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A Survey on Extraction of Brain Tumor using Image Processing Techniques

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Abstract

Image processing techniques are allowing earlier detection of abnormalities and treatment monitoring, because the time is a very important factor in tumor treatment. Image processing techniques are used for the easy detection of Brain tumor. Brain tumor analysis is made by doctor but its grading gives different conclusions which may vary from one doctor to another. Different types of methods like CT scan, x-ray and MRI can be used. Out of all the available methods, MRI is the most dependable and harmless method that can be used. MRI can be then processed and segmented for detection of tumor. This process includes various techniques which can be put upon. This research considers the use of several techniques proposed by professionals and reappraisal on these methods.

Keywords: *Filtering techniques, image processing, segmentation, tumor detection*

INTRODUCTION

Brain tumor is the abnormal grown inside the human brain. They are classified into two types, benign and malignant. Benign are considered non-cancerous, but can be extremely dangerous if present in a vital area. Malignant brain tumor are often termed cancerous but they cannot be put under that category that cause and they don't spread to other part of the human body.

MRI is one of the most preferred methods for detection a brain tumor as it is completely safe for the human body. A MRI uses magnetic radiations which have limitations of being unable to be used when a patient has anything metallic in their body. Other that limitation it is the safest and most preferred method as it is safe, as it doesn't use any radiation unlike a CT scan. Even after the MRI is done, the accuracy of detection depends highly upon the medical consultant. It is for this reason image processing methods are used to enhance the image and make the process of detection easier and accurate. From the MRI obtained the exact size, location of the tumor has to be found out. By using various segmentation and noise removal techniques the image is enhanced and the tumor can be easily and accurately located.

LITERATURE SURVEY

The first step is to convert the image into a greyscale image. Greyscale image is one in which the value of each pixel is a single sample representing only an amount of light, that is, it carries only intensity information. Greyscale images contain shades of grey where every pixel represents the intensity value at that pixel without showing any color. However, the intensity value at a pixel in a greyscale image is not absolute and can be in fractions. Converting an image into a greyscale image is important to acquire accurate color information which is necessary during segmentation. The resultant image is then filtered to remove excess noise. Noise in an image is random variation of brightness or color information, and is usually an aspect of electronic noise. These noises can be removed using filters. There are two kinds of filters: One that passes low end frequencies and the other that passes high end frequencies. A filter either flattens the image or sharpens the image. If a filter is used to flatten the image, then the noise is blurred resulting in a smoothened image. But if it is used to sharpen the image, then it enhances the finer details of the image. This increases the amount of noise and hence should be removed before processing to avoid from inaccurate results.

The first step in preprocessing includes filtering:
Median filter is mostly used since it retains the edges of the image and removed the noise. It also has applications in signal processing. The main idea is to run the pattern of neighbors called the "window", which slides, entry by entry, over the entire signal. For one dimension signals, the window that is most obvious is just the first few preceding and following entries. Note that if the window has an odd number of entries, then the median is simple to define: it is just the middle value after all the entries in the window are sorted numerically. If there are even number of entries, there is possibility of being more than one median. This filter is very effective for removing salt and pepper noise and poisson’s noise.

Dr. M. Karnan[1], A.Lakshmi [2] and Dr. A. S. Bhalchandra [3] all chose for using a median filter to remove noise. M. Usman Akra also used this technique to reduce noise [4].

Ming-Ni Wu [5] proposed a method using pseudo color translation. Here it transforms the greyscale image using red, green or blue. Pseudo-color processing is a technique that maps each of the grey levels of a black and white image into an assigned color. Various color maps can give contrast enhancement effects, contouring effects, or grey level mapping (depicting areas of a given grey level).Examples of pseudo color images are thermal imaging. It should be used when only a single channel of data is available.

R. B. Dubey [6] used a Gaussian Filter to remove noise from the input MRI image. It is used mainly in graphics software to reduce image noise by low pass filter. This filter results in smooth image. Since the noise present in an image is in high frequencies, a Gaussian filter, being a low pass filter, can be used.

M.H.O. Rashid [7] used anisotropic filtering to remove noise in digital images. Each of the resulting images in this family are given as a convolution between the image and a 2D isotropic Gaussian filter, where the width of the filter increases with the parameter. This is ideal for removing noise but also indiscriminately blurs edges too.

THRESHOLD
The simplest method of image segmentation is called the thresholding method. This method is based on a clip-level (or a threshold value) to turn a gray-scale image into a binary image.
The key of this method is to select the threshold value (or values when multiple-levels are selected). Several popular methods are used in industry including the maximum entropy method, balanced histogram thresholding, Otsu's method (maximum variance), and k-means clustering.

Recently, methods have been developed for thresholding computed tomography (CT) images. The key idea is that, unlike Otsu's method, the thresholds are derived from the radiographs instead of the (reconstructed) image. New methods suggested the usage of multi-dimensional fuzzy rule-based non-linear thresholds. In these works decision over each pixel's membership to a segment is based on multi-dimensional rules derived from fuzzy logic and evolutionary algorithms based on image lighting environment and application.

WATERSHED TRANSFORMATION

In the study of image processing, a watershed is a transformation defined on a grayscale image. The name refers metaphorically to a geological watershed, or drainage divide, which separates adjacent drainage basins. The watershed transformation treats the image it operates upon like a topographic map, with the brightness of each point representing its height, and finds the lines that run along the tops of ridges.

There are different technical definitions of a watershed. In graphs, watershed lines may be defined on the nodes, on the edges, or hybrid lines on both nodes and edges. Watersheds may also be defined in the continuous domain. There are also many different algorithms to compute watersheds. Watershed algorithm is used in image processing primarily for segmentation purposes.

