Image Identification Classification Detection and Obtaining 3D Shape Using Retrieval Technique and Segmentation

P.V. Rama Raju*, M. Hari Krishnam Raju** and Mallela Chanti***

ABSTRACT

This paper introduces a new method for retrieving images from large database and also presents an automatic approach for detecting the tumor area from brain tumor images. Retrieving brain tumor images based on the image information given in the form of query image. The information mainly contains shape, color or texture. Based on the contents of query image the image which is most similar to that query image is retrieved and the information of the retrieved image is displayed automatically. After retrieving the most similar image, the brain tumor detection techniques are applied on the retrieved image, after detecting the tumor region in the image the area of the tumor is measured. The 3d visualization of the tumor is drawn by using the software 3d slicer and the DICOM image viewer software. The shape of the tumor in 3d is shown in results. The results are shown for the biomedical images.

Keywords: Query image, Brain tumor,Detection technique, CBIR, Segmentation, Texture,Euclidean distance.

1. INTRODUCTION

In the present days technology developments grown very high and requires a fast and effective methodologies are needed. Image retrieval techniques based on the properties like shape, texture and color is one of the most effective methods for automatic retrieval of an image from the database contains a number of images. This paper gives a new method in order to obtain better relevant images .the method introduced in this paper based on the effective measurement of energy calculations of texture. In the earlier days, people's use some type of keywords like text word, drawn sketches (shapes) to retrieve images from the database for maintaining database biomedical images of different diseases like the brain tumor, lung tumor, iris and bone x-ray are taken from online. Image retrieval based on the content depends on query image information. Query image is taken as the reference image based on that information the comparisons are measured between the Query image and the images are stored in the database. Firstly a texture calculation of the query image is calculated and texture calculations of all image stored in the database are calculated by using the energy level algorithm is used. After calculations of the texture values, the similarity between the images is calculated. For algorithms for obtaining the distance vector. Performance analysis is carried by taking the distance .if the measured distance is zero or very less between the query and the database image then that database is treated as the most similar image or most relevant image. The main aim of this paper is to obtain the most similar image database and displaying the detail information of the image in output,

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*   Professor department of Electronics and Communication SRKR Engineering College, Bhimavaram Andhra Pradesh, India, *Email: Pvrraju50@gmail.com*

**   Asst. Professor department of Electronics and Communication SRKR Engineering College, Bhimavaram Andhra Pradesh, India, *Email: Mhkraju2005@gmail.com*

***   M. Tech Student department of Electronics and Communication SRKR Engineering College, Bhimavaram Andhra Pradesh, India, *Email: Chanti528@gmail.com*

and it will help to perform different types of diagnosis techniques on the retrieved image .this paper also describes the different types of detection techniques to find the affected tumor region in the brain. After completion of the detection process the detected tumor, area is figured in the 3d view. 3D designing work is carried out by using two types of software's, DICOM image viewer and 3d slicer software. These are used for obtaining the 3d volume of the 2d detected brain tumor area. This paper gives the results of different types of medical images mainly brain tumor and lung tumor. Basically, the process of image retrieval depends on intensity values of an image, where the pixel information is located maximum. Here in this paper texture property of an image were calculated using the wavelet transform based method .this paper uses the discrete wavelet transform techniques in order to calculate the texture values. Wavelet transforms based image retrieval system used to reduce the semantic gap between the visual features and improve the retrieval accuracy of the system. Measuring the similarity this paper proposes different methods. The similarity between images is calculated by using the distance measuring algorithm .This paper describes different

2. BLOCK DIAGRAM

Block diagram explains two stages of operation

    1. Brain tumor image retrieval procedure

    2. Brain tumor detection techniques

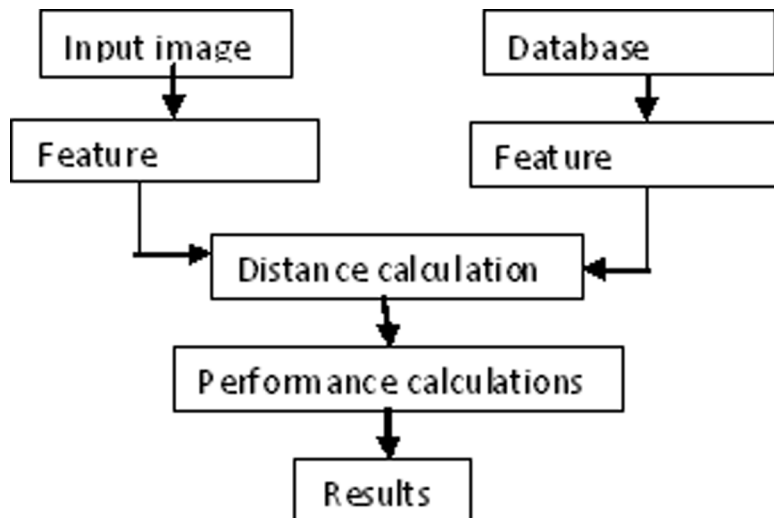In the below block diagram, it explains the internal process of the paper.

