Brain Tumor Detection by MRI Image using CNN

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ABSTRACT—Now a day's tumor is second leading cause of cancer. Due to cancer large no of patients are in danger. The medical needs fast, automated, efficient and reliable technique to detect tumor like brain tumor. Detection place very important role in treatment. If proper detection of tumor is possible then doctors keep patient out of danger. Various images processing techniques are used in this application. Using this application doctors provide proper treatment save a number of tumor patient. A tumor is nothing but excess cell growing in an uncontrolled manner. Brain tumor cells grow in a way that they eventually take up all the nutrients meant for the healthy cell and tissue, which result in brain failure. Currently, doctors locate the position and the area of brain tumor by looking at the MR images of the brain of the patient manually. This result inaccurate detection of the tumor and is considered very time consuming. A tumor is amass of tissue grow out of control. The performance of the model is to predict the imagetumor present or not in image. If tumor is present, it returns yes otherwise no and along with that it also predict the type of tumor.

INDEX: Brain tumor,MRI,CNN,RESNET,GREY LEVEL CO-OCCURANCE MATRIX

INTRODUCTION

Brain tumor is one of the rigorous diseases and type of cancer in the medical science domain according to Global Cancer Statistics data collected [1]. Group of cells are abnormal and they are formed from uncontrolled division of cells, which is also called as tumor and these are formed and spread to spinal cord and different cells of brain. Main key concern of a radiologist is the effective and efficient analysis of premature phase of tumorgrowth[2]. The tumors are assorted into two, benign and cancerous. If tumor is not properly diagnosed and treated there is a chance of causing death and the effected personshould pay Rs 518,094 in 16.3 months [3]. The tumor is an unusual growth of tissues and uncontrolled cells and its rise. Using MRI, this research work obtains the brain images.MRI (Magnetic Resonance Imaging), it is an imaging technique and extensively used for diagnose the patient and treatment of tumorsin clinical practice. The image contains non-invasive soft tissue and this is used for diagnosis of tumors within the brain. It uses a magnetic field and radio waves to create detailed images of the organs and tissue inside your body.During a MRI scan it may last for 15-90 min as per the area being scanned.Image processingMRI image processing can also be performed with data mining techniques. These techniques consist of four phases, which are the pre-processing for the first step, image segmentation for separating objects, feature extraction for colour or shape or texture, and classification to identify the brain tumor. Segmentation is a computer vision technique that partitions a digital image into group of pixels.Feature extraction is the process of classifying the segmented images. When we classify the image based on the pixels it makes a clarity in the image processing.

CNN (Convolutional Neural Network)is a type of deep learning algorithm specifically designed for image processing and recognition task (deep learning is a method in artificial intelligence that teaches a computer to process data in a way that is inspired by human brain .CNN can take in an input image and analyses the pixels in that image and can differentiate one from other. This is possible because of enough training to the data set and the ability to learn the algorithms[4]. Res Net is the architecture used to train the CNN model.RESIDUAL NETWORK (Resnet)ResNet is an artificial neural network that introduced a so-called "identity shortcut connection," which allows the model to skip one or more layers. This approach makes it possible t o train the network on thousands of layers without affecting performance. It's become one of the most popular architectures for various computer vision tasks.

