USE OF MACHINE LEARNING TO FIND AND CLASSIFY BRAIN TUMORS

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Abstract

Brain tumour segmentation is one of the most critical and time-consuming jobs in the field of medical image processing since a human-assisted manual categorization may lead to incorrect prognosis and diagnosis. Furthermore, when there is a big quantity of data to be handled, it is a time-consuming job to say the least. There is a great deal of variation in brain tumours. There is a resemblance in appearance between tumour and normal tissues, which allows for the extraction of tumour areas from normal tissues. Images grow stubborn as time goes on. Using 2D Magnetic Resonance Imaging, we presented a technique for extracting brain tumours from brain scans. The Fuzzy C-Means clustering technique was used to cluster brain images (MRIs), which was then followed by conventional classifiers and other methods. A convolution neural network is a kind of neural network. The experimental research was conducted out on a real-time dataset including tumours of varying sizes, and Locations, forms, and varying picture intensities are all explored. In the conventional classifier section, we used six different traditional classifiers. Support Vector Machine (SVM), K-Nearest Neighbour (KNN), Multilayer Perception (MLP), and Logistic Regression are examples of machine learning algorithms. Regression, Nave Bayes, and Random Forest are all machine learning techniques that have been incorporated in scikit-learn. Following that, we went on to Convolution Neural Network (CNN) is a kind of neural network that is built using Keras and Tensor flow since it produces superior results. Performance as compared to the conventional ones CNN had an accuracy rate of 97.87 percent in our research, which is very impressive. The In this article, the primary objective is to differentiate between normal and aberrant pixels using texture-based and statistical methods. Characteristics that are based on

KEYWORDS: — CNN, FCM, Medical Image, segmentation, SVM

I. INTRODUCTION

The different stages of MR imaging, such as pre-processing, feature extraction, segmentation, and post-processing, among others, are described in detail below. A total of 120,000 individuals have died as a result of the use of MRI scans to locate tumours in the last four years [4]. In addition, An It is predicted that 86,970 new instances of primary malignant and non-malignant brain and other Central Nervous System tumours would be diagnosed this year (CNS) In the United States, it is anticipated that more tumours will be diagnosed in 2019 [5]. When abnormal cells develop in the brain, this is referred to as a brain tumour. Inside the cerebral cortex [6]. Tumours may be classified into two categories: malignant and benign. Malignant brain tumours are thought to have their genesis in the brain develops at a quicker rate and invades the surrounding tissues with more vigour. It has the potential to spread to other regions of the brain. Influence the functioning of the central nervous system Primary tumours, which begin in the brain, and secondary tumours, which begin outside the brain, are the two types of cancerous tumours. As well as secondary cancers that have migrated from another location, which are known as brain metastasis tumours? As an example, consider the following: A benign brain tumour is a clump of cells that grows very slowly in the brain and does not cause any symptoms. As a result, early identification of brain cancers is essential. Has the potential to play a critical role in enhancing treatment options, as well as increasing the likelihood of survival. Accomplished. Manual segmentation of tumours or lesions, on the other hand, is a time-consuming, difficult, and onerous job as it requires In the course of medical practise, a significant number of magnetic resonance imaging (MRI) pictures are produced. MRI, also known as Magnetic Resonance Imaging, is a kind of imaging that uses radio waves to create images of the body. The majority of the time, it is utilised to identify brain tumours or lesions. The segmentation of brain tumours using magnetic resonance imaging (MRI) is one of the most important jobs. N medical image processing as it generally involves a considerable amount of data. Moreover, the tumours can be illdefined with soft tissue boundaries. So it is a very extensive task to obtain the accurate segmentation of tumours from the human brain.

