Brain Tumor Detection Through Image Segmentation

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***Abstract* - In today's world of medicine, brain tumor detection has become a common occurrence. A brain tumor is a deformed mass of tissue in which the cells expand rapidly and without control, i.e. there is no control over the cells' growth. The image segmentation method is used to extract aberrant tumor patches from the brain. The segmentation of brain tissue in an MRI (magnetic resonance image) is critical for detecting the existence of outlines related to a brain tumor. In the health-care industry, there is a wealth of unreleased data. Early disease prediction can be accomplished with the proper application of reliable data mining categorization algorithms. In the realm of medicine, the procedures of Machine learning (ML) and data mining both have a substantial presence. The vast majority of which is efficiently implemented. The study looks at a list of risk factors that have been identified through brain tumor surveillance systems. In addition, the suggested method guarantees that brain tumor detection, classification, and segmentation would be exceedingly efficient and exact. Precision automatic or semiautomatic methods are required to achieve this. The study provides a method for automatic segmentation that uses CNN (Convolution Neural Networks) to determine small 3 x 3 kernels. Segmentation and classification are achieved by combining this single technique. CNN (a machine learning technique) is derived from NN (Neural Networks), and it has a layer for the classification of outcomes. Significant relationships and patterns can be retrieved from data using DM (data mining) techniques. Machine learning and data mining techniques are being successfully used to detect and prevent brain tumors at an early stage.**

Index Terms - **Brain tumor detection, Machine learning, CNN.**

I.INTRODUCTION

The brain is the center of the mortal central nervous system. The brain is a complex organ as it contains around 60-100 billion neurons forming a gigantic network. A brain excrescence is a mass of gratuitous and abnormal cell growth in the brain, or it can also be defined as an intracranial lesion that occupies space within the cranium and tends to beget a rise in intracranial pressure. Brain excrescences are substantially classified into two i.e Benign and Malignant. Benign excrescences are noncancerous, and they infrequently grow back whereas nasty excrescences are cancerous, and they fleetly grow and foray to the girding healthy brain towel.

The identification and discovery of excrement-infected areas from brain MRI is a critical task. Clinical experts examine medical images to identify signs and positions of excrescence. Due to the complex nature of MRI, there's a limitation for the mortal eye to dissect the Nanosecond differences. In recent times Computer Backed Opinion (CAD) systems are introduced by various authors to help radiologists form accurate opinions. This paper focuses on a review of colorful automatic brain excrescence bracket styles and highlights their strengths and limitations. Relative analysis can be used as a new exploration aspect for developing better brain excrescence segmentation and bracket systems. Magnetic resonance imaging (MRI) is high-quality medical imaging, particularly for brain imaging. MRI inside the mortal body is helpful to see the position of detail. Most of the techniques for detecting brain tumors are slow, less responsible, and that is hard to quantify and retain a degree of subjectivity.

The Discovery of brain excrescence from MRI images involves different phases given as, Input brain Image, Pre-processing, Segmentation, Extracting Features, Localization and classification. MRI Image segmentation is grounded on a set of processes of brain excrescence discovery; pixel intensity grounded features are uprooted. Image Segmentation combines the pixels into regions and hence defines the object regions. Segmentation uses the features Uprooted from image. Localization and classification is the last step in the process which classifies to either benign or malignant tumor. This study evaluates the different ways which are used in excrescence discovery from brain MRI.

In this paper we are reviewing different methods of brain tumor image segmentation and also various different MRI images segmentation methods are provided for comparative study of all methods. We are building a ResNet 50 model for brain tumor detection and localization.

II.LITERATURE SURVEY

Baljinder Singh et al. states that, in contrast to previous methodologies, first introduced a process of pre-processing in which noise is removed from pictures using a fuzzy filter and a new mean shift-based fuzzy c-means algorithm, which consumes less computing time and provides superior segmentation output. A mean field phrase is used in the above segmentation procedures. The fuzzy c-means is a standard fuzzy c-means objective function. Since it is conceivable for the mean shift to find cluster centres in a peaceful manner, all techniques may be carried out quickly and easily and diagnostics of the imaging areas which are effective [1].

