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Automatic detection of breast cancer using mathematical morphological operations and machine learning technique

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ABSTRACT

A computer-aided diagnosis (CAD) system based on mammograms enables early breast cancer detection, diagnosis, and treatment. However, the accuracy of existing CAD systems remains unsatisfactory. This paper explores a breast CAD method based on feature fusion with Convolutional Neural Network (CNN) deep features. First, we propose a mass detection method based on CNN deep features and Unsupervised Extreme Learning Machine (US-ELM) clustering. Second, we build a feature set fusing deep features, morphological features, texture features, and density features. Third, an ELM classifier is developed using the fused feature set to classify benign and malignant breast masses. Extensive experiments demonstrate the accuracy and efficiency of our proposed mass detection and breast cancer classification method.

Keywords: Computer-Aided Detection, Breast Cancer, Mass Detection, Fusion Feature, Extreme Learning Machine

INTRODUCTION

In the field of radiology, mammographic screened pics (i.e. X-rays picture sensing) rectangular measure terribly difficult and difficult to interpret. The expert radiotherapist visually hunts the mammograms for any precise abnormality. However, human thing reasons an occasional diploma of preciseness which regularly ends up in biopsy and anxiousness for the affected person concerned. This paper proposes novel Computer-Aided Detection (CAD) device to scale back the human issue involvement and to assist the radiotherapist in automated diagnosing of benign/malignant breast tissues by using making use of the simple morphological operations. The enter Region of Interest (ROI) is extracted manually and subjected to extra variety of preprocessing stages. The geometrical and texture facets are used for characteristic extraction of suspicious region. After that a KNN classifier is introduced to classify the required type of the breast cancer.

LITERATURE SURVEY

Breast cancer detection using histogram based decomposition [1]

Ms. Jayashree, R. Parate , Prof. R. K. Krishna

Breast disease are continues to be a common health problem in the world for womens. The mammographic diagnostic method is very famous method for detecting breast cancer. But sometimes in some cases, it is not so easy for the radiologist for detecting the typical diagnostic symptoms, such as masses and micro calcifications on the mammograms. Compact region in digital mammographic images are usually contain noisy

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and have very low contras and the infected regions are very difficult to recognize by radiologist. In this paper, we develop a Histogram base adaptive thresholding to detect suspicious cancerous location in mammograms. The algorithm consumes the combination of adaptive histogram thresholding segmentation and adaptive wavelet based thresholding segmentation on a multiresolution representation of the original mammogram. At last it shows adaptive wavelet techniques to produce the best denoised mammographic image using efficient thresholding algorithm. The algorithm has been checked with different types of around 100 mammograms in the Mammographic Image Analysis Society. Correct result with exact micro calcified area.

Texture Analysis of Mammogram for the Detection of Breast Cancer using LBP and LGP: A Comparison [2]

NarainPonraj, Poongodi, Merlin Mercy

Breast cancer is an life threatening disease in USA and UK. It is also one of the major diseases that has greater death rate. Cancer is the erratic growth of cells that originate in the blood tissue and Tumors may be malignant or benign. Early detection increases the chances of survival and reduces the death rate. This paper compares the approach to classify the mammogram based on the features extracted using local binary pattern (LBP) and local gradient pattern (LGP) with their histograms and the results were compared. Local binary pattern and Local gradient pattern are the techniques that are generally used for textural pattern analysis. The generated pattern is used to classify tumors using support vector machine (SVM) classifier which classifies the breast cancer.

LBP Features for Breast Cancer Detection [3]

Pavel Kral; Ladislaw Lenc

Cancer is nowadays considered as one of the most dangerous diseases in the world. Especially, breast cancer represents for women the second most common type of cancer and is a main cause of cancer dead. This paper presents a novel method for breast cancer detection from mammographic images based on Local Binary Patterns (LBP). This approach successfully uses LBP based features with a classifier and thresholding. The proposed method is evaluated on a set composed of images extracted from MIAS and DDSM databases. We have experimentally shown that the proposed method is efficient and effective because the achieved accuracy is about 84%.