II. RELATED WORK

Several of the researchers presented many techniques and algorithms for to detect brain tumour, stroke and other types of \abnormalities in human brain using Mr Pictures. Manoj k kowar and sourabh yadav et al, 2018 his article "brain tumour \sdetection and segmentation using k- closest neighbour (k-nn) algorithms". This paper discusses innovative methods for the [4] Segmentation, histogram, and thresholding are all used in the identification of brain tumours. Rajesh c. patil and dr. A. S. Meyer's tumour was the subject of Bhalchandra et a article.'s "brain tumour extraction from MRI images using Matlab," which was published in 2010. This paper provides the flooded watershed method for segmentation, as well as the morphological operation [5]. Vinay Parameshwarappa and Nandish s. et al, 2018 in his work "segmented morphological method to identify malignancy in brain they developed an algorithm for segmented morphological approach [6] to deal with "pictures." The authors, M. Karuna and Ankita Joshi, et al., 2017, published a paper in which they discuss their work.in his article "automatic identification of brain tumour and analysis using mat lab" they offers the method includes Nero fuzzy classifier is used to segment the data. The issue with this system is that it must be trained using a neural network, which is difficult. In order to train the network, a large number of input pictures are needed. The newly created technology is solely utilised for tumour identification and not for other purposes. [7] There are additional anomalies. Image segmentation is compared by R. B. Dubey, M. Hanmandlu, Shantaram Vasikarla, and colleagues (2017). They use pre-processing approaches in his article "Evaluation of three strategies for mri brain tumour segmentation," which he published.

Techniques such as de-noising, picture smoothing, image contrast enhancement, and comparison of the level set approaches are all examples of what is possible. Additionally, morphological marker controlled watershed method and modified gradient magnitude region growth technique were used. For the purpose of MRI brain tumour segmentation they came to the conclusion that the mgmrgt technique produces superior results [8]. entilkumaran n, as well as Thimmiaraja et al., 2017, in their article "histogram equalisation for picture improvement," compares the image enhancement methods. "Image enhancement utilising mri brain pictures" was the topic of their presentation, which included a research of image enhancement methods and a comparison of the results.Histogram equalisation fundamental methods such as brightness-preserving adaptive histogram equalisation (AHE), local histogram equalisation (LHE), and others Inverse histogram equalisation (IHE), global histogram equalisation (GHE), and dynamic histogram equalisation utilising various quality levels are all examples of histogram equalisation. In MRI images, objective measurements are taken.

They also demonstrated that the bpdhe technique produced a superior outcome on contrast [10]. r. Preetha is an abbreviation for R. Preetha. in his article "Performance Analysis of Fuzzy C Means Algorithm in Automated Detection of Viruses," as well as G. R. Suresh and colleagues (2016), in their paper "Performance Analysis of Fuzzy C Means Algorithm in Automated Detection of Viruses,"For the segmentation of a "brain tumour," they utilised fuzzy c means clustering. Such approach, in light of the enormous computing requirement complexity. The precision of tumour segmentation and the performance of the fcm in segmenting tumour tissue are both excellent. Segmentation The svm classifier [11] was used to identify the candidate. amer albadarneh, hasan najadat, and ali m. alraziqi et al., 2016, [12]; amer albadarneh, hasan najadat, and ali m. alraziqi et al., 2016, [12]; amer albadarneh, hasan najadat, and ali m. alraziqi et al., 2016,developed a technique for classifying brain tumours using magnetic resonance imaging (MRI) pictures. The study work that was carried out was based on neural networks.The accuracy of the closest neighbour (NN) and k-nearest neighbour (K-NN) algorithms for tumour classification has been shown to be 100 percent using KNN and 98.92 percent using NN. Many academics have suggested a variety of algorithms and segmentation methods to help them locate information.MRI scans are used to diagnose disorders in the brain. The majority of them suggested different methods to identify the anomaly in the data. The brain, such as a brain tumour.

