Improved mammography classification by hybridization of CNN with Random Forest

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Abstract - *Breast disease is the most well-known harm of ladies and is the second generally normal and driving reason for malignancy passings among them. At present, there are no powerful approaches to forestall bosom disease, since its motivation isn't yet completely known. Early recognition is a powerful method to analyze and oversee bosom malignant growth can give a superior possibility of full recuperation. In this way, early recognition of bosom disease can assume a significant job in diminishing the related dismalness and death rates. Mammography has demonstrated to be the best apparatus for recognizing bosom disease in its soonest and most treatable stage, so it keeps on being the essential imaging methodology for bosom malignant growth screening and determination. Moreover, this test permits the location of different pathologies and may recommend the nature, for example, ordinary, benevolent or threatening. The presentation of computerized mammography is viewed as the most significant improvement in bosom imaging. PC supported recognition/determination (CAD) has been demonstrated to be a useful apparatus in the early identification of bosom malignancy by stamping suspicious districts on a screening mammogram, permitting hence to lessen the demise rate among ladies with this ailment. These frameworks use PC innovations to identify variations from the norm in mammograms and the utilization of these outcomes by radiologists for determination assume a significant job, once portray sores through programmed picture examination. The CAD execution can change since certain injuries are more hard to distinguish than others, this is on the grounds that they have comparative qualities to ordinary mammary tissue. Notwithstanding, it is essential to keep working so as to diminish the quantity of disappointments. PC Aided Detection (CAD) frameworks assume a significant job to identify mammographic variations from the norm as they decrease the blunder rate. Right now, novel weighted Convolution neural system with arbitrary woodland and lessen the covering between highlights.**Keywords-*
mammography,optimization,classification,accuracy,detection

I. INTRODUCTION

The diagnostic method is used when it is not possible to diagnose in the screening process. The detection process is mainly based on the shape, age, margin, the density of the tissues in the mammograms [2]. Mammogram is nothing but an x-ray image of the breast. These x-rays are used to recognize the breast cancer in ladies which have no sign or symptoms regarding this disease. Mammography is a type of screening, which indicates the disease of breast even we have no symptoms. As there are many women, which don't even have an idea about their disease. This image helps those women and also be considered as a key factor which can reduce the death of women because of breast cancer. As this disease has more significance in the womens having age between 40 t0 70. Which is now diminishes due to mammography. Mamaography is very helpful to reduce death, but it has some drawbacks too, like some time it used to show some cases which is abnormal but not cancer make a doubt on the patients and doctors, and sometimes it does not show cancer but it is actually there. [2]These are some common but important de-merits of the mamaography. The whole process of identification of breast cancer is by using the mammographic image is termed as a mammogram. As breast cancer is the second leading factor which causes death among the women throughout the world. If any women caught with this disease only early diagnosis can save her life or reduce the risk rate of death. The proper diagnosis is very important to recover the breast cancer. It helps to give relief for the patients suffering from breast cancer from physical and mental stress.[3]

Mamography is the medical image that uses to view inside the breast, and mammogram is the early identification and diagnosis of cancer in women. There are 4 methods for the treatment of breast cancer, i.e. surgical biopsy, magnetic resonance imaging which is termed as MRI, mammography and fine needle cytology. [4] Mammograms are approved for the women who are suffering from breast cancer and have a threat of that.

1.1 Mammography

It is an image used to view inside the breast, and a process of recent identification and diagnosis of breast cancer in women. It is a type of radiograph having a noninvasive therapeutic test that make a help for the analysis and treatment of cancer. The x-ray images demonstarte the piece of the body for the evaluation of ionizing radiation to make pictures of the inner body. X-ray takes little more time, but quite useful to recognize the variations in the body. Below there are a description about the development in the mammography.

Digital mammography, It is used to change x-rays into the mammography image of women breast by replacing x-ray film by electronics. It is also defined as full-field digital mammography, which is termed as FFDM. The function of

the system is same as that of a digital camera and have the capability to give a clear image even in lower radiation. These captured images can be stored in the computer and analyze by the radiologist.

Computer-aided detection (CAD) This system used to highlight the abnormal areas in the image captured. He abnormal areas contains are of density, mass, calcification, which may show the sign of cancer. This system helps the radiologist to take a special concern in those areas which is highlighted by the CAD system.