Cancer belongs to the today's most dangerous health issues in the world and its incidence is increasing. Particularly, breast cancer is for women the main cause of cancer death and the second most common type of cancer [1]. Unfortunately, thereis not possible to prevent this disease, because its cause is not known. However, early detection is very important to manage and heal it. Mammography represents a very effective method for early detection of breast cancer signs [2]. It may identify several abnormalities such as masses, calcifications, asymmetries, etc. Especially, Computer-Aided Detection (CAD) systems play a pivotal role for this task and they thus can save the life of many women.

Malignant tumor detection using linear support vector machine in breast cancer based on new optimization algorithms [4]

MohammadrezaNaeemabai;
MohamadrezaAfshari Saleh; Morteza

Breast cancer is one of the most common fatal diseases in women. Early detection of malignant breast cancer could be a great help in treating this cancer. Many studies have been performed in order to detect the malignant of cancer tumor till now. It has been tried to contribute more in accurate diagnosis of breast cancer by Support Vector Machine, in this paper. LS and SMO methods have been utilized instead of conventional learning method of QP in SVM in this probe. The feasibility of 100 percent in sensitivity for LS-SVM, and 100 percent in specificity for SMO-SVM has been achieved in this assay by the proposed method, which this percentage has not been achieved so far in the previous studies. The highest value among the previous studies has been presented by the obtained accuracy in LS-SVM method.

Breast Cancer Diagnosis Using Genetic Algorithm Feature Selection and Rotation Forest [5]

Aličković, Emina

Breast cancer is one of the primary causes of death among the women worldwide, and the accurate diagnosis is one of the most significant steps in breast cancer treatment. Data mining techniques can support doctors in diagnosis decision-making process. In this paper, we present different data mining techniques for diagnosis of breast cancer. Two different Wisconsin Breast Cancer datasets have been used to evaluate the system proposed in this study. The proposed system has two stages. In the first stage, inorder to eliminate insignificant features, genetic algorithms are used for extraction of informative and significant features. This process reduces the computational complexity and speed up the data mining process. In the second stage, several data mining techniques are employed to make a decision for two different categories of subjects with or without breast cancer. Different individual and multiple classifier systems were used in the second stage in order to construct accurate system for breast cancer classification.

The performance of the methods is evaluated using classification accuracy, area under receiver operating characteristic curves and *F*- measure. Results obtained with the Rotation Forest model with GA-based 14features show the highest classification accuracy (99.48 %), and when compared with the previous works, the proposed approach reveals the enhancement in performances. Results obtained in this study have potential to open new opportunities in diagnosis of breast cancer.

Investigating the role of model- based and model-free imaging biomarkers [6]

EleftheriosKontopodis*, Maria Venianaki

Imaging biomarkers (IBs) play a critical role inthe clinical management of breast cancer (BRCA) patients throughout the cancer continuum for screening, diagnosis and therapy assessment especially in the neoadjuvant setting. However, certain model-based IBs suffer from significant variability due to the complex workflows involved in their computation, whereas model-free IBs have not been properly studied regarding clinical outcome. In the present study, IBs from 35 BRCA patients who received neoadjuvant chemotherapy (NAC) were extracted from dynamic contrast enhanced MR imaging (DCE-MRI) data with two different approaches, a model-free approach based on pattern recognition (PR), and a model-based one using pharmacokinetic compartmental modeling. Our analysis found that both model-free and model-based biomarkers can predict pathological complete response (pCR) after the first cycle of NAC. Overall, 8 biomarkers predicted the treatment response after the first cycle of NAC, with statistical significance (p-value<0.05), and 3 at the baseline.

