TEXTURE FEATURE EXTRACTION OF IMAGE USING GRAY LEVEL CO-OCCURRENCE MATRIX (GLCM)

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Abstract : **Digital image has numerous features. A feature is an image representative that can capture certain visual property of the image. Feature extraction basically means collection of certain properties from large amount of properties, Only those properties/features are extracted that are essential for image accurately. Extraction of Features is done on the base of their texture, color, shape. Texture is an important and superior feature for image feature extraction as compared to color, as color features are not sufficient to identify the image as dissimilar images may still have similar histograms. Texture is a recurring form of data or structure with consistent breaks. Collecting texture feature from image is called texture feature extraction. There are different algorithm like Structural, spectral and Statistical for extraction of Texture features. The most popular way of extracting Texture features of selected image by statistical method is done by second order statics based Gray Level Co-occurrence Matrix (GLCM).**

In this paper Energy (Angular Second Moment), Contrast, Entropy and Variance are computed using GLCM Algorithm. As per the result, High accuracy rate is achieved when the extraction of texture features is done using GLCM. Therefore less computation time is required and hence this method can be proficiently used for real time pattern detection and recognition applications.

IndexTerms - GLCM Algorithm, Texture features, Image feature extraction.

1) INTRODUCTION

With the growth in availability of image database previously used methods for indexing of image right from storage of an image to linking it with a particular number, have verified to be unsatisfactory and tremendously time consuming. Hence CBIR has become important and necessary. It is the process of recovering important data from images based on various features like color of image , texture of image and shape. In CBIR, quick and valuable search for preferred images is done from large-scale image database. CBIR technology is preferred as it overcomes the shortcomings like severe workload and tough bias of old-fashioned text-based image retrieval technology. Complete use of all image content features is made in CBIR process, these features are examined and they are extracted without any human intervention by computer to attain the exact retrieval of desired image. Content-based image retrieval methods need has effectively enlarged in various areas like biomedical, military purpose, trade and business, learning .The most primary step in this process is Feature extraction, as from it unique and desirable information from the image is extracted.

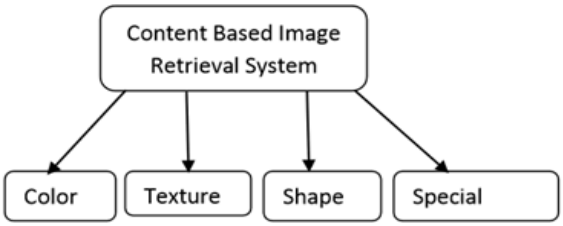

Figure 1: Content based image Retrieval System

Color feature is the significant feature for searching image from collection of images as color is easy-to analyze, but sometimes color features are not enough to distinguish and determine the image features as dissimilar images may still have similar histograms. In that case texture features are considered as they carry beneficial data for distinguish purposes of image. A texture means surface appearance given by its size, shape, density, arrangement. A process of analyzing texture and extracting feature from it is texture feature extraction method

The three methods used to measure texture properties of image are Statistical, structural and spectral.

- *Spectral based Feature Extraction*

  In spectral method, images in the frequency domain are required for analysis of texture. Hence in Spectral method it is obligatory to carry out Fourier transformation on the original image in order attain their equivalent representations in the frequency space.

- *Structural based Feature Extraction*

A texture of image is represented by structure on basis of features extracted from image. This structure is decided by local properties like micro-texture and spatial organization. This method is very beneficial for generation of texture as well as analysis of texture. But its not appropriate for ordinary textures as there is minute variability of both of micro texture and macro texture

- *Statistical based Feature Extraction*

For studying the spatial distribution of pixels and grey levels by calculating the native features of image at each and every point and then developing various statistics of image from the calculated local featuresthis method is used. The statistical methods are categorized into:

First order- In this only single pixel is considered

Second order- In this duo of pixels is considered

Higher order-In thismore than two pixels are considered for calculating statistics.

In the first order, statistics are determined by estimated properties of 'a' pixel values. In the second order and higher order, statistics are determined by estimated properties of more than one pixel, here single pixel is ignored

GLCM is upmostpopular way of extracting Textural features of image by statistical method . Every image consists of 'n' number pixels and each pixel has someintensity(Grey levels). GLCM is tabular representation of number of different combinations of pixels occurring in the imageThe statistical information of spatial relationship of pixels of an image in second order is provided by GLCM .With the help of directions and distances between pixels of original image, GLCM matrix is created and then required features are extracted from the GLCM matrix as texture features.

2) LITERATURE SURVEY

With the growth in availability of image database traditional methods for indexing of image have failed. Therefore various method and algorithms are needed to be discovered to handle the data efficiently. A lot of papers were studied keeping all these aspects in mind, which is presented in the section below.