Breast tomosynthesis, this system helps to give the images of breast from different angles or points in a 3-D manner. It is used to capture a number of images in 3-D. Due to this function, it is also termed as digital breast tomography, which is termed as DBT and 3-dimensional mammography. We can say that the function of tomosynthesis is same as that of CT which stands for computed tomography where for creating a 3-D remaking of the body we use to take the projection of thin cuts. In spite of the fact that the radiation computation of few breast tomosynthesis frameworks is higher than the dose utilized as a part of standard mammography, it stays inside the FDA-endorsed safe levels of radiation from mammograms. A few frameworks have dosages fundamentally the same as ordinary mammography.

II. RELATED WORK

de Oliveira et al. [1] proposed an approach which classifies the region of mass and non-mass in the mammograms. In this author uses the texture feature of the mammograms. For the analysis of features, internal mask and external mask are used. Support vector machine (SVM) is used for the classification. The result of the proposed methodology shows the better accuracy in the identification of mammograms.

Abdel-Nasser, Mohamed, et al. [2] in this paper, the author introduced a method to identify the tissue abnormality in the breast. The author introduced Uniform local directional pattern which classifies the tissue patterns from the mammograms. This method work in the three-part first is to segment the rate of interest secondly extract the features and third is classification. It uses the SVM classifier to classify the features. The result of the paper shows that it works very effectively.

Reyad et al. [3] in this paper, the author studied the effects of computer-aided diagnosis in detecting the various diseases. CAD uses different methods of classification of masses in the mammography. Here author studied the concept of the local binary patterns and multi-resolution analysis of mammograms. LBP is a text descriptor and it extracts the features from the region of interest. Multi-resolution features are obtained from the discrete wavelet transform. Classification of the features is performed by using the support vector machine classifier.

Hussain, Muhammad. et al. [4] Introduced a method for false-positive reduction in the features of the mammograms. The author introduced the Weber Law Descriptor. WLD integrates the local information content into the histograms. In this paper multi-scale spatial WLD is used to characterize the texture microstructures. It generates the high feature space. The result of the proposed approach shows the efficiency improvement in the results.

Jen et al. [5] developed a computer-aided system which detects the abnormal mammograms. In the proposed approach author extracts only five features of intensity for mass detection in the mammograms. Fore feature weight determination principal component analysis is used. The classification process is performed by using abnormality detection classifier. This classifier also adjusts the feature weight. This method improves the performance and provides the high accuracy of the system.

Junior, Geraldo Braz, et al. [6] proposed a Spatial Diversity approach which reduced the false positive. In this approach, it increases the sensitivity and also reduces the procedures. It analyses the diversity of approaches and enhances the spatial decomposition. The result of the paper shows that it is effective for the mammogram detection.

Hussain et al. [7] introduced a method of false positive reduction by using Gabor feature subset selection method. In this method, texture features are used for detection of masses in the mammograms. Gabor filter is used to identify the micro-patterns of the features. It represents the multi-scale and multi-directional features also which results in the effective accuracy. SVM classifier is used for the classification. The result of the proposed method provides the effective performance in cancer detection.

Chu, Jinghui, et al. [8] In this paper, the author proposed computer-aided detection system for cancer. This method is based on the morphological enhancements and superpixel segmentation. The proposed method consists of different components. Pre-processing is based on the morphological enhancements which group the tissues in the different region. Rule-based classification is used to eliminate the unwanted region. The false positive reduction is based on the feature extraction. Support vector machine classifier is used for the classification of the features. The results proved that this system reduced the FP rate and enhance the performance.

de Sampaio, Wener Borges, et al. [9] Proposed a method of detection by using the genetic algorithm. This method firstly detects the density of the masses of the breast is dense or non-dense. It firstly divides the mammograms into the segments and applies the genetic algorithm which creates the texture proximity mast to the suspected regions. The next task performed by the proposed method is to reduce the false positives which are generated by the previous state. For false positive reduction, it uses the DBSCAN and a proximity

ranking of the texture features extracted from the ROI. Classification of masses is done by SVM classifier. Results show that it enhances the sensitivity and reduced the false positive rate.

Costa et al. [10] Proposed a method to diagnose the cancer of the breast by using mammograms. In this method, the author uses the coding method and Gabor wavelet method. These methods differentiate the mass and non-mass regions from the mammograms. LDA (Linear discriminant analysis) and ICA (Independent component analysis) method are used for the prediction of the dataset.

