Feature Extraction Using Neighbourhood Derivatives For Image Retrieval

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Abstract— *An image retrieval system is used in large database system for searching and retrieving images. Indexing and retrieval of the images efficiently is an important task. Medical images maintaining using text or numbers is a difficult task and time taking. Numbering and retrieval of images can be done through query by text and query by image also termed as content based image retrieval. Content-based image retrieval takes in visual contents to search images from databases according to user interest. Texture is one among the efficient features for image retrieval. In texture based retrieval methods like local binary pattern and local mesh pattern the images are retrieved based on relationship among the pixel values. Based on local binary pattern local mesh pattern is calculated by the relationship between the neighbouring pixels. The efficiency of the system is enhanced or increased by combining with gabor transform. The gabor local mesh pattern and local binary pattern histograms are combined to get a feature vector. Effective comparisons algorithm is then used to retrieve the image of closest proximity. The mesh pattern is capable of extracting more edge information so the efficiency is increased for biomedical image application.*

Keywords— Gabor transform(GT), local binary pattern (LBP), local mesh patterns (LMeP), gabor local mesh pattern (GLMeP).

1. INTRODUCTION

Earlier image retrieval described images using keywords so retrieval can be performed by those keywords. Manual image retrieval is time consuming laborious and expensive to address. The increase in use of images in web applications and other application domain have lead to several web tools for image retrieval [13]. For Searching an image user may provide input in terms of keyword, link and the system will return images similar to the input. The similarity used for search criteria could be tags, color similarity in images, region or shape attributes. Images are searched by image data search includes searching using description of image and content based image retrieval not using textual descriptions but instead image retrieval is performed based on similarity in the image attributes.

Content based image retrieval [4] otherwise termed as query by image content and content based visual information retrieval [5] is the use of computer vision to the image retrieval the method of searching for similar images in vast databases. Content based means searching based on the content of the image and not using keywords or descriptions about the image. The content of the image [2] refers to colors, shapes, textures or any other attribute related to image. A medical image includes objects in the image conveying specific information, different methods of interpretations for a pathological area was made by different radiologist. The problems resulted in not using text based search for medical images. In an order to overcome the problem, content-based retrieval has came in to existence to automatically access images with minimal human intervention. The important characteristic of medical images is that most of the images are represented in gray scale. With the changing value of intensity, absent of monochrome fail to clearly display the actual region of lesion area [8]. The matching technique using histogram method was first invented by Swain and Ballard. Several variations of this technique are now used in a high combination of current CBIR systems. Many method of improving on the original technique involves use of cumulative color histograms combining histogram with some element of spatial matching and use of region based color querying.

Medical imaging is the technique used for creating visual description of the inner organs of a body for medical diagnosis and treatment. Medical imaging analyse the inner structures hidden by the skin and bones as well as to diagnose and treat disease. Medical image also maintain a database containing normal images and physiology in order to identify patient affected by disease. But imaging of removed parts of body affected by disease and tissue can be performed for analysis reasons such procedures are considered to be part of pathology instead of medical diagnosis.

Biomedical imaging [12] is concentrated on the capturing images for diagnostic and treatment purposes[11]. Biomedical imaging uses x-rays, ultrasound, magnetism MRI [10], radioactive pharmaceuticals or light endoscopy [2], to examine the condition of an organ or tissue and can monitor a patient report from time to time for diagnostic and treatment purpose.

A. A. Texture Retrieval

The retrieving images using texture [3] as similarity is efficient. For image retrieval application to match an image on texture similarity can be useful in distinguishing between regions of images with similar feature. A number of techniques has used for measuring texture similarity [9], the best approach rely on comparing values of known as second order statistics calculated from query image and image in the database and to Calculate the relative brightness of selected pairs of pixel from each image. It is possible to calculate measures of image texture like the degree of contrast, coarseness, directionality and regularity or periodicity, directionality and randomness [6,7]. The other method of texture [19] analysis for retrieval includes the use of Gabor filters and fractals. Various patterns are obtained using the texture techniques and desired textures are obtained by supplying query image.

1. LOCAL PATTERN

B. A. *Local Binary Pattern*

Local binary pattern (LBP) is computed based on the relationship between gray scale value of the center pixel from its neighbouring pixel value. The limitation about LBP [15] is slowing down the recognition speed particularly on large scale database and accuracy of the system is reduced and they produce long histogram . The LBP [20] is computed using

$$LBP_{P,R} = \sum_{i=1}^{P} 2^{(i-1)} \times f_1(g_i|_R - g_c)$$
$$f_1(x) = \begin{cases} 1 & x \ge 0 \\ 0 & else \end{cases} \quad (1)$$

