International Journal of Scientific Research in Computer Science, Engineering and Information Technology
ISSN : 2456-3307 (www.ijsrcseit.com)
doi : https://doi.org/10.32628/IJSRCSEIT

Review: Brain Tumor Detection using Digital Image Processing

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ARTICLEINFO

Article History:
Accepted: 15 Feb 2023
Published: 05 March 2023

Publication Issue
Volume 10, Issue 2
March-April-2023

Page Number
34-42

ABSTRACT

Now a day, one of the most common diseases is a brain tumor. The challenge is to identify a tumor at an early stage, which is essential to receiving good care and surviving brain cancer patients. In the human body, the uncontrolled growth of cells is called a brain tumor. They have different types and characteristics and have different treatments. Medical imaging techniques play an important role in the detection of brain tumors. Although MRI (Magnetic Resonance Imaging) is frequently regarded as the best method for identifying this type of tumor, it has several drawbacks, and MRI images are more sensitive to ambient noise and other disruptions. As a result, it is challenging for doctors to identify the tumor and its origin.

Keywords : DIP (Digital Image Processing), MRI (Magnetic resonance Image), Brain Tumor, classification, Segmentation, Feature Extraction, SVM (Support vector Machine)

1. INTRODUCTION

There are various types of cells found in the human body. The human body's most sensitive and highly specialized organ is the brain. A brain tumor is an extremely dangerous condition that can affect people [1]. An accumulation or mass of abnormal cells in your brain is referred to as a brain tumor. Your brain is protected by your incredibly strong skull. Problems can arise from any growth in such a constrained area.

A difficult task in medical image processing is brain tumor detection. To identify the tumor, doctors take various sorts of imaging of the human brain, such as MRI (Magnetic Resonance Imaging) and PET (Positron Emission Tomography), CT (Compute Tomography) scans. Inside the human brain, it can be exceedingly challenging to distinguish between tumors and other items that resemble a tumor [3]. Brain tumor extraction is a very challenging task based on color (intensity), other than the tumor different parts of the brain has also high intensity, in this situation identifying brain tumors and extracting

tumors is very difficult. Magnetic resonance (MRI) images are a very useful tool to detect tumors. Generally, a CT scan or MRI that is directed into the cranial cavity produces a complete image of the brain [2].

1.1 Types of Brain Tumors

Generally, two types of brain tumors: the first is **Primary brain tumor** which is the start of the tumor cell in the human brain itself and usually stays there and the second is the **Secondary brain tumor** which is more commonly it also called known as metastatic brain tumor. These tumors develop in the other part of the body and move to the brain. Some brain tumors are **I] Benign tumor** (non-cancerous) in Figure 1. A benign tumor is noncancerous the size and proliferation of the tumor cells are normal. Whereas others are **II] Malignant tumor** (cancerous) in Figure 2. The human brain is the primary location of a brain tumor. Benign brain tumors are common. When cancerous cells migrate from another part of the body and are abnormal in growth and size to your brain, a benign tumor might turn into a malignant tumor, and a low grade tumor can become a higher grade tumor. The result is a secondary brain tumor or metastatic brain tumor. Detecting brain tumors is a difficult task due to the complicated structure of the brain.

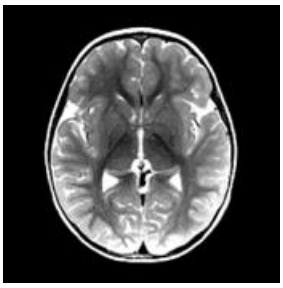

Figure 1. Brain MRI Image

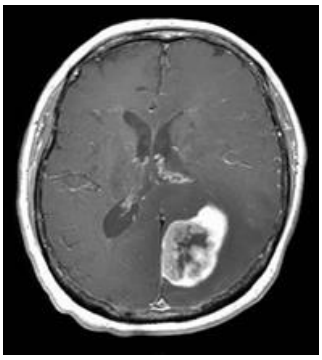

Figure 2. Brain Tumor MRI Image

1.2 Brain Tumor detection techniques

Detecting the edge of the brain tumor first acquires of MRI scan image, and then digital imaging techniques have applied for getting the exact location and size of the tumor. The detection of edges depends on nearby pixels, the 2D cellular automata idea was applied 0 [3]**Error! Reference source not found.**The wavelet decomposition, classification textural and feature extraction methods are used. The MR images were used to test the proposed technique, and the accuracy of classification using a probabilistic neural network (PNN). The first method is based on a coordinated collection of image processing algorithms, whereas other is based on a modified PNN [2] [7]. The technique of pre-processes on MRI images to remove noise using a median filter and a logarithmic transform before performing segmentation to identify tumors using thresholding. The tumors are extracted using thresholding methods, and the tumor area is then calculated [4].

