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Brain Tumor Detection using Deep Learning

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Abstract: ***Nowadays the leading techniques for diagnosing and revealing the different diseases are image processing. And there is an increase in the cases of cancer these days. The unrestricted development of cells cause's lumps which leads to brain tumor also called glioblastoma. There are mainly two types of tumor benign which has covering over the tumor and malignant is the one which spreads throughout the places. Earlier the development of unrestricted cells used to be diagnosed by doctors physically through monitoring the image by which the results were not used to be precise sometimes. But time along boarding of medical fields lead to different medical facilities by which the results could be precise. The broadly approach method of imaging that scrutinizes the internal structure of the human race is Magnetic resonance Imaging. This approach of imaging techniques is also used for detecting brain tumors. The detection of glioblastoma processes has machine vision methods such as Image pre-processing, Segmentation in Image, Feature extraction and classification. Several image segmentation and image classification techniques are available for detecting tumor of the brain. Convolution neural networks (CNN) based classifiers are proposed to prevail the limitations. This CNN is such a classifier which is used to differentiate between the competent data and the trail data, from which the results could be obtained.***

Keywords**:** ***Brain tumor Detection, Watershed Algorithm,Capsule Network, Convolutional Neural Network, MRI Images, Tumor Boundary.***

I. INTRODUCTION

The process of estimating, handling the given image as an input in order to accomplish some action to uproot the information from image processing. To disclose the internal structure of a tumor hidden by the external features of the body. To detect them and to treat the disease seeks the Medical imaging. To examine the tumor the database of normal anatomy and physiology to identify the abnormalities. Today's mortality of people has risen to the next level due to brain tumors. The Brain tumor is caused when there is an excessive development of cells within the body.

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The continuous growing of cells within the skulls leads to tumor, which causes the distraught of normal activity of the brain. The brain is a complex and vital organ, and treatment often causes life-long changes and can also cause the life threatening issue if not diagnosed properly in the early stage of the cells growth. The brain tumors are mainly of three types such as benign, malicious and pre malicious.

They mainly depend on the features such as type of lump, position, dimensions and the enlargement of the cells leads to the severity of the cancer. In early period, the diagnosis used to be done by the doctors on the observation of the images which usually caused inaccurate or not so precise results to diagnose properly.Sometimes it is a tedious job to detect the state manually. Nowadays there are many software tools used in the medical sector. Those software have the property of agile and precise results by proper Imaging techniques. MRI is often used by imaging techniques for the accurate structure of human anatomy.The only solution for the method to treat the tumor is proper detection of tumor and also requires proper recognition tools for appropriate treatment. Diagnosis of the presence of lumps into the brain through image processing consists of the few stages that follow Image pre-processing, Image segmentation, Feature extraction and Classification. The primary and the main task of pre- processing methods is improvising the quality of Magnetic Resonance Imaging (MRI) by removing the irrelevant noise and non required parts from the framework and by preserving the edges of the image. Further in the segmentation process the pre-processed image is converted in the form of binary image.The process in which gathering of elevated extent details of an image such as hue, figure, touch and disparity are considered is called as Feature Extraction. And the last classification of process, for grouping the normal brain image which are trained samples and the input of damage image sample is given for the better results classifiers are used.

II. IDESIGN SYSTEM

Convolution neural network (CNN or ConvNet) is a form of deep learning which is commonly applied for analyzing visual images. CNNs use their own pre-processing for variation of multilayer perceptrons designed which is also called as unchanged position or extent position artificial neural networks , based on their shared weights architecture and translation invariance characteristics. This grid provokes the connectivity pattern between neurons similarity the association of the animal perceptible cortex by biological processes into it. Individual cortical neurons rely on stimulants only in a limited area of the perceptible field known as the impressionable region. The impressionable region of various neurons which are partially overlapped such that they cover the entire visual field. CNNs have comparatively little pre-processing rather than other image classification algorithms.

The major advantage of independence is prior knowledge and human effort in feature design. They involve the applications in image and video recognition, suggested systems, image classification, medical image examine and natural language processing. A CNN consists of raw data and a result , and also the many concealed layers. The concealed layers of CNN has typically contains convolution layers, collaborative layers, fully connected layers and normalization layers.

