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Research Article

To Detect and Classify Breast Cancer Using Convolution Layer Depth Filter for Prediction of Disease with Feature Validation

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Abstract

Globally, the threat of Bio-war cannot be overlooked. Today, there are many popularly known biological diseases and treatments, of which few are dangerous and few are not. And breast cancer is one of them. The study proposes a model to analyze the severity of this problem and find a credible solution to it. Object detection and classification plays a major role for an in-depth analysis into neural network methods. The convolution layer helps in prediction and subsequently the features extracted from this layer are forwarded to feed forward networks. The data set is divided into two ways for the trained set and test set. Filter depth is considered as a measure to feature extraction with utmost quality. Breast histopathology helps in confirmation of the presence of cancerous cells but it is time consuming.

Keywords: Breast Cancer, Convolution, Feature Extraction, Filter,

1. INTRODUCTION

Cancer is an uncontrolled growth of abnormal cells that forms lump of tissue. Generally, tumors can be either benign or malignant type. The former type is localized and grows gradually but the latter grows rapidly and invades the adjacent structures of the body. There are many warning signs of the breast cancer such as hurting, bumps, swelling in the breast or the underarm while others may suffer with the changes in the nipple area. The symptoms will vary from person to person. Early detection of Breast cancer is important and can save lives. Processes such as mammography, Ct-SCAN, histopathology are some of the existing methods for early detection. Technological advancements with The Computer-Assisted Diagnosis monitoring system play a vital role in the diagnosis and analysis of the suspected areas. Method like CADM allows to minimize human error probability and expedite the analysis process which otherwise would be very time consuming and tedious. CADM does not however suppress the human role but it provides a second opinion that can enhance the analytical capabilities [11].

As per biopsy procedure, an affected piece of breast tissue is extracted through surgery or with pine needle absorption and examined under microscope. The nuclei are colored either purple/blue and protein is stained with eosin to pink color for obtaining cytoplasm. In histopathology, hematoxylin and eosin are two mark protocols studied under these criteria.

Analyzing breast cancer cells differs from patient to patient. It varies depending on sizes, shapes and densities. Hence the scanning skills, staining protocols, masking and marking

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techniques involved are different. Deep Convolution techniques efficiently extract contextual information both locally and globally. The training set with data outfit is effective which convolutes enabling multi-level filtering for extracting a feature map. Without convolution networks, many sample datasets suffer from over fitting.

Recent research demonstrated that multiple DCNNs (generally 3 to 5) perform better than a single DCNN. Resnet approach uses multiple DCNNS with concatenation feature vectors like Xception and Inception. Initially these two feature vectors are trained independently [10]

The role of width in deep learning and wide number of hidden layers are necessary in order to get guaranteed efficient feature extraction. The numbers of hidden layers are referred to as "depth filter" which consists of more filters for feature extraction. Kernel (also known as feature detector) is a filter that is used to extract the features from the images. With this, the input data is read from left to right and line by line column wise in a row. Each of the values extracted are multiplied by the value on the position.

In Inception Resnet V2, filters with different sizes operate on the same level. Large kernel represents globally distributed information while small kernel represents locally distributed information. This type of neural network is mainly depth-based and uses high number of sequential convolution blocks. The role of width in deep learning is vital and proves that sufficient wide hidden layers are needed to assure proficient feature extraction. The learning model Xception based on inception blocks makes the network wider and broader. The convolution block filters outputs followed by the point wise concatenation with convolution. An aggregation approach with integrated features from Inception Resnet and Xception will give the best result. Adopted collective learning focuses both on depth and width. It reduces the variance of the built neural network and improves the generalization of machine learning. The feature of two different models together enhances the diversity of the ensemble neural network. It was prof. Dietterich who proposed the reasons as why the ensemble learning boosts the generalization capacity. First, when a small amount of data is available, the training data might be insufficient for choosing only one learner in histopathological images. Second, representation of the search space can be extended by combining different models. Inception Resnet and Xception together improve representation of the search space. The similarities between benign and malignant tumors make the classification process tough.

II. CONVOLUTION LAYER

The purpose of convolution layer is to receive records of features in feature map. It requires less number of filters for low-level feature detection and more filters to detect high-level features. In Feature detection, 'Scanning' adds the filter of a needed size to it and apply matrix computations to derive a feature map.

Let us suppose 5×5 input matrix and a filter of matrix 3X3. (A filter is a set of weights in a matrix that are applied on an image or a matrix to acquire the required features).

Note: any functional criteria like sum, average, group are considered for calculation. It is necessary to take the sum or average of all the values while doing a convolution.

