European Journal of Business & Social Sciences
Available at https://ejbss.org/

ISSN: 2235-767X
Volume 07 Issue 01
January 2019

A Review on Brain Tumor Detection Classification Approach

Shadab Ali
Ph.D. Research Scholar
Sunrise University, Alwar, Rajasthan, India
csaukrn2030@yahoo.co.in

Dr. Amit Kumar
Professor
Sunrise University, Alwar, Rajasthan, India
amitpanwar889@gmail.com

Abstract

A harmful disease that is caused due to the abnormal growth of tissues on the brain to generate an intracranial mass is called brain tumor. Based on its type which can be either benign or malignant, the brain tumor can be identified in a human body. Malignant is cancerous kind of tumor whereas benign is non-cancerous. There are a number of learning classifiers such as support vector machine (SVM), k- nearest neighbor KNN, artificial neural network (ANN), Hidden Markov Model (HMM), Probabilistic Neural Network (PNN)& k-means Classification approach. Every classifier has its own advantages as well as disadvantages. KNN has advantages when feature sets are less, but when features set increases the KNN performance also degraded. ANN is fast and robust, but computing cost is more hence consuming high CPU's primary physical memory. SVM show great accuracy and work well with high dimensional space than other algorithms. But SVM has high training time hence in practice not suitable for large datasets and also do not work well with overlapping classes.

KEYWORDS: KNN, ANN, SVM, HMM Classification

1.Introduction

Brain tumor is identified as a situation in which the cells existing within the cranium increases abnormally. The brain cancer or tumor initiates from the nerves coming out of the brain, brain cells and the vessels of blood in most of the cases. These tumors will only apply potentially harmful pressure. The malignant tumors are described as fast increasing tumors. These tumors are capable to extend in the surrounding brain. The normal brain cells can be destructed by the tumors because of the generation of inflammation, applying pressure on the brain parts and rising pressure into the head.

The word similar to neoplasm that is caused due to the growth of cells in abnormal manner is known as tumor. It is not similar to cancer at all. Following are the three commonly known types of tumors:

- Benign
- Pre-Malignant

ISSN: 2235-767X
Volume 07 Issue 01
January 2019

- Malignant Benign Tumor

a. Benign

The tumor that does not expand in an abrupt manner is known as a benign tumor. The healthy tissues surrounding this tumor are not affected and on the non-adjacent tissues, the tumor does not expand.

b. Pre-Malignant Tumor

A disease which is a precancerous stage is known as premalignant tumor. This may lead to cancer if not treated properly.

c. Malignant Tumor

The type of tumor that becomes worse with the passage of time is known as malignancy. The person that suffers from this tumor dies eventually. A severe progressing disease is described using a medical term called malignant. In order to describe the cancer, the term malignant tumor is used.

Digital image processing is a rising field for the investigation of complicated diseases such as brain tumor, breast cancer, kidney stones, lung cancer, ovarian cancer, and cervix cancer and so on. The identification of cranium cancer is an extremely complicated job. In this procedure, image segmentation process is very crucial. A number of approaches are used for the scanning of a particular body part like CT scan, X-rays, and Magnetic Resonance Image (MRI). These pictures are then examined by the surgeons for the removal of the problem. Brain tumor has already become a very big reason of deaths and disabilities globally. Various investigational studies have been performed in the last few years for the recognition of brain tumor. Early detection of brain tumor is achievable with development of image processing. Medical Image Processing improves the prior diagnosis of patients who survived with brain cancer.

The image processing and image improvement techniques are used for the detection of cerebral cancer. These techniques are used for the improvement of the picture quality for medical image processing. For highlighting the characteristics of the MRI pictures, contrast adjustment and threshold approaches are used. Some techniques are used for the recognition and categorization of brain tumor; some of them are Histogram Method, Edge Recognition, Morphological operations and Segmentation.

2. Classification Approaches

2.1 Artificial Neural Network (ANN)

ISSN: 2235-767X
Volume 07 Issue 01
January 2019

Artificial Neural Network is a collection of interconnected artificial neurons which behaves like a human brain. There is a sequence of layers in ANN and a set of neurons is present in every layer. The weighted connections present on all the neurons present in the previous and next layers are linked with the neurons of every other layer. Just like the working of biological brain, each connection transmits a signal from one neuron to other. Depending upon the structure of network and number of inputs, the performance parameters are calculated.

