IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 11, Issue 4, April 2023

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.379

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 |

|| Volume 11, Issue 4, April 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1104132 |

An Effective Brain Tumor Detection System Using Deep Learning

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ABSTRACT - A brain tumor is an abnormal growth or mass of cells in the brain.Human brain is enclosed by a very rigid skull. Any development inside such a limited space can create some issues. This tends to compromise life and can harm the mind. However, you can receive neurological treatment as soon as possible if you are aware of the symptoms of a brain tumor. It's terrifying to think that you might have tumor in your brain, but early detection can help you survive and thrive. The brain tumor is diagnosed using a variety of algorithms, including SVM, VGG, K-means, and others. The CNN algorithm, which uses MRI images of brain tumor to determine whether a brain tumor is present or not in a human brain, is described in this paper. Image Pre-processing, normalization, feature extraction, Image analysis and image classification are all components of the algorithm. CNN algorithm contains various layers such as, Convolution layer, pooling layer, various hidden layers etc. In this we added one extra hidden layer to gain the better accuracy of model and detect brain tumor more accurately.

KEYWORDS - Brain Tumor,Deep Learning, Classification, Accuracy, MRI (Magnetic Resonance Imaging), CNN (Convolutional Neural Network).

I. INTRODUCTION

A brain tumor is an unnatural growth of cells in the brain. The symptoms of brain tumor can vary depending on its size, location and type. Cerebrum growths can be harmless (non-destructive) or threatening (malignant). Headaches, seizures, issues with vision or hearing, difficulty speaking, limb weakness or numbness, and shifts in mood or behavior are all possible signs.However, it is essential to keep in mind that a person with these symptoms does not necessarily have a braintumor, and that many of these symptoms can also be brought on by other conditions.A brain tumor diagnosis typically requires a biopsy, in which a small portion of the tumor is removed and examined under a microscope to determine whether it is cancerous. Brain tumor patients may benefit from earlier diagnosis and treatment.

Using medical imaging like MRI or CT scans, deep learning algorithms can aid in the process of finding and diagnosing brain tumors. Train a convolutional neural network (CNN) on a large dataset of brain images with and without tumors is one common strategy. The CNN figures out how to perceive examples and highlights that are related with the presence of a growth, and can then be utilized to characterize new pictures as one or the other positive or negative for a cancer. It is vital to note, in any case, that while profound learning can be a significant device in helping with cerebrum growth identification, it ought not be utilized as a trade for a prepared clinical expert. A trained medical professional should always be consulted before making any decisions regarding diagnosis or treatment.

A. Deep learning

A subfield of machine learning known as deep learning is entirely based on artificial neural networks. Since brain networks are intended to copy the human mind, deep learning is likewise a kind of mirroring the human cerebrum.

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Deep learning models can consequently gain highlights from the information, which makes them appropriate for errands like picture acknowledgment, discourse acknowledgment, and regular language handling.Feedforward neural networks, convolutional neural networks (CNNs), and recurrent neural networks (RNNs) are the architectures in deep learning that are utilized the most frequently. Deep learning achieves immense strength and adaptability by learning. A lot of named information and a lot of processing power are needed to create Deep Learning models. Deep learning has had the opportunity to advance in a wide range of applications due to the increasing accessibility of a lot of information and computational resources.

B. Supervised learning

In Supervised learningmachines are prepared utilizing great "marked" preparing information, and on premise of that information, machines anticipate the result. Some input data already carries the appropriate output tag, as indicated by the labelled data.In supervised learning, the machines preparation information go about as a manager to show them how to foresee the result accurately. Similar to how a student learns under a teacher's supervision, it applies.The process of providing the machine learning model with both accurate input data and output data is referred to as supervised learning. Finding a planning capability to coordinate the info variable (x) with the result variable (y) is the goal of a supervised learning calculation.

C. CNN

Deep learning architectures like the CNN (Convolutional Neural Network) are often used for tasks like image classification and recognition. Some of its many layers include pooling, fully connected, and convolutional ones. To remove highlights from the info picture, the Convolutional layer applies channels, the Pooling layer downsamples the picture to eliminate calculation, and the completely associated layer makes the last forecast. The network uses backpropagation and gradient descent to learn the best filters. Layers that make up a Convolutional Neural Network are a fully connected pooling layer and a convolutional layer. The following diagrams depict all layers.

Layer of Convolution: An activation map is created by scanning the images several pixels at a time with a filter in the convolution layer. The internal workings of the convolution layer are shown in the following figure.

