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Brain Tumour Detection of MR Image Using Naïve Beyer classifier and Support Vector Machine

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ABSTRACT

Brain tumour is a mass of tissue that is structured by a gradual addition of anomalous cells and it is important to classify brain tumours from the magnetic resonance imaging (MRI) for treatment. Human investigation is the routine technique for brain MRI tumour detection and tumours classification. Interpretation of images is based on organised and explicit classification of brain MRI and various techniques have been proposed. Information identified with anatomical structures and potential abnormal tissues, which are noteworthy to treat, are given by brain tumour segmentation on MRI. A novel idea is proposed for successful identification of the brain tumor using normalized histogram and segmentation using K-means clustering algorithm. Efficient classification of the MRIs is done using Naïve Bayes Classifier and Support Vector Machine (SVM) to provide accurate prediction and classification.

Keywords: Segmentation, Histogram, K-means clustering, Naïve Bayes Classifier, Support Vector Machine (SVM)

I. INTRODUCTION

Brain is the kernel part of the body. Brain has a very complex structure. Brain is hidden from direct view by the protective skull. This skull gives brain protection from injuries as well as it hinders the study of its function in both health and disease. But brain can be affected by a problem which cause change in its normal structure and its normal behavior .This problem is known as brain tumor. Magnetic Resonance Imaging (MRI) is a medical imaging technique. Radiologist used it for the visualization of the internal structure of the body. MRI provides rich information about human soft tissues anatomy. MRI helps for diagnosis of the brain tumor.

Image segmentation is an image analysis process that aims at partitioning an image into several regions according to a homogeneity criterion. Image segmentation is a very complex task, which benefits from computer assistance, and yet no general algorithm exists. Segmentation can be a fully automatic process, but it achieves its best results with semi-automatic algorithms, i.e. algorithms that are guided by a human operator.

Classification is the technique for classifying the objects into corresponding classes. Ones the brain images acquired they are classified as normal and abnormal. For classification of the images different features of the image are extracted. These features are used for classifying the brain MR image as normal and abnormal. After this classification, segmentation is performed on the images for tumor region extraction.

K-Nearest Neighbor (k-NN) classification technique is the simplest technique conceptually and computationally that provides good classification accuracy [18]. The k-NN algorithm is based on a distance function and a voting function in k-Nearest Neighbor's, the metric employed is the Euclidean distance. The k-NN has higher accuracy and stability for MRI data than other common statistical classifiers, but has a slow running time. Yet, the issues of poor run time performance is not such a problem these days with the computational power that is available.

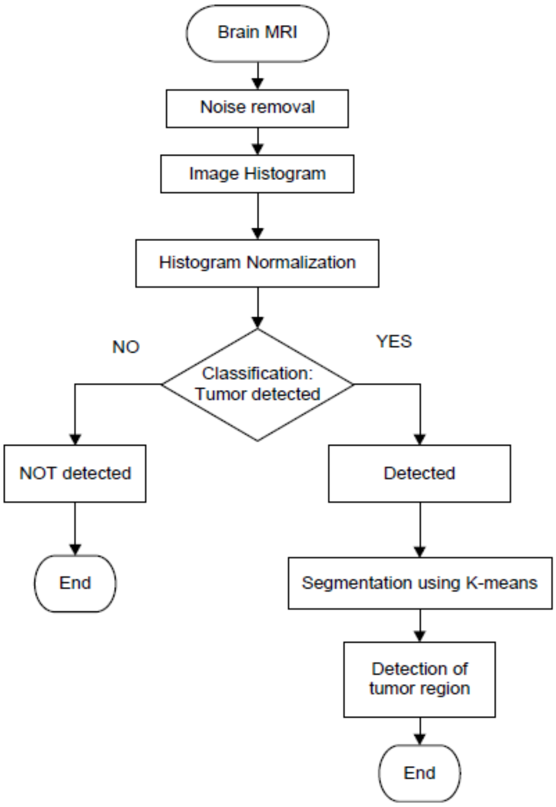


Figure 1. Block Diagram

In this paper, we try to develop a segmentation algorithm for abnormal MRI images using Fuzzy C-means clustering technique and to compare the results with the earlier techniques like Region growing method, K means clustering algorithms. Abnormal brain images from four class's metastases, meningioma, glioma and astrocytoma are being used in this work.

