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Uterus Tumour Detection Using Level Set Algorithm

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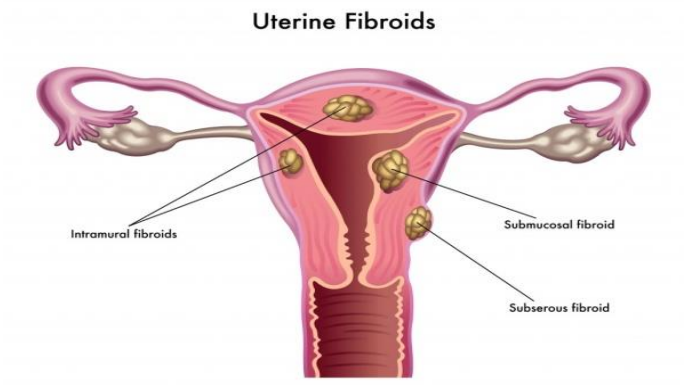
Abstract— Uterus Tumour is one of the most common form of cancer in women. It is very important to detect the tumour at early stage and provide proper treatment for it. This paper deals with the detection and segmentation of uterus tumour. This project is based on digital image processing. We take input as the ultrasonic image to detect the tumours part of uterus. Image processing involves different tasks like image pre-processing, segmentation and classification of input ultrasound image. In pre-processing of input we enhance the image by resizing it and then we adjust the contrast by using histogram equalization. After achieving this we perform segmentation using level set algorithm which is threshold based method. Input image and database feature extraction is done using discrete wavelet transform. At the end we detect the tumour and classify it as benign and malignant depending on the features extracted by using Euclidean distance method.

Keywords— Ultrasound image, Uterus, Tumour, Level set, Euclidean distance.

I. INTRODUCTION

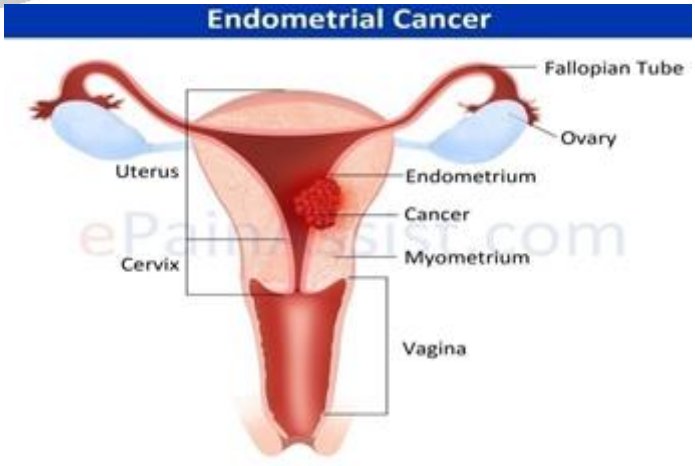
Uterus cancer occurs in 70% of the women in developing world, where very few resources exist for management. Since uterus cancer symptoms can be seen only in advanced stage of the disease, it becomes most deadly cancer in women. So, a solution is needed to overcome the deadly cause of women by detecting uterus cancer at the early stages and cure it. The uterus has three layers: the inner part with lining is endometrium; the middle muscular layer is myometrium; and the outer layer is perimetrium. The uterus is connected to the fallopian tubes, the cervix, and the vagina

The uterus can have two types of disease one is Benign and the other one is Malignant.



Uterine fibroids are benign masses that grow in the uterus for different unknown reasons. The medical term used for a fibroid is leiomyoma, which refers to a abnormal growth of smooth muscle tissue. Uterine fibroids grows from the tissue in the muscle layer of the wall of the uterus, called the myometrium. Fibroids or begins are not usually cancerous.

Sometimes there is abnormal growth of cells in this lining of endometrium. This abnormal growth of extra cells is called endometrial cancer. This cancer most probably occurs in women older than age 50. It causes heavy vaginal bleeding.



This cancer is also known as uterine cancer.

