RISK PREDICTION IN MAGNETIC RESONANCE IMAGING BRAIN IMAGES USING MACHINE LEARNING TECHNIQUES

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ABSTRACT

Brain diseases is one of the major cause of cancer related death among children and adults in the world. Brain diseases like brain tumor is characterized as a gathering of abnormal cells that becomes inside the brain and around the brain. There are various imaging techniques which are used for brain tumor detection. Among all imaging technique, MRI (Magnetic Resonance maging) is widely used for the brain tumor detection. MRI is safe, fast and non-invasive imaging technique. The early detection of brain diseases is very important, for that CAD (Computer-aided-diagnosis) systems are used. The proposed scheme develops a new CAD system in which pulse-coupled neural network is used for the brain tumor segmentation from MRI images. After segmentation, for feature extraction the Discrete Wavelet Transform and Curvelet Transform are employed separately. Subsequently, both PCA (Principal Componenet Analysis) and LDA (Linear Discriminant Analysis) have been applied individually for feature reduction. A standard dataset of 101 brain MRI images (14 normal and 87 abnormal) is utilized to validate the proposed scheme. The experimental results show that the suggested scheme achieves better result than the state-of-the-art techniques with a very less number of features.

Keywords: ***PCNN, DWT, Curvelet, PCA, LDA.***

1.Introduction

The human body comprised of several types of cells with each cell has a precise function. The cells in the body grow and divide in an orderly manner which forms new cells to keep the human body in good physical condition. While few cells cease their capability to control their growth and they grow in an improper fashion which leads to extra cells formed form a mass of tissue which is called tumor. Brain tumors are a solid neoplasm inside the skull which usually they grow in the brain or grow in other places such as in lymphatic tissue, in blood vessels, in the cranial nerves, in the brain envelopes. Brain tumors may grow as a result of the spread of cancers primarily located in other parts of the body [1]. Brain tumors can be classified according to the tumor location or the type tissue which the tumor created or whether the tumor is malignant or benign, and other considerations [2]. The tumors may be either benign or malignant in which malignant tumors lead to cancer while benign tumors are not cancerous. In most cases, cancers that spread to the brain to cause secondary brain tumors arise in the kidney, lumy and breast or from melanomas in the skin [2]. Medical imaging techniques like X-ray, CT scan and MRI are the source of medical image data which is used in medical diagnosis. Magnetic field excitation and RF coil pulses produces MRI image [3]. On comparing with CT scan MRI seems to be powerful for diagnosis since it doesn't utilize radiation. MRI images present a unique perception that determines whether brain tumor is present or not [4]. Manual examination of MRI image is a time consuming job, prone to error while manipulating huge scale of data. Moreover MRI accommodates noise results in flawed classification. In order to analyze large volume of MRI, automation is inevitable which results in economic analyzer. High accuracy of tumor detection is required, because human being is involved. Two common techniques used to classify the MR Images, they are supervised techniques such support vector machine, k-nearest neighbors, artificial neural networks, and unsupervised techniques such fuzzy c-means

and self-organization map (SOM). Many research used both supervised and unsupervised techniques to classify MR Images either as normal or abnormal. [5].R. J. Ramteke, KhachaneMonali Y[6] proposed a method to detect the brain tumor automatically on the basis of image features and automatic abnormality detection. K-Nearest Neighbour (K-NN) classification technique is modest technique which produces reasonable classification accuracy. Khushboo Singh, SatyaVerma[7] proposed and incorporated Support Vector Machines (SVM classification techniques) to brain MRI image by employing the features vector.

