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Brain Tumor Classification Using Machine Learning Mixed Approaches

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ABSTRACT
The Brain tumor is one of the dangerous diseases seen in adults and children. Brain tumor means uncontrolled or abnormal growth of tissues or cells in the brain part only. The Brain tumor is one of the main causes of death among people. For successful treatment of the disease, accurate and early detection of brain tumor is essential. Early detection not only helps to come up with better medications, but it can also save a life in due time.
In this paper, we are doing the Classification of brain tumor tissues using mixed method techniques. Here we are using a Genetic Algorithm for feature selection and then classify the image into normal and abnormal brains by using a Support Vector Machine. Then finally tumor tissues are identified and classified by using the mean, mode, median. Here we are going to use the brain MRI image as an input. The brain MRI image needs to be converted into a greyscale image first and then into a binary image.
This paper is focused on helping the radiologist and physician to have a second opinion on the diagnosis. These systems help specialists to perform tumor detection very easily. This study aims to diagnose brain tumor using MRI images.
Keywords: Support Vector Machine, Genetic Algorithms, MRI, Brain tumor.

I. INTRODUCTION

The Brain Tumor is the uncontrolled amplification of tissue in the brain that affects brain functions. A Brain tumor can either be a Primary Tumor or a Secondary Tumor. This classification is based on the origin of the tumor. Brain tumors are also classified based on the malignancy of the tumor into cancerous and noncancerous tumors. They are classified based on Grade as low-grade tumors - 'Grade 1 and Grade 2', high- grade tumors - 'Grade 3 and Grade 4'. In addition to these categorizations, there are 120 types of brain tumors categorized by the World Health Organization (WHO). Ultrasound, Computerized Tomography (CT), Magnetic Resonance Imaging (MRI) are the major electronic modalities used.

Brain MRI images are mainly used to detect the tumor and tumor progress modeling process. This information is mainly used for tumor detection and treatment processes.MRI image gives more information about a given medical image than CT or ultrasound image. MRI images provide detailed information about brain structure and anomaly detection in brain tissue. Scholars offered unlike automated methods for brain tumor finding and types cataloging using MRI images from the time when it became possible to scan and freight medical images to the computer. To help the Medical Imaging field for effective diagnosis of the patient's many techniques have been reported for the classification of brain tissues in MR images. Current methods have low accuracy. Because of these reasons we are proposing a mixed-method approach for the classification of brain tissues in MRI using GA and SVM. In this study, SVM is used for classification as it gives improved accuracy and better performance than other classifiers. The Classification rate is higher for SVM than a neural network.

II. EXISTING SYSTEM

Many systems have been developed to detect brain tumor from images. The existing system performs the brain tumor detection to identify the category from provided data by using algorithms like naïve Bayes classifier, support vector machine, convolution neural network, genetic algorithm and many more. It classifies the provided data with respect to brain tumor types. Every system gives different results like accuracy, precision and recall values.

The recent researches which uses feature extraction and classification process for classification of brain tumor tissues using some algorithms like Convolutional Neural Network, Support Vector Machine (SVM), Artificial Neural Network, Genetic Algorithms and classifiers.

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In 2013, Author Shweta Jain used Classification of Brain Cancer Using Feature Extraction in Artificial Neural Network (ANN). Firstly, MRI database are introduced, including Astrocytoma type of brain cancer classified into four tumor types namely pilocytic (grade1), low grade (grade2), anaplastic (grade3) and glioblastoma multiforme (grade4).Then the feature extraction are being discussed. Finally, architecture of artificial neural network is developed for classification of brain cancer. The scope of this work is to improve the ANNs architecture with improvement of feature functions to achieve well separated data [1].

In 2013, Authors Narkhede Sachin G, Prof. Vaishali Khairnar, addresses some of the challenging issues on brain magnetic resonance (MR) image tumor segmentation caused by the weak correlation between magnetic resonance imaging (MRI) intensity and anatomical meaning. In this paper At first, it checks the image can be divided into symmetric axis or not. If it is divided into Symmetric part then no tumor in brain and it can be divided in curve shape then chances of tumor in human brain. However, if there is a macroscopic tumor, the symmetry characteristic will be weakened. According to the influence onthe symmetry by the tumor, develop a segment algorithm to detect the tumor region automatically [5].