Novel Single Pixel Beta Detector For Intra-Operative Guidance In Breast- Conserving Surgery [7]

Amritpal Singh, Ryerson University

Breast-conserving surgery is imprecise requiring re-excision in up to 40% of cases. One potential method of improving breast-conserving surgery accuracy is to use a beta particle detector to evaluate the surface of the excised tissue for any cancerous deposits, intra- operatively. Patients could be injected with a radiopharmaceutical that emits beta particles and preferentially accumulates within cancer cells. Cancer cells found on the surface of the excised tissue indicate that the surgery is incomplete. The purpose of this study is to develop and analyze a novel single pixel beta sensitive detector. The detector is made up of a calcium fluoride europium doped (CaF2(Eu)) scintillation crystal, which is coupled to a silicon photomultiplier. A computational model of the detector response was derived from an empirically generated, two- dimensional, detector sensitivity map. This study determined that a CaF2(Eu) scintillator of 0.5 mm thickness provided superior beta to gamma detection ratio. According to the detector response, it is expected that with an acquisition time of 30 seconds, the tumor-to-background ratio of 5 or higher, and a normal breast tissue activity of 1.69 kBq/ml, less than 1 mm2 tumor detection is achievable. The result of this study indicates that the radio-guided surgery with a CaF2(Eu) scintillation detector could be feasible to intra-operatively assess tumor margin involvement.

On Combining Biclustering Mining and Adaboost For Breast Tumor Classification [8]

Qinghua Huang, Yongdong Chen, Longzhong Liu, Breast cancer is now considered as one of the

leading causes of deaths among women all over the world. Aiming to assist clinicians in improving the accuracy of diagnostic decisions, computer-aided diagnosis (CAD) system is of increasing interest in breast cancer detection and analysis nowadays. In this paper, a novel computer-aided diagnosis scheme with human-in-the- loop is proposed to help clinicians identify the benign and malignant breast tumors in ultrasound. In this framework, feature acquisition is performed by a user-participated feature scoring scheme that is based on Breast Imaging Reporting and Data System (BI-RADS) lexicon and experience of doctors.

Biclustering mining is then used as a useful tool to discover the column consistency patterns on the training data. The patterns frequently appearing in the tumors with the same label can be regarded as a potential diagnostic rule. Subsequently, the diagnostic rules are utilized to construct component classifiers of the Adaboost algorithm via a novel rules combination strategy which resolves the problem of classification in different feature spaces (PC-DFS). Finally, the AdaBoost learning is performed to discover effective combinations and integrate them into a strong classifier. The proposed approach has been validated using a large ultrasounic dataset of 1062 breast tumor instances (including 418 benign cases and 644 malignant cases) and its performance was compared with several conventional approaches. The experimental results show that the proposed method yielded the best prediction performance, indicating a good potential in clinical applications.

An Entropy-Based Method for Identifying Mutual Exclusive Driver Genes In Cancer [9]

Junrong Song, Wei Peng_ and Feng Wang

Cancer in essence is a complex genomic alteration disease which is caused by the somatic mutations during the lifetime. According to previous researches, the first step to overcome cancer is to identify driver genes which can promote carcinogenesis. However, it is still a big challenge to precisely and efficiently extracting the cancer related driver genes because the nature of cancer is heterogeneous and there exists tremendously irrelevant passenger mutations which have no function impact on the cancer's development. In this work, we proposed a novel entropy- based method namely Entro Rank to identify driver genes by integrating the subcellular localization information and mutual exclusive of variation frequency into the network.

Entro Rank can take into full consideration of different properties of driver genes. Considering the modularity of driver genes, the mutated genes in the network were firstly clustered into different subgroups according to their located compartments. After that, the structural entropy of the gene in the subgroup was employed to measure its indispensability. Considering mutual exclusive property between driver genes in the modules, relative entropy was utilized to measure the degree of mutual exclusive between two mutated genes in terms of their variation frequency. We applied our method to three different cancers including lung, prostate and breast cancer. The results showed our method can not only detected the well- known important drivers but also prioritized the rare unknown drivers. Besides, Entro Rank can identify driver genes having mutual exclusive property. Compared with other existing methods, our method achieved a better performance for most of cancer types in terms of Precision, Recall and F score.