Oliver, Arnau, et al. [11] the author proposed the automatic density segmentation algorithm which detects the density analysis. This method is based on the supervised pixel-based classification and it uses textual and morphological features. The proposed approach based on the density of the features on the mammograms. It checks the density of tissues is increased or decreased in the specific time and work on this basis.

Khan, Salabat et al. [12] in this paper, the author differentiate the six approaches of Gabor feature extraction. Gabor filters are used to extract the textural directional features from the mammograms. In the detection process segmentation of the regions to detects the suspected tissues. False positive are reduced by classifying the region of interest. In this SVM classifier is used for the effective classification.

Li, Yanfeng, et al. [13] proposed the new method of classification by using the Texton method. In this paper, the author classifies the masses as benign and malignant in mammograms. A segmentation process cannot be applied to the mammograms. In this classification, process author applied sub-sampling methods first and then Textron classification. It uses the KNN classifier for classification of the masses. The proposed method provides the highest accuracy rates.

Rehman et al. [14] introduced a method which is based on the diverse features. It used the Local Binary patterns and statistical features for the classification of the mammograms. The SVM classifier with RBF kernel is used for the classification of cancerous and non-cancerous mammograms. It is an effective method of detecting the breast cancer.

Berbar et al. [15] mammography is a method which is used to detect the cancer of the breast in the women. This method is totally based on the computer-aided detection. In the proposed method local binary patterns and statistical features are used for the classification. For classification KNN and SVM, filter is used. This filter classifies the abnormal cases in the mammograms

III. THE PROPOSED METHOD

3.1 Proposed Methodology

3.2 Deep Neural Network

Following are some architectural principles of deep networks:

i). Parameters
ii). Layers
iii). Activation functions
iv). Loss functions
v). Optimization methods
vi). Hyper-parameters

Parameters: The below given equation shows the basic deep learning in which parameters relate to the x parameters vector.

$Ax = b$ in basic machine learning.

Parameters denote the weight on the connections in the neural network. In this equation x represents the column vector and b column vector represents the dot product of matrix A and vector x. The value of vector b represents the actual value of training data and shows the model's effectiveness.

Layers: Layers are the sub-network of the network and classified into input layer, hidden layer and output layer. Each layer performs its functions on the basis of activation function. These layers are also customizing by changing the type of activation function that is used by the layer. Each layer required hyper parameters to learn on the network and reduce the over fitting.

Activation Functions: An activation function f is defined as f performs a mathematical operation on the output of signal. The common activation functions used in the neural network are.

a. Linear
b. Threshold
c. Sigmoid

Mostly used functions are tanh, hard tanh, Sigmoid and Rectified Linear Unit (ReLU)

Loss Functions: It is an agreement between the predicted output and ground truth output. This is used to define the penalty for incorrect classification of an input vector. These are the common loss functions:

• Squared loss
• Logistic loss
• Hinge loss
• Negative log likelihood

Optimization Algorithms: In the training process in machine learning it finds the best set of the values of the vector parameters. In the machine learning loss function is minimized by using prediction function. The most common methods used for optimization are Ant Colony Optimization, Particle Swarm Optimization, Genetic Algorithms, and Simulated Annealing.

Hyper-Parameters: Following parameters are used as hyper parameters in the neural network:

- Layer size: defines the number of neurons in the layer
- Magnitude (momentum, learning rate)
- Regularization (dropout, drop connect, L1, L2)
- Activations (includes activation function families)
- Weight initialization strategy
- Loss functions
- Settings for epochs during training (mini-batch size)
- Normalization scheme for input data (vectorization)

