SEGMENTATION OF BRAIN TUMOR IN MRI IMAGES USING HISTOGRAM CLASSIFICATION

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ABSRACT: At present, processing of medical images is a developing and important field. Image processing deals with many different types of imaging methods. These technologies allow us to detect even the smallest defects in human body using CT scans, MRI, X-rays etc. Detection of brain tumor is one of the emerging topics of research in biomedical image processing. Abnormal growth of tissues in the brain which affects proper brain functions is considered as a "Brain Tumor". Accurate detection is critical, especially when the tumor morphological changes remain subtle, irregular and difficult to assess by clinical examination. The main goal of medical image processing is to identify accurate and meaningful information using images with the minimum error possible. Proposed method consists of applying histogram classification approach and color segmentation on skull free MRI images for highlighting the necrotic tissue using" Convolutional Neural Network". Segmentation process differentiates the tumor tissues from normal brain tissues. Color segmentation is used because human eyes are sensitive to colors. Brain tumor classification is based on the type of tissue involved either benign (non-cancerous) or malignant.

Keywords: Brain Tumor segmentation, Convolutional neural network, Histogram classification, MRI images.

I.INTRODUCTION

Medical Imaging is the process of creating visual representations of the interior of a body for medical intervention, as well as visual representation of the function of organs or tissues. Biomedical Image Processing provides core innovation for medical imaging. Detection of brain tumor is one of the emerging topics of research in biomedical image processing. Magnetic Resonance Imaging (MRI) is mostly used for medical imaging of Brain tumor diagnosis. Brain tumor is defined as a cancerous or non-cancerous mass or growth of abnormal cells in the brain.

An image is an array or a matrix of square pixels arranged in columns and rows. An image is an artifact, for example a two dimensional picture, that has a similar appearance to some subject usually a physical object or person.

Image processing is a subset of the electronic domain where in the image is converted to an array of small integers, called "Pixels", representing a physical quantity such as scene radiance, stored in a digital memory and processed by computer or other digital hardware. Each pixel represents a value from 0 to 255 verifying the level of gray, where 0 represents a black pixel, 255 represent white pixel and values in-between represent shades of gray.

Image processing is any form of signal processing for which the input is an image, such as a photograph or video frame; the output of image processing may be either an image or a set of characteristics or parameters related to the image. Most image-processing techniques involve treating the image as a dimensional signal and applying standard signal-processing techniques to it. Image processing usually refers to digital image processing, but optical and analog image processing also are possible. The acquisition of is referred to as imaging. Image processing allows one to enhance image features of interest while attenuating detail irrelevant to a given application, and then extract useful information about the scene from the enhanced image. This introduction is a practical guide to the challenges, and the hardware and algorithms used to meet them.

Pre-Processing involves processes like conversion to greyscale image, noise removal, sharpen contrast and highlighting contours. Image Denoising estimates the state of the scene without the noise and is not a substitute for obtaining a "cleaner" image. Excessive noise reduction leads to a loss of detail, and its application is hence subject to a trade-off between the undesirability of the noise itself and that of the reduction artifacts. Noise tends to invade images when pictures are taken in low light settings. Some of the noise seen in images are Salt and Pepper noise, Speckle noise, Gaussian noise etc. These noises can be removed by

either linear filters or non-linear filters. Noise commonly seen in MRI image is salt and pepper noise. This noise can be removed by, Median filter.

Post-Processing involves Image segmentation, Feature extraction and Classification. Image segmentation is the process of partitioning a digital image into sets of pixels or meaningful regions. The goal of segmentation is to simplify and change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects lines, curves in images. The meaningful regions may represent objects in an image of three-dimensional scene, regions corresponding to industrial, residential, agricultural, or natural terrain in an aerial recognizance application

Threshold segmentation is one of the simplest segmentation methods. The input gray scale image is converted into a binary format. The method is based on a threshold value which will convert gray scale image into a binary image format. In Image processing, feature extraction starts from an initial set of measured data and builds derived values intended to be informative and non-redundant, facilitating the subsequent learning and generalization steps, and in some cases leading to better human interpretations.