In 2017, Authors Ravikumar Gurusamy and Dr Vijayan Subramaniam reprocessed and extracted the features of the MRI images. Both real-time images and simulated images are used in this project which is an added advantage. Secondly, an extensive pre-processing technique is employed to remove theunwanted noises. A new method for the denoising, extraction and tumor detection on MRI images is presented in this paper.The success rate of this step is high which has guaranteed the overall accuracy of the system [10].

In 2014, Author Subhashis Banerjee Investigated Deep Convolutional Neural Networks (ConvNets) for classification of brain tumors using multisequence MR images. And proposed three ConvNets, which are trained from scratch, on MRI patches, slices, and multi-planar volumetric slices. Author have presented three novel ConvNet architectures for grading brain tumors non-invasively, into HGG and LGG, from the MR images of tumors and explore transfer learning for the same task, by fine-tuning two existing ConvNet models. An improvement about 12% in terms of classification accuracy on the test dataset was observed from deep ConvNets compared to shallow learning models [9].

In 2021, Authors B Kokila1, M S Devadharshini1, A Anitha1 and S Abisheak Sankar used the Convolutional Neural Network. The Convolutional Neural Network (CNN) based multi-task classification is equipped for the classification and detection of tumors. This Brain tumor classification model uses a multi-task classifier rather than using a different model for each classification. This method will be suitable even for classifying rare tumor types as the diagnosis can be done with other results obtained [8].

In 2017 Authors, Sunil L. Bangare, G. Pradeepini and Shrishailappa T. Patil proposed an effective mixed method approach for classification of brain tumor tissues. Here proposed system will be using Genetic Algorithm for feature Extraction and Support Vector machine for classification. This mixed method approach shows the possibility of better brain tumor classification [3].

In 2017, Authors Saumya Chauhan, Aayushi More, Ritumbhra Uikey, Pooja Malviya, and Asmita Moghe proposed work MRI brain images are pre-processed by median filtering. To segregate lesion from image, colour based segmentation and edge detection is performed. Multiple feature extraction schemes, namely histogram of oriented gradients and gray level co-occurrence matrix are used to represent the images. In this work an automated method has been developed for the classification of normal, benign and malignant tumours in brain MRI images using IBkLG classifier [7].

In 2020, Authors Chirodip Lodh Choudhury, Chandrakanta Mahanty and Raghvendra Kumar proposed work involves the approach of deep neural network and incorporates a CNN based model to classify the MRI as “TUMOUR DETECTED” or “TUMOUR NOT DETECTED”. Author proposed a new system based on CNN, which discriminates between the BrainMRI images to mark them as tumorous or not. The model is having CNN with 3 layers and requires very few steps of pre- processing to produce the results in 35 epochs [8].

III. PROPOSED SYSTEM

In proposed method we are doing Classification of brain tumor tissues using machine learning mixed method techniques. Here we are using Genetic Algorithm for feature selection and then classify the image into normal and abnormal brain by using Convolutional Neural Network. Then finally tumor tissues are identified and classified by using mean, mod, median.

First we converted brain MRI image into a grayscale image. Here, the normal image

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transformed into a black and white image. After that that image converted into a binary image.We required thresholding for this conversion. In thresholding process, the boundaries, edges and curved are located. Thresholding is based on thresholding value. In thresholding the boundaries, edges, Curves are located [11].Then the histogram equalization of image is done on binary image. The flow of the proposed system is as shown in figure below.

