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An Intelligent System for Early Assessment and Classification of Brain Tumor

Keerthana T K
Dept. computer science
Jyothi engineering college
Thrissur, India
Keerthanatk9@gmail.com

Sobha xavier
Dept. computer science
Jyothi engineering college
Thrissur, India
sobhapxavier@gmail.com

***Abstract*— Data mining is a best technique in many fields and it has wide application in healthcare industry such as identifying healthcare patterns from large medical datasets, decision making, and providing early stage treatment to the patients. We can use data mining techniques to detect disease like brain tumor. Brain tumor is the abnormal growth of brain cell and it is one of the dangerous causes of death among people. Early stage tumor diagnosis is possible by a brain tumor detection system. This paper proposes an intelligent system for the diagnosis and classification of brain tumor disease that a user is suffering from along with disease description and healthy advice. The system works on a medical image dataset using data mining techniques.The proposed system comprises of four phases like pre-processing, segmentation, feature extraction and classification.The system identifies the type of tumor by Support Vector Machine. Here we can use genetic algorithm for optimizing the features and SVM parameter. Overall system works with brain MRI image and the usage of data mining techniques in tumor detection system will provide high detection rate.**

Keywords— brain mri; brain tumor; data mining; genetic algorithm; support vector machine.

I. INTRODUCTION

Brain is a complex organ in human body. Brain disorders are most common today. Growth of abnormal cells in brain is known as brain tumor and it can be occurs in various types. Tumor can be occurs in any size at any location in the brain. The growth of abnormal cells in brain causes high pressure inside the skull and it make many dangerous health problems in our body. Benign tumors are non-cancerous tumor. But some tumors can be cancerous (malignant) and it is difficult to diagnose and the chances of survival is least. The cost of treatment of brain tumor is not affordable by most of the patients.

The treatment of brain tumor is based on the size of the tumor, type of the tumor, and the growth stage of tumor. In healthcare industry doctors detect the presence of brain tumor with the help of various medical imaging techniques such as MRI (Magnetic Resonance Imaging) scanning, CT (Computed Tomography) scanning etc. They need to give more attention in addressing severe brain diseases. For better decision making medical industry started using data mining techniques to detect the presence of such sort of diseases. Doctors can use a brain tumor detection system as a second opinion for the diagnosis and the treatment of brain tumor. This paper proposes an intelligent system for the early stage diagnosis and classification of brain tumor using Optimized Support Vector Machine (SVM) along with Genetic Algorithm (GA) to optimize the features. The system also finds the growth stage of tumor and provides healthy advices to the patients.

II. LITERATURE SURVEY

Eman Abdel- Maksoud et al. in [4] have proposed a system for early detection of brain tumor with image segmentation technique. The system uses a K-means clustering technique integrated with Fuzzy C means algorithm for brain MRI segmentation. They use two further segmentation such as threshold and level set segmentation to make an accurate brain tumor diagnosis. The system provides improved accuracy in various datasets.

B.V.Kiranmayee et al. in [2] have proposed another method for the diagnosis and classification of brain tumor. They use decision tree approach for the classifying dataset in to normal image and abnormal image. The system consists of both training and testing part. Both parts consist of pre-processing, segmentation and feature extraction. They use ID3 as the decision tree and MATLAB tool for pre-processing and building the decision.

Tamer Hosny et al. in [1] have proposed a hybrid system for detecting the presence of tumor. The system consist of three stages such as feature extraction using discrete wavelet transform, dimensionality reduction using principal component analysis and classification with hybrid classifier includes K-nearest neighbor and feed forward back propagation artificial neural network.

Malathi R et al. in [3] have proposed tumor segmentation method using k-means clustering. System consists of two stages pre-processing and segmentation. Pre-processing includes to gray scale image conversion, noise reduction by median filter and sharpening of image using Gaussian filtering mask. Then clustering is performed on enhanced MRI images for the detection of tumor.

Pallavi Bhosale et al. in [7] proposed a framework for the diagnosis of brain tumor. Frist phase is image pre-processing. Second phase is image segmentation using K-means clustering

and Fuzzy c means. Resulted image is subjected to feature extraction and these features are used to train SVM classifier to classify the image in to normal and abnormal.

Dr. A.R. Kavitha et.al in [9] uses different approach for the detection of tumor. This paper includes de-noising by Weiner filter, Genetic algorithm based segmentation and feature extraction by GLCM (gray level co-occurrence matrix). Then they build SVM classifier to classify the image into normal and abnormal brain MRI.

III. PROPOSED SYSTEM

The proposed system can be used for early diagnosis and tumor type classification. The system made up of four phases. First phase is image pre-processing. The system uses brain MRI dataset which contains normal, benign, malignant brain MRI images and it will used for training purpose. Second phase is segmentation by threshold segmentation. Then in next phase features can be extracted from brain MRI and it can be done with GLCM (Gray Level Co-occurrence Matrix).Final phase is classification using SVM. Here extracted features and SVM parameters can be optimized by genetic algorithm to improve the classification performance. The proposed system will also use to find the tumor growth stage by calculating the tumor area. Finally, the system will diagnose the type of disease and provides disease description along with healthy advices. Architecture of the proposed system is given below:

