

# An Efficient Brain Tumor Detection system using Automatic segmentation with Convolution Neural Network

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**Abstract** - Brain is one of the most complex organs in the human body that works with billions of cells. A brain tumor is a collection, or mass, of abnormal cells in your brain. This can cause brain damage, and it can be life-threatening, so an early detection of tumor is required and for that a reliable technique is required, thus With the advancement in the technology the concept of image processing play an important role in medical field and with convolution neural network we get better promising results. In this paper we use the methodology in which first we filter the image by median filter then automatic segmentation by Otsu then morphological operation for filtration and dilation then classification done by CNN. We prepared the brain MRI dataset and performed the methodology using MATLAB R2015a Weka 3.9 tool was used for performing the classifications .The evaluation of the performance for the proposed methodology was measured in terms of average classification rate, average recall, average precision, PSNR and MSE with accuracy.

**Key Words:** (Size 10 & Bold) Key word1, Key word2, Key word3, etc (Minimum 5 to 8 key words)...

## 1. INTRODUCTION

In this research paper with the advancement in the technology the concept of image processing play an important role and especially with the concept of artificial neural network. And for efficient detection of brain tumor that is a medical field ,we use the image processing concepts with deep learning that give better promising results in the different field, for example, speech recognition, handwritten character recognition, image classification, image detection and segmentation and disease detection. Brain Tumor Symptoms: Symptoms (signs) of benign brain tumors often are not specific. The following is a list of symptoms that, alone or combined, can be caused by benign brain tumors; unfortunately, these symptoms can occur in many other diseases: vision problems ,hearing problems ,balance problems, changes in mental ability (for example, concentration, memory, speech), seizures, muscle jerking, change in sense of smell ,nausea/vomiting, facial paralysis, headaches, numbness in extremities. The research is based on the automatic detection of brain tumor and the classification is done by

using deep convolution neural network. In this paper, the main objective is to develop a high speed classifier using CNN to classify the abnormality of brain. We propose architecture for automatic brain tumor detection with preprocessing filtering object separation and segmentation with morphological operations. Our network is based on Mina Reza et al. [2] with some improvements and enhancements. First we take the input of brain MRI images. Then preprocessing, filtering is required for filtration. The Otsu segmentation system is use for location of irregular tissues inside the tumor. In the segmentation output, the size and shape of the tumor is shown. The textural and intensity base features are drawn. The CNN using stack auto encoders is used as a classifier. We stack and the softmax layers are used to construct the deep network with 10 hidden layers. Surgery is the usual first treatment for most brain tumors. Before surgery begins, you may be given general anesthesia, and your scalp is shaved. You probably won't need your entire head shaved. Surgery to open the skull is called a craniotomy. The surgeon makes an incision in your scalp and uses a special type of saw to remove a piece of bone from the skull. You may be awake when the surgeon removes part or the entire brain tumor. The surgeon removes as much tumor as possible. You may be asked to move a leg, count, say the alphabet, or tell a story. Your ability to follow these commands helps the surgeon protect important parts of the brain. After the tumor is removed, the surgeon covers the opening in the skull with the piece of bone or with a piece of metal or fabric. The surgeon then closes the incision in the scalp. But apart from that the early detection of tumors is required to save the life and for that we design an automated early detection system

## 2. LITERATURE REVIEW

(1). Umit Ilhan & Ahmet Ilhan "Brain tumor segmentation based on a new threshold approach" [5].

- Median filter.
- Threshold based segmentation.
- Tumor detection with limited number of parameters.

(2). Bhavana Ghotekar & K. J. Mahajan “Brain Tumor Detection and Classification using SVM”[6].

- Masking is not properly done used for threshold.
- Support vector machine is used for classification.
- Less accuracy was achieved about 86%.