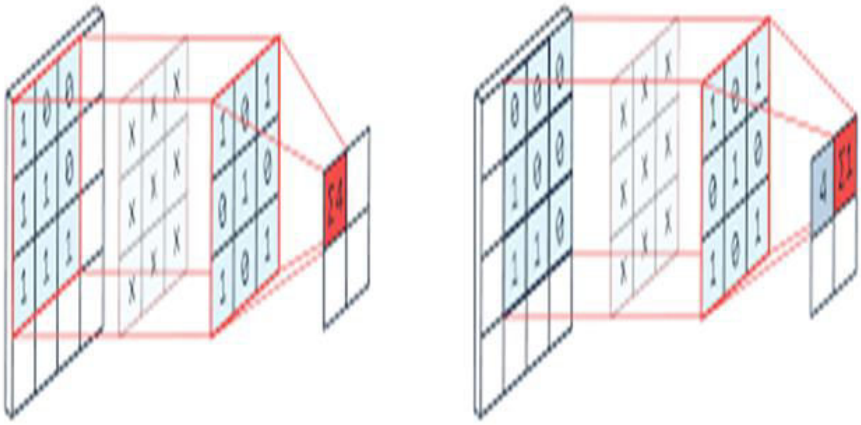

Figure 1: Layer of Convolution

Layer of Pooling: Layer of Pooling diminishes how much information made by the convolutional layer so it is put away more productively. The pooling layer's internal workings are depicted in the following Figure.

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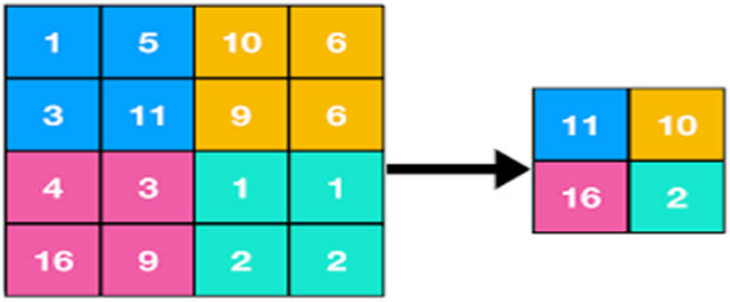

Figure 2: Layer of Pooling

Layer with Full Connectivity:A layer whose output is "flattened" into a single vector and used as an input for the subsequent stage is referred to as a layer with Full Connectivity. In order to anticipate the appropriate label, the first fully connected layer adds weights to the feature analysis inputs. The probability for each label is provided by the fully connected output layer at the end. The internal workings of a fully connected layer are depicted in the following figure.

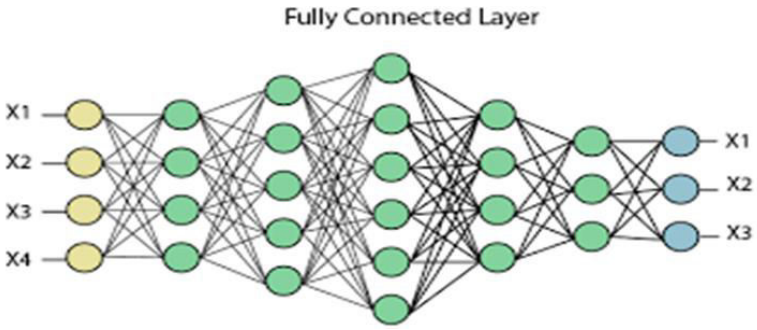

Figure 3: Layer with Full Connectivity

II. LITERATURE SURVEY

Li Qiang, Ayesha Younis,[1] and others proposed two deep learning techniques, CNN and VGG-16, were applied to MRI scans, with VGG-16 achieving better accuracy (98.5%) than CNN (96%) in accuracy.

ArkapravoChattopadhyayet al.,[2]put forward a CNN-based method for segmenting brain tumors from 2D MRI, next conventional classification and deep learning techniques.CNN outperformed other traditional classifiers in this study. In order to successfully train the model, they used a SVM classification and other activation algorithms to verify the model. Additionally, they took MRI images of a variety of tumor sizes, locations, shapes, and intensities.

Prof. Kavita Bathe and Others.[3] On the MRI dataset, two deep learning methods—CNN and Depth Wise CNN—were tested. The results showed that CNN had an accuracy of 95.7 percent, while Depth Wise CNN had an accuracy of 97%, which was higher than CNN.

Aryan Sagar, Methil, and Others.[4] In this paper, image preprocessing was the first step. The Convolutional Neural Network (CNN) is then used to classify images of tumors and non-tumors.On the training set, CNN had a recall of 98.55%, and on the validation set, it had a recall of 99.73%.

Ahmed Bakhtyar Mohammed et al.,[5] suggested processing 1258 MRI images from 2015 to 2020 using MATLAB software and their database. The study found that the proposed deep CNN-based approach had an accuracy level of 96%.

