Brain Tumor Classification using Decision Tree and Random Forest

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Abstract: Automated defect detection in medical imaging has become the emergent field in several medical diagnostic applications. Automated detection of tumor in Magnetic Resonance Imaging (MRI) is very crucial as it provides information about abnormal tissues which is necessary for planning treatment. The conventional method for defect detection in magnetic resonance brain images is human inspection. This method is impractical for large amount of data. So, automated tumor detection methods are developed as it would save radiologist time [2].

Brain cancer is one of the most wide disease among peoples in the India and the world. Correct and early diagnosis is an extremely important steps in treatment. However, it is not an easy one due to several uncertainties in detection. Machine Learning (ML) techniques can be used to develop tools for physicians that can be used as an effective mechanism for early detection and diagnosis of brain cancer which will greatly enhance the survival rate of patients. In the proposed work, Machine learning technique is used for brain cancer detection and diagnosis. For analysis purpose brain cancer dataset taken from the Open Access Series of Imaging Studies (OASIS), this set contains total 373 images. Brain cancer dataset used as a training set to evaluate and compare the performance of the ML classifiers in terms of key parameters such as accuracy, recall, precision and area of ROC (Receiver Operating Characteristics). Result of Proposed work achieved by two classifiers Decision Tree and Random Forest. result obtained by these two classifiers in the form of confusion matrix and receiver operating characteristic (ROC) curve as well as the comparative study of these two classifiers.

Index Terms – Machine Learning (ML), Decision Tree, Random Forest.

1 INTRODUCTION

The human body is composed of many types of cells. Each cell has a specific function. The cells in the body grow and divide in an orderly manner and form some new cells. These new cells help to keep the human body healthy and properly working. When some cells lose their capability to control their growth, they grow without any order. The extra cells formed form a mass of tissue which is called tumor. Most important organ in the human body is brain which contain billions of cells, abnormal growing of that cells is nothing but tumor. The group of abnormal cells can affect the normal and healthy cells and it will destroy healthy cells.

Brain tumor is very harmful disease it can cause of death. A lot of people have to face this problem. Detection and classification terms are helpful for diagnosis of disease. MRI is one of the best imaging technique that many researchers depends on for dectecting the brain tumor and treatment phases. MRI technique have a huge impact in the automatic medical image analysis field for its ability to provide a lot of information about the brain images and abnormalities present in the brain tissues. Machine learning (ML) is an important technique which will help to detect brain tumor. Here, ML technique is applying to MRI images. With the help of machine learning technique data can train which will help for proposed work. Machine learning is the most important solution of diagnosis of tumor. The proposed methodology aims to differentiate tumored and nontumored using MRI images by the given dataset, by using two classifiers and estimate the better classifier which shows better result.

2 LITERATURE REVIEW

The purpose of this chapter is to provide foundation of knowledge on related proposed work. Through this chapter the relationship between the work of different researchers can identified.

Review of brain tumor Classification and Detection using various Classifiers

1. Brain tumor classification using machine learning algorithm proposed by Balakumar, Raviraj and Devi [7]. Proposed system contains pre-processing, segmentation, feature extraction and classification. Here they use two steps for pre-processing i.e. De-noising and skull stripping. Using adaptive pillar K-means algorithm segmentation process is successfully done. With the help of GLCM technique features have been extracted neatly. Support vector machine is a classifier which has good separation ability. At the last they used SVM classifier for separate out the normal images and abnormal images and it gives 89.5% accuracy. Implementation of this system has been done by MATLAB 2014a.

2. Vani, Sowmya and Jayamma proposed brain tumor classification using support vector machine[13].The database is taken from www.cancerimagingarcieve.com, it is in DICOM (Digital Imaging and Communications in Medicine) format. In this work they show a prototype for object detection with SVMs that can achieve real-time performance while maintaining high detection accuracies. 82% of accuracy is obtained from the proposed model.

3. Classification using deep learning neural network (DLNN) for brain tumor is published by Heba Mohsen et al [17]. deep learning is a subfield of machine learning. Deep neural network is nothing but the extension of deep learning architecture with the addition of more hidden layers to the network architecture between the input layer and output layer methodology of proposed work is divided into four steps, first step in which they get a proper dataset having brain MRI images. Second step is segmentation of an images using Fuzzy C- means technique after the segmentation, features have been extracted using discrete wavelet transform (DWT) and Principle component analysis technique. The last and important step of this work done by using DNN classifier. The proposed work shows that the accuracy of DNN is better as compared to the K- Nearest Neighbor, Linear discriminant analysis (LDA) and Support Vector Machine.

