An Efficient Approach based on Machine Learning for Diagnosis of Brain Tumors

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Abstract : MRI images help physicians study and diagnose diseases or tumors present in the brain. This work is focused towards helping the radiologist and physician to have a second opinion on the diagnosis. Medical diagnosis via image processing and machine learning is considered one of the most important issues of artificial intelligence systems. Among the available approaches for diagnosis and evaluation of the brain, MRI imaging is a widely acceptable method which provides accurate brain images. This paper presents a machine learning approach to detect whether an MRI image of a brain contains a tumor or not. The results show that proposed approach is very effective and helpful to accurate prediction.

IndexTerms **–** Machine Learning, MRI image, Brain, Feature extraction.

I. INTRODUCTION

Nowadays, brain tumor detection has turned upas a general causality in the realm of health care. Brain tumor can be denoted as a malformed mass of tissue wherein the cells multiply abruptly and ceaselessly, that is there is no control over the growth of the cells. The process of Image segmentation is adopted for extracting abnormal tumor region within the brain. In the MRI (magnetic resonance image), segmentation of brain tissue holds very significant in order to identify the presence of outlines concerning the brain tumor. There is abundance of hidden information in stored in the Health care sector. With appropriate use of accurate data mining classification techniques, early prediction of any disease can be effectively performed. In the medical field, the techniques of ML (machine learning) and Data mining holds a significant stand. Majority of which is adopted effectively. The research examines list of risk factors that are being traced out in brain tumor surveillance systems. Also the method proposed assures to be highly efficient and precise for brain tumor detection, classification and segmentation.

To achieve this precise automatic or semi-automatic methods are needed. Tumor basically symbolizes abnormal and uncontrollable growth of cells within the body. Brain tumor signifies a malformed mass of tissue wherein the cells multiply abruptly and ceaselessly within the brain tissues (l).Brain tumor segmentation involves separating distinct tumor cells (effective tumor, solid, edema, and necrosis) from the normal brain cells (GM - grey matter, WM - white matter, and CSF - cerebrospinal fluid). Concerning brain tumor research, the unnatural cells tend to be explored any time [2]. The procedure of MRI doesn't involve any pain or radiation and is a non-invasive brain image process [3]. Early diagnosis and immediate treatment of brain tumor definitely increases the survival chances of an individual. Using DM techniques abundant data can be analyzed from various angles thus extracting valuable information. The research focuses on to build a diagnosis and prediction system related to brain tumor by incorporating predictive mining. Brain tumor can be related to numerous medical conditions associated with the heart. These abnormal health/medical symptoms have a direct impact on the brain. Presently, brain tumor is considered as a foremost health issue.

MRI can show different tissue contrasts through different pulse sequences, making it an adaptable and widely used imaging technique for visualizing regions of interest in the human brain. Gliomas are the most commonly found tumors having irregular shape and ambiguous boundaries, making them one of the hardest tumors to detect. Detection of brain tumor using a segmentation approach is critical in cases, where survival of a subject depends on an accurate and timely clinical diagnosis.

There are large class of tumor types which have variety of shapes and sizes. They may appear indifferent sizes and types with different image intensities. Some of them may also affect the surrounding structures that change the image intensities around the tumor. Moreover, the World Health Organization (WHO) states that around 400,000 people in the world are affected with the brain tumor and 120,000 people have died in the previous years. Before the treatment of chemotherapy, radiotherapy, or brain surgeries, there is a need for medical practitioners to confirm the boundaries and regions of the brain tumor and determine where exactly it is located and the exact affected area.

For reviewing the adverse effects of the cancer, the tool can be automatic or semi-automatic for brain tumor segmentation can helps and also acts as a pre-requisite stage for doctors to identify the brain tumor before performing surgeries. Tumor cells thermally represent a heat source; their temperature is high compared to normal brain cells. Nowadays, intense interest has been received in applying convolution neural networks in medical image analysis, but its performance is restricted by the limitation of the depth of the network. And how to accelerate the information propagation and make full use of all the hierarchical features in the network is also of vital importance. During images processing, some information of regions of small tumor could be discarded, for its resolution is attenuated to a single pixel by continuously convolution operations or any other deep learning technique.