II. PROPOSED METHODOLOGY

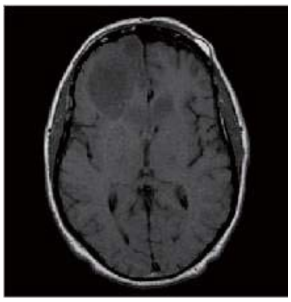
The method proposed here includes features extraction from brain MRIs, feature set dimensionality reduction using fuzzy c-means algorithm and finally, training a support vector machine with radial basis function to differentiate the MRI database into two classes namely, tumour present and tumour free. The components mentioned above are henceforth defined.

A. Image data collection

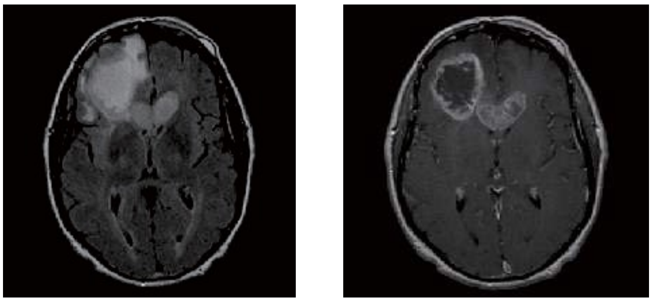
Image data of brain MRI is taken from internet public repository. The image of normal brain and tumor brain with Lower Grade Glioma or Glioblastoma Multiform is collected from. The number of the used data for each MRI image for classification of normal and tumor brain through SVM is of 39 images. There are 37 images for the classification of benign and malignant tumor stages.

B. Preprocessing

In, the literature, there are many pre-processing techniques, which are applicable in different circumstances. Moreover, in the case of inappropriate usage of these methods, the noise may be increased or small details may be eliminated. The noises and artifacts on the image are reduced in pre-processing step by using a Gaussian filter method. It was chosen because it is less sensitive to extreme values and able to remove outliers without reducing sharpness of the image. By using these noises in the pre-processed image is reduced.



(a) T2-FLAIR



(b) T1-PRE (c) T1-POST

Figure 2. Different MRI modalities.

Region Of Interest represents the borders of an entity. In this the variability of the entity are taken from the outside. This perception reflects the fact that images recurrently enclose collections of items each of which can be the source for a section. In a difficult image processing system it should be possible to apply explicit image processing operations to elected region. Thus, one part of an image (region) might be processed to contain motion blur while another part might be processed to develop color version.

C. Segmentation

Segmentation of image is the procedure to partition or divide the image into different regions or segments. The objective of this technique is to represent the image into a more significant and purposeful form which is easier to investigate.

K-means segmentation technique is unsupervised in nature. It segments a group of data points into k number of clusters.

Step 1: k clusters or groups and cluster center is selected randomly by the user for each group.
Step 2: Euclidean distance is calculated between the cluster center and every pixel of the given image.
Step 3: Each pixel is assigned to a cluster with the closest center depending upon the Euclidean distance.
Step 4: The position of the cluster center is re-calculated.
Step 5: The process is repeated until it converges.
Step 6: Cluster pixels are then reshaped into an image.

D. Feature extraction

Feature extraction can be seen as a special kind of data reduction of which the goal is to find a subset of informative variables based on image data. Since image data are by nature very high dimensional, feature extraction is often a necessary step for segmentation to be successful. In this work, nine textural features based on the probability matrices are calculated and used for the segmentation. The features used are angular second moment, sum average, sum variance, sum entropy, difference variance, difference entropy, correlation coefficient, mean and standard deviation. The formulas for these features are given. These features are selected based on the previous works. These features work especially well for brain tumor images.

E. Classification

1) Nearest Neighbor's Based Classifier: One of the simplest classification techniques is the k-nearest neighbor classifier. Classification of an input feature vector X is done by determining the k closest training vectors according to a suitable distance metric. Vector X is then assigned to that class to which the majority of those k nearest neighbor's belong. The k-NN algorithm is based on a distance function and a voting function in k nearest neighbor's, the metric employed is the Euclidean distance. The k-nearest neighbor classifier is a conventional nonparametric supervised classifier that is said to yield good performance for optimal values of k. Like most guided learning algorithms, k-NN algorithm consists of a training phase and a testing phase.

