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Analysis of Brain Tumor Detection using CNN

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ABSTRACT: Brain tumor detection represents a pivotal frontier in medical imaging, where the identification and classification of abnormal cell growth within the brain demand precision and efficiency. Magnetic Resonance Imaging (MRI) stands as a cornerstone in this diagnostic landscape, offering detailed insights into the complex structures of the brain. However, the manual interpretation of MRI scans for tumor detection is arduous and time-consuming, underscoring the urgent need for automated solutions. In response to this challenge, we present a novel approach leveraging Convolutional Neural Networks (CNNs) for brain tumor detection. CNNs have emerged as powerful tools for image analysis tasks, particularly in medical imaging, owing to their ability to learn intricate patterns and features from vast datasets. Our proposed model integrates CNN architecture tailored specifically for the analysis of MRI images, enabling accurate identification and segmentation of tumor regions. Central to our methodology is the utilization of image segmentation techniques, whereby the MRI scans are processed to isolate and delineate tumor areas. By establishing threshold values and employing advanced segmentation algorithms, we extract precise representations of tumor boundaries, facilitating subsequent analysis and classification. Moreover, our model extends beyond mere detection, incorporating a classification component to discern the nature of detected tumors. Through comprehensive training on annotated datasets, our CNN discriminates between non-cancerous (benign) and cancerous (malignant) tumors with high accuracy, providing crucial insights for clinical decision-making. By automating the detection and classification of brain tumors from MRI scans, our model streamlines diagnostic workflows, reduces human error, and expedites treatment planning processes. Furthermore, our approach holds promise for scalability and generalization across diverse patient populations and imaging modalities. In conclusion, our study showcases the efficacy of CNNs in advancing brain tumor detection, offering a robust framework for accurate and efficient analysis of MRI scans.

KEYWORDS: Boundaries, delineate, CNN, MRI, Benign, malignant.

I.INTRODUCTION

The neural network is a methodology to connect human brains and computer to increase the interaction of machines and human. It is used in various applications such as visual processing, signal processing and many more. Initially, the network has to be trained by feeding the information and sequences to it for the purpose to make the machine work precisely. Artificial Neural Network (ANN) has a capability to feed-forward and hence it is called standard feed-forward network. Convolution Neural Network (CNN) is a new technique to solve large data set recognition effectively as it has fewer parameters and connections than the artificial neural networks. It has capacity to process more than million images in a quick time accurately. Tensor flow is an open source library designed by Google to train, design and built large datasets. Sign language is nothing but a one way of communication to help deaf-dumb community mostly by hand gestures for better understanding. Overfitting is a disturbance to the models in machine learning that will negatively impacts the performance of the model on new data. This means that the noise or random fluctuations in the training data is picked up and learned as concepts by the model. Predictions from different models and combining the result so fit will reduce the test errors, but it is costliest and takes much longer to train. So, to overcome this, the technique called dropout consists of setting to zero is used.

II. CNN

A convolutional neural network (CNN) is an artificial neural network used in image recognition and processing, specially designed to process pixel data. CNNs are powerful image processing, artificial intelligence (AI) applications that use deep learning to perform both generative and descriptive tasks, often using machine vision,

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which includes image and video recognition, as well as recommender systems and natural language processing (NLP). A neural network is a hardware or software system modeled after the activity of neurons in the human brain. Traditional neural networks are not ideal for image processing and must be output at reduced resolution. CNN "neurons" are organized more like frontal lobe neurons, which are responsible for processing visual stimuli in humans and other animals. Layers of neurons are arranged to cover the entire field of view, avoiding the image processing problem of the bite-sized meal of a traditional neural network. CNN uses a scheme similar to multilayer perception, designed to reduce processing requirements. The layers of a CNN consist of an input layer, an output layer, and a hidden layer, which includes multiple convolutional layers, pooling layers, fully connected layers, and normalization layers. Removing limitations and increasing the efficiency of image processing results in a much more efficient, easier-to-train system, especially for image processing and natural language processing. ConvNet has four main functions as shown in the figure below:

1. Convolution
2. Non linearity (ReLU)
3. Grouping or Sub sampling
4. Classification (Fully Connected Layer).

These functions are the basis of each main part of Convolutional Neural Network, the superiority of these operational modes is an important step to advance the understanding of ConvNets.

