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Brain Tumor Detection Using Deep Learning

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ABSTRACT: A brain tumor is a growth of abnormal cells in the brain, some of which can lead to cancer. Magnetic resonance imaging (MRI) scan is the most common way to detect brain tumors. From MRI images Information about abnormal tissue growth in the brain is identified. In a Brain tumor detection is done by applying deep learning algorithms. when Algorithms are applied to MRI images make brain tumor detection is much faster and higher Accuracy helps in providing treatment to the patients. These detections also help radiologists in quick decision making. Various image processing techniques are used in the application. A tumor is nothing but excess cells growing in an uncontrolled manner. Brain tumor cells grow in a way that they eventually take up all the nutrients meant for the healthy cells and tissues, which results 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. The results in inaccurate detection of the tumor and is considered very time consuming. A tumor is a mass of tissue it grows out of control. It can use a Deep Learning architectures CNN (Convolution Neural Network) generally known as NN (Neural Network). Transfer learning for detect the brain tumor. The performance of model is detecting image tumor is present or not in image. If the tumor is present it return yes otherwise return no.

KEYWORDS : Magnetic Resonance Imaging, Deep learning, Convolution Neural Network, Detection

I. INTRODUCTION

The brain is the most important organ of the human body which controls the overall functionality of others. Helps with organs and decision making. The brain is the primary control centre of the central nervous system and is Responsible for performing daily voluntary and involuntary activities in the human body. A tumor is a fibrous web of unwanted tissue growth inside our brain that spreads uncontrollably. the year Around 3,540 children are diagnosed with brain tumors by age 15. The right way to understand brain tumor and their stages are an important task to complete the steps to prevent and cure the disease [1]. To do the, Magnetic Resonance Imaging (MRI) is the popularly used method by radiologists to analyze brain tumors. result of analysis explores whether the brain is normal or diseased by applying deep learning techniques.

Different types of brain tumors It might be benign or cancerous. While benign tumors typically grow slowly, malignant tumors can quickly enlarge and spread throughout the surrounding brain tissue. Benign tumours, however, can also be harmful because their growth may affect the surrounding brain tissues. 30% of tumours are malignant, and 70% are benign [2]. Meningioma, glioma and pituitary tumors, which are the most prevalent ones, are among the more than 120 different types of brain tumours that have so far been found and identified. Meningioma tumours are perhaps the most common primary brain tumours that affect the meninges and the brain and spinal cord among these three. In contrast, glioma tumours develop from glial cells known as astrocytes. The most noticeable glioma tumour is an astrocytoma, a low-risk tumour with slow growth. However, one of a the most dangerous brain tumours is high-risk glioma. Another type of a tumour is pituitary, which results from the overgrowth of a brain cells in the pituitary gland of the brain. As a result of a brain tumor's potentially fatal nature, early diagnosis is crucial. Brain and other Central Nervous System (CNS) tumors are among the most fatal cancers and account for substantial morbidity and mortality in the United States. In addition, important survival disparities by race/ethnicity remain for childhood tumors, with the largest Black-White disparities for diffuse astrocytoma and embryonal tumors. Increased resources for the collection and reporting of timely consistent data are critical for advancing research to elucidate the causes of sex, age, and racial/ethnic differences in brain tumor occurrence, especially for rarer subtypes and among understudied populations. Specifically, 5-year glioblastoma survival only increased from 4% to 7% during the same time period [3]. In addition, important survival disparities by race/ethnicity remain for childhood tumors, with the largest Black-White disparities for diffuse astrocytoma and embryonal tumors.

Malignant and non-malignant brain and other Central Nervous System (CNS) tumors comprise a diverse constellation of over 100 histologically distinct subtypes with varying descriptive epidemiology, clinical characteristics, treatments, and outcomes. Although primary malignant brain and other CNS tumors are rare in the United States, they account for a disproportionate burden of cancer mortality because of their high fatality rate; only one-third of individuals survive at least 5 years after diagnosis. The classification and reporting of these tumors have rapidly changed in recent years in parallel with expanding molecular understanding and advances in detection and diagnosis, although much of the etiology remains unknown [4]. That is provides an overview of primary malignant and non-malignant brain and other CNS tumor incidence, mortality, and survival rates and trends in the United States, as well as differences in occurrence by major histologic subtype, anatomic site, geography, race/ethnicity and sex.

