A Review on Identificationof Tumor Using Image Classification Techniques

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Abstract-*Image processing is frequently a fascinating area to study since it provides improved visual data for the simplicity of tasks performed by people, as well as processing of image data for transmission and depiction of tasks performed by machines. Image processing is used to provide digital photographs a better solution once they have been treated. Image processing makes use of a wide variety of techniques, including grayscale conversion, image segmentation, edge detection, feature extraction, and classification. The topic of biomedical image processing is one that is expanding and becoming increasingly demanding. It incorporates a wide variety of imaging techniques, including MRI scans, CT scans, and X-rays, among others. With the use of these methods, we are able to detect even the most minute anomalies within the human body. The basic purpose of medical imaging is to get information that is both useful and accurate from theseImage while making as few mistakes as is humanly feasible. This study provides a comprehensive review of the development of image processing algorithms for the identification and categorization of tumors in the human body. Through careful analysis of the many methods now in use, we will be able to identify the one approach that will provide the most fruitful outcomes for the ongoing and upcoming work in this area of study. Additionally, the breadth of the proposed methodologies is aware of the deficiencies, as demonstrated by their ability to produce accurate results in tumor detection.*

Index Term—Brain Tumor, Image processing, Image Classification, Segmentation.

I. INTRODUCTION

Currently, digital images have had an enormous effect and impact on contemporary culture in a variety of ways. In research and technology, digital image processing has developed as an indispensable tool. Different digital image processing methods have shown their application to the research of medicine[1]. " Medical image processing" is the deployment of digital image processing to medical applications. Magnetic Resonance Imaging (MRI) is a cutting-edge medical imaging technique. This method provides valuable insight into the anatomical structure of human soft tissues. This technique is more favorable than its competitors since it provides 3D data with great contrast between soft tissues. The identification and categorization of brain tumors has been a major area of study in MIP (Medical Image Processing) in recent years[2]. The identification of brain tumors manually by physicians is highly difficult and time-consuming. Therefore, automated identification and categorization of brain tumors must be adopted to prevent misclassification and save time. Among many imaging techniques, MRI is widely used for brain tumor identification owing to its high resolution and excellent capacity to identify change[3].

II. IMAGE PROCEESING AND ITS TECHNIQUES

Image processing is the method of converting an image into digital format & performing an operation on it in order to get an enhanced image or extract usable data from it. It is a signal dispersion method[4]. The procedure accepts an image as input and then applies efficient algorithms to generate an image, data, or attributes related with that image[5]. Covered in these processes are preprocessing, segmentation, extraction of features, classification, & clustering. Figure 1.1 depicts a block schematic of the aforementioned four steps.

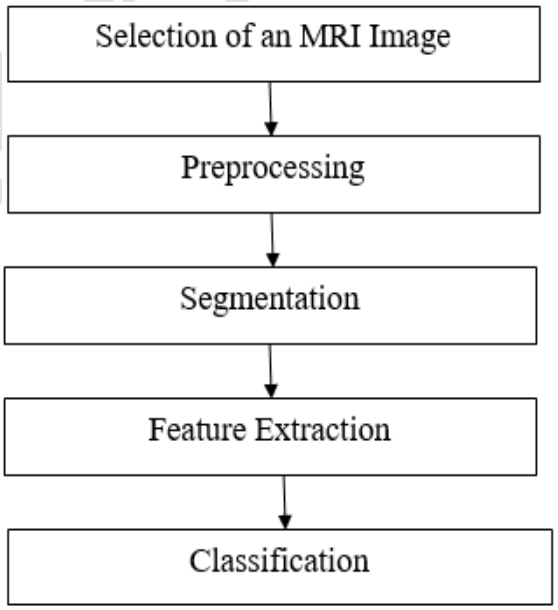

Fig.1.1: Phases involved in Brain Tumor Detection

A. IMAGE PREPROCESSING

In order to increase the likelihood of detecting questionable regions, MR images are used in this stage. Denoising and fine-tuning obtained images are the primary focuses of this stage. Medical MR images that have been damaged by noise are often less reliable. Intensity inconsistency, also known as radio frequency inhomogeneity or bias field, is a common source of image degradation in magnetic resonance imaging. This variant causes a softening of sharp visual features like edges and outlines. In order to enhance the segmentation and feature identification process of input MRI brain volumes, several image pre-processing approaches are applied[6]. In this process, images are filtered in a number of ways to remove unwanted noise. These methods help to reduce the distracting distortions and enhance certain features of an image. The primary goal of pre-processing is to increase the contrast level of an image and get rid of noise in an image so that the final captured picture is of higher quality. Preprocessing is the action of doing the following:

