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Breast Cancer Detection through Mammography Images Using Deep Learning

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Abstract - *Breast cancer is second amongst almost all types of cancers. It occurs more in woman than in men globally. Many people in the underdeveloped countries are suffering more due to inadequate resources, limited healthcare infrastructure etc. There is always a need for enhancement in the field of medical imaging to solve major problems.*

Deep learning play a major role in the medical imaging process. Deep learning is a family of machine learning techniques which is more used in medical imaging and also other fields. Here we use CNN algorithm for the efficient classification of benign and malignant cancer cells. After the cancer is detected the cancer stage is depicted using Corner Harris detection method and edge detection algorithm.

***Key Words*: CNN, fully connected, malignant, benign, mammography images**

1.INTRODUCTION

Cancer is a disease caused due to uncontrollable division of cells. This division of cells forms lumps which are called tumors. These tumors are of two types: Benign tumors and Malignant tumors. Benign tumors are those which doesn't contain cancerous cells whereas Malignant tumors are those which have cancerous cells. Breast cancer occurs more in women than men. Initial stages of breast cancer gives no pain and hence its asymptomatic and non-detectable which leads to deaths. Biopsy is the only traditional existing method to detect the existence of cancerous cells. Biopsy is a method in which a part of the human tissue is taken and tested for presence of cancerous cells. During this testing phase of cancer the patient's condition can become critical. Also Biopsy is a time consuming process as it needs almost 2-3 months for testing and it is very expensive. So here we develop a desktop application where a patient's mammographic image is given as input and our system predicts the presence or absence of cancer using convolutional neural networks algorithm. In addition to it, our system also detects different stages of cancer, preferred treatments and their life expectancy.

1.1 Challenge

Build an algorithm to automatically identify whether a patient is suffering from breast cancer or not by looking at mammography images. The algorithm had to be extremely accurate because lives of people is at stake.

1.2 Methodology :

Mammography image of a patient is given as input for our system. The data set was then divided into training and testing data. Training data constituted 70% of the data. The training data set was then pre processed using masking and segmentation. The input images to be preprocessed were 1024X1024 which were resized to 255X255.Noise was eliminated by applying morphological activities like binarization and concealing to extricate the Region of Interests (ROIs). The data set taken was broadly classified into two group normal and abnormal. The normal images were noncancerous images, these images were generally circumscribed masses with irregular shapes which could be malignant. The cancerous images were categorised into 4 categories, first, asymmetry where mammographic images showed increased density. Second ,architectural distortion where in abnormal arrangement of tissues can be seen. Third ,calcification where in small calcium deposits can be seen and identified . Fourth where speculated mass which is a mass with poorly defined margins and edges was included.

In CNN the first layers are used as feature mapping to extract the required features. Last layer can make extremely definite characterization by blending each one of the highlights recognized by the past layers. DCNN contains 7 layers with weights as displayed in fig., the initial four layers are convolutional layers and the excess 3 are fully connected layers. The contributions of the DCNN are gray scale pictures. Every neuron figures a spot result of weights to the local area which is associated with the input volume. We have utilized 4, 16 and 80 number of channels of size (2, 3, 5), padding of size (3, 2, 1) along all edges of the information layer. Filter size indicates filters of height 3 and width 3. Each channel is slided across the width and height of the input. Two pooling layers are utilized which performs down sampling to limit the calculation and improve the strength. Softmax Layer is for the most part utilized in the last layer of a CNN based classifier. Learning rate characterizes the progressions of weights on each epoch for example learning rate decides larger weight changes on each epoch and the network learns faster and vice versa. We have utilized learning pace of 0.01.

1.2.1 Data Collection

The data collection process involves the selection of quality data for analysis. Here we used ICIAR2018_BACH_dataset from https://iciar2018-challenge.grand-challenge.org/Dataset/ for deep learning implementation.

Fig 1 CNN Layers

1.2.2 Data preprocessing

The purpose of preprocessing is to convert raw data into a form that fits deep learning. Structured and clean data allows to get more precise results from an applied deep learning model. The technique includes data formatting, cleaning, and sampling for text data. Gray color conversion, segmentation and size reduction are some of the pre-processing techniques for image dataset.

1.2.3 Model training

After the collected data has preprocessed and split it into train and test can proceed with a model training. This process entails "feeding" the algorithm with training data. An algorithm will process data and output a model that is able to find a target value (attribute) in new data, an answer you want to get with predictive analysis. The purpose of model training is to develop a model

1.2.4 Model evaluation

The goal of this step is to develop the simplest model able to formulate a target value fast and well enough. The model tuning helps to optimize the model

parameters to achieve an algorithm's best performance.

