BRAIN TUMOR IDENTIFICATION AND CLASSIFICATION OF MRI IMAGES USING DEEP LEARNING TECHNIQUES

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ABSTRACT

The primary goal of medical imaging is to extract meaningful and accurate information from these images with the least error possible. A system to decide whether the brain has a tumor or not from the MR image using the combined technique of auto stacked encoder methodology. In the first stage, the input image is converted to greyscale using binary thresholding and the spots are detected. The set of features extracted are characterized by using the DNN algorithm, then the tumor recognition is done with fine-tuning. The most efficient and effective algorithms are discussed after studying several relevant research dissertations. Pre-processing brain images, segmenting them, feature extraction and detection of the tumor are the approaches in most researches. These techniques, limitations, and the advantages with further expansion are discussed extensively in the paper. Image Processing is a strategy that changes over the normal Image into advanced structure so as to upgrade the nature of an Image quality which gives valuable data. The different application, for example, report handling, entertainment world, clinical imaging, measurable investigations, distant detecting, and military relies upon the Image processing method.

Keyword: *MRI Image, Image pre-processing, Auto Stacked Encoder*

1. INTRODUCTION:

Image Processing is a strategy that changes over the normal Image into advanced structure so as to upgrade the nature of an Image quality which gives valuable data. The different application, for example, report handling, entertainment world, clinical imaging, measurable investigations, distant detecting, and military relies upon the Image processing method. The Image Processing's are grouped into types, for example, computerized Image processing and simple Image Processing. The clinical Image processing had been utilized in the exploration field medication. Clinical Images is a basic component in clinical examination and treatment, as it gives the data about structure of patients. The current strategy for MRI Brain tumor recognition, division is assessed in the part alongside its advantages and disadvantages. Early identification of Brain tumor is essential to spare the life of the patient, despite the fact that huge number of strategies where accessible to recognize Brain tumor. The MRI location of Brain tumor gives careful perspective on the Brain tumor. The division and grouping of Brain assume significant function in identification. The specific division of the Brain tumor helps in careful activity or expulsion of Brain tumor. The various techniques for Brain tumor division and grouping are as per the following, which gives detail data about Brain tumor discovery, division and order. In this work, mainly focus the identify and classify the tumor in the brain image (LSP). The tumors which ascend from the brain tissues and this category of tumor can spread through the supplementary portions of the body, malignantly attacks the tissue but histologically benign. The proposed work defines majorly six stages for tumor segmentation and classification in the brain image. In medical practices, the early detection and recognition of brain tumors accurately is very vital. Magnetic resonance imaging (MRI) is high-quality medical imaging, particularly for brain imaging. As per Ali S, Abood LK & Abdoon RS 2013[1] 'Brain tumor extraction in MRI images using clustering and morphological operations techniques', International Journal of Geographical Information System Applications and Remote Sensing

1.1 EXISTING WORKS

One of the most critical assignments in any Brain tumor recognition framework is the disconnection of unusual tissues from typical Brain tissues. Strangely, space of Brain tumor investigation has viably used the ideas of medical image handling, especially on MRI, to robotize the centre advances, for example extraction, segmentation, order for proximate recognition of tumor. CAD supported detection or identification frameworks are getting testing are as yet an open issue because of inconstancy in shapes, location of blocks and sizes of tumor. The previous works of numerous researchers under image processing and delicate processing have made essential analysis on programmed Brain tumor identification strategies centring segmentation just as arrangement and their blends. In the original copy, different Brain tumor location methods for MRI are explored alongside the qualities and challenges experienced in each to identify different Brain tumor types. The current segmentation, grouping and location procedures are additionally presented underlining on the upsides and downsides of the medical imaging approaches in every methodology. Specialists have significant specialized and financial significance of solid and quick identification and grouping of Brain malignant growth, in light of normal practices. The vast majority of the professionals are moderate, less Brainful, and that is difficult to measure have a level of subjectivity.

1.2 PROPOSED WORK

In the present situation, different strategies are accessible for imaging modalities, for example, X-Ray, Mammography, CT-Scan and Magnetic Resonance Imaging (MRI). X-ray gives image data about the life structures and the whole synthesis of the brain or skull. X-ray utilizes the advanced COMPUTER and solid attractive field, radio recurrence beats for the improvement of complete organ images, supple tissues, bones and the whole inward body syntheses. Thus, by utilizing the auto stacked encoder as classifier in DNN classification improves the efficiency of detection of tumor with the data.