a. **RGB to Gray scale conversion**: A grayscale image is just made up of grayscale values, while an MR image is made up of RGB values. In RGB space, the red, green, and blue parts of the color "gray" are all the same brightness. Because of this, it is important to give each pixel its own brightness level. MR scans look like they are black and white, but they have a few primary colors in them. Because of this, MR images must be turned into grayscale images.
b. **Filtering:**A filtering procedure modifies or enhances an image. Utilizing filtering, image processing activities such as edge improvement, sharpening, and smoothing are done.
c. **Contrast enhancement**: Improving the picture contrast is primarily intended to clarify ambiguous image elements and emphasize particular image aspects. Typically, noise and blurriness are eliminated from images prior to contrast enhancement.Contrast enhancement helps to identify the suspected tumorous area.

B. SEGMENTATION

During the segmentation procedure, an image is cut into smaller pieces. To segment an image is to divide it into several smaller portions for analysis or other purposes. For the sake of ease in image analysis, this method is often used to localize image objects and edges[7]. Every pixel in the image is labelled in this procedure. pixels with the same name have certain visual characteristics. How characteristics that need to be stored and retrieved affect the decision of an image segmentation algorithm. Listed below are a number of different approaches to segmenting images.

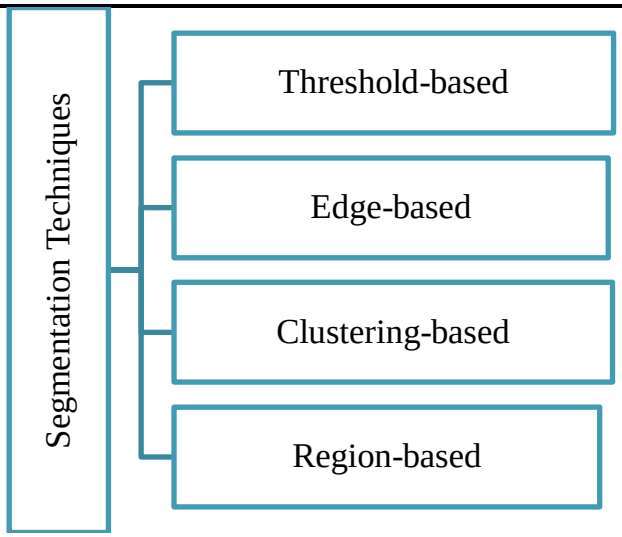

Fig.1.2: Image Segmentation techniques

C. FEATURE EXTRACTION

After the tumor has been segmented, characteristics are retrieved from the image that has been segmented in order to determine if the tumor is of a low grade or high grade [8]. There are a variety of tumor characteristics, such as form, size, and others, that may be used to discriminate between the different varieties of tumor. A high-grade tumor will have a greater degree of irregularity. The following are some common techniques for extracting features:

- **Feature extraction using DWT**

Feature extraction from brain MR images utilizing wavelets is regarded as the best method for highlighting picture pixels for improved outcomes. Discrete wavelet transform (DWT) performs wavelet transform using a discrete collection of wavelet scales and translations that adhere to a set of predefined criteria. In some other view, this transform decomposes the signal into a collection of similarly orthogonal wavelets[9].

- **Feature extraction using GLCM**

One of the most well-known algorithms for extracting features from textures is called GLCM (Gray level co-occurrence matrix). Using second-order statistics, this program conducts an operation on the Image to identify pixel-by-pixel textural relationships. Two pixels are used to do this task globally. The GLCM method calculates the combination frequency of these pixel intensities.

III. IMAGE CLASSIFICATION TECHNIQUE

The automatic identification of tumors in brain MR images requires classification, which is a complex process. The classification technique has to reveal the extent to which the image contains any suspicious tumor areas. Numerous classification methods exist for use in image classification[10]. Some brain tumor detection classification techniques have included theNaive Bayes(NB), Support Vector Machine (SVM),random forest(RF), K-nearest neighbor (KNN) etc. All of these algorithms are described in detail here.