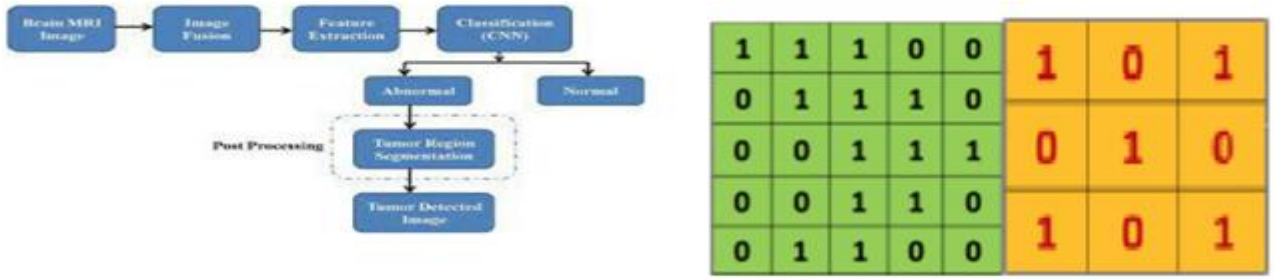


Fig. 1. System Architecture

III. METHODOLOGY

The Convolution Neural Network in the given fig. which is in architecture to the original LeNet that classifies in four categories as the input for classification: dog, cat, boat or bird. ConvNet shown in fig. above has four major steps:

1. Convolution method.
2. Non Linearity step.
3. Pooling process or Sub Sampling.
4. Classification for output.

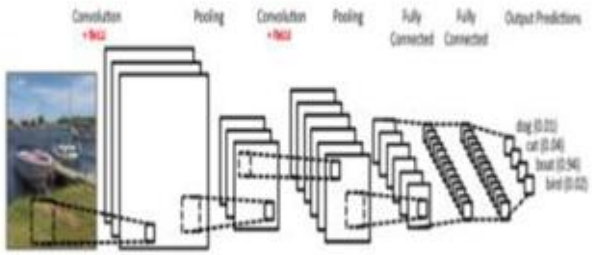


Fig2. Simple ConvNet

The pixel values of the matrix makes the images. Essentially,the matrix of pixel value represents every image. Standard label used to refer to a precise integrant of an image is called a Channel. A standard digital camera will have three channels for the image – red, green and blue – supposed to be imagined as three 2d-matrices assembled over each other having the range from 0 to 255 of the pixel.

The Convolution Step:

The name ConvNet is derived from the "convolution" operator. The main goal of Convolution is to abstract features from the input image in case of ConvNet. The special relation is preserved by learning and giving training of image features using minor squares of data and through CNN. By not going into further details of CNN, we will test it and check it for how it works on images. As mentioned earlier, a matrix of pixel values is considered as an image.

Also, consider another matrix of 3 x 3 as shown in the above image. Then, the transposition of Complexity of the given matrix is as shown in the peculiar in Fig below:

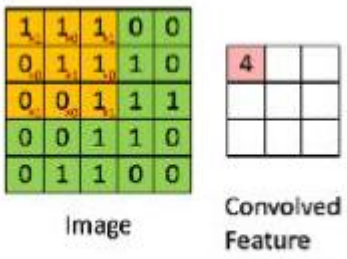
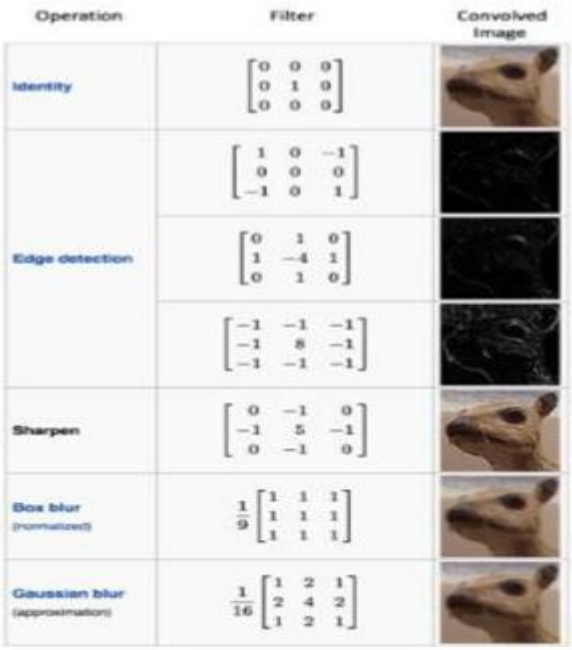


