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LUNG CANCER PREDICTION IN LUNG CT SCAN IMAGE USING CONVOLUTIONAL NEURAL NETWORK

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Abstract: More number of deaths occurring every year due to a common health issue cancer. It is one of the diseases distributed over large area. Among all, lung cancer is most predominant having high death rate. Hence this is most important and a lot of research is going on and to identify lung cancer CT (Computed Tomography) scanned images are used. They provide a picture detailed with growth of tumor and tracks its growth in body so it is better by providing good results compared to other techniques. Therefore in medical fields most of the image processing techniques are used to detect the cancer in its early stages .In this paper we present an approach to detect lung cancer in scanned images. Finally, the experiment result shows the accuracy performance of our proposed method.

***Index Terms* - Component, formatting, style, styling, insert.**

I. INTRODUCTION

LUNG CANCER is one of the most dangerous disease of the present world and the principal cause of deaths worldwide in last few decades. It is also responsible for more deaths per year than breast, prostate and colon cancer combined. One of the main reasons of lung cancer is the addiction of smoking cigarettes. Lung malignant growth is one of the most well-known tumors, representing more than 225,000 cases, 150,000 passing's, and $12 billion in social insurance costs yearly in the U.S. Determined to have lung malignant growth endure five years after the determination, and the endurance rate is lower in creating nations. The phase of a malignant growth alludes to how broadly it has metastasized. Stages 1 and 2 allude to tumors limited to the lungs and last stages allude to malignant growths that have spread to different organs. Current diagnostic methods include biopsies and imaging, such as CT scans. Early detection of lung cancer (detection during the earlier stages) significantly improves the chances for survival, but it is also more difficult to detect early stages of lung cancer as there are fewer symptoms Lung malignant growth is one of the hazardous illnesses on the planet that taking human life quickly. The passing of the individuals is expanding exponentially in light of lung malignant growth. A human's life, the lung disease recognition and determination framework are required II. Proposed Method The structure of the proposed approach is represented in the below image . Image acquisition is considered as the first step of the method. The identification of using images consists two processes: First one is pre-processing and the another is post-processing.

EXISTING METHOD VS PROPOSED WORK

In this Existing method, we compare and evaluate different testing protocols used for automatic lung diagnosis from X-Ray images in the recent literature. In our proposed system, the basic idea is to leverage the information given from Kaggle dataset. The fairness of a testing protocol using our tools and we encourage researchers to look for better techniques We show that similar results can be obtained using X-Ray images that do not contain most of the lungs. We are able to remove the lungs from the images turning to black the center of the X-Ray scan and training our classifiers only on the outer part of the images. We deduce that several testing protocols for the recognition are not fair and that the neural networks are learning patterns in the dataset that are not correlated to the presence of lung affected or not. We show that creating a fair testing protocol is a challenging task, and we provide a method to measure how fair a specific testing protocol is. In the future research we suggest to check than the ones that we propose. Since we use two datasets, a preprocessing step ensures that they are in the same field. The segmentation of lung tissues on chest images is an important step to reduce the search space, Kaggle datasets. Next, detection and segmentation of lung nodules from the available search space. This is achieved by using kaggle dataset, as it provides us with cancerous regions in the lungs. This is then fed to the Kaggle dataset to locate cancerous regions. The classification of the detected modules into malignan and benign is the final step.

I. ARTIFICIAL NEURAL NETWORKS

. In computer science , artificial intelligence (AI), sometimes called machine intelligence, is intelligence demonstrated by machines , in contrast to the natural intelligence displayed by humans. Leading AI textbooks define the field as the study of "intelligent agents " any device that perceives its environment and takes actions that maximize its chance of successfully achieving its goals. Colloquially, the term "artificial intelligence" is often used to describe machines (or computers) that mimic "cognitive" functions that humans associate with the human mind , such as "learning" and problem solving". As machines become increasingly capable, tasks considered to require "intelligence" are often removed from the definition of AI, a phenomenon known as the AI effect . A quip in Tester's Theorem says AI is whatever hasn't been done yet." For instance, optical character recognition is frequently excluded from things considered to be AI , having become a routine technology. Modern machine capabilities generally classified as AI include successfully understanding human speech , competing at the highest level in strategic game systems (such as chess and Go), autonomously operating cars , intelligent routing in content delivery networks , and military simulations .

