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Research on Detection of Brain Tumor using MRI Images in Machine Learning

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Abstract—Brain tumor is the growth of abnormal cells in the brain some of which may lead to cancer. The usual method to detect brain tumors is Magnetic Resonance Imaging(MRI) scans. From the MRI images information about the abnormal tissue growth in the brain is identified. In various research papers, the detection of brain tumors is done by applying Machine Learning and Deep Learning algorithms. When these algorithms are applied on the MRI images the prediction of brain tumor is done very fast and a higher accuracy helps in providing the treatment to the patients. These predictions also help the radiologist in making quick decisions.

Keywords- Brain Tumor, Machine learning, MRI Images

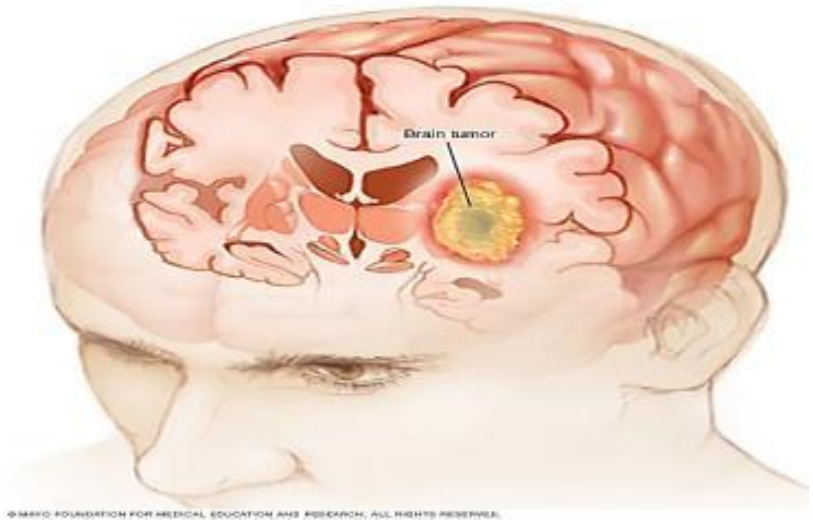
INTRODUCTION:

The brain is the most important organ in the human body which controls the entire functionality of other organs and helps in decision-making. It is primarily the control center of the central nervous system and is responsible for performing the daily voluntary and involuntary activities in the human body. The tumor is a fibrous mesh of unwanted tissue growth inside our brain that proliferates in an unconstrained way. This year at the age of 15 about 3,540 children were diagnosed with brain tumors. The right way of understanding brain tumors and their stages is an important task to prevent and carry out the steps in curing the illness. To do so, magnetic resonance imaging (MRI) is widely used by radiologists to analyze brain tumors. The result of the analysis carried out in this paper reveals whether the brain is normal or diseased by applying deep learning techniques. In this paper CNN is used in the classification of normal and tumor neurons. In CNN (convolutional neural network) convolutional is the name of a mathematical linear operation. The dimension of the image is reduced at each layer of CNN without the loss of information needed for training. Different processing techniques like convolve, max pooling, dropout, flattening, and dense are applied to create the model. This project focuses on creating a self-defined architecture of the CNN model and finally, the performance of CNN is applied to the brain tumor MRI dataset.

Brain Tumor:

A brain tumor is a collection, or mass, of abnormal cells in your brain. Your skull, which encloses your brain, is very rigid. Any growth inside such a restricted space can cause problems. Brain tumors can be cancerous (malignant) or noncancerous (benign). When benign or malignant tumors grow, they can cause the pressure inside your skull to increase. This can cause brain damage , and it can be life-threatening. Brain tumors are categorized as primary or secondary:

- A primary brain tumor originates in your brain. Many primary brain tumors are benign.
- A secondary brain tumor, also known as a metastatic brain tumor, occurs when cancer cells spread
- To your brain from another organ, such as your lung or breast



LITERATURE REVIEW:

Author: Nilesh Bhaskarrao Bahadure, Arun Kumar Ray, and Har Pal Thethi

In this paper using MR images of the brain, we segmented brain tissues into normal tissues such as white matter, gray matter, cerebrospinal fluid (background), and tumor-infected tissues. We used pre-processing to improve the signal-to-noise ratio and to eliminate the effect of unwanted noise. We can use the skull stripping algorithm based on the threshold technique to improve the skull stripping performance. the skull stripping algorithm based on the threshold technique to improve the skull stripping performance .

