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Recognition of Anomalous Object Using Gradient based Multilevel Thresholding

Ayyappan.V
Lecturer/ Department of ECE
JP College of Engineering,
Ayikudi, Tirunelveli District.

Kannabiran.A
Assistant Professor/ Department of EEE
Sastra University, Kumbakonam
TamilNadu

***Abstract*-- -Analyzing the abnormal region in various medical images is the critical issues because these images contain different types attenuation artifacts. This paper proposes recognition of anomalous object using gradient based multilevel threshold is to change the representation of an image into something that is more meaningful and easier to analyze. There are several methods that intend to perform identification, but it is difficult to adapt easily and identify the object accurately. To resolve this problem, this paper aims to presents an adaptable thresholding technique that can be applied to any type of medical images. In this approach, structures in the image are assigned a label by comparing their graylevel value to one or more intensity thresholds. the gradient of a scalar field is a vector field that points in the direction of the greatest rate of increase of the scalar field, and whose magnitude is that rate of increase. A threshold that is calculated at each pixel characterizes this class of algorithms. The value of the threshold depends upon some local statistics like range, variance, and surface fitting parameters or their logical combinations. The image gradient magnitude is obtained and threshold surface is constructed by interpolation with potential surface function.**

***Index terms* -Adaptive, Analysis, MedicalImage, Gradient, Thresholding, Histogram**

I. INTRODUCTION

Medical imaging is often perceived to designate the set of techniques that noninvasively produce images of the internal aspect of the body. In this restricted sense, medical imaging can be seen as the solution of mathematical inverse problems. This means that cause is inferred from effect. In the case of ultrasonography the probe consists of ultrasonic pressure waves and echoes inside the tissue show the internal structure. In the case of projection radiography, the probe is X-ray radiation which is absorbed at different rates in different tissue types such as bone, muscle and fat. The influence and impact of digital images on modern society is tremendous, and image processing is now a critical component in science and technology. The rapid progress in computerized medical image reconstruction, and the associated developments in analysis methods and computer-aided diagnosis, has propelled medical imaging into one of the most important sub-fields in scientific imaging thresholding.

Medical image processing has experienced dramatic expansion, and has been an interdisciplinary research field attracting expertise from applied mathematics, computer sciences, engineering, statistics, physics, biology and medicine. Computer-aided diagnostic processing has already become an important part of clinical routine. Accompanied by a rush of new development of high technology and use of various imaging modalities, more challenges arise; for example, how to process and analyze a significant volume of images so that high quality information can be produced for disease diagnoses and treatment.Medical imaging is the technique and process used to create images of the human body for clinical purposes or medical science . Although imaging of removed organs and tissues can be performed for medical reasons, such procedures are not usually referred to as medical imaging, but rather are a part of pathology. As a discipline and in its widest sense, it is part of biological imaging and incorporates radiology, nuclear medicine, investigative radiological sciences, endoscopy, thermographs, medical photography and microscopy. Measurement and recording techniques which are not primarily designed to produce images, such as electroencephalography, magneto encephalography, electrocardiography and others, but which produce data susceptible to be represented as maps can be seen as forms of medical imaging.

II. ANALYSIS OF BIOMEDICAL IMAGE

Biomedical medical imaging is a routine and essential part of medicine. Pathologies can be observed directly rather than inferred from symptoms. For example, a physician can non-invasively monitor the healing of damaged tissue or the growth of a brain tumor, and determine an appropriate medical response. Medical imaging techniques can also be used when planning or even while forming surgery. For example, a neurosurgeon can determine the “best” path in which to insert a needle, and then verify in real time its position as it is being inserted.

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A. Anomalous object

A lesion is an abnormal growth of tissue projecting from a mucous membrane. E.g. Polyps,ulcers,etc., Polyps are commonly found in the colon, stomach, nose, sinus, urinary bladder and uterus. They may also occur elsewhere in the body where mucous membranes exist like the cervix and small intestine .An ulcer is a sore on the skin or a mucous membrane, accompanied by the disintegration of tissue. Ulcers can result in complete loss of the epidermis and often portions of the dermis and even subcutaneous fat. Ulcers are most common on the skin of the lower extremities and in the gastrointestinal tract. An ulcer that appears on the skin is often visible as an inflamed tissue with an area of reddened skin. A skin ulcer is often visible in the event of exposure to heat or cold, irritation, or a problem with blood circulation. They can also be caused due to a lack of mobility, which causes prolonged pressure on the tissues. This stress in the blood circulation is transformed to a skin ulcer, commonly known as bedsores ulcers. Ulcers often become infected, and pus forms.

Skin ulcers appear as open craters, often round, with layers of skin that have eroded. The skin around the ulcer may be red, swollen, and tender. Patients may feel pain on the skin around the ulcer, and fluid may ooze from the ulcer. In some cases, ulcers can bleed and, rarely, patients experience fever. Ulcers sometimes seem not to heal; healing, if it does occur, tends to be slow. Ulcers that heal within 12 weeks are usually classified as acute, and longer-lasting ones as chronic.