Artificial intelligence was founded as an academic discipline in 1955, and in the years since has experienced several waves of optimism, followed by disappointment and the loss of funding (known as an AI winter), followed by new approaches, success and renewed funding. For most of its history, AI research has been divided into subfields that often fail to communicate with each other. These sub-fields are based on technical considerations, such as particular goals (e.g. "robotics " or " machine learning "), the use of particular tools ("logic" or artificial neural networks), or deep philosophical differences. Subfields have also been based on social factors (particular institutions or the work of particular researchers). The traditional problems (or goals) of AI research include reasoning , knowledge representation , planning , learning , natural language processing , perception and the ability to move and manipulate objects. General intelligence is among the field's long-term goals. Approaches include statistical methods , computational intelligence , and traditional symbolic AI . Many tools are used in AI, including versions of search and mathematical optimization , artificial neural networks , and methods based on statistics, probability and economics .

The AI field draws upon computer science , information engineering , mathematics , psychology , linguistics , philosophy , and many other fields.

II . DEEP LEARNING

Deep learning (also known as deep structured learning or differential programming) is part of a broader family of machine learning methods base on artificial neural networks with representation learning . Learning can be supervised , semi-supervised or unsupervised .

Deep learning architectures such as deep neural networks , deep belief networks , recurrent neural networks and convolutional neural networks have been applied to fields including computer vision , speech recognition , natural language processing , audio recognition , social network filtering, machine translation , bioinformatics , drug design , medical image analysis, material inspection and board game programs, where they have produced results comparable to and in some cases surpassing human expert performance. Artificial neural networks (ANNs) were inspired by information processing and distributed communication nodes in biological systems.

ANNs have various differences from biological brains . Specifically, neural networks tend to be static and symbolic, while the biological brain of most living organisms is dynamic (plastic) and analog. In deep learning, each level learns to transform its input data into a slightly more abstract and composite representation. In an image recognition application, the raw input may be a matrix of pixels; the first representational layer may abstract the pixels and encode edges; the second layer may compose and encode arrangements of edges; the third layer may encode a nose and eyes; and the fourth layer may recognize that the image contains a face. Importantly, a deep learning process can learn which features to optimally place in which level on its own. (Of course, this does not completely eliminate the need for hand-tuning; for example, varying numbers of layers and layer sizes can provide different degrees of abstraction.) The word "deep" in "deep learning" refers to the number of layers through which the data is transformed.

III . CONVOLUTIONAL NEURAL NETWORKS

Convolutional neural network is one of the most popular ANN. It is widely used in the fields of image and video recognition. It is based on the concept of convolution, a mathematical concept. It is almost similar to multi-layer perceptron except it contains series of convolution layer and pooling layer before the fully connected hidden neuron layer. It has three important layers:

- Convolution layer.
- Pooling layer.
- Fully connected layer.

A) Convo layer (CL)

Convo layer is sometimes called feature extractor layer because features of the image are get extracted within this layer. First of all, a part of image is connected to Convo layer to perform convolution operation as we saw earlier and calculating the dot product between receptive field (it is a local region of the input image that has the same size as that of filter) and the filter. Result of the operation is single integer of the output volume. Then we slide the filter over the next receptive field of the same input image by a Stride and do the same operation again. We will repeat the same process again and again until we go through the whole image. The output will be the input for the next layer. Convo layer also contains RLU activation to make all negative value to zero.

B) Pooling Layer(PL)

Pooling layer is used to reduce the spatial volume of input image after convolution. It is used between two convolution layer. If we apply FC after Convo layer without applying pooling or max pooling, then it will be computationally expensive and we don’t want it. So, the max pooling is only way to reduce the spatial volume of input image. In the above example, we have applied max pooling in single depth slice with Stride of 2. You can observe the 4 x 4 dimension input is reduce to 2 x 2 dimension. There is no parameter in pooling layer but it has two hyper parameters Filter(F) and Stride(S). In general, if we have input dimension
W1 x H1 x D1, then

$$W2 = (W1 - F)/S + 1$$
$$H2 = (H1 - F)/S + 1$$
$$D2 = D1$$

Where W2, H2 and D2 are the width, height and depth of output.

