LUNG CANCER DETECTION USING DEEP LEARNING TECHNIQUES

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Abstract-*Lung cancer recognition and classification is the greatest way to increase the existence amount of the humans. early stage of cancer identification and providing proffer treatment can help the patient with great chance of recovery .though automatic identification lung nodule is very important work since, existing system is very time taking, expensive, and less accurate. Main objective of this paper is to classify tumours and non-tumour cells in an efficient way. Deep Learning is one of the growing technologies in the artificial intelligence and computer vision field. we are Deep Learning technology to detect the lung cell using AlexNet Architecture and convolutional neural network(CNN)layer to provide the accurate result with the help Relu activation function.by using this method we got better result as compared to the previous papers.*

Key words: Lung Cancer, Deep learning ,AlexNet, Relu ,CNN(convolutional neural network).

1.Introduction

Cancer is the key cause for increasing deaths in all over the world, "according to the WHO, it is nearly about 10million demises in 2020 are from cancer. demises are high in Lung cancer, related to other categories of cancers since it is the primary source for cancer-related deaths in all around the universe. Particularly ,1.80 million deaths in 2.21 million active cases are related to lung cancers. lung cancer is one of the hazardous cancers. Only 17% of humans are endured after the five years proper treatment. hence the lifespan rate is lesser in so many countries. The stage of cancer refers to how widely it has metalized. Preliminary phases of cancer including phase 1 and phase 2 mentions that cancer cell restricted to lung regions. conclusion phases mentions that cancer cell have spread to other tissues in the body. Present analytical approaches comprise of surgeries and imaging, such as CT scans. recognition during the former periods of lung cancer implicitly advancements the possibilities for existence, but it is also more challenging to distinguish premature periods of lung cancer as there are rarer indications[1].

The computed tomography (CT) pictures are taken from a workshop, the professional doctor takes these pictures to distinguish and recognize cancer by using dissimilar measures. all these procedures are very challenging, luxurious, and inefficient for the patients as well as for radiotherapists. to overcome all these problems, we are using deep learning concepts to detect and identify lung cancer in a patient using CT scan images. CT scan images are chosen because they are having less amount of noise compared to other types of images[2]. Input images given to pre-processing, after that we pass the data to the CNN model ,we are using AlexNet layer for training the data since it has more number

layers ,take less time to train the data. which can raise the performance and reduce charge and speed up the process.

Classification of the object is easy in the CNN, because it has many hidden layers it takes more time to train data with repeated number of times to improve the result in recognition and organization of the data. The proposed system uses the profound learning method and web html application page that takes the input image and CNN process the data lastly, output will be displayed to user.

2.Related Work

In this paper[3] CT images are taken as the input because they have high clarity compared to the other types of scan images. They applied the pre-processing step on the input image. they taken filter to the back the images under test. these filters simply replace the pixel value with filter value to restore the data. After pre-processing images are passed to the segmentation process using K means clustering. GLCM(Gray level co-occurrence Matrix) is used to extract the feature from the images .these extracted features will be passed to the classification stage .they used CNN for classification of objects. They achieved the accuracy about 96%.

In this paper[4] author used the CAD(computer-aided diagnosis) to classify the lung cells from the Kaggle data set. for segmentation they used the Thresholding method. firstly, cell portions are detected in the Kaggle data using U-Net method on LUNA16 data. Output from the nodule detection is passed to the convolutional neural network to categorize the images as malignant and benign. This method produced the accuracy of 86.6%.in this paper it only contains 3 main steps that is segmentation ,nodule detection and classification.

In this paper[5] author developed the web application, where used need to upload the input images and output will displayed to the user. He collected the dataset from the LUNA 2016 where CT scans are used as data. He used the deep learning U-Net architecture. U-Net acts as a segmentor to segment the interested region in input images .CSV Logger ,Model Check point, Learning Rate Scheduler are used to increase the training time of model. He extracted the nodules from the images and created the mask to the images used U-Net architecture. He got the accuracy about 65%.