4. Brain tumor classification using Convolutional Neural Networks (CNN) is proposed by J. Seetha and S. Selvakumar Raja [16]. main aim of this work is automatic classification of brain tumor using an MRI images. MRI images are more important for the information purpose than the other like Computed Tomography and ultrasound image. The proposed system work on CNN. CNN technique work through five layers i.e. input, Convolutional, Rectified Linear Unit (ReLU) layer, pooling layer and fully connected layer. CNN has one benefit than the normal Neural Network that is CNN can take 3- dimensional input and output. It has one important advantage also that, it doesn't need to extract features separately hence it will take less time and give high accuracy. Proposed work gives better accuracy result than the other classifiers i.e. SVM and DNN.

5. Byale, Dr. Lingaraju and Shivasubramanian proposed an automatic segmentation and classification of brain tumor ML techniques [13]. proposed system performs through four stages that are Pre-processing, segmentation, feature extraction and classification. main aim of first stage that is Pre-processing is to remove noise for the better image with the help of adaptive medium filter. Region of Interest find out using GMM technique, it will help for segmentation purpose. Extraction of features carried out using GLCM. Propose system shows that, the particular person has tumor or not, if the person has tumor then it can identify it is benign or malignant.

3 PROPOSED SYSTEM

The brain tumors, are the most aggressive and harmful disease. It directly effects on human life. It can cause death of human, by classification of brain tumor it will get that the particular person is tumored or not. If the particular person has cancer it is easy for diagnosis purpose. Here Machine learning play an important role, it can detect cancer cells in brain using Magnetic Resonance Technique (MRI). Here two classification techniques used that are Random forest and Decision tree. proposed work shows classification of brain with the help of above given classifier.

The proposed work shows information about two classifiers and find out the classifier which will have better accuracy. Specified model classifies brain tumor using two classifiers and will shows better classifier which will gives better accuracy.

3.1 Machine Learning Theory

Machine learning is a key enabler of an artificial intelligence. it is about making computers to act without explicitly programming them. It is figure out how to perform task based on generalizing data and examples and they can learn to improve themselves from the experience of past data.

Learning, like intelligence, covers such a broad range of processes that it is difficult to define precisely. A dictionary definition includes phrases such as 'to gain knowledge, or understanding of, or skill in, by study, instruction. or experience. and 'modification of a behavioural tendency by experience.' machine learning is a field of artificial intelligence that uses statistical techniques to give computer systems the ability to learn (e.g., progressively improve performance on specific task) from data, without being explicitly programmed.

3.2 Methodology of proposed model

The proposed model can be implemented by using the following methods. Decision Tree and Random Forest are some ways by achieving above problem statement.

3.2.1 Decision Tree Classifier

Decision tree is a type of supervised learning algorithm that is mostly used for classification purpose. It works for both categorical and continuous dependent variables. In this algorithm, the splitting of the samples into two or more homogeneous sets. This is done based on most significant attributes/ independent variables to make as distinct groups as possible.

To split the samples into different heterogeneous groups, it uses various techniques like Gini, Information Gain, Chi-square, entropy.

3.2.2 Random Forest classifier

Random Forest is a trademark term for an ensemble of decision trees. In Random Forest have collection of decision trees (so known as "Forest"). To classify a new object based on attributes, each tree gives a classification and we say the tree "votes" for that class. The forest chooses the classification having the most votes (over all the trees in the forest).

3.3 Implementation of Specified Model

The framework for proposed brain MRI classification technique is as shown below.

Proposed Framework:

