THINK INDIA JOURNAL
ISSN: 0971-1260
Vol-22-NO-30 Special Issue-December-2019

Study of Deep Learning For The Detection of Brain Tumor

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ABSTRACT

Image processing has very good use in the most of recent and very demanding technologies. When in the body of human we observe a very fast or uncontrolled growth of cell, then this might lead to the Cancer Tumor. This tumor can be verified by using various medical technologies such as biopsy, MRI etc. Basically there are three types of tumors, namely, benign, malignant & pre-malignant. When doctor detects malignant tumor then this tumor may leads to cancer tumor. Magnetic Resonance Images (MRI) is the most popular and used worldwide imaging technique for studying the internal body part structure. MRI is used widely used for the detection of most dangerous diseases for example brain tumor. Detection of brain tumor with the help of deep learning process consist of four stages. Image pre-processing, image segmentation, feature extraction, and finally classification. These techniques are having some advantages and some drawbacks associated with it. To overcome these drawbacks of the existing brain tumor detection system, we have proposed the new technique which is based on the latest technologies like deep learning.

Keywords:-Convolutional Neural Network, Deep Learning, Brain Tumor.

I. INTRODUCTION

In our paper we are going to use image processing techniques [1]. Image processing is the process in which the images are processed for the purpose of the extracting some information from it. This information we are going to use for the purpose of research in the particular field. For 100% perfect diagnosis of disease we use the various medical imaging techniques. Once the disease is diagnosis perfectly then the treatment of it will be easier for the doctor. This also helps to improve the dataset of particular disease which will ultimately help to identify abnormalities. Right now the main reason for increasing the death ratio of people is because of brain tumor. As we know that abnormal growth of cells forms tumor, brain tumor grows within the skull, due to

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which briain not able to work normally. Brain tumor is a most deadliest disease. So this disease need to be detected in the early stages so that we can reduce the death ratio. If tumor is of benign or pre malignant type, then it is not so dangerous but malignant tumor leads to cancer. The proper treatment is needed which depends of location of tumor, size of tumor and variety of tumor.

Magnetic Resonance Images (MRI)[2] is the best technique and also it is widely used techniques for studying the internal structure of the brain in human body. By studying the internal structure of brain through MRI we can detect the tumor properly. Through the various images received through MRI, we will be able to detect the location of tumor, actual size of the tumor and we will be able to predict the type of tumor, which may be malignant or pre-malignant or begine. Once the images are available from MRI we will apply image processing on those images. In the 1st stage of the image processing, normally the non essential parts of the images are removed and ultimately the image will get clear by the first stage of image processing. In the next part segmentation of these clear images will happen, in which we convert it into the binary images. In an advance stage feature extraction process is done, in which the higher level of information like size of tumor, color of tumor, texture of tumor is received from preprocessed, segmented images. And in the last stage classification of the images is done. This classification[3] is done with the help of machine or deep learning algorithm, in which we use some dataset for the training of the machines and limited dataset for the testing purpose.

II.Literature Survey

Brosch and Tam [4] have used DeepBeliefNetwork (DBN) method for their research work. In their research work they have considered two classes namely Alzheimer Disease(AD) and HC. The research methodology used is DBN which used along with RBMs for manifold learning. Plis et. al. [5] have proposed method of DBN. This proposed method is evaluated on estimation of brain network. Shen & Suk [6] have used Stacked Auto Encoders (SAE) & for the classification have considered the AD & Mild Cognative Impairment(MCI) classes. Suk at. el. [7] have considered classes as AD, HC and MCI for classification and for method have used deep restricated boltzman machines and mostly considered the MRI images for their study. Montana et. al [8] have proposed pretrained 3D Convolutional Neural Network with SAE & have

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considered AD,MCI & HC for classification purpose. Hosseini et. al [9] have used CNN as method for their research work and with the pretrained 3D convolutional auto encoders applied on the MRI images. Brebisson et.al. [10] have used CNN with fusing multi scale patches and for the image segmentation purpose they have used anatomical segmentation method. Jin et.al. [11] have also used CNN method along with the striatum segmentation, in this they have used 2Staged that is global and local along with CNN. Stollenga et.al [12] have used recurrent neural network (RNN) and used MRI based images for the training and the testing purpose. For the segmentation of images authors have used tissue, PyraMid LSTM method.

III.Methodology

From the literature survey, we can say that the society is in deep need of system which will help the doctors to detect the brain tumor in the early stages so that the mortality rate due to brain tumor will come down.