Many skin properties like allergics roughness may cause skin cancer of malignant melanoma. Hence it is crucial to detect certain spots on the skin and compare it to certain features to detect the skin cancer disease in advance.In this paper Authors Hutokshi Sui, ManishaSamala, Divya Gupta, NehaKudu[1] have found a solution to this problem.They have made the use of skin gray color profile as the input parameter to determine the skin profile.Then different skin images are classified based on GLCM features, for classification trained SVM classifier is used. This Computer aided skin cancer of malignant melanoma detection system is claimed to be better than the conventional biopsy method as here the detection of symptoms are more accurate and less time consuming.

Proper Recognition of different food is complex process as most of the food items are varies in shape, size and colors. To achieve this task, in this paper, Akshada A. Gade, Arati J. Vyavahare [2] has made use of segmentation process for labeling the food. The features of each segmented regions are extracted by bagging visual content of image. The six most appropriate statistical parameters of texture are computed by using method of GLCM. With the help of this process the food portion and size information can be analyzed, which can also help in calculating calories and nutrition values. For obtaining better performance and accuracy in food recognition, system needs to extract multiple features.

Human emotional conditions could be recognized through affective calculations of speech, different facial expression,various body language, physiological signals etc. There are two methodologies to recognize emotional conditions; invasive and noninvasive. From past Decades researches have mostly concentrated on the invasive approach. But not on noninvasive approach. Very few numbers of researchers have done work on noninvasive approach. Among those few researchers some are Latif M. H, Md. Yusof H., Sidek S. N., Rusli N and SadoFatai [3] they have worked on noninvasive approach of emotional conditions recognition and presented an efficient method for thermal image feature extraction using the Gray Level Co-occurrence Matrix (GLCM) technique. The initial findings of their research is very encouraging as they have found that thermal imaging could provide contactless, noninvasive alternative for affect detection in Human Robot Interaction (HRI).

In last decades, a dynamic growth has been observed in the region of cerebral cancer diagnosis. Cerebral cancer is spreading widely among the world population and taking lives of many. Hence early detection and diagnosis of Cerebral cancer is necessary. Various researches are now taking place in this field for premature detection of Brain tumor.For this Author B. Thamaraichelvi and G. Yamuna [4]have classified and analysed Brain'sMRI and Liver Computed Tomography images using supervised technique. This is done by using technique of Gray Level Co-occurrence Matrix (GLCM) method. Detection of abnormalities in magnetic resonance brain images and computed tomography liver images is evaluated invarious terms.The performance of the proposed classifier was analyzed and compared with the other existing classifier techniques, it has been concluded that the RBFSVM classifier is best suited with better accuracy rate for the classification.

Glaucoma is leading cause of blindness. It is caused by higher pressure in the eye-this causes damage to eye optic nerve. It is very necessary to detect Glaucoma at early stage for prevention. So for this purpose authors SakthiveKarthikeyan and N Rengarajan [5] have captured fundus images of eye and use them directly as input. This fundus images were first preprocessed using histogram equalization and then from equalized histogram Texture features are extracted using GLCM .For feature selection

Sequential Forward Floating Selection (SFFS) method is used whereas for classification of Glaucoma as normal and abnormal-Black propagations network classifier is used.

To classify or describe biomedical images GLCM texture features have always been widely used But to describe biomedical images GLCM features has previously considered single or limited color space only due to the use of single color model. To simulate human color sensitivity and perception, along with predictable RGB color model other color space models should also be accompanied for better human vision representation. Keeping this in mind,AuthorsMohdZulfaezalCheAzemin, MohdIzzuddinMohdTamrin, MohdRadziHilmi and KhairidzanMohd Kamal and Kulliyyah[6] had intended to find an optimum set of GLCM features which can be extracted from different color space for pterygiumgrading.After the research,it has been verified that GLCM features extracted from predictable RGB color space are not sufficient and must be supplemented with features in other color space. GLCM features shows better representation of human perception when extracted in various color space.

3) EXTRACTION OF TEXTURE FEATURES OF IMAGE

For collecting texture feature from original images Gray Level Co-Occurrence Matrix (GLCM) is deliberated to be one of the bestest statistical method.Various features can be extracted from the GLCM matrix generated from original matrix, Haralick has defined fourteen textural features out of them some are Energy, Entropy, Contrastetc Out of various features in this paper four important features, Energy (Angular Second Moment), Contrast, Entropy and Variance are selected and displayed

GLCM prepares tabular format about the different combinations of pixel brightness values occurred in particular original image. The information about the number of combination of pixel having similar gray level values in image is stored in GLCM. The relationship between two adjacent pixels is considered in Gray-Level Co-occurrence Matrix (GLCM) ,Out of two pixels the first pixel is named as a reference pixel and the second pixel is named as neighbor pixel.