Author: Luxit Kapoor, Sanjeev Thakur

This paper surveys the various techniques that are part of Medical Image Processing and are prominently used in discovering brain tumors from MRI Images. Based on that research this Paper was written listing the various techniques in use. A brief description of each technique is also provided. Of All the various steps involved in the process of detecting Tumors, Segmentation is the most significant.

Author: Praveen Gamage

This paper survey of Identifying brain tumors through MRI images can be categorized into four different sections; pre-processing, image segmentation, Feature extraction and image classification

Author: Deepa, Akansha Singh

In this paper, some of the recent research work done on Brain tumor detection and segmentation is reviewed. Different Techniques used by various researchers to detect brain tumors from MRI images are described. By this review we found that automation of brain tumor detection and Segmentation from the MRI images is one of the most active Research areas.

Author: Devendra Somwanshi , Ashutosh Kumar, Pratima Sharma, Deepika Joshi

In this paper, we have investigated the different Entropy functions for tumor segmentation and its detection from various MRI images. The different threshold values are obtained depending on the particular definition of the entropy. The threshold values are dependent on the different entropy function which in turn affects the segmented results

Author :Sachdeva, Jainy, et al. &quot

While in this paper the author proposed a hybrid method in the combination of SVM with GA (genetic algorithm) to get higher accuracy. GA-SVM system is proposed for selection of features on the basis of texture and intensity, and multiclass classification. This system evaluated individual class accuracy and overall accuracy with the large dataset of 428 images (50% training dataset and 50% testing dataset). GA-SVM gave overall accuracy of 91%. According to the study, accurate results or performance of the system depends on the proper selection of features.

Author : Vandhana, S., et al.

In another study MR Images are segmented using the technique of thresholding segmentation. Before the segmentation process images are converted into gray scale images and then filter to remove the noise and brighter or sharper the images to get better output. SVM classification technique is used as a classifier which illustrate whether it is malignant, benign or normal

METHODOLOGY:

These projects implement CNN for detection of tumors. This study accepts input images and labeled yes or no from the raw dataset

Image Preprocessing

Image preprocessing is created to smooth training as their different variants, of intensity, contrast and size and images

The algorithm used - CNN Convolutional neural network

Block diagram

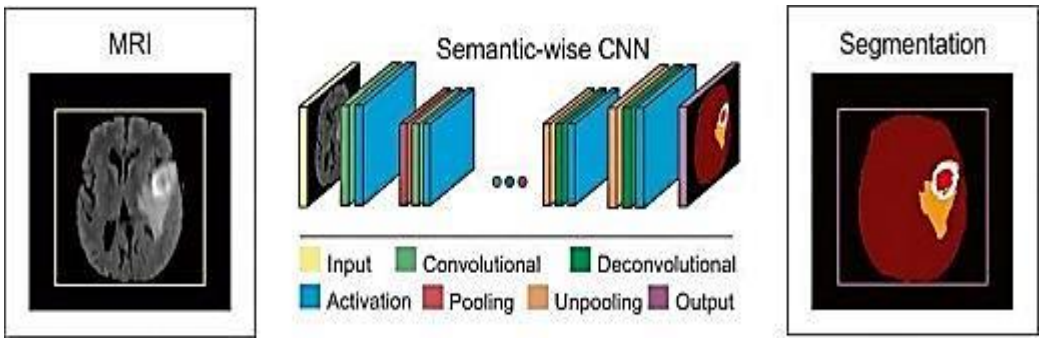
Convolution 2D: In the Convolution 2D extract the featured from input image. It given the output in matrix form.

➢ MAX Poolig2D: In the MAX polling 2D it takes the largest element from rectified feature map.