Gaussian Mixture-Model Exploiting Pathway Knowledge for Dissecting Cancer Heterogeneity [10]

Rajan Kapoor, Student Member

In this work, we develop a systematic approach for applying pathway knowledge to a multivariate Gaussian mixture model for dissecting a heterogeneous cancer tissue. The downstream transcription factors are selected as observables from available partial pathway knowledge in such a way that the subpopulations produce some differential behavior in response to the drugs selected in the upstream. For each subpopulation, each unique (drug, observable) pair is considered as a unique dimension of a multivariate Gaussian distribution.

Expectation-maximization (EM) algorithm with hill-climbing is then used to rank the most probable estimates of the mixture composition based on the log- likelihood value. A major contribution of this work is to examine the efficacy of the EM based approach in estimating the composition of experimental mixture sets from

cell-by-cell measurements collected on a dynamic cell imaging platform. Towards this end, we apply the algorithm on hourly data collected for two different mixture compositions of A2058,HCT116 and SW480 cell lines for three scenarios: untreated, Lapatinib- treated and Temsirolimus-treated.

Computer-Aided Breast Cancer Detection Using Mammograms A Review [11]

Ganesan K1, Archana UR, Chua CK, Min LC, Abraham KT, Ng KH.

The American Cancer Society (ACS) recommends women aged 40 and above to have a mammogram every year and calls it a gold standard for breast cancer detection. Early detection of breast cancer can improve survival rates to a great extent. Inter-observer and intra-observer errors occur frequently in analysis of medical images, given the high variability between interpretations of different radiologists. Also, the sensitivity of mammographic screening varies with image quality and expertise of the radiologist. So, there is no golden standard for the screening process. To offset this variability and to standardize the diagnostic procedures, efforts are being made to develop automated techniques for diagnosis and grading of breast cancer images. A few papers have documented the general trend of computer-aided diagnosis of breast cancer, making a broad study of the several techniques involved. But, there is no definitive documentation focusing on the mathematical techniques used in breast cancer detection. This review aims at providing an overview about recent advances and developments in the field of Computer-Aided Diagnosis (CAD) of breast cancer using mammograms, specifically focusing on the mathematical aspects of the same, aiming to act as a mathematical primer for intermediates and experts in the field.

Big Data Deep Learning: Challenges and Perspectives [12]

Xue-Wen Chen ; Xiaotong Lin.

Deep learning is currently an extremely active research area in machine learning and pattern recognition society. It has gained huge successes in a broad area of applications such as speech recognition, computer vision, and natural language processing. With the sheer size of data available today, big data brings big opportunities and transformative potential for various sectors; on the other hand, it also presents unprecedented challenges to harnessing data and information. As the data keeps getting bigger, deep learning is coming to play a key role in providing big data predictive analytics solutions. In this paper, we provide a brief overview of deep learning, and highlight current research efforts and the challenges to big data, as well as the future trends.

Segmentation and detection of breast cancer in mammograms combining wavelet analysis and genetic algorithm [13]

Danilo Cesar Pereira, Rodrigo Pereira Ramos

Radiographic images obtained from mammography equipment's are one of the most frequently used techniques for helping in early diagnosis. Due to factors related to cost and professional experience, in the last two decades computer systems to support detection (Computer-Aided Detection – CADe) and diagnosis (Computer-Aided Diagnosis – CADx) have been developed in order to assist experts in detection of abnormalities in their initial stages. Despite the large number of researches on CADe and CADx systems, there is still a need for improved computerized methods. Nowadays, there is a growing concern with the sensitivity and reliability of abnormalities diagnosis in both views of breast mammographic images, namely cranio-caudal (CC) and medio-lateral oblique (MLO). This paper presents a set of computational tools to aid segmentation and detection of mammograms that contained mass or masses in CC and MLO views. An artifact removal algorithm is first implemented followed by an image denoising and gray-level enhancement method based on wavelet transform and Wiener filter. Finally, a method for detection and segmentation of masses using multiple thresholding, wavelet transform and genetic algorithm is employed in mammograms which were randomly selected from the Digital Database for Screening Mammography (DDSM). The developed computer method was quantitatively evaluated using the area overlap metric (AOM). The mean ± standard deviation value of AOM for the proposed method was 79.2 ± 8%. The

experiments demonstrate that the proposed method has a strong potential to be used as the basis for mammogram mass segmentation in CC and MLO views. Another important aspect is that the method overcomes the limitation of analyzing only CC and MLO views.

