Statistical Texture Feature Analysis & Segmentation for MRI Abnormalities Detection

Mayanka Peters¹ and Ankita Pandey²

¹ M.Tech.- 4th sem(Digital Communication), Acropolis institute of technology, Bhopal, India
Email: mayanka.peters@gmail.com

² Assistant Professor, Acropolis institute of technology, Bhopal, India
Email: pandey.ankita0312@gmail.com

ABSTRACT
The image processing method are used broadly in various medical field for improving earlier recognition and treatment stages, in which the time factor is very essential to discover the disease in the patient as possible as fast, especially in various cancer tumours such as the brain cancer, lung cancer etc. Process passed the available brain cancer images and its database in basic three stages to achieve more quality and accuracy in experimental results, firstly image enhancement stage which is used low pre-processing image techniques. Gabor filters using a Gaussian rule in which produced the best resultant enhanced images. In the image segmentation stage mechanism used is Fuzzy C Means Segmentation. Finally it relied on texture features which helped for making a comparison between normal and abnormal images. Textures features of MR images have been calculated. The analyses of both the normal and abnormal images are done. The ranges of both the types of images are calculated and then the comparison is performed between them. So, to determine the abnormality in the image, its texture features are compared and the feature lying inside the range is considered as abnormal image.

Keywords — Segmentation, Texture feature, Thresholding

1. INTRODUCTION
This paper is proposed a method to determine the abnormality in the image. Texture features are compared and the feature lying inside the range is considered as abnormal image. There are three major steps is to be followed.

- Convert the brain medical images into a form of data using MATLAB.
- Process the brain medical MRI images using different methods.
- Deal with the same size of the brain medical images. Distinguish between normal and abnormal of the brain medical images

Image segmentation is important for classification and analysis. Manual brain segmentation probably is more accurate than fully automated segmentation ever likely to achieve. However, the major drawbacks of manual image segmentation are time consuming and subjectivity of human segmentation. Therefore, it is significant to develop a reliable automated segmentation to overcome the drawbacks of manual segmentation. The challenges for automatic segmentation of the CT head images have given rise to many different approaches. The techniques of segmentation developed so far include statistical pattern recognition techniques[1] morphological processing with thresholding [6], clustering algorithm [9] and active contour [11].

2. IMAGE PROCESSING
Medical image processing is concerned with developing methods for the reconstruction, enhancement, and analysis of the resulting images. It focuses on facilitating the extraction of the clinically relevant information about the morphology, physiology and function from the images. MATLAB supports many filters for altering images in various ways. Image enhancement techniques can be divided into two broad categories:

1. Spatial domain techniques, which operate directly on pixels.
2. Frequency domain techniques, which operate on the Fourier transform of an image.

3. GABOR FILTER ENHANCEMENT TECHNIQUE

Gabor filters [4, 5] have the ability to perform multi-resolution decomposition due to its localization both in spatial and spatial frequency domain. Texture segmentation requires simultaneous measurements in both the spatial and the spatial-frequency domains. Filters with smaller bandwidths in the spatial-frequency domain are more desirable because they allow us to make finer distinctions among different textures. On the other hand, accurate localization of texture boundaries requires filters that are localized in the spatial domain. However, normally the effective width of a filter in the spatial domain and its bandwidth in the spatial-frequency domain are inversely related according the uncertainty principle. That is why Gabor filters are well suited for this kind of problem. A Gabor function [5] in the spatial domain is a sinusoidal modulated Gaussian

3.1 Gabor Filter

\[ h(x, y) = s(x, y)g(x, y) \]

\[ s(x, y) : \text{Complex sinusoid} \]

\[ g(x, y) : 2-D \text{ Gaussian shaped function, known as envelope} \]

\[ s(x, y) = e^{-j2\pi(u_0x + v_0y)} \]

\[ g(x, y) = \frac{1}{\sqrt{2\pi\sigma}} e^{-\frac{1}{2} \left( \frac{x^2}{\sigma_x^2} + \frac{y^2}{\sigma_y^2} \right)} \cos \left( 2\pi f' x' \right) \]

\[ x' = x \sin \theta + y \cos \theta \]

\[ y' = x \cos \theta - y \sin \theta \]

Where \( f \) is the frequency of the sinusoidal plane wave at an angle \( \theta \) with the x-axis, and \( \sigma_x \) and \( \sigma_y \) are the standard deviations of the Gaussian envelope along the x and y axes, respectively.