LITERATURE REVIEW

Uncontrolled and fast cell proliferation is the cause of brain tumors. Early cancer detection is vitally important to save many lives. Brain tumors can be divided into several categories depending on the kind, place of origin, pace of development, and stage of progression; as a result, tumor classification is crucial for targeted therapy.. A specialist with a thorough understanding of brain illnesses is needed to manually identify the proper type of brain tumor. Additionally, processing many images takes time and is tiresome. Tumors can be quickly and safely detected by brain scans using imaging modalities, including computed tomography (CT), magnetic resonance imaging (MRI), and others. Machine learning (ML) and artificial intelligence (AI) have shown promise in developing algorithms that aid in automatic classification utilizing various imaging modalities.As we stated in the introduction, brain tumors are a leading cause of death worldwide. Computer-aided detection and diagnosis refer to software that utilizes DL, ML, and computer vision for analysing images. This review explored different artificial intelligence approaches, including ML and DL, for automatically classifying tumors.Design and implementing Brain Tumor Using Machine Learning" by G. Hemanthest at (2019)[5] : This review paper provide a overview of deep learning method for brain tumor detection. As a large volume of medical MRI imaging data is gathered through image acquisition, the researchers are now proposing different machine learning methods to identify brain tumors. These methods are based on feature extraction, feature selection, dimensionality reduction. Most of those suggested machine learning models are focused on the binary identification of brain tumors."Brain Tumor Detection Using CNN Features " by P. Ameer est at (2019) [6] refers :The CNN model is used to train the machines. One of the three pathogenic kinds of brain tumors, BrainTumor Classification using CNN, has been established using an accurate and automated classification technique (glioma, pituitary tumor and meningioma). To extract features from brain MRI images, a deep transfer learning CNN model is used. Known classifiers are used to sort the extracted characteristics into different groups. Afterwards, the whole system is thoroughly inspected. The suggested technique had the greatest classification performance of all similar articles when evaluated on the publicly accessible dataset .In order to classify and the three distinct types of brain tumors, which are pituitary tumors, meningioma's, and gliomas, it was not necessary to perform any data pre-processing on the input images in order to delete vertebral or skull column components prior to analysing the MRI images. This was the case because it was not necessary to do any pre-processing on the input images.An MRI dataset from 1500 patients who have affected with tumor and 1500 images of people who haven't affected with tumorwas used to evaluate the method's performance against previously published traditional machine learning and deep learning technique

METHODOLOGY

As brain tumor is most dangerous tumor that causes death. The CNN network is used to detect whether the person has tumor or not. A MRI image is used to detect it and the image processing is input field.
The first stage in the classification procedure was to extract the picture components.And element extraction is done by GREY LEVEL CO-OCCURANCE MATRIX

GREY LEVEL CO-OCCURANCE MATRIX

To better understand brain tumors, a Grey Level Co-occurrence Matrix combined with a Convolutional Neural Network may be used. In this research, TI1 data from brain cancers such as glioma, meningioma, and pituitary tumor will be used to test the accuracy of a convolutional neural network. The information that is collected from the grey level co-occurrence matrix will be fed into the network. According to the practical application of this study, the results of a Convolutional Neural Network classification show that the contrasting characteristics of the Gray Level Co-occurrence matrix may improve the accuracy by up to 20% in comparison to the other features. By using this extraction characteristic, Convolutional Neural Networks (CNNs) may accelerate the classification process. In order to get statistical data on the texture of an image, GLCM functions, which determine how often specific pairs of pixels in an image have the same value and are in a predetermined spatial relationship, may be utilized. easy-to-understand depiction of direction and distance. Second-order statistical texture characteristics may be extracted using the Level Co-occurrence Matrix (GLCM) technique. For example, third- and higher-order textures look at the interactions between three or more pixels in a scene. As a result, it's common to use fewer shades of grey. Three-dimensional GLCM plots have been developed, compared, and discussed for a variety of acquired pictures. In addition, the GLCMs were used to compute and compare statistical metrics (such as the matrix's maximum occurrence, location, and standard deviation) with the arithmetic average roughness. There's also a brand-new parameter for measuring surface roughness, termed the maximum width of the matrix.

Residual Neural Network (resnet)

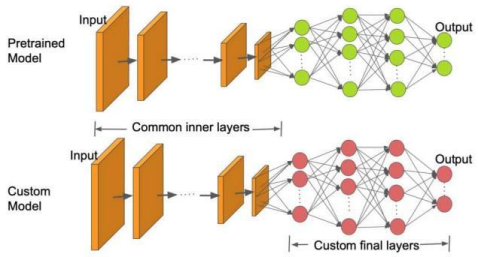
Residual Network (Resnet) is a deep learning model used for computer vision applications. It is a Convolutional Neural Network (CNN) architecture designed to support hundreds or thousands of convolutional layers. Previous CNN architectures were not able to scale to a large number of layers, which resulted in limited performance. However, when adding more layers, researchers faced the "vanishing gradient" problem.

Neural networks are trained through a backpropagation process that relies on gradient descent, shifting down the loss function and finding the weights that minimize it. If there are too many layers, repeated multiplications will eventually reduce the gradient until it "disappears", and performance saturates or deteriorates with each layer added.