II. REVIEW OF LITERATURE

Many approaches were applied to detect the brain tumor. In this research paper, the authors have proposed a new system based on CNN, which discriminates between the Brain MRI images to mark them as tumorous or not. The model achieved an accuracy of 96.08%, with an f-score of 97.3. The model is having CNN with 3 layers and requires very few steps of pre-processing to produce the results in 35 epochs [5]. The purpose of the research is to highlight the importance of diagnostic machine learning applications and predictive treatment.

Ming Li, et. al proposed a method with three-dimensional MRI brain tumor detection combining multimodal information fusion and CNN is proposed. Firstly, it is better to use the improved multimodal 3D-CNNs to obtain the three-dimensional features of brain tumor lesions under different modalities [6]. The experimental results show that the three evaluation indexes of dice, SN and SE are optimized respectively, and the two-dimensional brain tumor detection network and the original single-mode brain tumor detection method are compared.

Tonmoy Hossain, et. al studied The paper focuses on detecting brain tumors using machine learning. The authors of this paper had compared the SVM Classification Technique and CNN Classification Technique. So, as per the paper first model is segmented by Fuzzy C Means Algorithm (FCM) and then classified by a traditional machine learning algorithm. The second model focused on deep learning for tumor detection. FCM gives better results for noisy clustered data set [7]. SVM Classification Technique gives 92.42% of accuracy. And 5-layer CNN Classification Technique gives 97.87% of accuracy.

Milica M, et. al studied The paper discusses the detection of brain tumors for three types- meningioma, glioma, pituitary tumor. So, they had taken images from three different planes- sagittal plane, axial plane, coronal plane. Then, with all the images Data Augmentation process is performed [8]. Then it goes through a 5-layer CNN classification of the technique. Further, the output came from the CNN process is been trained by use of Confusion Matrices Algorithm. P. Muthu Krishnammal, et. al applied a convolutional neural network (CNN) is designed for classifying the tumor. For extracting quantitative information from an image discrete wavelet transform was used for extracting wavelet coefficients and gray-level co-occurrence matrix (GCLM) for statistical feature extraction [9]. Uses a K -means segmentation algorithm for localizing and segmentation of tumor part once the classification of tumor image was done This study used a dataset of 100 images for training the model and 40 epochs.

Masoumeh Siar, et. al proposed a new system which is a combination of clustering algorithm for feature extraction and CNN was proposed [10]. For evaluation purpose, different classifiers such as Soft Max Fully Connected layer classifier, RBF classifier and the DT classifier in the CNN architecture was used. This paper uses a dataset that was collected from the imaging center.

III. PROPOSED SYSTEM

This consists of various modules of the proposed model. It consists of five modules, namely, **Module 1:** Data collection, **Module 2:** Preprocessing, **Module 3:** Data Modelling, **Module 4:** Methodology, **Module 5:** Tumor Detection.

Module 1: Data collection: Ahmed Hamada published the dataset, which was previously used by numerous researchers in their project, on the Kaggle website. There are 3116 MRI pictures in total in this dataset. Data collection methods are techniques and procedures used to gather information for research purposes [11]. These methods can range from simple self-reported surveys to more complex experiments and can involve either quantitative or qualitative approaches to data gathering.

Module 2: Preprocessing: A preprocessing step is done on the MRI images before feeding them to the proposed structure. In the picture preprocessing section, the keras library's Image Data Generator method is used to generate batches of tensor image data with real-time data augmentation so that our model receives a variety of images [12]. The preprocessed input argument of the Image Data Generator method of the keras library is also set to an appropriate MRI picture in the format required by the model. This Image Data Generator method of the keras library does all essential preprocessing tasks such as cropping, rotation, determining brightness range, flipping the picture, and obtaining the 4 rectangle boundary coordinates of the cropped image.

Module 3: Data Modelling: After standardizing our complete dataset, divided it into two sets: a training set and a test set. Data is used for training in 80% of cases and testing in 20% of cases. The photos are then divided into test and training sets using Image Data Generator [13]. Data modelling is the process of creating a visual representation of either a whole information system or parts of it to communicate connections between data points and structures.

Module 4: Methodology: When developing deep learning models, transfer learning is a knowledge-sharing strategy that decreases the bulk of the training data, the time, and the computational expenses. Transfer learning allows a pre-trained model's learning to be transferred to a new model. Tumor classification, software defect prediction, activity recognition, and sentiment classification are just a few of the fields where transfer learning has been employed. The suggested Deep CNN model was compared to the popular transfer learning approach Alex net in this study. A convolutional neural network is Alex net [14]. The input to the first convolution layer is a 224 by 224 RGB image with a fixed size. The image is processed through a series of convolutional layers, each having a receptive field of 33 (the smallest size that can capture the concepts of left/right, up/down, and centre). It also uses 11 convolution filters in the configurations, which can be viewed as a linear change of the input channels. The convolution stride is set to 1 pixel, as is the convolution spatial padding.

