ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

IJARCCE

International Journal of Advanced Research in Computer and Communication Engineering

ICACTRP 2017

International Conference on Advances in Computational Techniques and Research Practices

Noida Institute of Engineering & Technology, Greater Noida

Vol. 6, Special Issue 2, February 2017

Texture and Color based Image Retrieval using Gray Level Co-Occurrence Matrix

Ayushi Jain[1], Hemlata Agrawal[2]

Computer Science & Engineering, Noida Institute of Engineering & Technology, Greater Noida, India[1]

Computer Science & Engineering, College of Engineering Roorkee, India[2]

Abstract: Content Based Image Retrieval (CBIR) allows us to retrieve most similar image/images from the database based on the visual content of the image. The major steps being feature extraction and computing similarity. In this paper we extracted 17 color and texture features of image. To extract color feature we use F-Norm and to extract texture feature we use statistical measures (mean, standard deviation) and GLCM that is being applied at four different angles. The features thus extracted are then subjected to similarity measures using Euclidean distance. This technique showed a significant improvement in retrieval performance when compared to other methods such as Weighted Standard Deviation (WSD), Gradient operation using Sobel operator.

Keywords: CBIR, Gray Level Co occurrence Matrix (GLCM), F-Norm.

I. INTRODUCTION

Colour, shape, texture and spatial layout are the visual contents of an image used by Content Based Image Retrieval technique. These visual contents of the images are computed and described by multi-dimensional feature vectors. These feature vectors of the images in the database forms the feature database.

Colour is extensively used visual content and is widely used in CBIR due to its easy and fast computation. Its three-dimensional values (Red, Green, Blue / Hue, saturation, Intensity) are superior to its gray level representation. The concept of Colour moments have been used in many retrieval systems especially when the images just contain the objects. The first order (mean), second order (variance), third order (skewness) colour moments have been very effective and efficient in representing the colour distribution in an image.

Texture can be defined by certain constant, slowly varying or periodic local statistical properties computed over different regions of an image. This descriptor, intuitively, provides measures of properties such as smoothness, coarseness, and regularity of an image.

Our paper explores these two visual contents of an image.

II. MATERIALS AND METHODS

Technique 1-GLCM WHOLE

1. Take an input colored image.

F-NORM

2. Find three Bands corresponding to the input image namely RGB (Red, green, blue) bands.
3. Find F-Norm of the three bands:

3.1. Normalize each band by using the below formula: $(I_{i,j,k} - min\_val_i) / (max\_val_i - min\_val_i)$
Where $I_{i,j,k}$ is the intensity of i^{th} band at , k position; min_val_i is the minimum value of i^{th} band; max_val_i is the maximum value of the i^{th} band. These normalized values are used to calculate the F-norm.

3.2. for each normalized band we calculate F-norm. Fnorm is calculated using following steps:

3.2.1. Suppose A is a N*N square matrix and A_i is its i^{th} order sub matrix where $1 \le i \le N$, then F-norm of A_i is calculated as:

3.2.2. F-Norm is applied on the values, one N-dimensional feature vector is obtained.

$$FNF_{AX} = \{\|A_1\|_F, \|A_2\|_F, ..., \|A_i\|_F, ..., \|A_n\|_F\}$$

Where, FNF_{AX} stands for F-Norm Features.

3.2.3. The feature vector values are then assigned weights by

$$\Delta A_i = \|A_i\|_F - \|A_{i-1}\|_F \text{ and } \|A_0\|_F = 0 \text{(presumed)},$$

We can define the feature vector as:

$$VAF = \{\Delta A_1, \Delta A_2 \ldots \Delta A_n\}.$$

3.2.4. F-norm of each band will be average of VAF.

3.3. Hence we get **three** F-norm features.

Mean & Standard Deviation

4. Convert the input image into gray scale image using the formula:

$$I_{i,j} = [\,11 * C_{i,j}(R) + 16 * C_{i,j}(G) + 5 * C_{i,j}(B)\,]/32$$

Here, $I_{i,j}$ is the intensity assigned to pixel (i,j) of Image C; $C_{i,j}$ (R, G, B) denotes (i, j)th pixel of red, green and blue band.