We are going to use level set method for image segmentation process. The level set method may be used as a strongest method for segmentation of a tumour to achieve an accurate

estimation of its volume. The level set method is a numeric technique for tracking interfaces and shapes for segmentation. In this method, equation parameters are being set or speed function is being set. It is threshold based method which is introduced for tumour segmentation. Tumour segmentation and its extraction is achieved by a threshold based scheme and by utilizing a global threshold, the level set speed function is designed. This threshold based scheme provides better flexibility and it is updated through the whole process. Search based and adaptive bases threshold can be used here for better efficiency through segmentation. Tumour segmentation does not need any vast knowledge about the tumour and non-tumour density function. Depending upon the tumour shape and size, it may be implemented in an automatic or semi-automatic form. We see that the performance can be evaluated accurately for quantitatively images. The results from this experiment provide better efficiency and high performance.

II. PAST WORK

Many research papers from reputed national and international journals are surveyed and few are presented here:

Setu Garg et.al,[1] proposed a System in which a cervical cancer is detected using a watershed algorithm. It is practical and efficient method to find cervical cancerous area.

Quanquan Zheng et.al,[2] proposed a method here which use level set to segment and extract calcifications. It is good to segment and extract features from uterus ultrasound images that are a group of database with typical characteristics from Ultrasound Diagnosis Department of Lanzhou local Hospital. It is helpful to make a correct scheme for patients in hospitals.

Carmelo Militello et.al,[3] proposed a method for detecting fibroids from uterus using region growing algorithm. The implemented approach gives the quantitative and qualitative evaluation of the treatment providing the volume and the three-dimensional (3D) model of the treated fibroid area

Abhishek Basak et.al,[4] proposed a concept of a wearable ultrasonic assembly for point-of-care autonomous diagnostics of malignant growth. They have shown that the proposed POC diagnostic system can reliably detect an anomaly at a much smaller size (mostly stage 1) than typically achieved through conventional symptomatic detection.

J. Saranya et.al, [5] proposed a system in which instead of doing the segmentation manually, this work proposes a new method for segmenting the fibroid in the uterus. The performance of this method is also commendable.

III. PRESENT SYSTEM

Present system consists of:

MATLAB 2009a: To create GUI, to run matlab code for different tasks like feature extraction, segmentation etc. , to create database.

Image

The input image is ultrasound image of uterus. The format of image is jpeg.

Pre-processing

In this block we are going to perform different enhancement methods to improve the quality of image. Different methods are histogram equalization, median filtering and resizing.

In resizing we are going to convert image in 200x200 pixel size. In histogram equalization contrast of image is adjusted to improve quality of image. We are using median filter to remove impulse noise and to smooth the image.

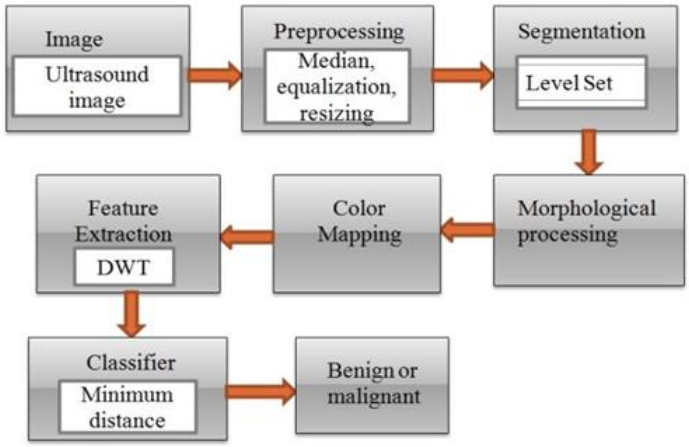


Fig.1 System Block Diagram

Level set

Level set is nothing but segmentation of an image. This method is based on thresholding segmentation. In this we are going set a seed pixel in expected tumours area. We are going to set threshold level for comparison purpose. We are going to use systematic approach for segmentation. We are going to set direction for spreading or detecting nearby area of seed pixel. If threshold of the pixel is below threshold then we will assign zero to the pixel and we will move forward and if pixel is above threshold level then we will assign one to the pixel and we will include it in seed pixel area.

Morphological Processing

The output of Level set is binary image which has two grey levels. But due to thresholding ,black portion contains white bolbs and white contains black bolbs. This is nothing but a noise. This noise is removed by morphological processing. The removal of such noise is done by closing operation. Closing is an important method from the field of mathematical morphology processing. Closing operation enlarges the boundaries of foreground which is similar to dilation operation i.e bright regions in an image and shrink background color holes in such regions, but it is

comparatively less destructive than other processes, in this the original boundary shape is almost retained. The exact operation is determined by a structuring element which is defined by programmer . It is defined by method of dilation which is followed by an erosion using the same structuring element for both operations.