Fig3. The Convolution operation

The output of a given matrix is known as a Feature Map by complexity of the above. By sliding the matrix which is in orange color in the given fig over our original image that means in the green color matrix by 1 pixel and for every pose, we perform amplification allying any two matrices by consider each element at a time and by adding the multiplication of outputs for the concluding numeric which results in a matrix of single component. Note that the 3×3 matrix is able to see only bits of image in every step. In CNN parlance,there are various terms declared for the 3×3 matrix is such as 'filtrate' or 'attribute locator' and the matrix formed by sliding the filter over the image and then again calculating the dot product is called the 'Convolved Feature' or the 'Feature Map'. It is essential that its filter acts as feature detectors from the original image which we feed as an input . It is perceptible if you take a look at animation in the above several values of the filter matrix will also generate a number of different Feature Maps for the similar input image. Consider the following input image as an example:

In the table given below, the effects of convolution of the above image with different filters can be seen.

As shown the operations such as Edge Detection, Sharpen and Blur can be performed just by changing the numeric values of our filter matrix before the convolution operation– this means that different features can be detected through different filters from the image,for example edges, curves etc.



IV. ALGORITHM

Pooling includes an important step which is known as Spatial Pooling. It is also referred to as sub sample or down sampling. The main motive for pooling is reducing the dimensional feature, but it holds on to all the required data. Down Sample Pooling includes various ranges such as Max, Average, Sum and many more. In Max Pooling we need to consider the largest element. Considering the Average Pooling, in case of Max Pooling we need to take the largest element but in average pooling we can consider the average element. In Sum Pooling we consider the total of all the elements.In the fig. given below take the maximum value in each region by our sliding window 2*2 which is also called stride. This reduces the dimensionality features.

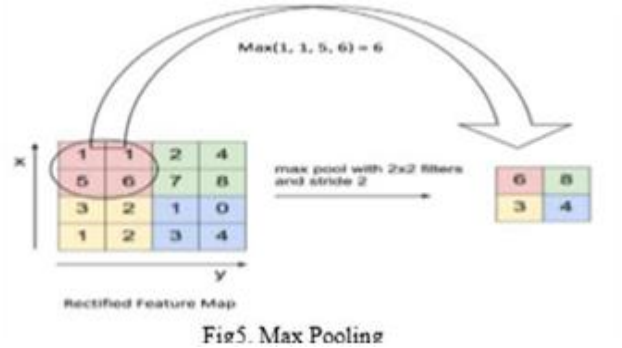


Fig5. Max Pooling

Introducing Non Linearity (ReLU):

In this we use RELU operation. It is done basically after every Convolution operation and it stands for Rectified Linear Unit. ReLU is a non-linear operation. The given below is the output after every Convolution step.

ReLU performs operation which works element wise, which is applied pixel by pixel. This is used to replace all negative pixel values and is applicable in feature maps. Since most of the real world applications learn from the non linear method. Convolution is a linear option but ReLU is non linear operation and can help in matrix addition, subtraction.

The general process is given as below:

1. Take an MRI image as input, you can upload it directly or choose it from a directory.
2. Once you choose the image, the image will be converted into grayscale. In short pre processing is done, which includes removing canny edges, sharpening, feature extraction.
3. Now, you get the image in gray scale and you can predict whether it's a normal brain or tumor brain.
4. In this, we will also predict the severity of tumor in percentage form so that tumor at early stage will be detected at first stage only.
5. The infected part of the brain tumor will be highlighted for this. We have used the Watershed algorithm. In this way, the overall system works.

V. CONCLUSION

For segmentation of brain tumor by MRI images here we propose a CNN-based method. Segmentation and classification of brain tumors has many existing techniques available. There are many advantages and disadvantages of the existing techniques available. So to overcome this limitation we propose a system for tumor detection using deep learning. In such a manner, we implement a Convolution based classifier to test and train the module and this helps us to get data with best accuracy.

The Pooling Step:

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