We have proposed the system which will work on the MRI images to detect the brain tumor size, shape and type.

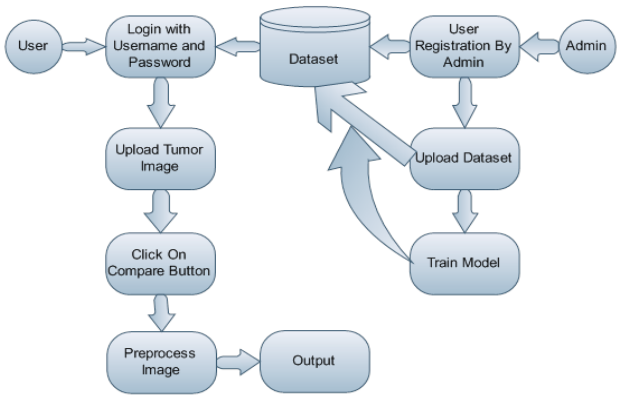

Fig.1:- System Architecture

In the receptive field the single cortical neuron gives positive sign to stimuli. The neurons have the receptive fields, which are overlap partially in such a way that they are going to cover the visual field. When we are going to compare CNN with other classifiers, it uses less pre-processing. The meaning of this is that the CNN network updates the filters in traditional algorithm is hand engineered [13]. This the major advantage of CNN. It has wide applications in all the fields for example image & video processing, natural lang processing, to build the

ISSN: 0971-1260
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predication system. The convolution neural network is consist of various layers, in which some layers are hidden. It also consist of input and output layer which is not the hidden layer. The total count of hidden layer is based on the predication model, it may consist of single or multiple hidden layers. These hidden layers are consist of various other layers, which are essential in the process of classification, these are i)convolutional layer, ii)pooling layers, iii)fully connected layers and iv)normalization layers**.**

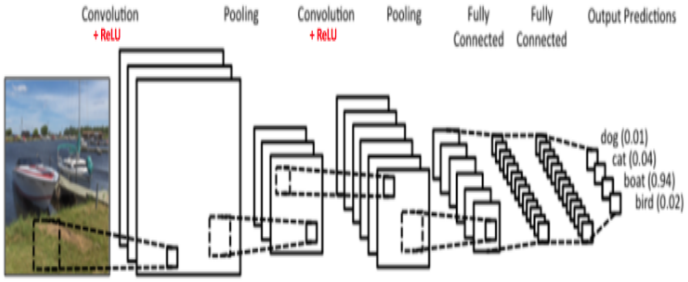

Figure 2: Simple CNN

The Convolutional Neural Network in Fig.2 is identical in internal structure to the original LeNet. There are four main steps in the CNN shown in Fig.2 above:

1. Convolution
2. Non Linearity (ReLU)
3. Pooling or Sub Sampling
4. Classification (Fully Connected Layer)

The Convolution Step:

From the convolution operator, ConvNets/CNN name is derived[14]. The first aim of this step in case of a CNN is to retrieve the best suitable part from the inputed image. This step maintains some kind of relationship between the number of pixels. In this, each and every image is considered as the pixel matrix. Let us consider image of size 5X5 which has pixel's value as 0 and 1.

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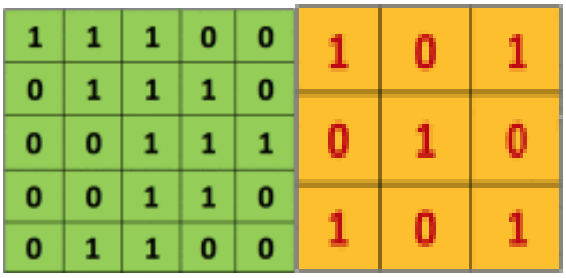

Figure 3: Matrix

In above Fig.3 we have considered another matrix of size 3X3. Convolution of the 5X5 matrix and the 3X3 matrix can be achived as shown in following Fig.4,

