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Deep Learning for Early Diagnosis of Breast Cancer Using Mammogram Images

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Abstract:

Breast cancer is one of the frequent diagnosis diseases among women. The X-ray mammography is the main test used for screening of detection of breast cancer with early diagnosis, and its analysis and processing are the keys to improving breast cancer diagnosis. The problem with mammography images are complex and usually of low contrast and noisy. Therefore, detection of cancerous lesions in mammogram images becomes an active research area. Mammogram image is input to the system then different pre-processing phases are performed.

Then Segmentation of image is done. In this we have applied two different algorithm, sliding window algorithm and dispersed region growing algorithm for removing pectoral muscle and finding the region of interest respectively. Segmented image given to Deep Convolution neural network(DCNN). Based on the feature extraction, classification of tumor is done stages wise and corresponding treatment is suggested.

Keywords— Deep learning, breast cancer, mammogram images, pre-processing, image segmentation, classification.

"1. Introduction"

Breast cancer is the second leading cause of cancer deadliest after lung cancer in women according to World Health Organization (WHO).The ratio of death from breast cancer have been decreasing since about 1980s for the women less than 50 year-old. These decreases are believed to be the result of screening technology and awareness. The factors that may cause breast cancer and may accelerate growth of the cancer type. Early diagnosis of breast cancer at initial stages is very important in treatment. In contrast, late diagnosis and wrong treatment of this cancer type reduces both the life time and life quality of patients. Awareness and some clinical treatments may not be enough for early diagnosis of breast cancer. There is a need for more objective criteria in order to definitive diagnosis of the breast cancer. In this context, development of computer aided diagnostic systems has great importance as a secondary assisted/reader systems. Determining the aggressiveness of cancer and detecting the grade of the cancer by using CNN systems may facilitate the studies of clinical experts. Breast cancer is uncontrolled growth of breast cells. It is not only found in breast cells but also in many parts of the body. It forms lumps in the ducts which carry milk.

A small number of cancers start in other tissues in the breast. There are different stages of breast cancer. It is always found that the detection of cancer at the first stage can cure it. A sample image is taken as an input and compared with the images already stored in database detected with cancer.

"2. Motivation"

Early diagnosis of breast cancer at initial stages is very important in treatment. In contrast, late diagnosis and wrong treatment of this cancer type reduces both the life time and life quality of patients. Awareness and some clinical treatments may not be enough for early diagnosis of breast cancer. There is a need for more objective criteria in order to definitive diagnosis of the breast cancer. In this context, development of computer aided diagnostic systems has great importance
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"3. Proposed System"

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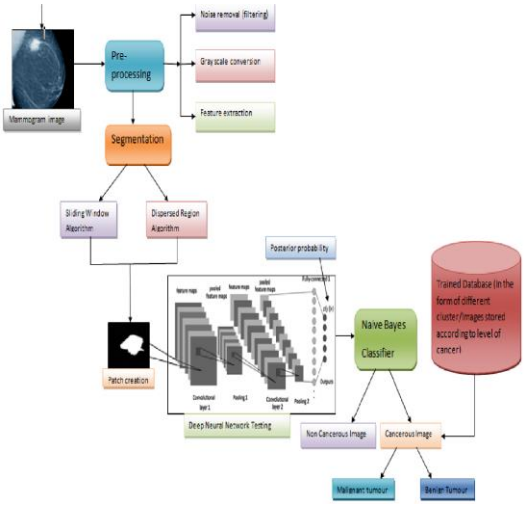


Figure 1. Architecture of Proposed System

Description

Input Mammogram image

For the system our input will be mammogram image; Mammogram is a radiological tool used to image breast tissue, it detects classification, cysts, fibro adenoma (non-cancerous breast lumps) and cancer and is currently one of the standard screening tools for early detection of breast cancer. Mammography, the present "Gold Standard" for breast imaging, is the most widely used method to screen asymptomatic women for early detection of breast cancer. It gives the anatomical structure of a lesion.