For getting more knowledge about of GLCM matriximagine of the 4 by 4 matrix of an original image I .The Equivalent GLCM matrix for the above image I is

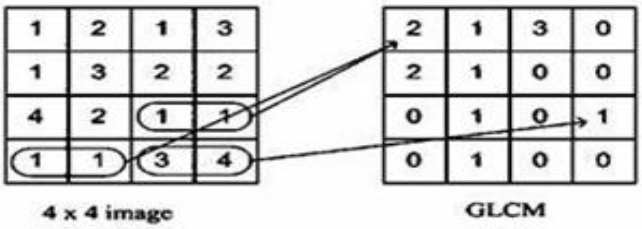

Figure 2: Image and its equivalent GLCM Matrix

In the GLCM matrix,element (1, 1) has the value 2 as the occurrence of (1,1) in the original image is 2. Whereas in the GLCM matrix,element (3,4) has value 1 as occurrence of (3,4) in the original image is 1 time.. In the same manner entire matrix of GLCM is filled based on information of Grey level in original image .

The overall rules used for selection of the textural features are

• Energy is chosen to entropy as its values belong to normalized range.

• Contrast is connected with the average gray level difference between neighbor pixels. It is similar to variance however preferred due to reduced computational load and its effectiveness as a spatial frequency measure.

• Energy and contrast are the very important parameters for visual assessment and for reduction of computational load to differentiating between different textural patterns

The various important features calculated by GLCM are:

3.1 Angular Second Moment/Energy

Angular Second Moment is the sum of squares of entries in the GLCM. Angular Second Moment measures the homogeneity of image. Angular Second Moment is considered to be high when image has very good homogeneity or when pixel values are very similar and is considered to be low when image has poor homogeneity. Energy is 1 for a constant image. The Energy/ Angular Second Moment is given by formula:

$$\text{Energy} = \sum_{i,j}^{0} P(i,j)\text{^}2$$

3.2 Contrast

The local variations in the gray-level co-occurrence matrix are calculated by Contrast. The contrast is calculated by formula:

$$Contrast = \sum_{i,j} P(i,j)|i-j|^2$$

Contrast is large means texture is deeper.

3.3 Entropy

Every image has certain data which even if compressed makes no effect on image quality. The amount of data that can be compressed without affecting image quality is given by Entropy. Entropy calculates information loss, transmitted message and also measures the image information. Entropy is given by formula

Entropy=

4) RESULT AND DISCUSSION

The extraction of the textural features of image by GLCM are extracted using MATLAB by using the formulas mentioned above. Following major syntax are used in the code:

- **Graycomatrix** (Gray-level co-occurrence matrix from an image)

  Syntax :glcm = graycomatrix(I)
  Description
  It creates a gray-level co-occurrence matrix (GLCM) from image I.

- **Graycoprops** (Properties of gray-level co-occurrence matrix)
  Syntax :stats = graycoprops(glcm,properties)
  Description
  It calculates the statistics specified in properties from the gray-level co-occurrence matrix glcm

featureselection.m

```
function [feat_disease]=featureselection(im)
img=im;
seg_img=im;
img=rgb2gray(img);
% Create the Gray Level Cooccurance Matrices (GLCMs)
glcms = graycomatrix(img);
%Evaluate 13 features from the disease affected region only
% Derive Statistics from GLCM
stats = graycoprops(glcms,'Contrast Correlation Energy Homogeneity');
Contrast = stats.Contrast;
Correlation = stats.Correlation;
Energy = stats.Energy;
Homogeneity = stats.Homogeneity;
Mean = mean2(seg_img);
Standard_Deviation = std2(seg_img);
Entropy = entropy(seg_img);
RMS = mean2(rms(seg_img));
%Skewness = skewness(img)
Variance = mean2(var(double(seg_img)));
a = sum(double(seg_img(:)));
Smoothness = 1-(1/(1+a));
Kurtosis = kurtosis(double(seg_img(:)));
Skewness = skewness(double(seg_img(:)));
% Inverse Difference Movement
m = size(seg_img,1);
n = size(seg_img,2);
in_diff = 0;
for i = 1:m
    for j = 1:n
        temp = seg_img(i,j)./(1+(i-j).^2);
```

Figure 3: Snapshot of GLCM Algorithm

Below is the image of the leaf that has been taken to show the outputs

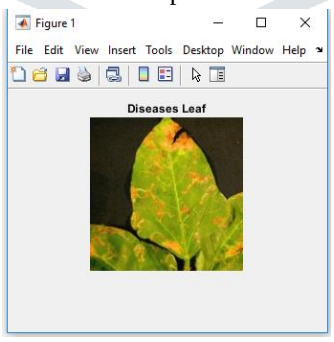

Figure 4: Image of Leaf A.

