Brain Tumor Detection using Convolution Neural Network (CNN)

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Abstract –
Brain tumor is a fatal disease, and their treatment presents a significant challenge. However, recent developments in the disease diagnosis industry have led to advancements in brain tumor findings. Magnetic Resonance Imaging (MRI) images can be used to identify brain tumors, and image processing techniques are commonly used for this purpose. Machine learning approaches have also been used in recent studies for tumors detection, but more effective models and applications are needed to tackle this lifethreatening disease. Fortunately, a vast amount of data is available for the mentioned research, and this can be effective in utilization by machine as well as deep learning model. These techniques are increasingly being used for disease diagnosis, including brain tumor detection. We are proposing a model, CNN classification, for brain tumor detection. Our model achieves high classification accuracy, with the CNNbased sorting achieving a classification accuracy of approximately 99.5%. We also propose an application that allows users to upload their MRI images to determine whether they contain a tumor or not. Our observational results demonstrate a high precision value of 99.4% and having improved training and testing epochs.

Keywords: Deep Learning, Image Processing, classification algorithm, Convolution Neural Network, Machine learning

1.INTRODUCTION

The researchers of WHO, Cancer is one of the utmost diseases making it the utmost impermanence throughout the globe. The increament of different cells of cancer in the body is a key risk and dangerous to health. The tumor is challenging and dangerous for handling. Malignant or Benign are two kinds of tumor, life taking or threatning are malignants while benigns are quit normal which do not blowout and can be detached by surgerical operations. Usually discovery of cancer might be supportive in life saving. Mining of data is data mining. These methods are extremely trustworthy for considering big volumes of data, extraction and decision making of data. The utmost used methods of like data mining in deep and machine learning are classifications and clustering. Numerous deep learning projects are available for classification like Decision Tree, Supprot Vector machine and Naïve Bayes. Similarly, machine learning designs can be used for detection.

There are many various kinds of analysis accessible, whereas magnetic resonance imaging (MRI) is the utmost for detecting tumors. Nevertheless, some errors are probable on recognition of Brain tumors due to lack of incorrect observations and data. Precise detection of tumor mainly be influenced by on the knowledge of the radiologist. Biopsies are done for detection of malignant or benign tumors. Biopsies are common for all kind of cancer, though, tumor biopsies need specific operation. Hence, avoid this challenging surgery and, an impactful instrument is required for detection of illness and separation of illness.

Magnetic resonance Imaging (MRI) is a magnetic field perused by a computer to harvest full pictures of reqiured organs. This MRI image by a computer using a radiologist for handling. MRI pictures are useful in identifying other portions of the body for detection of illness. Computerized recognition of tumors after MRI pictures is a puzzling job and a extremely required research area in medical world. Computerized identification requires separation, which splits pictures into fragments and procedures for analysis.

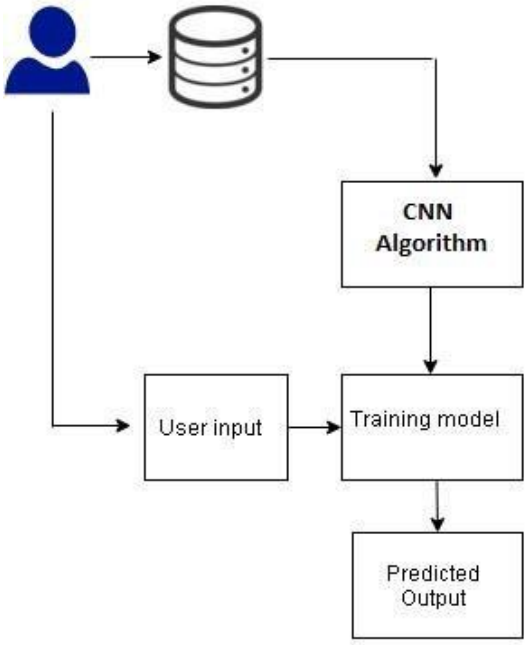

Figure: 1 Outline of Tumor Detection

The main goal of research is to predict tumor through deep and machine learning design using CNN from MRI pictures. Dualistic sorting of MRI pictures is measured, here malignant or benign are the two different kinds of tumor. The testing and training is done with improved constraints of periods to get higher and advanced precision of sorting. Another aim is to make an presentation, which uses the advanced and trained design. When a operator uploads a picture, then this will categorize it as a tumor or normal with higher accuracy. The Python flask is used for this application.

Following topics/units researches are interrelated job. In unit- 3, the explanation of the research methodology is being done. In unit- 4,observational or Observational outcomes are conferred. In unit -5, future enhancements and this job's conclusion are conferred.

