Content Based Image Retrieval System Using Texture Features And Fuzzy Membership Function

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Abstract- Digital Image Processing is the process to perform various types of operations on different types of images. Content based image retrieval is branch of digital image processing. CBIR works in the principle of contents. In CBIR collared, medical and gray scale images have been used for processing. In medical images different types of content shapes have been extracted from the query image and image that contain particular shapes or contents have been extracted from database images. We studied various papers on CBIR. The main problem in the CBIR for medical images is that these shape or content features does not provide better results. In our work we will remove this by using various features like angular movement of image, correlation, entropy and energy of the image also has been computed.

Keywords: DIP, CBIR, QBIC, CBVIR).

1. INTRODUCTION

1.1 Content-based image etrieval (CBIR)

Content-based image retrieval (CBIR), also known as query by image content (QBIC) and content-based visual information retrieval (CBVIR) is the application of machine vision strategies to the picture recovery issue, that is, the issue of hunting down computerized pictures in huge databases .Substance based picture recovery is restricted to customary idea based methodologies.

"Content based" implies that the inquiry dissects the substance of the picture instead of the metadata, for example, catchphrases, labels, or depictions connected with the picture. The expression "content" in this setting may allude to colors, shapes, compositions, or whatever other data that can be gotten from the picture itself. CBIR is attractive in light of the fact that ventures that depend simply on metadata are reliant on annotation quality and culmination. Having people physically clarify pictures by entering decisive words or metadata in an extensive database can be drawn out and may not catch the catchphrases wanted to depict the picture.

1.2 CBIR Techniques

1.2.1 Query Techniques: Diverse executions of CBIR make utilization of distinctive sorts of client questions. Question by illustration is an inquiry procedure that includes furnishing the CBIR framework with a case picture that it will then base its pursuit upon. The hidden inquiry calculations may fluctuate relying upon the application; however result images should all share normal components with the given sample.

1.2.2 Semantic retrieval: Semantic recovery begins with a client making an appeal like "discover pictures of Abraham Lincoln". This sort of open-finished undertaking is extremely troublesome for machines to perform - Lincoln may not generally be confronting the cam or in the same stance. Numerous CBIR frameworks accordingly for the most part make utilization of lower-level gimmicks like composition, color, and shape.

1.2.3 Relevance Feedback: Consolidating CBIR seeks procedures accessible with the extensive variety of potential clients and their goal can be a troublesome errand. A part of making CBIR fruitful depends completely on the capacity to comprehend the client intent. CBIR frameworks can make utilization of pertinence input, where the client dynamically refines the query items by stamping pictures in the results as "important", "not significant", or "nonpartisan" to the inquiry question, then rehashing the hunt with the new data. Illustrations of this kind of interface have been developed.

1.2.4 Iterative/Machine Learning: Machine learning and application of iterative systems are getting to be more basic in CBIR.

1.2.5 Other query methods: Other inquiry strategies incorporate searching for instance pictures, exploring tweaked/various leveled classes, questioning by picture district questioning by numerous illustration pictures, questioning by visual portrayal, questioning by immediate detail of picture gimmicks, and multimodal inquiries.

1.3 Content comparison using image distance measures

The most widely recognized technique for contrasting two pictures in substance based picture recovery (ordinarily a sample picture and a picture from the database) is utilizing a picture separation measure. A picture separation measure looks at the similitude of two pictures in different measurements, for example, color, composition, shape, and others. Case in point a separation of 0 implies an accurate match with the question, regarding the measurements that were considered. Query items then can be sorted focused around their separation to the questioned image. Many

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measures of picture separation (Similarity Models) have been created.

1.3.1 Color: Processing separation measures focused around shade similitude is attained to by registering a color histogram for each one picture that recognizes the extent of pixels inside a picture holding particular values. Examining pictures focused around the colors they contain is a standout amongst the most broadly utilized procedures in light of the fact that it can be finished without respect to picture estimate or orientation. However, inquire about has additionally endeavored to section shade extent by locale and by spatial relationship among a few shade regions.

1.3.2 Texture: Surface measures search for visual examples in pictures and how they are spatially characterized. Compositions are spoken to by texels which are then set into various sets, contingent upon what number of surfaces is identified in the picture. These sets not just characterize the composition, additionally where in the picture the surface is located. Composition is a troublesome idea to speak to. The distinguishing proof of particular compositions in a picture is accomplished essentially by demonstrating composition as a two-dimensional ash level variety. The relative splendor of sets of pixels is figured such that level of differentiation, consistency, coarseness and directionality may be estimated. The issue is in distinguishing examples of co-pixel variety and partners them with specific classes of compositions, for example, smooth, or unpleasant.