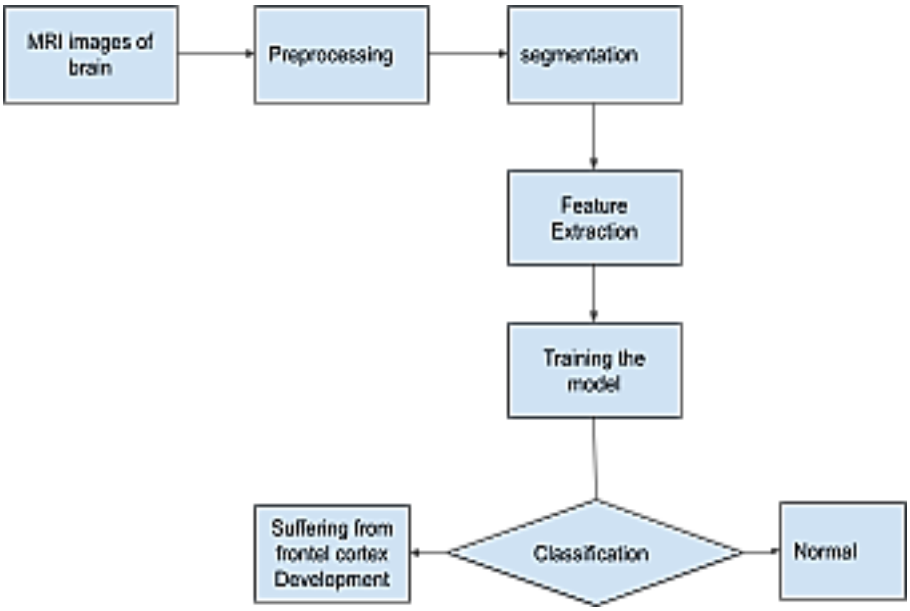
➢ Dropout: Dropout is randomly selected neurons are ignored during training.

➢ Flatten: Flatten feed output into fully connected layer. It gives data in list form.

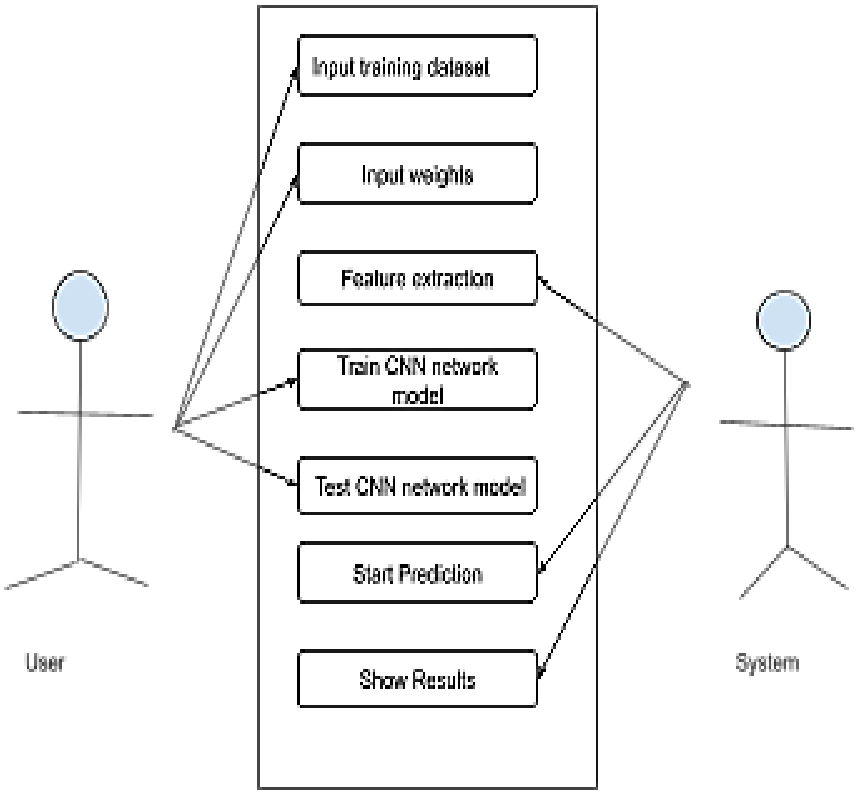
➢ Dense: A Linear operation in which every input is connected to every output by weight. It is followed by nonlinear activation function. Activation: It used Sigmoid function and predict the probability 0 and 1



