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Classification and Feature Extraction of Brain Scans Using Convolution Neural Network for Detection of Tumor

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ABSTRACT
Brain is an influential, necessary and paramount part of the human body. There are many brain disorders, the most prevalent of them is a brain tumor. The diagnosis of tumor is done using brain imaging which is magnetic resonance imaging. Convolution neural network uses feature extraction and classification to see if tumor is present in a magnetic resonance image of brain. Convolution Neural Network classifies tumor scans from non-tumor scans for grayscale and colored magnetic resonance images with an accuracy of 98 percent.
KEYWORDS: *Brain Image, Convolution Neural Network, Classification, Magnetic Resonance Imaging.*

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I. INTRODUCTION

Brain tumor is an abnormal growth of cells in the tissues of the brain. Tumors can be malignant, with cancer cells growing quickly or benign with no cancer cells. Brain tumors can be primary, they grow in brain or, tumors can be metastatic, they grow somewhere else and move to the brain. Brain tumor affects the physical and mental wellbeing of the individual. Brain tumor is envisioned using Magnetic Resonance Imaging, Computed Tomography. Magnetic Resonance Imaging only reveal the structure of the brain. Techniques have been developed to automate detection of tumor mostly using segmentation.

II. RELATED WORKS

Image segmentation is the process of clustering pixels of an image based on common shared properties. Image segmentation helps in finding the region of interest like locating a tumor.

In an implementation on Brain Tumor Detection Using Digital Image Processing threshold segmentation has been used.[3] Threshold based segmentation is done by grouping all pixels with intensity between two such thresholds into one class.On the identification of a good threshold, this method relies and failing of such threshold may guide to poor segmentation [1].

In an implementation, fuzzy c-means algorithm has been used for bias field estimation and segmentation of Magnetic Resonance Imaging. data. This technique generates faster results but is limited to single feature input [5]. Segmentation of Brain Magnetic Resonance Imaging through Hidden Markov Random Field Model and the Expectation- Maximization algorithm, encodes spatial and statistical properties of an image however, the method requires estimating threshold [4].

Many segmentation algorithms have been used for medical image processing. The problem is that the segmentation technique used on an image depends on its application. Image segmentation is affected by color, intensity, level of noise, etc. thus there is no single algorithm that is applicable on all types of images and nature of the problem [2]. A procedure involving a combination of various segmentation techniques helps overcome the problem, but its implementation becomes complex.

III. PROBLEM STATEMENT

Brain Tumor is an abnormal growth in brain that affects the cognitive and motor abilities of a person. In recent times techniques have been developed for tumor determination using image processing, image segmentation and classification. This consists of two separate processes feature extraction and classification. The problem with existing feature extraction methods is that they work only with predetermined set of features taken from images and feature extraction will not be able to determine new features when images from another category are given. Image segmentation has many different techniques and a single image segmentation technique cannot to applied to all images in data set for extracting features. Thus a integrated model involving both feature extraction and classification has to be used like a multi-layer feed forward network. The problem with multi-layer feed forward network is dimensionality and many training parameters for features extracted which is not practical. This led to the usage of convolution neural network for image classification purposes.

IV. PROPOSED SYSTEM

In the existing techniques used for brain tumor detection there is problem of choosing segmentation technique as it is not possible for a single technique to work for all images in dataset. The proposed system solves the issue by using the convolution neural network which performs segmentation that works with all images in a dataset. Convolutional Neural Network has a simple structure and perform feature extraction by taking into consideration all the discriminating features which are later used by Convolutional Neural Network to perform classification. Convolutional Neural Network performs classification efficiently using the extracted features due to translational invariance. Translational invariance suggests recognition of objects regardless of where they're located in the image.

V. CONVOLUTION NEURAL NETWORK

A convolution neural network belongs to the class of deep neural network and is used for analyzing images.

5.1 Selection of Magnetic Resonance Imaging

Magnetic Resonance Imaging is used to form images of the anatomy and is used extensively in the field of medicine especially radiology. Magnetic Resonance Imaging is usually used for brain scanning. At times Magnetic Resonance Imaging contrast agents are used which improve the visibility of internal body structure yet, the scans are still in greyscale. Procedures have been developed to add color to Magnetic Resonance Imaging images. The colorization methods are excellently refined and clearly unveil the hidden information that is difficult to observe with the naked eye under gray scale image[6].In the images being classified MRI images have been used, all of them are in grayscale except for few of colored images.

5.2 Feature Extraction

In feature extraction the information which is useful from an image is extracted in terms of shape, color, texture. In Convolution operation feature extraction is performed. This is implemented using Conv2D function. The Conv2D function is taking 4 arguments.

Table 1 Parameters used in convolution.

Parameter	Value
filters	32
Filter shape	3X3 dimensionality
Input shape	64X64 resolution
Type of image (RGB or not)	3 for RGB
Activation function	Rectifier linear unit function

5.3. Classification

It is the process of categorizing images into subsets. From a given dataset images are assorted into different classes.