2.2 Convolutional Neural Network (CNN)

CNN or ConvNet is one of the deep learning and feed forwarding algorithm, in which multiple layers are connected to analyze the images effectively. The main building blocks of CNN are Convolutional layer, Pooling layer, ReLu layer and Fully-connected layer. In medical image analysis, they play a significant role to classify the tumors or any affected part of the human body.

In the proposed CNN based classificationdoesn't require feature extraction steps separately.The feature value is taken from CNN itself. Infig.2. shows the classified result of Tumor andNon-tumor brain image. Hence the complexityand computation time is low and accuracy is high.

The output of brain tumor classification accuracyis given in fig.3. Finally, the classification resultsas Tumor brain or non-tumor brain based on theprobability score value. The normal brain imagehas the lowest probability score. Tumor brain hashighest probability score value, when compared tonormal and tumor brain[1].

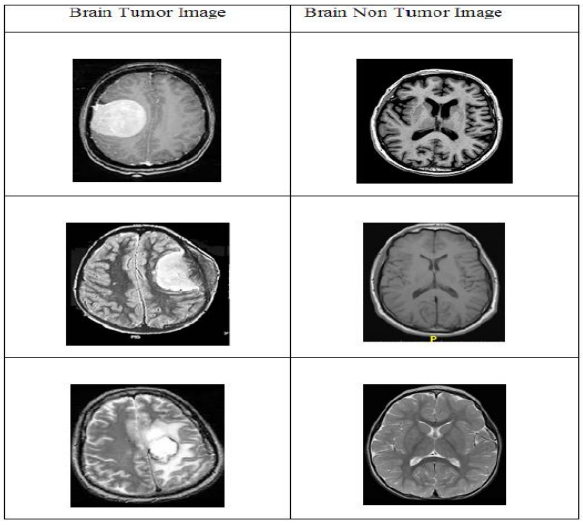

Fig. 2. CNN based classified results

ISSN: 2235-767X
Volume 07 Issue 01
January 2019

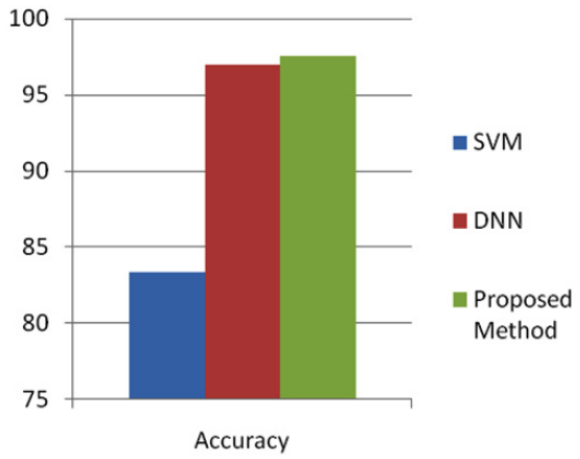

Fig. 3. Accuracy of brain tumor classification

2.3 Decision Tree (DT)

A dataset is divided into uniform subsets repeatedly for calculating the class membership through DT classifier. In every intermediary state, the acceptations and rejection of class labels are achieved through the hierarchical classifier. The node partitioning, identification of terminal nodes and allocating the class label to terminal nodes are the three major parts of this classifier.

2.4 Support Vector Machine (SVM)

With the help of Support Vector Machine (SVM), a hyper plane or suit of hyper planes is generated in high dimensional space for performing classification. The hyper plane located remotely from the adjacent training data end of some class supports in the attainment of good division. Basically, the generalization error of classifier is less in case when the margin is large. It is possible to handle more input data in a very efficient manner by using non-parametric with binary classifier technique in SVM. Depending upon the chosen hyperplane and kernel parameter, high performance and accuracy are achieved.

2.5 logistic Regression :

Logistic regression is a supervised learning classification algorithm used to predict the probability of a target variable. The nature of target or dependent variable is dichotomous, which means there would be only two possible classes.

In simple words, the dependent variable is binary in nature having data coded as either 1 (stands for success yes) or 0 (stands for failure/no).

