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BRAIN TUMOR DETECTION USING DEEP NEURAL NETWORK AND MACHINE LEARNING ALGORITHM

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Abstract:

The determination of tumor extent may be a major challenging task in brain tumor planning and quantitative evaluation. Magnetic Resonance Imaging (MRI) is one among the non-invasive techniques that has emanated as a front- line diagnostic tool for brain tumor without radiation. Deep learning has shown remarkable progress in image-recognition jobs. Works on going from convolutional neural networks (CNN) to variational auto encoders have discovered endless applications in the medical picture investigation field, driving it forward at a fast speed. In radiology, the experienced doctor outwardly assessed clinical pictures for the recognition, portrayal, and observing of illnesses. In this work, automatic brain tumor detection is proposed by using Machine learning and Convolutional Neural Networks (CNN) classification. The deeper architecture design is performed by small kernels. The neuron's weight is given as small. It is observed that CNN achieves a good rate of accuracy with low complexity as compared to all other methods. This improved accuracy will help doctors to treat well.

I. INTRODUCTION:

Brain is one of the vital organs in the human body, which consists of billions of cells. The abnormal group of cell is made from the uncontrolled division of cells, which is additionally called as tumor. The Brain tumors are divided into two types as low grade (grade1 and grade2) and high grade (grade3 and grade4) tumor. Low grade brain tumor is called benign. Similarly, the high grade tumor is also called malignant. Benign tumor is not a cancerous tumor. Hence it doesn't spread with other parts of the brains. However the malignant tumor is a cancerous tumor. That's why it spreads rapidly with indefinite boundaries to other regions of the body easily and also it is risky. It leads to immediate death clinical experts to facilitate more efficient e-health care systems to the patients. There are a number of medical domains where e-health care systems are beneficial. Computer vision-based applications of biomedical imaging are gaining more importance as they supply recognition information to the radiologist for better treatment-related problems. Different medical imaging techniques and methods are available some of them are X-ray, Magnetic resonance Imaging (MRIs), Ultrasound, and computerized tomography (CT), have an excellent influence on the diagnosis and treatment process of patients.

MRI image is especially won't only detect the tumor but also the tumor progress with modeling process. This information is especially used for tumor detection and treatment processes. MRI image gives more information than the CT or ultrasound image. MRI image provides detailed information about brain structure and anomaly detection in brain tissue .Actually, Scholars offered unlike automated methods for brain tumors finding and sort cataloging using brain MRI pictures from when it got conceivable to output and cargo medical pictures to the computer. On the other hand, Neural Networks (NN) and Support Vector Machine (SVM) are the typically utilized strategies for their great establishment over the latest few years. As of now, Deep Learning (DL) models fixed a mixing pattern in AI as the underground design can effectively address complex connections without requiring countless hubs like in the shallow structures for example K-Nearest Neighbor (KNN) and Support Vector Machine (SVM).Consequently, they grew quickly to become the state of the art in unlike health informatics areas for instance medical image analysis, medical informatics and bioinformatics.

Literature Review:

A set of research has been studied for the tumor identification and some recent are discussed here: The paper "Basis Function (RBF) classifier, Decision Tree (DT) CNN Soft max classifier" by Masoumeh Siar, Mohammad Teshnehlab were used to detect the brain tumor and getting a good accuracy. Their study were summarized in three phases: First phase is preprocessing of MRI images Second phase is post processing of images like segmentation, morphological operations, feature extraction, etc. final phase is implement the feature of images for pattern recognition to detect the tumor[5].Remi Y, Cédric Balsat YE, Verset L, (2018) discussed the proposed work classifies the high grade gliomas. Generally, astrocytoma is the most common type of glioma found in both adults and children. Astrocytoma are classified into low grade gliomas and high grade gliomas. The work uses a fully automatic convolutional neural network. The convolutional neural network was implemented using python programming. The anaconda framework was utilized in AI idea, and it utilizes neural organization network for preparing of BRATS database which is carried out utilizing tensorflow. By using this, the accuracy of segmentation is improved and it's the features to process the larger dataset. The result analysis of the segmentation of MRI brain tumor was compared with the images of BRATS database 2015. The dice coefficient is the parameter to define the accuracy of automatic segmentation [6].Bjoern H. M has introduced new brain tumor segmentation which

is also called multimodal brain tumor segmentation scheme. The scheme combined different segmentation algorithms in order to achieve high performance than the existing method. But the complexity is high [7].Huda S has introduced Hybrid feature selection with ensemble classification which is applied for brain tumor diagnosis process. The GANNIGMAC, decision Tree, Bagging C based wrapper approach is used to obtain the decision rules [8].The paper introduced by J Seetha put forth the usage of MRI images for brain tumor diagnosis. The MRI check as a rule produces information in plenitude which makes the manual order interaction of tumor versus non-tumor very time consuming. In spite of the fact that it offers exact quantitative measurements for limited number of pictures. Accordingly there emerges a requirement for automated and trustworthy classification approaches to reduce the human death ratio. The automated brain tumor classification tends to be very complex in large spatial and structural inconsistency of nearby areas of brain tumor. Thus, proposed a programmed cerebrum tumor identification approach by receiving the CNN classification [9].