1.5 CNN Architecture Overview

3.2 Proposed methodology: Flowchart

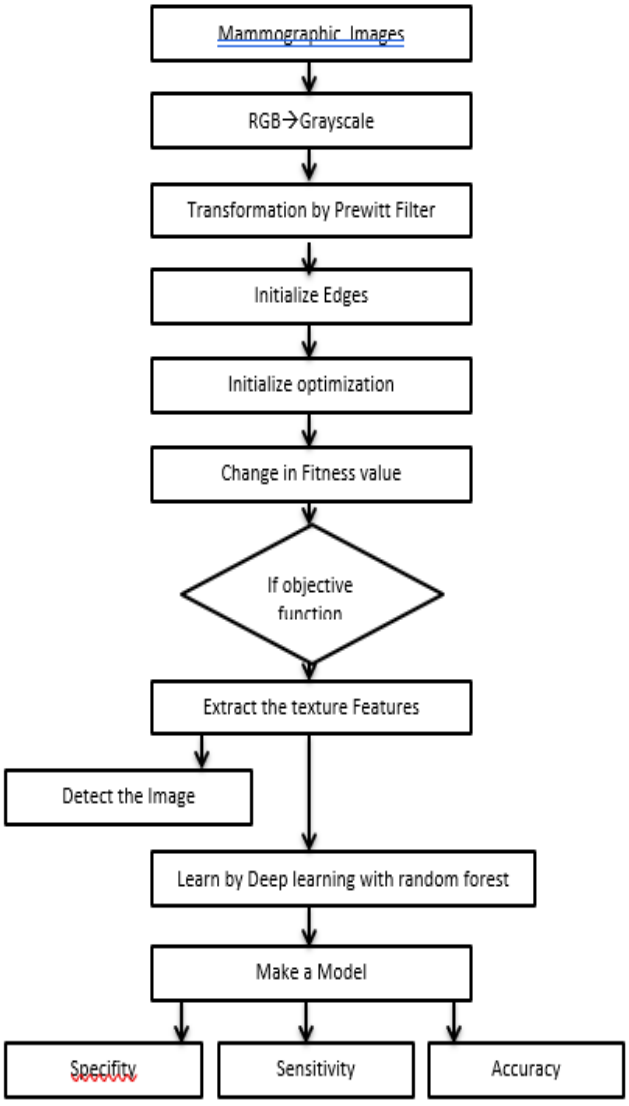


Fig. 3: Proposed Flowchart

IV. RESULT ANALYSIS

3.1 Result Analysis

Results after detection:

