An Efficient Scheme for Brain Tumor Detection of MRI Brain Images Using Euclidean Distance With FVT

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Abstract—Brain tumor is one the most common or major reason for death among individuals. It is apparent that survival of chances of patient could be expanded if tumor is identified at its initial stage. In this research work, we have developed a simple approach for detection of brain tumor which is based on the method using Euclidean distance classifier and making use of feature vector table and which over comes the limitations of conventional in which combination of supervised and unsupervised learning have been implemented to build cancer detection system, as there is huge overhead in this approach and there is a need to maintain large size training datasets. The new proposed method first convert the image into indexed image, than after de-noising it with 3*3 mean filter, it conducts the block wise scanning to get feature set of statistical features in both frequency and time domain and finally based on Euclidean distance measures an optimized tumor part is segmented which is ROI (region of interest) then this segmented part is validated and test to arrive at exact brain tumor part required. The result show high reduction of time, increases specificity with better accuracy in terms of true positive rates.

Index Terms—MRI scan, Brain Tumor Segmentation, Feature Extraction, Machine Learning, Computer Aided Diagnosis.

I. INTRODUCTION

Brain tumor is defined as irregular development or growth of cells inside the brain. Brain tumor is standout amongst the common and dangerous ailments or diseases in the world, if the exact location of tumor is detected in the initial stage than it is a key of its cure. There are diverse kind of brain tumors are found which make the decision very complicated [1]. Tumors are differing to a great degree or extent in size and area; incorporate an extent of shape characteristics covering the customary brain tissues. Extending tumor can recognize by gathering in the cerebrum giving irregular shape to the sound tissue.

A paramount venture in most medical image analysis and examination frameworks is to get the desired limit of area required we are intrigued by and plays a vital role especially in harmless cancer treatment. Numerous demonstrative imaging procedures might be performed for the early location of mind tumor as there are many imaging techniques are available like MRI & PT etc. Contrasted with the other imaging procedures, MRI is effective in the application of cerebrum tumor recognition and distinguishing proof, because of the high complexity of delicate tissues, high spatial determination and since it doesn't create any unsafe radiation, and is a non-intrusive system. MRI could be used to identify various diverse conditions of brain, for example, blisters, tumors, swelling, structural variations from the norm, contaminations, provocative conditions or issue with veins. Obvious pictures of parts of the brain might be acquired through MRI [2].

In this work, the brains MRI’s have been chosen for reference on the grounds that the brain lesion influence great size region of the organ. Brain controls and direct practices, developments, and homeostatic body capacities, for example, pulse, liquid parity, circulatory strain, and body temperature [3]. The orders of brain MRI information as typical (non-tumor part) and unusual (tumor part) are imperative to discrete the ordinary patient and to consider just the individuals who have the likelihood of having irregularities or tumor [4].

II. RELATED WORK

There is plethora of techniques which segment or detect the tumor part from MRI images. Most of these techniques initially conduct the standard preprocessing steps which include image resizing, image de-noising using filters and morphological operations [5] like dilution and erosion. After doing these preprocessing steps whole data base of brain tumor images slices are subjected to the multiple feature extraction algorithm which include text texture [6], statistical, color, morphological feature[7]. Many researchers or authors had made many combination of these feature to come up with feature row vector pattern which can differentiate between tumor and non-tumor part in highly diffused and enforces image of various kinds of tissues (white matter, gray matter and fluids). Accumulation of existing research evidences show that more and more researchers
are using deep machine learning algorithms with the interplay of optimization searching techniques [8][9]. These techniques are highly successful in identifying the pattern of tumor and non-tumor based on features discussed earlier in this section.

Research in the brain tumor detection in MRI images can be categorized in the following methods-
- Thresholding based methods
- Region growing based methods
- Neural network methods
- Fuzzy methods

MRI image segmentation using thresholding is thought to be a very straightforward and influential method to section the image that has dark backgrounds and it helps to compensate uneven brightening in. P. Natarajan et.al[10] have proposed a method for proficient recognition of a brain tumor in MRI images using Thresholding based method, this technique comprises steps like preprocessing by using filters, for contrast adjustment histogram equalization, to perform the division of image thresholding is done. It further make use of methods like morphological operations, at last the required region or area might be gotten by utilizing other method like subtraction of image can be performed. K. Thapaliya et.al [11] method use thresholding value to binarize the image followed by the morphological operations and combination of the morphological operations allows computing local thresholding image supported by flood-fill algorithm and pixel replacement process finally to extract the tumor from the brain.