A fully automated scheme for mammographic segmentation and classification based on breast density and asymmetry [14]

Tzikopoulos SD, Mavroforakis ME, Georgiou HV, Dimitropoulos N, Theodoridis S.

A fully automated segmentation and classification scheme for mammograms, based on breast density estimation and detection of asymmetry. First, image preprocessing and segmentation techniques are applied, including a breast boundary extraction algorithm and an improved version of a pectoral muscle segmentation scheme. Features for breast density categorization are extracted, including a new fractal dimension- related feature, and support vector machines (SVMs) are employed for classification, achieving accuracy of up to 85.7%. Most of these properties are used to extract a new set of statistical features for each breast; the differences among these feature values from the two images of each pair of mammograms are used to detect breast asymmetry, using an one-class SVM classifier, which resulted in a success rate of 84.47%. This composite methodology has been applied to the miniMIAS database, consisting of 322 (MLO) mammograms -including 15 asymmetric pairs of images-, obtained via a (noisy) digitization procedure. The results were evaluated by expert radiologists and are very promising, showing equal or higher success rates compared to other related works, despite the fact that some of them used only selected portions of this specific mammographic database. In contrast, our methodology is applied to the complete miniMIAS database and it exhibits the reliability that is normally required for clinical use in CAD systems.

Automated Breast Ultrasound Lesions Detection using Convolutional Neural Networks [15]

Moi Hoon Yap, Member, IEEE, Gerard Pons

Breast lesion detection using ultrasound imaging is considered an important step of Computer-Aided Diagnosis systems. Over the past decade, researchers have demonstrated the possibilities to automate the initial lesion detection. However, the lack of a common dataset impedes research when comparing the performance of such algorithms. This paper proposes the use of deep learning approaches for breast ultrasound lesion detection and investigates three different methods: a Patch-based LeNet, a U-Net, and a transfer learning approach with a pretrained FCN-AlexNet. Their performance is compared against four state-of-the-art lesion detection algorithms (i.e. Radial Gradient Index, Multifractal Filtering, Rule-based Region.

Ranking and Deformable Part Models). In addition, this paper compares and contrasts two conventional ultrasound image datasets acquired from two different ultrasound systems. Dataset A comprises 306 (60 malignant and 246 benign) images and Dataset B comprises 163 (53 malignant and 110 benign) images. To overcome the lack of public datasets in this domain, Dataset B will be made available for research purposes. The results demonstrate an overall improvement by the deep learning approaches when assessed on both datasets in terms of True Positive Fraction, False Positives per image, and F-measure.