2. Objective of Research

The main aim of this investigation is to develop a new machine learning framework/system for classification and risk assessment of brain MRI images.
Instead of so many advantages, diagnostic images obtained from MRI brain tumor rescreening methods as discussed in section 2 suffers from major shortcomings such as low resolution and low contrast, speckle noise, and blurry edges. So it is more difficult for a radiologist to read and interpret these images. Any decision is guided by radiologists own intuition. In addition, ultrasound diagnosis is heavily dependent on a doctor's personal experience. This reality is compounded by the fact that reading an ultrasound image is tedious, hard work, which can lead to fatigue and burn out, which, in turn, can ultimately lead to an increased rate of misdiagnosis and missed diagnosis. Further majority of non medical professionals tend to treat MRI brain tumor themselves, there are a lot of incorrect decisions and inadequate surgeries, and this directly affects the outcome and longevity of the patient [2]. Thus shortcomings of existing techniques as discussed above motivates for a very challenging problem of automatic classification of MRI brain images. The proposed research will investigate the problems in accurate diagnosis and classification of MRI brain abnormalities and addresses them using image processing and machine learning techniques. Image processing techniques can be employed to enhance the MRI Brain image and also to extract unique features/patterns representing each category of MRI brain image. In this research Image processing techniques will be investigated to filter/enhance the MRI brain images followed by feature extraction and appropriate feature selection. Then various machine learning techniques will be employed and evaluated to classify brain abnormalities.

3. Brief Review of Work Already Done in the Field

This section presents the relevant contributions of other researchers in the proposed research area.
In recent years, for the feature extraction and classification of the brain MR images various techniques have been suggested by different researchers. Extracting essential feature from brain MR image is very important for further analysis and classification.

V.Vani , M. Kalaiselvi Geetha [2016] observed that "Automatic Tumor Classification of Brain MRI Images using DWT Features " it has taken (200 images) 120 Images are used for training & 80 images for testing . it has used for preprocessing Median filter and Feature Extraction using Discrete Wavelet Transform (DWT) and Classification for used SVM, k-NN and Decision Tree. the Performance Accuracy of SVM= 78.61% ,k-NN = 88.89 % Decision Tree =81.48 % . This paper presents an efficient method of classifying MRI brain and Disadvantages of system could not distinguish Astrocytomas class of tumor.

N. Subash and J. Rajeesh.[2015] suggested that Brain Tumor Classification Using Machine Learning Here feature extraction from MRI Images has been done by gray scale and texture features From the simulation results it is observed that SVM based classification has been efficient for the classification of the human brain into normal and abnormal. It also achieves high degree of accurate classification (i.e. more than 95%). From the outcomes it has been concluded that this technique seems to be rapid, easy to operate, non-invasive and cost effective

Nayak et al.[2015] have proposed hybrid technique for brain MR image classification. For feature extraction through brain MR images they utilizes the approximation coefficient of level-3 of discrete wavelet transform (DWT). To reduce the large set of extracted features from brain MR images they have employed kernel principal component analysis (KPCA). After getting the reduced set of features they have employed least square support vector machine (LS-SVM) as a classifier with different kernel function and they have reported that proposed scheme outperform with high accuracy.

Yang et al.[2015] suggested a wavelet-energy based approach for brain MR image classification. For feature extraction they have used 2D DWT. For brain image classification SVM classifier was employed and BBO method was utilized to optimize the weights of the SVM. They noticed that their scheme was superior then KSVM, PSO-KSVM and BPNN.

N.V.S. Natteshan and J. Angel Arul Jothi [2015] it investigated that Automatic Classification of Brain MRI Images Using SVM and Neural Network Classifiers This work has developed a CAD system for automatically classifying the given brain Magnetic Resonance Imaging (MRI) image into 'tumor affected' or 'tumor not affected'. The input image is preprocessed using wiener filter and Contrast Limited Adaptive Histogram Equalization (CLAHE). The image is then quantized and aggregated to get a reduced image data. Neural network and Support Vector Machine (SVM) classifiers are trained using these features. Results indicate that Support vector machine classifier with quadratic kernel function performs better than Radial Basis Function (RBF) kernel function and neural network classifier with fifty hidden nodes performs better than twenty five hidden nodes. It is also evident from the result that average running time of FCM is less when used on reduced image data.