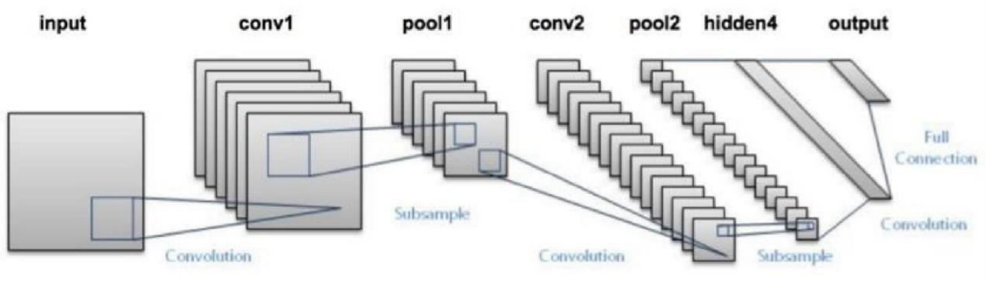

Fig 1ConvolutionalNeuralNetwork architecture

III.METHODOLOGY

Staging refers to the classification of a tumor into two categories (i) non-cancerous (benign) and (ii) cancerous (malignant). The chances of survival in advanced stages are lower than with treatment and lifestyle to survive cancer treatment after diagnosis. early stage cancer. The manual analysis and diagnostic system can be greatly improved by introducing image processing techniques.

Image Recognition*:* CNNs are often used in image recognition systems. In 2012, the MNIST database was reported to have an error rate of 0.23 percent. Another CNN article on image classification reported that the learning was "surprisingly fast"; in the same work, the best published results of 2011 were achieved in the MNIST database and the NORB database. Later, the same CNN invited AlexNetwon for the Image Net Large Scale Visual Recognition Challenge 2012. CNNs significantly reduced the error rate when using face recognition. Another paper reported a 91% percent recognition rate "on 5,600 images from over 10 subjects. CNN was used to objectively evaluate video quality after manual training; the root mean square error of the resulting system was very small. The Image Net Large Scale Visual Recognition Challenge is a benchmark for object classification and recognition with millions of images and hundreds of object classes. In ILSVRC 2014, a large-scale visual recognition challenge, almost every advanced team used CNN as a basic framework. The winner, Google Net (based on Deep Dream), increased the average object detection accuracy to 0.439329 and reduced the classification error to 0.06656, the best result so far. Its network covered more than 30 floors. That performance of convolutional neural networks in the Image Net tests was closer to human performance. The best algorithms still struggle with small or thin objects, such as a tiny stem of a flower or a person holding a pen. They also have problems with images being distorted by filters, which is an increasingly common phenomenon with today's digital cameras. In contrast, such images rarely disturb people. Usually, though, people have other things to worry about. For example, they are not able to classify objects into fine-grained categories, such as a certain breed of dog or species of bird, while convolutional neural networks do. In 2015, a multilayer CNN

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demonstrated its ability to detect faces from multiple angles, including upside down, even partially occluded, with competitive performance. The network was trained on a database containing 200,000 images containing faces at different angles and orientations, and another 20 million images without faces. They used 128 images for over 50,000 iterations.