Figure 1: Retrieval Block Diagram

The developed code takes the input image from the user by browsing the query image it is denoted as the reference image, after browsing the query image calculation of texture feature analysis take place and at the same time texture values of all the images stored in the database one after another. All the calculated values are stored in the database. By using the distance measuring algorithms it calculates the distance between the query image and the every image in the database one by one, after completion of the distance calculations performance calculations are carried out. Finally, it shows the extracted image which is most similar to the given query image, which is shown in results. The second stage follows detection techniques, are applied on the extracted image.

In this detection process, the extracted similar image is taken and it is given to the brain tumor detection algorithm, the algorithm uses different types of detection techniques and processes the image further and gives the detected tumor area i.e. Disease affected region in the brain tumor of the patient
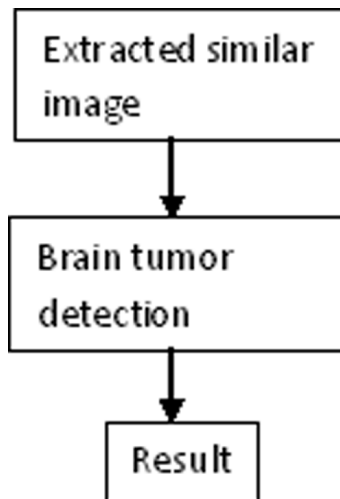
Figure 2: Detection Block Diagram

3.   RELETED WORK

This paper process the operation in two different steps, firstly retrieval algorithm and secondly detection algorithm .

3.1. Retrieval algorithm

This paper proposes a new retrieval algorithm based on the wavelet transform method. In this particularly discrete wavelet transform is used for the calculations of the texture extraction. In this process getting the input query image feature extraction of image classifying image and finally images are sorted in image feature database, this is useful for similar image retrieval from feature database.

3.1.1. Input Image Processing

MRI Brain tumor image is taken as the input query image and this image is pre-processed by fixing its size to a fixed value .The database is used here is containing more number of MRI brain tumor images belongs to different patients. Images are taken from the internet. The image features are extracted from query image and values are stored in the form of mat data. This process is done by using the code. This image is used for further analysis. In the next step texture, feature calculation is obtained by using the wavelet transform.

3.1.2. Texture Analysis

The texture is defined as the structure of surfaces formed by repeating particular element or several elements in relative spatial positions. For texture analysis, this paper uses wavelet transform based method. The property of all surfaces that describes surface patterns, each of which having homogeneity property is termed as texture. It also describes the relationship of surface to the surrounding environment. The texture is a feature that describes distinct physical compositions of a surface. It also includes coarseness directionality regularity and roughness. The texture is a property that gives the rich source of detail information about the natural visible image. Any visible object is having some sort of texture. Appearance and surface characteristics of an image are given by its shape size density and arrangement proportions of elementary parts. In an image texture refers to pattern and properties of homogeneity and don't result from the presence of intensity value or single color. It is a powerful discriminating feature present everywhere in nature. In order to calculate the energy values of texture, this paper follows discrete wavelet transform analysis. A wavelet is a waveform of effectively having the limited duration that has an average value zero. Texture feature extraction is calculated by following different ways.

A. Spectral analysis

B. Statistical analysis

In the spectral technique, it uses wavelet transform method. DWT is used to reduce the image size without losing the information that is resolution values computed and values less than specified threshold. So this process is used to reduce the total memory required to represent given the image. In DWT image or signal is sub decomposed into different levels i.e. Converted into series of wavelets, due to finite time duration these stored efficiently. In the analysis of wavelet transform the approximation coefficients are taken at high scale, low-frequency components of signal and detail coefficients are taken at low-scale, high-frequency components. The low-frequency content is the most important part. Matlab includes commands like DWT, IDWT and wave record for signal decomposition and reconstruction. For better approximations of a signal wavelet transform is used.