1.3 Objective

The detection of brain tumor stages and their classification of tumors is based on characteristics or features of the tumor because of the comparison with specific techniques. Brain tumor extraction and its analysis are challenging tasks in medical image processing because brain image is complicated.

Finding a brain tumor in its early stages is the biggest challenge to surviving the patient.

2. LITERATURE REVIEW

To locate brain tumors, most of the researchers came up with a variety of approaches, methodologies, and algorithms. MRI images are also utilized to find various kinds of abnormalities in the human brain.
The following table shows the different techniques for the detection of tumors.

Table 1. Literature Review

Sr. No	Author	Paper Name/ Year	Methods/ Techniques	Accuracy/Observations
1	Pratibha Sharma, Manoj Diwakar, Sangam Choudhary	Application of Edge Detection for Brain Tumor Detection, November 2012	Image processing techniques, Magnetic resonance imaging (MRI), amplitude thresholding, texture segmentation, Template matching, Region-growing segmentation,	An effective technique for locating the edges of brain tumors is presented in this research. To determine the precise location and size of the tumor, digital imaging techniques are first used to acquire an MRI scan image. The ultimate result's accuracy is dependent on image processing methods (image enhancement, Binary to gray image, morphological operations) the detection of edges depends on nearby pixels, the 2D cellular automata idea was applied.
2	D. A. Dahab, Samy S. A. Ghoniemy, G. M. Selim	Automated Brain Tumor Detection and Identification Using Image Processing and Probabilistic Neural Network Techniques, October 2012	Probabilistic Neural Network (PNN) model, learning vector quantization (LVQ, MRI	Using MRI scan pictures, The first method is based on a coordinated collection of image processing algorithms, whereas other is based on a modified PNN. The technique for processing images is based on canny edge detection.

3	Kamal Kant Hiran, Ruchi Doshi	An Artificial Neural Network Approach for Brain Tumor Detection Using Digital Image Segmentation 5 September – October 2013	MRI images, Edge detection, segmentation, Artificial Neural Networks, Morphological operation,	Using the image processing tools at the MAT lab, we successfully implement the detection and classification of brain tumors in this paper. We employed methods for improving the pixels that were indicative of a brain tumor in an MRI. We looked at a few DIP techniques and spoke about the prerequisites and characteristics of brain tumor identification. We provide improved details on the segmentation and detection of brain tumors.
4	Vishal S. Shirsat, Seema S. Kawathekar	Classification of Brain Cancer Detection by using Magnetic Resonance Imaging, February – 2014	Magnetic Resonance Imaging (MRI), Logarithmic Transform (LT), Receiver operating characteristic (ROC)	They use brain MRI pictures to find tumors. They employed "Proposed" The technique on the brain MRI images first uses a medial filter to eliminate noise, an algorithmic transformation, and then thresholding to identify tumors in the brain MRI images before performing segmentation.
5	Vipin Y. Borole, Sunil S. Nimbhore, Dr. Seema S. Kawathekar	Image Processing Techniques for Brain Tumor Detection: A Review, September - October 2015	Brain Tumor (BT), MRI-Images, CT, IP, X-ray.	They describe many methods for picture preprocessing, including edge recognition, contrast enhancement, and filtering. they are utilized for image post-processing procedures (threshold, segmentation, histogram, and morphological, These are used to enhance the images)
6	Amrutha Ravi, Sreejith S.	A Review on Brain Tumor Detection Using Image Segmentation	Brain Tumor, Image Segmentation, Magnetic Resonance Imaging	We have covered several segmentation techniques for brain MR images in this study. We suggest an automated tumor detection approach that makes use of image segmentation.