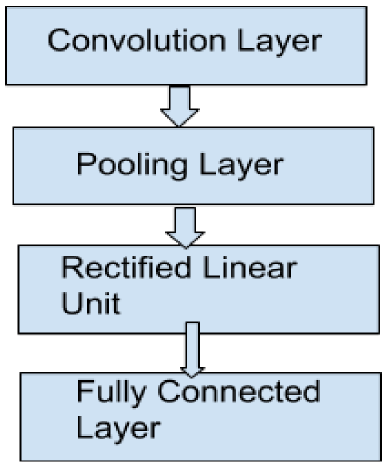

Fig.1. Layers of convolution neural network.

The convolution neural network has a convolution layer that performs filtering operation. In this operation an input array is multiplied with an array of weights called a filter. The array of weights is smaller than the input array and the product of the two arrays is a dot product. The filter is small and the same filter is multiplied with the input at different points from top to bottom and left to right. When a filter is designed to determine a feature and the filter is applied all over the image, it allows for the feature to be detected anywhere in the image. This concept is known as translational invariance. The values in filter are weights learned during the training of the network. Convolution neural networks are trained using stochastic gradient descent method and learn the kind of features to be extracted from input. The convolution neural network can learn multiple features in parallel from input by applying many filters on it parallel. This filtering option helps in detection of shapes, objects and much more. Convolution is a linear operation. The application of filter on the input multiple times results in an array of values called feature map Once a feature map is obtained each and every value in it is sent through the Rectified linear unit layer. Rectified linear unit is a nonlinear operation. In this operation all negative values in the feature map are replaced by zero this makes nonlinearity a part of our network. This operation is necessary as most of the real-world entities support nonlinearity. The pooling operation in this network is reducing a large image i.e., its feature map while preserving the important information of the image. The pooling operation applies a window throughout the image systematically and chooses the maximum or minimum value from each block of values called max pooling or min pooling depending on the value selected. This operation reduces number of parameters and computations in the network. The output of pooling layer is input for fully connected layer. After performing pooling operation, flattening operation is performed in which the pooled featured maps are tuned into a one dimensional vector having all the values of pooling matrices. The fully connected layer produces an N dimensional vector where N is the number of classes available to classify the data. Each value in the vector corresponds to the probability of a particular class. This layer is called fully connected as every node in the preceding layer is connected to every node of fully connected layer .Fully connected layer takes the features from previous layer which shows strong resemblance to a particular class and then multiplies the input values from the previous layer with particular weights ,with the products between the weights and inputs, the proper probabilities for the different classes are obtained. The fully connected layer uses a sigmoid activation function for classification.

VI. EXPLORATORY RESULTS DATASET

The Convolution Neural Network has been trained with dataset having tumor and no tumor brain scan images taken using magnetic resonance imaging. The dataset has been taken from Kaggle [7].The few colored MRI scans used have been taken from research papers [6] and [8].There are 247 images total in the database used for training out of which 242 are in greyscale and 5 are colored images.

When new images have been provided to the network it classified them into categories of scan with abnormal mass i.e. tumor or normal brain scan accurately.

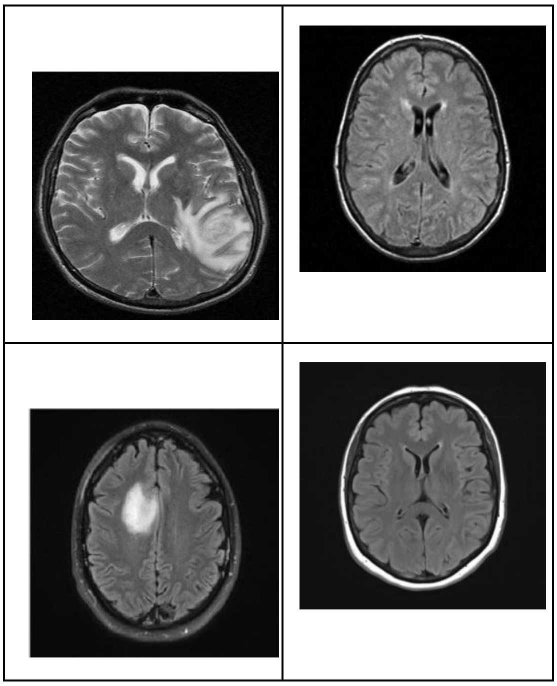

Fig 2: Brain scan having tumor to the left, scan without tumor to the right.

VII. CONCLUSION

Medical diagnosis is conventionally carried out by doctors using medical imaging. Techniques have been developed to implement this using image processing and classification so as to make medical diagnosis an automated procedure. Convolution neural network having a simple structure performed the function of properly classifying a normal brain scan from that with abnormalities for many grey scale and few colored images by using fewer nodes and less number of training parameters. Researchers have developed a way to add color to MRI images which can help throw light on more sensitive information regarding tissues, cells and organs using contrast agents instead of coloring procedures. Changing color of MRI[9].There is not always a large training dataset available to train artificial neural networks, this problem can be solved by synthetic images developed using generative adversarial networks. Furthermore, these same algorithms can be trained on completely anonymized datasets allowing for sharing of training data. When combined with smaller, institution- specific data sets, modestly sized organizations are provided the opportunity to train successful deep learning models[10].Convolution Neural Network which works meticulously in classification of brain scans could be used in future to extensively classify the color MRI images and synthetic MRI images to produce new insights that will help in improving medical diagnosis.

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