There are different types of wavelet transforms are there. Example Harr, Morlet, Mexican Hat, Coiflet, Daubechies etc. Harr is simplest and Daubechies is vital for the current application so both these are used in this paper. DWT it decomposes the given image into pyramid structure of sub decomposed images with different resolution belongs to different images. It particularly uses pyramidal structure wavelet transforms notation. In this transform, it recursively decomposes sub-signals in low-frequency channels. It is very essential for textures having dominant frequency components. Where the information is presented in lower frequency channels. For the images contains most of their information in low-frequency channels or lower sub-bands, this transform is very useful. Using this transform the textured image is subdivided into four sub-levels or sub-bands or sub-images. As L-L, L-H, H-L, H-H sub-bands. This decomposition is called first level decomposition;

The texture calculation of every sub band image is calculated. For further decomposition, it uses the L-L sub-band image and this process is continued up to 5th level because the information exists in lower frequency levels.
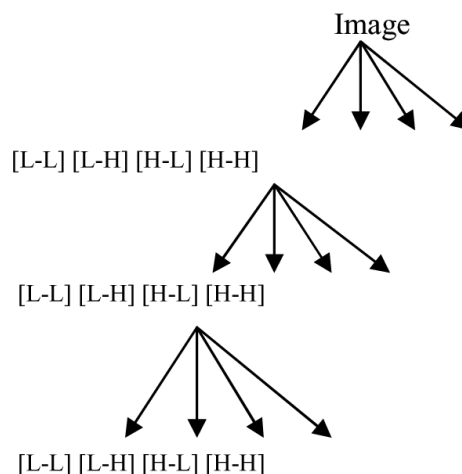
Figure 3: PWT Structure

Query image energy is calculated by using the energy level algorithm. Based on this algorithm program calculates the energy of query image and all images presented in the database.

Texture calculations

In this for obtaining the energy, it uses energy level algorithm

First it sub decomposes into 4 levels

For each level, it calculates the energy of all sub decomposed images

$$E = \frac{1}{MN} \sum_{i=1}^{m} \sum_{j=1}^{n} |X(i,j)|$$

Where M, N are the image dimensions, X is image pixel intensity is located at row i, column j

By using the above-mentioned algorithm obtain texture energy in further levels; those calculated energy values are stored in the dataset for future reference.

There are several other methods to find the texture energy of images stored in the database. Gabor wavelet transform, tree structure wavelet transform and uniform decomposed waveform are can be used. But in the case of uniform decomposed wavelet transform, it decomposes the image into uniform levels. To extract texture features from images Gabor wavelet or Gabor filter can be used. It is a group of wavelets, and each wavelet in this captures energy at different orientations and different frequency. Because of its scale and orientation Gabor filter is useful in texture calculation.

3.1.3. Similarity Measurement

Similarity measurement is obtained between the query image and the all images presented in the database. To obtain similarity it will uses distance measuring algorithm. There are several techniques are proposed to find the distance matrices between two vector images. The proposed methods can be used for finding the distance. They are Euclidean distance, Mahalanobis distance, Manhattan distance, trigonometric distance algorithm etc. This paper mainly focused on Euclidean distance. Mahalanobis distance, DWT (Dynamic time warping) and Manhattan distance algorithm can be used. These algorithms measure the distance between query image and database image. After calculations distance matrices are obtained and sorted in order.

Euclidean distance algorithm

$$D_i = \sqrt{\left[\sum_{k=1}^{k} \left(x_k - y_{i,k} \right)^2 \right]}$$

Where x is the distance matrix of image database and y is the distance matrix of query image.

Based on the distance between two images the feature based similarity is measured. Mahalanobis distance is also termed as quadratic distance, it is used to measure the separation between two groups of objects.

Mahalanobis distance algorithm

$$d(\underline{x}, \underline{y}) = \sqrt{(\underline{x} - \underline{y})^T s^{-1} (\underline{x} - \underline{y})}$$

This is Mahalanobis distance formula. Where x and y are two random distance vectors, S is the covariance matrix. If the covariance matrix is identity matrix then Mahalanobis distance reduces to Euclidean distance. The distance measured when the covariance matrix is diagonal then the measured distance is called as Normalized Euclidean distance, is defined as the distance when the covariance matrix is diagonal.

Normalized Euclidean distance algorithm

$$d(\underline{x}, \underline{y}) = \sqrt{\sum_{i}^{N} \frac{(x_i - y_i)^2}{s_i^2}}$$

Where s_i is called as standard deviation of x_i and y_i over the sample set.

