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Detection of Uterine Cancerusing Computer Aided Diagnosis System

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ABSTRACT

Cancer is a potentially fatal disease caused mainly by environmental factors. Uterine Cancer is the fourth most common cancer among women overall. 19 out of 20 uterine cancers are cancers of the endometrium, the inner lining of the uterus, known as endometrial cancer. The paper gives a detailed study of detection of endometrial cancer using CAD systems& its early diagnosis. The ultrasound image act as an input which is filtered using median filter & then the ROI is segmented using Region Growing Segmentation approach. Then different statistical features are extracted from the ROI which are then used to train the ANN for classification of the Cancer.

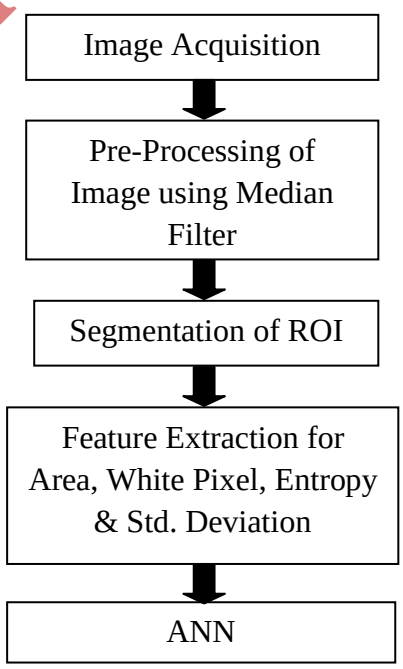
Keywords: Artificial Neural Network., Back Propagation, Benign, CAD, Malignant, Median Filter, Region Growing Algorithm.

1. INTRODUCTION

The CAD system helps the physician as well as the radiologist to identify the suspicious nodules of endometrial cancer and thus increases the sensitivity, specificity, accuracy & efficiency of the diagnosis. The CAD Systems are beneficial to detect cancerous nodules & have a lot to offer to modern medicine. By using a CAD system, a radiologist considers the output from a computer analysis of the interpreted image. CAD systems uses image processing techniques where ultrasound images of the endometrial are given as input & the output from the ANN is the result i.e. Benign or Malignant.

2. METHADOLOGY

The Detailed block schematic of the proposed system is as shown in Fig. 2.1.



2.1 Image Acquisition

Maximum ultrasound images are collected from resources like Internet, Radiologists, Medical Atlases and Hospitals etc. Different Images in the format of JPEG, JPG, PNG, TIFF, GIF etc. are converted into one standard format of unit.8. Uint.8 is a format where the image is converted into integer value sothat further pre-processing can be carried out on it easily.

2.2 Pre-Processing of Image Using Median Filter

Image processing is based on filtering the content of images. Filtering is used to modify an image to remove the noise & different artifacts present in it. Median Filter is a simple and powerful non-linear filter. Median filter is used for reducing the amount of intensity variation between one pixel and the other pixel. Here, we do not replace the pixel value of image with the mean of all neighboring pixel values, we replaces it with the median value.[6]

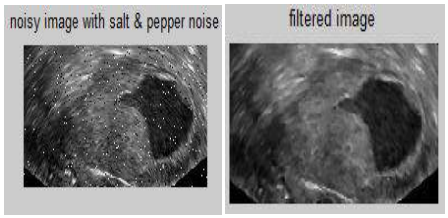


Fig.2.2 : a) Benign Image with Salt & Pepper noise; b) Filtered Benign Image using Median Filter

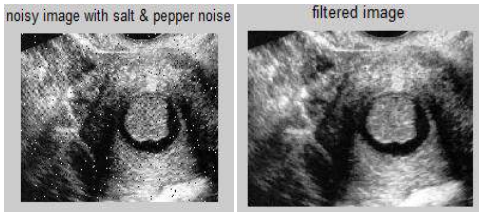


Fig.2.3 : a) Malignant Image with Salt & Pepper noise; b) Filtered Malignant Image using Median Filter

2.3 Segmentation of ROI

The division of an image into meaningful structures is known as Image Segmentation.The system uses Region based segmentation i.e. Region Growing approach. The basic approach to image segmentation using merging includes:

1. Obtain an initial (over)segmentation of the image,
2. Merge those adjacent segments that are similar –in some respect– to form single segments,
3. Go to step 2 until no segments that should be merged remain.