Fig 1: Gabor Filter in the Spatial Domain

Fig 2: Gabor Filter in the Frequency Domain

Fig 3: Original Image

Fig 4: Enhanced by Gabor

4. SEGMENTATION METHOD

Here Fuzzy C-means clustering segmentation method is used for image segmentation. Fuzzy C-means clustering (FCM), also known as ISODATA, is a data clustering scheme in which every data point belongs to a cluster to a degree specified by a membership value. FCM is used in many applications like pattern identification classification image segmentation FCM divides a collection of n vectors c fuzzy groups and finds a cluster centre in each group such that a cost function of dissimilarity measure is minimized. FCM uses fuzzy partitioning such a way that given data point can belong
to numerous groups with the degree of belongingness specified by membership values between 0 and 1. The Fuzzy c-mean (FCM) approach is able to make unsupervised classification of data in a number of clusters, by identifying different tissues in an image without the use of an explicit threshold. The FCM algorithm performs a classification of image data by computing a measure of membership, called fuzzy membership, at each pixel for a specified number of classes. The fuzzy membership function, constrained to be between zero and one, reflects the level of similarity between the image pixel at that location and the prototypical data value or centroid of its class. Thus, a membership value near unity means that the image pixel is close to the centroid for that particular class. FCM is formulated as the minimization of the following objective function with respect to the membership function $u$ and centroids $v$:

$$J_{FCM} = \sum_{j \in \Omega} \sum_{k=1}^{C} u_{jk}^q ||\mathbf{v}_j - \mathbf{v}_k||^2$$

where $W$ represents the pixel location in image domain, $q$ is a parameter greater that one which determines the amount of fuzziness of the classification (typically $q=2$ is used), $u_{jk}$ is the membership value at location $j$ for class $k$, $\mathbf{v}_j$ is the intensity value at $j$-th location, $\mathbf{v}_k$ is the centroid of the class $k$, and $C$ is the number of classes. When the above objective function is minimized, the value of $u_{jk}$ approaches one only if the pixel intensity at $j$-th location is close to the centroids of class $k$.

Similarly, the value of $u_{jk}$ approaches zero only if the pixel intensity at $j$-th location is far from the centroids of class $k$. Also, the pixels with the same intensity value are grouped into the same groups with the same probability. The minimization of $J_{FCM}$ is based on suitably selecting $u$ and $v$ by using an iterative process through the following equations:

$$u_{jk} = \left( \sum_{l \in \Omega} \left( \frac{||\mathbf{v}_j - \mathbf{v}_l||^2}{||\mathbf{v}_j - \mathbf{v}_k||^2} \right)^{2q-1} \right)^{-1}$$

The algorithm stops when the value of $u_{jk}$ converges. The results of the algorithm are the intensity values that characterize the tissue classes ($\mathbf{v}_k$), and the $u_k$ masks that describe the distribution of the classified tissues along the processed image.

The main objective of a clustering analysis is to divide a given set of data or objects into a cluster, which represents subsets or a group. The partition should have two qualities:

1. Homogeneity inside clusters: the data, which belongs to one cluster, should be as similar as possible.
2. Heterogeneity between the clusters: the data, which belongs to different clusters, should be as different as possible.

### 5. Texture Analysis

A wide variety of techniques for describing image texture have been proposed. Four major categories for analysis techniques statistical, geometrical, model-based and signal processing.

#### 6. Feature Extraction

In pattern recognition and in image processing, feature extraction[7] is a special form of dimensionality reduction. When the input data to an algorithm is too large to be processed and it is suspected to be notoriously redundant (much data, but not much information) then the input data will be transformed into a reduced representation set of features (also named features vector). Transforming the input data into the set of features is called features extraction. If the features extracted are carefully chosen it is expected that the features set will extract the relevant information from the input data in order to perform the desired task using this reduced representation instead of the full size input.

#### 7. Analysing the Texture of an Image

Texture analysis refers to the characterization of regions in an image by their texture content. Texture analysis[8] attempts to quantify intuitive qualities described by terms such as rough,
smooth, silky, or bumpy as a function of the spatial variation in pixel intensities. In this sense, the roughness or bumpiness refers to variations in the intensity values, or gray levels [9]. Texture analysis is used in a variety of applications, including remote sensing, automated inspection, and medical image processing. Texture analysis can be used to find the texture boundaries, called texture segmentation. Texture analysis can be helpful when objects in an image are more characterized by their texture than by intensity, and traditional thresholding techniques cannot be used effectively.

8. CONCLUSIONS

From this paper it is observed that the performance of the two-dimensional C mean algorithm has a better segmentation approach than the one dimensional algorithm. To determine the whether the abnormality is there or not in the image, its texture features are observed.

To obtain more accurate results we divided our work into three stages:

1. Image Enhancement stage: to make the image better and to enhance it from noising, corruption or interference gabor enhancement technique are used.
2. Image Segmentation stage: to divide and segment the enhanced image ostu segmentation are used.
3. Features Extraction stage: to obtain the general features in the enhanced segmented image glcm matrix are used.

REFERENCES


AUTHOR PROFILE

MAYANKA PETERS
is pursuing M.Tech.in Digital Communication (4th sem). His current area of research includes Image Processing, Digital Communication, and Microcontroller & Embedded System.
ANKITA PANDEY

is an assistant professor in the department of Electronic & Communication Engineering at Acropolis institute of technology, Bhopal. Her current area of research includes Nano Technology, Image Processing, and Digital Communication.