Artificial Neural Network (ANN)

ANN is a system of linked artificial neurons that mimics the functioning of the brain. There is a sequence of layers in ANN and a set of neurons is present in every layer. The weighted connections present on all the neurons present in the previous and next layers are linked with the neurons of every other layer[11]. Just like the working of biological brain, each connection transmits a signal from one neuron to other. Depending upon the structure of network and number of inputs, the performance parameters are calculated.

Convolutional Neural Network (CNN)

CNN or ConvNet is a popular deep learning and feed forwarding algorithm, in which multiple layers are connected to analyze the images effectively. The main building blocks of CNN include four layers of Convolutional, Pooling, ReLu and Fully-connected. In medical image analysis, they play a significant role to classify the tumors or any affected part of the human body [12].

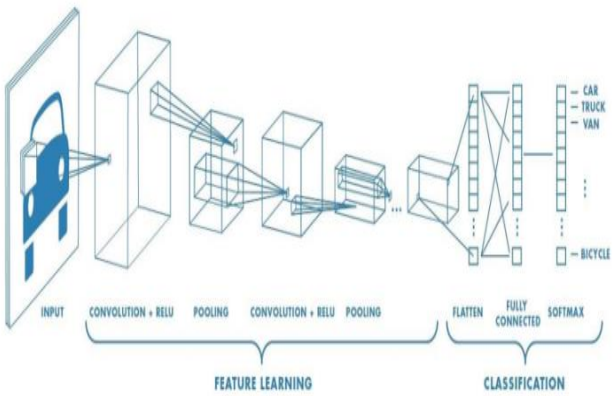

Fig.1.3: Convolutional Neural Network

Decision Tree (DT)

In order to calculate the class label using a DT classifier, a dataset is subdivided into uniform subsets on many occasions. The hierarchical classifier is responsible for determining whether a given set of class labels should be accepted or rejected at each and every intermediate level. The main parts of this classifier are dividing up the nodes, finding the terminal nodes, and giving the class labels to the terminal nodes.

Support Vector Machine (SVM)

With the help of SVM, a hyper plane or suit of hyper planes is generated in high dimensional space for performing classification. The hyper plane located remotely from the adjacent training data end of some class supports in the attainment of good division. In a nutshell, the generalization error of the classifier is reduced in situations when the margin is increased. Using the non-parametric with binary classifier approach in SVM, it is feasible to process more inputs in a highly effective way. High performance and accuracy are attained based on the hyperplane as well as kernel parameters used.

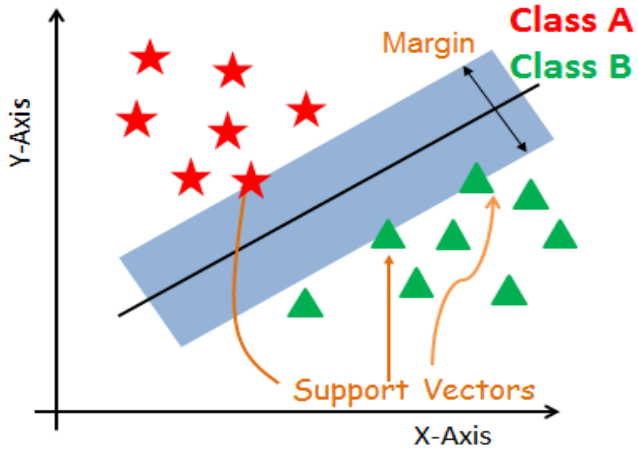

Fig.1.4: Support Vector Machine

IV. LITERATURE SURVEY

Mansi Lather, et.al (2020) analyzed that digital image processing acted significantly while analyzing the medical images. In the segmentation of brain tumor, the abnormal brain tissues were split from the normal tissues of brain. The semi and fully automatic techniques were suggested by many researchers to detect and segment the brain tumor earlier. This article suggested various schemes which were present to segmentation. A number of previous researchers' efforts to mechanize, in whole or in part, the task of brain tumor segmentation was highlighted in this article. An aggregate data table was created from the literature that was examined. The ease of use and amount of human supervision provided by a certain segmentation technique determined its clinical acceptability[13].