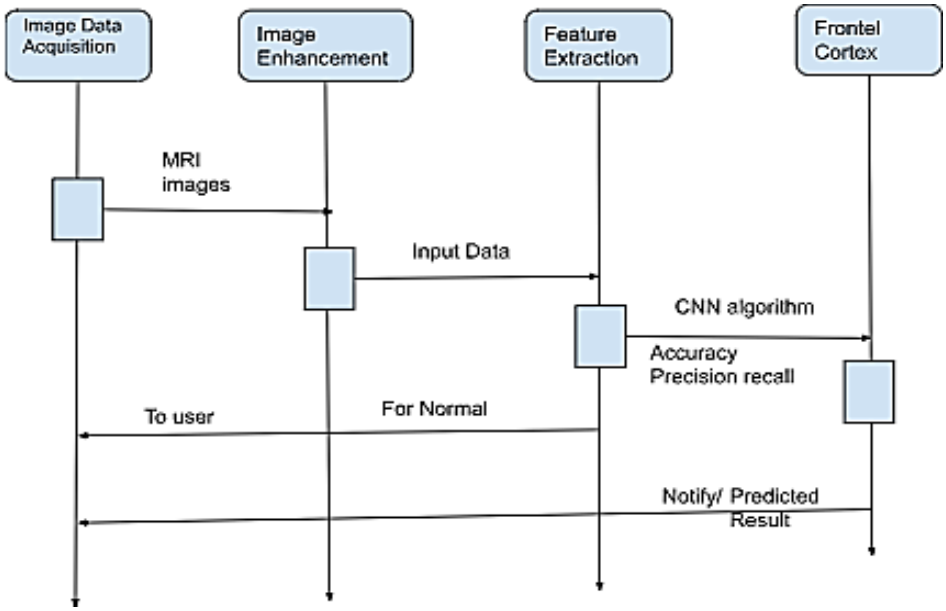
FLOW CHART:



UML Diagram



SEQUENCE DIAGRAM



SYSTEM REQUIREMENT:

Hardware Requirements:

Processor: Intel Core i7- 8 th Gen

Installed memory (RAM): 4.00GB

System Type: 64-bit Operating System

Software Requirements:

Python 3.8.4 Language

Anaconda IDE

Module

- Open cv - used for image vision
- Joblib - used for pipeline creation
- Skimage - used for image transformation
- Numpy - used for undefined array

APPLICATION:

1] Breast tumors:

A Camelyon grand challenge for automatic detection of metastatic breast cancer in digital whole slide images of sentinel lymph node biopsies is organised by the International Symposium of Biomedical Imaging

2] Lung diseases Interstitial:

Lung disease (ILD) is the disorder of lung parenchyma in which lung tissues get scarred leading to respiratory difficulty. High resolution computed tomography (HRCT) imaging is used to differentiate between different types of ILDs. HRCT images have a high visual variation between different classes and high visual similarity within the same class. Therefore, accurate classification is quite challenging.

3] Coronavirus disease 2019 (COVID-19)

COVID-19 is a global pandemic disease spreading rapidly around the world. Reverse Transcription Polymerase Chain Reaction (RT-PCR) is a commonly employed test for detection of COVID-19 infection. RT-PCR testing is the gold standard for COVID-19 testing, RT-PCR is very complicated, timeconsuming and labor-intensive process, sparse availability and not very accurate. Chest X-ray could be used for the initial screening of the COVID-19 in places having shortage of RTPCR kits and is more accurate at diagnosis. Many researchers have used deep learning to classify if the chest infection is due to COVID-19 or other ailments.

4] Immune response:

Abnormalities Autoimmune diseases result from an abnormal immune response to a normal body part. The immune system of the body attacks the healthy cells in such diseases. Indirect immunofluorescence (IIF) on human epithelial-2 (HEp-2) cells is used to diagnose an autoimmune disease. Manual identification of these patterns is a time-consuming process.