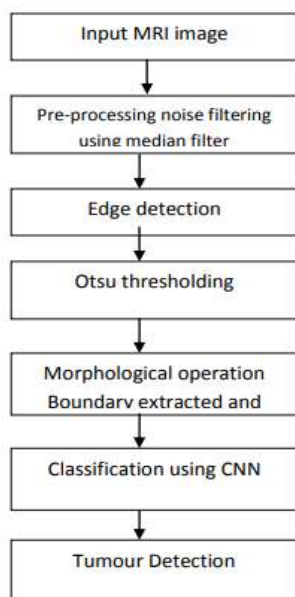
(3). Heba Mohsen et al “Classification using deep learning neural networks for brain tumors”2017[7]

- Deep learning used .
- Discrete wavelet transform is used with the high accuracy was achieved.

After reading various research papers, the conclusion of all these papers is the tumor detection accuracy is achieved by using various complex approaches for detecting the goal of detecting tumor by MRI image understanding, color/grey-level/texture/shape can help locate interesting zones/objects. Though, a partition based on such criteria will often contain too many regions to be exploitable, interesting objects hence being split into several regions. As after studying many research papers the conclusion is that the methods used in these papers detect the brain tumors but have so many limitations.

**3. PROPOSED SYSTEM –Proposed Technique**

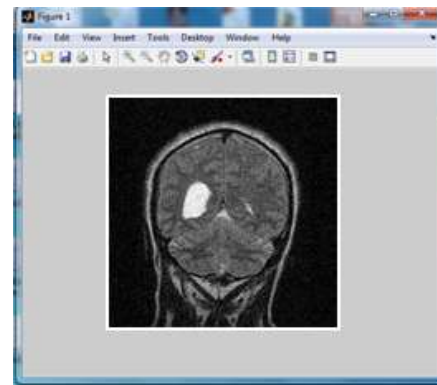
- Edge detection with Median filter for noise removal and edge linkup.
- Otsu’s threshold through histogram.
- Morphological operations.
- Convolution Neural Network for classification using Weka tool 3.8.3 version for precession, recall and other parameters .



**Figure(1 ). Proposed Methodology**

**3(1). IMAGE ACQUISITION**

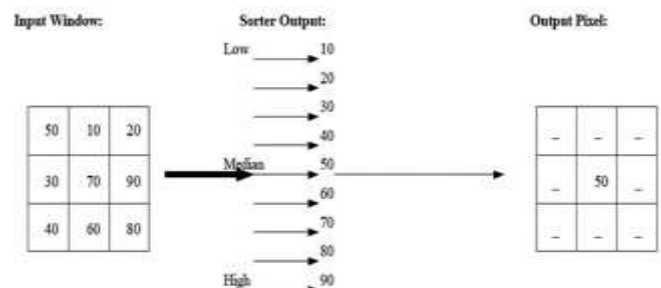
The proposed method designed for extraction the tumor with accuracy. It composed of seven stages, including image capturing, pre-processing, and edge detecting, region of interest filtration, dilation and candidate regions detection and classification of tumor as shown in Figure(2).The input of the method is the original image of the vehicle in RGB scale of size 2048×1536 pixels taken from real scene. The details of other stages are presented in the following subsections.



**Figure (2). Input Image**

**3(2). NOISE FILTERING-**

A median filter is a non-linear digital filter which is able to preserve sharp signal changes and is very effective in removing impulse noise (or salt and pepper noise). An impulse noise has a gray level with higher or lower value that is different from the neighborhood point [11]. A standard median operation is implemented by sliding a window of odd size (e.g. 3x3 windows) over an image. At each window position, the sampled values of signal or image are sorted, and the median value of the samples replaces the sample in the center of the window as shown in Figure 3 x 3 windows