II. METHODOLOGY

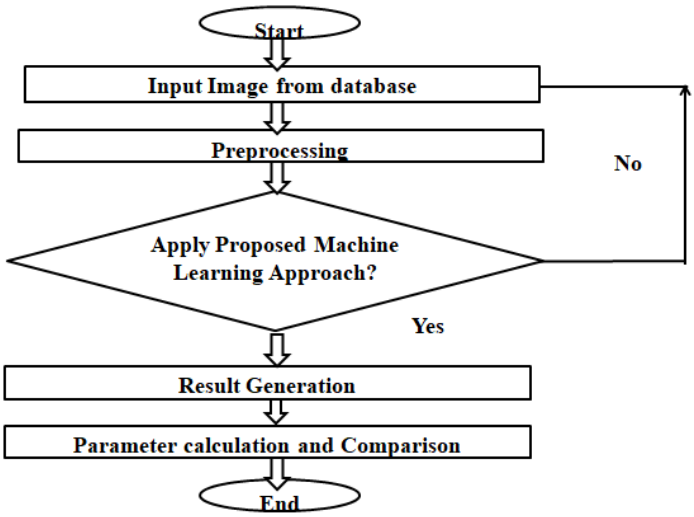


Figure 1: Flow Chart

A brain tumor is a collection, or mass, of abnormal cells in your brain. Your skull, which encloses your brain, is very rigid. Any growth inside such a restricted space can cause problems. Brain tumors can be cancerous (malignant) or noncancerous (benign). When benign or malignant tumors grow, they can cause the pressure inside your skull to increase. This can cause brain damage, and it can be life-threatening.

- The goal of proposed project is to detect and classify brain tumors using image processing techniques with accuracy more than 80%.
- MRI brain scans will undergo 4 phases: Preprocessing, Segmentation, Feature extraction and classification.
- The resources that will be used for accomplishing the goal are MRI brain scans and image processing tool - MATLAB.
- The MRI brain scans (datasets) will be obtained from online archives.
- After successful completion of the project, a software application can be developed which takes the MR images as input and the diagnosis report as the output.
- In future, the system can be directly installed into the MRI scanning machines which scan the brain and then gives the MR image and diagnosis report as the output of the machine.

Algorithms:

There are two major areas that we use algorithms. They are:

- Segmentation and Feature Extraction
- Canny Edge Algorithm

The Canny edge detector is an edge detection operator that uses a multi-stage algorithm to detect a wide range of edges in images.

Classification Approach:-

1) SVM Algorithms

In machine learning, support vector machines (SVMs, also support vector networks) are supervised learning models with associated learning algorithms that analyze data used for classification and regression analysis.

2) Artificial Neural Network Algorithms

Artificial neural networks (ANNs) or connectionist systems are a computational model used in computer science and other research disciplines, which is based on a large collection of simple neural units (artificial neurons), loosely analogous to the observed behavior of a biological brain's axons. Each neural unit is connected with many others, and links can enhance or inhibit the activation state of adjoining neural units.

3) KNN

In pattern recognition, the k-nearest neighbors algorithm (k-NN) is a non-parametric method used for classification and regression.[1]In both cases, the input consists of the k closest training examples in the feature space. The output depends on whether k-NN is used for classification or regression: In k-NN classification, the output is a class membership. An object is classified by a majority vote of its neighbors, with the object being assigned to the class most common among its k nearest neighbors (k is a positive integer, typically small). If k = 1, then the object is simply assigned to the class of that single nearest neighbor. In k-NN regression, the output is the property value for the object. This value is the average of the values of its k nearest neighbors.

III. SIMULATION AND RESULTS

The simulation is performed using MATLAB software. The following support vector machine (SVM) model is proposed for the simulation.

