with thinner tail and less peak is called Platykurtic. The value range for Platykurtic is 1 and 3. The distribution with fatter tails and more peaks has value greater than 3.

F. *Visibility (V)*

Visibility of an image is calculated by equation(4)

$$V = \frac{I_{max} - I_{min}}{I_{max} + I_{min}} \qquad (4)$$

where I_{max} and I_{min} represents Maximum and minimum Brightness.

G. *Spatial Frequency*

Spatial Frequency is the measure of repetition of an event per unit distance. It is also measured as lines per millimeter. Edges have abrupt spatial changes. Sharp edges have high spatial frequency. Low Spatial frequency represent large coarse image. High Spatial Frequency images have good visibility.

H. *Moments*

Image pixel intensities are measured by Moments. To identify some attractive features of an image, Moments are calculated. For the Gray images with Pixel Intensity *I(x,y)*, equation (5) is used to calculate the raw image Moments.

$$M_{ij} = \sum_{i=1}^{P}\sum_{j=1}^{Q} x^i y^j\, I(x,y) \qquad (5)$$

where P and Q represents maximum row and column size of the image, M_{ij} is the Moment for given values : i= 1 to P and j =1 to Q.

V. RESULTS AND OBSERVATIONS

In the repository, different dimension gray images are stored. The Features are extracted from the Intensity, Weibull, Contrast and Fractal images. Paint Shop Pro 5 is used to edit the images into different sizes. Lena(good visible and blur), Airplane, Baboon images are considered for the results which are tabulated in this paper (Table I to Table V). Feature Vectors for texture images are obtained for each image. The Statistics of Standard Deviation, Mean, Median, Spatial Frequency, Separability, Visibility and seven Moments are calculated. Figure 2 to 6 represents the Original images, Intensity, Contrast, Weibull and Fractal images. It is observed that first few moments represent the Standard Deviation, Mean, Skew and Kurtosis. It is also observed that Normalization is required for analysis of higher order moments and Multiple Feature vectors are required for classification of images into Clusters.

Table I. Intensity Properties

Sl. No.	Property Name	Lena	Baboon	Airplane
1	Entropy	7.446	7.139	6.486
2	Standard Deviation	47.857	36.345	39.866
3	Brightness	124.05	127.32	169.89
4	Skewness	0.288	0.554	1.165
5	Spatial Frequency	14.531	31.433	15.559
6	Separability	0.699	0.682	0.832
7	Visibility	4653.8	3371.42	2276.10
8	Kurtosis	-0.815	0.642	0.714
9	Moment 1	6.618	6.656	6.898
10	Moment 2	18.950	19.539	21.229
11	Moment 3	16.756	16.846	17.691
12	Moment 4	15.600	15.687	16.526
13	Moment 5	31.778	31.954	33.634
14	Moment 6	25.078	25.515	27.141
15	Moment 7	36.802	35.348	39.710

Table II. Contrast Properties

Sl. No.	Property	Lena	Baboon	Airplane
1	Entropy	5.233	6.587	5.225
2	Standard Deviation	20.909	29.451	26.789
3	Brightness	16.995	41.178	17.278
4	Skewness	1.804	1.042	1.680
5	Spatial Frequency	15.430	20.921	19.296
6	Separability	0.672	0.695	0.741
7	Visibility	37661.48	16399.22	47921.29
8	Kurtosis	14.323	1.395	8.813

Table III. Weibull Properties

Sl. No.	Property	Lena	Baboon	Airplane
1	Entropy	7.701	7.517	6.920
2	Standard Deviation	57.550	48.451	55.540
3	Brightness	118.009	156.103	195.026
4	Skewness	0.309	0.735	1.230
5	Spatial Frequency	16.649	21.935	22.825
6	Separability	0.696	0.651	0.811
7	Visibility	6044.90	3164.64	2486.58
8	Kurtosis	-0.814	0.036	1.420

TABLE IV. FRACTAL PROPERTIES

Sl. No.	Property	Lena	Baboon	Airplane
1	Entropy	5.396	5.813	4.231
2	Standard Deviation	22.307	19.399	22.110
3	Brightness	147.472	120.158	141.972
4	Skewness	1.631	1.458	1.752
5	Spatial Frequency	20.388	18.920	19.889
6	Separability	0.545	0.523	0.626
7	Visibility	1416.723	1671.508	1298.655
8	Kurtosis	14.185	11.051	1.566

Table V. Lena (blur) Image Properties

Sl. No.	Property	Contrast	Fractal	Weibull	Intensity
3	Entropy	4.558	5.393	7.678	7.392
2	Standard Deviation	12.914	26.800	56.230	45.636
1	Brightness	9.499	157.865	120.29	122.910
4	Skewness	1.995	1.354	0.231	0.135
7	Spatial Frequency	6.343	20.364	13.125	6.582
6	Separability	0.605	0.703	0.695	0.599
8	Visibility	59607.8	1747.51	5742.9	4518.26
5	Kurtosis	28.541	7.651	-0.798	-0.838

Figure 2. Airplane, Baboon, Lena (Good Visible) and Lena (Blur) Original Images

Figure 3. Intensity, Contrast, Weibull and Fracal Images of Airplane

Figure 4. Intensity, Contrast, Weibull and Fracal images of Baboon

Figure 5. Intensity, Contrast, Weibull and Fracal Images of Lena (Good Visible Image)

Figure 6. Intensity, Contrast, Weibull and Fracal imges of Lena (Blur Image)

VI. CONCLUSIONS

In the proposed CICP, different Features are analyzed and observed that Mean, Standard Deviation, Kurtosis and Skew are represented by first few Moments. It is also observed that Normalization is required for higher order Moments. The analysis is done for the different types of images which are good visible, moderate and blur images. Two best maximum discrimination Features which can able to identify the differentiate are selected. It is observed that Separability and Entropy of Intensity images provides the good discrimination to classify the images into clusters.

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