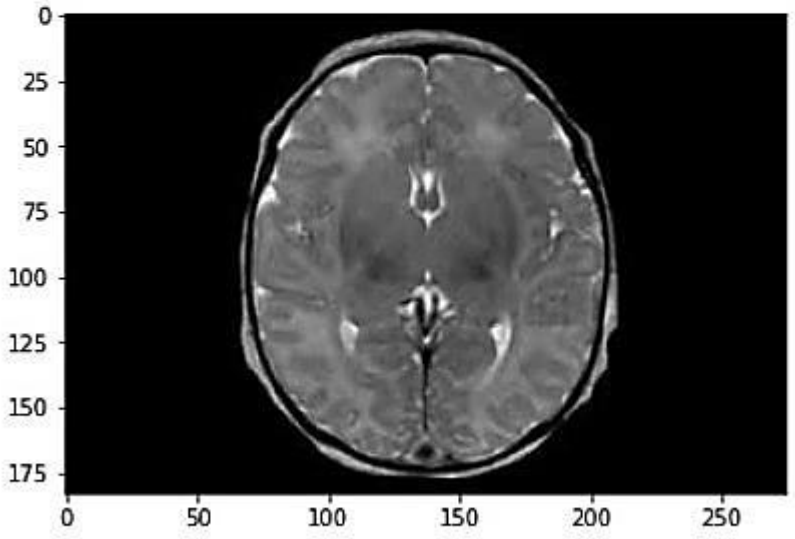
Disadvantages:

1. Worked only on 2D images.
2. We could have tried more traditional classifiers to increase the accuracy
3. Types of the tumor could not be classified

RESULT:

The Result of Proposed System gives 84 % Accuracy of given CNN model with F1 Score. the given 6.1 and 6.2 are the images showing the Brain without Tumor and Brain with Tumor. The CNN gives good Accuracy in the Result.

```
plt.imshow(img)
plt.show()
img = cv2.resize(img,(240,240))
img = np.reshape(img, (1, 240, 240, 3))
classes = (model.predict(img)).astype("int32")
if(classes>=0.5):
    print("Tumor")
else:
    print("Normal")
```




```
1/1 [==============================] - 0s 60ms/step
Normal
```

Fig 6.1 brain without tumor

```
In [346]: im = img[0]
          p = classes[0]
          plot_pred(im,p)
```

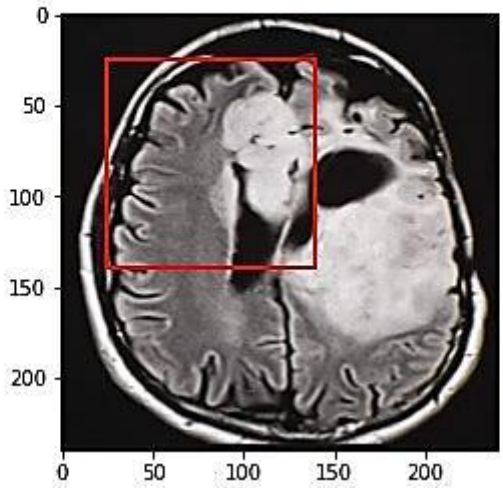


Fig 6.2 shows brain with Tumor

The accuracy of the CNN model on applying the testing data is 84%. Having the precision, recall and f1 score in the hand and CNN in detecting the presence of brain tumor, CNN proves to be the best supporting technique as it has the maximum precision value.

```
14/14 [==============================] - 11s 771ms/step - loss: 0.4447 - accuracy: 0.8417

In [80]: print (f"Test Loss = {loss}")
         print (f"Test Accuracy = {acc}")

         Test Loss = 0.4446648955345154
         Test Accuracy = 0.8417266011238098

In [81]: y_test_prob = model.predict(X_test)

         14/14 [==============================] - 12s 813ms/step

In [82]: f1score = compute_f1_score(y_test, y_test_prob)
         print(f"F1 score: {f1score}")

         F1 score: 0.888135593220339

In [83]: y_val_prob = model.predict(X_val)

         14/14 [==============================] - 12s 811ms/step

In [84]: f1score_val = compute_f1_score(y_val, y_val_prob)
         print(f"F1 score: {f1score_val}")

         F1 score: 0.8524590163934427
```

CONCLUSION:

CNN is considered as one of the best techniques in analyzing the image dataset. CNN makes the prediction by reducing the size of the image without losing the information needed for making predictions. The model developed here is generated based on the trial and error method. In future optimization techniques can be applied so as to decide the number of layers and filters that can be used in a model. As of now for the given dataset, the CNN proves to be the better technique in predicting the presence of brain tumor.

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