El-Dahshan et al[2014.] suggested a hybrid technique, in which feed forward pulse-coupled neural network is applied for the segmentation of the brain images. For feature extraction they consider approximation component of DWT. For feature reductuion they used PCA and for the classification they used back propagation neural network and achieved 99% accuracy.

ShwetaJain [2013] stated that classifies the type of tumor using Artificial Neural Network (ANN) in MRI images of different patients with Astrocytoma type of brain tumor. The extraction of texture features in the detected tumor has been achieved by using Gray Level Co-occurrence Matrix (GLCM). An artificial neural network (ANN), generally called neural network (NN).

Saritha et al.[2013]. Suggested a scheme, in which they have used entropy of wavelet approximation component at level-8 computed along with SWP for feature extraction. For the classification they used Probabilistic neural network (PNN) and their results indicate that they achieve high success rate.

4. Noteworthy Contribution in the Field of Proposed Work

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Kailash D.Kharat & Pradyumna P.Kulkarni & M.B.Nagori [2012] Brain Tumor Classification Using Neural Network Based Methods This paper presents two Neural Network techniques for the classification of the magnetic resonance human brain images. The proposed Neural Network technique consists of three stages, namely, feature extraction, dimensionality reduction, and classification. In the first stage, we have obtained the features related with MRI images using discrete wavelet transformation (DWT). In the second stage, the features of magnetic resonance images (MRI) have been reduced using principles component analysis (PCA) to the more essential features. In the classification stage, two classifiers based on supervised machine learning have been developed. The first classifier based on feed forward artificial neural network (FF-ANN) and the second classifier based on Back-Propagation Neural Network. The classifiers have been used to classify subjects as normal or abnormal MRI brain images.

Noramalina Abdullah, Umi Kalthum Ngah , Shalihatun Azlin Aziz [2011] have showed that Image Classification of Brain MRI Using Support Vector Machine The main motivation of this work is to use wavelet approximate coefficient of a Brain MRI as the input for SVM. Through a machine learning method, we hope to achieve better precision and accuracy in interpreting a normal and abnormal brain image.

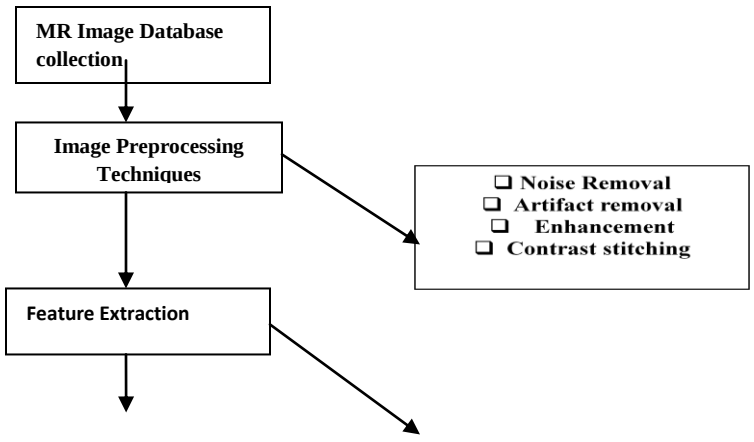
Dipali M. Joshi, Dr.N. K. Rana , V. M. Misra. [2010] It intended to "Classification of Brain Cancer Using Artificial Neural Network " for Texture Feature Extraction using Gray Level Co-occurrence Matrix (GLCM) and for Classification Neuro Fuzzy logic used Classifier it has advantages that the designed and implemented system provides precision detection and real time tracking by classifying the unknown sample Image into appropriate Astrocytoma type of Cancer, thus do not involve any pathological testing. Disadvantages is that More features that could be added to the system include metabolic and genetic data as well as anatomical attributes of the brain.