Module 5: Tumor Detection: Finally analyze the image using filters and Convolutional neural networks algorithm to detect the tumor or Non-tumor.

IV. METHODOLOGY

Deep learning (DL) is a subfield of machine learning based on learning multiple levels of representations by making a hierarchy of features where the higher levels are defined from the lower levels and the same lower level features can help in defining many higher level features. DL structure extends the traditional neural networks (NN) by adding more hidden layers to the network architecture between the input and output layers to model more complex and nonlinear relationships.

A **Convolutional Neural Network (CNN)** is a type of Deep Learning neural network architecture commonly used in Computer Vision. Computer vision is a field of Artificial Intelligence that enables a computer to understand and interpret the image or visual data. The network used primarily for image recognition and processing, due to its ability to recognize patterns in images [15]. A CNN is a powerful tool but requires millions of labelled data points for training. In a regular Neural Network there are three types of layers: Input Layers: It's the layer in which we give input to our model.

The number of neurons in this layer is equal to the total number of features in our data (number of pixels in the case of an image). Hidden Layer: The input from the Input layer is then fed into the hidden layer. There can be many hidden layers depending on our model and data size. Each hidden layer can have different numbers of neurons which are generally greater than the number of features.

The output from each layer is computed by matrix multiplication of the output of the previous layer with learnable weights of that layer and then by the addition of learnable biases followed by activation function which makes the network nonlinear Output Layer: The output from the hidden layer is then fed into a logistic function like sigmoid or soft max which converts the output of each class into the probability score of each class. A typical convolutional neural network architecture generally has several components:

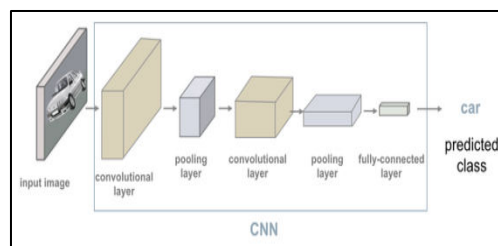


Fig 4.1 Basic CNN Architecture

AlexNet is a convolutional neural network that is 8 layers deep. You can load a pretrained version of the network trained on more than a million images from the ImageNet database [16]. The pretrained network can classify images into 1000 object categories, such as keyboard, mouse, pencil, and many animals. AlexNet was the first model to score a sub-25% error rate. The nearest competitor scored 9.8 percentage points behind. AlexNet dominated the competition, and they did it with a deep-layered Convolutional Neural Network (CNN), an architecture dismissed by most as impractical. The performed feature extraction consists of three basic operations:

- 1 Filter an image for a particular feature (convolution)
- 2 Detect that feature within the filtered image (ReLU)
- 3 Condense the image to enhance the features (maximum pooling)

Convolution The convolutional layer performs the filtering step. The weights that ConvNet learns during training are primarily contained in its convolutional layers. These scales are called cores. The core works by scanning the image and producing a weighted pixel sum.

ReLU (Rectified Linear Unit): This is the most commonly used activation function in CNNs. It returns 0 if it receives any negative input, but for any positive value x , it returns that value back. Hence, it can be written as $f(x) = \max(0, x)$. The model trained with ReLU converged quickly and thus takes much less time when compared to models trained on the Sigmoid function

Max pooling is a down sampling technique commonly used in convolutional neural networks (CNNs) to reduce the spatial dimensions of an input volume. Max pooling is a pooling operation that selects the maximum element from the region of the feature map covered by the filter. Thus, the output after max-pooling layer would be a feature map containing the most prominent features of the previous feature map.

Deep learning (also known as deep structured learning) is part of a broader family of machine learning methods based on artificial neural networks with representation learning. Learning can be supervised, semi-supervised or unsupervised.

Deep-learning architectures such as deep neural networks, deep belief networks, deep reinforcement learning, recurrent neural networks and convolutional neural networks have been applied to fields including computer vision, speech recognition, natural language processing, machine translation, bioinformatics, drug design, medical image analysis, material inspection and board game programs, where they have produced results comparable to and in some cases surpassing human expert performance.

Deep-learning is the subset of machine learning methods based on artificial neural networks (ANNs) with representation learning. The adjective “deep” refers to the use of multiple layers in the network. Methods used can be either supervised, semi-supervised. Deep learning is a subfield of machine learning that involves the use of neural networks to model and solve complex problems.

