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NOTTINGHAM GRADING SYSTEM FOR AUTOMATIC MITOSIS DETECTION AND DIAGNOSIS OF BREAST CANCER GRADING

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ABSTRACT

Breast cancer is the second most common cancer in Women. The possibilities of occurring breast cancer is above the age of 40. Breast cancer is a tumor that starts in the cells of the breast region. Pathologist perform these process by grading system in order to find the Mitosis count in Histo-pathological image , but it is a tedious job. So an accurate and high efficient approach by automatic detection of mitosis count in the histo-pathological image is proposed. In this research, it provide high accuracy level of segmenting tumor cell. So the current detection process is done with ANFIS classifier and classification is done with Feature extraction process, but the previously used diagnosis is done with RFC(Random Forest Classifier).ANFIS classifier replace the RFC in order to obtain high specificity and accuracy ,so it is the first step towards diagnosis of breast cancer grading, Which is quit efficient when compared with earlier stage of detection process.

Keywords : Mitosis Diagnosis ,ANFIS Classifier ,Feature Extraction ,Breast Cancer Grading.

INTRODUCTION

Breast cancer is one of the most common Cancers in the World. Women have the major possibility of affecting Breast Cancer. If any lump or change is identified in the breast region then consulting a doctor is necessary. However, treatment can often slow the progress of the cancer. The recent Research given that 48,000 cases occur in the UK each year. Most develop in women over the age of 40 but younger women are sometimes affected. Breast cancer develops from a cancerous cell which develops in the lining of a duct or lobule in one of the breasts. Lymph nodes are small, bean-shaped collections of immune system cells (cells that are important in fighting infections) .The disease occurs almost entirely in women, but men can get it, too. Breast Cancer is curable disease, if it is detected and treated in at early stage.

The main objective is the automatic diagnosis of Mitotic cell in Invasive Breast cancer grading. Internationally recommended system for breast cancer grading by the World Health Organization, is the Nottingham Grading System. Suppose if the cancer cells break off from the original tumor and spread in other parts of the body through the blood. This is called Metastasis. The Cancer cells are identified if there is any lumps or tumors in the breast region which damage the surrounding normal tissues. The Detection and Diagnosis of Mitotic cell is the most common method of recovering Tumor cells. The reason for replication of cells in abnormal manner is due to the mutation in the cell DNAs. Tubule Formation, Nuclear Pleomorphism and Mitotic Count are the major Morphological features

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.The clinical diagnosis ,grading of invasive breast cancer is occurred on the Hematoxylin and Eosin (H&E).The major obstacle in Mitotic process is wide variety of shape configurations, background texture, size, etc,. so the Manual xamination of multiple tumor cells is a tedious job. The variation may include aberrant chromosomal makeup such as(Aneusomy, Polysomy, Translocations, Amplifications ,Deletions).Mitosis cell division phases are: Prophase, Metaphase,Anaphase and Telophase .The major issue of manual mitotic detection is possibility of misclassification of mitotic cells which look similar to Apoptotic cells, Lymphocytes, Junk objects, dense nuclei.In this project a new method for Mitosis Detection and Diagnosis from an Histo-pathological Images is being proposed. However intensity pattern remains similar, although the significant variation differ. If the appearance of mitotic nucleus is more denser than the non-mitotic nucleus then it is consider as the good feature for classification, if and only if the cells are segmented accurately. To improve the efficiency of diagnosis of tumor cells by using a new algorithm which is for segmentation purpose , is Region Growing Algorithm is our main motto . If any Grey level, presented in the image they are operated by morphological scale space operation. Relative-Entropy is used to differentiate the affected cell from the background structure by parameterize only those gray levels, so there is a need for designing a novel Relative-Entropy Maximized Scale Space (REMSS).On the other hand, the Random Forest Classifier (RFC) is used for segmentation of mitotic and non –mitotic cell, which use uses color histogram features for classification purpose to yield more specificity and high accuracy within a short time .finally the remaining part of the paper is about the following: Section II.Related Work And Motivation , Section III. Cell Segmentation Scheme,Section IV. Result,Section V. Conclusion And Future Work, Section VI.References.