7	V. Vani	Probabilistic Neural Network design for Classification Of Brain Tumor, 1st Jan 2019	Classification, Feature extraction, Probabilistic neural network, Texture analysis, Wavelet decomposition	In this study, they present and wavelet decomposition, classification textural, and feature extraction methods are used. The MR images were used to test the proposed technique, and the accuracy of classification using a probabilistic neural network.
8	Moitra D.and Mandal R.	Review of Brain Tumor Detection using Pattern Recognition Techniques, 28/Feb/2017	image processing segmentation, Artificial Neural Network (ANN),	They take PET images, preprocess them, and then provide the images to ANNs in order to precisely locate and localize the tumor.
9	Vipin Y. Borole, Seema S. Kawathekar	Study of various DIP Techniques used for Brain Tumor detection and tumor area calculation using MRI images, 31/July/2016	Preprocessing, Segmentation, Morphological operation, Feature extraction, tumor area calculation	They talk about the several digital image processing techniques that are used to find tumors. Additionally, an MRI image is used to calculate the tumor extent and assess the image quality after the suggested method has detected the tumor-affected area and segregated it from the surrounding area.
10	Sheetal A. Wadhai , Seema S. Kawathekar	Techniques of Content-Based Image Retrieval: A Review 2017	Content-Based Image Retrieval (CBIR), Shape, Feature Extraction	Based on content characteristics including color, texture, and shape, the CBIR is used. Recognizing and utilizing the form and color parallelogram to explain the local and global distribution of colors They compared how close the automatically generated features (color, shape, and texture) of the query image and the database-stored image were.
11	Saurabh Kumar , Iram Abid , Shubhi Garg , Anand	BRAIN TUMOR DETECTION USING IMAGE	Image Segmentation, Support Vector Machine, Self-	They used image processing to automate the diagnosing process for identifying brain tumors. The entire process of identifying a brain tumor has been covered, from the MRI image acquisition

	Kumar Singh , Vivek Jain	PROCESSING, 2019	Organized Mapping, MRI.	through the pre-processing and categorization of the tumor utilizing the two segmentation algorithms. They have also used wavelet-based methods, Edge sharpening, improvement, noise removal, and unwanted background removal increasing both the image quality and the detection process, making quality enhancement and filtering crucial.

3. METHODS AND MATERIAL

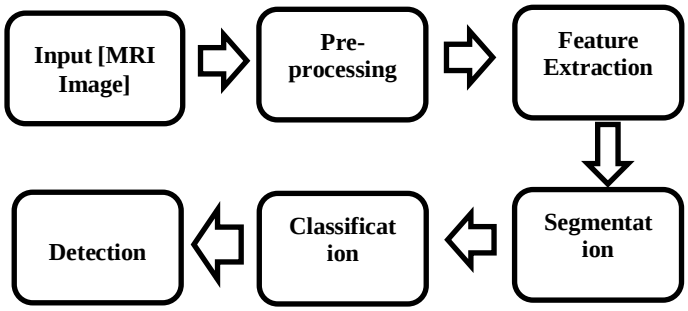

Figure 3. A block diagram of the feature extraction techniques for digital images

A. Input image

In Figure 1. Brain MRI Image We have gathered image data from a common medical imaging database taken from kaggle for the proposed task [3]. These images, which are used as the input image, were taken with an MRI scanner of various sizes. These colored MRI scan images are then transformed into corresponding grayscale images. These scanned images are displayed using pixel-based two-dimensional matrices. The image intensity scale is ranged in between 0 and 255 [12].

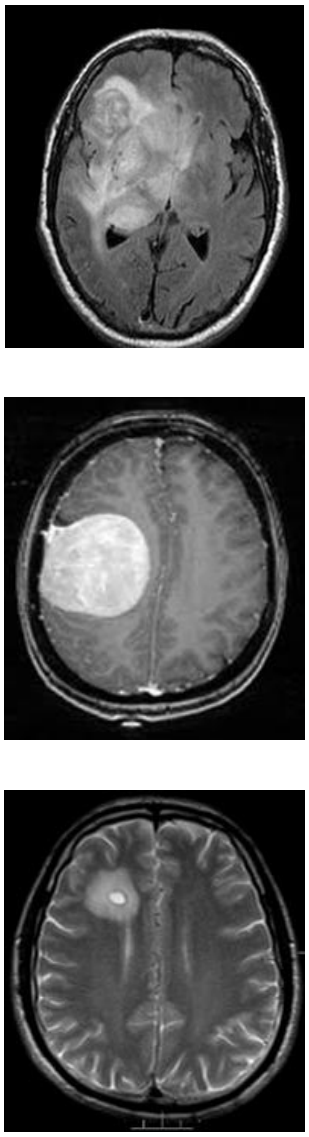

Figure 4. Input images of brain tumor

B. Image Preprocessing

The definition of image noise is the random variation in an image brightness or certain color information. Typically, a scanner's sensor or a digital camera's electronics can produce it [14]. Image smoothing and image registration are two of the preparation steps that the image goes through. The many filter are used to remove noise from image. Average filter are used to remove pepper noise and white noise, and median filter are used to remove salt noise and pepper noise. Weighted filter is used to improve quality of image. Image enhancement follows image smoothing in contrast, image smoothing removes white noise, paper noise and sharpening from the image to provide a standard image that can be processed further. In order to maintain image quality, highlight its features, and subsequently reduce noise, de-noising is required.