2 REQUIREMENTS ENGINEERING

These are the requirements for doing the project. Without using these tools and software's we can't do the project. So we have two requirements to do the project. They are
1. Hardware Requirements.
2. Software Requirements.

2.1. HARDWARE REQUIREMENTS

The hardware requirements may serve as the basis for a contract for the implementation of the system and should therefore be a complete and consistent specification of the whole system. They are used by software engineers as the starting point for the system design. It shows what the system does and not how it should be implemented.

- Hard disk: 500GB and Above
- RAM: 4GB and Above
- Processor: I3 and Above

2.2. SOFTWARE REQUIREMENTS

The software requirements document is the specification of the system. It should include both a definition and a specification of requirements. It is a set of what the system should do rather than how it should do it. The software requirements provide a basis for creating the software requirements specification. It is useful in estimating cost, planning team activities, performing tasks and tracking the teams and tracking the team's progress throughout the development activity.

- Operating System: Windows 7, 8, 10 (64 bit)
- Software: Python
- Tools: Anaconda (Jupyter Note Book IDE)

3 METHODOLOGY

3.1 ARCHITECTURE DIAGRAM

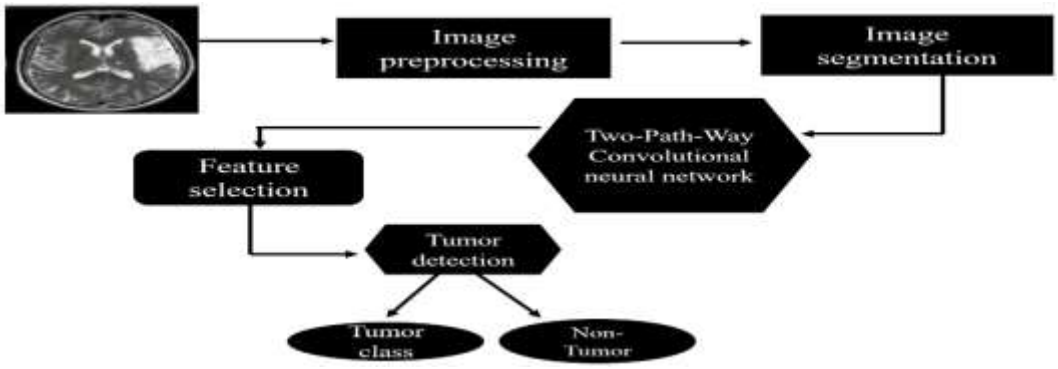

Fig 1: Architecture Diagram

3.2 CHOICE OF MRI IMAGES

In the present situation, different strategies are accessible for imaging modalities, for example, X-Ray, Mammography, CT-Scan and Magnetic Resonance Imaging (MRI). X-ray gives image data about the life structures and the whole synthesis of the brain or skull. With the assistance of the MRI check, data about the blood supply inside the brain can be acquired. Along these lines it very well may be said that for the acknowledgment of oddity, for looking at the expanding of the illness and for the determination, MRI procedures have become a significant instrument. X-ray utilizes the advanced COMPUTER and solid attractive field, radio recurrence beats for the improvement of complete organ images, supple tissues, bones and the whole inward body syntheses. The got images at that point broke down with the assistance of a COMPUTER. After this, images are moved by electronic methods, duplicated to a conservative plate or printed.