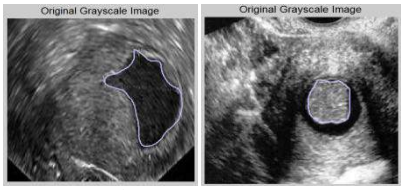


Fig.2.4: a) Selected ROI of Benign Image; b) Selected ROI of Malignant Image

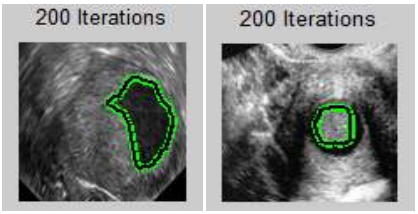


Fig.2.5 : a) Area of Benign Image after 200 iterations; b) Area of Malignant Image after 200 iterations

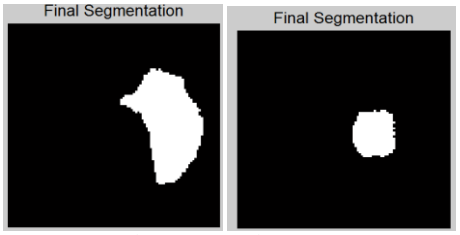


Fig.2.6: a) Final result of segmentation for Benign Image; b) Malignant Image

2.4 Feature Extraction

Feature extraction is used to denote a piece of information which is used for solving the computational task related to certain application.[9]The statistical features that are used in this study are Area, White Pixel Count, Entropy and Standard Deviation.

2.4.1Area: Area is the quantity that expresses the extent of a two-dimensional figure or shape. The segmented image is masked & then area of this ROI is calculated by using the function **"bwarea(seg)"**

The result is then used as an input to the Artificial Neural Network (ANN).

2.4.2 White Pixel Count: White Pixel Count will give the white contents from the selected ROI. Thus, when the ROI from the binary image is selected using a seed then the result is the number of nonzero elements from the Region of Interest.

The function used to calculate this feature is "**nWhite = nnz(BW5)".**

Where,

BW5 = the ROI from the image;

The function NNZ is used since "white" is represented as 1 and "black" as 0 in a binary image.

2.4.3 Entropy*:* Image entropy is a quantity which is used to describe the amount of information which must be coded.

"E = entropy(I)" is the function used to calculate the entropy of an 2D grey scale ultrasound image.

Where,

I= the filtered image whose entropy is to be calculated & the result will be saved in E.

2.4.4 Standard Deviation: Standard deviation is a quantity of expressing by how much the members of a group differ from the mean value. The function used to calculate this feature is

"val = std2(K)" Returns the array val,

Where,

Each output pixel contains the standard deviation around the corresponding pixel in the input image K.

2.5 Artificial Neural Network

The final step of the proposed system is classification. There are a number of classifiers available such as PNN, SVM, Decision making Tree, ANN etc. The proposed work uses ANN classifier to classify the tumor as Malignant or Benign.The system implements feed-forward, back-propagation architecture.

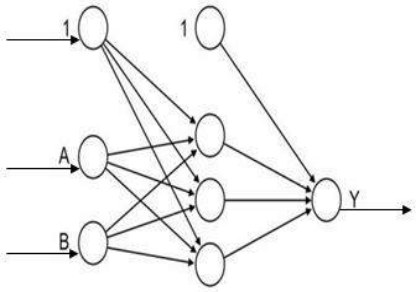


Fig. 2.7: Example of a neural network with two inputneurons (A and B), one output neuron (Y) andone hidden layer consisting of three hidden neurons.