1.3 Implementation

According to the CNN architecture, we should analyze the layers of Convolutional Neural Network step by step :

Step 1 : Input

The input must be in the shape of [WIDTH,HEIGHT,CHANNELS].

Step 2 :Convolution

This layer creates feature maps for feature extraction. we begin with less number of filters for lower - level feature detection. The deeper we go into the Convoluted Neural Network, the more number of filters we use to detect higher - level features. Features are detected based on scanning the input image with the filter of the given size and applying the matrix computations in order to derive a feature map. The resulting 2D grid is compared against the standard grid ,the mean values of the grids are taken are inserted into the feature map. This filter is iterated throughout the image.

Step 3 : Pooling

The goal of this layer is to reduce the size of the input image to reduce computation . Max pooling is done to reduce the size of the feature map . Pooling of the images is done to make the model tolerant towards small distortions and variations. Pooling reduces overfitting of the data. Pooling and convolution are together gives position invariant feature detection.

Step 4 : Fully Connected

In a fully connected layer, we flatten the feature maps into 1D arrays of the last convolution layer and connect every node of the current layer with the other nodes of the next layer to make a dense neural network. All the neurons in a fully connected neural network have all connections to all activations in the previous layers, as seen in regular Neural Networks and work in a similar way.

Step 5 : Image Classification

The complete image classification process can be summarized as follows:

- The input is a training dataset that consists of *6GB of* image data with an approximation of 20000 images, each labelled with one of 2 different classes.
- Then, the training set is used to train a classifier to learn what every one of the classes looks like.
- At the end, we test the quality of the classifier by testing it to predict cancer for a new set of images that it has never seen before. We will then compare the output of these images to the ones predicted by the classifier.

1.4 Results

1.4.1 Browsing page

Fig-2: Browsing Image

1.4.2 Prediction class 1

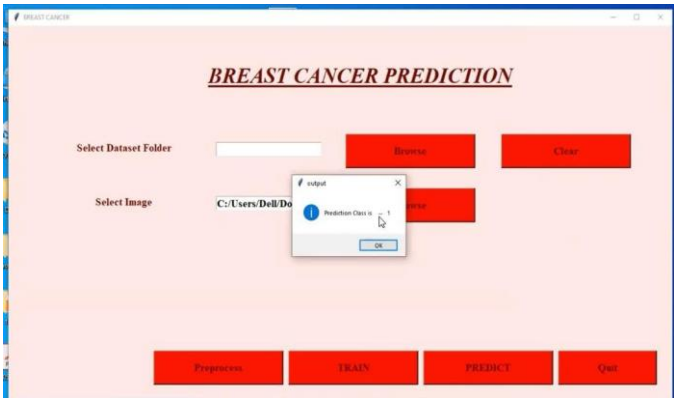

Fig-3: Prediction class 1

1.4.3 Preferred treatment

Fig-4: Preferred treatment

1.4.4 Survival rate

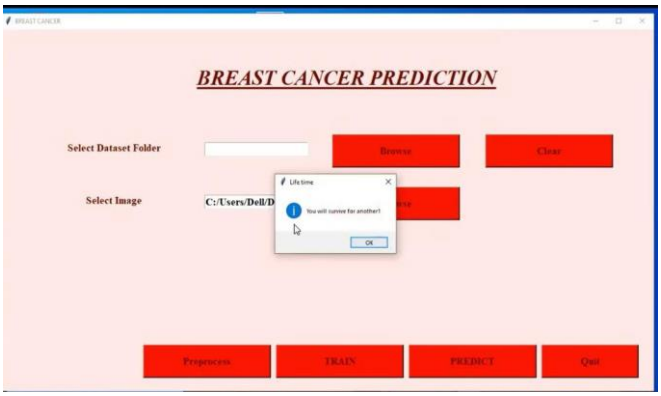

Fig-5: Survival rate

1.5 Conclusions

Convolution Neural Network with changing the parameter and testing it on dataset image of breast cancer using deep learning frame work Tensor Flow. With the help of deep learning technique and Convolutional Neural Architecture, we have extracted the features of an image and have classified the image into benign and malignant tumor. When the tumor is malignant, we have successfully determined the stage of the cancer. The model also shows the recommended treatment successfully.

It is observed that the classification accuracy mainly depends on how CNN extracts and learns the feature in different layers with the variation in parameter. In the proposed system, efficiency is 92%, still there is a room for improvement.

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