Comparision table for the literature survey

S.No	Title and author	Advantages	Disadvantages
1	Breast Cancer Detection Using Histogram Based Decomposition Ms.Jayashree,R. Parate, Prof.R. K. Krishna	It shows adaptive wavelet techniques to produce the best denoised mammographic image using efficient thresholding algorithm	It is not so easy for the radiologist for detecting the typical diagnostic symptoms, such as masses and micro calcifications on the mammograms
2	Texture Analysis of Mammogram for the Detection of Breast Cancer using LBP and LGP: A Comparison NarainPonraj, Poongodi	Cancer is the erratic growth of cells that originate in the blood tissue and Tumors may be malignant or benign	It is also one of the major diseases that has greater death rate
3	LBP Features for Breast Cancer Detection. Pavel Kral; Ladislaw Lenc	Mammography represents a very effective methodfor early detection of breast cancer signs	Breast cancer represents for women the second most common type of cancer and is a main cause of cancer dead
4	Malignant tumor detection using linear support vector machine in breast cancer based on new optimization algorithms MohammadrezaNaeemabai; MohamadrezaAfshari Saleh; Morteza	It has been tried to contribute more in accurate diagnosis of breast cancer by Support Vector Machine	The most common cancer in women after skin cancer, and it is considered as the second leading cause of death in females.
5	Breast Cancer Diagnosis Using Ga Feature Selection And Rotation Forest Aličković, Emina	The Tresent different data miningtechniques for diagnosis of breast cancer	Different individual and multiple classifier systems were used in the second stage in order to construct accurate system for breast cancer classification.
6	Investigating The Role Of Model-Based And Model-Free Imaging Biomarkers EleftheriosKontopodis*, Maria Venianaki	Extracted from dynamic contrast enhanced MR imaging (DCE-MRI) data with two different approaches	Due to the complex workflows involved in their computation
7	Novel Single Pixel Beta Detector For Intra-Operative Guidance In Breast-Conserving Surgery	The detector is made up of a calcium fluoride europium doped (CaF2(Eu)) scintillation crystal, which is	Patients could be injected with a radiopharmaceutical that emits beta particles and preferentially accumulates within

	Amritpal Singh, Ryerson University	coupled to a silicon photomultiplier.	cancer cells
8	On Combining Biclustering Mining And Adaboost For Breast Tumor Classification Qinghua Huang, Yongdong Chen, Longzhong Liu	It has been validated using a large ultrasounic dataset	The problem of classification in different feature spaces
9	An Entropy-Based Method For Identifying Mutual Exclusive Driver Genes In Cancer Junrong.	A big challenge to precisely and efficiently extracting the cancer related driver genes	The subcellular localization information and mutual exclusive of variation frequency into the network.
10	Gaussian Mixture-Model Exploiting Pathway Knowledge For Dissecting Cancer Heterogeneity	A systematic approach for applying pathway knowledge to a multivariate Gaussian	A major contribution of this work is to examine the efficacy of the EM Based approach in
	Rajan Kapoor, Student Member	mixture model	estimating the composition
11	Computer-Aided Breast Cancer Detection Using Mammograms A Review. Ganesan K1, Archana UR, Chua CK, Min LC, Abraham KT, Ng KH	Early detection of breast cancer can improve survival rates to a great extent.	The high variability between interpretations of different radiologists with image quality and expertise of the radiologist
12	Big Data Deep Learning: Challenges and Perspectives Xue-Wen Chen ; Xiaotong Lin	It has gained huge successes in a broad area of applications such as speech recognition, computer vision, and natural language processing	The data keeps getting bigger, deep learning is coming to play a key role in providing big data predictive analytics solutions
13	Segmentation and detection of breast cancer in mammograms combining wavelet analysis and genetic algorithm Danilo Cesar Pereira ,Rodrigo Pereira Ramos.	a set of computational tools to aid segmentation and detection of mammograms	factors related to cost and professional experience, in the last two decades computer systems

14	A fully automated scheme for mammographic segmentation and classification based on breast density and asymmetry. Tzikopoulos SD, Mavroforakis ME, Georgiou HV, Dimitropoulos N, Theodoridis S.	The fact that some of them used only selected portions of this specific mammographic database	The image preprocessing and segmentation techniques are applied, including a breast boundary extraction algorithm
15	Automated Breast Ultrasound Lesions Detection using Convolutional Neural Networks Moi Hoon Yap, Member, IEEE, Gerard Pons,	The use of deep learning approaches for breast ultrasound lesion detection and investigates three different methods	The lack of a common dataset impedes research when comparing the performance of such algorithms

EXISTING SYSTEM

This paper proposes a mass detection approach based on CNN deep facets and Unsupervised Extreme Learning Machine (US-ELM) clustering. Second, they build a feature set fusing deep features. Third, an ELM classifier is developed using the fused. Feature set to classify benign and malignant breast masses. The convolution neural network has a set of layers in order to section and classify the images.