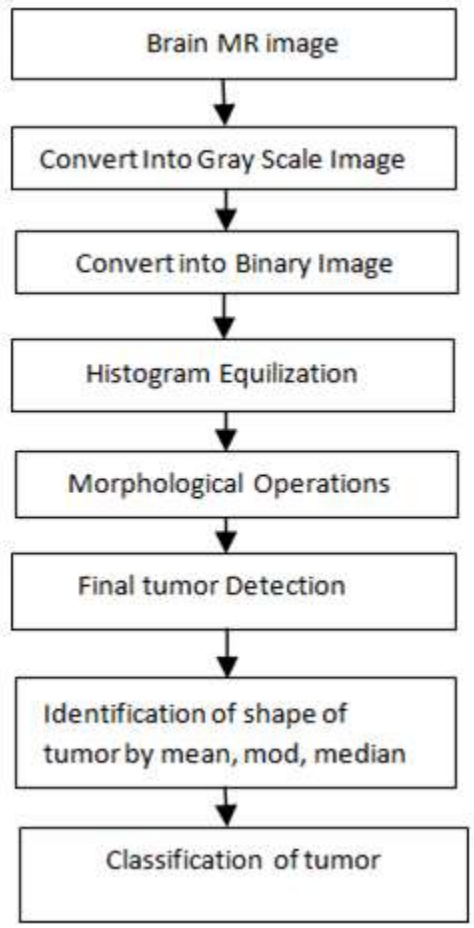

Fig 1: Proposed System

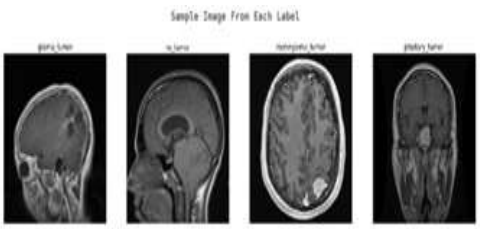

Fig.2 Sample image from each label

Gray Scale Imaging:

The use of grey scale imaging in ultrasound renders a two- dimensional image in which the organs and tissues of interest are depicted as points of variable brightness. The formation of a B-mode image relies on the pulse-echo principle; assuming the speed of sound remains constant, the position of a target of interest may be inferred by the time taken from emission to its return to the transducer. In order to construct a cross-sectional image, the pulse-echo sequences from a multitude of neighbouring scan lines are sequentially summated in real- time, generating a moving image.

Histogram Equalization:

This method usually increases the global contrast of many images, especially when the image is represented by a narrow range of intensity values. Through this adjustment, the intensities can be better distributed on the histogram utilizing the full range of intensities evenly. This allows for areas of lower local contrast to gain a higher contrast. Histogram equalization accomplishes this by effectively spreading out the highly populated intensity values which use to degrade image contrast.

The method is useful in images with backgrounds and foregrounds that are both bright or both dark. In particular, themethod can lead to better views of bone structure in x- ray images, and to better detail in photographs that are either over or under-exposed. A key advantage of the method is that it is a fairly straightforward technique adaptive to the input image and an invertible operator. So in theory, if the histogram equalization function is known, then the original histogram can be recovered. The calculation is not computationally intensive. A disadvantage of the method is that it is indiscriminate. It may increase the contrast of background noise, while decreasing the usable signal.

Genetic Algorithm

The genetic algorithm works on the evolutionary generational cycle to generate high-quality solutions. These algorithms use different operations that either enhance or replace the population to give an improved fit solution.

It basically involves five phases to solve the complex optimization problems, which are given as below:

- Initialization
- Fitness Assignment
- Selection
- Reproduction

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- Termination

1. Initialization

The process of a genetic algorithm starts by generating the set of individuals, which is called population. Here each individual is the solution for the given problem. An individual contains or is characterized by a set of parameters called Genes. Genes are combined into a string and generate chromosomes, which is the solution to the problem. One of the most popular techniques for initialization is the use of random binary strings.

2. Fitness Assignment

Fitness function is used to determine how fit an individual is? It means the ability of an individual to compete with other individuals. In every iteration, individuals are evaluated based on their fitness function. The fitness function provides a fitness score to each individual. This score further determines the probability of being selected for reproduction. The high the fitness score, the more chances of getting selected forreproduction.

3. Selection

The selection phase involves the selection of individuals for the reproduction of offspring. All the selected individuals are then arranged in a pair of two to increase reproduction. Then these individuals transfer their genes to the next generation.

