A Novel Technique for Brain Tumor Detection and Analysis Using Image Segmentation

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***Abstract*-**BRAIN TUMOR extraction and its analysis are challenging tasks for medical image processing because brain image is complicated. Segmentation plays a very important role in the medical image processing. So it becomes difficult for doctors to identify tumor and their causes. In this project, first we present a comparative study of different methods implemented for tumor detection. After a brief review different segmentation methods used for detection of tumor from Magnetic Resonance Imaging (MRI) of brain has been discussed. Finally we will propose a technique for detection of tumor using image segmentation. The brain is the most important part of the central nervous system. The main task of the doctors is to detect the tumor which is a very time consuming task for which they feel burden. The only optimal solution for this problem is the use of image segmentation. Extraction and classification of brain tumor from MRI scan images of brain which incorporates segmentation and morphological function which are the basic functions of image processing. Here we detect the tumor, segment the tumor and we calculate the area of the tumor and also the Severity of the disease can be known, through classes of brain tumor.

Keywords*-Brain Tumor; Image Segmentation; Magnetic Resonance Imaging.*

I. INTRODUCTION

Tumor is an uncontrolled growth of cancer cells in any part of the body. Brain tumor segmentation is one of the crucial procedures in surgical and treatment planning. Brain tumor segmentation using MRI has been an intense- research area. Brain tumors can have various sizes and shapes and may appear at different locations. Varying intensity of tumors in brain magnetic resonance images (MRI) makes the automatic segmentation of tumors extremely challenging. There are various intensity based techniques which have been proposed to segment tumors on magnetic resonance images. A texture based image segmentation using GLCM (Gray-Level Co-occurrence Matrix) combined with classifier is proposed here. From the MRI images of brain, the optimal texture features of brain tumor are extracted by utilizing GLCM. This method provides more efficient brain tumor segmentation compared to the segmentation technique will provide more accurate result. Tumor is the abnormal growth of the tissues. A brain tumor is a mass of unnecessary cells growing in the brain. Brain cancer can be counted among the most deadly and intractable diseases. Today, tools and methods to analyses tumors and their behavior are becoming more prevalent. Magnetic Resonance Imaging (MRI) has become a widely-used method of high-quality medical imaging, especially in brain imaging where MRI's soft tissue contrast and non-invasiveness are clear advantages. An important use of MRI data is tracking the size of brain tumor as it responds treatment. The MRI-scan images an ideal source for detecting, identifying and classifying the right infected regions of the brain. Applying digital image processing ensures the quick and precise detection of the tumor. One of the most effective techniques to extract information from complex medical images that has wide application in medical field is the segmentation process. The main objective of the image segmentation is to partition an image into mutually exclusive and exhausted regions such that each region of interest is spatially contiguous and the pixels within the region are homogenous with respect to a pre defined criteria. In this thesis, the major novel approaches for analyzing tumor-bearing brain images in an accurate way are presented as convolution neural network classification. The method has been evaluated with good results on a large number of clinical and synthetic images.

II. LITERATURE SURVEY

A. Manoj K Kowar and Sourabh Yadav presented a aper on detection& segmentation using histogram thresholding. This paper presents a technique for the detection of tumor in the brain using segmentation and histogram thresholding. The proposed method can be successfully applied to detect the contour of the tumor and its geometrical dimension this gave an idea of segmentation and thresholding on brain tumor image.

B. Jawad Haider Kazmi, Kalim Qureshi, and Haroon Rashid presented a paper on Enhanced MRA images quality using structure adaptive noise filter and edge sharpening methods This paper presented a new enhancement technique namely SAN filter. The ordinary image filters blur the image and also remove important structural information like lines and edges. This loss of structural

information could be dangerous in a clinical environment and could leads to incorrect diagnosis. To address this problem, a structure preserving noise filter is designed.

III. BRAIN TUMOR SEGMENTATION

In this paper, we segmented the tumor structure into three intra-tumoral regions: peri tumoral edema, necrotic and non enhancing tumor core, and enhancing tumor region. Each of these regions has different radiological properties [4], which facilitates recognition by image processing techniques. Different biological structures that have similar radiological properties may be identified as one region. Thus, all brain biological structures are categorized into four broad regions -the three tumor regions and the healthy tissues region, each region contains similar looking structures. These regions are labeled into four classes for the segmentation task: class 0 for the healthy tissues and background, class 1 for the necrotic and non-enhancing region, class 2 for the edema, and class 4 for the enhancing tumor region.