In this paper[6] author presents the illness using the Chest images .firstly, author used the lung image Database consortium(LIDC) and Image Database Resource Initiative (IDRI)[7].median filter are used in pre-processing and segmentation to extract the interested sections from the CT images. segmented parts are passed to the CNN model it has so many layers like Convolution, Relu, pooling and fully connected layer used for train the data and classify the data according to input. finally output layer classifies and gives the result as cancerous and non-cancerous cells. the author got the accuracy is about 95%.

In this paper[8] author considered that key reason of death in cancer is lung cancer.in the beginning stage recovery rate is high with proffer treatment so that we can reduce the mortality rate. discovery of cancer cells in the lungs at initial stage is very significant to increase the existence rate of patients.in this CT images are taken because they have less noise compared to other types of images. MATLAB software is used to further process which free and public software. pre-processing and segmentation ,features

extraction and organization of images are processed using MATLAB software.by using the current process they achieved less error in recognition of lung images.

In this paper[9] author describes that unconscious recognition is very effective in many analytical methods.
Since CT images contains unclear areas it very difficult to categorization and division of lung nodules. automatic method can decrease the time and increase the accuracy of data. Author used CT images for extracting the attributes from the images he used The Dual-tree complex wavelet transform (DTCWT) and images is consisting of pixels to analyse this pixels GRAY LEVEL CO-OCCURRENCE MATRIX (GLCM) is used, for training the extracted features PNN (Probabilistic Neural network) algorithm is used it has input layer, pattern layer and summation layer. finally, for classification normal and abnormal cell PNN is used which gives accurate result and uses less time for computation.

In this paper[10] deep learning is most prevalent and influential for detecting and categorizing objects.in this project author used Lung Image Database Consortium (LIDC) dataset for classification of lung cells. Computer tomography(CT) images are segmented with help of radiotherapists. down sampling and rotation are done on dataset to maintain the accuracy.in this project they used three different deep learning algorithms to compare the accuracy of each algorithm. including convolutional neural network(CNN), Deep Belief Networks (DBNs), Stacked Denoising Autoencoder (SDAE).these models' performance are compared with existing method called CAD (computer aided diagnosis) system. The accuracy of each algorithm is CNN is 0.7976,DBNs is 0.8119 and SDAE is 0.7929.and existing CAD method accuracy is 0.7940 which is lesser than CNN and DBNs methods.

3.Metedology

In the proposed system, it mainly includes four main steps ,inputting CT images ,pre-processing of data, CNN model to extracting features ,training model with interested regions and classification, and display the result to the user as cancerous and non-cancerous.

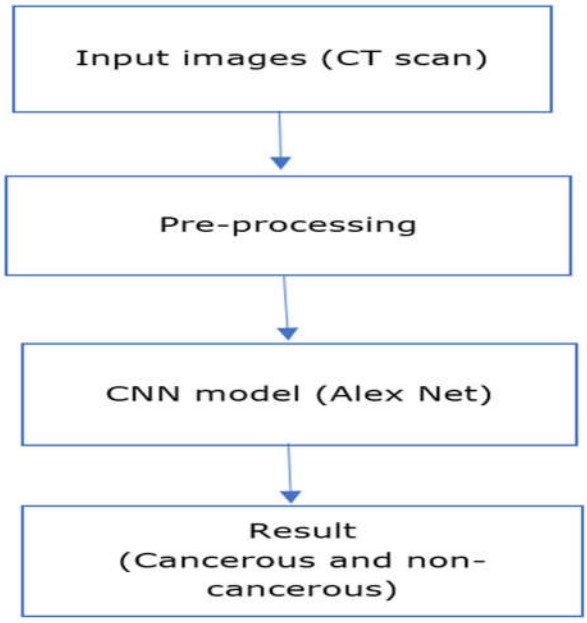

Fig 1: block diagram of lung cancer

3.1 Input images: This is the project beginning stage, where user will pass the CT scan photo as an input, we preferred CT scan pictures because it has less amount noise comparatively to MRI and X-ray pictures. clarity of the photo is high in CT scan .