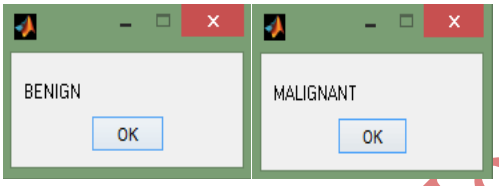


Fig.6.20: a) Final Result for Benign Image; b) Final Result for Malignant Image after ANN training

2.6 Validation Results

Results of Benign &MalignantSamples with 4 features extracted are tabulated below:

Table 2.1: Features extracted from 11 Benign Samples

Benign Samples					
Samples	**Area**	**White pixel count**	**Entropy**	**Std. Deviation**	**Result**
B1	299.25	6224	7.044	57.1738	**TN**
B2	339.75	3394	7.4718	59.7769	**TN**
B3	810	4877	6.6687	53.8096	**TN**
B4	1628.75	17802	7.2056	59.7799	**TN**
B5	1245.875	2542	7.3022	55.757	**TN**
B6	536.375	13264	6.9697	56.7668	**TN**
B7	1383.75	4100	7.5403	63.2643	**TN**
B8	208.125	2626	6.8683	49.5496	**TN**
B9	449.25	8811	7.215	64.0444	**TN**
B10	1962.25	18570	6.8045	71.4256	**FP**
B11	488.25	2062	6.2889	59.6927	**TN**

Table 2.2: Features extracted from 25 Malignant Samples

Malignant Samples					
Samples	**Area**	**White pixel count**	**Entropy**	**Std. Deviation**	**Result**
M1	774.625	5896	6.6452	72.0331	**TP**
M2	195.75	2130	7.16	58.9453	**TP**
M3	99.75	2454	7.1135	73.3521	**TP**
M4	58	364	6.0838	98.6641	**TP**
M5	443.25	9292	6.5875	60.3345	**TP**
M6	272.375	12780	7.2565	51.418	**TP**
M7	442	808	7.5517	66.0741	**TP**
M8	294.25	67	7.9085	72.4538	**TP**
M9	461	20315	7.8369	72.0723	**TP**
M10	98.125	2607	6.6837	56.8241	**TP**
M11	477.25	1390	7.1649	68.6206	**TP**
M12	223.4	2426	6.8159	72.5375	**TP**
M13	116	2258	5.8172	70.087	**TP**
M14	108.625	679	5.9854	94.9243	**TP**
M15	41	4936	6	63.7676	**TP**
M16	416.375	5008	7.0491	64.2064	**FN**
M17	342.625	3385	7.4718	59.7769	**FN**
M18	310.375	611	4.1194	67.8407	**TP**
M19	282.625	184	7.2633	71.2906	**TP**
M20	34.5	644	6.1672	85.3009	**TP**
M21	236.625	51	7.1232	68.5956	**TP**
M22	1140.25	2080	7.2836	58.7513	**TP**
M23	146.25	1191	7.0673	73.4093	**TP**
M24	229.25	1889	6.2958	78.9949	**TP**
M25	822.625	4378	7.4431	59.2278	**TP**

3. COMPARISON OF FEATURES FOR BENIGN & MALIGNANT IMAGES

For 11 Benign & 25 Malignant images, features such as area, white pixel count, and entropy & standard deviation are extracted. These are compared for 5 samples each, as follows:

3.1 Comparison of Feature 'AREA':

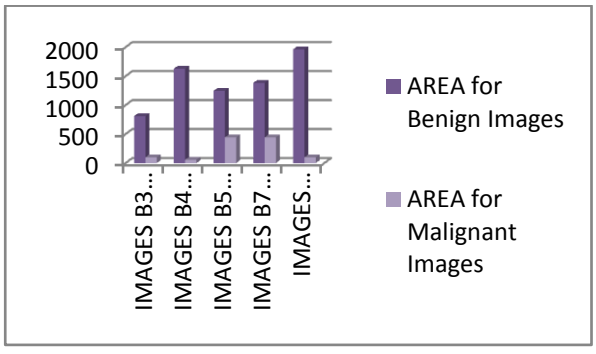


Fig.3.1: Bar chart representation of the feature AREA for 5 sample images each.