ISSN: 2235-767X
Volume 07 Issue 01
January 2019

Mathematically, a logistic regression model predicts P(Y=1) as a function of X. it is one of the simplest ML algorithms that can be used for various classification problems such as spam detection, Diabetes prediction, cancer prediction etc.

2.6 K-nearest neighbor

The k-nearest neighbor (KNN) algorithm is based on a distance function to measure the similarity or difference between data points [50]. In order to determine the class of a new data point x, the distance between x and xi is computed. A distance function that is often used for this purpose is the Euclidean distance

$$d_i = \sqrt{(x - x_i)^T (x - x_i)},\ i = 1, \ldots, N. \qquad (2.1)$$

The nearest neighbor rule assigns a new data point x to the class of the data point xi which is closest to x. This approach may produce an unreliable classification result since the classification rule assigns the new data point based on only a single of the N points. For instance, it may happen to be an outlier that is not representative for its class. Considering k neighbors instead of one, may produce a more reliable result. The KNN algorithm determines the k data points that are the nearest to x and classifies it according to the majority of equal classifications in this group. Data normalization can be used to avoid that the variable with the largest scale dominates the distance measure.

2.7 Hidden Markov model

The Hidden Markov model is a statistical model for a sequence of observation items. There are three different sub-problems that are very useful in many application areas. Those three areas are:

- The evaluation problem: The evaluation problem is to find the probabilities of the observation given a sequence and a model. The solution of this problem measures how well a model matches the observation sequence.
- The decoding problem: given the model and a sequence, what is the optimal state sequence? The solution to this problem is useful for solving word segmentation problem such as classifying Chinese compound words.

The learning problem: The learning problem is the most interesting of all three problems. If there is existing models, we can use this technique to find the model for a sequence and re-apply the sequence to the model for the learning and decoding problem. This is extremely useful. It is also the problem that our experiments are focused on. The technique is to apply the forward-

ISSN: 2235-767X
Volume 07 Issue 01
January 2019

backward algorithm to this problem and use the Baum-Welch Algorithm to refine the model parameters.

The most efficient technique of breast cancer detection is based on morphological scanning, split and merge segmentation and on nearest neighbor classifier. to improve efficiency of the breast cancer detection nearest neighbor classifier is replaced with HMM classifier. The split and merge segmentation will split the input image on the basis of their properties. The output of split and merge segmentation is given as input to HMM classifier which will classify the features of the basis of their properties. [15].

3. Literature Review

Heba Mohsen, et.al (2018) In fact, Researchers presented different automated approaches for brain tumors detection and type classification using brain MRI images since it became possible to scan and load medical images to the computer. However, Support Vector Machine (SVM) and Neural Networks (NN) are the widely used approaches for their good performance over the last few decades [3].

Heba Mohsen, et.al (2017) The system is based on sequential minimal optimization (SMO) algorithm for training Support Vector Machine (SVM) classifierto classify three different types of malignant brain tumors (i.e., glioblastoma, sarcoma and metastatic bronchogenic carcinoma) on 66 brain MR images. The system is composed of three main stages namely: image segmentation, feature extraction and selection and finally, the classification stage.The average classification rate for all classes using 7-fold cross-validation was 93.94% with average area under the receiver operating characteristic (ROC) curve of 0.963 and the average classification rate on the training set and the 85% percentage spilt was 100% with average area under the ROC curve of 1.00 [2].

Kailash D.Kharat, et. Al (2012) In this 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 componentanalysis (PCA) to the more essential features. In the classification stage, two classifiers based on supervised machine learning havebeen developed. The first classifier based on feed forward artificial neural network (FF-ANN) and the second classifier based onBack-Propagation Neural Network. The classifiers have been used to classify subjects as normal or abnormal MRI brain images.
Artificial Neural Networks (ANNs) have been developed for a wide range of applications such as function approximation, featureextraction, optimization, and classification. In particular, they