3.2 Pre-processing: advancing the superiority of the pictures is the foremost determination of this step.it can be achieved using filters , misrepresentation of pictures and some attributes enrichment in the pictures. this is crucial to the supplementary processing. Though CT scan pictures has minor quantity of noise. goal of this phase to eradicate that less noise and increase the quality of the performance. median filtering is used to sustaining edges.it provides the successive outcome for image smoothing technique.

3.3 Segmentation: Image division is a procedure where; digital copy of the pictures is divided into smaller patches called Image segments. This procedure helps us to operate and examine the pictures in efficient way and reduces the complication. In this step tags are used to assign each pixel value in the picture. The attributes in the photos which belong to the same group will have same tagging value. restoring of photos is straight forward by using this tagging values.

3.4 CNN network architecture:

Alex net is the CNN(convolutional neural network) architecture which we are using in our project. CNN comprises of 5 convolutional sheets, regularization sheets, fully coupled layers and lastly SoftMax sheets.

Rectified linear Activation (Relu), is the non-linear activation function used in our structure. Relu function layer is present later the convolutional layer and previous to the pooling layer. Relu reduces the overfitting of the system. after pooling layer fully connected layer is present which classifies the data using SoftMax layer.

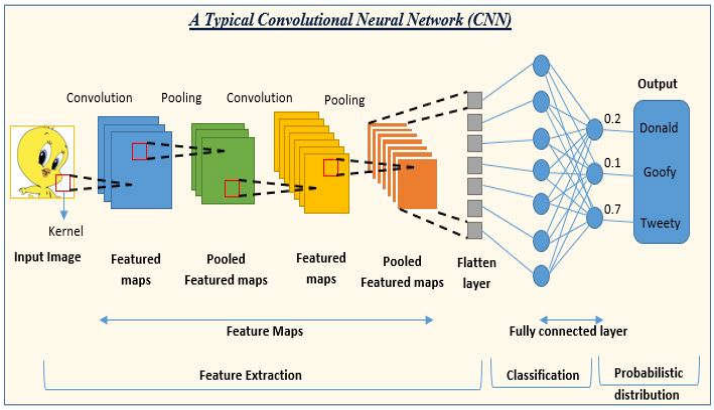

Fig 2: Architecture of convolutional neural network

Image-Input Layer:

It is the first layer in CNN ,input layer encompasses of pictures used for future process.at picture input layer users will set the magnitudes of the photos required for the procedure. Pictures are indicated as the 3-dimensional matrix. 129*129*1 is the magnitudes of images in our project. 129 is the altitude of the image , 129 is breadth of the image and 1 is number of channels in the process. 1 represents the grayscale image input information.

Convolutional Layers:

Another name of this layer is feature extraction layer. since it extracts the attributes of the pictures. Pieces of the pictures are linked with convolutional layers to perform the extract operation. during this process it estimates the dot product operation between fields and filters. Process repeats this step repetitively until it finishes the entire picture. outcome of this step is sent to further layer as an input. Relu activation function is present in convolution layers to increase the regularization.

separating measurement, the measure of networks, & padding are the arguments of this layer.In our system 10 is employed as a measurement channel. That is 10 x 10 channel description. Here, number 10 is utilized which indicates 10 neurons are connected to the network. the measurement of the expected picture and measurement of the real pictures are identical since, we are using 1 for cushioning.

ReLU activation function Layer:

AlexNet neural network consists of Relu (rectified linear unit) layer. which is mainly used in activation function.it helps in adjustment of measures by provides the clumping methods so it is called as standardization layer. Which is placed consequent to pooling layer to present a nonlinear inclination work. The consequence of this function is to raise the rapidity of preparation and reduce the affectability.

Max Pooling Layer:

In the pooling procedures this layer is utilized. This layer provides the down-sampling approaches which is applied for convolutional layer operation. after convolutional layer pooling layer is present.in the down sampling technique max pooling layer is utilized. In this proposal, the pool measurement is put to 3, and the training magnitudes evolution measurement is 3.

