Brain Tumor Detection and Classification

Abhishek Kadu, Pragya Khandelwal, Shrija Keshari, Dhiraj Bhise

***Abstract*— Detecting tumor is one of the most crucial things for a doctor before moving on for the treatment.Traditionally tumor was detected by drilling an hole in the skull and a small portion of tumor was taken out and examined. Nowadays with the help of ML and MRI images the detection has become an easier task.MRI images of patients are given to the system and the system performs the detection and classification on the given set of images. There are many different algorithms present for this task. In this paper there are some methods which reviewed for Brain tumor detection and classification. Brain MRI images are taken as input to our system.The key target is to provide doctors with a highly accurate system that classifies the type of tumor.**

***Index Terms*— Deep learning, Brain tumor, Magnetic Resonance Images (MRI), Feature Extraction, Segmentation, Classification.**

I. INTRODUCTION

In recent times, the advent of information technology and the e-health care system has enabled healthcare practitioners to provide better healthcare for patients. In medical diagnosis, as a first step in care, doctors prefer to scan the brain to obtain MRI images. In this method, there is not one image obtained, but there are large numbers of images. One of the ways of coping with this complexity is machine learning by image processing, which has become an important part of the artificial intelligence system . It uses a machine learning technique to detect whether a tumour is known or not. The type of tumour can be classified if a tumour is detected. There are two types of tumour in general, one benign tumour and one malignant tumour.

Benign is non-cancerous and remains in this form and does not return after it has been removed, whereas the pre-malignant is not cancerous in the initial stage, but appears to be cancerous later.

According to the American Brain Tumor Association and WHO, the most popular classification scheme uses a tumour scale of grades I and II to be benign, and grades III and IV are malignant tumours.

Segmentation is used in medical imaging modalities to detect infected tumour tissues. In image analysis, it is a essential and important step to divide an image into different regions or blocks that share similar and equal properties, such as colour , texture, contrast, brightness, boundaries and grey level.

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For diagnosis, multiple magnetic resonance imaging (MRI) sequence images are used in science. For better treatment, the early detection of a brain tumour is a critical issue. When a brain tumour is clinically suspected, it is important to carry out a radiological test to determine its location, size and impact on the surrounding areas. [19]

Deep learning is one of the methods of machine learning that uses neural network architecture with perhaps hundreds of hidden layers between the input and output layers. It has been used in various problems such as image classifica- tion, identification of objects and recognition of expression. Convolutional neural networks (CNN) where one of three types of operations is performed are a typical deep learning architecture: convolution, pooling, featuring.

The standard CNN will decide whether an image contains an object, but without its location information. On the other hand, the region-based CNN (RCNN), an extended version of CNN, is mainly used to classify objects in pictures.

MRI brain images are more conveniently analysed using Mask R-CNN to identify and locate tumours in the images, according to the report. The detected tumours are often classified into one of the tumour categories: meningioma, glioma, and pituitary cells. The tumour has not been investigated on this issue yet. Furthermore, the outcomes of the selection of different thresholds for success. By weighing several layers, the layer was analysed in detail. Metrics of consistency, such as accuracy, precision , sensitivity. [19]

II. PROCEDURE

A. Preprocessing

The only goal of Brain Tumor Identification and Classification is the ability to use machine learning to identify and recognise the type of brain tumour. [19]

B. Detection

Detection is basically the process of detection of presence or absence of tumor using MRI image database. The output of detection phase if an MRI image either labelled as normal or abnormal.

It can be performed by using different techniques such as SVM, ANN, KNN. [17] [20]

C. Segmentation

Segmentation is used to change the image of the MRI. Images may be more relevant and easier to read in terms of tumour location and borders. The tumour is differentiated by segmentation. Tumour segmentation approaches are based on similarities and discontinuities in image strength. MRI photos, including histograms, ANN segmentation methods, edge-based algorithms, physical model-based approaches, region-based methods, and algorithms for clustering, such as k-means, mean Shift, FCM. [18]

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III. REVIEW ANALYSIS

A. Preprocessing

• ***Tumor Detection in the Brain using Faster R-CNN by R.Ezhilarasi and P.Varalakshmi***

Continuous Adaptive Mean Change, a dataset preprocessed using the Camshift algorithm with the aid of the Visual Object Tagging Method, is very simple and powerful computing. In order to increase the window size with the orientation measurement of the best fit box, CAMSHIFT uses a mean shift algorithm until it obtains the exact result and finally generates the box parameters. The annotation tool that helps create a dataset with an annotation tag is the Visual Object Tagging Tool.Camshaft VOTT is used to export tags for each input image and move those assets to the model for training in the Faster R-CNN format. [1]

• ***Brain Tumor Classification and Segmentation in MRI Images using PNN by R.Lavanyadevi, M.Machakowsalya, J.Nivethitha, A.Niranjil Kumar***

A non linear filtering technique is the median philtre. It is used to isolate the MRI image from the noise. Pixel intensity values are adjusted to achieve those picture characteristics, perfection to enhance contrast and smoothing to remove noises, and also to identify known patterns for the template. [2]