C) Fully Connected Layer (FC)

Fully connected layer involves weights, biases, and neurons. It connects neurons in one layer to neurons in another layer. It is used to classify images between different categories by training.

IV . K-NEAREST NEIGHBOR

K-Nearest Neighbors is one of the most basic yet essential classification algorithms in Machine Learning. It belongs to the supervised learning domain and finds intense application in pattern recognition, data mining and intrusion detection. It is widely disposable in real-life scenarios since it is non- parametric, meaning, it does not make any underlying assumptions about the distribution of data (as opposed to other algorithms such as GMM , which assume a Gaussian distribution of the given data). K-Nearest Neighbor is one of the simplest Machine Learning algorithms base on Supervised Learning technique K-NN algorithm assumes the similarity between the new case/data and available cases and put the new case into the category that is most similar to the available categories. K-NN algorithm stores all the available data and classifies a new data point based on the similarity. This means when new data appears then it can be easily classified into a well suite category by using K- NN algorithm. K-NN algorithm can be used for Regression as well as for Classification but mostly it is used for the Classification problems. K-NN is a non-parametric algorithm, which means it does not make any assumption on underlying data. It is also called a lazy learner algorithm because it does not learn from the training set immediately instead it stores the dataset and at the time of classification, it performs an action on the dataset. KNN algorithm at the training phase just stores the dataset and when it gets new data, then it classifies that data into a category that is much similar to the new data. For Example, Suppose, we have an image of a creature that looks similar to cat and dog, but we want to know either it is a cat or dog. So for this identification, we can use the KNN algorithm, as it works on a similarity measure. Our KNN model will find the similar features of the new data set to the cats and dogs images and based on the most similar features it will put it in either cat or dog category.

V . CONCLUSION

The accuracy of classification of the CT scans is calculated for the developed deep convolutional neural network (CNN) architecture to detect nodules in patients of lung cancer and detect the interest points using CNN architecture. This step is a pre-processing step for CNN. The deep CNN models performed the best on the test set. While we achieve state-of-the-art performance AUC of 0.97, precision of 0.87 and recall of 0.74. The model has a specificity of 0.97. We perform well considering that we use less labeled data than most state-of-the-art CAD systems. As an interesting observation, the first layer is a pre-processing layer for segmentation using different techniques. Threshold, Watershed, and U-Net are used to identify the nodules of patients. The network can be trained end-to-end from raw image patches. Its main requirement is the availability of training database, but otherwise no assumptions are made about the objects of interest or underlying image modality. In the future, it could be possible to extend our current model to not only determine whether or not the patient has cancer, but also determine the exact location of the cancerous nodules. The most immediate future work is to use Watershed segmentation as the initial lung segmentation. Other opportunities for improvement include making the network deeper, and more extensive hyper parameter tuning. Also, we saved our model parameters at best accuracy, but perhaps we could have saved at other metrics, such as F1. Other future work include extending our models to 3D images for other cancers. The advantage of not requiring too much labeled data specific to our cancer is it could make it generalizable to other cancers.

VI. RESULT AND DISCUSSION

For the creation of our proposed model, we have used the tens or flow deep learning.= The framework provides for the creation of deep networks by choosing appropriate layers and specifying the preceding and succeeding layers in the design. The inputs to the framework can be in the HDF5 format, which is particularly suitable for the representation of 2D data, such as a CT scan. The steps in preparing the data are explained in the previous section, and are the same for each CT scan. Hence, we have one HDF5 file representing all the CT scans of a patient, and each HDF5 file has the data along with the label. This label is used in both the training and testing phase.

Models	Accuracy %	Sensitivity %	Specificity %	AUC
2D CNN slice-level	86.7%	78.6%	91.2%	0.926 $\pm$0.014
2D CNN nodule-level	87.3%	88.5%	86.0%	0.937 $\pm$0.014
3D CNN	87.4%	89.4%	85.2%	0.947 $\pm$0.014

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