A Novel Algorithm for Region-Based Image Retrieval Framework

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Abstract: The digital image is probably the most important tools in the medicine since this is used for the diagnosis of the diseases, for drug treatment responses and also manages the diseases of patients, having very few side effects and an effective cost-effective relationship. With the wide growth of medical images database, the statistical analysis of medical images is becoming a big challenge. CBIR (content-based image retrieval) is the modern image retrieval system is used to extract medical image features, index those using appropriate structures and efficiently process user queries providing the required answers. Radiology images have rich, varied and subtle features that need to be interpreted accurately, so that the medical practitioners can suggest best treatment. Another problem in accessing medical images is semantic gap. These problems are reduced by using texture image features and using linguistic terms for retrieving images. Proposed approach helps in solving these problems.

Keywords: CBIR, linguistic terms, fuzzy clustering

I. INTRODUCTION

In the last decade the number of medical images especially digital images is increasing which is used for diagnosing and therapies. With the wide growth of medical images database, the statistical analysis of medical images is becoming a big challenge. When a physician is studying a case he is interested in more similar cases and the similarity measures usually involves a medical background. The benefit of archiving medical images can be gained only when a good query tool is adapted to allow users to browse the medical images. Content-based image retrieval faces few problems when it is applied on medical images. Two of the major difficulties are:

Complexity of radiology images: Image retrieval in CBIR is a difficult task. Radiology images have rich, varied and subtle features that need to be interpreted accurately, so that the medical practitioners can suggest best treatment. Color features are not much useful in medical domain as most of the radiology images are gray images. Shape features are also applicable in some cases. This problem is reduced by using texture image features in the proposed approach.

Semantic gap: Semantic gap is a major problem in usage of CBIR in radiology. Semantic gap is the gap in low-level features and high-level concepts i.e. the difference between numerical descriptors and textual descriptors. To reduce the semantic gap we can use image contents as well as metadata such as laboratory reports, physiological measurements etc. we can also use relevance feedback to reduce the semantic gap errors and to provide more refined result. In this approach we used linguistic terms to pose queries.

These terms are easy to understand and easy to pose.

In proposed approach images are retrieved in two phases:

Database creation: Database creation in the proposed approach is shown in fig 1.the image features are clustered using fuzzy clustering algorithm.

Query comparison: Query comparison is shown in fig 2.the query is posed using linguistic terms i.e. high-level terms.

II. DATABASE CREATION

The database is created in various steps.

(A) Creating dataset of DICOM images**:**

The radiology images of liver CT scan are chosen to create database.

Extract DICOM image texture features: The texture features are extracted from each image by GLCM technique. The number of features extracted is 4 and these features are as follows;