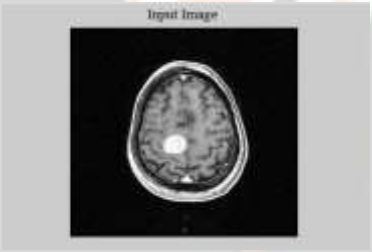

Fig 2: Input Image Of MRI

3.3 IMAGE PRE-PROCESSING

Image pre-processing method speaks to fundamental advance of Image division which greatly affects consequent advances. In the proposed work, three pre-processing procedures are utilized. They are

a) Histogram Equalization
b) Binarization
c) *Morphological Operations*

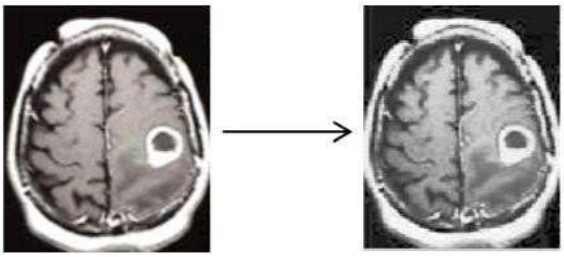

Fig 3- Histogram Equalized Image

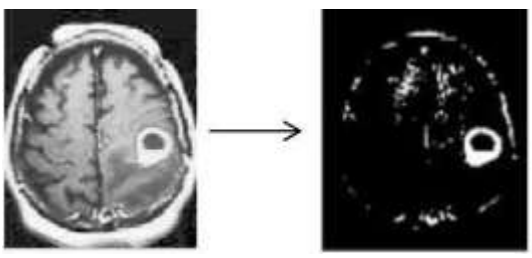

Fig 4- Binarization

3.4 SEGMENTATION

Segmentation is the way toward dividing an advanced picture into numerous fragments (sets of pixels). Such regular segmentation assignments including fragmenting composed content or portioning tumors from solid mind tissue in a MRI picture, and so forth Chan-Vese model for dynamic shapes is an amazing and adaptable technique which can portion numerous sorts of pictures, including some that would be very hard to fragment in methods for "old style" segmentation – i.e., utilizing thresholding or inclination based strategies. This model depends on the Mumford-Shah practical for segmentation, and is utilized generally in the clinical imaging field, particularly for the segmentation of the cerebrum, heart and windpipe.

3.4.1 FEATURE EXTRACTION USING KNN

[A] FEATURE SELECTION

KNN has no model other than putting away the whole dataset, so there is no learning required. Proficient executions can store the information utilizing complex information structures like k-d trees to make gaze upward and coordinating of new examples during expectation productive. Since the whole preparing dataset is put away, you might need to ponder the consistency of your preparation information. It may be a smart thought to minister it, update it frequently as new information opens up and eliminate incorrect and anomaly information. KNN makes forecasts utilizing the preparation dataset legitimately. Forecasts are made for another case (x) via looking through the whole preparing set for the K most comparable examples (the neighbors) and summing up the yield variable for those K occurrences. For relapse this may be the mean yield variable, in arrangement this may be the mode (or generally normal) class esteem.

[B] AUTOENCODER

Autoencoders are a solo learning strategy where we influence neural organizations for the assignment of portrayal learning. An autoencoder has three layers as feedforward neural system, in particular information layer, shrouded layer and yield layer. Autoencoders have a similar number of neurons in the info layer and yield layer, as it trains itself to recreate the given input. The shrouded layer of autoencoder encodes the information vector got from input layer into code (highlights). By expanding or decreasing the quantity of concealed layer neurons as for the Input layer neurons, an autoencoder is prepared. During the preparation stage, the info vector is mapped to the highlights. In any case, autoencoder att empts to speak to the info vector into highlights which are valuable for information characterization process.

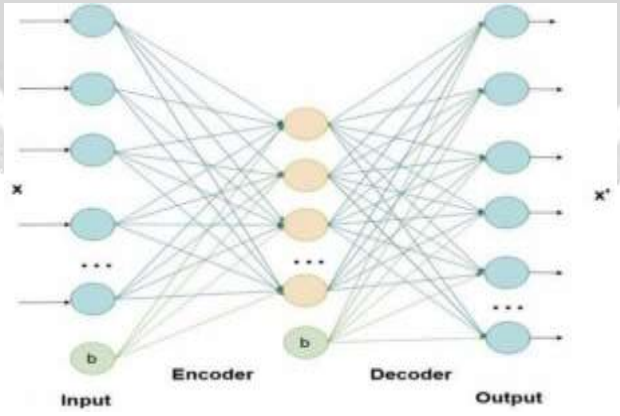

Fig 5-An autoencoder with hidden layer
consists of encoder and decoder

3.5 DNN FOR DATA CLASSIFICATION

Right now, by the intriguing highlights of profound systems, we proposed a DNN based structure utilizing stacked autoencoders for the Brain Tumor information characterization which improves all the assessment measurements of the order issue.
The remaking of information is finished via preparing the auto encoder as follows,

$$x' = f_D(W', b'; f_E(W, b; x))$$

which can be communicated as,

$$x' = f_{AE}(W, b, W', b'; x)$$

where fAE speaks to the capacity which maps the contribution to yield in the autoencoder.