3.2 Comparison of Feature 'WHITE PIXEL COUNT':

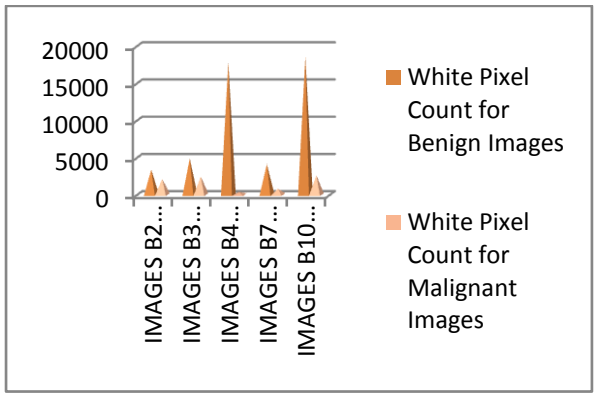


Fig.3.2: Bar chart representation of the feature WHITE PIXEL for 5 sample images each.

3.3 Comparison of Feature 'ENTROPY':

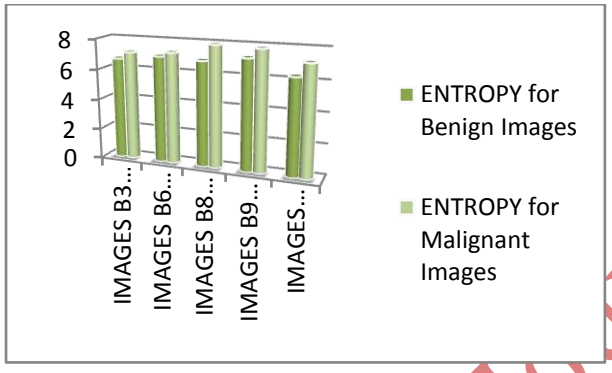


Fig.6.28: Bar chart representation of the feature ENTROPY for 5 sample images each.

3.4 Comparison of Feature 'STANDARD DEVIATION' :

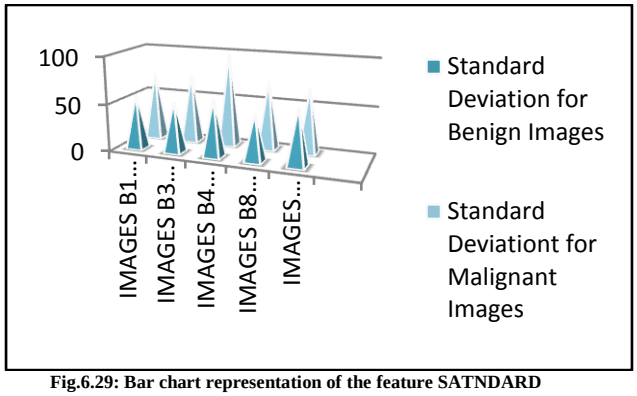


Fig.6.29: Bar chart representation of the feature SATNDARD DEVIATION for 5 sample images each.

4. CONCLUSION

The different Modules of CAD systems use the best algorithms so far to obtain as accurate results as possible. At every iteration more accurate results are obtained. This led the system to provide accuracy of 91.64%.Yet the Accuracy depends upon how accurately the user is going to select the cancerous endometrium i.e. the required Region of Interest (ROI). If the user selects the ROI exactly then the accuracy may increase giving even more accurate results for the Cancer of Endometrial.

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