# Brain Tumor detection by using HMM Classification Approach

***Shadab Ali**
****Dr. Amit Kumar**

**Abstract**

A human body consists of innumerable cells. A sensitive and specialized organ of human body is the brain. 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. An optimal technique for brain tumor detection will be designed in this research which will be highly beneficial for the professionals and researchers of medical organizations. The SVM classification approach is applied for the classification of tumor and non tumor portion. The technique of filtering is applied for the image denoising, the approach of k-mean segmentation is applied for the segmentation and HMM classification is applied for the segmentation of tumor and non tumor portion. The proposed approach is implemented in MATLAB and results are analyzed in terms of accuracy and execution time. It is analyzed that when HMM classification is applied on the place of SVM classifier accuracy is increased up to 10 percent.

**KEYWORDS**: Denoising, SVM, HMM Classification

**Introduction**

Images today are being used for sending as well as receiving information. The images are received from internet, satellites, cameras, and many other evolved technologies [10]. The images that are available with some information in them are considered to be as raw images. These images have in them much useful information, which can be used for investigation purposes. There is a lot of duplicity and copying of original data and using for personal issues and also for destroying others privacy [2]. Image processing is known as the enhancement of raw images gathered from day-to-day lives that are collected from any kind of sources like satellites, cameras, internet, etc. such data can be useful either for scientific results or for the criminal investigations. Image processing is computer imaging where application includes an individual in the visual circle. At the end of the day the image are to be analyzed and a followed up on by individuals [3]. It is a strategy in which the information from an image are digitized and different numerical operations are connected to the information by and large with a digital computer keeping in mind the end goal to make an enhanced image that is more valuable to human onlooker. Image processing system regard images as two dimensional signals and set of signals processing strategies are connected to them. It is most recent technologies and its applications in different parts of a business. Image Processing shapes center examination territory inside engineering and computer science teaches excessively [4]. This research worried with digital image in which utilizing a computer to change the way of digital image. Presently nowadays image processing innovation is utilized as a part of each territory like Biotechnology (planning drugs), Medicine (comparing DNA images for clinical and measurable exploration), and Environmental. 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 [5]. 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). There are many techniques which are used for image preprocessing. Medial filter is a non-linear digital filtering method. This filter is utilized for the elimination of pepper and salt noises from the altered gray scale pictures. This filter is utilized for the replacement of center pixel value with the median of brightness level in vicinity of that pixel. This filter gives better performance in comparison with mean filter. Median filers are extremely beneficial in the presence of impulse noise. Adaptive Median filter is a modified version of the existing Median filter [6]. This is one of the linear filters, in which optimization algorithm is utilized for the varying picture parameter. The Weiner filter also categorized under linear filters, used to eliminate the additive noise and blur from the degraded images [7]. An optimal tradeoff is executed between noise smoothening and inverse filtering in this filter. This implies that when a specified low-pass filter blurs the picture then inverse filtering is used for its recovery. Gaussian filter is a non-uniform, low-pass filter. This linear filter is utilized for the blurring of edges and decreases contrast or noise from the pictures [8]. Image classification includes a number of things like image preprocessing, object division, characteristic extraction, image detection and much more. Image classification is specified as an extremely imperative and complex job. Artificial Neural Network is a collection of interconnected artificial neurons which behaves like a human brain. 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.

**Literature Review**

**R. Meenakshi, et.al.,** MRI brain tumor identification and 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) classifier and Hidden Markov Model (HMM) classifier. In this method consists of three stages, such as, preprocessing, feature extraction and classification. Here, the Gaussian filtering technique is used to preprocess the given image by eliminating the noise and filtering the image. The feature extracting involve extracting the first order statistical features, second order statistical features and moment invariant features. Finally, the K-NN and HMM classifiers are employed to classify the given image as normal or abnormal. The experimental results evaluate the performance of the proposed algorithm in terms of sensitivity, 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 the detection of brain tumor. The segmentation method proposed is fuzzy c-means (FCM) which can improve medical image segmentation. The algorithm is easy to handle and identification of tumor and its classification in scanned region has been done accurately. A user friendly environment has been created by using GUI in MATLAB resulting in an automated brain tumor detection system for MRI scanned images. By using the GUI tool, the physician and other practitioners are facilitated in detecting the tumor and its geometrical feature extraction. Multi-SVM has used to classify the various 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 work helps in recognition of tumor which

in turn saves the precious time of medical diagnostic to diagnose the tumor automatically in short span of time.[8]

Fuzzy C- means segmentation, feature extraction and by using SVM classifier. The accuracy of the method was high when run on a dataset of 100 images.[8]