J. Seetha et al. proposed using MRI images to diagnose brain tumors. The MRI scan normally generates a large amount of data, making manual classification difficult. The tumor vs. non-tumor process takes a long time. Despite the fact that it provides exact quantitative measures for a limited number of situations, a lack of images as a result, automated systems are required. Using reliable categorization methods to lower the

Ratio of human deaths Automated brain tumor detection in broad spatial and temporal scales, classification is notoriously difficult. Nearby parts of the brain tumor have structural irregularity. An automatic brain tumor detection system is proposed in this paper. By using the CNN classification [2], you can take a different method.

Shamsul Huda et.al presents hybrid feature selection using ensemble classification for per forming brain tumor diagnosis. Decision Tree, GANNIGMAC, and Bagging C based wrapper approaches are used to acquire decision rules, and decision rules are simplified using a hybrid feature selection strategy that combines (Decision Tree + MRMR C + GANNIGMAC + Bagging C) [3]. Sergio Pereira et al. offer automated methods for recognising and categorizing brain cancers using MRI pictures of the brain, beginning with the first attempt to scan and freight medical images into a computer system. On the other hand, NN (Neural Networks) and SVM (Support Vector Machine) have recently become popular methodologies because of their superior performance.

Navpreet Kaur and Manvinder Sharma [4] proposed using self-adaptive K-Means grouping to locate brain tumors. The X-ray images of the cerebrum show an unpredictable system of synapses, as well as hard structures and suspected high growth (if present). As a result, a division procedure is required to remove the development. The quantity of bunches is characterized by the customer in a unique K-implies computation, for example, client information is necessary. In any case, this stumbling block is overcome by employing the self-adaptive K-implies bunching computation to properly identify a cerebrum tumor.

Hayder Saad Abdulbaqi et al.[5] proposed using magnetic resonance imaging to diagnose brain tumors. The threshold method and the hidden Markov Random field MRI scan images are transformed to 2D images. These images are segmented and a number is assigned to each segment. A label aids in the detection of an object's borders as well as assisting in the analysis of the tumor's growth. Here the pixel threshold value is set, and the photographs are examined. Pixels with a value less than the threshold will be denoted in black and the rest with a higher threshold value will be denoted with a different color. This aids in the detection of a brain tumor.

III.METHODOLOGY

1. Machine Learning Techniques

There are four main stages to brain tumor detection using machine learning algorithms, namely, Preprocessing, Segmentation, Feature Extraction, and Classification.

a. Preprocessing

The medical field requires precise images for accurate observations of a disease. However, the quality of these images depends upon the sources of artifacts used such as MRI, PET, CT, and other such devices. MRI scans may contain many unwanted and irrelevant parts in its actual images. MRIs are influenced by Rician noise. Rician noise is signal-dependent and is very challenging to eliminate. Image preprocessing techniques like filtering, contrast enhancement, skull stripping is used to retain the properties of the original image.

b. Segmentation

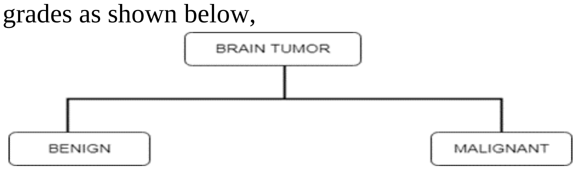
Segmentation is the division of the problem into separate parts. In this algorithm, it is used to extract the Region of Interest (ROI) from digital images. This is an essential part of the algorithm as it is crucial to segregate the tumor region from the brain. Various supervised and unsupervised techniques like thresholding, atlas based, soft computing, clustering, and neural networks exist for segmentation. Thresholding includes methods like adaptive, global, Otsu's, histogram-based thresholding. Unsupervised clustering techniques include K-means, Fuzzy C-means algorithms. It gives effective segmentation of brain MRI into Gray Matter (GM), White Matter (WM), Cerebrospinal Fluid (CSF).

c. Feature Extraction

In feature extraction different features like shape, texture, wavelet, Gabor features are extracted from MRI scans. Gray-Level Co-occurrence Matrix (GLCM) is used by most researchers. It is a second-order statistical method that can give texture features like energy, correlation, and contrast. Wavelet features are extracted using Discrete Wavelet Transform (DWT). It is applied to raw images, approximation coefficients are extracted and selected as feature vectors. It is observed that handcrafted features along with automatic features using deep learning models like CNN, ResNet, Capsule network have shown good performance. Feature reduction is achieved using PCA, GA.