A pass through a filter can be of any depth, if a filter is having depth "d" it can go to a depth of "d" layers and convolute i.e. sum all the weights-weights x inputs of d layers. Fig. 1 describes about Levels of Convolution Filters for Feature Extraction.

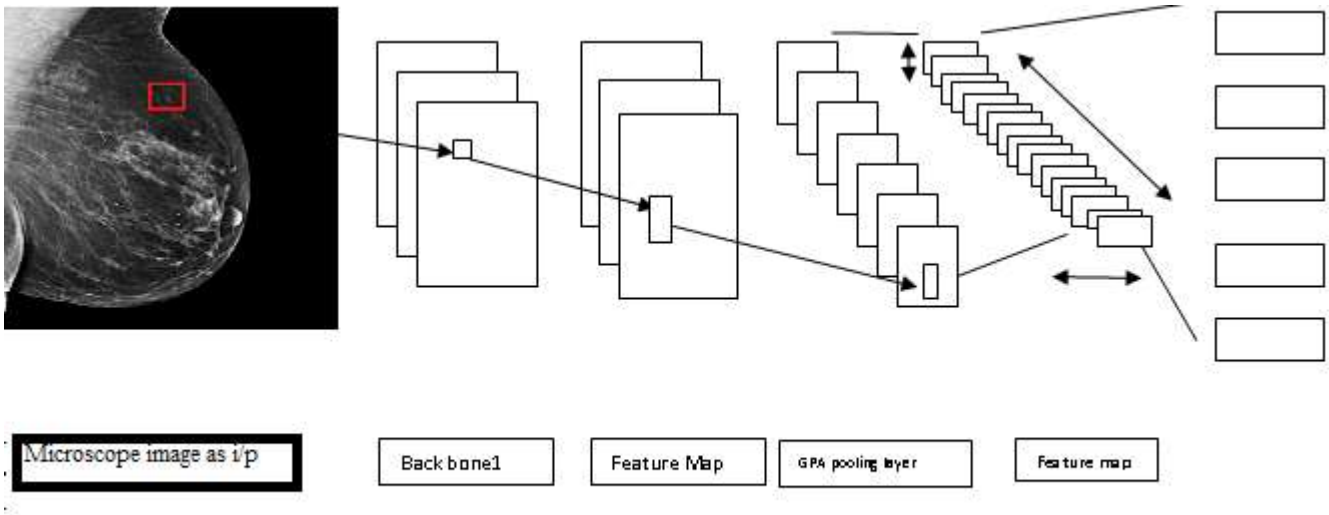

Fig. 1: Levels of Convolution Filters for Feature Extraction

Here we are predicting digits based on the input image given. The dimensions are as follows: height = 32 pixels, width = 32 pixels and depth of 1. Now we can assume whether it is a grayscale or a black and white image and based on that the output is a softmax of all the 10 values. The softmax gives probabilities or ratios for all the 10 digits and we can take the number as output with highest probability or ratio.

III. LITERATURE REVIEW

A thorough survey of various studies like deep learning, convolution neural networks, image processing and object detection are basic requirements for analyzing and predicting the presence of malicious cells in the given image.

The working of CNNs on image classification and image captioning are important in modern computer vision. CNN in connection with deep learning analyze more datasets and predict results.[1].To tune the data sets efficiently, DCNNs require more hyper parameters such as more number of round to get the correct result rate, rules for testing different test results, search methods etc. It leads to many changes in performance, robustness, and computational characteristics and in discovering more patterns [5]. CNN based approach Cancer diagnosis in histopathological image [2] achieved the result in the form of binary classification with the classification 0 and 1(where 0 for benign 1 for malignant cells). It applied multimodal fusion technique comprising of various methods like MRI scan, CT scan, ultra sound and mammographic images. The method use auto encoder to compress images without compressing data.

Support Vector Machine (SVM), GRU-SVM Linear Regression, (MLP), Nearest Neighbor search, Softmax Regression are some of the methods compared. It aims to achieve better image sensitivity, specificity values and accuracy in result [3].

Study of cancer based on incidence, patterns, trends, projections and mortality from 28 PBCRs and also their stages are presented. The type of treatment of patients with cancer from 58

HBCRs (N = 667,666) from the pooled analysis for the composite period 2012-2016 is analyzed by Prashant Mathur , DNB, PhD. Noncommunicable diseases (NCDs) are more prone to deaths and one of the types of NCD is Cancer and 9% of NCds are dangerous [7].