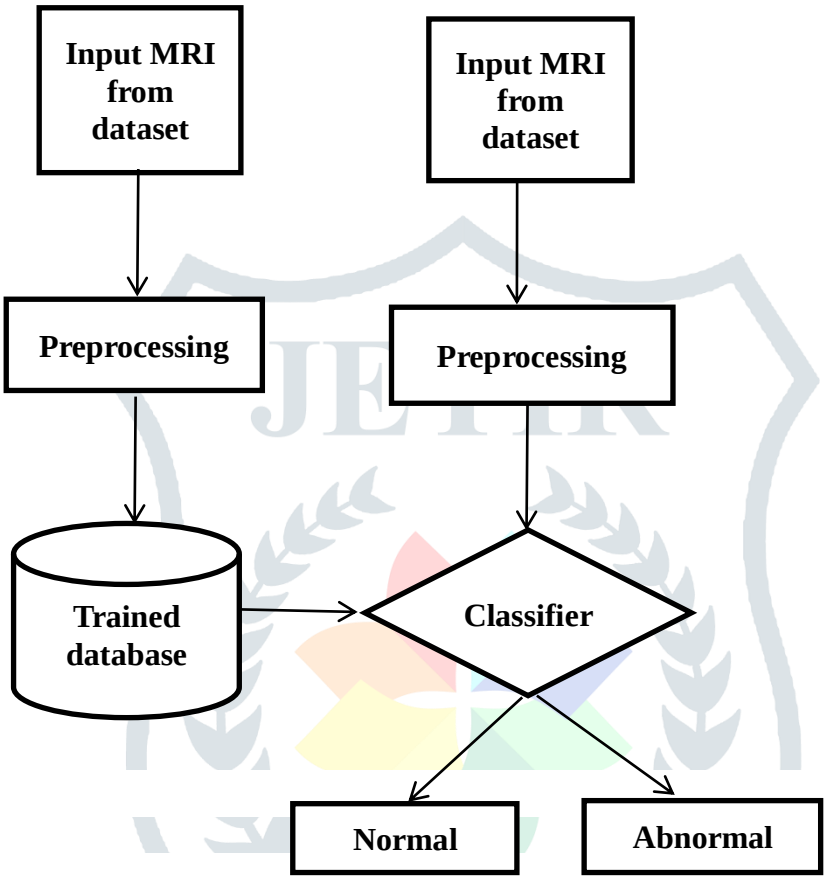


Fig.1 Framework for proposed model

There are mainly two steps to build and use a machine learning model. Proposed framework as shown in above fig.1 has explained below

Dataset

This set consists of a longitudinal collection of 150 subjects aged 60 to 96. Each subject was scanned on two or more visits, separated by at least one year for a total of 373 imaging sessions. For each subject, 3 or 4 individual T1-weighted MRI scans obtained in single scan sessions are included. The subjects are all right-handed and include both men and women. 72 of the subjects were characterized as nondemented throughout the study. 64 of the included subjects were characterized as demented at the time of their initial visits and remained so for subsequent scans, including 51 individuals with mild to moderate Alzheimer's disease. Another 14 subjects were characterized as nondemented at the time of their initial visit and were subsequently characterized as demented at a later visit.

Pre-Processing

The pre-processing is the first step in building a machine learning model. At this step, acquire and prepare the data for future usage. clean up the data, tidy it and select the features we want to use from our data. Data pre-processing is a technique which involves transforming raw data into a simple or understandable format. Sometimes, in real world data is incomplete, having many errors, noisy. Pre-processing technique is used for solving such issues.

Classification

The last step classification is performed by the aid of two classifiers Decision Tree and Random Forest. these two are used for classification as demented or nondemented.

4 RESULT

In this work, an automatic detection and classification has been done by classifying the MRI images into normal and abnormal. For the classification two algorithms used, that is decision tree and random forest. In this model comparative study of these two classifiers and it gives the accuracy of random forest classifier better than decision tree by used dataset.

If we predicted yes and they do have disease then it is true positive. if we predicted no and they don't have disease then it is true negative. if we predicted yes and they don't have disease then it is false positive. if we predicted no and they do have disease then it is false negative.