Related Work:

Medical Sciences is working in this field as tumors can spread widely and may worsen the situation of the patient. As we all the medical science is having the use of technology since many years i.e with help of the technology the medical science field is also getting the best results at appropriate time. In collaboration with medical sciences and technology many doctors, researchers and scientist are working and we studied few papers as below:

1] Brain Tumor Detection Using Deep Neural Network and Machine Learning Algorithms.
2] Brain Tumor Detection Using Artificial Neural Network.
3] Design & Implementing Brain Tumor Detection Using Machine Learning.
4] A Novel Approach for the Brain Tumor Detection and Classification using SVM.

1] Brain Tumor Detection Using Deep Neural Network and Machine Learning Algorithms:

The timely and prompt disease detection & proper treatment plan leads to improved quality of life and increases the life expectancy of patients. The brain tumor can be classified as benign and malignant. So, here the most important practical method used was deep neural Network (DNN). In this paper, the author uses Convolutional Neural Network (CNN) to detect the tumor through brain Magnetic Resonance Imaging (MRI) images. The CNN was firstly applied to images. The accuracy of the softmax fully connected layer which is used to classify obtained images is 98.67%. The accuracy of CNN was obtained with the help of Radial Basis Function (RBF) classifier has accuracy of 97.34% and the Decision Tree (DT) classifier has accuracy of 94.24%, Also, the accuracy of criterion, the author used the benchmark of sensitivity, specificity and precision evaluate network performance. The obtained from categorizers, the softmax classifier gaves the best accuracy in CNN, According to the results obtained from network accuracy on the image testing. The author also has a new method based on the combination of feature extraction technique with the CNN for tumor detection from brain images. The proposed method gives accuracy of 99.12% on the test data. The importance to the diagnosis given by physicians and the accuracy of the doctor in diagnosing the tumor and treating the patient increased.

2] Brain Tumor Detection Using Artificial Neural Network:

The brain tumor is one of the most dangerous diseases which requires early and accurate detection methods , most of the time the detection and diagnosis method depends on the decision of neurospecialists and radiologists for picture assessment which is feasible to human mistakes and time consuming In this paper, the author studies reviews & describes the process and technique used for detection of brain tumor

based on Magnetic Resonance Imaging (MRI) and Artificial Neural Network (ANN) techniques. It was executed in different steps of Computer Aided Detection System (CAD) after the collection of image data (MRI). The 1st step used preprocessing and after post processing of MRI images enhanced it and made it more suitable for analysis and then used threshold to segment the MRI images applied by mean gray level method. The 2nd stage uses the statistical feature analysis to extract features from images, the feature computed from equation the Haraticles feature based on the spatial gray level dependence matrix (SGLD) then selected the suitable best feature to detect the tumor localization. In the 3rd stage ANN were designed and it has the feed forward back propagation neural network with supervised learning were applied as the automatic method to classify the images under investigation into tumor or none tumor. The performances were evaluated successfully and accomplished the best outcome with precision of 99% and affectability 97.9%.

3] Design & Implementing Brain Tumor:

Detection Using Machine Learning:

Brain tumor can be denoted as a mass of tissue in the cells multiply abruptly and Ceaselessly, i.e there is no control over the growth of cells. The process of image segmentation is adopted for extracting abnormal tumor regions within the brain. In the MRI segmentation of brain tissue holds very significant in order to identify the presence of outlines concerning the brain tumor. There is an abundance of information stored in the health care sector. The appropriate use of accurate data mining classification technique, early prediction of any disease can be effectively performed. In the medical field , the technique of machine learning and data mining holds the significant stand. Majority of which is adopted effectively. The examination inspects a rundown of hazard factors that are being followed out in brain tumor observation frameworks. The proposed technique guarantees to be exceptionally productive and exact for brain tumor detection, classification and segmentation. To achieve this precise automatic or semi automatic methods were needed. The research proposes an automatic segmentation method that relies upon CNN, determining in small 3x3 kernels by incorporating this single technique, segmentation and classification is accomplished. CNN is a machine learning technique from a neural network where it has a layer based for result classification. The various mechanism levels were involved in these are 1] Data Collection 2] Preprocessing 3] Average Filtering 4] Segmentation 5] Feature Extraction and 6] CNN via classification and identification by utilizing the data mining techniques, significant relations and patterns from the data can be extracted. These techniques of machine learning and data mining are effectively employed for brain tumor detection and prevention at an early stage.