1.3.3 Shape: Shape does not allude to the state of a picture yet to the state of a specific locale that is being searched out. Shapes will regularly be resolved first applying division or edge recognition to a picture. Different routines utilization shape channels to recognize given states of an image. Shape descriptors might likewise need to be invariant to interpretation, pivot, and scale.

2. REVIEW OF LITERATURE

Jyothi, B. et al [1] "An effective multiple visual features for Content Based Medical Image Retrieval" In the medical field accurate diagnosis is very crucial for successful treatment. With the rapid development of technology, the ever increasing quantity of medical images is produced in hospitals for diagnosing. A multiple features vector gives better-quality performance as compared to a single feature. This paper presents a new approach which takes the advantages of each individual feature. The content of the image extracted with the help of texture and region based shape descriptor, which have better features representation capabilities and are more robust to noise. The texture features are extracted with the help of Gabor filter and chebichef Moments used for Shape features extraction.

Pradeep et al [2] "Content based image retrieval and segmentation of medical image database with fuzzy values" The content based image retrieval (CBIR) is one of the most popular, rising research area of the digital image processing. In this technique which uses visual content to search image from large scale image database and its main goal of CBIR is to extract visual content of

a medical image. Image retrieval based on a query image is necessary for effective and efficient use the information that is stored in medical image database. This allows the retrieval of images by performing flexible queries on the database. Our main purpose is to get high accuracy of medical image obtained by retrieving techniques.

Rajalakshmi et al [3] "Improving relevance feedback for content based medical image retrieval"Inthe medical field, content based image retrieval is used to aid radiologist to retrieve of images with similar contents. CBIR methods are usually developed for specific features of images, so that those methods are not readily applicable across different kinds of medical images. Content-Based Medical Image Retrieval (CBMIR) refers to techniques thatretrieve images from medical image databases.

Zakariya et al [4] "Combining visual features of an image at different precision value of unsupervised content based image retrieval" CLUE (Cluster based image retrieval) is a well known CBIR technique retrieves the images by clustering approach. In this paper, we propose a CBIR system that also retrieves images by clustering just like CLUE. But, the proposed system combines all the features (shape, color, and texture) with some percentage of all features value for the purpose. In this paper we proposed two methods of CBIR by combining some percentage value of two features namely color-texture features and color-shape features and we also take the union of these two features. This combination of features provides a robust feature set for image retrieval. We evaluated the performance of proposed methods at different precision value of the image retrieval on each category of image database. We compared the performance of the proposed system with the two other existing CBIR systems namely UFM and CLUE at precision 100.

Khodaskar, A.A. ; Ladhake, S.A. et al [5] "A novel approach for content based image retrieval in context of combination S C techniques"Traditional content based image retrieval system are retrieved images using low level visual features, hence, suffer from semantic gap. There is need to reduce semantic gap and improve accuracy of CBIR even though size of image databases increase rapidly. A user gives input to the system in the form of specified query image and system return set of relevant images. Proposed system employs relevance feedback based on SVM.

3. METHDOLOGY

In thesis work we have implemented a high level combined features fuzzy query-based CBIR system to retrieve medical images from huge database. Proposed CBIR system is shown in Fig 5.1below. Whenever a user inserts a new image via the graphical user interface, the system begins an online process to transform that image into a set of features and store these features in the database.

Query image is the desired image, which we want to retrieve from a large image collection. Every time a user wants to

perform a query, three parameters have to be specified. The first is the location of the file containing the future query image. When this file path is specified, the system checks if the file corresponds to a valid image, and if its width and height correspond to one of the allowed query dimension.
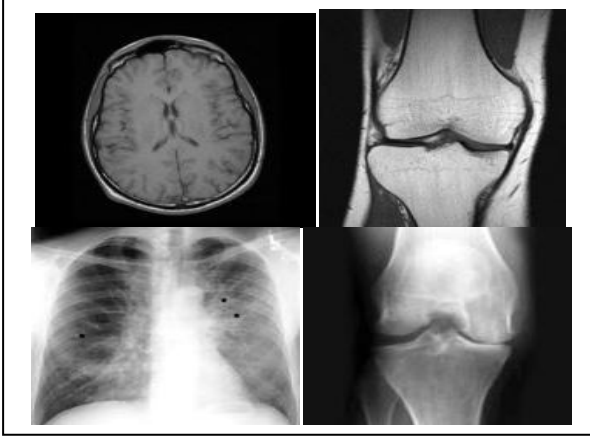
3.1 Image Feature Extraction: Texture features of images are extracted, like contrast, energy, mean, intensity, entropy etc. In this stage we extract the texture features gray scale images and store them into the features database.