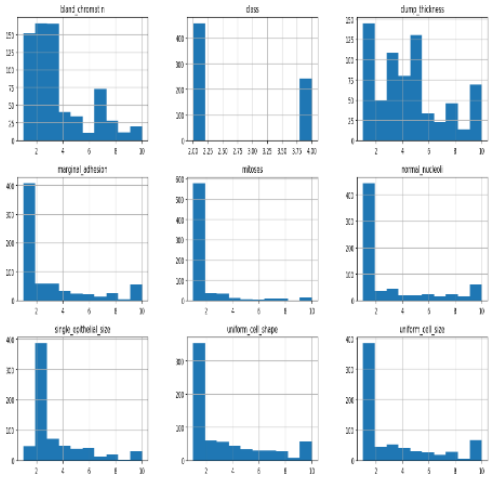


Figure 5.1 Features of mammography Image bar graph

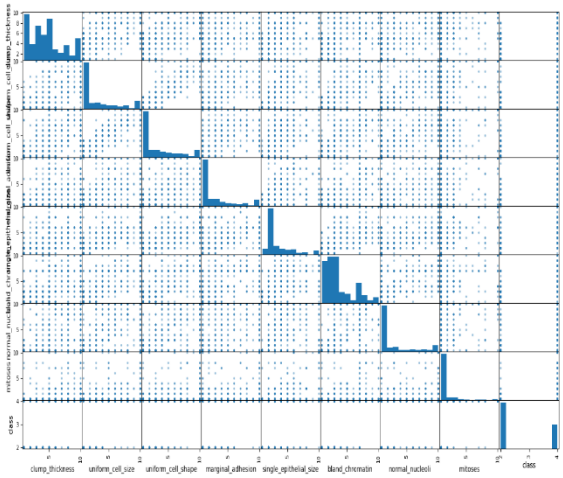


Figure 5.1 Features of correlation bar graph

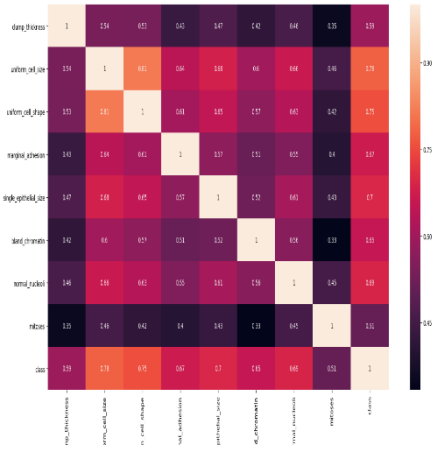
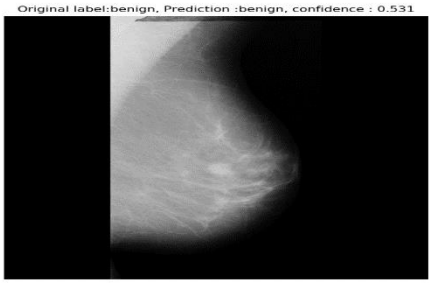
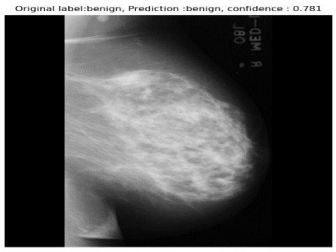
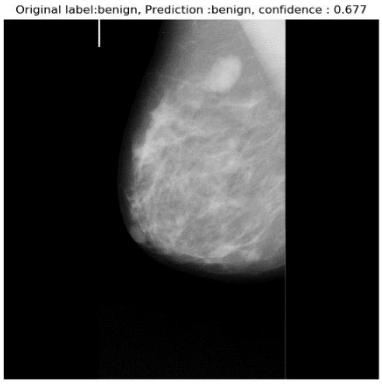
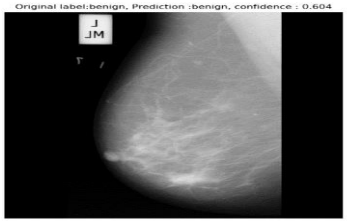


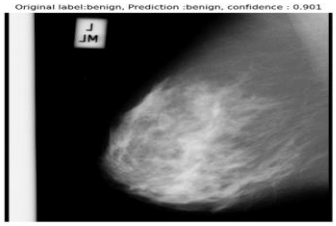
Figure 5.3 Features of mammography correlation value











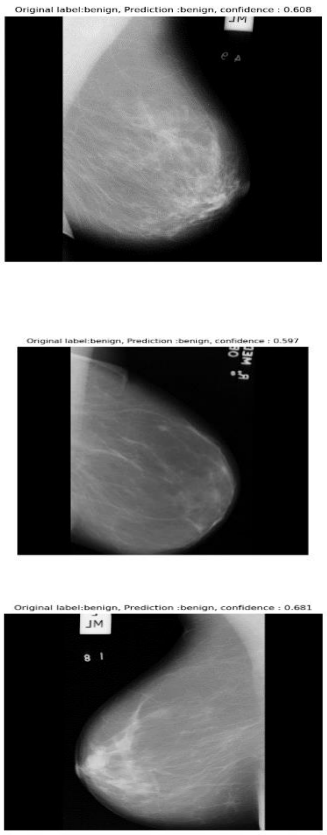


Figure 5.4 Test images classification and confidence score

Classification Results

Table 5.1 Result table of different classifier.

Parameters	Proposed	SVM	N.N
Accuracy	95.32	86.34	83.22
Sensitivity	90.23	78.33	76.32
Specificity	94.32	90.34	88.23