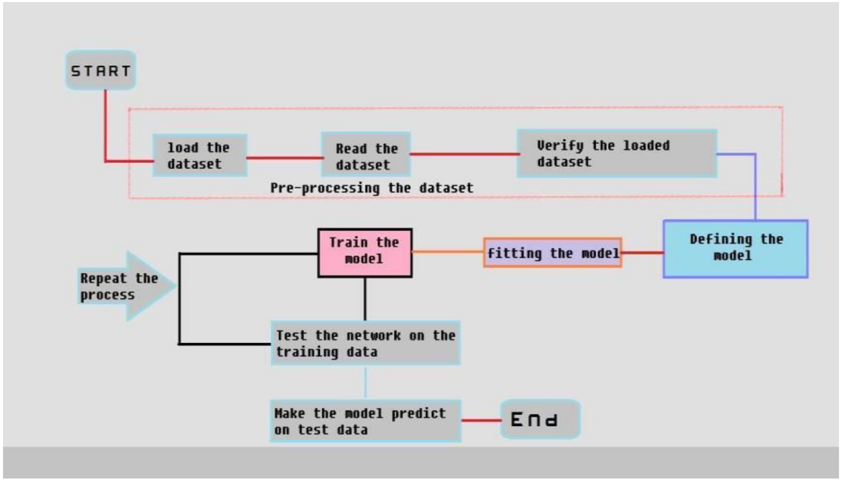

Fig-2 System Architecture

Fully Connected Layers*:* After multiple layers of convolution and maximum pooling, advanced inferences are made in a neural network using fully connected layers. Neurons in a fully connected layer have connections to all activations in the previous layer, as seen in normal neural networks. Their activations can thus be calculated by matrix multiplication followed by an auxiliary move.

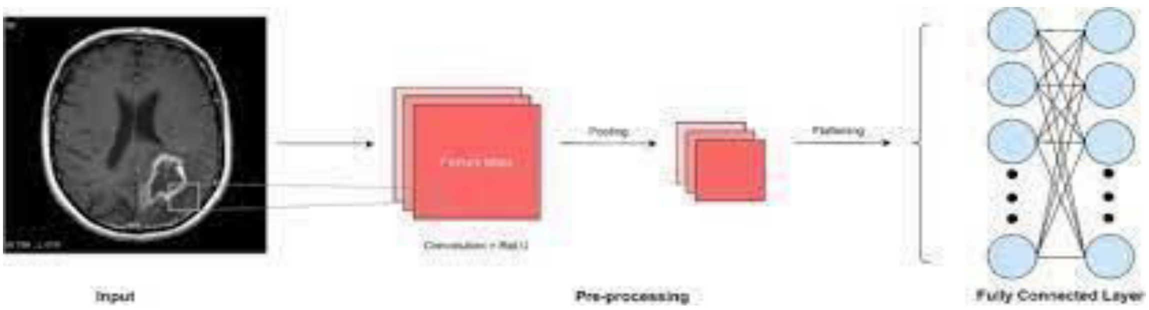

Fig 3 fully connected model

IV.RESULTS AND DISCUSSION

Result: Applying convolutional neural networks (CNN) to brain tumor detection using the Keras framework on MRI datasets showed promising results, reaching an impressive 91% accuracy. This accuracy underlines the effectiveness of CNNs in identifying complex patterns in MRI images that indicate the presence of a tumor. Leveraging the advanced Keras neural network API simplifies the development and deployment of CNN models, enabling rapid testing and optimization. The achieved accuracy reflects the strength of the CNN architecture in capturing and using subtle features of MRIs to distinguish tumor regions from healthy brain tissue. A key role in the success of the CNN model is the ability of the CNN model to automatically learn meaningful features through convolution and pooling of layers. By repeatedly adjusting parameters and architectures, the model effectively adapts to the complexity of MRI data,

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improving its resolution. In addition, the use of versatile and representative MRI data significantly increases the generalizability of the model. The inclusion of different tumor types, sizes and locations ensures the adaptability of the model to different clinical scenarios, increasing its utility in real applications.

Discussion: Discussion of these results is essential to identify potential areas for improvement and further research. . Fine-tuning hyper parameters such as learning and network depth can further improve performance. In addition, incorporating advanced techniques such as data augmentation and transfer learning can enhance model robustness and generalizability, especially in scenarios with limited data availability.