Pre-processing

1. Gray scale

Grayscale is a range of shades of gray without apparent color. Converting a color image into gray scale image following 3 steps:

1. Take the RGB value of the pixel.
2. Find the average of RGB

Avg= (R+G+B)/3

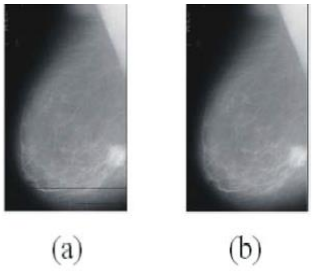
3. Replace the R,G and B value of the pixel with Avg.

2. Noise removal

Noise reduction is the process of removing noise from a signal.

$D=\arg\min\|I-d\|2+\lambda\|f(d)\|1$

Where, DD is de noised image, II is noisy image, ff is transformation operator (e.g. DFT matrix) and λλis regularization factor. The first term tries to make DD closer and closer to original image, and the second term tried to keep DD as sparse as possible. Through solving the above problem, we would remove noise from the image.



(a) (b)

Fig. 11: (a) Original image (b) Filtered image after noise removal

Figure 2. Noise removal

3. Feature Extraction

The term "Feature Extraction" deals with extracting feature such as energy, entropy randomness, correlation, homogeneity.

$$\text{Energy}= \sum_{i,j=0}^{N-1}(P_{i,j})^2$$

$$\text{Contrast}= \sum_{i,j=0}^{N-1}P_{i,j}(i-j)^2$$

$$\text{Homogeneity}= \sum_{i,j=0}^{N-1}\frac{P_{i,j}}{1+(i-j)^2}$$

$$\text{Correlation}= \sum_{i=1}^{N}\sum_{j=1}^{N}\frac{(i-m_r)(j-m_c)P_{ij}}{\sigma_r\sigma_c}$$

$$m_r=\sum_{i=1}^{N} i\sum_{j=1}^{N}P_{ij} \qquad m_c=\sum_{j=1}^{N} j\sum_{i=1}^{N}P_{ij}$$

Here, N is the number of rows/columns of image matrix Q, Pij is the probability that a pair of points in Q will have values (Ni, Nj) , mr and mc are the mean of rows and columns respectively, and are the standard deviation of rows and columns respectively.

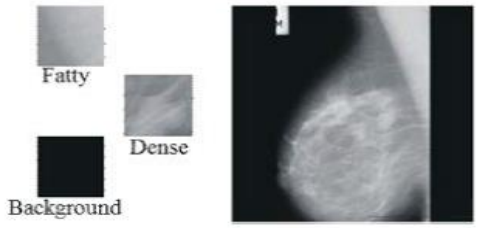


Figure 3. Feature Extraction

Segmentation

Segmentation plays a major role in breast cancer analysis form mammograms. The segmentation process is used to take out the region of interest(ROI) form mammogram. For that purpose following two algorithms are used:

1. Sliding Window Algorithm (SWA) : Sliding Window Algorithm (SWA) is used for removal of pectoral muscle from

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mammograms which is necessary as the intensity values of pectoral muscles are similar to that of ROI which makes it difficult to separate out.

INPUT:
I, WinSize, WinSumT, WinCornerT
I =Query Image
WinSize= size of window
WinSumT=max intensity
WinCornerT=min intensity
OUTPUT: O

1. Dispersed Region Growing Algorithm (DRGA): Dispersed Region Growing Algorithm (DRGA) is used for segmentation of mammogram which disperses seeds in different regions instead of a single bright region.

INPUT: I, DistT, MaxSeeds, MeanRegT
I =Query Image
DistT=max distance
Maxseeds=mpre than 1 seed having less value of DistT
MeanRegT=intensity and mean intensity of growing region specified
OUTPUT : i
i= l is the output segmented image having ROI.

Deep convolutional Neural Network

CNN contain convolutional layer, pooling layer, fully connected layer. Each layer can learn features at a different level of abstraction. However, training neural networks with multiple hidden layers can be difficult in practice. One way to effectively train a neural network with multiple layers is by training one layer at a time.