ResNet provides an innovative solution to the vanishing gradient problem, known as "skip connections". ResNet stacks multiple identity mappings (convolutional layers that do nothing at first), skips those layers, and reuses the activations of the previous layer. Skipping speeds up initial training by compressing the network into fewer layers.

Then, when the network is retrained, all layers are expanded and the remaining parts of the network—known as the residual parts—are allowed to explore more of the feature space of the input image.

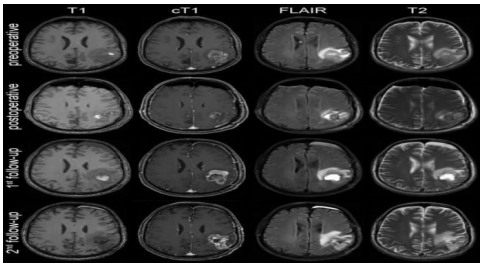
Most ResNet models skip two or three layers at a time with nonlinearity and batch normalization in between. More advanced ResNet architectures, known as HighwayNets, can learn "skip weights", which dynamically determine the number of layers to skip.



DATASET DESCRIPTION

In this paper we use Brain _ tumor _ detection _ MRI dataset to detect the tumor. This dataset includes 1500 images with tumor and 1500 images without tumor. The dataset is publically available in IEEE dataport. The CNN model is trained according to this images.

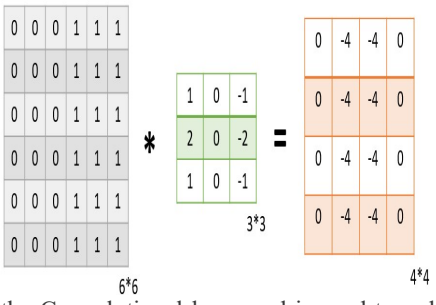
The architecture used here is Resnet. In order to solve the problem of the vanishing gradient, this architecture introduced the concept called residual blocks. In this network we use a technique called skip connections. The skip connection concept activation of a layer to further layers in between. This forms a residual block.



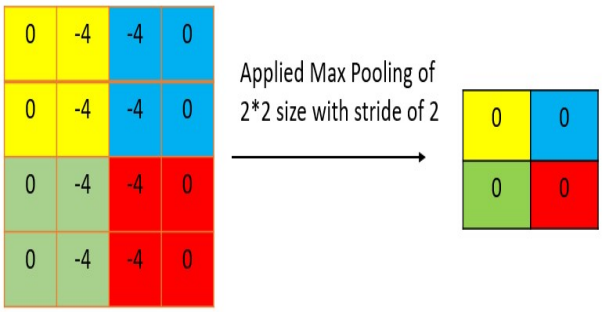
SYSTEM IMPLEMENTATION

Convolutional Neural Networks (CNNs) are built in such a way that they can account for the input's spatial structure. They were originally developed to work with images and were inspired by the visual system of the mouse. CNNs feature fewer parameters than ordinary neural networks, allowing for the efficient training of very deep designs (usually more than 5 layers which is almost impossible for fullyconnected network. An input layer, an output layer, and several hidden layers make up a convolutional neural network. Convolutional, RELU (activation function), pooling, fully connected, and normalization layers are often seen in a CNN'shidden layers.

In this approach the brain tumor is first transformed to grey scale .Next the model extract various features of the data and with applied filter and training makes prediction.
The convolution layer is the layer where the filter is applied to our input image to extract or detect its features. A filter is applied to the image multiple times and creates a feature map which helps in classifying the input image.



The pooling layer is applied after the Convolutional layer and is used to reduce the dimensions of the feature map which helps in preserving the important information or features of the input image and reduces the computation time.



As the process is detection of brain tumor using CNN model some software requirements which contain collection of programs, libraries and utilities.
So in the development of this system there are some environment used are