Divyamary. D, et.al (2020) stated that the major purpose of this paper was that an effective technique was constructed for detecting the brain tumor in premature phases [14]. The research consisted of numerous steps, including collecting the patient's brain image, removing noise from the image, segmenting the image, extracting features, and training an NB classifier. First, we pre-processed the collected image, and then we used that processed image to classify the data before we used that data to execute the feature extraction. Thus, the brain tumor was forecasted in accurate way with the utilization of NB classifier technique.

Aya S Derea, et.al (2019) proposed the designed software for detecting and recognising brain tumours[15]. The ROI was detected in MR images using threshold based on segmentation. The GRLM was carried to extract the texture attributes. Afterward, the segmentation-based threshold method was utilized to detect the tumours in MRI image and features image. The MRI tumor's location and characteristics were identified using the histogram and the behavior complement pictures. Both the tumor and its complementary picture were determined by their geometrical features. The segmentation approach yielded very accurate detection results by isolating the tumor's entirety. With the use of GRLM, we were able to reliably divide the tumor from its complement, and the resulting texture characteristics were of very high quality.

R. Meena Prakash, et.al (2019) recommended the CNN-based automated system to detect the tumour in brain images. The huge image database of ImageNet was utilized for pre-training the CNN model. The input images of brain were trained using this model. The extracted high-level attributes considered as input to the fully connected layer after that softmax activation. The database taken from Harvard medical school contained MR brain images had employed for testing the technique. The VGG16, ResNet and Inception were three pre-trained models that had implemented to perform the analysis. Its accuracy obtained on experimented database was evaluated 100%. The obtained outcomes demonstrated that the classification accuracy was enhanced from the data augmentation[16].

R. Ezhilarasi, et.al (2018) discussed that the brain tumor was the cancerous disease in which abnormal cells were present in the brain. The detection of brain tumor in premature phase was assisted in curing this disease. The suggested system described and marked the tumor portion to define the type of tumor present in the brain tumor MRI image. Various kinds of tumors were classified using AlexNet model as a base model along with RPN through Faster R-CNN algorithm. The concept of transfer learning was carried out while training in this. The suggested scheme assisted in forecasting the accurate kind of tumor with superior accuracy[17].

K. Venu, et.al (2018) described that the segmentation procedures of MRI acted significantly for the detection of brain tumors. As there were numerous magnetic resonance images that had implemented to diagnose the cancer, the manual image segmentation was a tiresome job because time constraints. The former limitation was reduced using automatic image segmentation techniques. The images were segmented in automatic way with the deployment of several algorithms. The deep learning method was carried out in more effective manner for numerous images for discovering the size and location of a cancer. A number of review papers had published for providing insight on image segmentation based on MRI. This review aimed at using deep learning algorithm based on CNN that provided superior accuracy to identify image problems[18].

Pham N. H. Tra, et.al (2016) suggested the segmentation technique for separating the MRI image of brain to detect edge of tumor structure. The unsharp approach was employed to improve the MRI brain image particularly earlier than segmenting the MRI image with the utilization of the Otsu technique. The Otsu was capable for detecting an appropriate threshold so as the tumor part was segmented from the image. Some objects were appeared by the binary image subsequent to the detection of threshold. Thus, the label was assigned to an image for generating a binary image with the completely white tumor region in order to determine the view of the region in the image in accurate manner. Therefore, the unsharp masks in particular had employed to discover the edge of tumor image. The edge image was processed and integrated with the original to displace the segmented image to estimate the image structure. The outcomes of simulation on brain MRI image set represented that the efficiency of suggested technique and it was designed to detect the benign and malignant tumors in biomedical images[19].

V. CONCLUSION

In this work, a review of several categorization methods for in the human body is carried out. Following an analysis of a well-known methodology, it has become abundantly evident that a variety of techniques exist that are able to detect and categorize the tumor in an effective manner while delivering precise results. Some algorithms may be able to produce accurate and reasonable results, but they may also have drawbacks such as being unsuitable for bigger data sets or taking too long to compute. Because diagnosing a tumor is a difficult and delicate process, accuracy and dependability are always given considerably more weight than they deserve in the evaluation process. The process of using data to categorize photographs is referred to as image classification. The ANN, CNN, SVM, and Decision Tree classifiers for image processing techniques are investigated throughout this study. In general, the articles provide information on the most effective procedures that are utilized for the identification and categorization of tumors in the human body.

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