4] A Novel Approach for the Brain Tumor Detection and Classification using SVM:

The brain is an important organ of the human nervous system; it controls all the body activities. The brain tumor is the main reason for loss of life. The tumor takes place in the extraordinary cells inside the brain. There are three main types of tumors named as malignant, benign or cancerous tumors respectively. In this paper, the author uses the steps of preprocessing, segmentation, feature extraction and classification. The segment of tumor with the use of a set of rules detects and it also classifies the tumor with the usage of (SVM) classifier. The main intention to help the health practitioner is to investigate the type of tumor at earlier degrees.

Proposed Approach:

The human brain was modeled by using design and implementation of a neural network which functions like the original human brain. The neural network is especially used for vector quantization, approximation, data clustering, pattern matching, optimization functions and classification techniques. The

neural network is split into three types supporting their interconnections. Those three types of neural networks are feedback, feed forward and recurrent networks respectively. The Feed Forward Neural network is further divided into a single layer network and multilayer network. In the single layer network, the hidden layer isn't presented. But it contains only input and output layers. Moreover, the multilayer consists of three layers as follows: input layer, hidden layer and output layer. The closed-loop system based feedback network is named as recurrent network. The diagram of brain tumour classification supported convolution neural network is shown in fig.1. The CNN based brain tumour classifies and split into two phases like training and testing phases. The number of images is split into different categories by using labels like tumor and non-tumor brain image…etc. In the training phase, preprocessing, feature extraction and classification with Loss function is performed to form a prediction model. Initially, label the training image set. In the preprocessing image resizing is applied to a varying size of the image. The following block diagram works in two phases as follows: 1] Training Phase and 2] Testing Phase. Both the phases have the same steps. The only difference is that the training phase has the prediction model and the testing phase has the classified results.

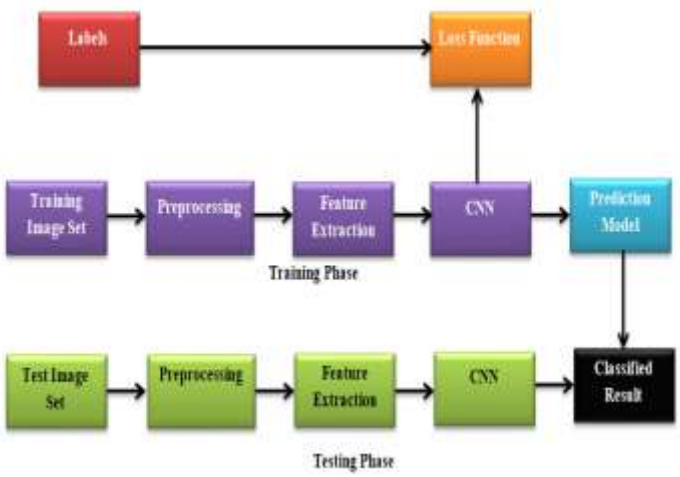

Fig: Block Diagram of brain Tumor Detection using Machine Learning

Result:

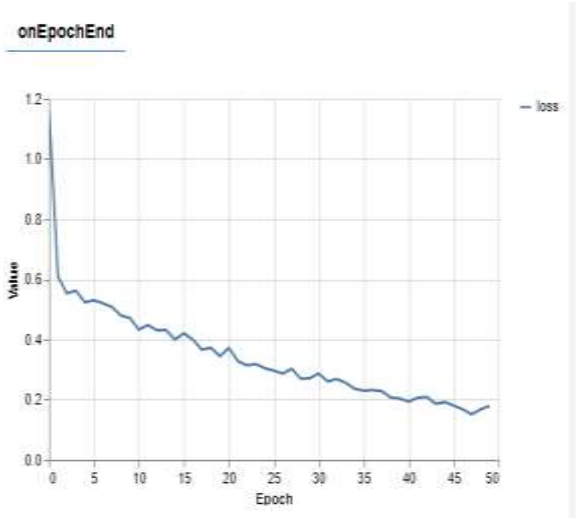

Fig: CNN Layer 1 Graph for loss.

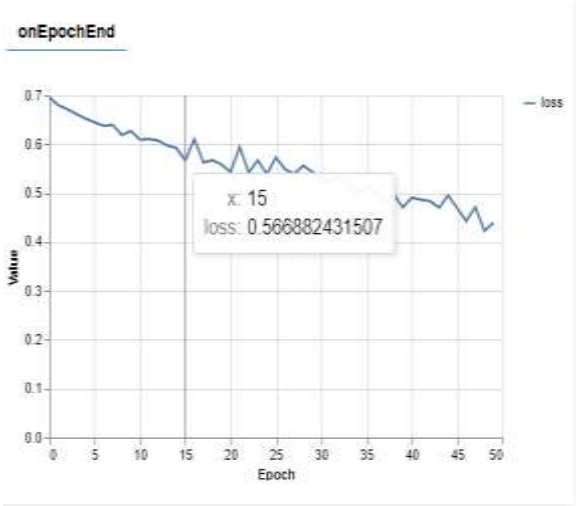

Fig: CNN Layer 2 Graph for loss.