Manika Gupta and others[6] paper aims to use three distinct CNN models to create three distinct classifications of brain tumors. Mind growth recognition is accomplished with 91.29% precision utilizing the main CNN model. With padding, dropout, and data augmentation, the second CNN model which correctly performs classification of brain tumor with an accuracy of 79.79 percent. The brain tumors can be grouped with an accuracy of 87.27 percent by utilizing the third CNN model, VGG16.

AnkitaParmar and others.[7] An examination of various methods for detecting brain tumors is carried out. An overview of the brain, a brain tumor, and MRI images are discussed in this paper. The conventional method and a few segmentation techniques are also discussed. According to this review, the most efficient and useful research area is automated brain tumor detection using CNN from magnetic resonance images.

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III. PROPOSED SYSTEM

In the past, numerous deep learning methods were utilized for brain tumor detection. Right now we have creating cerebrum tumor discovery by utilizing CNN algorithm. Our method predicts that deep learning CNN algorithms outperform other algorithms in terms of accuracy.

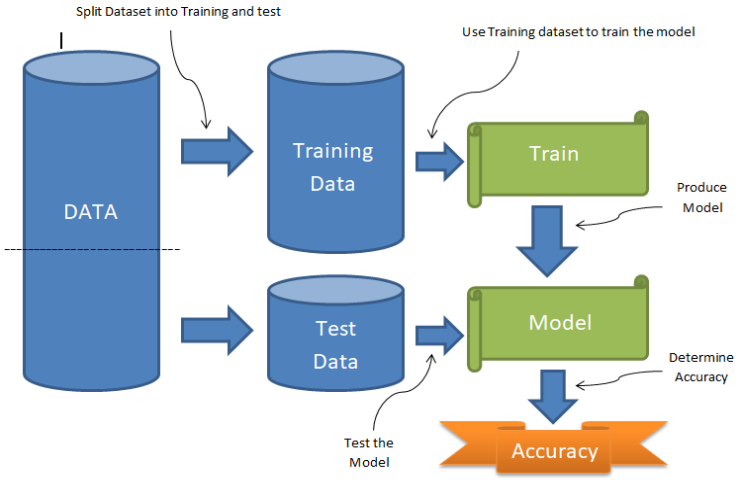

Figure 4: Train Test Split data

Steps to split data and produce model :

a) Identify the kind of training dataset first.
b) Collect the training data with labels.
c) Divide the training dataset into test, validation, and training datasets.
d) Determine the info highlights of the preparation dataset, which ought to have sufficient information with the goal that the model can precisely foresee the result.
e) Selecting an appropriate algorithm for the model.
f) Put the algorithm into action using the training dataset.
g) Use the validation set to determine accuracyof the model . If the model gives expected results and correctly predicts the output then our model is accurate.

IV. METHODOLOGY

The project implementation flow, which includes image dataset, preprocessing of image, normalization, CNN algorithm implementation, then testing of model and output, is depicted in the following figure.

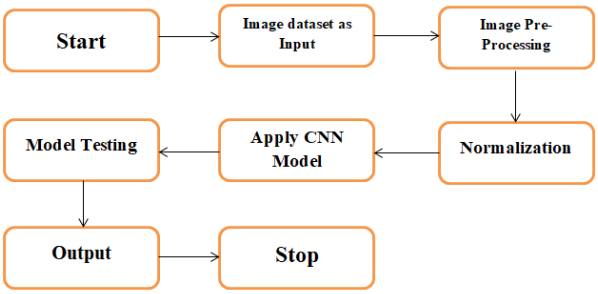

Figure 5: Layer with Full Connectivity

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A. Image Dataset:
We obtained this dataset from the websites of Kaggle. There are a various datasets to choose from. There are 3,000 images of brain tumors in the dataset, which have been divided into two groups: yes and no. There are 1500 images with a tumor, and there are 1500 images without a tumor.

B. Image preprocessing:
The goal of preprocessing is to improve the quality of the image so that we can better analyze it. Preprocessing enables us to improve specific qualities that are crucial to the application we are working on and eliminate unwanted distortions. In this firstly we read the image then convert it into array. Resizing of image and applying label to it is also performed in this.

C. Normalization :
A set of data undergoes scale transformation when it is normalized. For deep learning models, our objective is generally to re-center and rescale our information to such an extent that is somewhere in the range of 0 and 1 or - 1 and 1, contingent upon the actual information. Because the different features are on the same scale, normalization can help our neural networks train better because it stabilizes the gradient descent step. This allows us to utilize higher learning rates or assist models with meeting quicker for a given learning rate.