III. PROPOSED ALGORITHM

For the sake of segmentation and identification of brain tumours, we have suggested two different models in our approach. Both models utilised FCM to segment the tumour and categorised it using conventional machine learning methods, with the first focusing on tumour detection and the second on deep learning for tumour detection. When dealing with a noisy clustered data collection, FCM segmentation produces superior results [15]. Despite the fact that it takes longer to execute, it retains more information. A. Tumor Segmentation and Classification Methodology Using Traditional Classifiers: Proposed Methodology of Tumor Segmentation and Classification Using Traditional Classifiers Brain tumour segmentation and identification utilising a machine learning algorithm has been successfully accomplished in our initial prospective model. It has been completed, and a comparison of the classifiers for our model has been drawn out. The suggested method for segmenting brain images is described in detail below. Contains seven stages: skull stripping, filtering and enhancement, segmentation using the Fuzzy C Means algorithm, segmentation using the SVM algorithm, and segmentation using the SVM algorithm. Traditional classifiers are used to perform morphological operations on the tumour, tumour contouring, feature extraction, and classification. The outcomes of our labour were acceptable, and we were pleased with them. The following are the major phases of our suggested model (Fig. 2): The next parts will demonstrate this.

Fig.3. Proposed methodology for classification using Traditional Classifiers

One of the most essential steps in medical image processing is skull stripping. This is necessary since the backdrop of an MRI picture does not contain any relevant information and thus increases the processing time. In our research, we eliminated the skull part of the MRI scans in three stages, one after the other. The three steps are as follows:

In order to remove the skull, we first utilised Otsu's Thresholding technique, which automatically removed the skull after a certain amount of time. Calculates the threshold value and divides the picture into two parts: background and foreground the threshold that is used in this approach is the class that is chosen has the lowest intra-class variance, which is defined as the weighted sum of deviations between the two classes. When we got to the end of our skull stripping process, we utilised linked component analysis to help us figure out what we were looking at. The study was conducted in order to isolate just the brain area, and as a result, the skull portion was eliminated. In order to achieve better segmentation, we must enhance the MRI picture quality while keeping noise levels as low as possible. Noise as a metaphor for the brain MRI pictures is more susceptible to noise than any other medical image, and this is true for all medical imaging. The Gaussian blur filter was utilised in this project. Our work on Gaussian noise reduction in Brain MRI was successful, and the performance of the segmentation was improved as a result.

3)Segmentation using the Fuzzy C-Means Clustering Method: The Fuzzy C-Means clustering algorithm was used for segmentation, which enables one piece of data to be segmented from another piece of data. Data that may be classified into two or more clusters At this point, we had obtained the fuzzy clustered segmented picture, which guaranteed a good result. Improved segmentation of the population

4) To segment the tumour, we only require the brain portion rather than the whole skull, which reduces the amount of time spent in the operating room. As a result, we in our pictures, we used morphological procedures to enhance their appearance. Initially, erosion was carried out in order to separate poorly linked areas of the landscape. Image from an MRI scanner. As a result of the erosion, we will have numerous unconnected areas in our pictures after the process. Following that, dilation was applied.

5) Tumor Contouring: The extraction of tumour clusters was accomplished using an intensity-based method that is threshold. The result of this picture is a tumour region that is emphasised against a dark backdrop.

6) The extraction of two kinds of features was performed in order to classify the information. Texture-based characteristics such as dissimilarity, homogeneity, energy, correlation, and ASM, as well as statistical characteristics such as mean, entropy, and variance. The centred, standard deviation, skewness, and kurtosis of the segmented MRI images were calculated using statistical methods.

7)Conventional Classifiers: We employed six traditional machine learning classifiers, including K-Nearest Neighbor, Logistic Regression, and Support Vector Machines. To improve the accuracy of the prediction, regression, multilayer perceptron, Nave Bayes, random forest, and support vector machine are used. Our suggested paradigm for tumour identification has a number of advantages.

8) Evaluation Stage: Comparing our suggested technique to existing region-based segmentation methods that have been implemented. The ROI is segmented and the tumour part is segregated the most correctly using our model's segmentation method. Here's an example: The flow diagram of the whole operation is shown in Fig. 5. Following the tumour's segmentation and feature extraction, we used six different techniques. Techniques for categorising things. We achieved the best result with SVM, with an accuracy of 92.42 percent, out of all of the models tested.