The autoencoder is prepared by limiting the suitable target work which is given by complete blunder work as,

$E_{Total} = E_{MSE} + E_{Reg} + E_{sparsity}$

3.6 SOFTMAX LAYE

Softmax classifier is a multiclass classifier utilizes calculated relapse which arranges the information. Softmax layer utilizes regulated learning calculation which uses stretched out strategic relapse to arrange numerous classes. In this manner strategic relapse is the reason for the softmax classifier. In multiclass classifier issue, the softmax classifier gauges the likelihood of each class with which the information is arranged.

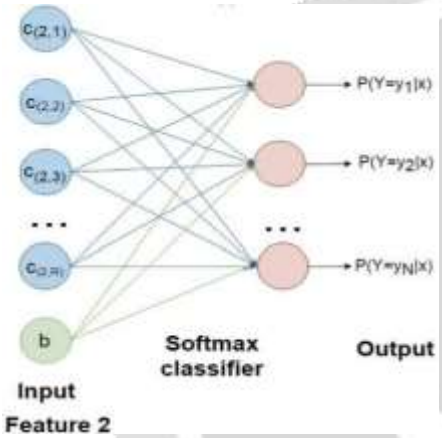

Fig 6(a)- Softmax Classifier

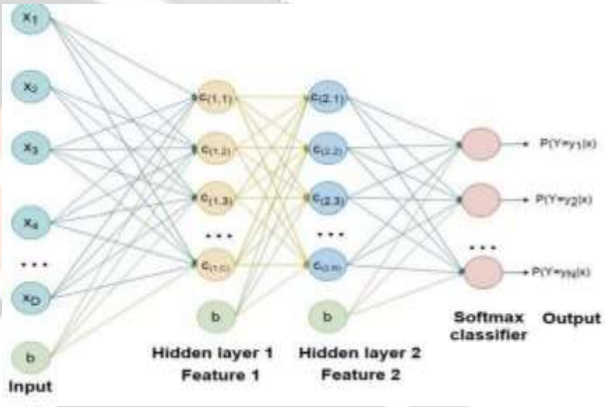

Fig 6(b)- DNN

4 RESULT AND ANALYSIS

Classification Accuracy: Classification Accuracy is picked as an assessment metric for looking at the outcomes delivered by a few techniques applied in the PID dataset in the writing. Classification Accuracy can be given by the condition

$$Accuracy = \frac{\sum_{i=0}^{|N|} evaluate(i)}{|N|} \qquad evaluate(n) = \begin{cases} 1 \; if \; classify(n) = cn \\ 0 \qquad else \end{cases}$$

where N is the trying dataset to be arranged, |N| speaks to the size of the testing informational collection to be characterized and classify(n) gives the grouping aftereffect of the information thing n by the profound system. The classification accuracy can likewise be spoken to utilizing the parameters of disarray grid.

These measurements are given by the conditions given underneath.

$$Accuracy = \frac{TP + TN}{TN + TP + FP + FN}(\%) \qquad Specificity = \frac{TN}{TN + FP}(\%)$$

$$Precision = \frac{TP}{TP + FP}(\%) \qquad Recall = \frac{TP}{TP + FN}(\%)$$

$$F1 - Score = 2 * \frac{Precision * Recall}{Precision + Recall}(\%)$$

Classification Accuracy is what we usually mean, when we use the term accuracy. It is the ratio of number of correct predictions to the total number of input samples