4. Reproduction

After the selection process, the creation of a child occurs in the reproduction step. In this step, the genetic algorithm uses two variation operators that are applied to the parent population. The two operators involved in the reproduction phase are given below:

- Crossover: The crossover plays a most significant role in the reproduction phase of the genetic algorithm. In this process, a crossover point is selected at random within the genes. Then the crossover operator swaps genetic information of two parents from the current generation to produce a new individual representing the offspring.

- Mutation

The mutation operator inserts random genes in the offspring (new child) to maintain the diversity in the population. It can be done by flipping some bits inthe chromosomes.
Mutation helps in solving the issue of premature convergence and enhances diversification.

5. Termination

After the reproduction phase, a stopping criterion is applied as a base for termination. The algorithm terminates after the threshold fitness solution is reached. It will identify the final solution as the best solution in the population.

Convolutional Neural Network (CNN)

A Convolutional Neural Network (ConvNet/CNN) is a Deep Learning algorithm which can take in an input image, assign importance (learnable weights and biases) to various aspects/objects in the image and be able to differentiate one from the other. The pre-processing required in a ConvNet is much lower as compared to other classification algorithms. While in primitive methods filters are hand-engineered, with enough training, ConvNets have the ability to learn these filters/characteristics.

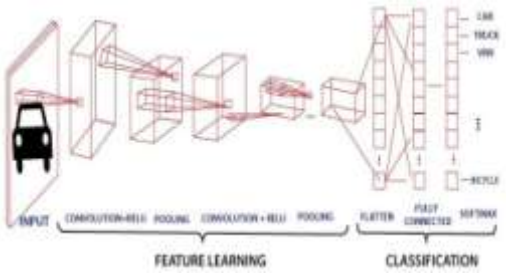

Fig 3. Layers of CNN

$$\text{accuracy} = \frac{\text{Number of correct predictions}}{\text{Total number of predictions}},$$

$$\text{precision} = \frac{\text{True positives}}{\text{true positives} + \text{false positives}}$$

$$\text{recall} = \frac{\text{True positives}}{\text{true positives} + \text{false negatives}}$$

IV. EXPERIMENTAL RESULT

In this paper classification of brain tumor and tissues was proposed. The proposed technique was implemented on human MRI dataset. The algorithm described in this paper is successfully implemented.

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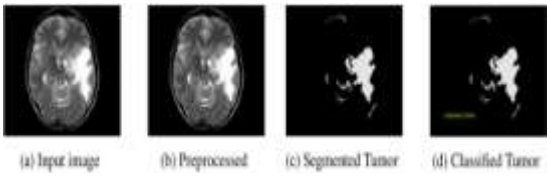

Fig.4 Result

(a)

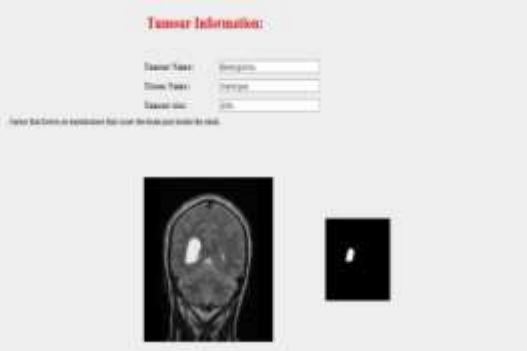

Fig 5.(b). Tumor Detection module

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CONCLUSION:

We proposed a computerized method for the classification andidentification of a brain tumor using the Convolution Neural Network. The input MR images are read from the local deviceusing the file path and converted into grayscale images and then to binary image which helps in noise reduction. For increasing intensity of images that system apply histogram equalisation. After that apply canny edge detection which works as filter to the passed image and then apply morphological operations on image. Genetic algorithm helps for feature selection. After morphological operations proposed method apply Convolutional Neural Network (CNN)algorithm for tumor detection.
Here we used different approaches in machine learning for accurate result of brain tumor detection which will be definitely useful in medical field.

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