**Rajeshwar Nalbalwar, et.al. (2014)** Brain Cancer Detection and Classification System has been designed and developed. The system uses computer based procedures to detect tumor blocks and classify the type of tumor using Artificial Neural Network in MRI images of different patients with astrocytoma type of brain tumors. The image processing techniques such as histogram equalization, image segmentation, image enhancement, and feature extraction have been developed for detection of the brain tumor in the MRI images of the cancer Detected patients.[5]

The tumor is extracted from the MRI brain images by using mentioned techniques/ methods & the extracted tumor image further classified on ANN classifier in this way. The Classification of MRI brain cancer images are also successfully implemented by using artificial neural networks. The developed system efficiently classifies the brain tumor MRI images into different grades. [5]

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

**Khushboo Singh et al.** [8] Proposed a MRI image classification technique based on SVM classifier. Advanced classification techniques based on Support Vector. Support vector machine is a supervised learning algorithm. In SVM, the classification is performed by quadratic programming.

**Pavel Dvorak, Sheela.V. K. S. Bauer et. al.** Even under treatment, patients do not survive on average more than 14 months after diagnosis [3]. Current treatments include surgery, chemotherapy, radiotherapy, or a combination of them [4]. MRI is especially useful to assess gliomas in clinical practice, since it is possible to acquire MRI sequences providing complementary information [1]. The accurate segmentation of gliomas and its intra-tumoral structures is important not only for treatment planning, but also for follow-up evaluations.

**Research Methodology**

In this research work, technique will be proposed for the detection of brain cancer. The MRI images are given as input and on that images region based segmentation will be applied with the technique of classification to classify cancer and non-cancer cells. The k-mean clustering will be applied for the region based segmentation and HMM will be applied to classify cancer and non-cancer cells. Algorithms for classification typically go through a sequence of steps, with a set of choices at each step. For many optimization problems, using dynamic programming to determine the best choices is overkill; simpler, more efficient algorithms will do. In order to model the generative sequences those are characterized through an underlying process that creates an observable sequence. It is a powerful statistical tool by which generative sequences are modeled. These sequences further can be characterized by a fundamental process generate an observable sequence. In the various areas application of HMMs can be found in signal processing such as in speech processing. In the low level

NLP tasks this process can be utilized which provide successful results such as part-of-speech tagging, phrase chunking, and extracting target information from documents. In the weighted automaton, a Markov chain is a special case according to which weights are probabilities. The state of the automaton it passing through is uniquely determined by the input sequence. This Markov chain is only useful for assigning probabilities to explicit sequences as inherently ambiguous issues are not represented by it. For both observed events and hidden events, one can provide its view that what one can think of causal factors in the probabilistic model as it is allowed by this model.

It is the method which provides the probability of transitioning between any two states due to which it is called as fully connected or ergodic HMM. There are some cases in HMM in which zero probability exists in various transitions be Bakis network tween states. For instance, from left to right the transition state proceed in the left-to-right HMMs also called as Bakis. There are no transitions happen from a higher-numbered state to a lower-numbered state in case of above mentioned method. There is zero probability if transitions occur from a higher-numbered state to a lower numbered state. With the help of this temporal processes like speech can be modeled by it

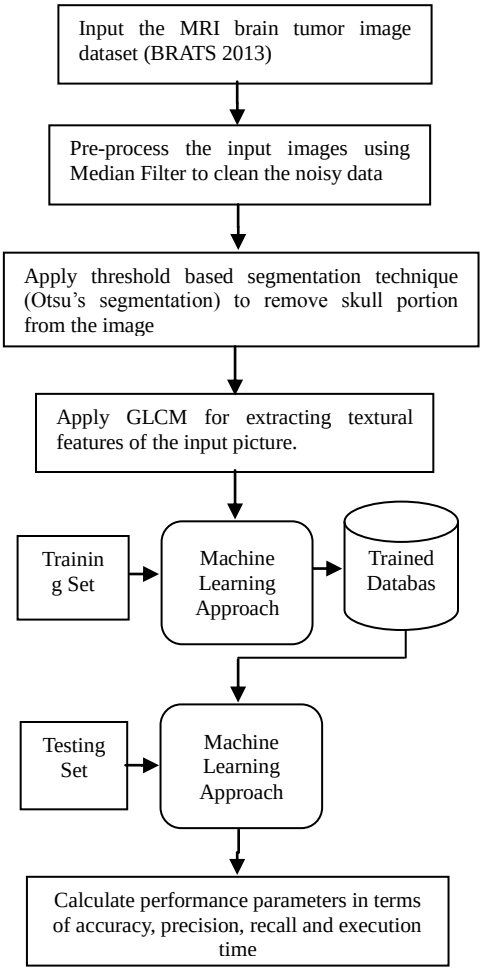


Figure 1: Proposed Flowchart

**Experimental Results**

The proposed research is implemented in MATLAB and the results are evaluated by comparing proposed and existing techniques with respect to various parameters.