Region growing is also a fundamental region based segmentation approach used for tumor detection. T. weglinksi et.al [12] proposed a seeded region growing approach which was developed to segment the area of the brain affected by a tumor and the proposed method was tested on real MRI data set. [13] proposed an automatically region growing based technique to detect a brain ventricle by making use of technique called wavelet transform in MRI brain images and [14] proposed a modified texture based region growing technique.

A multitude of neural network based approaches have been introduced [15], which rely on a neural network architecture for image segmentation all of these techniques are mainly categorized in to supervised & unsupervised techniques. In supervised learning based techniques, desired output vector for each input vector is already known. It is the technique which is also known as learning with a teacher. A supervised learning algorithm analyses the training data and generates a desired output vector and classifies the training data according to their output vector. Unsupervised learning deals with the problem of finding hidden structure in unlabeled data. Since the training data available to the network are unlabeled, there is no error signal to evaluate a satisfactory solution. Unsupervised learning is also known as learning without a teacher.

The idea of a fuzzy, that permits slow transformation from membership to non-membership, is the premise for fuzzy division procedures [16].

III. RESEARCH GAP AND PROBLEM FORMULATION

After conducting systematic literature survey and studying associated material from high quality journal related to brain tumor identification using image processing we can come to conclusion that there is ample scope to improve previous work in terms of their complexity, accuracy, and ease of process of identification of brain tumor. We have also found that most of the work has also not been validated against ground truth i.e. marking of tumor part done by expert (doctors), therefore, this current work we shall also include the part of evaluation to judge the performance of the system.

Our scope of work revolves around the work done for detection of brain tumor by usage of machine learning algorithms, especially the work done in terms of combination of supervised and unsupervised learning work done for tumor detection. In Previous work mostly both supervised and unsupervised learning techniques for the detection of brain tumor and for learning about the feature of the tumor part is done on the basis of neural network and that works on the texture features. Later on, it uses K-means clustering to segment the tumor part that seems to account for very large computation time and complexity. Some resources are also consumed when preprocessing is done on the images. There is ample chance of improvement in the studied algorithms in terms of time, computational complexity and accuracy in detection of brain tumor. The proposed work also reduces complexity and time even while extraction of features by independent component analysis and would maintain better accuracy.

IV. WHAT’S NEW?

In this research work, our novel contribution include following works
- Reduction of time in processing by using combination of histogram equalization and dct instead of these method as well as using machine learning sets
- Reduction in complexity of finding tumor
- Evaluation of outcomes of the system against actual marked ground truth tumor by expert doctor

High level of accuracy in terms of sensitivity, specificity without need of building neural network (IHO) architecture where arriving at right number of hidden layer is difficult.

V. PROPOSED WORK

In this section we shell discusses the various implementation steps which are used to achieve highest level of accuracy for tumor detection in MRI images based on the new proposed algorithm. The block schematic diagram of the proposed architecture for detection of tumor in MRI brain images is shown in figure 4.1.
A. Development of Representative Data Set of Images

In this step we built a data set of images that shall be considered for our research work following was the characteristics of the images used for building.

<table>
<thead>
<tr>
<th>CHARACTERISTICS OF DATA SET USED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total images used</td>
</tr>
<tr>
<td>Each image type</td>
</tr>
<tr>
<td>Source</td>
</tr>
<tr>
<td>No. of ground truth image used</td>
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</tbody>
</table>

B. Pre Processing

The real goal of the image preprocessing is to enhance the information contain in image and quality of the image by suppressing undesired contortions and enhancing the obliged image characteristics for further processing. The superfluous information introduce in the image has removed by utilizing the preprocessing steps. The incomplete and inadequate information contain in image might be removed through image preprocessing. In order to achieve the goal to enhance the characteristics of images taken from the MRI brain images preprocessing is vital.

- **Noise filtering**
  
  All images were subjected to de noising filter for removal of white Gaussian noise. 2D-mean filter is used to denoised the image. In which summing up the elements and dividing by their number becomes output called average or mean output. The 2D window or mask which we have chosen for filtering process is of size 3*3. Window size chosen only influences the elements selection. The image is de noised using mean filter rather than median filter because it smoothes the grayscale image data more accurately, do spatial filtering on each individual pixel and pick the average value of the window elements not just the median value. Before preprocessing skull marking and extraction is done to eliminate all non-brain tissues from brain image. Skull extraction in this work is done using mathematical morphology.

- **Histogram equalization**
  
  This step include the process of applying bin based equalization on each image of the data set for this research 255 bin based histogram were made and the new image matrix was developed having enhanced image quality suitable for optimized feature set extraction for tumor detection is made available as better level of contrast are now built globally.