Fully Connected Layer:

After the max pooling layers their exist a layer called Fully connected layers. theses layer comprises partialities, masses, and nerve cell. This layer interconnects the nerve cell in present layer with future layer nerve cells. this layer key purposes are to establish the connection with all the nerve cells in the network with its previous layer nerve cells. In this system 10 is used the input dimension the layer . here, 10 designates 10 classes in the layer.

SoftMax Layer:

After fully linked layer their exist a layer called SoftMax layer . this layer benefits in regularization function.in the convolutional neural network SoftMax is the final layer. It provides the arithmetic values as the outcomes thus this layer is also termed as logistic layer.by using this arithmetic values classification layer catalogue the objects as positive and negative results. In multiclassification procedure SoftMax layer is employed. In two fold arrangement Soft max layer is utilized in the process.

Classification Layer:

In convolutional neural network Cataloguing layer is the final layer. functionality of this layer is categorizing the objects into respective subclasses. Soft max layer provides the

numeric values as an input ,this layer takes values and estimates the cost for individual functions. Classification layer easily categorize the object using probabilistic principles from earlier layer.

3.5 Alex Net Architecture:

In the Neural networks it is also one type of architecture . this network is the collection of 8 layers with parameters.it is also called as first efficient performance networks since it provides greatest accuracy. Eight layers with parameters are present in this layer. Input to this layer Lung CT image. It has max-pooling layer and 5 CNN layers to extract the attributes from the objects. two DropOut layers are utilized in this network. For classification purpose it has three fully Connected layers .Relu is the nonlinear function utilized between all the layers. Fully connected layers take SoftMax layer for activation function.

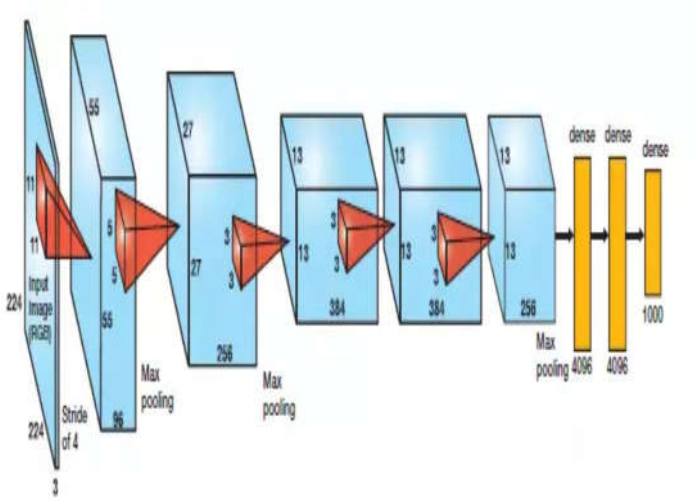

Fig 3: AlexNet Architecture

By taking help from their instructors Alex Krizhevsky designed and implemented the AlexNet network. basically, in the existing types of neural network Sigmoid procedure is utilized. but in proposed method Relu (Rectified Linear Unit) is employed in the nonlinear information parts.

Assume function of Relu is given by

$$F(x) = \text{Maximum}(0, x) \quad (1)$$

Compared to the outdated system ,Relu procedure delivers quicker training rate this is one of the advantages of using Relu. Existing system like sigmoid fails to work in the small portion ,weights rationalized for that area will be vanished. this problem sometimes we call is as vanishing gradient problem.

Cnn network consists of relu layer which is existing between pooling layer and convolutional layer. cnn also contains fully linked layer, softmax layer in the network.

Another functionality of relu is it reduces the over-fitting problem utilizing 2 dropout layers in the network. followed by the fully connected layers this dropout layers are employed. all the neurons in the networks are assigned with the probabilistic values produced by the softmax layer. with the help of this values inevitably network will switch off the function.