If the measured distance between the query image and database image is zero or minimum then that database image is called as the most similar image and remaining sorted distances of the image are called as relevant images compared to the given query image.

3.1.3.4. Performance measurement

Retrieval system performance is analyzed by using Precision and Recall. Accuracy of the retrieval system is me is measured by using the precision formula.

$$Precision = \frac{Numbe\ of\ relevant\ images\ retrieved}{Total\ number\ of\ images\ retrieved}$$

Recall is defined as the how fastness of the retrieval system.

$$Recall = \frac{Total\ number\ of\ images\ retrieved}{Total\ number\ of\ relevant\ images\ in\ database}$$

By measuring these two parameters the retrieval system performance is obtained. In this paper precision and recall rate is high compared to the other proposed methods.

3.2. Detection Algorithm

After retrieving the similar image which is equal to the query image is separated and it is shown in the separate figure window. In detection algorithm, the separated image is taken and is processed further. This method mainly contains the detectionalgorithm, which is used to detectthe diseased part in the brain or body. Here in this paper the database is organized with different biomedical images, contains brain tumor, lung tumor, diabetic retinopathy, liver tumor etc.

In this methodology, the biomedical image is processed with detection algorithm. The abnormal growth of tissues in the brain is called as the tumor. In the region of the brain tumor cells are grown and multiply very rapidly. A brain tumor is classified into different types, like malignant, benign, primary or metastatic. In the MRI brain tumor image, the affected area is extracted and segmented by using image processing techniques. For extraction of tumor in scanned MRI brain image, it uses most practical approaches in image processing toolbox. The methodology contains different parts. First input MRI brain tumor image is taken and this image is pre-processed with image processing techniques. The input image is converted into gray scale image. When the part of the body is scanned using MRI technology the captured image looks like a black and white image. Generally, gray scaled images are in the form of or looks like black and white. In the conversion of RGB to grayscale image, the pixels values are changed 00000000 and 11111111. But in the case of color image red, green, blue colors are represented each with 0 to 255-pixel values. In grayscale image these colors represented by R = G = B = 00000000 for black and for white 11111111.

After converting image into grayscale, the grayscale image is given to high-pass filter for noise removal. High pass filter is used for sharpening the image i.e. Attaining high frequency information and reducing the low-frequency information.

To enhance the image further it uses the median filter, it is a nonlinear filtering technique, used to reduce noise. Median filtering is widely used in digital image processing because in preserves edges while removing noise

After median filtering, the filtered image is given to the segmentation. The simplest method used for segmentation is called threshold method. It turns the gray scale image into binary image clip level process.

4.   RESULTS

The above figure represents retrieved images. It shows top 21 images which are similar to given query image. In above figure, the first image represents the most similar image compared to the query image, and this image is separated from above and it will give to the detection algorithm to segment the image.

Fig 6 represents the thresholding and segmentation process . After thresholding and segmentation, it detects the region of the tumor. In the last image shows the exact region of the tumor.

Fig represents the 3D designing of the tumor area in the MRI brain tumor image. For designing the 3D image it uses 3D slicer software. 3d slicer supports DICOM and MRML images so to convert jpg image to DICOM image it uses dicom image viewer software. After loading the image into the 3d slicer software based on the operations used in the detection algorithm those are used in this analysis for developing the 3d design. It contains a different type of modules. The designing steps are given below.

- First, load image into 3d slicer software
- Using editor module edit the image
  1. Add pre-structure volumes related to that image.
  2. Perform thresholding operation.
  3. Perform Erode and dilation operation.
  4. Save island effect.
- Use model maker module design the saved island effect of image. Model maker is used to designing the 3D shape of threshold image. After performing these operations it will give the 3d image

Fig 8 shows the results of the brain tumor image in 3d analysis. Volume also can be obtained numerically.
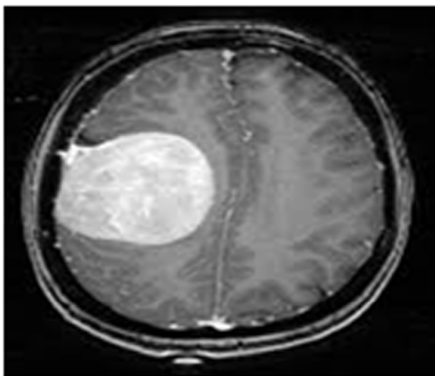