(a) Contrast
(b) Cluster shade
(c) Homogeneity
(d) Entropy

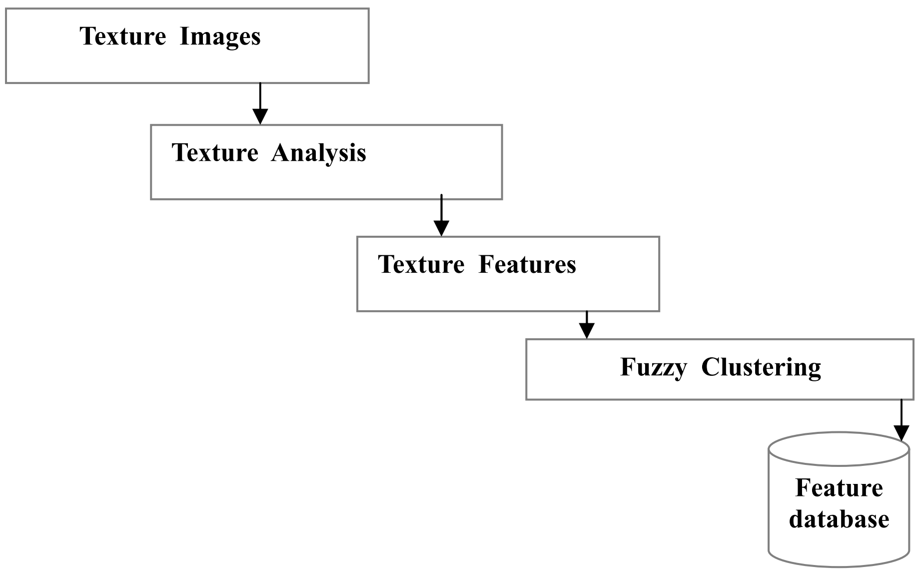


Fig 1. Database creation of proposed approach

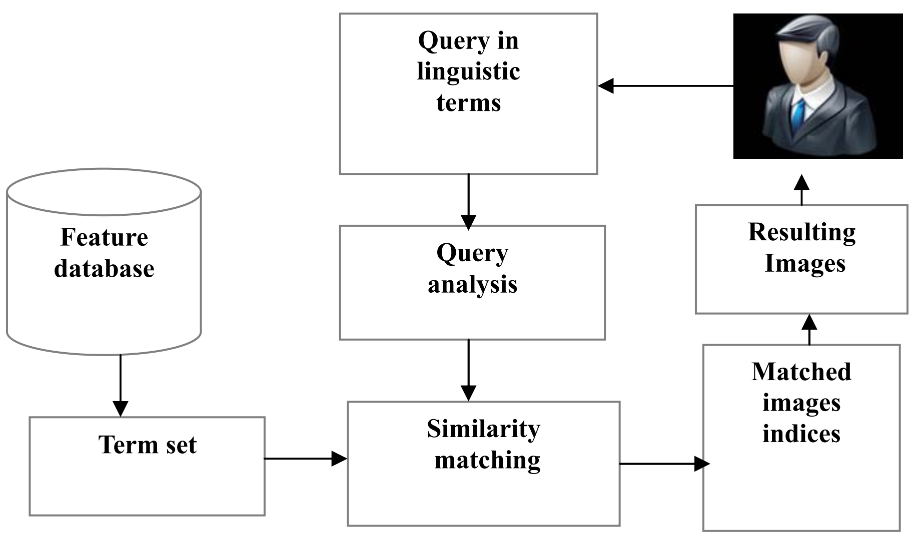


Fig 2. Query comparison in proposed approach

The statistical method that considers the spatial relationship of pixels is the gray-level co-occurrence matrix (GLCM), also known as the gray-level spatial dependence matrix. Given an image composed of pixels each with an intensity (a specific gray level), the GLCM is a tabulation of how often different combinations of gray levels co-occur in an image or image section.

CONTRAST:

Contrast is the difference in luminance and/or color that makes an object distinguishable. It returns a measure of the intensity contrast between a pixel and its neighbor over the whole image. The Contrast feature is calculated as:

$$\text{Contrast} = \sum_{i,j=0}^{N-1} (i-j)^2 P_{ij}$$

Where:

P = element i, j of the symmetrical GLCM

N= number of gray levels in the image as specified by GLCM texture page.

CLUSTER SHADING:

The Shade feature is calculated as:

Sum (sum (Pij.*((i+j-u_x-u_y). ^3)));

WHERE

u_x = sum (sum (i.*Pij));

u_y = sum (sum (j.*Pij));

Pij = element i, j of normalized symmetrical GLCM

HOMOGENEITY:

It returns a value that measures the closeness of the distribution of elements in the GLCM to the GLCM diagonal.
Homogeneity = sum (sum(Pij./(1+abs(i-j).^2)));

ENTROPY:

Entropy is a statistical measure of randomness that can be used to characterize the texture of the input image. Entropy is defined as

-sum (p.*log2 (p))

Where: p =element i, j of the normalized symmetrical GLCM.

(B)Develop feature matrix:

For the extracted features, a feature matrix is created. The vales for contrast, homogeneity, and entropy and cluster shade of all the images are arranged in a matrix.

(C)Develop lexical text phrases:

Lexical phrases are developed for the uses to reduce the semantic gap. These phrases can be easily understood by the user as these are high level phrases rather than low-level features which are hard to understand. For e.g. Contrast is divided into four lexical terms i.e. low contrast, medium contrast, high contrast and very high contrast. These phrases are shown in a table 1.

(D)Run fuzzy clustering algorithm:

The fuzzy clustering algorithm is used to divide
the features of the images into above developed lexical phrases. If then else rules are used to create the range.

(E)Dataset stored in database:

The above said four image texture features are extracted from each of the image and are stored in the database. When a query is posed in the high level phrase, the data is retrieved from this database. Image indexing is done in this phase. This indexing helps retrieving the images when a query is posed.

III. QUERY PHASE

At last stage the query is made to retrieve the desired images. The query can be made in the terms of above said lexical phrases. For e.g.:

"Find images having low contrast"

query can also be posed by using Tamura features. The Tamura features used in this approach are regularity, smoothness, coarseness. For e.g.

