A NOVEL MEDICAL IMAGE SEGMENTATION AND CLASSIFICATION USING COMBINED FEATURE SET AND DECISION TREE CLASSIFIER

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Abstract

Diagnosis is the first step before giving a medicine to the patient. In the recent past such diagnosis is performed using medical images where segmentation is the prime part in the medical image retrieval which improves the feature set that is collected from the segmented image. In this paper, it is proposed to segment the medical image a semi decision algorithm that can segment only the tumor part from the CT image. Further texture based techniques are used to extract the feature vector from the segmented region of interest. Medical images under test are classified using decision tree classifier. Results show better performance in terms of accuracy when compared to the conventional methods.

Key Words: *Medical Images, Decision Tree Classifier, Segmentation, Semi-decision algorithm*

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1. INTRODUCTION

With the rapid increase in the population there is a need for development of fast diagnosis in the field of medicine. Thus an efficient and more effective method is required for better diagnosis of medical image information. Segmentation is the prime part in the automatic diagnosis of a disease where a system is given an input such that it segments the input image and further diagnoses based on the intelligence that is provided to it. Figure 1 shows the basic block diagram of a medical diagnosis system.

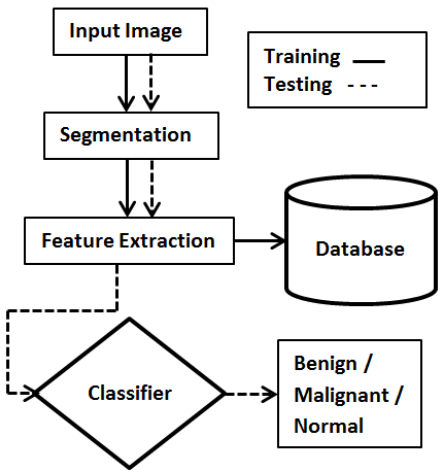

Fig - 1. Basic Block Diagram of a medical diagnosis system.

The basic problem with such a system is the segmentation process. Optimal algorithms need to be formulated for proper segmentation of the region of interest such that features can be extracted from the region of interest. Further these features must be selected in such a way that they do not pose any classification problems.

Content based image retrieval has gained much importance in the recent past and this is applied over medical image where based on the content of the medical image, similar images are retrieved from the database. Several ways were determined to improve the relevance of multi-modal information retreival in medical system that are being developed. There are several medical information retreival systems. An attempt is made to get the metadata about the image from the full text of the subject and retreive the similar images in response to that of the query image is provided[1]. Further a step forward in the diagnosis is done which extracts the mycardial wall of the left and right ventricles from cardiac CT images. The ventricles are primarily located and then detected by first identifying the endocardium and then segmenting it by locating it using active contour model. This method proved to be robust and accurate[2]. In order to analyse skin histopathologial images for the diagnosis of skin cancer various computer aided automated diagnosis techniques are developed. To improve the speed fo the technique a FPGA based hybrid implementation framework is developed[3]. Existing segmentation techniques are used for segmenting only 2D

images. Hybrid Extreme Rotation Forest classifier is developed for segmenting 3D CTA images which is a group of classifier composing of extreme learning machine and decision trees[4].Biomedical research has been extended by segmenting the interested objects from the microscopic images and classifying them. It is achieved using RBF network combined with fuzzy and graph based discrete approach[5]. With the rapid increase in the number of images that are stored in the database there is a problem with image annotation which cannot be manually done. Hence it is the problem which is still pertinent and remained despite the development of many content based multimedia retrieval solutions[6]. The problem becomes more worse as the images that are store may be homogeneous in nature. Hence a technique was proposed which segments using 3D points[7]. Further various algorithms exists which can improve the contrast of the image as the images that are acquired are of low quality in nature which need to be enhanced for further processing[8].

With the technological advancement security lapse is of major concern. Hence different techniques are adopted to provide better security. In this juncture, biometrics is widely used. Iris is one of such biometric which can provide high security when compared to other existing biometric traits. A novel segmentation method is developed for segmenting the iris part which is occluded and can be seen partially[9]. Segmentation is primarily based on partitioning an image based on the changes in the regions which is nothing but based on the content of the image[10-11]. Edge in an image which enmark the boundaries between two regions. Edge based segmentation are used to detect the sharp discontinuities in an image. Further such a edge based segmentation can also be extended using various color models[12-16].

This paper is organized in five sections. Section I introduces the topic. Section. II clearly delineates the problem definition and Section III elaborates the proposed solution. Section IV shows the results of the proposed solution. Section V outlines the conclusions.

2. PROBLEM DEFINITION

Image segmentation is mainly based on the properties of the image like discontinuity and similarity which further depend on the gray, color or texture properties. Section I clearly elaborates the existing techniques used for image segmentation. The result of segmentation must be appropriate for any image processing system such that the classifier has to classify the image as a class based on the features that are extracted from the segmented image. In any medical image system, segmentation plays a prime role as all components of the image may not be related to be useful for classification. Hence it is quite obvious and necessary to have a better segmentation such that only the region of interest need to be extracted. Section II clearly defines the solution to extract such region of interest.