In the training phase, data points are given in a n-dimensional space. These training data points have labels associated with them that designate their class. In the testing phase, unlabeled data are given and the algorithm generates the list of the k nearest (nearest classified) data points to the unlabeled point. The algorithm then returns the class of the majority of that list. The correct classification given in the test phase is used to assess the correctness of the algorithm. If this is not satisfactory, the k value can be tuned until a reasonable level of correctness is achieved.

2) Support Vector Machine (SVM): The support vector machine (SVM) is a machine learning technique, which originated from the statistical theory and is used for the classification of images. It is one of the popular tool for classification tasks due to their appealing generalization properties; this has led several groups to pro-pose using SVMs for brain tumor segmentation.

The key concept of SVM is the use of hyper planes to define decision boundaries separating between data points of different classes. SVMs are to handle simple, linear, classification tasks, as well as more complex i.e. nonlinear, classification problems. Both separable and nonseparable problems are handled by SVMs in the linear and nonlinear case. In this research there are two classified data of normal and abnormal (Tumor) brain images. The hyper planes for SVMs is used to separate these classified data as normal data and tumor data.

III. EXPERIMENTAL RESULT

An approximate data set was made of about 100 MRI images in order to apply FCM for feature selection. From the set of 12 features, 9 were finally selected, eliminating the redundant features namely, correlation, sum average and kurtosis. A new dataset, of 100 images, was created of normal

Table 1. Observation Results

Session	Normal image	Identified correctly	Abnormal image	Identified correctly
Training	65	65	41	41
Testing	54	54	41	39

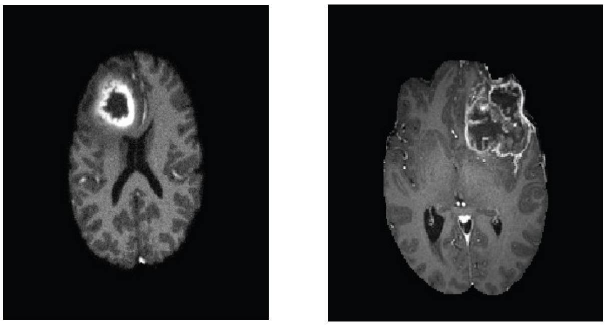


Figure. 3 Tumor affected MR images.

and abnormal (tumor present) images for training the support vector machine. Finally with a dataset of 95 images a test was run which produced the given results. Different sized of images (512×512, 640×640, 1500×1845, 586×586, 1000×1100) has been used to determine universality of the algorithm. All programs are implemented using MATLAB. Efficiency or accuracy of the classifiers for each analysis method is analyzed by error rate. The terms normal and abnormal right and normal and abnormal wrong define this error rate as follows:

1. Abnormal Right (AR): The test gives positive result if tumor is present.
2. Normal Right (NR): The test gives negative result if
3. tumor is absent.
4. Normal Wrong (NW): The test gives positive but tumor is absent.
5. Abnormal Wrong (AW): The test gives negative but tumor is present.

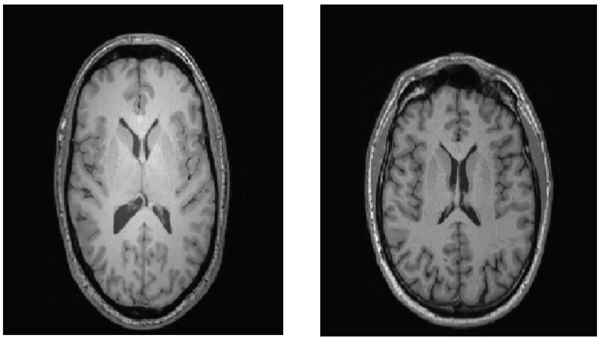


Figure 4. Tumor free brain MR images.

IV. RESULTS AND DISCUSSION

In this paper, Naive Bayes classifier and SVM are used for classification. A dataset of 110 brain images (MRI) is taken from Yatharth Hospital, Noida [14]. Histogram of the input image is normalization and the values of γ and β are calculated. The calculation value of γ is 8.9523, it is considered as the threshold value. The images are classified into 'Tumor MRI' and 'Non- Tumor MRI' by comparing the values β with γ.