Feature extraction involves reducing the amount of resources required to describe a large set of data. When performing analysis of complex data one of the major problems stems from the number of variables involved.. Feature extraction is a general term for methods of constructing combinations of the variables to get around these problems while still describing the data with sufficient accuracy. The parameters can be evaluated from feature extraction about image are Peak signal noise ratio (PSNR), Mean square error (MSE), Variance, Mean ,Energy, Entropy, Skewness and Kurtosis.Image classification refers to the task of extracting information classes from a multiband raster image. The resulting raster from image classification can be used to create thematic maps

II .FLOW DIAGRAM

First the input image selected for identification of brain tumor type. The selected MRI image then converted from RGB model to Grayscale model so that the pixel contains only the same weights. Then the image filtered by using median filter which removes the salt and pepper noise in the image. The filtered image then segmented using "Threshold segmentation" which segments the affected part of the brain MRI image. Then the features of the image are extracted. Then the features of the input image are compared with the trained dataset using "Convolutional Neural Network". The trained dataset consists of features of two type of brain tumors. Finally, the result will be shown which type of brain tumor was detected i.e. either benign or malignant.

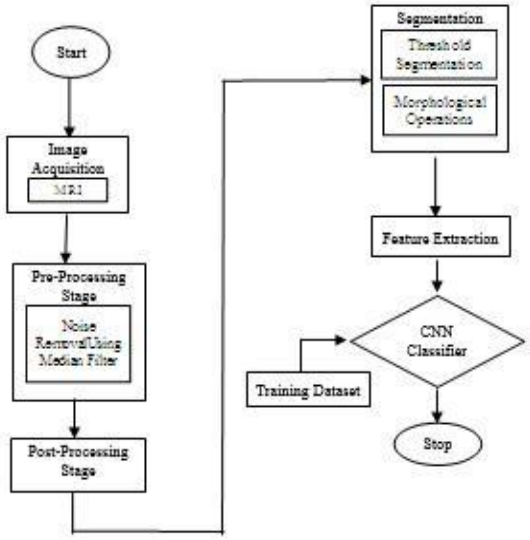

Figure 1.Workflow Diagram

IMAGE ACQUISITION

Magnetic resonance imaging (MRI) is a medical imaging technique used to form pictures of the anatomy of the body. MRI Scanners use strong magnetic fields to generate images of the organs in the body. MRI does not involve X-rays or the use of ionizing radiation, which distinguishes it from CT images. Images of patient obtained by MRI Scan are of three types: axial images, saggital images, coronal image.

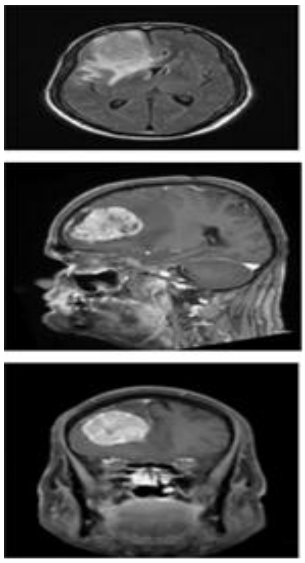

Figure 2: Types of Images obtained from MRI Scan

IMAGE DENOISING

Image denoising is the process of removing noise from an image. Image filters can be classified as linear or nonlinear.

Linear filters are also known as convolution filters as they can be represented using a matrix multiplication. A non-linear filter is a filter whose output is not a linear function of its input.

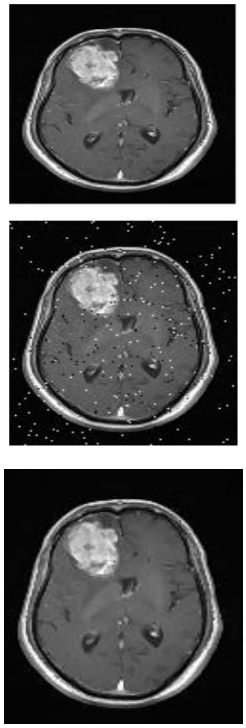

Figure 3: a) Original Image b) Noise added image c)Median Filtered Image

IMAGE PRE-PROCESSING

Pre-Processing involves processes like conversion to greyscale image, noise removal, and image reconstruction. After the image is converted to Grey scale, excess noise can be removed using different filtering methods.

III.ALGORITHM DESCRIPTION

The main idea of the median filter is to run through the signal entry by entry, replacing each entry with the median of neighboring entries. The pattern of neighbors is called the "Window", which slides, entry by entry, over the entire signal. For 1D signals, the most obvious window is just the first few preceding and following entries, whereas for 2D signals such as images, more complex window patterns are possible. Note that if the window has an odd number of entries, then the median is simple to define: it is just the middle value after all the entries in the window are sorted numerically. For an even number of entries, there is more than one possible median, see median for more details.