II.RELATED WORK AND MOTIVATION

The cell segmentation is entailed with the division or separation of the cell into regions of similar features. The segmentation of cell plays a lead role in the process of Mitotic detection which is used in the proposed method. The definitive aim is to achieve the image processing applications in Breast Cancer Grading is to extract the affected region of tumor cell , from the normal cell in order to obtain the descriptive, interpretative, or understandable prospect of the process. when large scale progonosis of detecting mitosis is consider as a major demerit.in order to reduce the burden of the operator-bias,more time consumption,the automated detection of mitosis is facilitated. the knowledge of cell segmentation of breast cancer grading in histopathological image has been gained by various methods and techniques employed by researchers. The cell segmentation approaches were studied under 2 categories. These are as follows:1) region based cell segmentation 2) boundary based cell segmentation**.**

A) NOTTINGHAM GRADING SYSTEM

Well known method for Breast Cancer Grading is the Nottingham Grading System.[6] which primarily relies on the mitosis count in histopathological slides.Mitotic Counting is consider as the one of the major factors of Nottingham-

International **S**tandard. The rigid factor is accurate Mitotic counting of affected cells and it is time consuming activity which suffers from conflicts such as inter-observation and intra- observations of cells.

B) RELATIVE-ENTROPY PROCESS

REMSS(Relative-Entropy Maximized Scale Space) is constructed in the critical situation such as over Segmentation process.[2] Scale Space does not use the entire spectrum of gray levels, the entire spectrum of gray levels isn't used. Instead they use parameterizing for construction of REMSS occurred in-between the affected cell and background feature.

C) RANDOM FOREST CLASSIFIER

For Multiple Image Classification between the normal cell and affected cell,[4] the widely used classifier is Random Forest Classifier. when

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compared with other image classification methods the major advantages obtained such as: non-parametric, capable of using continuous and categorical data sets, easy to parametrize, not sensitive to over-fitting, good at dealing with outliers of the cell, and it calculates ancillary information such as classification error etc,.

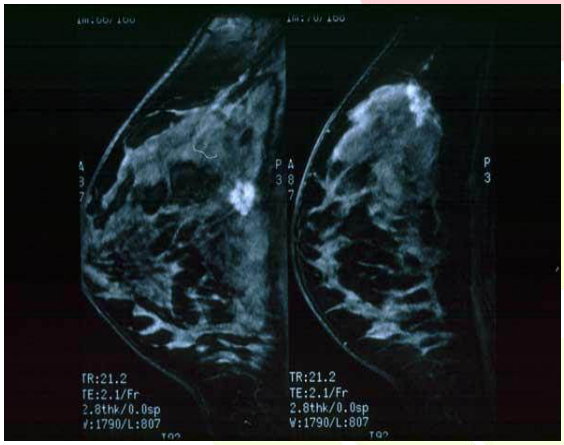

Fig 1.MRI scan of the breast reveals two discrete areas of abnormality, which proved to be cancer.

III.CELL SEGMENTATION SCHEME

The task of Cell Segmentation Scheme of the image is focused on the automatic recognition and separation of each cell for further processing, in order to obtain stable features, useful in recognition of the affected cell .Segmentation of cellular elements ,Identification of nucleus and cytoplasm, and Separation of overlapped blood cells are the three major process involved in it.

A)PRE- PROCESSING

Image resizing is the most important part of pre-processing technique which is used to resize the image,it can be reduced or enlarged. the intensity patterns of mitoic cells differen from non-mitotic cells in different cell division phases which are performed by pathologist.The red channel is denoted as (I_r) which is used in pre-processing and segmentation process.seperation of affected image is done by obtainig information of cell and background that safeguard the edge position.Thus the update control factor (αi) helps in implicit identification of the region and update the intensity accordingly. Finally, the update equation for the gray scale image *Ir* is given by:

$$\Delta \mathrm{Itr}(x,y)/\Delta t = -\lambda \exp\{-\beta t V(Lt(x,y))\}(Itr(x,y) - \mu \mathrm{tL})$$

But Ir should be updated,to obtain the gray scale image I_s with normal cell region and its background region.Finally the ANFIS classifier is used ,which is the combination of Neural Network and FUZZY logic.ANFIS is abbrivated as [ADAPTIVE NEURO FUZZY INFERENCE SYSTEM].The automatic detection and diagnosis of breast cancer grading is done with these effective classifier in the proposed method.