D. Apply CNN Model :
In this we apply CNN model to prepare machines/PCs with the goal that they can gain for a fact, order and perceive information/pictures very much like a human cerebrum does. It is used to recognize and classify images and objects. In this Different CNN layers such as, Convolution layer, pooling layer, and various hidden layers etc. are applied and used sequential model.

E. Model Testing:
We test our trained model to make sure that the learned model will behave consistently and produce the expected results.

V. ALGORITHM

i. Model Building

1. Start
2. Install and Import required Libraries.
3. Fetch image dataset from directory.
4. Assign dataset path to variable.
5. Create lists to store image and label.
6. Image Pre-processing

```
Iterate loop through no_tumor_images:
    If img_name[1]== '.jpg':
        Read image
        Convert img into array
        Resize img
        Append array of img into list
        Append label as '0' into list
Iterate loop through yes_tumor_images:
    If img_name[1]=='.jpg':
        Read image
        Convert img into array
        Resize img
        Append array of img into list
        Append label as '1' into list
```

7. Store numpy array of image into variable.
8. Store numpy array of label into variable.
9. Split Dataset into Train and Test.
10. Normalize the data.
11. Apply CNN Model.
12. Compile the model with 'accuracy' metrics.

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13. Fit the model.
14. Save model with '.h5' extension.

ii. Model Testing

1. Install and Import required libraries.
2. Load model.
3. Read image from dataset for prediction.
4. Convert image into array.
5. Resize image.
6. Convert image into numpy array
7. Expand dimensions of numpy array
8. Predict model.
9. Print result.
10. Connect it with Web using Flask framework.
11. Run and display it on Web.

VI. RESULT AND DISCUSSION

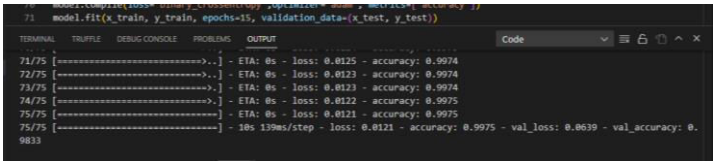

Figure 6: Accuracy after model building

The accuracy of this proposed model, which is higher than that of a straightforward CNN algorithm, is 99.75 percent.

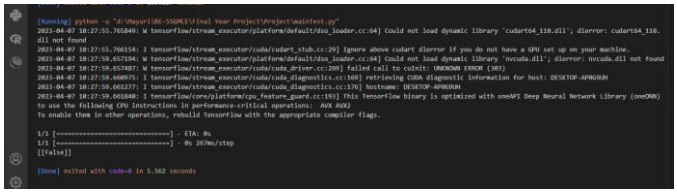

Figure 7: Model Testing result

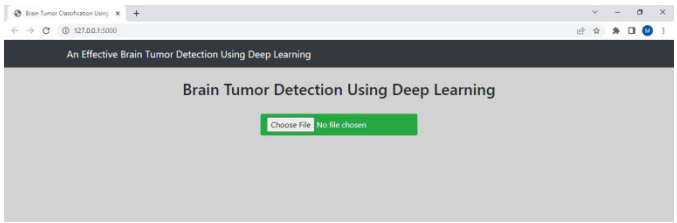

Figure 8: Model on Webpage

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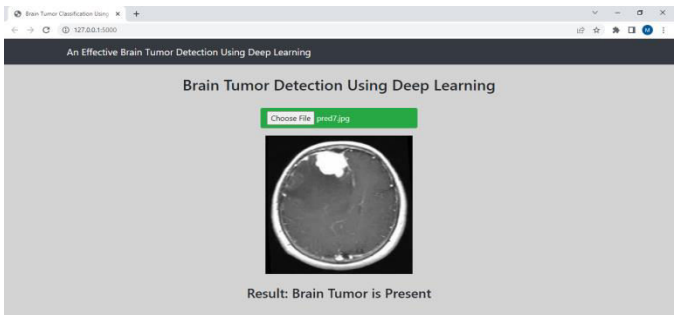

Figure 9: Brain tumor prediction on web

VI. CONCLUSION

The study and implementation of CNN algorithms clearly demonstrates that it aids in the effective and more accurate detection of brain tumors. Since diagnosing a brain tumor is difficult due to its complexity and sensitivity, accuracy is essential when determining whether or not a tumor is present in a patient's brain and how frequently it occurred. We have done practical implementation by adding one extra hidden layer in CNN algorithm which gives better accuracy than simple CNN algorithm. We will need to use a variety of deep learning algorithms in the future to develop model which will provide severity and location of tumor with faster, more effective and more dependable methods for early brain tumor classification and detection.

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Impact Factor: 8.379

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ISSN INTERNATIONAL STANDARD SERIAL NUMBER INDIA

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