• ***Review on Brain Tumor Segmentation Methods using Convolution Neural Network for MRI Images by K.Venu, P.Natesan, N.Sasipriyaa and S.Poorani***

Artifacts such as motion and field inhomogeneity could influence the MR image and lead to false level and output strength. The artefact effects could be removed using non-parametric, non-uniform intensity normalisation algorithms to boost the image intensity values through bias field correction techniques. [3]

• ***Computer Aided System for Brain Tumor Detection and Segmentation by M. Usman Akram and Anam Usman***

The first step in our proposed technique is brain MR image preprocessing. An picture is preprocessed to decrease noise and to increase the MR image of the brain for further processing. The aim of these measures

is essentially to enhance the image and image quality in order to detect the tumour more safely and easily. [4]

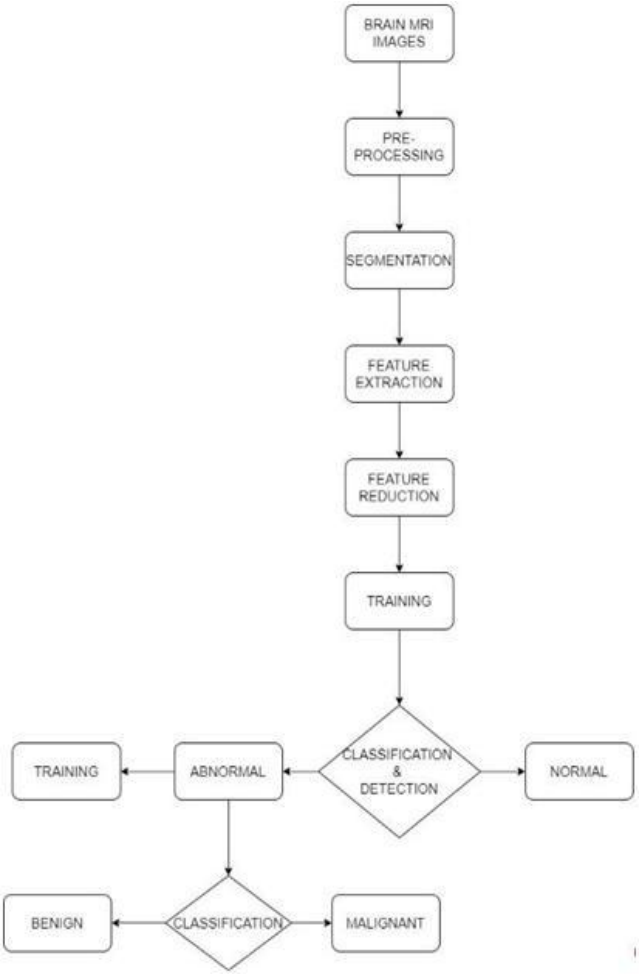

Fig. 1. FLOW CHART

The following are steps for preprocessing:

1)The picture will be translated into a grey scale. 2)In order to eliminate the noise, a 3x3 median

philtre is added to the brain MR image to get more confidence and ease of detecting the tumour.

3) To detect edges, the image acquired is then passed through a high-pass philtre.

4) In order to acquire the enhanced image, the edge image detected is applied to the original image. [4]

• ***Tumor Detection and Classification of MRI Brain Image using Different Wavelet Transforms and Support Vector Machines by Mircea Gurbin, Mihaela Lascu, and Dan Lascu***

In denoising MRI brain images, Mircea Gurbin, Mihaela Lascu, and Dan Lascu have introduced Haar, Symlet, Morlet, and Daubechies. The Signal to Noise Ratio (SNR), Peak Signal to Noise Ratio (PSNR) and Mean Square Error (MSE) are used to perform output estimation and analysis. They use wavelets in order to denoise the pictures. In medical images, edges are areas where the brightness of the image changes rapidly. For intuitive consistency, maintaining edges

while denoising an image is seriously necessary. Traditional low-pass filtering reduces noise, also smoothes the edges and affects the quality of images. Wavelets, while retaining essential features, are able to eliminate noise. It can be confirmed from the results obtained that the higher level wavelets appear to provide good results. [5]

B. Detection

• ***Classification of MR Brain Images for Detection of Tumor with Transfer Learning from Pre-trained CNN Models by R. Meena Prakash1 and R. Shantha Selva Kumari***

This paper discussed the MRI and ultrasound used by Shantha Selva Kumari. The merits and disadvantages of various CAD systems for brain tumour classification based on Fuzzy logic, Support Vector Machine (SVM), Artificial Neural Network (ANN), CNN, etc. were discussed. [8]

• ***Automatic Segmentation of Multimodal Brain Tumor Images Based on Classification of Super-Voxels by M. Kadkhodaei, S. Samavi, N. Karimi, H. Mohaghegh, S.M.R. Soroushmehr, K. Ward, A. All, K. Najarian***

The authors of these papers have worked on super- voxels that are used to provide a meaningful grouping of voxels based on local image characteristics. Super-voxel segmentation is a super-pixel segmentation extension in 3D. Based on their strengths and their proximity, it utilises voxels. SLIC produces an effective super-voxel 3D, inspired by clustering k-means, which respects the boundaries of an image naturally. [9]