B. Gradient

Gradient is a directional change in the intensity or color in an image. Image gradients may be used to extract information from images. In graphics software for digital image editing, the term gradient is used for a gradual blend of color which can be considered as an even gradation from low to high values, as used from white to black in the images to the right. Mathematically, the gradient of a two-variable function is at each image point a 2D vector with the components given by the derivatives in the horizontal and vertical directions. At each image point, the gradient vector points in the direction of largest possible intensity increase, and the length of the gradient vector corresponds to the rate of change in that direction.

Since the intensity function of a digital image is only known at discrete points, derivatives of this function cannot be defined unless we assume that there is an underlying continuous intensity function which has been sampled at the image points. With some additional assumptions, the derivative of the continuous intensity function can be computed as a function on the sampled intensity function, i.e., the digital image. It turns out that the derivatives at any particular point are functions of the intensity values at virtually all image points. However, approximations of these derivative functions can be defined at lesser or larger degrees of accuracy.

$$x(k) = x(k-1) - tk\nabla f(x(k-1)),\ k = 1, 2, . .$$

IV. MULTILEVEL ADAPTIVE THRESHOLDING

In Multilevel adaptive thresholding process, separating an image into different regions based upon its gray level distribution. Key to the selection of a threshold value is an image's histogram, which defines the gray level distribution of its pixels. The bimodal nature of this histogram is typical of images containing two predominant regions of two different gray levels as objects and background. When dealing with digital pictures, most images are having continuous intensity variation and if only a single threshold level is used then many important regions are lost. It becomes difficult to identify significant regions of such images having multimodal histogram. A better method of Thresholding the gray level image is thus to use multilevel Thresholding instead of bi level thresholding. This is the approach that is taken in the implementation of optimal thresholding.

A. Adaptive Threshold Selection

Thresholding is called adaptive thresholding when a different threshold is used for different regions in the image. This may also be known as local or dynamic thresholding In thresholding process, individual pixels in an image are marked as "object" pixels if their value is greater than some threshold value and as "background" pixels otherwise. This convention is known as threshold above. Variants include threshold below, which is opposite of threshold above; threshold inside, where a pixel is labeled "object" if its value is between two thresholds; and threshold outside, which is the opposite of threshold inside Typically, an object pixel is given a value of "1" while a background pixel is given a value of "0." Finally, a binary image is created by coloring each pixel white or black, depending on a pixel's labels.

Thresholding process is the choice of the threshold value. Several different methods for choosing a threshold exist; users can manually choose a threshold value, or a thresholding algorithm can compute a value automatically, which is known as automatic thresholding.simple method would be to choose the mean or median value, the rationale being that if the object pixels are brighter than the background, they should also be brighter than the average. In a noiseless image with uniform background and object values, the mean or median will work well as the threshold, however, this will generally not be the case. A more sophisticated approach might be to create a histogram of the image pixel intensities and use the valley point as the threshold. The histogram approach assumes that there is some average values for both the background and object pixels, but that the actual pixel values have some variation around these average values. However, this may be computationally expensive, and image histograms may not have clearly defined valley points, often making the selection of an accurate threshold difficult. In such cases a unimodal threshold selection algorithm may be more

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appropriate. One method that is relatively simple, does not require much specific knowledge of the image, and is robust against image noise, is the following iterative method:

An initial threshold (T) is chosen, this can be done randomly or according to any other method desired.

The image is segmented into object and background pixels as described above, creating two sets:

$$K1 = \{f(m,n):f(m,n)>T\} \text{ (object pixels)}$$

$$K2 = \{f(m,n):f(m,n)\leq T\}$$

The average of each set is computed.

m_1 , m_2= average value of k1and k2.

A new threshold is created that is the average of m_1 and m_2

$$T' = (m_1 + m_2)/2$$

Go back to step two, now using the new threshold computed in step four, keep repeating until the new threshold matches the one before.

Finally, the image is analysed by using adaptive threshold method which is given by

$$Y_n = \sum_{j=0}^{N-1} x_j u_{n-j}$$

Fig 1.Proposed Method- Multilevel Thresholding

B.Histogram Analysis

Histogram is a graphical representation showing a visual impression of the distribution of data.. The total area of the histogram is equal to the number of data. A histogram may also be normalized displaying relative frequencies. It then shows the proportion of cases that fall into each of several categories, with the total area equaling 1. The categories are usually specified as consecutive, non-overlapping intervals of a variable. The categories must be adjacent, and often are chosen to be of the same size. The rectangles of a histogram are drawn so that they touch each other to indicate that the original variable is continuous.

Histograms are used to plot density of data, and often for density estimation: estimating the probability density function of the underlying variable. The total area of a histogram used for probability density is always normalized to 1. If the length of the intervals on the *x*-axis is all 1, then a histogram is identical to a relative frequency plot.