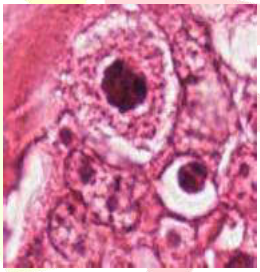

Fig 2.Original Image

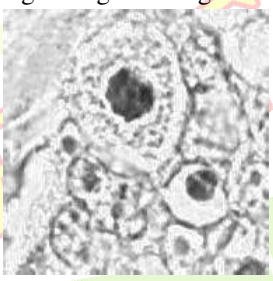

Fig 3.Initial Segmentation

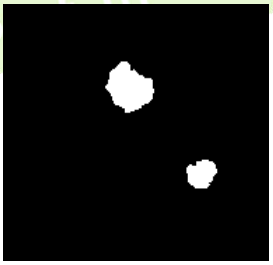

Fig 4.After Segmentation.

B) SEGMENTATION

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Morphological operations are used in solving the segmentation. The morphological operations aim at extracting relevant structures of the cell by probing the cell image with another set of a known shape called structuring element, chosen as the result of prior knowledge concerning the geometry of the relevant and irrelevant cell structures. The most known morphological operations include erosion, dilation, opening and closing [5]. In our experiments,the result is obtained by using relative entropy technique.generally,the RGB image is converted into gray scale image,so let us assume that,If ξ is the maximum value of the gray level present in the image, then the total entropy of *Ir* is given by:

$$H = \sum p(g) \log 1/p(g)$$

Thus, *H* is not a function of *gtr*. Thus a *Relative-Entropy* process is performed between *pa(g)* and *pb(g)* with threshold at gray level *gtr* is defined as:

$$\mathrm{E(gtr)} = \sum_{g=1}^{\xi} \mathrm{p(g)} \log 1/\mathrm{p(g)}$$

Thus, threshold *gtr* which maximizes *Relative-Entropy (E(gtr))*.
So ,the condition is:

$$gb \leq gm < gc.$$

Threshold value *gm* which maximizes the separation between the cell and the background. In this way the tumor cells are partitioned into affected and non-affected regions of mitotic structure.
Our basic process of cell segmentation is done with,transformation of the RGB image into gray scale image.and thus the application of closing and erosion operations to smooth the contours and to eliminate the distortions by using region growing algorithm.

C) FEATURE EXTRACTION

Applying Individual features on affected cell image,feature extraction is processed.Individual features are further classified into 2 category such as:1)GLCM 2)LBP.

GLCM ia abbrivated as GREY LEVEL CO-ACCURANCE MATRIX. This GLCM matrix stores the co occurrence frequencies of the pairs of grey levels which are grouped by a distance and orientation.GLCM is commonly used for analyse the 2D image. measure of contrast was between an intensity of pixel and its neighbouring pixels over the whole ROI[REGION OF INTEREST] is portion of an image that need to seperated, where N is the number of different gray levels.

Contrast= $\sum_{i}^{n}(\mathrm{i}-\mathrm{j})2\mathrm{p}(\mathrm{i},\mathrm{j})$

LBP is abbrivated as LOCAL BINARY PATTERNS is a type of visual descriptor used for classification by binary pattern.The morphological approach to image segmentation combines regions growing and feature extraction .the region based cell image segmentation which is further classified as pixel based image segmentation method is known as REGION GROWTH ALGORITHM.

Dataset	DS1	DS2	DS3	DS4	DS5
TF	96	128	112	64	80
TM	135	264	151	39	25

Table I
Description Of Five Datasets With Total Number of Frames In Each Dataset (TF) And Total Number Of Mitotic Cells (TM)

Dataset	Re	Pr	F1	Er(μm)
DS1	0.65	0.78	0.71	3.8
DS2	0.66	0.81	0.73	3.2
DS3	0.61	0.83	0.70	4.3
DS4	0.75	0.92	0.83	5.1
DS5	0.63	0.79	0.70	4.8
Average	0.66	0.826	0.734	4.24

Table II
Performance Measures Showing Recall(Re),Precision (Pr),F-Measure (F_1),Average Distance Error(E_r)