Color Mapping

In this block we require two inputs of images, one is output of pre-process block and one is from morphological process block. This two images are multiplied in this block so that tumours part comes in white portion of binary image(morphological output) and other part of image remains black.

Feature Extraction

In this block the texture and size of tumour is extracted using discrete wavelet transform(DWT).DWT is method used for extraction of characteristics from an image on various scales proceeding by successive high pass and low pass filtering is used. The wavelet coefficients are the successive continuation of the approximated and detailed coefficients

The basic feature extraction procedure consists of

1. Decomposing the signal using DWT into N levels using filters and decimation is used to obtain the approximated and detailed coefficients.

2. Then the features from the DWT coefficients are extracted.

The features extracted from the image are

1) Mean

Mean is average of all the coefficients

$$m = \left(\frac{1}{n}\right)\sum_{i=1}^{n} x_i$$

2) Variance

It is distance of each coefficient from mean calculated.

$$v \quad \frac{1}{n-1}\sum_{i=1}^{n}\left(x_i - m\right)^2$$

3) Energy

It is sum of squares of all the coefficients.

$$m_e = \left(\frac{1}{n}\right)\sum_{i=1}^{n} x_i^2$$

4) Homogeneity

Similarities between two variables are found out by using homogeneity.

5) Correlation

Mutual relation between two or more variables is known as correlation.

Classifier

The classifier used is Euclidean classifier. The formula of Euclidean is.

$$d(a, b) = |p - q|$$

$$\sqrt{(p_1 - q_1)^2 + (p_2 - q_2)^2 + \cdots + (p_n - q_n)^2}$$

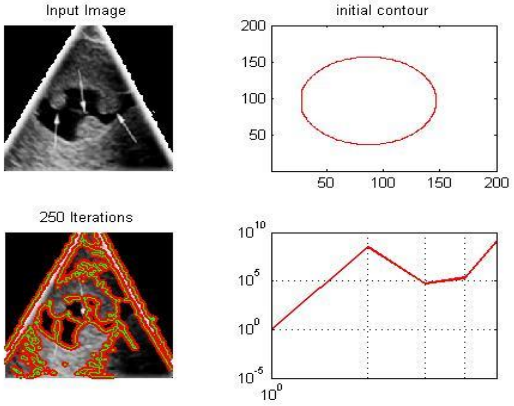
$$= \sqrt{\sum_{i=1}^{n}(p_i - q_i)^2}$$

Where pi are features of input image and qi are features of database.

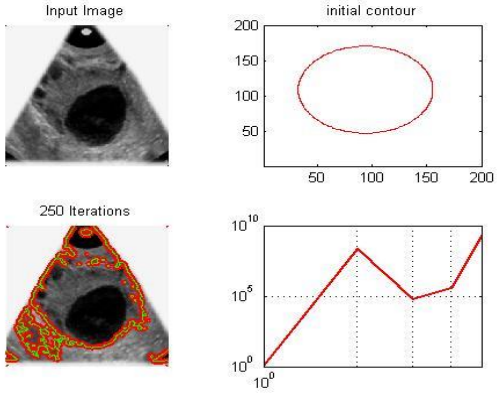
It will compare the output of feature extraction and database to label different feature like cancerous or non-cancerous and different stages tumour.

IV. RESULTS

A] The detected part is malignant



B] The detected part is benign



Above image is the output we get after implementation of the algorithm proposed in the paper. From the four images 1st image is the input ultrasound image given by user and 2nd image shows the counter where seed pixel is decided which is decided by the probability of tumour. The 3rd image is segmented image which shows the tumour part and last image is graph of features extracted.

V. CONCLUSION & DISCUSSIONS

We have proposed a method for detection of masses in ultrasound image by using level set algorithm. The threshold

value used in this method is 0.6 that detects all the malignant and benign parts of uterus in ultrasound images. We have created a database of 85 images in which 30 images are benign , 25 images are malignant and remaining images are normal. The below table shows the test results of the project. Columns shows the outputs of project while rows shows the expected output. By using this results the accuracy calculated is 76%.

	Benign	Malignant	Normal	Total
Benign	25	3	2	30
Malignant	4	18	3	25
Normal	4	4	22	30

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