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GLCM and its Features

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***Abstract*— GLCM points to Gray level co-occurrence Matrix. It maps the pixel brightness of an image which takes place.It was offered by Harlick in 1970.It is also called Grey tone Spatial Dependency Matrix**

In this research work, we have used Digital Image procesing with Mat Lab R2007b and find the GLCM features. In this proposed work, we have taken different DDSM/MIAS images and extracted features from them.[1],[2]

***IndexTerms*—Contrast, Correlation, homogeneity, GLCM, Energy.**

I. INTRODUCTION

GLCM points to Gray level Co-occurrence matrix. It is of 2nd order statistics, so information with regards to pixels of pairs are collected by GLCM.GLCM exhibits how the pixel brightness in an image occurs..A matrix is built up at a distance d=1 and at angles in degrees(0,45,90,135) .Haralick also offered different measures i.e. entropy, energy, contrast, correlation etc. These dimensions calculate at different angles.[1]

GLCM is texture character profile and this profile mention to touch i.e. smooth, silky and rough etc. The order of character profile statics are:

First order texture measures are statistics declared from the original image values, like variance, and pixel neighbour relationship are not implemented.

Second order measures defines the relationship between groups of two (usually neighbouring) pixels in the original image.

Third and higher order textures (noting the relationships among three or more pixels) are theoretically possible but practically/ commonly not implemented due to calculation time and interpretation difficulty.

GLCM texture picks up the relation between two pixels at a time, called the reference and the neighbour pixel. GLCM expounds the distance and angular spatial relationship over an image sub- region of specific size. GLCM is prepared from gray scale values. It is taken into account how often a pixel with gray level(gray scale intensity or gray tone) values come either horizontally, vertically and diagonally to levelled the pixels with the value j. GLCM directions are:

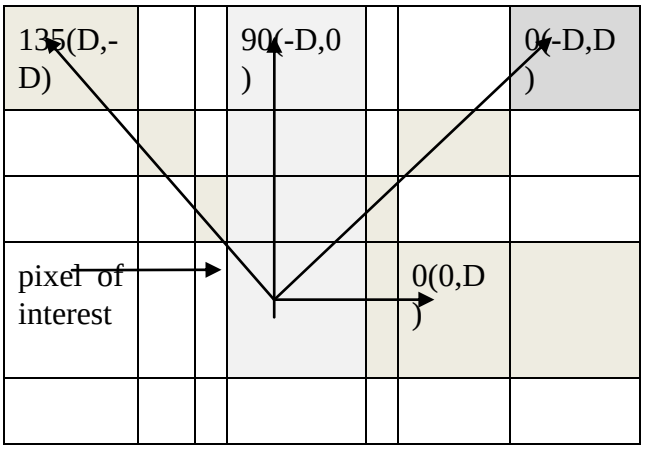
Horizontal(0)
Vertical(90)
Diagonal
a)bottom left to top right(-45)
b)top left to bottom right (-135)

They are announced as P0, P45, P90 and P135 respectively.[1],[2]

II. GLCM CALCULATION

An input image of 8 tone is taken.

I Sub-region/image



1	1	5	6	8
2	3	5	7	1
4	5	1	1	2
8	5	1	2	5

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II GLCM

1	2	0	0	1	0	0	0
0	0	1	0	1	0	0	0
0	0	0	0	1	0	0	0
0	0	0	0	1	0	0	0
1	0	0	0	0	1	2	0
0	0	0	0	0	0	0	1
2	0	0	0	0	0		0
0	0	0	0	1	0	0	0

Firstly fetch angle at 0 degree (horizontal).In the GLCM output, the element(1,1) has value1 because in the input image, there is only 1 opulence where two horizontally near to pixels of distance 1 having values 1 and 1.GLCM(1,2) has value 2 because in the input image there are two opulences where two horizontally near to pixels of distance 1 having value 1 and 2. GLCM(1,3) has value 0 because in the input image there are no opulence where two horizontally near to pixels of distance 1 having value 1 and 3.The procedure is repeated for the whole GLCM matrix at different angles.[2]

III. PROPERIES OF GLCM

The properties of GLCM are:

1. GLCM is of square in shape because the reference and neighbouring pixels have same range of values.

2. Number of rows and columns equal to the quantization level of the image.

The test image consists of four gray level values that is 0,1,2 and 3.Eight bit data consists 256(2^8) possible values,256X256 matrix would be obtained,65536 cells.16 bit data having matrix of 65536X65536,having cells 429,496,720.

3. It is symmetrical about the diagonal.

The diagonal elements pairs having no gray level difference(0-0,1-1,2-2,3-3etc).Most pixels are identical to their neighbouring cells,very less contrast is there in the image.If there is a difference of 1 cell away from the diagonal,one level gray difference is there(0-1,1-2,1-3 etc).More the distance from the diagonal,more the gray level difference.[1],[2]

IV. GLCM FEATURES

The texture rules according to the weight of the equation. The texture is grouped according to the degree. Square term second order equation. Cube term ways third order equation it is. The features extracted are:

1. Contrast: In short form, it is called CON. 'Sum of Square Variance' is the another name of Contrast. It defers the calculation of the intensity contrast linking pixel and its neighbor over the whole image. At constant image contrast value is 0.In contrast measure, weight increases exponentially(0,1,4,9) as persists from the diagonal.
Range=[0,size(GLCM,1)-1)^2]

$$\sum_{I,J=0}^{N-1} Pi,j(i-j)^2$$

Since (i-j) increases contrast continue to increase exponentially. When i and j are equal i.e. i-j=0.no contrast is there. When i and j are differ by 1,small contrast is there is 1. When i and j differ by 2, the contrast is expansing and weight is 4.[1],[2]

1. Correlation: It passes the calculation of the correlation of a pixel and its neighbor over the whole image means it figures out the linear dependency of gray levels on those of neighbouring pixels. On behalf a perfectly positively or negative correlated image, the correlation value is 1 and -1.On behalf of constant image its value is NaN..Range=[-1,1] and the formula is

$$\sum_{i,j=0}^{N-1} Pi,j[\frac{(i-\mu i)(j-\mu j)}{\sqrt{(\sigma i^2)(\sigma j^2)}}$$

2. Energy: Since energy is used for doing work, Thus orderliness. It makes use for the texture that calculates orders in an image. It gives the sum of square elements in GLCM. It is fully different from entropy. When the window is proficient orderly, energy value is high .The square root of ASM(Angular Second Moment) texture character is used as Energy. Its range is[0 1].Since constant image its value is 1.The equation of energy is

$$\sum_{I,J=0} P(i,j)^2$$

3. Homogeneity: In short term it is going by the name of HOM. It passes the value that calculates the tightness of distribution of the elements in the GLCM to the GLCM diagonal. For diagonal GLCM its value is 1 and its range is [0,1].Opposite of contrast weight is homogeneity weight values, with weight decreases exponentially loose from the diagonal. The weight employed in contrast is (i-j)^2 and in homogeneity ,it is 1/1+(i-j)^2.The equation is

$$\sum_{i,j=0}^{N-1} P(i,j)/R$$

V. CONCLUSION

We have extracted four feature values of GLCM (Contrast, Correlation, Homogeneity and Energy).Contrast has value 2.2578,Correlation has value .7739,Homogeneity has value .9597 and Energy has value .7523 .

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