BOUNDARY ISSUES

Note that, in the example above, because there is no entry preceding the first value, the first value is repeated, as with the last value, to obtain enough entries to fill the window. This is one way of handling missing window entries at the boundaries of the signal, but there are other schemes that have different properties that might be preferred in particular circumstances:

- Avoid processing the boundaries, with or without cropping the signal or image boundary afterwards,
- Fetching entries from other places in the signal. With images for example, entries from the far horizontal or vertical boundary might be selected,
- Shrinking the window near the boundaries, so that every window is full.

ALGORITHM IMPLEMENTATION ISSUES

Typically, by far the majority of the computational effort and time is spent on calculating the median of each window. Because the filter must process every entry in the signal, for large signals such as images, the efficiency of this median calculation is a critical factor in determining how fast the algorithm can run. The "Vanilla" implementation described above sorts every entry in the window to find the median; however, since only the middle value in a list of numbers is required, selection algorithms can be much more efficient. Furthermore, some types of signals use whole number representations: in these cases, histogram medians can be far more efficient because it is simple to update the histogram from window to window, and finding the median of a histogram is not particularly onerous.

EDGE PRESERVATION PROPERTIES

Median filtering is one kind of smoothing technique, as is linear Gaussian filtering. All smoothing techniques are effective at removing noise in smooth patches or smooth regions of a signal, but adversely affect edges. Often though, at the same time as reducing the noise in a signal, it is important to preserve the edges. Edges are of critical importance to the visual appearance of images, for example. For small to moderate levels of noise, the median filter is demonstrably better than Gaussian blur at removing noise whilst preserving edges for a given, fixed window size. However, its performance is not that much better than Gaussian blur for high levels of noise, whereas, for speckle noise and salt and pepper noise, it is particularly effective. Because of this, median filtering is very widely used in digital image processing.

IMAGE POST-PROCESSING

The Post-Processing processes are Image segmentation, Feature extraction and Classification.

IMAGE SEGMENTATION

"Image Segmentation" is the process of distributing an image into minor portions. It creates several sets of pixels within same image. Assign a tag to every pixel in an image and the pixels with the similar label share particular features. Segmenting makes it easier to further analyze and recognize important information.

THRESHOLD SEGMENTATION

Threshold segmentation is one of the simplest segmentation methods. The input gray scale image is converted into a binary format. The method is based on a threshold value which will convert gray scale image into a binary image format. The main logic is the selection of a threshold value.

MORPHOLOGICALOPERATONS

Morphology is a broad set of image processing operations that process images based on shapes. Morphological operations apply a structuring element to an input image, creating an output image of the same size.

FEATURE EXTRACTION

Feature extraction plays an important role in the area of Image processing since, "Features" defines the behavior of an image. Feature extraction can be defined as "Extracting features or information from the raw data which is useful for classification purposes".

- Feature extraction makes the transition from pictorial to non-pictorial data representation. The resulting representation can be used as an input to various classification techniques, which will then classify the semantic contents of the images. The non-pictorial data members obtained after Feature extraction process are, PSNR,MSE, Mean, Variance, Energy, Entropy, Correlation Coefficient ,Skewness.

CLASSIFICATION

"Convolutional Neural Network", a deep learning model, is used as a classifier. "Deep learning "is a particular kind of machine learning that achieves great power and flexibility by learning to represent the world as nested hierarchy of concepts. In a deep learning model, the algorithm can determine on their own if a prediction is accurate or not. Convolutional neural networks (CNNs) are widely used in pattern- and image-recognition problems as they have a number of advantages compared to other techniques. A neural network is a system of interconnected artificial "neurons" that exchange messages between each other. The connections have numeric weights that are tuned during the training process, so that a properly trained network will respond correctly when presented with an image. The network consists of multiple layers of feature-detecting "neurons". Each layer has many neurons that respond to different combinations of inputs from the previous layers

a. WORKING OF CNN

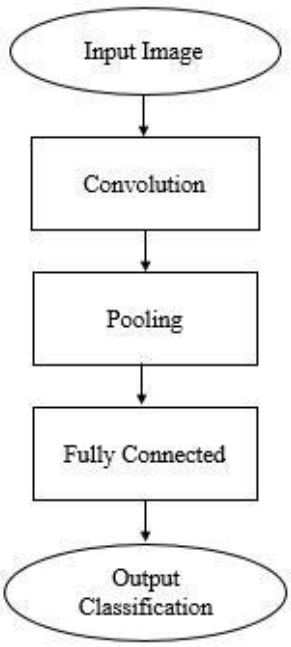

Figure 4.Workflow of CNN Algorithm

Convolution: In Mathematics, "Convolution" is a function derived from two given functions by integration. The term "Convolution" refers to both function and to the process of computing it.