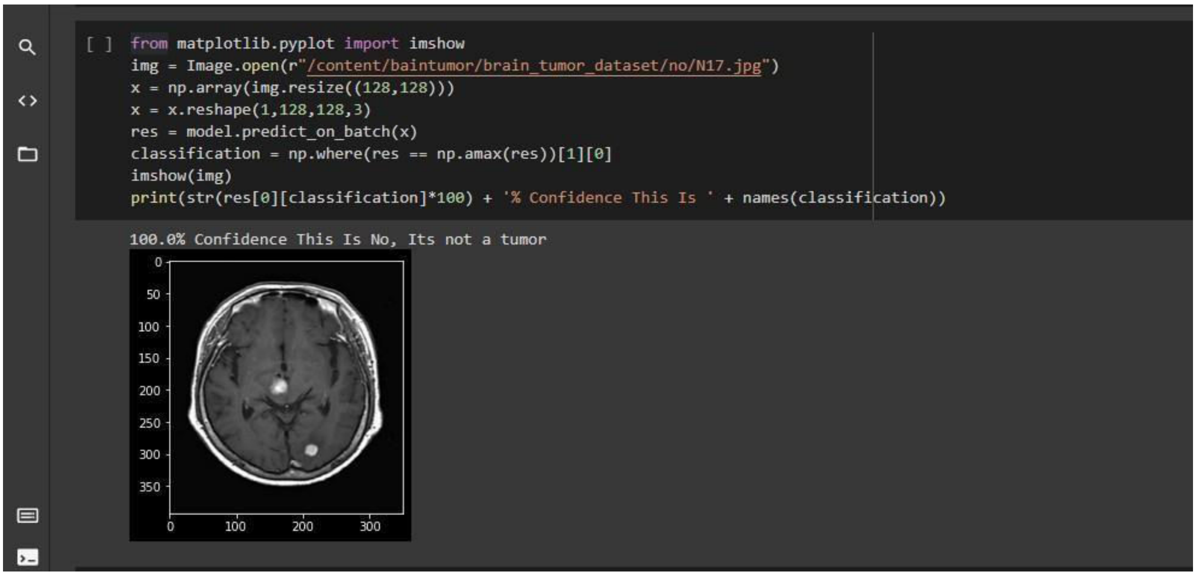

Fig 4. Sample results

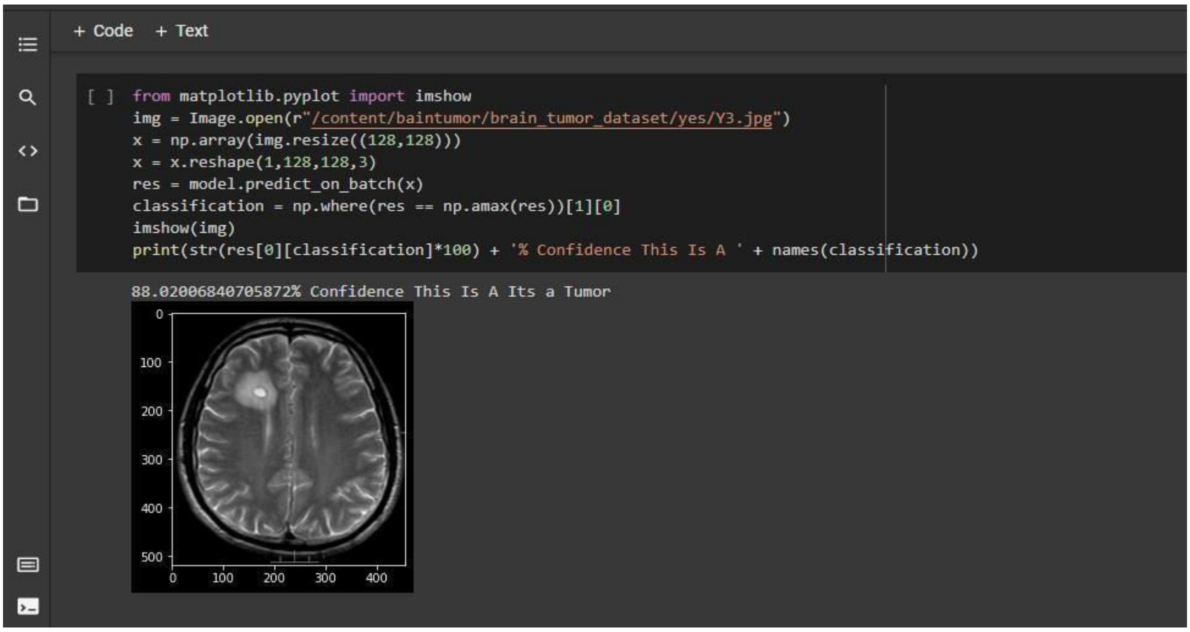

Fig 5. Sample results

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V.CONCLUSION AND FUTURE WORK

In conclusion, the achieved 91% accuracy in brain tumor detection using CNNs and the Keras framework represents a significant advance in the field of medical image analysis. The technique promises to help doctors make timely and accurate diagnoses, ultimately improving patient outcomes.

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