ISSN: 2235-767X
Volume 07 Issue 01
January 2019

have been developed for image enhancement, segmentation,registration, feature extraction, and object recognition and classification. Among these, object recognition and image classification ismore important as it is a critical step for high-level processing such as brain tumor classification. Multi-Layer Perceptron (MLP),Radial Basis Function (RBF), Hopfield, Cellular, and Pulse-Coupled neural networks have been used for image segmentation. Thesenetworks can be categorized into feed-forward (associative) and feedback (auto-associative) networks.
The purpose is to develop tools for discriminatingmalignant tumors from benign ones assisting decisionmaking in clinical diagnosis. In this approachutilizes a combination of these two neural networktechniques and is composed of several steps includingsegmentation, feature vector extraction and modellearning. These two methods can then be used to filterout non-suspecting brain scans as well as to point outsuspicious regions that have similar property as thetumor regions.[3]

Vaishnavi S. Mehekare, et.al (2017) a novel CNN-based technique for division of brain tumors in MRI images. It begin by a prepreparing stage, then feature extraction, image segmentation and post-processing. Also, various existing segmentationmethods for brain MR image have been discussed. In this successfully implemented a Convolutional Neural Network based approach to segment tumors from MRI scans using a moderately deep network with not too many parameters. able to get high classification accuracy.[4]

RajeshwarNalbalwar, et.al. (2014) Brain Cancer Detection and ClassificationSystem has been designed and developed. The system uses computer based procedures to detect tumor blocksand classify the type of tumor using Artificial Neural Network in MRI images of different patients withastrocytoma type of brain tumors. The image processing techniques such as histogram equalization, imagesegmentation, image enhancement, and feature extraction have been developed for detection of the brain tumorin the MRI images of the cancer Detected patients.[5]
The tumor isextracted from the MRI brain images by usingmentioned techniques/ methods & the extracted tumorimage further classified on ANN classifier in this way.The Classification of MRI brain cancer images arealso successfully implemented by using artificialneural networks. The developed system efficientlyclassifies the brain tumor MRI images into differentgrades. [5]

Jiarui Ding, et.al,developed a robust HSMM, and applied the model to analyseaCGH data. Compared with HMMs, the robust HSMM is more suitable to analysesequences with succession of homogenous zone by explicitly modelling the state durationdistributions. The SMM emission distributions have large tails and provide protectionagainst outliers. Therefore, the model is less likely to be disturbed by small segmentoutliers. Experiments show the superior performance of the proposed model on data withhigh S/N or low S/N.[6]

ISSN: 2235-767X
Volume 07 Issue 01
January 2019

R. Meenakshi,et.al., MRI brain tumor identificationand detection is an important, but time consuming task performed by medical experts. An automatic MRI brain detection and classification method based on K-Nearest Neighbor (KNN) classifierand Hidden Markov Model (HMM) classifier. Inthis method consists of three stages, such as,preprocessing, feature extraction and classification. Here, the Gaussian filtering technique is used topreprocess the given image by eliminating the noise and filtering the image. The feature extracting involveextracting the first order statistical features, second order statistical features and moment invariantfeatures. Finally, the K-NN and HMM classifiers are employed to classify the given image as normal orabnormal. The experimental results evaluate theperformance of the proposed algorithm in terms ofsensitivity, specificity and classification rate.[7]

SONU SUHAG, et.al., (2015) Magnetic Resonance Imaging (MRI) is a non-invasive imaging modalities which is best suited for thedetection of brain tumor. The segmentation method proposed is fuzzy c-means (FCM) which can improvemedical image segmentation. The algorithm is easy to handle and identification of tumor and its classification in scannedregion has been done accurately. A user friendly environment has been created by using GUI in MATLAB resulting in anautomated brain tumor detection system for MRI scanned images. By using the GUI tool, the physician and otherpractitioners are facilitated in detecting the tumor and its geometrical feature extraction. Multi-SVM has used to classify thevarious type of tumors like Gliomas, Metastasis, Astrocytoma etc. In this work, Multi Support Vector Machines (m-SVMs)has been proposed and applied to brain scanned image slices classification using features derived from slices. This workhelps in recognition of tumor which in turn saves the precious time of medical diagnostic to diagnose the tumorautomatically in short span of time.[8]
Fuzzy C- meanssegmentation, featureextraction and by using SVMclassifier. The accuracy of the method was 91% whenrun on a dataset of 100 images.[8]