3.1.1 Contrast (C) basically represents clarity [11] i.e. the fitness of the texture image. If the grooves in the image texture are deep then the contrast is large and the image is clearer conversely more blurred [8].

$$C = \sum_{i=0}^{L-1}\sum_{j=0}^{L-1}(i-j)^2 p_{i,j}$$

3.1.2 Mean ($\bar{X}$) represents amount of brightness present in an image [6]. The mean calculate the average value of gray level intensities. If mean value is high then image is bright and if mean value is low then image is dark. Mean of an image may be defined [6] as:

$$\bar{X} = \sum_{i=1}^{L} iP(i)$$

3.1.3 Standard Deviation (σ) shows the contrast of gray level intensities. The low value indicates low contrast and high value shows high contrast in the image. Standard deviation may be defined [6] as:

$$\sigma = \sqrt{\sum_{i=1}^{L}(i-\bar{X})^2 P(i)}$$

3.1.4 Energy (E) also known as consistency measures the image uniformity [12] i.e. Intensity level distribution present in the image [6]. Coarse texture has more energy than fine texture [11]. If energy value is high then intensity level distribution is small in the image. Energy can be defined as:

$$E = \sum_{i=1}^{L}\left[P(i)\right]^2$$

3.1.5 Entropy (H) shows the amount of information [11] and density level present in the texture of an image. Entropy measures the loss of information [12]. If density level is high entropy is large and vice-versa i.e. plain images have low entropy as compared to complex one [6].

$$H(X) = -\sum_{i=1}^{L}P(i)\log_2 P(i)$$

3.2 Fuzzy Inference System: The reasoning mechanism also called fuzzy inference engine as shown in Fig 5.2 below; is a subsystem of fuzzy logic based system that carries out the decision making process for the system. In this work we have applied the fuzzy approach to convert crisp features into fuzzy features. This approach made the system much simpler as compared to other systems.
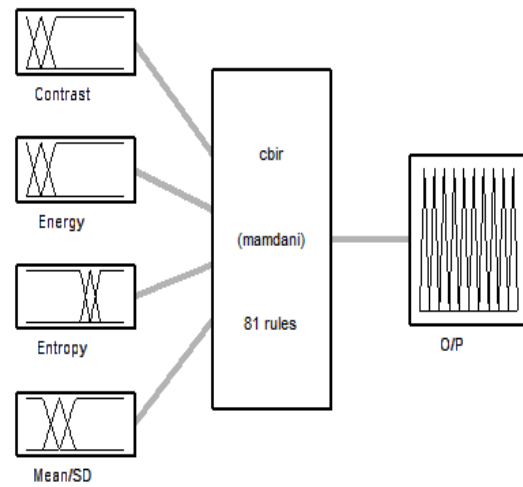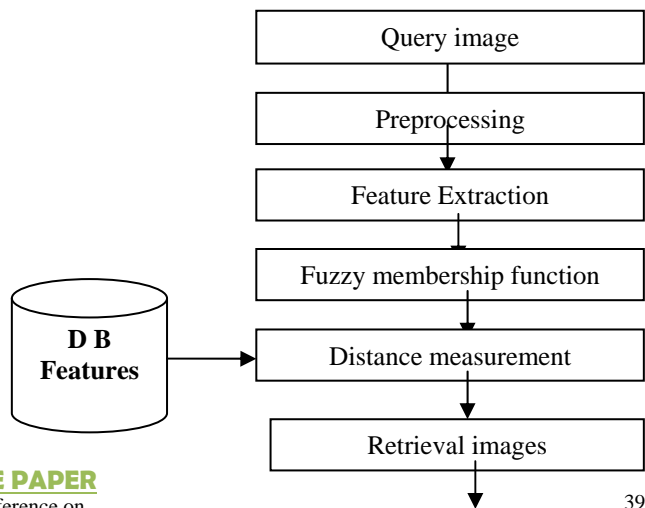

Fig 3.1 Fuzzy Inference System
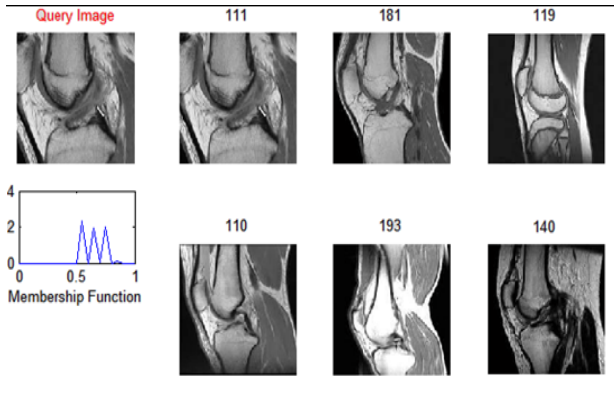
Parameter analysis