"Find Images which are coarse."

All of these features are interrelated and are shown in the table 2.

Table1: linguistic terms for four texture features

Texture features	**Linguistic terms**			
Contrast	**Low contrast**	**Medium contrast**	**High contrast**	**Very high contrast**
Homogeneity	**Low homogeneity**	**Medium homogeneity**	**High homogeneity**	**Very high homogeneity**
Entropy	**Low entropy**	**Medium entropy**	**High entropy**	**Very high entropy**
Cluster shading	**Low cluster shading**	**Medium cluster shading**	**High cluster shading**	**Very high cluster shading**

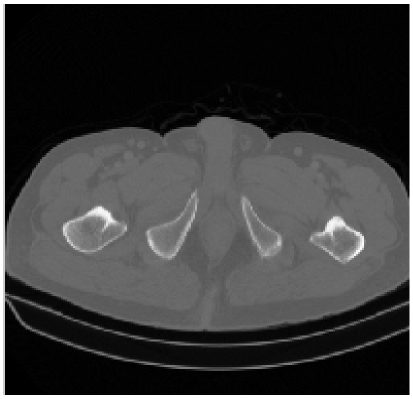
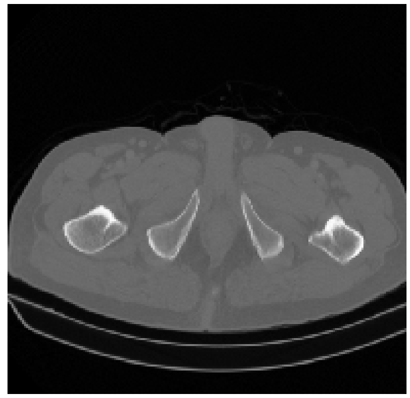
Table 2: Relation between various texture image features

TEXTURE FEATURES	**LOW**	**MEDIUM**	**HIGH**
Homogeneity	Coarse	Regular	Smooth
Entropy	Smooth	Regular	Coarse
Contrast	Smooth	Regular	Coarse
Color shade	Smooth	Regular	Coarse

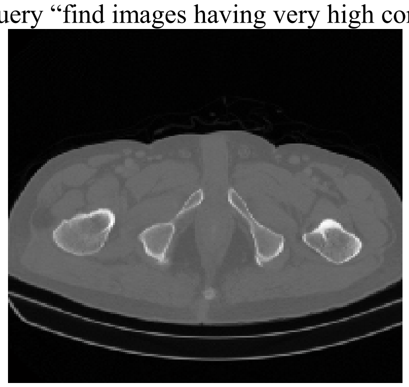
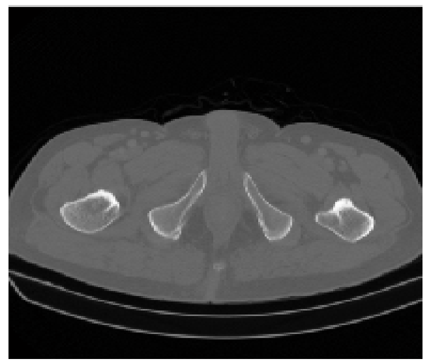
IV. EXPERIMENTAL RESULTS

For the experiments in this section, all the 3030 images in the new database are indexed. The system shows relevant results in decreasing order of similarity. We are showing two relevant images for each query.

After the query is posed, the resulting two images are shown as a result. The query retrieves the images which lie in this range and from the retrieved images two images are shown as a result. The results of a query "find images having low contrast" are:

The result of a query “find images having very high contrast” is as follows.

V. CONCLUSION AND FUTURE SCOPE

In this approach we aimed to reduce the semantic gap by using linguistic terms as the query to retrieve radiology images. In this case we used abdomen CT scan images. Four features are extracted using GLC M technique. The extracted features are categorized into linguistic groups. A novel Fuzzy clustering algorithm is used for clustering. The user can pose queries in the high level language called linguistic terms. For a radiologist or for someone for which image accuracy is a major concern, this approach is an easy way to get the results.

This research concentrates solely on one kind of radio images. This approach can also be applied to a database which has all kind of radio images. To achieve the accurate and fast results, query by example can be posed first which extracts the similar kind of images. In these selected images, the above approach can be applied to get the more relevant results and finding the accuracy at highest level. This approach can also be applied using color and shape features in combination with texture features.

VI. REFERENCES

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