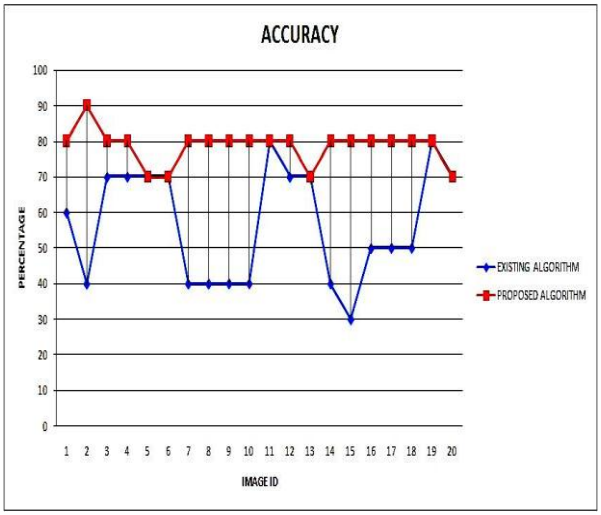


Fig 2: Accuracy Analysis

As shown in figure 2, the accuracy of the existing method which is SVM is compared with the HMM classification. The accuracy HMM classifier is high as compared to SVM classifier

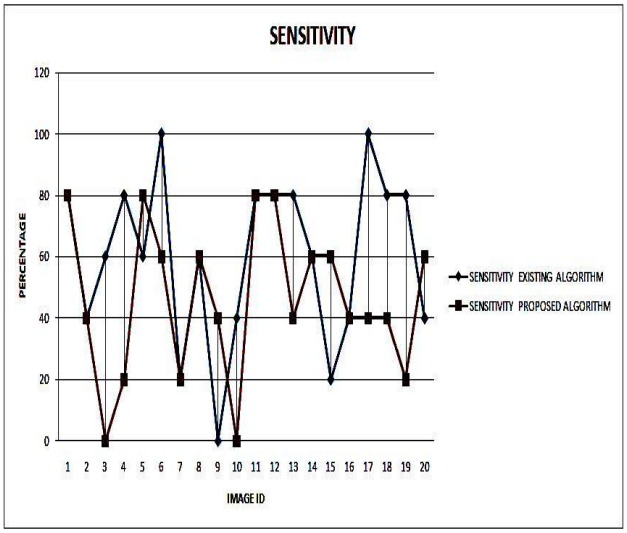


Fig 3: Recall Analysis

As shown in figure 3, the recall (sensitivity) of the existing method which is SVM is compared with the HMM classification. The recall HMM classifier is high as compared to SVM classifier.

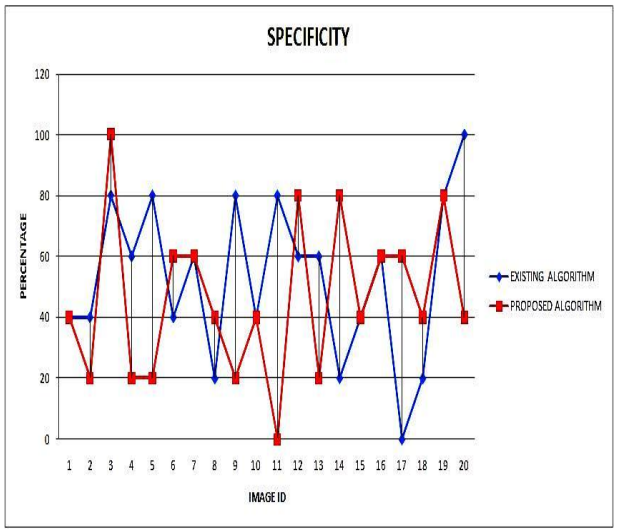


Fig 4: Precision Analysis

As shown in figure 4, the precision (specificity) of the existing method which is SVM is compared with the HMM classification. The precision HMM classifier is high as compared to SVM classifier.

**Conclusion**

Medical image processing gains popularity due to various types of disease detection, prediction and classification. The processing and evaluation of normal as well as abnormal images is the major objective of medical image processing which helps in diagnosing the tumor affected regions from brain image dataset. The textural feature extraction algorithm called GLCM will be applied for the feature extraction. For the localization and categorization of tumor region from MRI image, the machine learning algorithms will be applied in the final phase. Computer vision and machine learning toolbox are used by the proposed method when implemented in MATLAB simulator. For detecting the tumor portion, the performance of proposed and existing lesion localization and characterization approaches will be compared at the end. Certain performance parameters like precision, recall and accuracy will be calculated for analyzing the performance of proposed approach.

***Research Scholar**
****Professor**
**Sunrise University, Alwar (Raj.)**

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