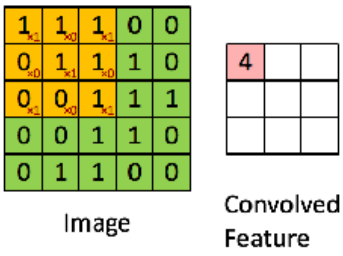

Figure 4: The Convolution operation

Feature map is the output matrix. Now understand how and in which way the computation of above matrix is done. We are going to put the orange coloured matrix over the actualssss image that is green coloured matrix by only one pixel. It is called as stride & for every position of pixel, we are going to manipulate element wise multiplication that will be between these two matrices and we will add the outputs of multiplication, so we will get final integer, which is nothing but the 1st element of the pink coloured output matrix. Over here the 3X3 matrix is able to "see" some part of the input image in each stride. As per the terminology used for the CNN, the 3X3 matrix is known as i)filter or ii)kernel or iii)feature detector

Figure 5: Test image

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As mentioned in the Table no 1, we are able to see convolution effects of Figure 5 with different and unique filters. As mentioned in the Table no1 we are able to perform various operations on Figure 5. Before the actual Convolution step opration, we will perform the operation like detection of edge, sharping the image and blur, it is achived by changing teh numeric value of filter matrix. From this we can conclude that this stage will help us to detect the various features from an image, such as edges, curves etc.

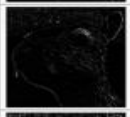
Operation	Filter	Convolved Image
Identity	$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix}$	
Edge detection	$\begin{bmatrix} 1 & 0 & -1 \\ 0 & 0 & 0 \\ -1 & 0 & 1 \end{bmatrix}$	
	$\begin{bmatrix} 0 & 1 & 0 \\ 1 & -4 & 1 \\ 0 & 1 & 0 \end{bmatrix}$	
	$\begin{bmatrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{bmatrix}$	
Sharpen	$\begin{bmatrix} 0 & -1 & 0 \\ -1 & 5 & -1 \\ 0 & -1 & 0 \end{bmatrix}$	
Box blur (normalized)	$\frac{1}{9}\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$	
Gaussian blur (approximation)	$\frac{1}{16}\begin{bmatrix} 1 & 2 & 1 \\ 2 & 4 & 2 \\ 1 & 2 & 1 \end{bmatrix}$	

Table 1: Effect of convolutinon

Introducing Non Linearity (ReLU):

ReLU is nothing but Rectified Linear Unit[15]. This operation is additional operation which is used after the first operation that is convolution operation. In each stages shown in the Table 1. It is non linear operation.

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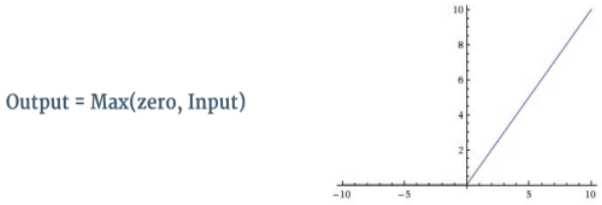

Figure 6: Output of ReLU

ReLU operation is the element wise operation, which we are apply per pixel. In the feature map, it replaces all negative pixel values by zero. The main objective of the ReLU operation is to implement non linearity in CNN as given in Figure 6.

The Pooling Step:

This Step is also known down or sub sampling. To reduce the dimention of feature map but at the same time maintaining or keeping safe the information which is very sensitive for the research. This pooling step may be of various kinds which may be average or maximum or sum.

The maximum or max pooling, by considering the window for feature map from the largest element, it declares the spatial neighborhood. When we are going to consider the average element then it is termed as average pooling.
But it has been observed that the max pooling always yields best result.
Figure 7 illustrate Max Pooling operation on a Feature map. This feature map is identified after the previous two steps that is convoulution and ReLU.

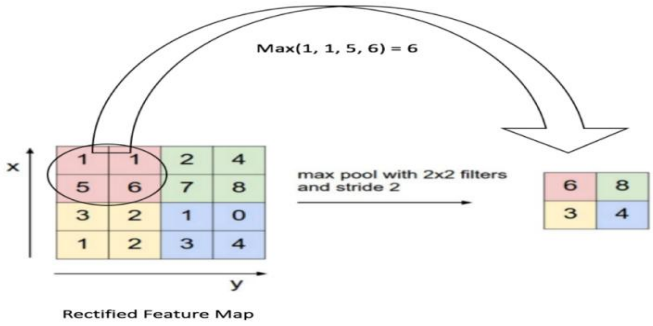

Figure 7: Max Pooling

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IV.Conclusion

From our study we can say that the brain tumor can be detected with the help of machine learning algorithms but as it yields some disadvantages so that we are going to move to latest algorithms which uses deep learning. The deep learning will give more accurate results when we compare it with the machine learning.

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