Huge amount of data can be handled in many ways. In deeper layers, hidden patterns can be drawn. Convolution is the mathematical operation derived from mathematical linear operation between matrices.

The Very Deep Convolutional Networks that are suitable for Large-Scale Image Recognition [8]. AlexNet took 90 epochs and trained for 6 days simultaneously on two Nvidia Geforce GTX 580 GPUs. This is the reason for their network splitting into two pipelines. Unlike AlexNet [9], inception also follows Deep convolution layers [4].

CNN is best suitable for solving complex tasks. The multiple layers available in CNN are convolution layer, pooling layer, Non-Linearity layer and fully connected layer. Represented layers may or may not significantly contain parameters but fully connected layers have parameters. Pooling and non-linearity layers do not contain any parameters. Parameters includes size of input images, classes of dataset, time to train each dataset, time to train all datasets, number of images selected in one training.

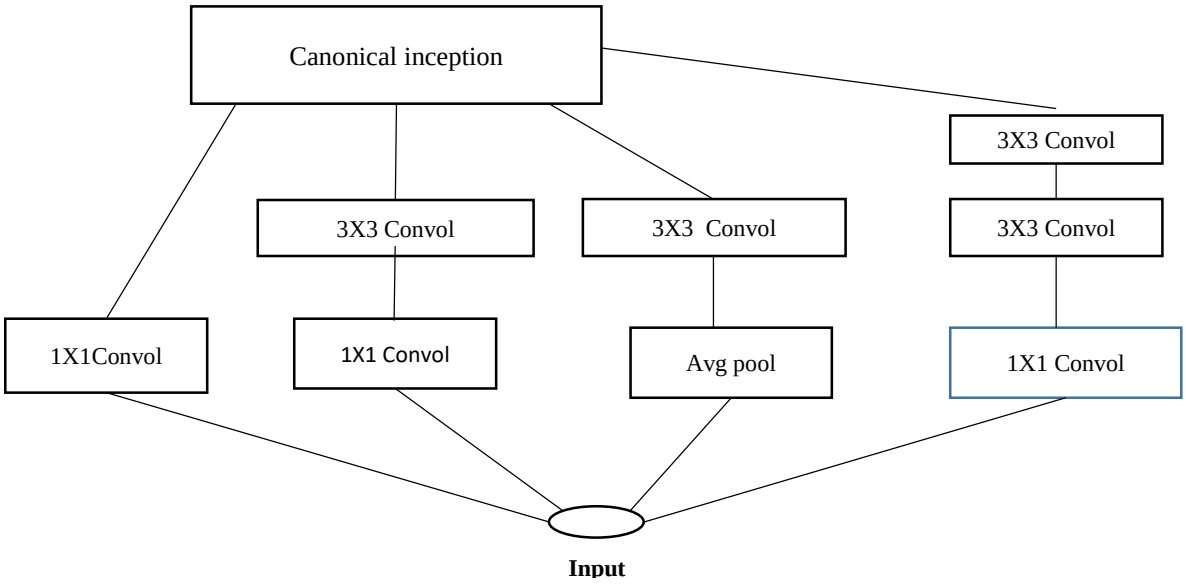

Fig. 2: canonical covered Inception module

The following is a more in-depth look into convolutions: Szegedy, Christian Wei Liu, University of North Carolina at Chapel Hill, Google Inc. Jia Yangqing Google Inc. is a technology company based in California. Sermanet, Pierre Google Inc. is a technology company based in California. University of Michigan's Scott Reed Anguelov, Dragomir Google Inc. is a technology company based in California. Erhan Dumitru Vincent Vanhoucke, Google Inc. Andrew Rabinovich, Google Inc. Google Inc. claims that better usage of resources, such as processing or networking, through virtualization is necessary to keep cost-effective devices in the network while designing devices with a budget in mind. ILSVRC14 is termed as GoogLeNet with 22 layers deep network. It is a large project for visual data base responsible for setting the

new trend for classification and detection in the ImageNet Large-Scale Visual Recognition Challenge 2014. Fig.2 describes canonical covered Inception module.