4	15	2
6	16	12
19	81	27

-12	-1	-14
-10		-4
3	65	11

0	0	0
0		0
1	1	1

8	4	2
16		1
32	64	128

	224	

Fig 1. Local binary Pattern

Where g_c the gray value of the center pixel , g_p is gray value of its neighbours , P the number of neighbours and radius of the neighbourhood is represented by R. The LBP for a sample pattern is computed as in Figure1

B. Local Mesh Pattern

The Local Mesh Pattern (LMeP) feature value is calculated by considering the relationship among the neighbouring pixel for a center pixel in an image using

$$LMeP^{j}_{P,R} = \sum_{i=1}^{P} 2^{(i-1)} \times f_1(g_\alpha|_R - g_i|_R),$$
$$\alpha = 1 + mod((\, i + P + j - 1), P)$$
$$\forall j = 1,2,\ldots,(P/2) \quad (2)$$

4	15	2
6	16	12
19	81	27

2	-11	13
13		-10
62	-54	-15

1	0	1
1		0
1	0	0

8	4	2
16		1
32	64	128

15	-9	2
75		3
8	69	-25

1	1	1
1		0
0	0	0

8	4	2
16		1
32	64	128

77	4	4
21		-8
-7	-79	1

1	0	1
1		1
1	1	0

8	4	2
16		1
32	64	128

Fig 2. Local Mesh Pattern

Where $g_i|_R$ is the gray value of neighbour at radius R from the center pixel(g_c), j represents the LMeP index. P is the number of neighbours at a distance R form the center pixel (g_c) in an image. The LMeP is computed as in Figure 2.

The LMeP value is computed based on the LBP, the efficiency is enhanced for the biomedical application [16,17]. From local mesh pattern 1,2,3 value are computed by multiplying pattern value with 20-27 and finally adding the value. The LMeP 1,2,3 value obtained are 58,123,30.

The P neighbours has possible LMeP patterns for as P/2. Compared to LBP ,LMeP shows better performance as, indicating it can capture more edge information than LBP for biomedical image [14] The local mesh pattern is combined with the gabor transform.

C. *Gabor Local Mesh Pattern*

The GLMeP performance is analyzed with *P*/2 directions and different scales. The Gabor real part are utilized for GLMeP feature value calculation. For a center pixel at a point (*x*, *y*), the GLMeP pattern value is calculated for *P* = 8 and *R* = 1 using

$$GLMeP^{1}_{P,R}|_{P=8,R=1} = \begin{Bmatrix} f_1(G^{\circ}_{45}(x-R,y+R) - G^{\circ}_{0}(x,y+R)) \\ f_1(G^{\circ}_{90}(x-R,y) - G^{\circ}_{45}(x-R,y+R)) \\ f_1(G^{\circ}_{135}(x-R,y-R) - G^{\circ}_{90}(x-R,y)) \\ f_1(G^{\circ}_{0}(x,y-R) - G^{\circ}_{135}(x-R,y-R)) \\ f_1(G^{\circ}_{45}(x+R,y-R) - G^{\circ}_{0}(x,y-R)) \\ f_1(G^{\circ}_{90}(x+R,y) - G^{\circ}_{45}(x+R,y-R)) \\ f_1(G^{\circ}_{135}(x+R,y+R) - G^{\circ}_{90}(x+R,y)) \\ f_1(G^{\circ}_{0}(x,y+R) - G^{\circ}_{135}(x+R,y+R)) \end{Bmatrix} \quad (3)$$

$GLMeP^2_{P,R}|_{P=8,R=1}$ =

$$\begin{Bmatrix} f_1(G_{90^\circ}(x-R,y)-G_{0^\circ}(x,y+R)) \\ f_1(G_{135^\circ}(x-R,y-R)-G_{45^\circ}(x-R,y+R)) \\ f_1(G_{0^\circ}(x,y-R)-G_{90^\circ}(x-R,y)) \\ f_1(G_{45^\circ}(x+R,y-R)-G_{135^\circ}(x-R,y-R)) \\ f_1(G_{90^\circ}(x+R,y)-G_{0^\circ}(x,y-R)) \\ f_1(G_{135^\circ}(x+R,y+R)-G_{45^\circ}(x+R,y-R)) \\ f_1(G_{0^\circ}(x,y+R)-G_{90^\circ}(x+R,y)) \\ f_1(G_{45^\circ}(x-R,y+R)-G_{135^\circ}(x+R,y+R)) \end{Bmatrix} \quad (4)$$

$GLMeP^3_{P,R}|_{P=8,R=1}$ =

$$\begin{Bmatrix} f_1(G_{135^\circ}(x-R,y-R)-G_{0^\circ}(x,y+R) \\ f_1(G_{0^\circ}(x,y-R)-G_{45^\circ}(x-R,y+R) \\ f_1(G_{45^\circ}(x+R,y-R)-G_{90^\circ}(x-R,y) \\ f_1(G_{90^\circ}(x+R,y)-G_{135^\circ}(x-R,y-R) \\ f_1(G_{135^\circ}(x+R,y+R)-G_{0^\circ}(x,y-R) \\ f_1(G_{0^\circ}(x,y+R)-G_{45^\circ}(x+R,y-R) \\ f_1(G_{45^\circ}(x-R,y+R)-G_{90^\circ}(x+R,y) \\ f_1(G_{90^\circ}(x-R,y)-G_{135^\circ}(x+R,y+R) \end{Bmatrix} \quad (5)$$