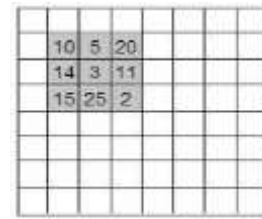
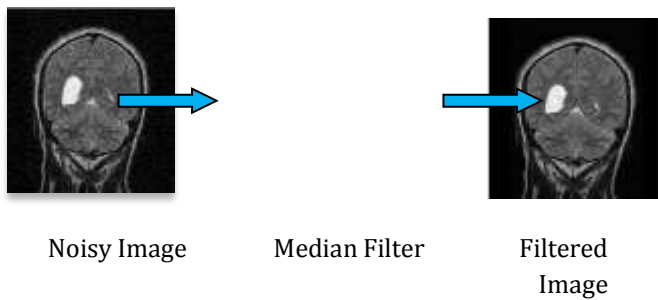


Figure (4)(a) & (b) Image segmentation

### 3(2). EDGE DETECTION TECHNIQUES

Edge Detection is a technique of finding and identifying the sharp discontinuities presented in an image. The term discontinuities are defined as sudden changes that are made in pixel intensity which describe the boundaries of substances in a scene. All standard methods of edge detection include the Convolving of the image with an operator, and to get big gradients in the image though returning values of zero in constant regions. Mostly, there are numbers of edge detection operators exists, and each of these operations is designed to be sensitive toward the certain types of edges. The programming structure of the operator is applicable for determining the characteristic direction in which direction it is very sensitive to the obtained edges. The operators are developed to look for vertical, horizontal, and diagonal edges. Edge detection is hard to obtain in noisy images, because the noise and the edges are high frequency content [15]. All the edge detection operators are grouped under two groups as 1st order Derivative.

### 3(4).IMAGE SEGMENTATION &MORPHOLOGICAL OPERATIONS

Segmentation subdivides an image into its constituent regions or objects. Segmentation is a process of grouping together pixels that have similar attributes. Image Segmentation is the process of partitioning an image into non-intersecting regions such that each region is homogeneous and the union of no two adjacent regions is homogeneous [12]. Segmentation is typically associated with pattern recognition problems. It is considered the first phase of a pattern recognition process and is sometimes also referred to as object isolation. Converting a grey scale image to monochrome is a common image processing task. Otsu's method named after its inventor Nobuyuki Otsu, is one of many binarization algorithms as shown in figure (3).

As otsu thresholding play an important role in image segmentation and its is an automatic thresholding that give much better result as compared with the other segmentation algorithms. That's why we use automatic otsu thresholding algorithm in our work. Also we use morphological operations for dilation erosion and extraction the main infected area only so for that we use mathematically morphological operations also in our work.

### 3(5). CLASSIFICATION USING DEEP LEARNING

Convolutional Neural Networks (**ConvNets** or **CNNs**) are a category of Neural Networks that have proven very effective in areas such as image recognition and classification. ConvNets have been successful in identifying faces, objects,diseases detection and traffic signs apart from powering vision in robots and self driving cars.The Convolutional Neural Network in Figure 3 is similar in architecture to the original LeNet and classifies an input image into four categories: dog, cat, boat or bird (the original LeNet was used mainly for character recognition tasks). As evident from the figure above, on receiving a boat image as input, the network correctly assigns the highest probability for boat (0.94) among all four categories. The sum of all probabilities in the output layer should be one (explained later in this post).There are four main operations in the ConvNet shown in Figure 5 below:

- **Convolution-** Convolution networks are composed of an input layer, an output layer, and one or more hidden layers. A convolution network is different than a regular neural network in that the neurons in its layers are arranged in three dimensions (width, height, and depth dimensions). This allows the CNN to transform an input volume in three dimensions to an output volume. The hidden layers are a combination of convolution layers, pooling layers, normalization layers, and fully connected layers. CNNs use multiple conv layers to filter input volumes to greater levels of abstraction. CNNs improve their detection



capability for unusually placed objects by using pooling layers for limited translation and rotation invariance. Pooling also allows for the usage of more convolutional layers by reducing memory consumption. Normalization layers are used to normalize over local input regions by moving all inputs in a layer towards a mean of zero and variance of one. Other regularization techniques such as batch normalization, where we normalize across the activations for the entire batch, or dropout, where we ignore randomly chosen neurons during the training process, can also be used. Fully-connected layers have neurons that are functionally similar to convolution layers (compute dot products) but are different in that they are connected to all activations in the previous layer.