Fig: CNN Layer 3 Graph for loss

Table 1: CNN Layers

CNN Layers	CNN Layer 1	CNN Layer 2	CNN Layer 3
Activation Function	Softmax	Softmax	Softmax
No of Epoch	50	50	50
Project Accuracy	82.5	72.5	67.5
Precision	0.8	0.65	0.4
Recall	0.84	0.76	0.88
F1 Score	0.82	0.70	0.82
Specificity	0.80	0.69	0.55

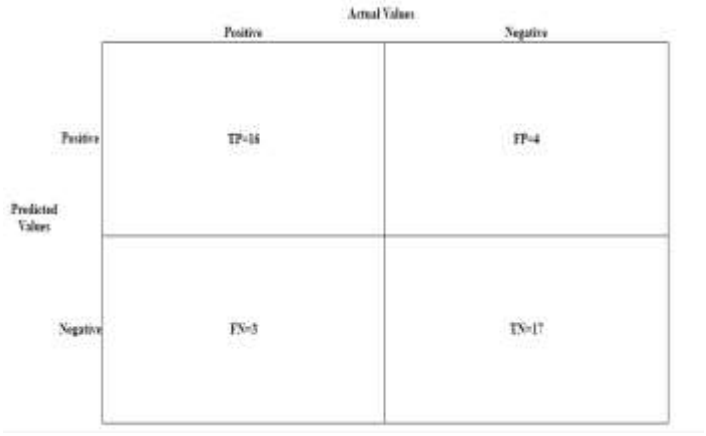

Fig: CNN Layer 1 Confusion Matrix

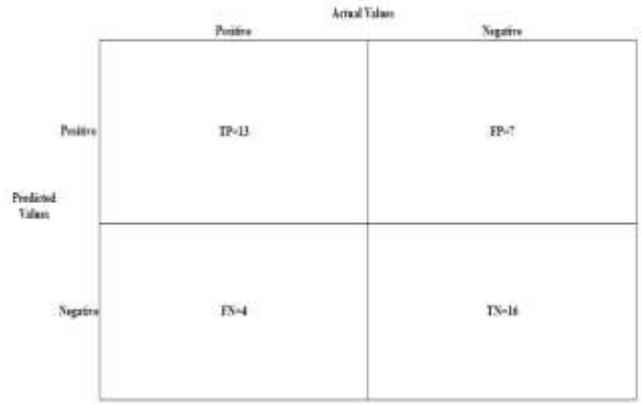

Fig: CNN Layer 2 Confusion Matrix

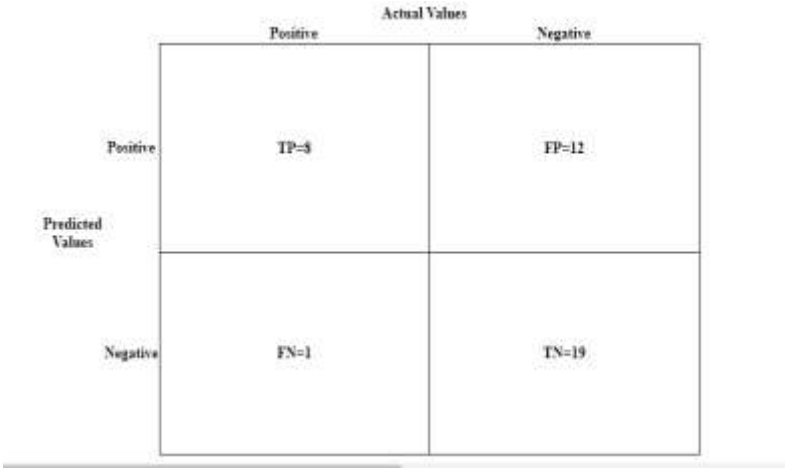

Fig: CNN Layer 3 Confusion Matrix

Conclusion:

This work shows that Deep learning techniques are often used towards problems in many areas, and that they can help extract large amounts of data out of huge amounts of knowledge Timely and prompt disease detection and treatment plan results in improved quality of life and increased anticipation within the patients. One of the foremost practical and important methods is to use Deep Neural Network (DNN).This is one use case where Deep learning is more than useful and can help experts like physicians and Neurologist Doctors in their work towards studying and analyzing medical life.

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