B.The Methodology That Has Been Proposed Using CNN

As an example Medical image processing is an area in which Convolutional Neural Networks (CNNs) are widely used. Throughout the years, a large number of the researchers attempted to develop a model that would be more effective at detecting tumours. We attempted to come up with an excellent solution. It is capable of correctly classifying tumours from 2D brain MRI scans. A neural network with all of its connections can detect the we considered using CNN for our model, but because of parameter sharing and the sparsely of connections, we decided against it.

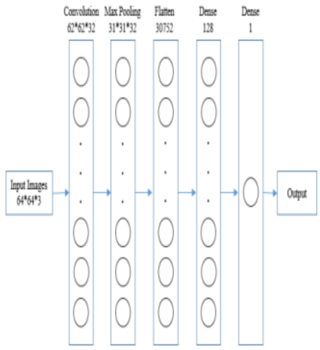

Fig. 3. Proposed Methodology for tumor detection using 5-Layer Convolution Neural Network

Algorithm 1: Evaluation process of CNN model

```
loadImage();
dataAugmentation();
splitData();
loadModel();
for each epoch in epochNumber do
    for each batch in batchSize do
        ŷ = model(features);
        loss = crossEntropy(y, ŷ);
        optimization(loss);
        accuracy();
        bestAccuracy = max(bestAccuracy, accuracy);
return
```

Fig. 4. Algorithm of the performance evaluation

A. The Experimentation Dataset

For the purpose of evaluating the performance of our proposed model, we utilised the benchmark dataset in the area of brain tumour segmentation, which is the BRATS dataset [16], which is divided into two classes—class-0 and class-1, which represent the non-tumour and tumour MRI images, respectively. MRI images containing tumour and non-tumour were categorised as follows: 187 and 30 images containing tumour, respectively. There are two classes: class-1 and class-0. All of the pictures are MRI scans taken in various modalities, including T1, T2, and FLAIR. In the case of conventional Using machine learning classifiers, we were able to get the best possible outcome by dividing the dataset in half (70 to 30 in terms of training to test). We split the dataset in two formations: 70 to 30 and 80 to 20. We then compared the results of the testing pictures with the CNN. Outcomes.

B. Segmentation using Image processing techniques

Based on our proposed methodology, we segmented the tumor without loss of any subtle information. We removed the skull because for tumour segmentation the role of skull is approximately null and ambiguous in this process.

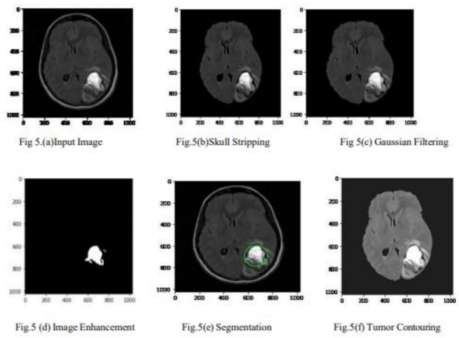

Fig 5.(a)Input Image Fig.5(b)Skull Stripping Fig 5(c) Gaussian Filtering

Fig.5 (d) Image Enhancement Fig.5(e) Segmentation Fig.5(f) Tumor Contouring

A 2D MRI scan from the dataset was used as an input picture. The skull stripping method (Fig. 1b) was applied to the input image, followed by image enhancement (Fig. 1c), in order to fully comprehend the characteristics of the MRI scan. A Gaussian filter (Fig. 1d) is then used to remove noise before replicating the FCM segmentation method is completed (Fig. 1e) following that, tumour contouring (Fig. 1f) is used to determine the ROI that contains the tumour for Brain MRI purposes. Following the segmentation, we categorised the tumour using various conventional Machine Learning Algorithms to determine the origin of the tumour. The use of machine learning to classify objects in

C. classification Using Machine Learning

Texture and statistically based characteristics are more often used for identifying the Region of Interest than other types of features (ROI). As a result of these using these characteristics, we can distinguish between timorous and non-timorous MRI. We utilised texture and statistically based characteristics to make our decisions. Classification. Texture-based characteristics such as dissimilarity, homogeneity, energy, correlation, and ASM, as well as statistical characteristics the following characteristics were retrieved from the data: mean entropy, centroid, standard deviation, skewness, and kurtosis. Brain tumour that has been segmented the tumour's Area, Convex Hull Area, and Diameter were all calculated as a result of this procedure. Extrapolating the tumour's Convex Hull Area and Diameter are also measured. We categorised the patients based on these characteristics derived from the segmented MRI. The presence of normal and pathological tissue is shown by the picture.