5. Using the formula of normalization mentioned in step 3.1, normalize the gray scale matrix

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

IJARCCE

International Journal of Advanced Research in Computer and Communication Engineering

ICACTRP 2017

International Conference on Advances in Computational Techniques and Research Practices

Noida Institute of Engineering & Technology, Greater Noida

Vol. 6, Special Issue 2, February 2017

6. Find Mean & standard Deviation of normalized gray scale image using the formula:

Mean = $\frac{1}{N \times N}\left(\sum_{i=0}^{N-1}\sum_{j=0}^{N-1} G_{i,j}\right)$

SD = $\sqrt{\frac{1}{N \times N}\left(\sum_{i=0}^{N-1}\sum_{j=0}^{N-1}\left(G_{i,j} - \text{Mean}\right)^2\right)}$

Where $G_{i,j}$ is the normalized gray scale image. Here we are getting two features.

GLCM

7. Apply GLCM on gray scale image at four angles namely 0°, 45°, 90°, and 135°:

7.1. Construct GLCM co-occurance matrix at :

7.1.1. 0° by applying the given code:

```
For (int i=0;i<size;i++)
    For (int j=0;j<size-1;j++)
  ++matrix [qa[i][j]][qa[i][j+1]];
```

7.1.2. 45° by applying the given code:

```
For (int i=0;i<size-1;i++)
    For (int j=0;j<size-1;j++)
        ++matrix
[qa[i][j]][qa[i+1][j+1]];
```

7.1.3. 90° by applying the given code:

```
For (int i=0;i<size-1;i++)
    For (int j=0;j<size;j++)
        ++matrix [qa[i][j]][qa[i+1][j]];
```

7.1.4. 135° by applying the given code:

```
For (int i=0;i<size-1;i++)
    For (int j=1;j<size;j++)
        ++matrix  [qa[i][j]][qa[i+1][j-1]];
```

Where qa[i][j] is gray scale image ,matrix is co-occurrence matrix with the size equal to highest pixel intensity value.

7.2. Now divide each of the above GLCM matrices by sum of elements of GLCM to get the probability matrix (Q) .

7.3. Corresponding to each (0°, 45°, 90° & 135°) probability matrix (Q) we will find

Energy = $\sum_{i=1}^{N}\sum_{j=1}^{N}\left(P_{i,j}\right)^2$

Homogeneity = $\sum_{i=1}^{N}\sum_{j=1}^{N}\frac{P_{i,j}}{1+|i-j|}$

Correlation = $\sum_{i=1}^{N}\sum_{j=1}^{N} P_{i,j}\frac{(i-\mu_r)(j-\mu_c)}{\sigma_r\sigma_c}$

$RowMean\ (\mu_r) = \sum_{i=1}^{N}\sum_{j=1}^{N}\left(i \times P_{i,j}\right)$

$ColumnMean\ (\mu_c) = \sum_{j=1}^{N}\sum_{i=1}^{N}\left(j \times P_{i,j}\right)$

$RowDeviation\ (\sigma_r) = \sqrt{\sum_{i=1}^{N}(P_r(i) \times (i-\mu_r)^2)}$ Or $\sqrt{\sum_{i=1}^{N}(rowmean_i \times (i-\mu_r)^2)}$

$ColDeviation\ (\sigma_c) = \sqrt{\sum_{j=1}^{N}(P_c(j) \times (j-\mu_c)^2)}$ Or $\sqrt{\sum_{j=1}^{N}\left(colmean_j \times (j-\mu_c)^2\right)}$

Where, P_r (i) = $\sum_{j=1}^{N}\left(P_{i,j}\right)$ and Pc (j) = $\sum_{i=1}^{N}\left(P_{i,j}\right)$.

Here, N is the number of rows/columns of Probability matrix Q, Pij is the probability that a pair of points in Q will have values (Ni, Nj), μ_r and μ_c are the mean of rows and columns respectively, σ_r and σ_c are the standard deviation of rows and columns respectively. Here we are getting twelve GLCM features.

Technique 2-Gradient operation

1. Take an input colored image.
2. Convert the input image into gray scale image using the formula:

Ii,j = [11* C i,j (R) + 16 * C i,j (G)+ 5* C i,j (B)]/32

Here, Ii,j is the intensity assigned to pixel (i,j) of Image C; Ci,j (R, G, B) denotes (i, j)th pixel of red, green and blue band.