- **ReLU Layer-** The rectifier function is an activation function  $f(x) = \text{Max}(0, x)$  which can be used by neurons just like any other activation function, a node using the rectifier activation function is called a ReLU node.
- **Pooling or Sub Sampling-** Convolutional networks may include local or global pooling layers, which combine the outputs of neuron clusters at one layer into a single neuron in the next layer. For example, max pooling uses the maximum value from each of a cluster of neurons at the prior layer
- **Classification (Fully Connected Layer)-** Finally, after several convolutional and max pooling layers, the high-level reasoning in the neural network is done via fully connected layers. Neurons in a fully connected layer have connections to all activations in the previous layer, as seen in regular neural networks

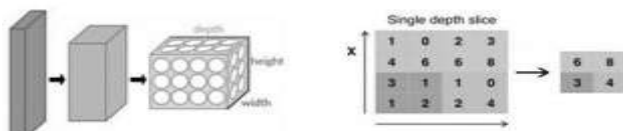
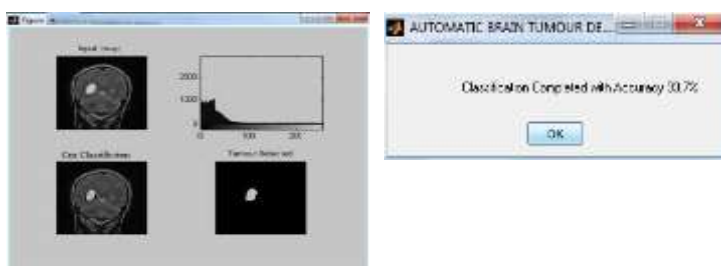
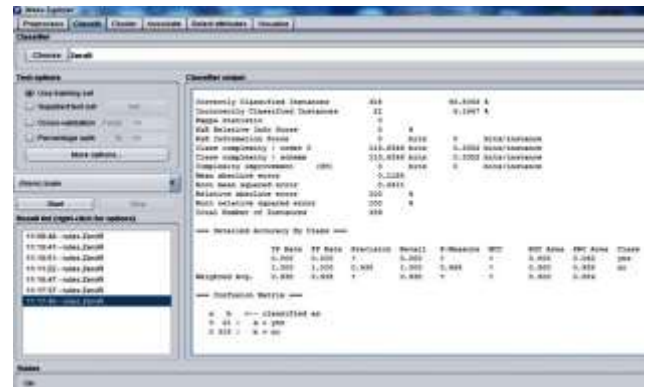


Figure (5). CNN Model



Figure(6). Final Classification with tumor detection

- **Weka Simulation-** Weka is a collection of machine learning algorithms for data mining tasks. The algorithms can either be applied directly to a dataset. Weka contains tools for data pre-processing, classification, regression, clustering, association rules, and visualization. In this paper we use weka 3.8.3 version for classification Purpose



#### 4. CONCLUSIONS

The Objective of this paper is to review the idea behind making an automatic System that use deep convolution neural network. Studying and resolving all the issues regarding Algorithms used for brain tumor detection in previous few years. The algorithm used in this paper not only accelerates the process but also increases the probability of detecting the tumor and extraction of tumor under certain set of constraints. As classification performs an important role in tumor detection thus we are focusing on the number of iterations (Hidden layers). The result of proposed method shows higher accuracy of infected region removal. Tumor identification system plays an important role in early detection of tumor and thus it saves the life. The system uses MATLAB R2014a and image processing for its implementation with higher accuracy of 93.7%.

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## BIOGRAPHIES

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