a. Noise
b. Blur low contrast
c. Sharpening
d. Smoothing

This pre-processing stage is used to clean up image noise, highlight important areas, and display obvious areas of digital images.

De-noise: In the phase median filter is used. A nonlinear filter called median filtering is used to efficiently remove noise. Reducing the grainy spots this technique is used while minimizing the loss of quality [2].

C. Image Segmentation

For identification the tumor region the segmentation algorithm has used canny edge detection and Otsu's segmentation method. Both the approach is used to edge detection for segmenting images. The goal of segmentation is to locate the area of interest, target that area for the identification of tumors. When a brain tumor is detected we can calculate its area and identify whether the tumor is in the primary or secondary stage.

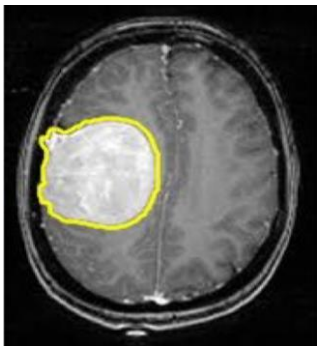

Figure 5. Tumor extracted region

D. Image Classification

In this phase, the identification features of the MRI image are extracted. Feature extraction includes mean and standard deviation, smoothness, entropy, and correlation. Using these features the given image feature is extracted and analyzed. The threshold is 45 to 255 in range.

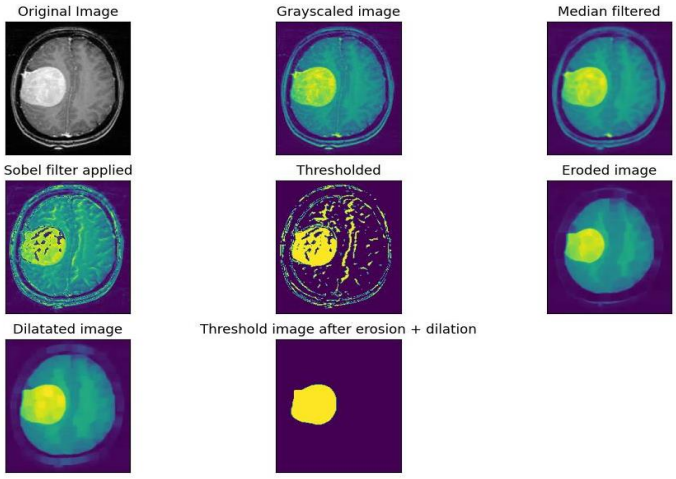

Figure 6. Tumor Feature Extraction

After that the algorithm attempts to correctly identify the tumor image and categorize it as benign or malignant, and primary or secondary tumor detection. The technique used for classification is SVM (Support Vector Machine). The classification results have been

used for the prediction of brain tumor detection in the early stage.

4. CONCLUSION

Tumors are now frequently seen in disorders. MRI imaging is the most effective imaging method for locating brain malignancies. In this study, it was found that the use of digital image processing methods is a significant source for identifying brain tumors from MRI scans. Preprocessing involves a number of techniques, including filtering, De-nosing, removing blur from images, and sharpening for segmentation Otsu's segmentation is used and the features like standard deviation and eccentricity are calculated and then classification is done using the SVM technique.

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Cite this article as:

Dinesh M. Barode, Rupali S. Awhad, Seema S. Kawathekar, "A Review : Brain tumor detection using Digital Image Processing", International Journal of Scientific Research in Computer Science, Engineering and Information Technology (IJSRCSEIT), ISSN : 2456-3307, Volume 9, Issue 2, pp.34-42, March-April-2023. Available at doi : https://doi.org/10.32628/CSEIT2390154
Journal URL : https://ijsrcseit.com/CSEIT2390154