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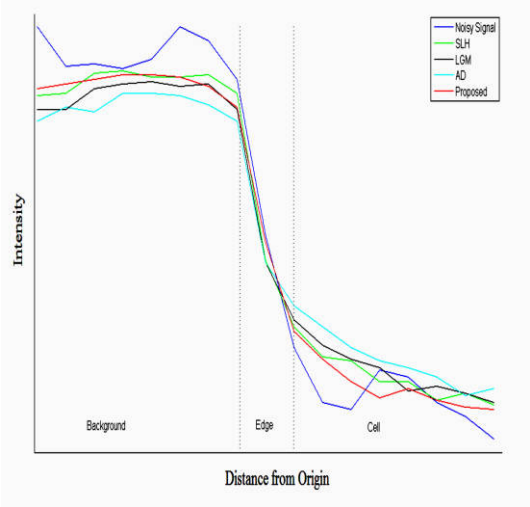

Fig 5. The performance of different edge preserving filters.

IV.RESULT

GROUND TRUTH NUCLEOUS SEGMENTED IMAGES:-

NON-MITOTIC CASE

Fig 6.Non Mitotic Segmented Image

MITOTIC CASE

Fig 7.Prophase

Fig 8.Metaphase

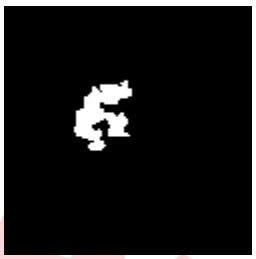

Fig 9.Anaphase

Fig 10.Telophase

TEST IMAGE

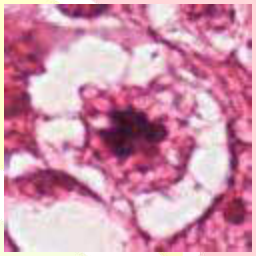

Fig 11.Prophase I.

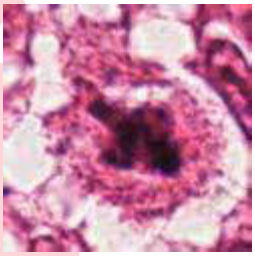

Fig 12.Metaphase I.

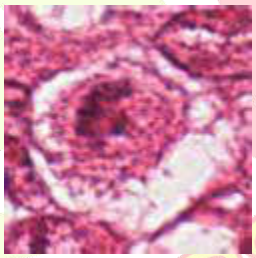

Fig 13. Anaphase I.

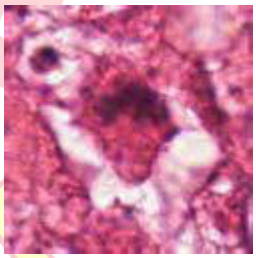

Fig 14.Telophase I.

PROPOSED SEGMENTATION IMAGE

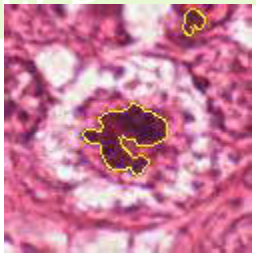

Fig 16. Segmented Prohase II .

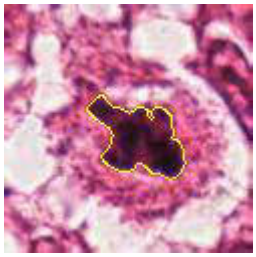

Fig 17.Segmented MetaphaseII.

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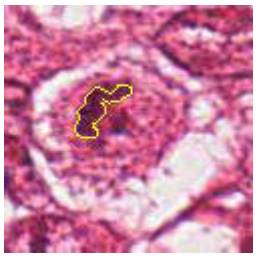

Fig 18. Segmented Anaphase II.

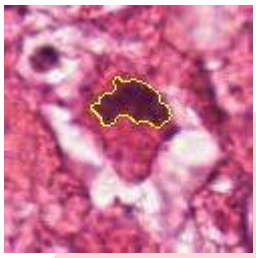

Fig 19.Segmented Telophase II.

V.CONCLUSION AND FUTURE WORK

Relevance of these methods are the direct medical application for segmentation of affected cell nuclei, detection and further diagnosis process, where the project is concerned with, is positive approach and this tool helps them in diagnosis, the treatment procedure and state of the tumor monitoring. This paper is enhanced with the classification of tumor cell which defines the Feature Extraction process. These proposed method aim to develop the automatic detection of Breast Cancer Grading on Histo-pathological Image using ANFIS classifier and performing some Morphological operations. In future , it help the pathologist to easy auto Diagnosis of tumor cell, with high accuracy and less expenses.

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