Farias M. Santos V. Lopez [2008] has reported that Brain Tumour Diagnosis with Wavelets and Support Vector Machine. A computation tool that merges Wavelets and SVM has been developed. The wavelet-SVM classifier

allows to observe the influence of the design parameters of each technique on the clustering, so to reduce the classification time and to improve the results.

5. Proposed Methodology During Tenure of the Research Work

- Literature survey and review: This involves collection of research papers from renowned technical journals such as relevant journals listed in IEEE, Springer, ACM, Elsevier, Science Direct etc.
- Preparation of Database: Collection of data from various hospitals and online open source (authenticated) for research purpose.
- Preprocessing The raw images always hold characters, non uniformity in size and orientation, noise etc. Thus before feature extraction preprocessing of raw image is required. It involves:
    a) Enhancement
    b) Noise Filtering
    c) ROI extraction.
    d) Comparison and evaluation of various filtering/denoising techniques will also be carried out to select the best filter.
- Feature Extraction: In most of the cases benign tumors often have round or ellipsoid shapes, smooth borders and homogenous internal echoes; whereas malignant tumors often have branch patterns, irregular/angular boundary and heterogeneous internal echoes . For classifying the mri brain tumor in to benign, malignant etc. features based on shape, texture etc will be extracted.
- Feature selection: High dimension data could contain a high degree of irrelevant and redundant information which may greatly degrade the performance of learning algorithms. A suitable/optimal set of features will be selected for classification while maintaining acceptable classification accuracy.
- Automatic Classification: Various machine learning techniques will be then used for classifying MRI Brain images in to benign, malignant etc.The input to the classifier will be features obtained in step 5.
- Evaluation and validation of classifiers: Evaluation of the performance of the developed system will be then carried out using evaluation parameters such as Accuracy, Sensitivity, and Specificity etc. Finally performance of various classifiers will be compared on the basis of evaluation parameters.
- Report writing/ Documentation: To write documentation/report/conference papers/Journal papers etc.



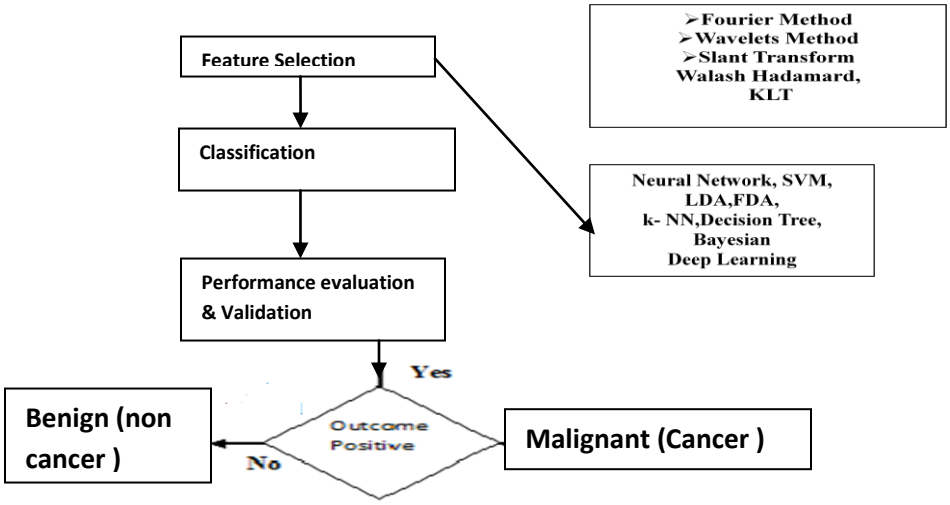


Fig 1: Framework of the Proposed Methodology

6. Conclusion

The proposed work is expected to improve the sensitivity, specificity, and efficiency of brain cancer diagnosis, and possibly reduce health care costs. Further it will increase detection and diagnosis accuracy and save labor. The proposed system will help/assist radiologists/Doctors to evaluate medical images and improve their diagnosis accuracy.

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