IV. NEURAL NETWORKS

Neural networks are powerful machine learning tools that try to mimic the way the brain processes data. A typical neural network aims to represent a mapping between its input and output, deep neural networks have a multilayer structure where data are processed in each layer. Convolution neural network is a variant of the deep forward neural network, it is highly inspired by the way the human visual cortex work, it has multiple receptive fields that capture data and then it detects features in the data at multiple scales. Patch-wise convolution neural networks can be used for segmentation, in which the image t\4 be segmented is divided into small patches and each patch is used to classify the pixel at the center to determine the region to which it belongs. Neural networks were used extensively for brain tumor segmentation, although they had achieved high accuracies we believe there is still a room for improvements. In this paper, we focus on patch-wise CNN models to segment brain tumor in MRI images and point out some decisions that can help in improving existing models, and designing-and-training of new patch-wise CNNs for Brain tumor segmentation.

V. PROPOSED METHODOLOGY

The implementation of brain tumor detection involves following steps:

A. Input Image-

An image is a rectangular array of values (pixels). Each pixel represents the measurement of some property of a scene measured over a finite area. The property could be many things, but we usually measure either the average brightness (one value) or the bright nesses of the image filtered through red, green and blue filters (three values). The values are normally represented by an eight bit integer, giving a range of 256 levels of brightness. We talk about the resolution of an image: this is defined by the number of pixels and number of brightness values

B. Image Pre-Processing-

In photography, computing, and colorimetric, a grayscale or grey scale image is one in which the value of each pixel is a single sample representing only an amount of light, that is, it carries only intensity information. Images of this sort, also known as black-and-white or monochrome, are composed exclusively of shades of gray, varying from black at the weakest intensity to white at the strongest.

C. Segmentation-

In computer vision, image segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as super-pixels). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain characteristics

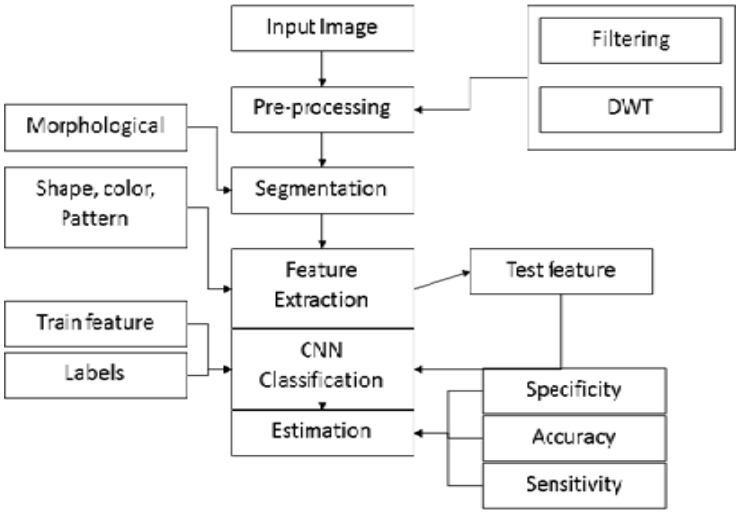

Fig.1: Flow Chart for Proposed Methodology

D. Feature Extraction-

The GLCM is a well-established statistical device for extracting second order texture information from images. A GLCM is a matrix where the number of rows and columns is equal to the number of distinct gray levels or pixel values in the image of that surface. GLCM is a matrix that describes the frequency of one gray level appearing in a specified spatial linear relationship with another gray level within the area of investigation. Given an image, each with an intensity, the GLCM is a tabulation of how often different combinations of gray levels co-occur in an image or image section. Texture feature calculations use the contents of the GLCM to give a measure of the variation in intensity at the pixel of interest.