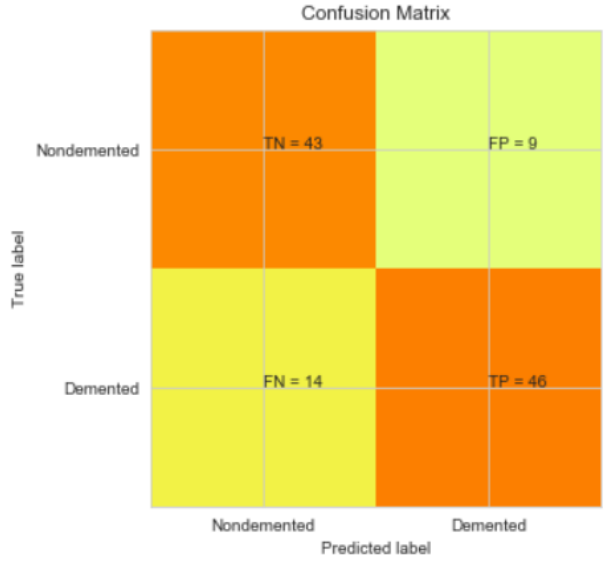
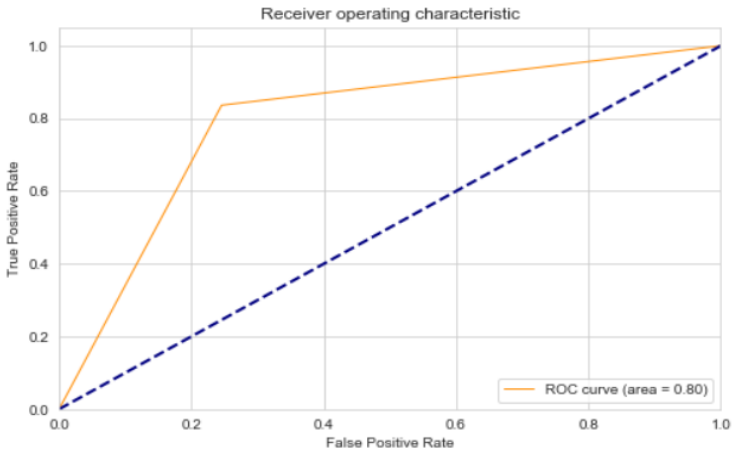


Fig.2 Result of confusion matrix obtained from Decision Tree classifier

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Acuuracy Of the Model:  0.7946428571428571
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Fig.3 Result of Decision Tree classifier by ROC curve

Fig.2 shows the result of confusion matrix obtained from Decision Tree classifier. and fig.3 shows the result of same by ROC curve gives accuracy of 79%.

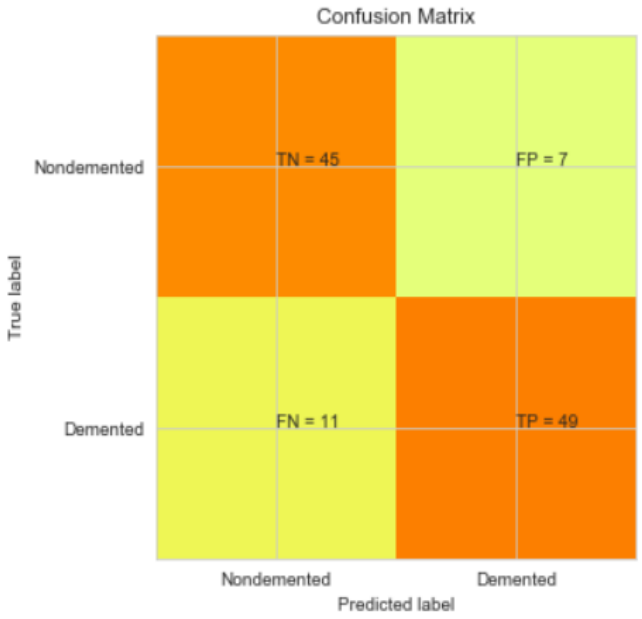
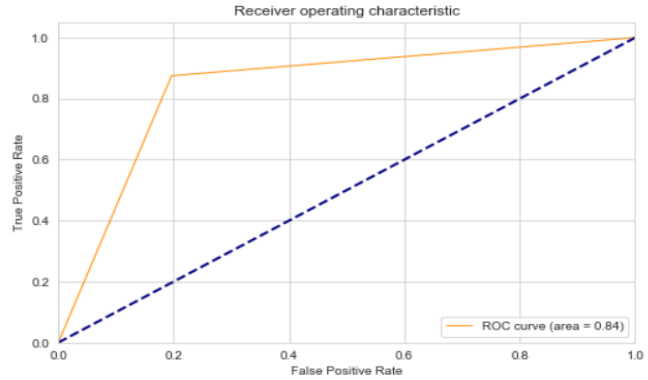


Fig.4 Result of confusion matrix obtained from Random Forest classifier

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Acuuracy Of the Model:  0.8392857142857143
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Fig.5 Result of ROC curve obtained from Random Forest classifier.

Fig.4 shows the result of confusion matrix obtained from Random Forest classifier. and fig.5 shows the result of same using ROC curve gives accuracy of 83%.

CONCLUSION

An important challenge in machine learning areas is to build accurate and computationally efficient classifiers for Medical applications. In this work, we work on classification algorithm of machine learning and used brain Cancer datasets. Comparison of efficiency and effectiveness of those algorithms in terms of accuracy, precision, sensitivity and specificity has done to find the best classification algorithm.

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