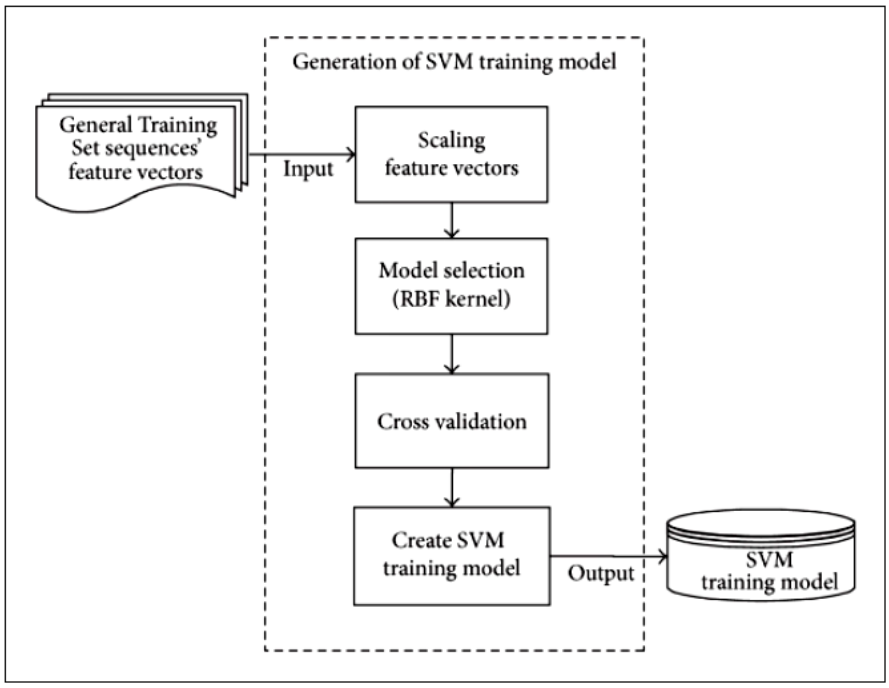
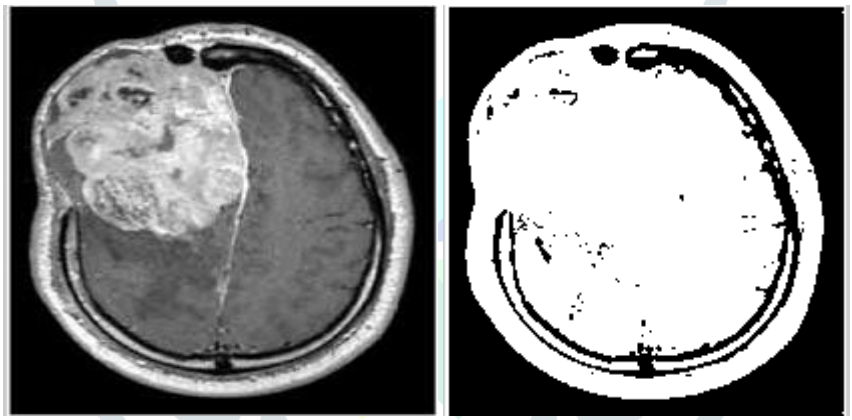


Figure 2: SVM Model



(a) (b)