D. Classification Using a Neural Network

The suggested five-layer technique yields a respectable outcome in terms of tumour identification when used in conjunction with other methods. Convolution, The suggested five-layer CNN model includes Max Pooling, Flatten, and two dense layers in addition to two sparse layers. The augmentation of data had been completed. Translation invariance is a property of the CNN model that must be considered when fitting the model. We assess the performance in two ways, each depending on how the dataset is divided. We achieve 92.98 percent accuracy for the 70:30 time periods. When the training accuracy is 99.01 percent, the splitting ratio is 0.5. Then, in the second round, 80 percent of the pictures allocated for the project were selected. Training and the remainder of the pictures that were certified for testing, where we determined that 97.87 percent of the images were accurate and 98.47 percent of the images were trained accuracy. As a result, when the division is 80:20, our proposed model produces the best results. We achieved an accuracy of 97.87 percent, which is amazing considering that we used a five-layer CNN. We conducted our investigation using a different number. In terms of utilising this five-layer CNN model, the results were not significantly different, although the differences were not statistically significant. Some Increased calculation time and increased difficulty of the problem are two characteristics that we saw when we increased the number of layers. The batch size and number of steps per technique were very large. Furthermore, we chose 0.2 as the dropout value but did not choose a number that was comparable with it.

No	Training Image	Testing Image	Splitting Ratio	Accuracy (%)
1	152	65	70 : 30	92.98
2	174	43	80 : 20	**97.87**

Table 1.PERFORMANCE OF THE PROPOSED CNN MODEL

IV. CONCLUSION AND FUTURE WORK

This research sought to develop, deploy, and test a software pattern recognition system that would enhance the accuracy of distinguishing between primary and metastatic brain cancers on magnetic resonance imaging (MRI). In this paper, various existing brain tumour segmentation and detection methodologies for magnetic resonance imaging (MRI) of the brain are reviewed. Image. All of the processes involved in identifying a brain tumour, including the pre-processing procedures, have been addressed. Pre-processing it includes a variety of operations such as nonlocal operations, analytical correction techniques, Markov random field methods, and wavelet transformations. It has been debated how to use evidence-based approaches. Quality improvement and filtering are essential because edge sharpening, for example, is crucial. Picture enhancement, noise reduction, and unwanted background removal are all used to increase the image quality as well as the image clarity. Detection method must be followed. The median filter, of the many filtering techniques described above, was the most effective at suppressing noise. It is considerably more difficult to use mean filter without blurring the borders and without decreasing the clarity of the pictures. It is also lot more expensive. When it comes to smoothing a picture, the sensitivity of the filter is greater than that of the median filter. Gaussian filtering lowers noise, improves picture quality, and is computationally more efficient than other types of filtering. Methodology. Following the many discussions on picture quality enhancement and noise reduction held here, several potential solutions have been identified. Techniques for segmentation include intensity-based binarized segmentation, region-based segmentation, classification-based segmentation, and texture-based segmentation. the use of knowledge-based techniques; clustered techniques; neural network techniques; fuzzy techniques; edge-based techniques; atlas techniques; knowledge-based techniques; fusion techniques The process of detecting or segmenting a brain has been explained above with a brief explanation, as well as advantages and disadvantages. Image of a tumour taken from an MRI of the brain The Kapur technique is the most effective in threshold intensity-based binnarized segmentation. Techniques and they generate very successful outcomes. The majority of the binarized failures as a result of the significant intensity difference between the foreground and background. As well as the backdrop, which is the black background of the MRI picture?

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