d. Classification

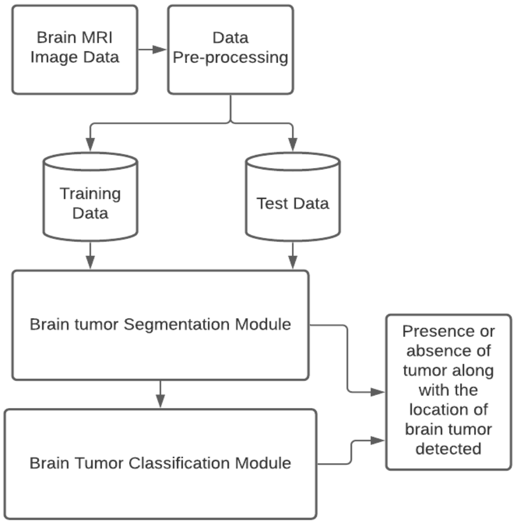
Brain tumors are broadly classified as benign and malignant tumors. Malignant tumors are further divided into Glioma, Meningioma and Pituitary types. WHO has given a grading of Glioma into 4 different grades as shown below,



2. Deep Learning methods

Deep learning methods and algorithms are used for the detection, classification and segmentation of brain tumors using MRI images. The CNN models provide a high rate of accuracy and hence are majorly used for image data. In general CNN is like a hierarchical model, which consists of several different architectures. When a CNN model is provided with images for training, it understands the image from base level. The two modules for the detection of Brain Tumor are its Classification and Segmentation, which are proposed for building the classification model transfer.

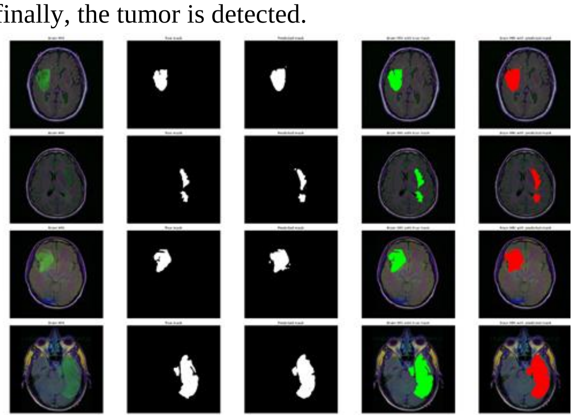
Deep learning (DL) is generally performed by convolutional neural networks(CNN) consisting of an input layer, output layer, hidden layers and hyperparameters. It is a supervised classification method in which the kernel convolves around input images to produce feature maps. DL is useful for automatic segmentation and feature extraction. Besides its popularity for the diagnosis of medical diseases, it suffers from some disadvantages like needing to build complex architectures, tuning of hyperparameters, the need of large amounts of data for training, more training time, and cost. Recent study shows that in order to overcome the large data availability issue, extensive data augmentation methods like rotation, cropping, scaling, transformation are used. In transfer learning methods pre-trained neural networks are applied on application specific dataset to extract the similar features. Classification model is used for building the classification model and the ResNet50 model is used for training the model. ResNet (Residual Network) is the Artificial Neural Network(ANN) trained on the ImageNet dataset which can be used to train the model on top of it. ResNet50 is a variant of the ResNet model which consists of 48 Convolution layers along with 1 MaxPool and 1 Average Pool layer. We add additional layers on the top of the layers of ResNet50, which turns the old features into predictions. Callbacks are added to increase the performance of the model. Segmentation model is built to localize the brain tumor cells detected in the MRI images. The model is trained with the above models and then evaluated for the testing dataset based on which the accuracy of the model is calculated. The basic architecture of the proposed system is as shown below,



The basic architecture of the proposed methodology

IV.RESULT

Detection of brain tumor is done by getting an initial MRI scan which then undergoes the following procedures- pre-processing, feature extraction, segmentation and classification, and localization, and finally, the tumor is detected.



V. CONCLUSION

In light of the preceding part, the result generated is quite exact and clear. The accuracy attained at the end is dependent on the processing of each step. Because there are numerous exiting techniques for each phase, the ones that provide the best results are chosen. Finally, the categorization of brain tumors takes place. There are various classical techniques for detecting brain tumors, however, the current work uses the standard neural network strategy for detecting brain tumors because the brain tumor detection images rely on the neighborhood pixels. The CNN method is effective in detecting brain tumors. The proposed algorithm is tested on a variety of photos, and the results are the best and most effective.

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