PYTHON
Python has earned its place as one of the most popular programming languages among ML professionals its easy-to-read syntax, extensive libraries, and cross-platform compatibility. As a high-level, open-source programming language, Python has become the go-to choice for a wide range of machine learning tasks, from data analysis to deep learning.
Easy-to-read syntax
Python's syntax is designed to be intuitive and straightforward, making it a popular programming language that is easy to read. Object-oriented programming provides developers with a logical method to organize, process and plan code accordingly. This facilitates the development of clean and succinct code for projects of any complexity. As a result, Python has become a popular introductory language for aspiring developers and a go-to choice for experienced programmers alike.
Extensive libraries
The key factors that sets Python apart from other programming languages is its comprehensive library ecosystem. Python offers a wide range of libraries and frameworks specifically designed for machine learning, making it easier for developers to implement ML algorithms.
NumPy: NumPy is a fundamental Python library for efficient numerical computations and array operations.
Pandas: Pandas is a powerful library for data analysis and manipulation, providing intuitive data structures like Data Frames and Series.
Matplotlib: is a plotting library for creating static, animated and interactive visualization on python. Matpltlib can be used in python scripts, the python and IPython shell, web application servers and various graphical user interface toolkits like Tkinter.
Pyplot:Pyplot is a collection style functions that make matplotlib work like MATLAB.

Resnet:Residual Network: In order to solve the problem of the vanishing/exploding gradient, this architecture introduced the concept called Residual Blocks. In this network, we use a technique called skip connections. The

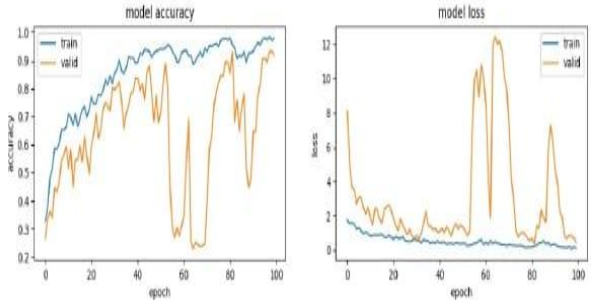
skip connection connects activations of a layer to further layers by skipping some layers in between. This forms a residual block.

Resnets are made by stacking these residual blocks together.The advantage of adding this type of skip connection is that if any layer hurt the performance of architecture then it will be skipped by regularization.Using the Tensorflow and Keras API, we can design ResNet architecture (including Residual Blocks) from scratch. And import the necessary libraries.

RESULT

The brain tumor detection using deep learning is designed to predict brain tumor using CNN. In order to implement this system, a neural is used. In this approach, the brain image is first transformed to grayscale and remove noise.Next the model extract various features of the data and with applied filters and training makes prediction.

The maximum accuracy obtained when the model applied to training dataset which has almost 200 epochs is 95.00. This following figure 1.1 shows the ratio of the training accuracy against the validation accuracy and training loss against validation loss respectively.



(Fig1.1)

EXISTING AND PROPOSED

Existing

Existing work has limitations and challenges for identifying substructures of tumor region and classification of healthy and unhealthy images. Brain tumors are graded as slow-growing or aggressive A benign tumor does not invade the neighboring tissues in contrast, a malignant tumor propagates itself from an initial site to a secondary site. This survey covers all important aspects and latest work done so far with their limitations and challenges. It will be helpful for the researchers to develop an understanding of doing new research in a short time and correct direction

Proposed

In this project CNN is used in the classification of normal tumor detection .The detection of brain tumor is done by applying Machine Learning and Deep learning algorithms. When these algorithms are applied on the MRI image the prediction of brain tumor is done very fast and higher accuracy helps in providing the treatment to the patients. These prediction also helps the radiologist in making quick decisions, In the proposed work, a self defined Convolution Neural Network is applied in detecting the presence of the brain tumor and their performance is analyzed annual segmentation of brain tumors from MR images An automated brain tumor classification from MRI scan is non-invasive so that it avoids biopsy and make a diagnosis process safer The purpose of this project is to provide a comprehensive survey of three , recently proposed , major brain classification.

CONCLUSION

MRI is most vastly used for tumour segmentation and classification. Although, convolutional neural networks (CNN) have the advantage of automatically learning representative complex features for both healthy brain tissues and tumour tissues directly from the multi-modal MRI images.When used in conjunction with an MRI image, the brain tumour ensemble effectively detects brain tumours from normal brain tissue with high accuracy, exceeding predictions from a broad variety of other sophisticated algorithms. We aggregate the model's outputs in order to produce the best potential outcomes.

The aim of this project is to determine the accurate prediction of brain tumour andalso to classify the tumour as positive or negative and type of tumour which a personsuffer with it. As the existing braintumour has dangerous implications since it has the tendency to migrate to other position of the brain.

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