Image Segmentation of image is done first before going on with the process, to simplify the image and to make it more meaningful analyze the image data. Image segmentation is the method of dividing an image into different small parts or regions. Below are the outputs of segmented images. From the segmented images we can select the proper region on which we can work

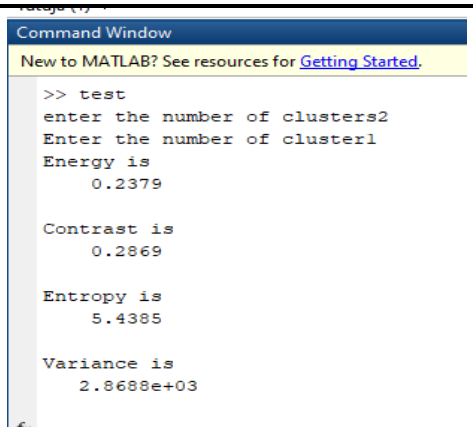

Figure 5: Parameters extracted from Leaf Image

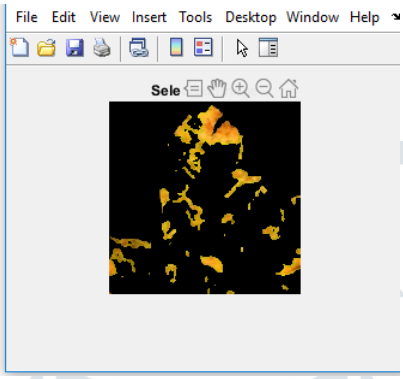

Figure 6: Segmented Image

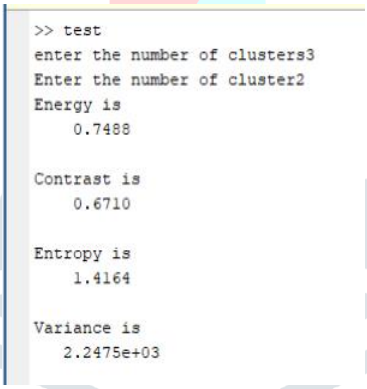

Figure 7: Parameters extracted from Segmented Leaf Image

The tabular form of above mentioned output and its values are mentioned below

table 1:Tabular representation of diferent parameters

Leaf A	Energy	Contrast	Entropy	Variance
Segmentation 1	0.2379	0.2869	5.4385	2.8688e+03
Segmentation 2	0.7488	0.6710	1.4164	2.2475e+03

5) CONCLUSION

As discussed about the Gray level Co-ocurrence Matrix (GLCM) method is used here for extracting various texture features of the image.Out of them considered and displayed parameters are- Entropy, variance, Angular Second Moment/Energy and Contrast
Image Segmentation of image is done first before going on with the process, to simplify the image and to make it more meaningful and easier to analyze the image data.
By extracting the features of an image by GLCM approach, the image compression time is greatly reduced when compared to other DWT Techniques, The results even show that these texture features have high discrimination accuracy, requires less

computation time and hence can be efficiently used for Real Time Pattern Recognition applications like Military & Medical Applications.

REFERENCES

1) Hutokshi Sui, ManishaSamala, Divya Gupta, Neha Kudu, "TEXTURE FEATURE EXTRACTION FOR CLASSIFICATION OF MELANOMA" , International Research Journal of Engineering and Technology (IRJET), e-ISSN: 2395-0056 ,Volume: 05 Issue: 03 | Mar-2018 .
2) Akshada A. Gade, Arati J. Vyavahare, " Feature Extraction using GLCM for Dietary Assessment Application" , International Journal Multimedia and Image Processing (IJMIP), Volume 8, Issue 2, June 2018.
3) Latif M. H, Md. Yusof H., Sidek S. N., Rusli N. and SadoFatai ," EMOTION DETECTION FROM THERMAL FACIAL IMPRINT BASED ON GLCM FEATURES", ARPN Journal of Engineering and Applied Sciences, VOL. 11, NO. 1, JANUARY 2016, ISSN 1819-6608.
4) PriyankaUdayabhanu ,AnjalyViswan ,SeemaPadmarajan, "MRI Brain Image Classification using GLCM Feature Extraction and Probabilistic Neural Networks" , International Conference on Emerging Trends in Engineering & Management (ICETEM-2016), e-ISSN: 2278-2834, p- ISSN: 2278-8735. PP 04-15
5) Anagha S. Aghav, Prof N.S.Narkhede , "Application-oriented approach to Texture feature extraction using Grey Level Co-occurrence Matrix (GLCM) "2017, IRJET ISO 9001:2008 Certified Journal.
6) B. Thamaraichelvi and g. Yamuna,"Gray level co- occurrence matrix features based classification of tumor in medical images "Department of Electrical Engineering, Annamalai University Annamalainagar, Volume 8, Issue 2, June 2016. Tamil Nadu, India E-Mail: thamsnatraj@yahoo.com