$\beta \geq \gamma$; Tumor detected

$\beta < \gamma$; Tumor not detected

Images with brain tumor are classified into one group and non-tumor brain MRIs are classified into another group. The efficiency of both the classifiers is computed. Percentage efficiency of classifiers:

Naive Bayes Classifier = 87.23%
SVM Classifier = 91.49%

It can be concluded by comparing the percentage efficiency of classification that SVM is much better than Naive Bayes classifier. After classification, the image in which tumor was detected is segmented using K-means clustering algorithm.

V. CONCLUSION

The abnormality of the tissues is needed to be identified or classified for the betterment of the human body. In this paper, the incorporated SVM and NBC based classification technique is proposed. The processed brain MRI images are firstly segmented. In which the k value and updated membership are different from conventional process. There are two kind of features have been extracted from segmented images for the purpose of isolating and classifying tumor. The images were classified into 'tumor image' and 'non-tumor image' after histogram normalization using Naïve Bayes classifier and SVM. Efficiency of SVM = 91.49% and Naïve Bayes = 87.23%. It is concluded that SVM has given better efficiency than Naive Bayes classifier.

VI. REFERENCES

[1]. A. B. Author, "Title of chapter in the book," in Title of His Published Book, xth ed. City of Publisher, Country if not

[2]. First Author and Second Author. 2002. International Journal of Scientific Research in Computer Science, Engineering and Information Technology. (Nov 2002), ISSN NO:XXXX-XXXX DOI:10.251XXXXX

[3]. Oh, K. H., Kim, S. H., & Lee, M. (2014). Tumor Detection on Brain MR Images using Regional Features : method and preliminary results.

[4]. N, H. R., Nadu, T., & Nadu, T. (n.d.). Automatic Classification of MR Brain Tumor Images using Decision Tree, (Iceci 12), 10-13.

[5]. Bandyopadhyay, S. K. (2011). Journal of Global Research in Computer Science Available Online at www.jgrcs.info Detection of Brain Tumor-A Proposed Method, 2(1), 55-63.

[6]. Unit, M. I. (1993). A review on image segmentation techniques, 26(9).

[7]. Sundararaj, G. K. (2014). Robust Classification of Primary Brain Tumor in Computer Tomography Images Using K-NN and Linear SVM, 1315-1319.

[8]. Naik, J., & Patel, P. S. (2013). Tumor Detection and Classification using Decision Tree in Brain MRI, 49-53.

[9]. Aslam, H. A., Ramashri, T., Imtiaz, M., & Ahsan, A. (2013). A New Approach to Image Segmentation for Brain Tumor detection using Pillar K-means Algorithm, 2(3), 1429-1436.

[10]. Anbeek, P., Vincken, K. L., & Viergever, M. A. (2008). Automated MS-Lesion Segmentation by K- Nearest Neighbor Classification, 1-8.

[11]. Latif, G., Kazmi, S. B., Jaffar, M. A., & Mirza, A. M. (n.d.). Classification and Segmentation of Brain Tumor using Texture Analysis Department of Computer Science, 147-155.

[12]. Halder, A. (2016). Detection of Tumor in Brain MRI Using Fuzzy Feature Selection and Support Vector Machine, 1919-1923.

[13]. John, P. (2012). Brain Tumor Classification Using Wavelet and Texture Based Neural Network, 3(10), 1-7.

[14]. Elaiza, N., Khalid, A., Ibrahim, S., & Mara, U. T. (2011). MRI Brain Abnormalities Segmentation using, 3(2), 980-990.

[15]. Singh, G. (2016). Efficient Detection of Brain Tumor from MRIs Using K-Means Segmentation and Normalized Histogram, 1(2).

[16]. Hemanth, D. J., Vijila, C. K. S., & Anitha, J. (2009). Comparative Analysis of Neural Model and Fuzzy Model for MR Brain Tumor Image Segmentation, 1616-1619.

[17]. Jayachandran, A., & Dhanasekaran, R. (2013). Brain Tumor Detection and Classification of MR Images Using Texture Features and Fuzzy SVM Classifier, 6(12), 2264-2269.

[18]. Ahmmed, R., Swakshar, A. Sen, Hossain, F., & Rafiq, A. (2017). Classification of Tumors and It Stages in Brain MRI Using Support Vector Machine and Artificial Neural Network, 229-234.