Figure 3: (a) Sample Image 1 (b) Enhanced Image

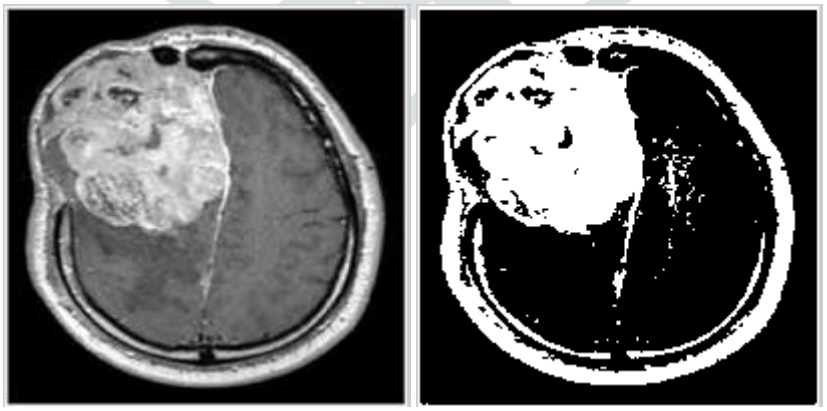
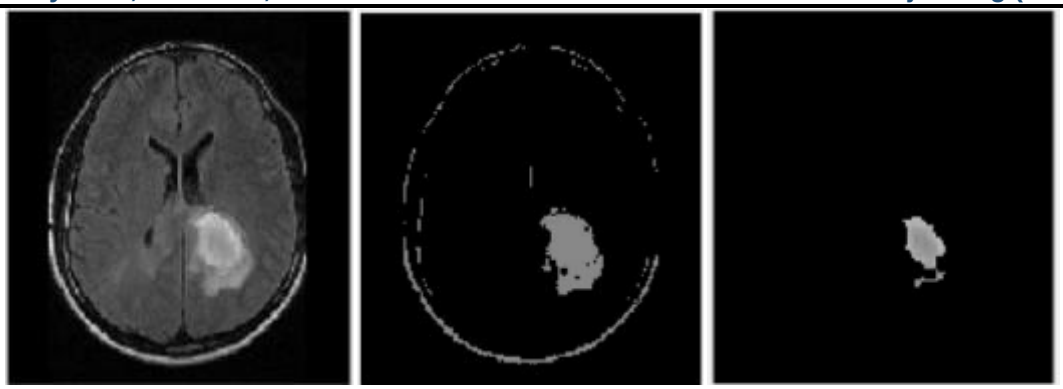


Figure 4: (a) Cluster (b) Detection using SVM Approach

Support Vector Machine (SVM) is a non-probabilistic binary linear classifier. A SVM takes the set of feature vectors as input, generates a training model after scaling, selecting and validating, and generates a training model as the output. This training model is then used to classify the image as either benign or malignant based on the features generated from the feature extraction step. The accuracy relies completely on the accuracy of features extracted during training and testing.



(a) (b) (c)

Figure 5: (a) Sample image 2 (b) Segmentation (c) Detection

Support vector machines (SVMs) are a type of supervised learning models along with associated learning algorithms that analyze data and recognize various patterns, used for classification analysis. The basic SVM takes a set of input data and predicts, for each given input, which of two possible classes, malignant and benign forms the output, making it a non-probabilistic binary linear classifier. Now that there are set of training examples at hand, each marked as belonging to one of two categories, an SVM training algorithm constructs a model that assigns new examples into one category or the other. An SVM model is a representation of the examples as points in space, mapped so that the examples of the separate categories are divided by a clear gap that is as wide as possible. Newer examples are then plotted into it and then predicted to belong to a category based on which side of the gap they fall on.

More formally, a support vector machine constructs a hyper plane or set of hyper planes in a high- or infinite-dimensional space, which can be used for classification, regression, or other tasks. Intuitively, a good separation is achieved by the hyper plane that has the largest distance to the nearest training data point of any class (so-called functional margin), since in general the larger the margin the lower the generalization error of the classifier.

A SVM takes a set of feature vectors as input, generates a training model after scaling, selecting and validating, and generates a training model as the output.

Table 1: Performance Parameter

Sr No.	Parameter	Value
1	Method Name	SVM
2	Precision	86
3	Recall	89
4	F-Measure	87
5	Accuracy	88
6	Error Rate	12

IV. CONCLUSION

This paper proposed the SVM machine learning approach for brain tumor detection with improved accuracy. Further this system can be integrated with cloud platform where medical scans from partner MRI centers can be made available to train the system with new training set. Real time classification can be made possible by integrating Artificial Intelligence (AI) with the developed Brain Tumor Detection and Classification system combined with live input from the MRI scanning instrument.

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