• ***Parasuraman Kumar, B.VijayKumar, "Brain Tumor MRI Segmentation and Classification Using Ensemble Classifier", International Journal of Recent Technology and Engineering (IJRTE), Volume-8, Issue-1S4, June 2019***

A procedure for detecting brain tumour based on the method of segmentation and region measurement was suggested by the authors. In the following sequence, the suggested approach includes 5 phases. Image acquisition, preprocessing, clustering of K-means, morphological procedure, identification of tumours and measurement of the region. The first stage is the acquisition of images linked to the acquisition of brain MRI images. [10]

C. Segmentation

• **Computer Aided System for Brain Tumor Detection and Segmentation by M. Usman Akram, Anam Usman**

The next step is segmenting the MR image of the brain tumour after improving the brain MRI image. To separate the foreground of the picture from its background, segmentation is performed. Segmenting an image often saves the processing time that has to be added to the image for further operations. In order to segment the tumour image, use of global threshold. For global threshold segmentation. [6]

The basic steps are as follows:—

1) For the image, select a threshold value.
2) To transform the image into a binary, add the threshold value to the enhanced image.
3) If the pixel value is above the threshold value, the background is otherwise considered to be the foreground value.

• ***Current Trends on Deep Learning Models for Brain Tumor Segmentation and Detection by S.Somasundaram and R.Gobinath***

Picture segmentation is a method in which the digital image is separated into many segments or partitioned. Provide a reproductive template for image synthesis and generate an accurate segmentation of the abnormal in post-processing soft segmentation of the network. Another unsupervised procedure, a saliency- based approach that investigates brain asymmetry in
pathological cases, was suggested by Erihov. [7]

D. Classification

• ***Tumor Detection and Classification of MRI Brain Image using Different Wavelet Transforms and Support Vector Machines by Mircea Gurbin , Mihaela Lascu , and Dan Lascu***

As the data had two classes, the authors used SVM. The establishment of the best hyper plane for an SVM implies the one between the two classes with the largest margin. The margin is defined by the maximum width of the plate parallel to the hyper plane, which has no interior data points. As a useful separating criterion, complex binary classification issues do not have a straightforward hyper plane. [11]

• ***Automatic Segmentation of Multimodal Brain Tumor Images Based on Classification of Super-Voxels M. Kadkhodaei, S. Samavi, N. Karimi, H. Mohaghegh, S.M.R. Soroushmehr, K. Ward, A. All, K. Najarian***

Since the brain structure typically has a clear continuous form, in its third dimension, MR image sequences have a high correlation that could support tumour segmentation. Therefore, rather than individually operating on voxels, use of super-voxels that include a meaningful grouping of voxels based on local image characteristics. Super-voxel segmentation is a super-pixel segmentation extension in 3D. Based on their strengths and their proximity, it utilises voxels. SLIC[14] produces an effective super-voxel 3D, inspired by clustering k-means, which naturally respects an image's boundaries. [12]

• ***Classification of Brain11 Cancer using Artificial Neural Network by Dipali M. Joshi; N. K. Rana; V. M. Misr***

This paper's authors suggested a method for the diagnosis and classification of brain tumours. Histogram equalisation,

followed by a feature extraction algorithm and neuro-fuzzy classifier, is first applied to the image. [13]

• ***Chang PD. Fully convolutional deep residual neural networks for brain tumor M.K. Abd-Ellah, et al. Magnetic Resonance Imaging 61 (2019) 300–318 317 segmentation.***

A completely convolutional residual neural network (FCR-NN) for brain tumour localization is implemented in a network with 22 layers. The FCR-NN is paired with residual identity mappings with a completely convolutionary architecture and optimization benefits.

The score obtained by Dice was 0.87. [14]

• ***Zhang N, Ruan S, Lebonvallet S, Liao Q, Zhu Y. Multi-kernel SVM based classification for brain tumor segmentation of MRI multi-sequence. 2009 16th IEEE International Conference on Image Processing (ICIP) Nov 2009. p. 3373–6***

With a window size of 11 to 11 pixels, Zhang used PCA for FS, which reduced the number of features to 10. To identify the tumour area, a Multi Kernel SVM (MKVM) is used. To improve the contour of the tumour area, the distance and the maximum probability measures are applied. 3 separate image types, FLAIR, T2, and PD images, with 60 samples for each type, are included in the used dataset. [15]

IV. CHALLENGES

Lack of large datasets for training. Tumorized image marking is not only time-consuming, it also requires a lot of experience. Slice-by-slice annotations are required for the training of systems based on deep learning algorithms and segmentation, which are not only difficult but also time-consuming.

V. CONCLUSION

In addition to using the Mask R-CNN for segmentation, dif- ferent methods for segmentation and classification are explored in this paper, including Neural Network, HMM, fuzzy ,c- means clustering.For preprocessing camshaft algorithm, global threshold for segmentation and SVM for classification.There are many algorithms that can be used. Choosing a specific recognition algorithm depends on the application required Explanation of problems of Tumor Detection and classification, as well as thorough discussion of recent tumor detection and classification systems are presented.

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