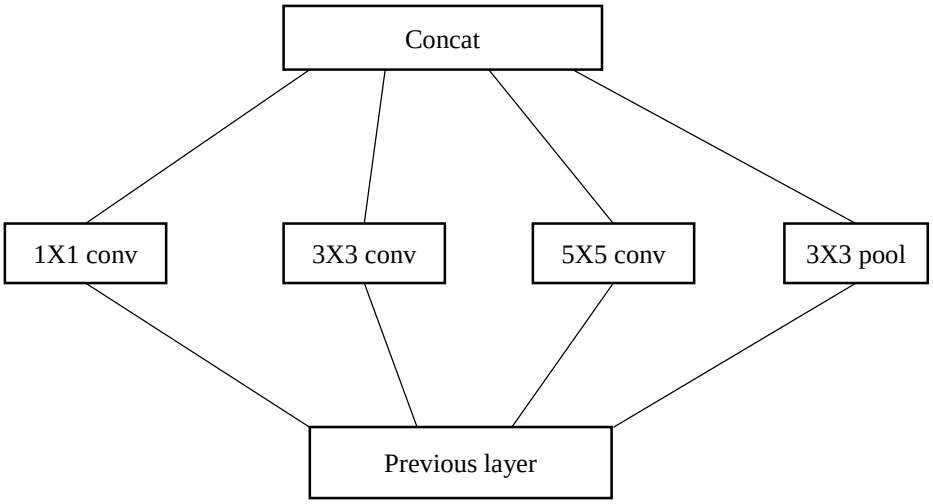

Fig. 1: Inception module of former model.

Fig.3 shows Inception module of former model, pooling layers plays an important role in the success of convolution layers. In terms of cost, point of view 1X1 convolution filters are cheaper than 3X3 convolution filters. 5X5 convolution filters are more expensive as shown in this approach of inception model. The layers are sequentially stacked one over the other and their output correlation statistics vary from one dataset to another as features of higher abstraction layers gets captured to next layers. This architecture covers the optimal thin structure very inefficiently leading to computational blow up contained in following stages.

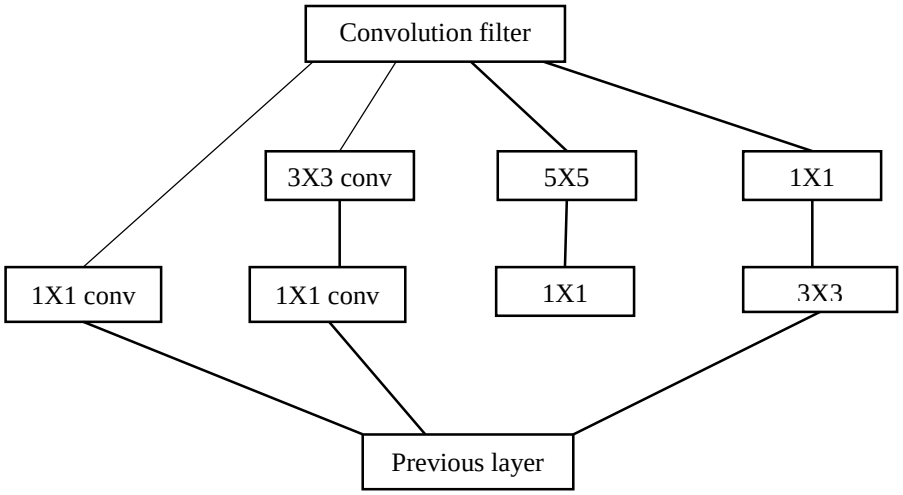

Fig. 2: Inception Model with Dimensional Reduction

Fig.4 shows about Inception Model with Dimensional Reduction, to overcome problems such as expense and over fitting, the dimension reduction approach is applied without an uncontrolled blow-up in computational complexity.

The ubiquitous use of dimension reduction makes it eligible for shielding the large number of input filters of the last stage to the next layer. Their dimensions are first reduced before convolving over them with a large patch size. Another practically useful aspect of this design is that, it aligns with the intuition that visual information should be processed at various scales and then aggregated so that the next stage can abstract many features from different shades of scales simultaneously

IV. METHODOLOGY

Fig. 5 represents the architecture of the methodology implemented in this effort. The various steps involved in a computer-aided diagnosis (CADM) system with the conventional workflow are as follows:

Image cleansing: The process of identifying pixels that are not useful can be detected and segregated as a set for future use. Removing corrupted and inaccurate records, identifying unfilled and incomplete records, malicious and proxy records from data set are part of cleansing and pre-processing. The former is known as data cleaning and latter known as polishing or scrubbing.