E. Cnn Classification-

In pattern recognition, the k-nearest neighbors algorithm (k-NN) is a non-parametric method used for classification and regression. In both cases, the input consists of the k closest training examples in the feature space. The output depends on whether k-NN is used for classification or regression. In k-NN classification, the output is a class membership. An object is classified by a majority vote of its neighbors, with the object being assigned to the class most common among its k nearest neighbors (k is a positive integer, typically small). If k = 1, then the object is simply assigned to the class of that single nearest neighbor.

F. Estimation-

1) True positive (TP) = the number of cases correctly identified as patient.
2) False positive (FP) = the number of cases incorrectly identified as patient.
3) True negative (TN) = the number of cases correctly identified as healthy.
4) False negative (FN) = the number of cases incorrectly identified as healthy.

VI. RESULTS AND DISCUSSIONS

A. Input Image-

The MRI Images are collected from database.

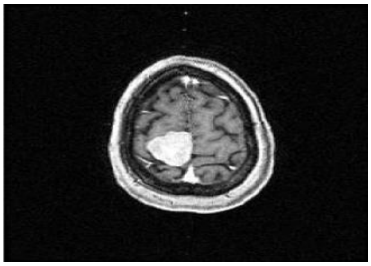

Fig. 2: Input image 1

B. Pre-Processing-

It performs high degree of noise reduction in an image and equalizes all the intensity of the pixel values in the image without any loss.

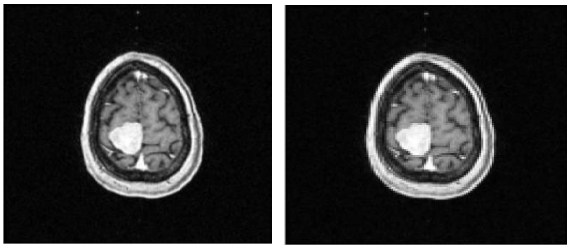

Fig. 3: Filtered and DWT images

C. Segmented Image-

The process of dividing an image into multiple parts. This is typically used to identify objects in digital image.

Fig. 4: Segmented image

D. Feature Extraction-

It is used to transforming the input data into set of features like shape, size and area etc.,

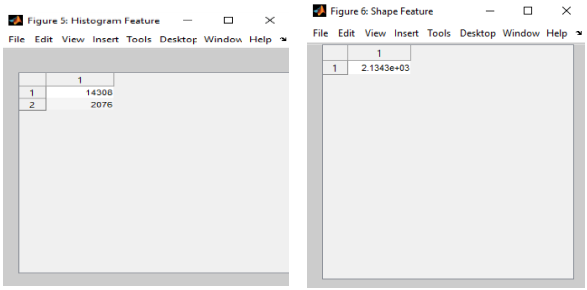

Fig.5: Histogram Features And Shape Extraction

E. Cnn Classification-

It is a type of artificial neural network used in image recognition and processing, that is specifically designed to process a pixel data.

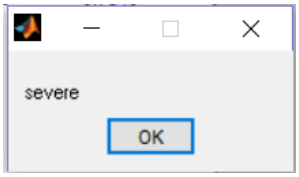

Fig. 6: Classification image

F. Estimation-

In this process we calculate the accuracy, sensitivity and specificity of the output image.

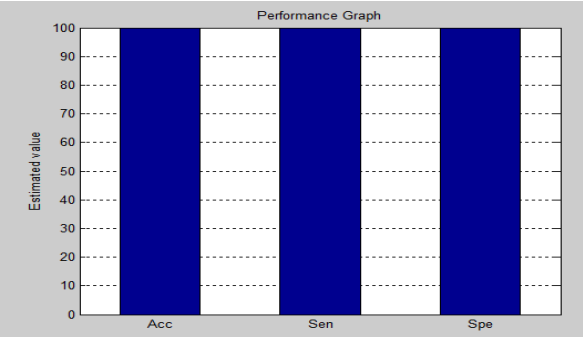

Fig. 7: Estimated Histogram image

G. Input Image-

The another MRI Images are collected from database.