1.1. RESEARCH MOTIVATION

The life becomes risky if tumor is found in the human body, if identified in starting then the survival chance is quit high.MRI images or the CT scan are the finest preparation for brain tumor ananysis monitored in present days. When certain pictures are acquiesced for manual confirmation, then it takes some time because there are not so many experts are available. Tumor separation from pictures is a time taking job. Later, a necessity for extremely accurate and reliable recognition of Brain tumor from pictures. One of the developing area in medical world disease analysis is Artificial Intelligence, large dataset is available that help in machine learning by predicting correct recognitions. The objective is to categorize different pictures as normal and tumor applying machine learning. The preference for machine learning pictures is CNN, as CNN can abstract the essential structures from the picture spontaneously. The additional idea of this study is to attain extraordinary precision of tumor sorting. The preferred algorithm for the same research is CNN as it abstracts the structures inevitably and discovers the layers and relations between them.

2. RELATED WORK

Tumor recognition is one of the difficult jobs advanced through various researchers on various methods, Here, the old school method that is image processing is used for brain tumor identification. Whereas, machine as well as deep learning techniques are developing for the medical image analysis commerce.

Tumor classification and identification was conducted with Support Vector Machine algorithm and Different Wavelet Transforms (DWT) feature extraction by author in [1].The classification presented decent outcomes as a binary sorting design.

Deep learning sorting is broadly used between investigators for tumor sorting. The task[2] presented Naïve bayes classifier for tumor. The Magnetic Resonance Imaging (MRI) dataset implementation was conducted in Matlab. After separation, algorithm like Legendary level arrays is applied for abstraction. The mined structures trained by Naïve Bayes. This work accomplished over 84% accuracy.

Tumor identification by Support Vector Machine algorithm, approached/tended by different authors [3]. For noise removal, picture processing is deliberated and separation accompanied. Then, MO that is, Morphological Operation applied for discovery of brain tumor. The following task used in recognizing exact brain tumor position through separation. Support

Vector Machine algorithm is used for recognition of tumor, this effort has accomplished nearly 84 % precision.

Another study proposed tumor discovery by the Tsallis entropy
Technique in [4].The Thresholding technique used in image pre-processing was Tsallis entropy, which catches the finest threshold significance. Bats-classifier was too applied for pre-processing. Separation like Water shed is conducted on pre-processing pictures. The design attained an accuracy over 91% and the tumor region is extracted effectively.

A study by authors in [5] addressed tumor detection using many deep learning approaches. The image pre-processing method used at this time was feature abstraction in the form of histogram The BraTS datasets were used for this research, and the KNN and linear as well as decision tree classifier were matched. DWT used for picture reducing noise. Investigational outcomes presents linear classifier with higher accuracy of 68.7%.

Magnetic Resonance Imaging for depiction of dataset categorized through deep learning algorithm and performance evaluated through various authors[6]. NCI in the CI dataset applied for the research, the following dataset has 34 patients with 25 pictures for every ill people. Machine and deep learning conducted were KNN, SVM, LDA, etc calculated. Investigational outcomes revealed that Support Vector Machine has accomplished 90% precision, while finest user of over 88% precision using KNN.

Literature Surveys point of view, it is sufficient, that there were remaining researches accessible for tumor recognition with picture processing and deep learning. The remaining techniques reached precision nearly 90%. Tumor sorting is a difficult and utmost necessary precise recognition is required for additional conduct. Therefore, the model used a machine learning for sorting. Convolution Neural Network is used to acquire correct results.

3. PROPOSED WORK

The implementation of tumor classification applying machine learning is an essential part of this study. This purpose of the Python 3 programming language used along with the various libraries like Keras and Tkinter for deep as well as maching learning environments. The application used in this study designed using HTML-flask, a popular web development framework in Python. Flask allows for the creation of web applications that can interact with the deep learning models created in Keras and TensorFlow.

DATASET DETAILS

The tumor dataset used in study obtained from kaggle.com and consisted of binary classes with separate training & testing folders for malignant and benign images. Here datasets have MRI images of the malignant class and other images of the benign class, with 20% of the dataset used for authentication.

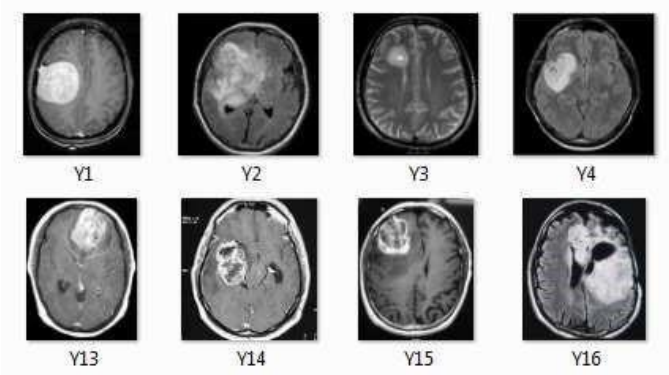

Figure2: Illustration View of Dataset

IMAGE PRE-PROCESSING

The extreme appropriate contribution to the system is picture pre-processing. One is image augmentation and the second is resizing are the pre-processing image procedures.