Miss. Rajeshwari G. Tayade, et.al. (2016)A fully automatic technique for brain tumor detection using MRI images is presented. This technique is carried outin three steps: The first step is a pre-processing in which the unwanted & extra parts of skull are removed and image acquisitionand image enhancement is carried out which includes filtering method to removing noise from MRI images. After that in secondstep FBB algorithm is used to locate tumor and also determines region of interest by locating position of tumor. Further SVMclassifier is used to extract tumor from MRI image. By comparing the results of this approach to the existing approaches it clearlyshows more reliable and accurate results. Future work includes extending the technique into 3D application and also to find outthe size of tumor. [9]

4. Conclusion

ISSN: 2235-767X
Volume 07 Issue 01
January 2019

In this research paper a comparison study of the different classification approach for medical images such as support vector machine (SVM), k- nearest neighbor KNN, artificial neural network (ANN), Hidden Markov Model (HMM)Classification approach. Every classifier has its own advantages as well as disadvantages. KNN has advantages when feature sets are less, but when features set increases the KNN performance also degraded. ANN is fast and robust, but computing cost is more hence consuming high CPU's primary physical memory. SVM show great accuracy and work well with high dimensional space than other algorithms. But SVM has high training time hence in practice not suitable for large datasets and also do not work well with overlapping classes.The accuracy HMM classifier is high as compared to SVM classifier.

References

[1]J. Seetha and S. Selvakumar Raja "Brain Tumor Classification Using Convolutional Neural Networks" Biomedical & Pharmacology Journal, September 2018. Vol. 11(3), p. 1457-1461.

[2]Heba Mohsen, El-Sayed A. El-Dahshan , El-Sayed M. El-Horbaty, Abdel-Badeeh M. Salem "BRAIN TUMOR TYPE CLASSIFICATION BASED ON SUPPORT VECTOR MACHINE IN MAGNETIC RESONANCE IMAGES" Annals of "Dunarea DE JOS" University of galati Mathematics, Physics, Theoretical Mechanics Fascicle II, Year IX (XL) 2017, No. 1, pp 75-88.

[3] Kailash D.Kharat& Pradyumna P.Kulkarni&M.B.Nagori"Brain Tumor ClassificationUsing Neural Network Based Methods", International Journal of Computer Science and Informatics ISSN (PRINT): 2231 –5292, Vol-1, Iss-4, 2012, pp 85-90.

[4] Vaishnavi S. Mehekare, Dr.S.R.Ganorkar, "Brain Tumor Detection Using Neural Network" International Journal of Advanced Research in Electrical,Electronics and Instrumentation Engineering, Vol. 6, Issue 5, May 2017, pp 3661-3668.

[5] RajeshwarNalbalwar,Umakant Majhi ,Raj Patil,Prof.SudhanshuGonge "Detection of Brain Tumor by using ANN", International Journal of Research in Advent Technology, Vol.2, No.4, April 2014E-ISSN: 2321-963, pp 279-282.

[6] Jiarui Ding, Sohrab Shah, "A robust hidden semi-Markov model with applicationto aCGH data processing", Int. J. Data Mining and Bioinformatics, Vol. x, No. x, xxxx, pp-1-16.

[7] R. Meenakshi and P. Anandhakumar," A Hybrid Brain Tumor Classification and Detection Mechanism Using Knn and Hmm" VOLUME: 11 ISSUE: 2.

[8] SonuSuhag, Lalit Mohan Saini, "AUTOMATIC BRAIN TUMOR DETECTION AND CLASSIFICATIONUSING SVM CLASSIFIER", International Journal of Advances in Science Engineering and Technology, ISSN: 2321-9009, Spl. Issue-4 Oct.-2015,pp 121-125.

ISSN: 2235-767X
Volume 07 Issue 01
January 2019

[9] Miss. Rajeshwari G. Tayade,Mr. C.S. Patil, Mr. R. R. Karhe, "Automatic Brain Tumor Detection using SVM andFBB Algorithm", July 2016 IJSDR | Volume 1, Issue 7, pp 318-322.

[10] Archana A.Mali, Prof.S.R.Pawar, "Detection & Classification of Brain Tumour", International Journal of Innovative Research in Computerand Communication Engineering, Vol. 4, Issue 1, January 2016pp 407-411.