SOBEL

3. Perform Sobel operation on gray scale image obtained.

3.1. Applying Sobel in X direction(X i,j)

$$Gx = \begin{bmatrix} 1 & 2 & 1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{bmatrix}$$

Convolve gray scale image with the Gx to get Sobel_x matrix.

3.2. Applying Sobel in Y direction(Y i,j)

$$Gy = \begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix}$$

Convolve gray scale image with the Gy to get Sobel_y matrix.

3.3. Find gradient angles θ by :
tan-1 (Sobel_y /Sobel_x) degree.

4. Assign gradient to the 9 bins of 40°each and calculate the following features corresponding to each bin

i. Mean
ii. Standard deviation
iii. Entropy
iv. Energy

Mean = $\frac{1}{N}\sum_{i=1}^{N}\theta_i$ SD = $\sqrt{\frac{1}{N}\sum_{i=1}^{N}(\theta_i - \text{mean})^2}$

Energy = $\sum_{i=1}^{N} P_i * P_i$ Entropy = $-\sum_{i=1}^{N} P_i\ \log(P_i)$

Where θi = Angle at position i in bin; N is size of bin. P is probability matrix for bin. Logarithm is at base 2.Here we get thirty six features (9 bins* 4 features).

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

IJARCCE

International Journal of Advanced Research in Computer and Communication Engineering

ICACTRP 2017

International Conference on Advances in Computational Techniques and Research Practices

Noida Institute of Engineering & Technology, Greater Noida

Vol. 6, Special Issue 2, February 2017

Similarity Criteria

1. Compute Euclidean distance between the query image & database images for the (3+2+12) features.

$$d(x, y) = \sqrt{\sum_{i=1}^{N}(X_i - Y_i)^2}$$

Where d(x, y) is the distance between the query image & database image; Xi is query image feature & Yi is database image's corresponding feature; N is total number of features; i= 1, 2, 3……., 17.

2. Retrieve 10 most similar images.

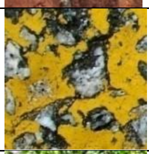
III. RESULT AND DISCUSSION

A. Database

We worked on 6 classes of images namely: asphalt, brick, concrete, ground, rock and wood. Each class has approximately 240 images each. Therefore we worked on a database consisting of 1,440 images.

B. Experimental result

The experiments were performed with Java as front end and MySQL as back end. Following table show improvement in retrival accuracy.

Image name (.jpg)	Images	Gradient approach (precision ratein%)	GLCM (precision rate)
A4_2		30	70
A2_14		30	80
A6_9		60	10
B8_15		10	80
C9_20		30	10
G2_8		30	70
G3_22		30	80
G9_8		60	99.99

IV. CONCLUSIONS

This experiment has brought forward the use of content based image retrieval on different type of images.

GLCM gave much better results as compared to sobel gradient approach.

REFEERENCES

[1] Rafael Gonzalez and Richard Woods. Digital Image Processing. Addison Wesley, 1992.

[2] Mazid Mirmehdi, Xianghua Xie & Jasjit Suri, Handbook of Texture Analysis

[3] Dr. Fuhui Long, Dr. Hongjiang and Prof. David Dagan Feng, Fundamentals of Content-Based Image Retrieval.

[4] Kuo-An Wang, Hsuan-Hung Lin, Po-Chou Chan, Chuen-Horng Lin, Shih-Hsu Chang, Yung-Fu Chen, "Implementation of an Image Retrieval System Using Wavelet Decomposition and Gradient Variation", ISSN: 1109-2750, Issue 6, Volume 7, June 2008.

[5] Herbert Schildt, "Java: The Complete Reference", 5th ed., Tata McGraw Hill, 2005, pp.223-254.

[6] Vistex Database [Online]: http://vismod.media.mit.edu/pub/VisTex/VisTex.tar.gz

[7] MehranYazdi, KazemGheysari: A New Approach for Fingerprint Classification based on Gray-Level Co-occurrence Matrix, World Academy of Science, Engineering and Technology 47, 2008.