The primary thing of picture pre-processing operated in the research is picture resizing. The input pictures contrasts in size, therefore it is obligatory to provide a constant input to system. The pictures are re-sized with measurement 224x224.

The procedure of creating new pictures from current pictures for learning is called Data Augmentation, this procedure converts pictures by image manipulations methods like flip, zoom, shift etc. The objective of expansion is to enhance additional models to the testing and training dataset. Picture expansion helps in creating pictures from dataset and hence to deliver additional statistics for current preparation. From Keras ImageDataGenerator is used for statistics expansion. This class creates novel tensor picture statistics from the current pictures. Data expansion is applied to contain pictures on testing and training statistics with _zoom and shear range is 0.2, horizontal flip.

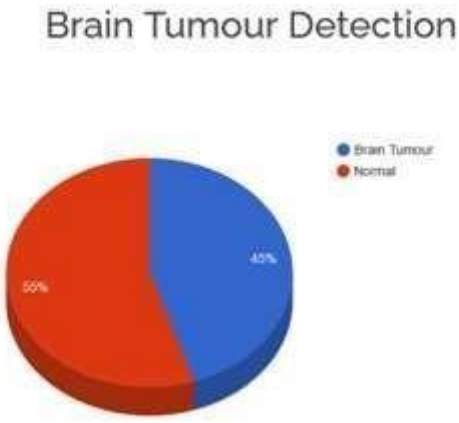

Figure:3 Data Visualization of Brain tumor dataset

This diagram signifies picture conception of the dataset. In this figure dataset has confined 45% tumor and 55% normal pictures. The class disproportion is undecorated difficulty whereas deep learning. The group disproportion to be lectured for operation of the dataset. The dataset contained 45% tumor and 55% normal pictures, which could be used for testing and training deprived of some additional dispensation.

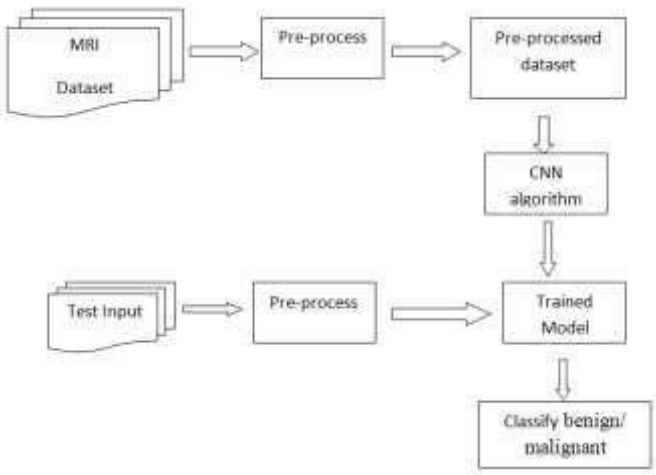

Figure 4: Design of Tumor Identification

The main architecture for tumor discovery using MRI images is in the given figure. The binary sorting is performed as well as done by using a CNN machine as well as deep learning algorithm. The Convolution Neural Network algorithm is used to train and authenticate brain MRI images with a batch size of 5 and an input image dimension of 224x224. The CNN model has two convolutional shields with a size of 3x3 and maximum pooling. Two different dense levels with 126 and 63 neurons are included in this model. The activation purpose applied in the first level is the Resolved Linear Unit (ReLU) and the activation function used in the another dense level is sigmoid. A waster degree of 0.24.9 is applied, and the pool phase have pool sizes of (2,2) and (3,3). The figure which is given below illustrates the CNN architecture applied for tumor discovery.

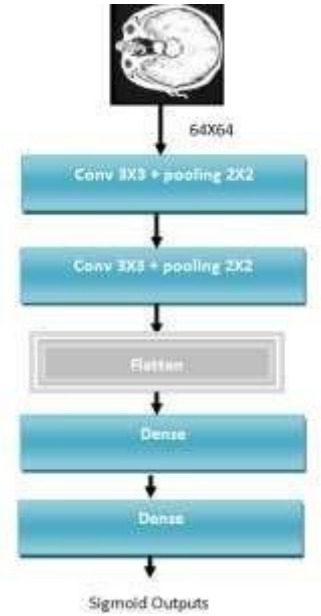

Figure 5: Brain tumour classification using CNN

The design assembled with the definite cross-entropy loss function and the Adam optimizer used for elevating the model.