$$f(t) * g(t) = f(t-T)\, g(T)\, dT$$

As t changes, the weighting function emphasizes different parts of the input function. Convolution layer will compute the output of neurons that are connected to local regions in the input, each computing a dot product between their weights and a small region they are connected to in the input volume.

Pooling: A pooling layer is another building block of a convolutional neural network. Its function is to reduce the spatial size of the representation to reduce the amount of parameters and computation in the network. Pooling layer operates on each feature map independently.

Fully Connected: Fully connected layer will compute the class scores. Each neuron in this layer will be connected to all the numbers in the previous volume. In this way, Convolutional neural network transforms the original image layer by layer from the original pixel values to the final class

scores to classify the segmented images as either benign or malignant.

IV. RESULTS AND DISCUSSIONS

Magnetic Resonance Imaging (MRI) does involves X-rays. Computed Tomography (CT) scans involves X-rays, which uses Ionizing radiations. These radiations can cause cancer to human beings when they exposed to X-rays often. Other important advantage is that, segmented CT images were not often clearer when to compared to MRI images.

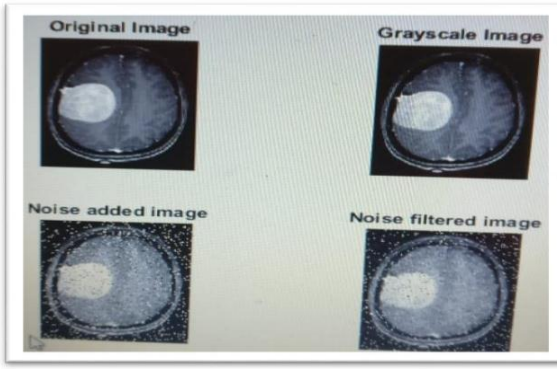

Figure 5:Filtered Image using Weiner Filter

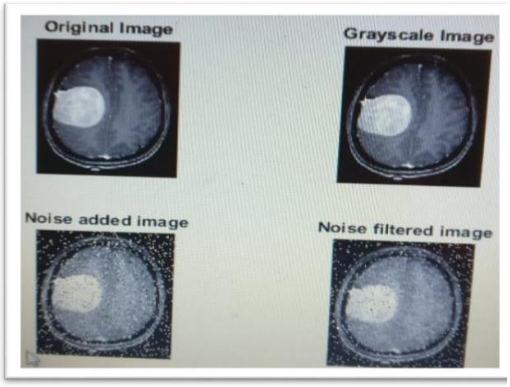

Figure 6: Filtered Image using Median Filter

From the above images, it is clearly seen that, Median filter has more accuracy than Weiner filter in removing salt and pepper noise from MRI Images. Both Mean square error and Peak signal noise ratio are said to be "Error Metrics". These values are used to measure the quality of reconstruction in image compression. High values of Peak signal noise ratio and low values of Mean square error indicates less amount of error in output image.

The values of energy and entropy indicates the degree of disorder or rate of change in color, brightness and magnitude of the pixels over local areas. High entropy indicates that, there is not a uniform level in pixel distribution.

The values of Kurtosis and skewness related with the presence of noise and smoothness level in image surfaces. High kurtosis value means, low noise in the image. High skewness value means, surface of the image is more smoother than result of feature extraction. When the size of the input data increases, the performance of a machine learning model tends to decline. But in case of a deep learning model, huge amount of input data is needed to make a accurate prediction and at the same time, performance is also maintained.

V. CONCLUSION

This method incorporates with some Noise removal functions (Median filtering), Segmentation (Threshold segmentation),Feature extraction and Classification (Convolutional Neural Network). Detection and segmentation of tumor from MRI scan images of the brain is done by using MATLAB software. Color segmentation is used in this project to differentiate the tumor tissues form normal tissues. All the above processes are done. The tumor part of brain was segmented and the classification was done which gives the result which type of brain tumor (either benign or malignant) affected in brain.

VI.REFERENCES

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