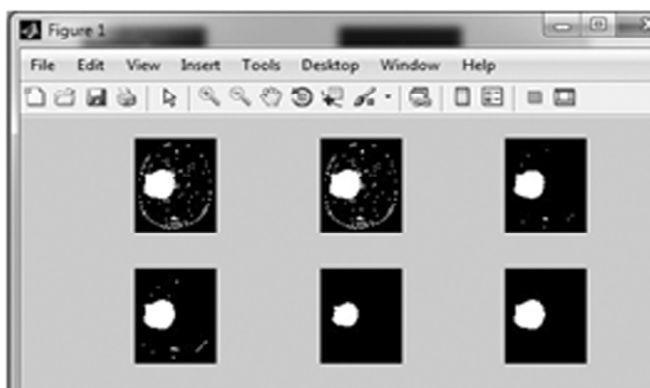Figure 4: Input brain tumor image as query

Figure 5:Retrieved similar images

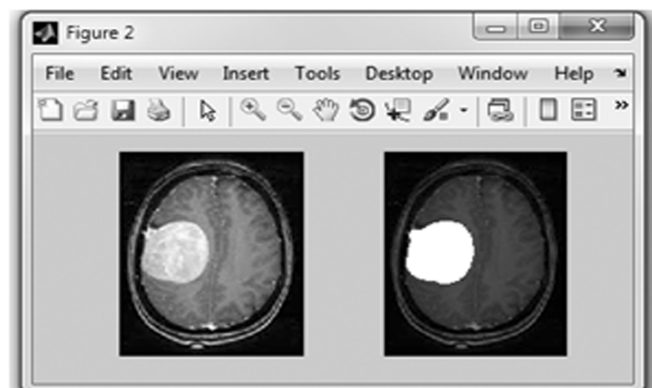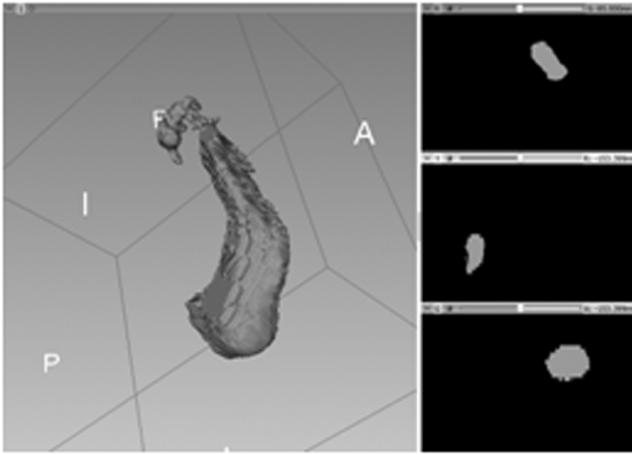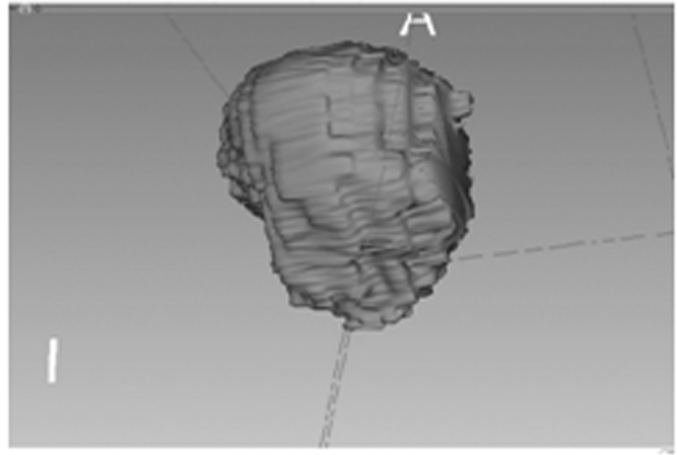Figure 6: Detecting tumor region in Query MRI brain image

Figure 7: 3d Showing of detected tumor in 2d

Figure 8: Separated tumor volume in 3d from MRI brain tumour image.

Figure 9: Front view of the volume.

5. CONCLUSION

In this paper, it gives an automatic method for identifying and classifying image which is stored in the large database. The image is compared to all the images stored in the database and finally gives exact similar image and the other images which are relevant to that input query image and it gives an automatic method for detecting the tumor from MRI brain tumor scanned image. In this method, it gives the exact region of the affected image. And also gives the 3D shape of the brain tumor area.

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