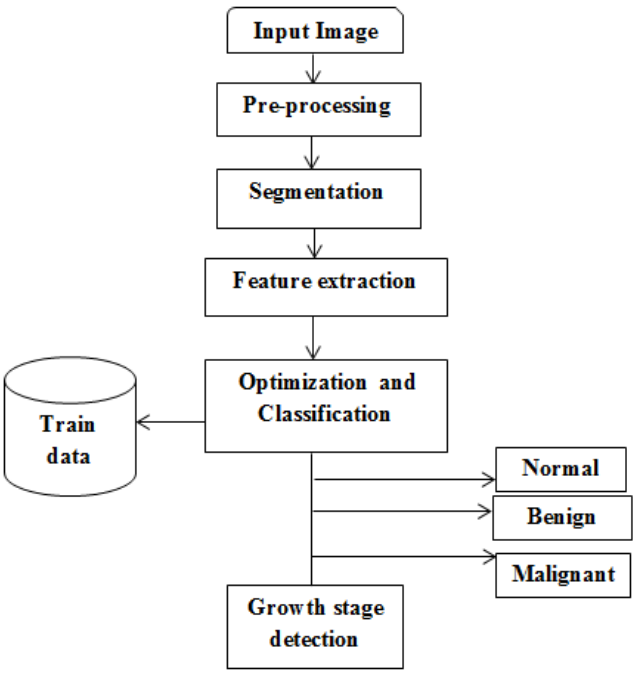

Fig 1: Proposed system architecture

A. Pre-processing

Image pre-processing is used for enhancing the quality of image data by avoiding the unwanted distortions. Scanned brain images are sensitive than other medical images. It contains minimum noise and it is high informative for disease diagnosis. Here preprocessing consist of following two steps:

1) Noise removal

First step is conversion of input image in to gray scale image. Gray scale image consists of different levels of gray and it gives 256 possible levels from black to white. Then the unwanted noise can be removed from the gray scale image using median filtering. Median filter is non-linear filtering method and it removes each pixel by median value of its neighboring pixel. Filter will preserve the edges and provides better image enhancement. The output of this sub-step is noise free brain MRI.

2) Skull removal

Skull removal is an important step to detect the brain abnormality. It will increase the processing speed. Noise free brain MRI is taken as the input to skull removal process by morphological operations. It is a non-linear operation related to morphology of features in an image which includes erosion and dilation. It will remove small scale details from input binary image.

B. Segmentation

Image segmentation is the process of partitioning the whole image into multiple set of pixels and it is easier for further processing. The system uses intensity based segmentation by threshold segmentation. It is based on a threshold value. Initial the value is taken by calculating average value of the total pixel in the input image. After segmentation the system will produce image with dark background and lighting tumor area. Here the system will find the growth stage of tumor by calculating the total number of white pixels.

C. Feature extraction

Feature extraction is the method of dimensionality reduction. It transforms the input data in to set of features which are used for classification purpose. Here we can extract the features using GLCM. It works based on the presence of gray levels present in the image. Entries in GLCM are done by finding relationship between two pixels. GLCM is an 8×8 square matrix and the number of rows and columns equal to the number of pixels in the input image. From this matrix the system extract 13 features as follows:

Autocorrelation, Contrast, Correlation, Energy, Dissimilarity, Entropy, Homogeneity, Sum of squares variance, Cluster shade, Cluster prominence, Information measure of correlation1, Information measure of correlation2 and Inverse difference.

D. SVM Classification

Support Vector Machine is a classification and regression algorithm under supervised learning method. It produces classification by constructing hyper plane that separate different classes and the hyper plane make maximum marginal distance from the two classes. Selection of hyper plane is based on kernel trick. SVM plots the features in the dataset in space as a point. If the dataset contains of n features then the features are represented in n-dimensional space. SVM classifier is widely used for two class and multi class classification. Multiclass SVM classification is possible with multi SVM. It is a non-linear classification and it is done by doing series of binary classification based on one-versus-rest approach. Multi SVM can be used her for classification and selection of hyper plane is based on RBF (Radial Basis Function) kernel function. Here the system consists of three classes and it make three binary classification for building the multi SVM classifier.

E. Optimization

System classification performance will improved by feature weighting and SVM parameter optimization. Here we simultaneously optimize the SVM parameter and feature by genetic algorithm. In the case of multi SVM error penalty parameter C and Gamma is optimized using GA.GA is a heuristic search algorithm based on natural selection. It is proposed by John Holland in1970. GA provides efficient method for optimization and it is inspired by evolutionary biology.GA includes following operators like selection, crossover and mutation. The algorithm starts with random population. Then find the fitness function of each data and perform selection, cross over, mutation to produce new generation with better quality.

Classification by optimized SVM is based on following steps:

1. Take initial population of features.
2. Start with initial value of SVM parameter C and gamma.
3. Do weighting.
4. Perform classification with feature.
5. Calculate the fitness of each data in the population.
6. Apply genetic operators: selection, cross over and mutation.
7. Replace the current population with new and find best SVM parameters.
8. Go step3.
9. Quit when stopping criteria (satisfactory solution) are met.

IV. CONCLUSION

Using the above proposed method brain tumor disease can be classified and diagnosed from brain MRI. Pre-processing and skull removal process will increase the performance of the system. The system can also give disease description along with healthy advices that may help the user. The system will provide better accuracy with GA-SVM classifier and will increase the decision making capacity

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