3. PROPOSED SOLUTION

Section II elaborated the need for segmentation in a medical image retrieval system. For proper segmentation of an image it is necessary to enhance the image first and then apply any of the segmentation techniques. The raw image that is acquired will be of noisy in nature and it need to be enhanced. Hence it is proposed to enhance the image using adaptive histogram equalization and then follow the segmentation process.

There exists various segmentation techniques[10] out of which thresholding is a very old, simple technique which resolves most of the problems. It is proposed to use manual thresholding based on the gray level values of the image. The technique proposed computes the threshold manually by locating the pixel values that are irrelevant to the current process of segmentation. The pixels values which are having a gray level within the prescribed limits are retained and the remaining are discarded. It is clearly identified from the thresholding process that only the regions that are malignant and benign are only visible and normal cases are not at all visible after this stage of processing.

After thresholding a novel algorithm is proposed for segmentation[9] by selecting an edge point and removing the point on the edge by computing the neighborhood in the divided search area of size 3 x 3. If no neighboring pixels is located, then the point is considered as an isolated point and removed from the edge pixels list. In this way all the pixels of the image are marked.

The result of this process is the segmented image. But the aim is to segment only the tumor part and not the remaining parts. Hence it is proposed to apply morphological image processing techniques to extract the tumor from the brain MRI image. It is observed that the proposed segmentation has resulted in better segmentation over the existing techniques.

In order to automate the process of classification it is proposed to extract various features[9] from the segmented image and are classified using Decision Tree Classifier[9]. The next section clearly explains the result of segmentation and classification process.

4. RESULTS

Fig – 2 shows the database that is used for this research. In this research it is proposed to consider all types of tumor images which contain malignant, benign and normal case.

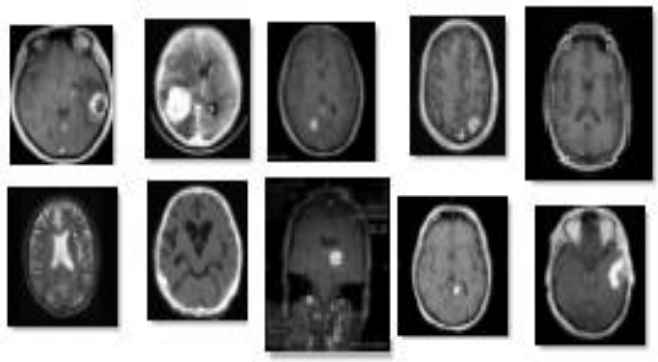

Fig - 2. Database used for this work.

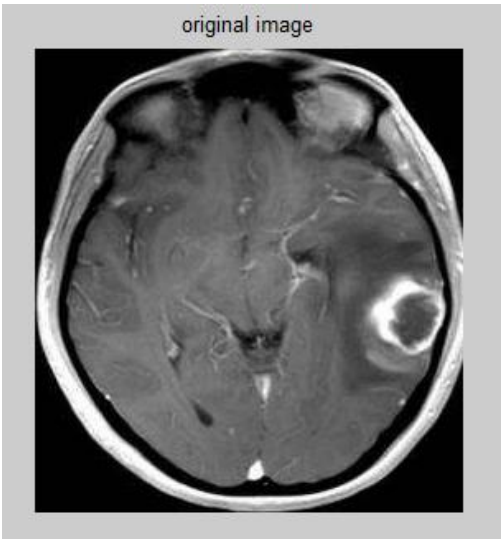

Fig - 3. Original Image

Fig - 4. Result of Thresholding

Fig – 5. Result of Segmentation

The original image taken for segmentation is showin in Fig. – 3. Fig. – 4 shows the result of thresholding proposed prior to segmentation. As discussed earlier the proposed segmentation has resulted in optimal segmentation when compared to the conventional techniques and the result of segmentation of the tumor is shown in Fig. – 5. It is observed that the proposed segmentation has resulted in 70% accurate segmentation. Further various texture based features [9] are computed from the extracted tumor and are saved in the database for further testing.

The system is tested with the saved feature set and in this work it is proposed to use decision tree classifier for testing. A decision tree can be expressed as a repetitive partition of the given data space. A decision tree consists of a rooted tree which will be directed with a node called root, which is prime and remaining nodes are leaves. Decision tree algorithm constructs a decision tree for the given dataset automatically such that the error is minimal. Decision tree classifier tries to optimize the cost function to find a decision tree T with a given set of L labeled samples. Here it tries to optimize the decision tree and find an optimal class out of the given dataset when a query image is given as a test case[9].

When the system is tested with the proper segmented results it is observed that the proposed technique has achieved 94% accuracy.

5. CONCLUSIONS

Automated medical image diagnosis requires proper segmentation for further processing and identification. In this work a novel segmentation based on morphological processing and identification of the tumor images based on thresholding is proposed. It is observed that the system has resulted in 70% accurate segmentation and using the features that are extracted from the segmented tumor image, the test results are promising and an accuracy of 94% is achieved.

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