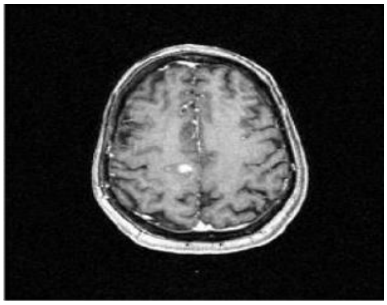

Fig. 8: Input image 2

H. Pre-Processing-

It performs high degree of noise reduction in an image and equalizes all the intensity of the pixel values in the image without any loss.

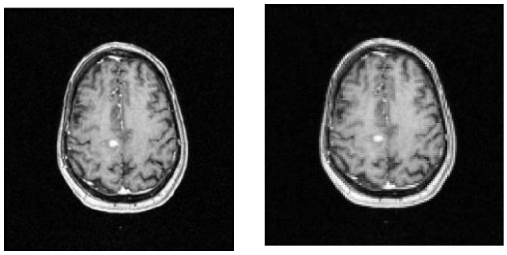

Fig. 9: Filtered and DWT images 2

I. Segmented Image-

The process of dividing an image into multiple parts. This is typically used to identify objects in digital image.

Fig. 10: Segmented image 2

J. Feature Extraction-

It is used to transforming the input data into set of features like shape, size and area etc.,

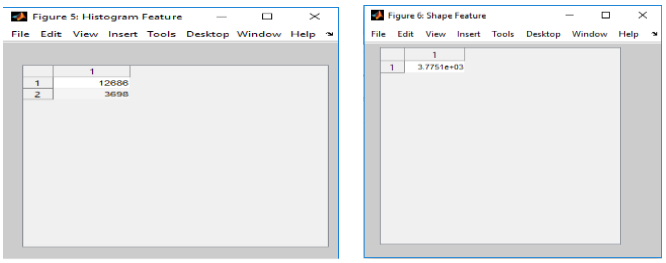

Fig. 11: Histogram Features and Shape Extraction

K. Cnn Classification-

It is a type of artificial neural network used in image recognition and processing, that is specifically designed to process a pixel data.

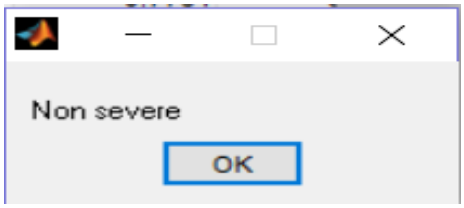

Fig. 12: Classified Output 2

L. Estimation-

In this process we calculate the accuracy, sensitivity and specificity of the output image

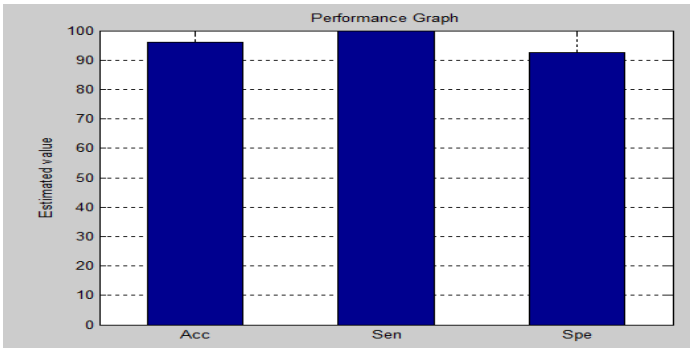

Fig. 13: Estimated image 2

VII. CONCLUSION

This paper has provided a comprehensive overview of the state of the art MRI-based brain tumor segmentation methods. Although most of brain tumor segmentation algorithms have relatively good results in the field of medical image analysis, there is a certain distance in clinical applications. Due to a lack of interaction between researchers and clinicians, clinicians still rely on manual segmentation for brain tumor in many cases. The existence of many tools aims to do pure research and is hardly useful for surgeons. In summary, we propose a novel CNN-based method for segmentation of brain tumors in MRI images. In this project various existing segmentation methods for brain MR image have been discussed. Using the knowledge from the above discussions our project proposes a Tumour Detection from MRI Images using Image Segmentation.

VIII. FUTURE SCOPE

We have worked on gray images in this project. We can also work on color images directly. We can implement a training set and classify the tumor according to its grades. In this project we have detected the location of the tumor in the MRI scanned image. The next step will be classifying the tumor according to its features. We can also predict the tumor growth by using this method.

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