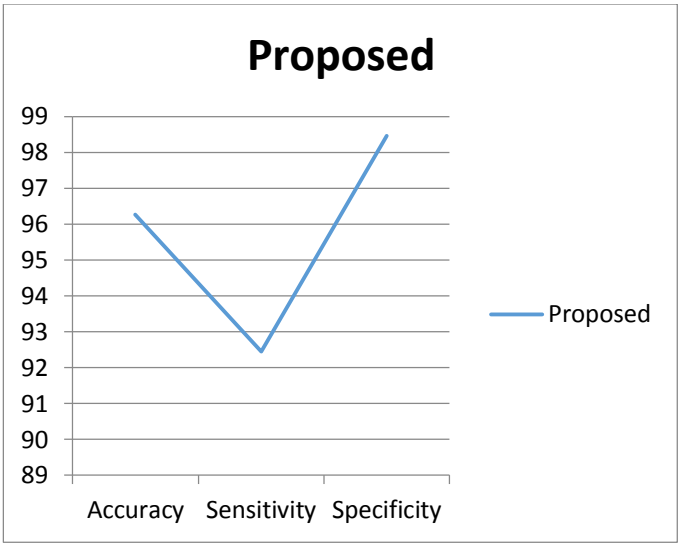


Figure 5.5 Proposed method results

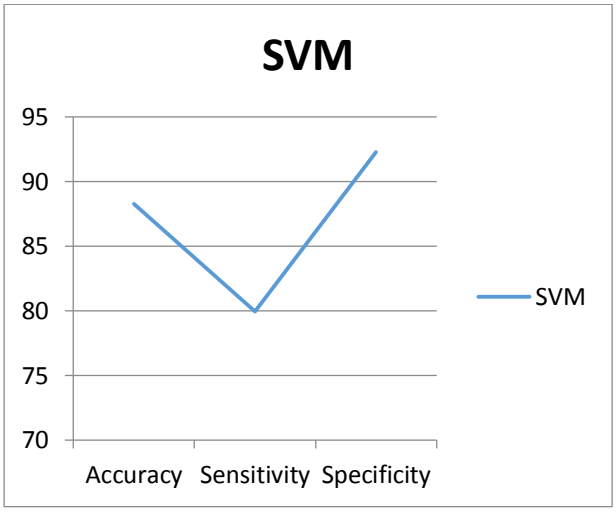


Figure 5.6 SVM Results

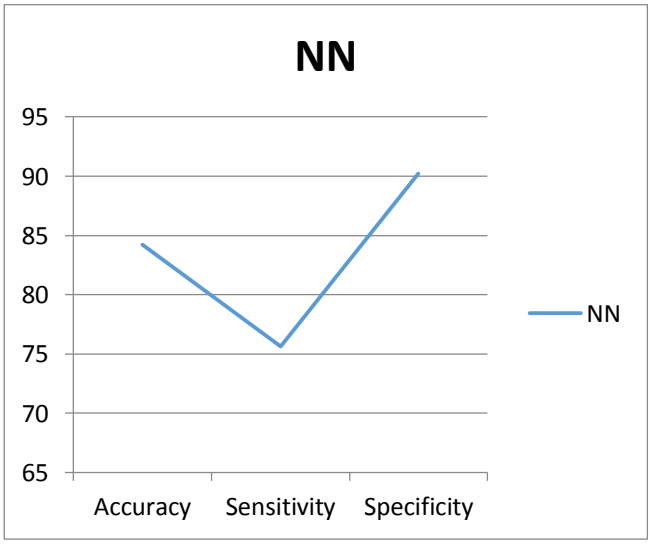


Figure 5.7 Neural Network Result

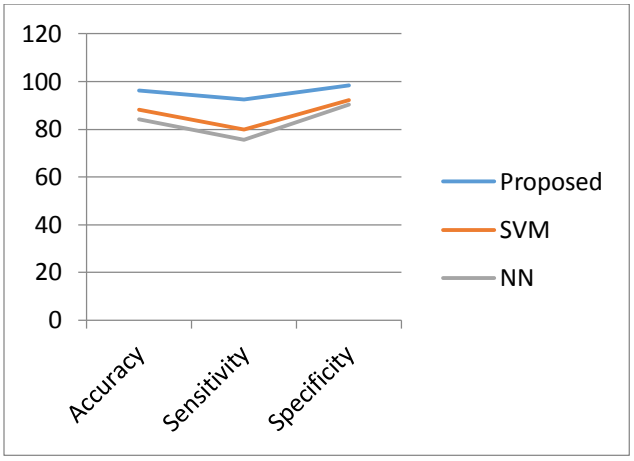


Figure 5.8 Comparison with proposed method

IV CONCLUSION

Computer aided design for mammography is heavily studied problem that gives its potential for large real world imact. This field is also like others due to transistioning of hand engineered feature to feature learned in deep learning framework. defined the concept of mammography its advantages and limitations in detail. Mammography is the medical image that uses to view inside the breast, and mammogram is the early identification and diagnosis of cancer in women. This research work based on the concept of deep learning in which we use convolution neural network of optimal and effective outcomes. In CNN, input layer, feature extraction layer, and classification layer are the building blocks of the CNN architectures. While there have been many efforts to apply dep learning to the sub components of the mammography pipeline, here we are concerned with full image classification. This process gives the high resolution and relatively small ROIs but effectively desigining is an end to end challenging task.. In the proposed approach false positive is reduced when compare to other existing approach like SVM and neural network.

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