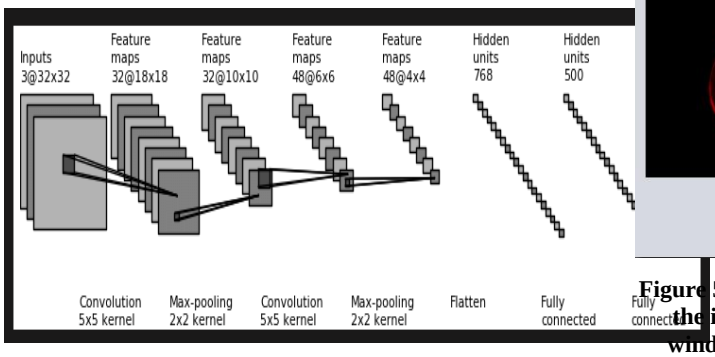

Figure 4. Layerd Architecture Of Convolutional Neural Network

Severity of Tumour

After applying classifier we will get result either cancerous image or non cancerous image. If the image is belong to cancerous image then it will be compare with the trained database (which is stored in the form of cluster i.e. Images stored according to the severity (level) of cancer). If input images are matches with trained database image then result will be generated accordingly and treatment will suggested according to severity of cancer

"4. Result"

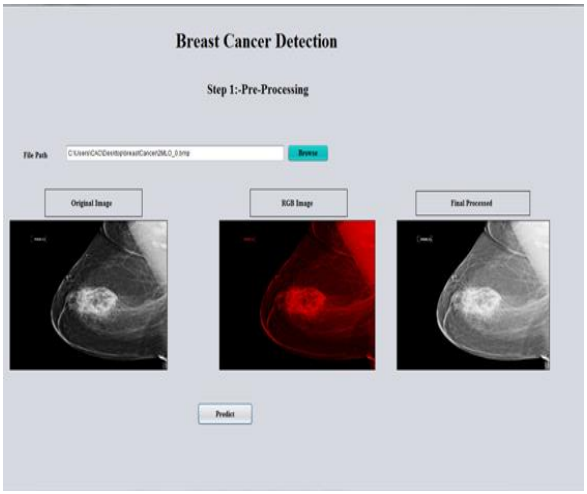

Figure 4. Browse the mammogram image and click on given predict button.

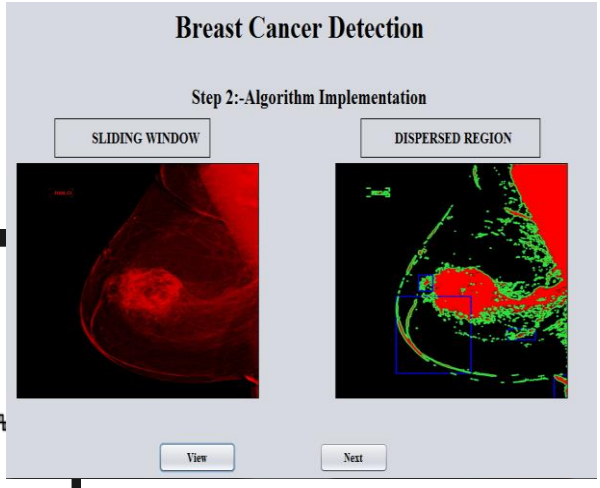

Figure 5. After clicking on predict button it will display the images after segmentation algorithms(sliding window algorithm and disperse region algorithm)

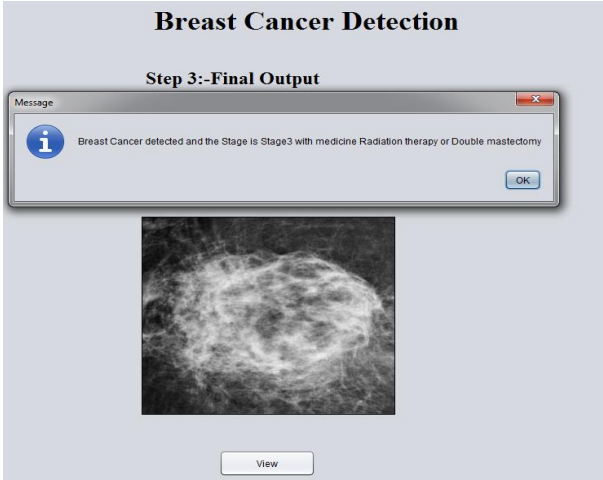

Figure *6.* After clicking on next button it will display the tumor stage and according to stage it will suggest the treatment.

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