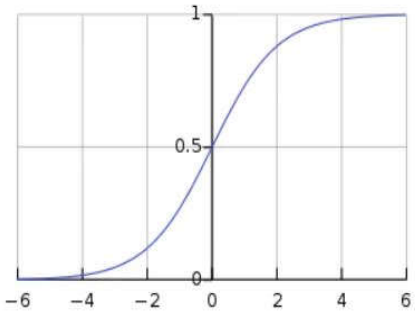

Fig 4: Relu nonlinear function

Dropout layer work:

In the advanced learning Dropout is the distinct appearances techniques. attributes of some neurons will be turned off to preceding layer by the dropout layer. Dropout layer will not pass the Neurons which are not modified to the succeeding step. several types of constructions are denoted by these layers. Weights will be assigned to all the nerve cells in the network. By using mass structures models are skilled. Input and unseen layers can utilize dropout layer only if it turns off some attributes of the nerve cell. In the training procedure dropout layer employed to diminish the overfitting of training information.

4.Results and Discussion

Deep Learning based Convolutional neural network of AlexNet system has been established .dataset is trained properly by splitting 80% training data and 20% test data. CT image is passed as the input to the system through the web application. process includes pre-processing of image ,feature extraction and classification of image as normal or abnormal cell.

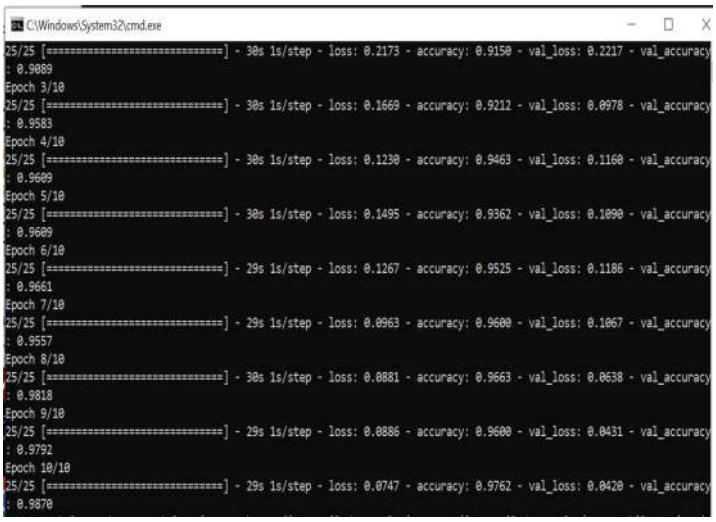

Fig 5: epochs vs loss and accuracy

In the above figure 4 ,we can see that as the number of epochs increases performance of the system also increases and loss of the model decreases slowly.

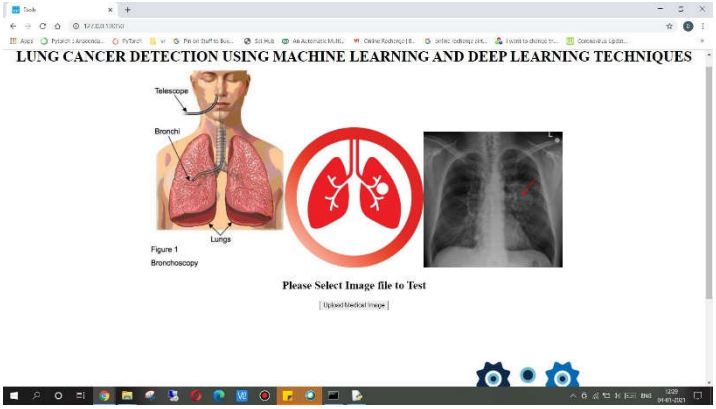

Fig 6 : web html page to upload input image

The above figure shows the html web application to upload the input images from the user .users need to click the button and select image from computer which they are interested.

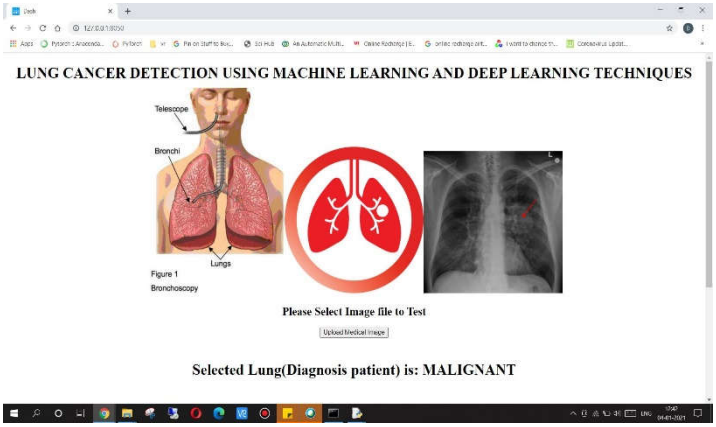

Fig 7 : displaying result in the web page

If the uploaded image contains cancerous cells output will be displayed on the web page as malignant or benign