The key characteristic of Deep learning is the use of deep neural networks, which have multiple layers of interconnected nodes. These networks can learn complex representations of data by discovering hierarchical patterns and features in the data [17]. Deep learning algorithms can automatically learn and improve from data without the need for manual feature engineering. Training deep neural networks typically requires a large amount of data and computational resources. However, the availability of cloud computing and the development of specialized hardware, such as graphics processing units, has made it easier to train deep neural networks

V. RESULT AND DISCUSSION

This is the home page of my project Brain tumor detection. Here we have given the information like Choose File, Upload File and Click here to run the file.

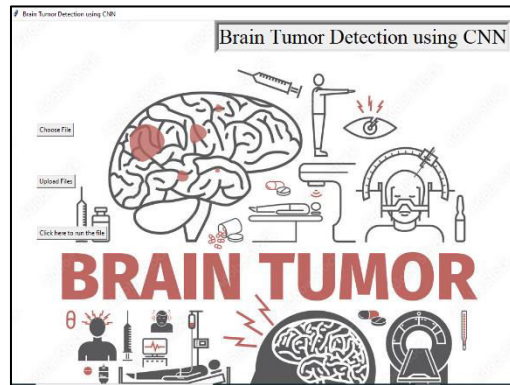


Fig 5.1 Home page

First we have click the choose file to select the MRI images and click to upload file. Then the file was successfully uploaded.

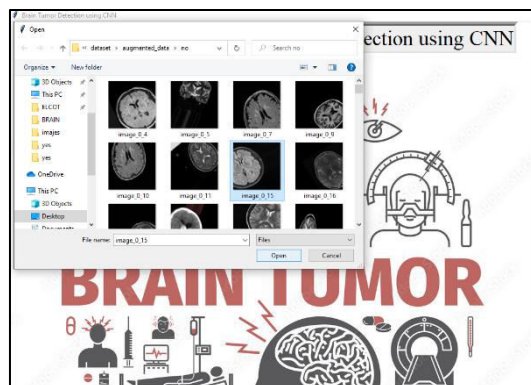


Fig 5.2 Insert the input images

Brain tumor detection using convolutional neural network algorithm to detect the person is not having brain tumor.

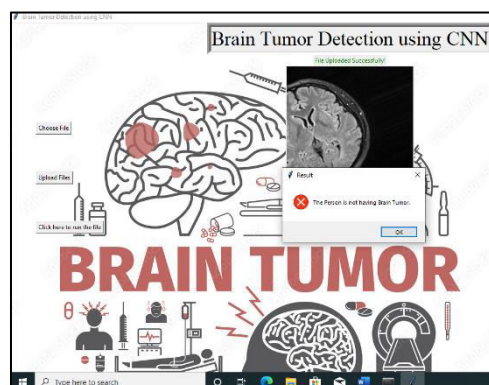


Fig 5.3 Detection of No Brain Tumor

Brain tumor detection using convolutional neural network algorithm to detect the person is having brain tumor.

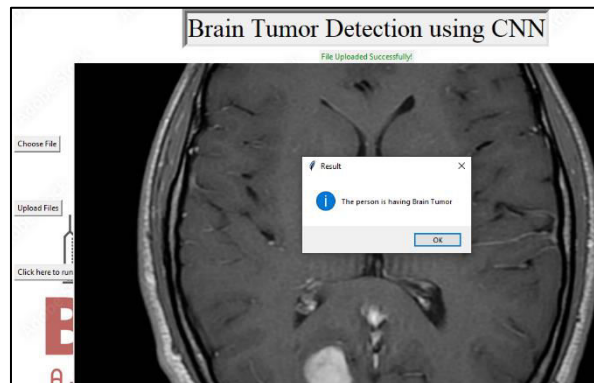


Fig 5.4 Detection of Brain Tumor

VI. CONCLUSION AND FUTURE ENHANCEMENT

Tumor identification is difficult, and the results may differ from the physicians. Doctors may also take the risk of identifying the tumor. The problems are solved by using Deep Learning Techniques like CNN. Early detection of tumors helps to increase the patient's lifetime, and if it is detected very early stage, it can be cured as well. Our model can detect the tumor as well as classify it. So, the time required for each process is considerably reduced. In the future, three aspects will be of the highest interest that needs improvement in future: Improvement of visualization and improvement of the data. One way that might improve CNN's performance would be depth. With more computer resources, a deeper network can be tested. Progress of CNN using deep learning find the accuracy of the brain tumor detection. A convolution network might perform better with a deeper network.

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