4. RESULTS

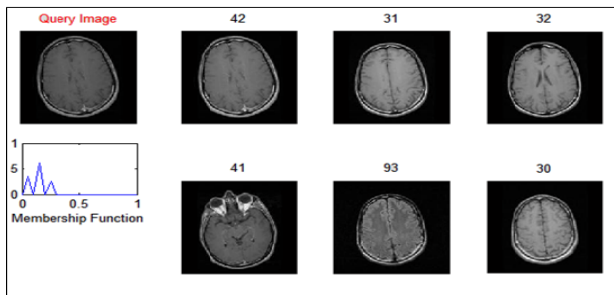**Fig 4.1 Knee as Query Image (p=1, r=.21, acc=80.25%)**

Fig4 .2 Brain as query image (p=1, r=.2, acc=80.25%)

We evaluate the system efficiency by (a) calculating number of comparisons with feature vectors, (b) measuring the time processor take to respond a query and (c) relating the previous measures with the number of results returned. Matlab provides a reasonable way to approximate the processing time in milliseconds by calling the method System. Unfortunately, it does not show how much time it take to process query image, since it shows only the actual time a query image takes to complete. The average time taken by each query is 1.25 second.
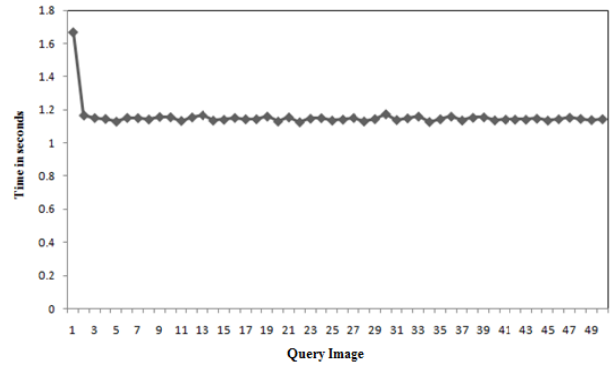

Fig 4.3 Time taken vs. Query image

EFFECTIVENESS TEST: This scheme is normally utilize in information retrieval to test the quality of results returned to manually classify all images in database as relevant or not-relevant for given query image i.e. if retrieved images are relevant with query image or else. Subsequently, query has four associated measures as given in table 6.1.

Table 4.1: Retrieval of relevant and non-relevant Images

	Relevant Images	Non-relevant Images
Retrieved Images	True Positive (tp)	False Positive (fp) Type I error
Not-retrieved Images	False Negative (fn) Type II error	True Negative (tn)

Using these quantities we can define two measures: (a) precision and (b) recall in the interval [0 and1].

In pattern recognition or image retrieval with binary classification, precision i.e. positive predictive value, is portion of retrieved relevant images, whereas recall i.e. sensitivity, is portion of relevant images returned. Thus precision and recall are basis of understanding and measure of relevance.

Precision is portion of retrieved images which are analogous and given by equation

$$p = \frac{t_p}{t_p + f_p}$$

Recall is the portion of images which are analogous to query image and successfully retrieved given by equation

$$r = \frac{t_p}{t_p + f_n}$$

Accuracy is defined as the closeness of a measured value to a standard value or known value and given by equation 6.3.

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$$Acc = \frac{t_p + t_n}{t_p + t_n + f_p + f_n}$$

Where,

t_p : is no. of relevant images retrieved.

f_p : is no. of non-relevant images retrieved.

f_n : is no. of non-relevant images that are not retrieved.

t_n : is no. of relevant images that are not retrieved.

Measuring only precision or recall is worthless, because maximizing those measures independently is very simple. A system that retrieves simply relevant images and no non-relevant images has highest precision, while a system that retrieves all images has maximum recall. In practice, when recall increases, precision decline and vice-versa, therefore goal of CBIR system is to maximize both quantities.

Table 4.2: Proposed System Precision, Recall and Accuracy

Test Image	Precision	Recall	Accuracy (%)
Knee	1	.50	88
Brain	.96	.48	87
Chest	.66	.33	79
Leg	.62	.31	78

The relative importance of precision and recall may be different depending on the objective of the system.

5. CONCLUSION

CBIR systems are still far from being able to extract high-level features using only image low-level contents due to semantic gap problem. For that reason, we have to rely on extracting image low-level features, like texture or object structure and attempt to merge them to build a higher level image representation. In this work, a combined feature fuzzy approach is proposed for content based image retrieval (CBIR) system. In the proposed method image texture feature like mean, SD, contrast etc. are utilized to represent an image. Fuzzy aggregation membership function is utilized to represent image characteristics. Accordingly relevant images are retrieved from vast database by comparing fuzzy membership function of query-image with database images using cityblock distance. To alleviate semantic gap problem fuzzy linguistic terms are used which maps image low-level features to human high-level notions and perception subjectivity problem is reduced by assigning weights to each rule in knowledge base. The proposed method is simple and fast in retrieval. The average precision evaluated for the proposed approachis92%.

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