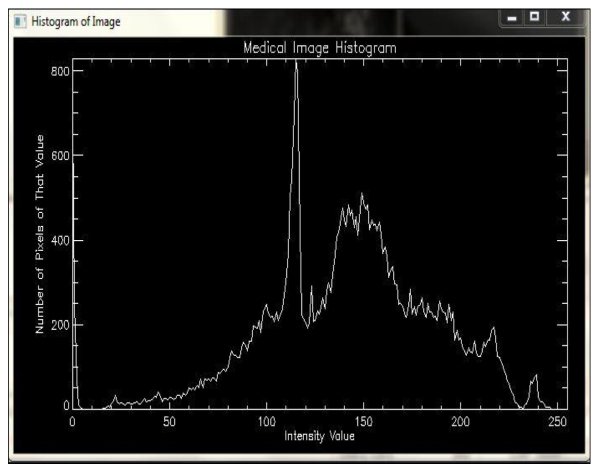

Fig 2. Histogram Analysis

Histogram is a function m_i that counts the number of observations that fall into each of the disjoint categories (known as *bins*), whereas the graph of a histogram is merely one way to represent a histogram. Thus, if we let n be the total number of observations and k be the total number of bins, the histogram m_i meets the following conditions:

$$n = \sum_{i=1}^{k} m_i.$$

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III. EXPERIMENTAL RESULTS

Our algorithm has been tested for a variety of images. The result shows that our methodology is adaptable to identify lesion structure in various medical images.

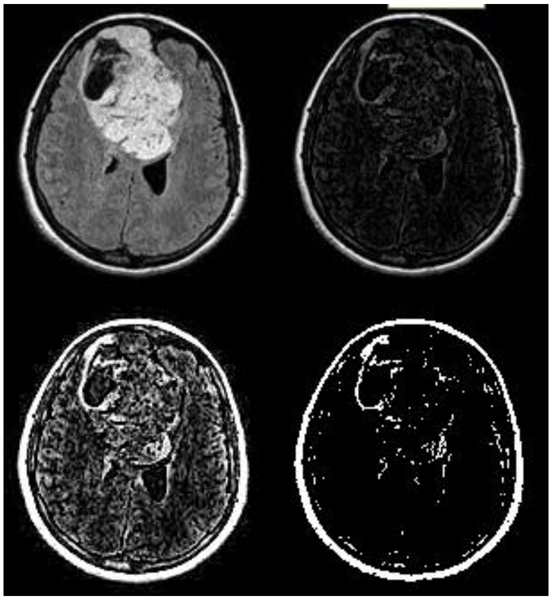

Fig 3. Object identification

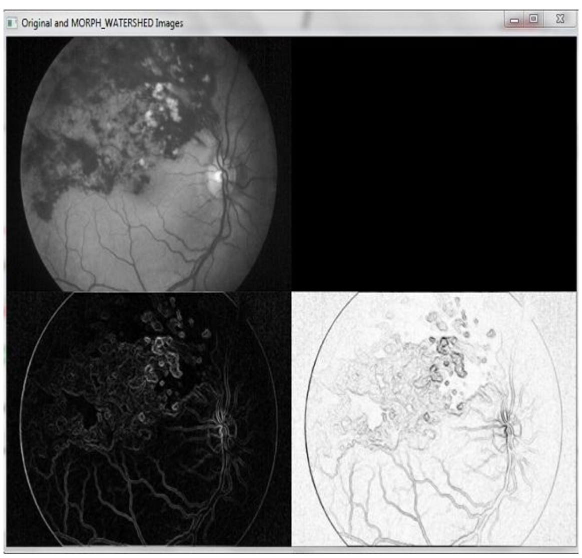

Fig 4. Minute Nerves identification

V. CONCLUSION

This paper proposes an analysis of medical image by using gradient based multilevel thresholding method. Our algorithm is easily adaptable to identify all types of lesion structure in various medical images. Therefore, we conclude that the proposed method identifies the abnormal objects clearly and contrast effectively.

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V.Ayyappan received his M.E degree in Communication Systems at Sudharsan Engineering College, Pudukottai Dist (Affiliated to Anna University, Trichy), B.E. degree in Electronics and Communication Engineering from Shanmuganathan Engineering College, Pudukottai dist (Affiliated to Anna University, Chennai) in 2006. He received M.B.A degree at Alagappa University, Karaikudi in 2008. He has experience in both teaching and industry. Presently, he is presently working as Lecturer in ECE department, JP College of Engineering, Ayikudi. His current research interests include Medical image processing.

A. Kannabhiran his M.E degree in Power Electronics and drives from A.C College of Engineering and Technology, Karaikudi in the year of 2007. B.E degree in Electrical and Electronics Engineering from Sree Sowdambika college of Engineering, Viruthunagar in the year of 2005. He has 4 years of teaching experience. Presently working as Assistant professor, EEE department in Sudharsan Engineering College.