Considers the gradient magnitude of an image as a topographic surface. Pixels having the highest gradient magnitude intensities (GMIs) correspond to watershed lines, which represent the region boundaries. Water placed on any pixel enclosed by a common watershed line flows downhill to a common local intensity minimum (LIM). Pixels draining to a common minimum form a catch basin, which represents a segment.

CLUSTERING TECHNIQUES

They are often used to segment images. A cluster is a set of pixels that share some similar characteristics. It involves classifying objects on the basis of their similarity to each other. Clustering techniques can be further divided into 2 types. Hard type clustering techniques state that an object can only belong to one cluster only. This results in very definitive segmentation. However, if the image has low resolution and contrast then this technique becomes very hard. An example of hard clustering algorithm is the K-Means Clustering Algorithm. The aim of the K-Means algorithm is to segment the image into n partitions with each object belonging to the cluster with the nearest mean. Here each point can belong to only one cluster. This technique was used by A.Lakshmi [J. selvakumar, A.Lakshmi and T.Arivoli, "Brain Tumor Segmentation and Its area calculation in brain MR Images using K-Mean Clustering and Fuzzy C-Mean Algorithm" 2012 IEEE-International Conference On Advances In Engineering, Science And Management (ICAESM - 2012) March 30, 31, 2012], [3]and in the research of Ming-Ni Wu, M.-N. Wu, C.-C. Lin, and C.-C. Chang, "Brain Tumor Detection Using Color-Based K-Means Clustering Segmentation," Third International Conference on Intelligent Information Hiding and Multimedia Signal Processing (IIH-MSP 2007), 2007] [5]. Another type of clustering technique is the soft clustering technique. An example of this is the Fuzzy C-Means Algorithm. Here, unlike K means algorithm, we assume that each object has the probability of belonging to each cluster rather than just a single cluster. It further assumes that an object may belong partially to more than one cluster. This method is very commonly used in the field of image segmentation.

EXTRACTION

After preprocessing and segmentation, the next important technique is the post processing or the extraction. It compromises of steps to detect the tumor and also optimization techniques to enhance it.

The use of particle swarm optimization was a technique devised by Dr M karnan [1] which is similar to a generic algorithm, but uses meta-heuristic technique without any need for assumptions. It creates a sample population and searches for optimum solution.

Another technique used by A. Lakshmi [2] uses the principle sharp change in the contrast of the image at the boundaries of the objects. These edges are the point where the changes are considered. When there are sharp changes in the edges a Gaussian filter is used to smooth them and hysteresis is used on the edges.

Sneha Khare [9] opposed a process using a support vector machine with curve fitting for classification. Support Vector Machines are earning models with learning algorithms. It is more accurate than other methods as the date is pre define in the initial stages only. Ehab F. Badran [10] had a proposal of using to use LOG-Lindeberg algorithm for further optimization.

LOG-Lindeberg algorithm [6] uses morphological operations like binary dilation and binary erosion for optimization of the MRI.

Chia-Chen Lin [4] and Deepthi Murthy [6] proposed of using Histogram Equalization. This contrast adjustment technique is very useful with images whose foreground and background are both dark.

Whereas, Ehab F. Badran [10] used neural networks. It is one of the most important models as it uses machine learning that can take input date and make decisions.

COMPARISON

Out of the many different filtering techniques available, the median filter is the most commonly used. This is due to its simplicity and its efficiency in removing salt-and-pepper noise. It works on the principle of convolution. Median filter, unlike a Gaussian filter is a nonlinear filter. The result of this is that it is an edge preserving filter. On the other hand in a Gaussian filter, as it is a low pass filter so the edge information is lost and edges appear blurry and displaced.

However, Gaussian filter is cheap to implement and less complex than the median filter. Gaussian filter is very effective in smoothening Gaussian noise. If edge preservation is the main goal of pre-processing, then Sobel filter is a better option than both median and Gaussian filter.

When it comes to segmentation, thresholding is the easiest to implement and is widely used. This technique works well when the contrast between the background object and the foreground objects is relatively high, so that this difference in dynamic range can be thresholded. As segmentation is the most important process while detecting tumor's from an MRI Image, the following table describes the typical usage and susceptibility factors for the various segmentation methods [11]. However, as thresholding is solely based on the contrast of the image, this is not very useful as it does not extract much information from the input MRI. Due to its simple nature, it is ideal for use in the initial stages of processing.

Another common segmentation technique is watershed segmentation. Unlike thresholding, this is a slow and demanding calculation. The success of the segmentation is dependent on the selection of the seed region. Also unlike thresholding, which is hardly effected by the presence of noise, water shed segmentation isn't. However, noise may lead to holes in the segmented image. Another common technique is Fuzzy C Means Clustering and Fuzzy K means.

Both of these make use of fuzzy logic and are unsupervised techniques and involves the generation of clusters. However this determination of fuzzy membership is a difficult task and hence makes it more CPU and memory intensive then Watershed segmentation and thresholding. Also, these pixel-based segmentation techniques are highly susceptible to noise and hence proper preprocessing must be done [11].

Comparison of segmentation techniques can also be made on the basis of human interaction involved. In this case, segmentation can be classified as manual segmentation, semi auto and fully automated [11]. When dealing with digital images we hardly use Manual or the Semi Auto techniques as the results will be poor and redundant to errors. Also, using manual segmentation techniques for computerized image processing renders its whole purpose.

CONCLUSION

This study surveys the various techniques that are part of Medical Image Processing and are prominently used in discovering brain tumors from MRI Images. At first the various methods, which are being currently used in medical image processing were extensively studied. This involved studying the available research. Based on that research this study was written listing the various techniques in use. A brief description of each technique is also provided. Also of all the various steps involved in the process of detecting tumors.

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