C. Feature Extraction and Construction of FVT

In this step each image is scanned block wise and discrete cosine transformation is applied, this way we are able to do re distribution of energy contained in the image, as it expresses the finest sequences of data points (image intensities) in terms of cosine function oscillating at different frequency. Here cosine function is used rather than the sine function as fewer approximations are required to rebuild the image which is scanned block wise. We are taking features as mean, min and max values for all segmented blocks and store in an array named as FVT, for precise outputs we are taking two blocks of the same image, frequency components which extracted using DCT and time components extracted using RGB domain.

D. Segmentation

Euclidian distance classifier is used for the binaryzation of the image to get the region of interest (ROI). We sort FVT according to the Euclidian distances and extract most dis-similar components from expected ROI using maximum Euclidian distance with pre-defined threshold value. After segmentation process we have the most dis-similar objects from whole image. Number of dis-similar objects depends upon the value of threshold we take. ROI is extracted as the process of doing dct is increase the overall power of image to get the tumor part Step:-once the ROI is available we conduct morphological operation like erode on the mask image and apply ‘and’ operation between the ROI image and image to image mathematics which lead to some hole artifacts. These artifacts are taking care of by adding holes to finally label the ROI image part as tumor part.
E. Parameter Analysis

Since all the steps in the identification of the tumor by our system are done to find how accurate are the results, they are compared to the marking of tumor done by experts /doctor for this purpose we have maintained ground truth images against which each predicted tumor part is evaluated with the outcomes of the evolution is shown in the result section in detail.

VI. RESULTS

Any CAD system, must be evaluated for its accuracy, in terms of its correct selection of feature vectors, as well as correct rejection of features vectors based on which it gives the decision that where the image part has tumor or not, if so, it is or not, properly recognizable. Above all, it must also be able to stand against the ground truth (tumor marked by the doctor/ expert). Here is the graph shown of comparison of the previous SOM and proposed method of following parameters:

- Accuracy
- Specificity
- Sensitivity
- Time analysis

**Accuracy:** Accuracy or Precision is the extent of real or true results, either in positive or negative sense, in a populace. It quantifies the level of veracity of an indicative test on a condition.

\[
\text{Accuracy} = \frac{\text{TN} + \text{TP}}{\text{TN} + \text{TP} + \text{FN} + \text{FP}}
\]

**Specificity:** Specificity is the extent of real negatives accurately distinguished by a symptomatic test. It recommends how great the test is recognizing ordinary (negative) condition.

\[
\text{Specificity} = \frac{\text{TN}}{\text{TN} + \text{FP}}
\]

**Sensitivity:** Sensitivity is the extent of genuine positives that are accurately distinguished by a symptomatic test. It indicates how great the test is recognizing an ailment.

\[
\text{Sensitivity} = \frac{\text{TP}}{\text{TP} + \text{FN}}
\]

**Concluding Time:** It the total time taken by the proposed scheme to get the final required output or the final result.
The inputs and output images snapshots are shown below:

Fig.6 Original image  
Fig.7 Predicted tumor  
Fig. 8 Comparison of both ground truth and predicted tumor

VII. FUTURE SCOPE
For future scope work we suggest a new approach for cancer detection, which may be based on using combination of matrix transformations techniques which not only reduce computational overhead but also reduces computational time. Both the transformations methods may be based on contrast and cluster shade gradient between the highly diffused tissue matters of brain. By doing this prominence of tumor in increased and easily mark able even when the contrast based artifacts are more .We can take entropy of each region also into account.

VIII. CONCLUSION
This work has attempted to segment out the MRI Brain scans utilizing Euclidean distance classifier with FVT strategy for recognition of tumor. Combination of skull extraction with separating methods had known to be beneficial for the methodology of division of remedial images as preprocessing dislodged the undesirable noise from the scan images. Characteristic extraction has been done to parameterize the capability of the method. Our framework has exhibited that it is better than other SOM techniques in perceiving tumor more correctly and accurately. The past work has make utilization of supervised and unsupervised learning on segmentation of brain MRI images in spite of the fact that the proposed strategy is producing great results for cerebrum MRI images utilizing straightforward and simple approach as contrasted with customary the same can be reached out to recognize tumors in different parts. Different upgrades could be possible toward making utilization change systems additionally which can diminish the handling time of tumor location and also proficiency might be expanded and distinguish tumors in huge and distinctive image datasets.

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REFERENCES
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