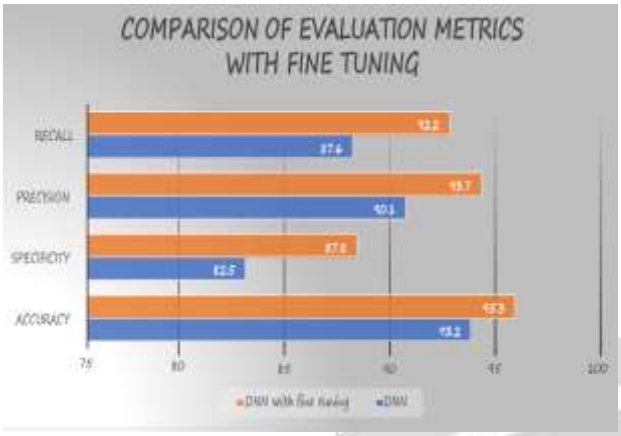

Fig 7- Parameter Comparison Filtered Example I

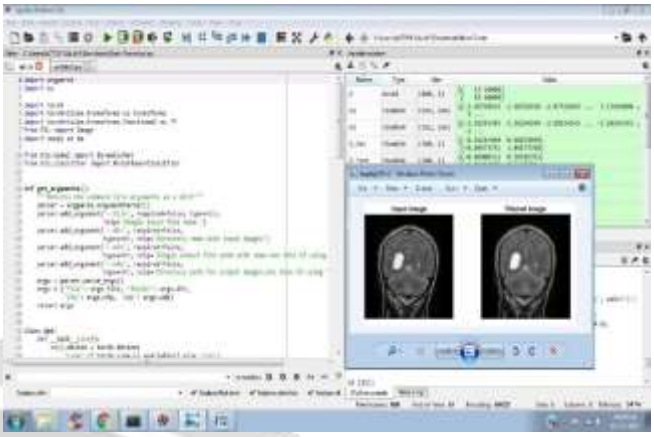

Fig 8- Input Image With Image

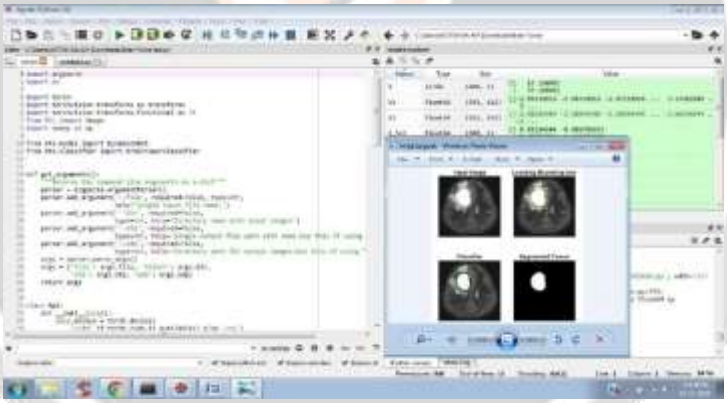

Fig 8- Input Image With Filtered Image Example II

5 CONCLUSION AND FUTURE WORK

This chapter presents the summary of the research and the work consists of four phases. Image division process assumes a significant job in therapeutic Image handling. Right now, this work, we proposed a DNN structure for Brain Tumor order of information utilizing stacked autoencoders. The DNN is manufactured utilizing stacked autoencoders fell with softmax classifier. The HFEs (GLCM, HOG, and LBP) removed the ideal element esteems from fragmented area. At that point, the element choice strategy was applied to the component extraction information for best element choice. At last, the suspicious bits were ordered by utilizing stacked autoencoder DNN classifier dependent on chose highlights. Our model is contrasted and a few neural system draws near and other condition of craftsmanship approaches in the writing. From the outcomes it is obvious that our model outflanks other model with a precision of 95.3%. Besides, our model gives accuracy estimation of 93.7% and review of 92.2% %, which is a lot of promising to recognize the unusual Brain tumors order from understanding MRI Image, and the proposed strategy can be utilized to group the different kinds of tumor

concurring through therapeutic analysis framework. In view of the investigations and perceptions it is presumed that the proposed DNN system for Brain Tumor grouping can be utilized as integral asset for the infection analysis process. Our model aides in foreseeing the Brian Tumor of a patient with better exactness, particularity, accuracy and review which are significant in the restorative world**.** In future, the proposed work can be extended with different types of modalities for detecting the tumors and the optimization technique uses to increase the classification accuracy.

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