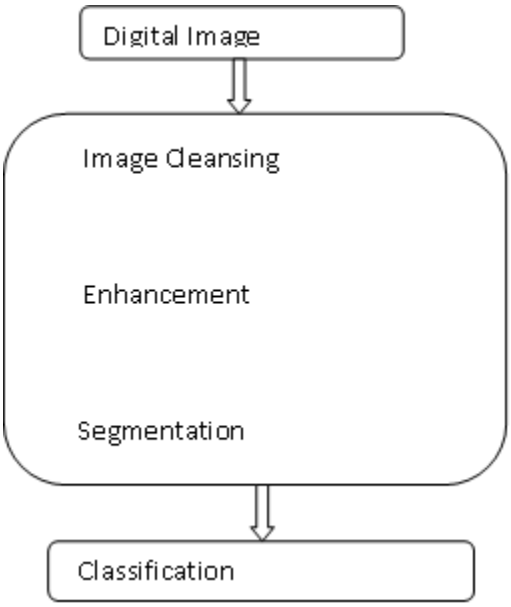

Fig. 3: architecture methodology

Enhancement: In general, the process of image enhancement is done before data cleaning. It will identify errors or scratches. It improves the quality and information of the original data and makes it easier to interpret compared to the original image.

Image segmentation: It's a good idea to segment the image as there may be unwanted data in a given image. Processing only the required data by detecting an object helps to figure out the shape of the object which can guarantee to study the cell whether it is being increased or not. The size and shape of the cancerous cell plays an important role in determining the behavior and severity of the cancer. In object detection, the pieces are put together but object detection alone

will not be very useful because the bounding boxes are not enough in identifying the shape of the cells.

Image Segmentation techniques make a huge impact. It helps in approaching the problem in a more granular manner and hence more meaningful results.

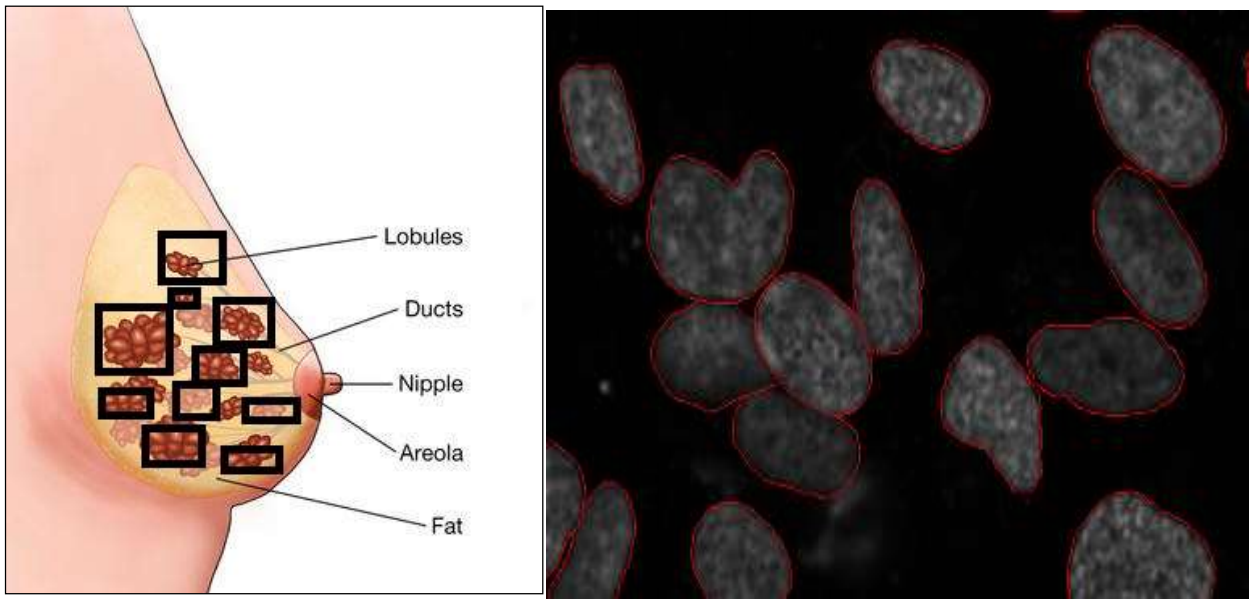

Fig. 4: Feature Extraction

Feature Extraction: Fig. 6 show results of feature extraction with deep learning based convolution neural networks. Unlike image processing which represents only the clusters with identical/different shapes, the Feature extraction with deep learning based convolution neural networks helps to identify very minute details. Features are parts or outline of an object of an image that assist to recognize. Example: Triangle has 3 corners and three edges which are called the features of triangle.

Transform coordinates [6] of feature points using a graph neural network into local features make it easy to employ a simple inference algorithm for feature matching.

V. CONCLUSION

The representation of various methods is discussed. Implementation of the variants among deep learning methods on convolution neural network of ResNet V2 with depth filter for breast cancer image processing. Training set is classified and furthered filtered on feature extraction at various levels of layers. Test set validation enhances accuracy.

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