Based on the three GLMeP feature value, the fourth GLMeP value is calculated from that four images are retrieved matching the query image of closest similarity. The first four images of most similar are retrieved. The images of various sizes P=8,16,24 can also be calculated and the first four images of close similarity are then retrieved. The P represents no of neighbours considered for the mesh pattern calculation

D. D. Feature Extraction

Feature extraction is used to reduce the amount of resources needed to describe a large set of data. Analysing of large data is one of the problem involved. Analysis a large variables requires a large amount of resources and computation power or a classification algorithm. Feature extraction is a common term for the methods of constructing combinations variables to solve the problems describing the data with accuracy.

Feature extraction is a special form of dimensionality reduction. The input image to technique is large to be analysed and is susceptible to contain redundant then the input will be transformed into a reduced form called set of features [18]. Converting the input image into the set of features is called feature extraction. If the extracted features are correctly chosen it is expected the features set will extract the matching information from the input image in order to perform the desired task for the application using reduced representation instead of the full size input.

Feature extraction is a type of reduction that effectively represents certain parts of an image as a feature vector.

If the image size is large it is used and a reduced feature vector is required for image matching and image retrieval

The algorithm for GLMeP is calculated as

Step 1: Load the gray scale image
Step 2: Generate the first four GLMeP operators for each center pixel.
Step 3: Calculate the local differences among the neighbor pixels.
Step 4: Calculate the binary patterns.
Step 5: Construct the histograms.
Step 6: Form a feature vector by concatenating the histograms.

E. E. Similarity Measurement

The query image Q feature vector is denoted as $f_Q = (f_{Q1}, f_{Q2}, \ldots, f_{QL_g})$, is obtained from feature extraction. Similarly each image in the database is denoted as feature vector $f_{DBj} = (f_{DBj1}, f_{DBj2}, \ldots, f_{DBjLg})$; $j = 1, 2, \ldots, |DB|$. The goal is to select the n best images that match the query image. This includes matching of n top matched images proposed by measuring the distance between query image and database image|DB|. For the purpose of image matching, we use $d1$ similarity distance metric computed using

$$D(Q_i, DB_{ji}) = \sum_{i=1}^{L_g} \left| \frac{f_{DB_{ji}} - f_{Q_i}}{1 + f_{DB_{ji}} + f_{Q_i}} \right| \quad (6)$$

Where f_{DBji} is ith feature of jth image in the database |DB|. This similarity measurement is used to retrieving images in biomedical application.

2. RESULT

The sample images for the image retrieval purpose consists of images from different parts of body including brain, lungs, bones and the images include X-ray, MRI, CT Scan images of patients. Image retrieval is potentially useful in analysing brain activation patterns in classifications and in diagnoses by comparing obtained patterns with known diseased pattern leading to clinical applications. In biomedicine content-based image retrieval is critically important in digital libraries, clinical diagnosis, clinical trials, searching for 2-D electrophoresis gels, and pathological slides. The MATLAB execution to the above algorithm to the medical image is as in Fig 4. The MATLAB execution to the above algorithm to the medical image is as in Fig 4. The comparison between efficiency of local binary ,local mesh and gabor local mesh pattern is as in Fig 5.

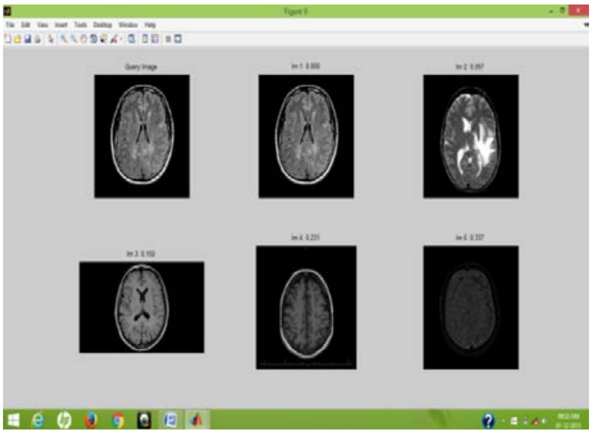

Fig 4.Image retrieval result

3. CONCLUSION

The GLMeP features are extracted for the images in the database. It calculates the value based on the relationship among the neighbouring pixels. But LBP value is calculated based on the relationship between the centre pixel and neighbouring pixel. The result obtained show a significant improvement as compared to LBP and other existing methods on respective databases.

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