PROPOSED SYSTEM

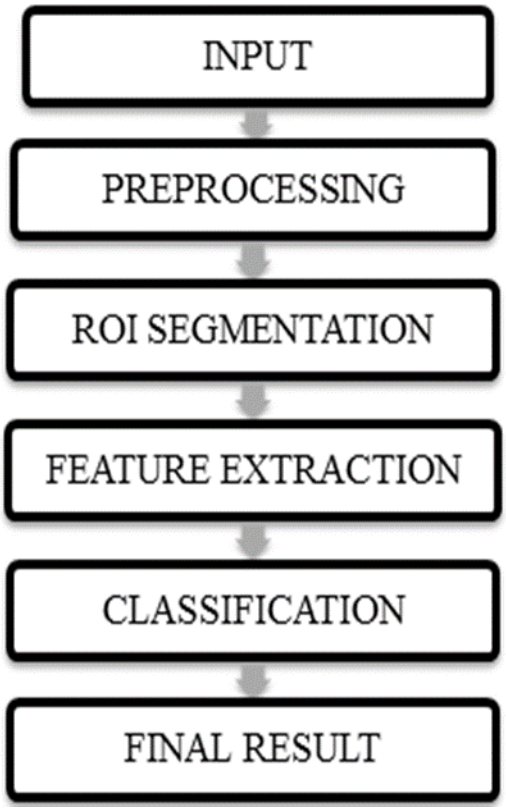
Basic morphological operations. The enter Region of Interest (ROI) is extracted manually and subjected to in addition variety of preprocessing stages. The geometrical and texture facets are extracted for characteristic extraction of suspicious region. After that a KNN classifier is brought to classify the required class of the breast cancer. In preprocessing we have first transformed the breast images from to Black and White model. This converts the two color (BW) image from the three color (GREY) picture in the breast cancer image. Morphological picture processing is a series of non-linear operations related to the form or morphology of aspects in an image. Morphology is a wide set of image processing operations that technique snap shots primarily based on shapes. Morphological operations practice a structuring factor to an enter image, creating an output photo of the equal size.

DRAWBACKS

- The CNN comes under deep learning techniques.
- The deep learning processes need some advanced hardware requirements like high amount of RAM, graphics cards and etc.

PROPOSED BLOCK DIAGRAM

This paper proposes a novel Computer-Aided Detection (CAD) device to reduce the human thing involvement and to assist the radiologist in computerized analysis of benign/malignant breast tissues. It is a characteristic extraction approach That features represent the texture of an picture by means of calculating how often pairs of pixel with unique values and in a exact spatial relationship take place in an image, developing a GLCM, and then extracting statistical measures from this matrix. In sample recognition, the k-nearest neighbor's algorithm is a non-parametric approach used for classification and regression. In both cases, the input consists of the ok closest coaching examples in the feature Space.



ADVANTAGES

The machine learning process is a lot quicker when compare to the deep gaining knowledge of techniques.

- The laptop mastering processes desires only the normal hardware requirements.
- The process is effortless to understand.

CONCLUSION

This paper proposes a breast CAD method primarily based on fusion deep features. Its primary notion is to observe deep elements extracted from CNN to the two degrees of mass detection and mass diagnosis. In the stage of mass detection, a approach based on sub-domain CNN deep elements and US-ELM clustering is developed. In the stage of mass diagnosis, an ELM classifier is utilized to classify the benign and malignant breast masses the use of a fused characteristic set, fusing deep features, morphological features, texture features, and density features. In the method of breast CAD, the choice of points is the key in identifying the accuracy of diagnosis. In preceding studies, either typical subjective features or goal points are used, in which standard subjective facets consist of morphology, texture, density, etc., and objective features encompass points extracted from CNN or DBN. These points are flawed to some extent. In this paper we mix subjective and goal features, taking the doctor's ride and the necessary attributes of the mammogram into account at the same time. After extracting the features, the classifier is used to classify the benign and malignant of the breast mass. In this paper, ELM, which has a better impact on multi- dimensional feature classification, is chosen as the classifier.

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