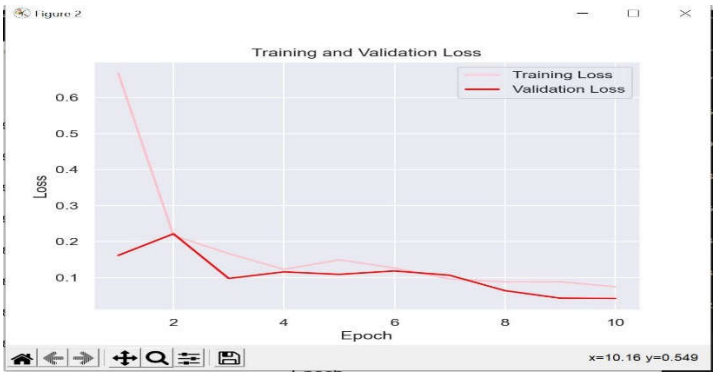

Fig 8 :Epoch vs loss graph

In the above figure we can see that as the epoch number increases the loss value decreases gradually.in the beginning both training and validation loss value is very high but after certain time it decreases.

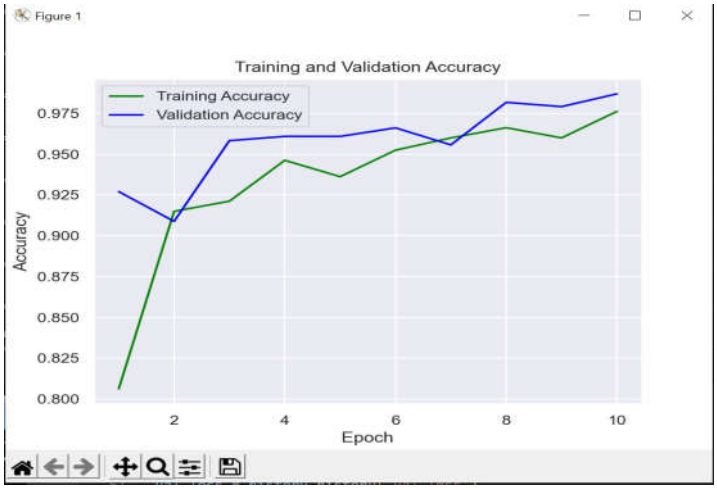

Fig 9 :Epoch vs training and validation accuracy graph

In the above figure Fig: we can see that as number of epochs increases the training and validation accuracy also increases .initially ,training accuracy is very less by training a greater number of times with more dataset we can increase the accuracy of the structure.

5.Conclusion and Future Work

Convolutional neural network system is established to detect and classify the tumour cells in the lung CT images.in this we particularly used AlexNet architecture. Because it has 5 Convolution layer ,3 pooling layer and lastly fully connected layer. training is easy and the model gives the better accuracy about greater than 97% ,which is greater compared to the previous systems.

primarily, pre-processing step along with segmentation operations are used to increase the clarity of picture. image is passed as input to convolution layer--> Relu nonlinear layer--> merging layer to extract the attributes from the object. Extracted features transmitted to the cataloguing layer called fully connected layer to catalogue the pictures as cancerous and non-cancerous cells.

Upcoming system is not specific only to recognize and categorize the cancerous and non-cancerous imageries, it can also recognize the particular location of cancer part in the image. then stress the spot of cancer part. Other future work may be to extend our work to detect other categories of tumour cells . And use of more 3D datasets and applying regularization methods to reduce the overfitting and improve accuracy.

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International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 Published by, www.ijert.org RTICCT - 2019 Conference Proceedings

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