This figure signifies CNN design, in input layer, the image Structures mined through CNN by itself. Every nerve in the

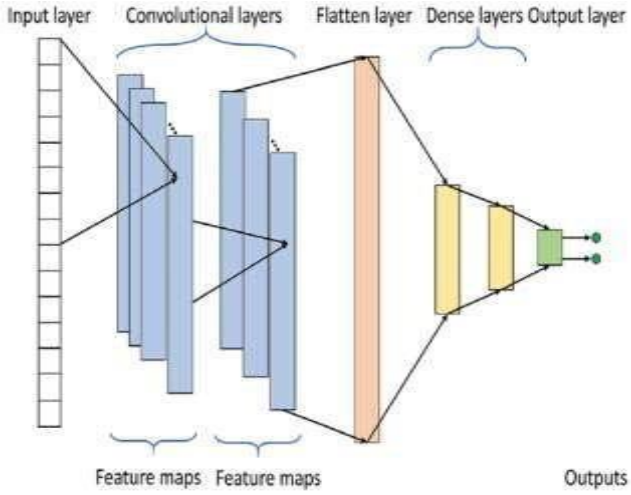

Figure 6: Design for CNN

hidden coating are associated entirely. In the hidden coating feature maps are learned with dimension 5.

Model: "sequential"

Layer (type)	Output Shape	Param #
conv2d (Conv2D)	(None, 220, 220, 32)	2432
max_pooling2d (MaxPooling2D)	(None, 73, 73, 32)	0
conv2d_1 (Conv2D)	(None, 71, 71, 32)	9248
max_pooling2d_1 (MaxPooling2	(None, 35, 35, 32)	0
conv2d_2 (Conv2D)	(None, 33, 33, 64)	18496
max_pooling2d_2 (MaxPooling2	(None, 16, 16, 64)	0
flatten (Flatten)	(None, 16384)	0
dense (Dense)	(None, 512)	8389120
dropout (Dropout)	(None, 512)	0
dense_1 (Dense)	(None, 128)	65664
dense_2 (Dense)	(None, 2)	258

Total params: 8,485,218
Trainable params: 8,485,218
Non-trainable params: 0

Figure:7 CNN layer Summary

It is great to hear about the implementation of a tumor discovery using Python and Flask! Using a trained Convolution Neural Networks design for the classification of MRI pictures is a influential tool in healthcare for initial discovery of tumors. I'm sure this application will be very useful for health centers and hospitals. The user boundary looks user-friendly and straight forward, allowing users to easily upload their MRI images and receive quick outcomes as malignant or benign.

Figure 8: Brain tumor Identification Applicationa

4. RESULTS AND DISCUSSIONS

The implementation of tumor identification from Python and apusing libraries Tensorflow, keras, Tkinter, matplotlib, etc. Tumor dataset measured for this model is Magnetic Resonance Imaging pictures downloaded directly from the kaggle.com. Machine learning classifier, Convolutional Neural Network is used for validation. To develop the effort, enhanced the number of epochs to obtain extreme precision of tumor sorting. The observational outcomes represents that the model has acquired maximum precision nearly 99.5%. The table below displays the estimation metrics Convolutional Neural Network model.

CNN Algorithm	Metrics (%)
precision	99.6
Recall	99.4
Accuracy	99.6

Table 1 : Experimental Results

The table below displays the matrix (confusion) reached in the investigation tests. This matrix helps in discovery of predicted and true labels. The predicted label represents 1500 benign and 1500 malignant pictures.

		Predicted	
Actual		**Malignant**	**Benign**
	Benign	5	1495
	Malignant	1490	10

Table 2 : Matrix for Brain tumour identification

The confusion matrix is represented by the figure below is true and predicted .

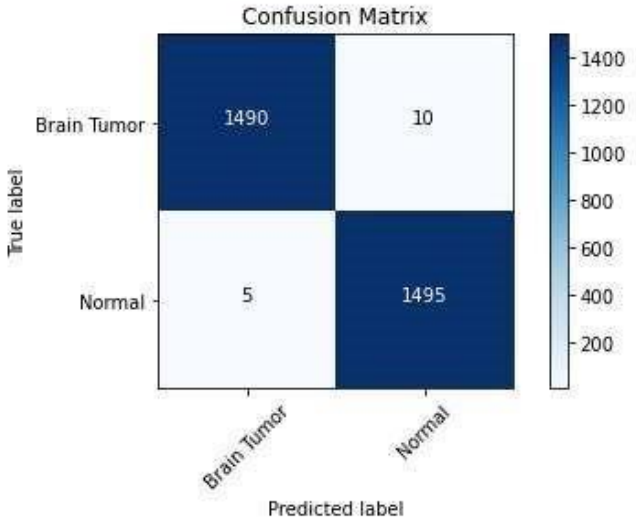

Figure 9: Brain tumor identification using Confusion Matrix

For the calculation of outcomes we ar using formula.

Accuracy =(TP+TN)/(TP+TN+FP+FN)

Where True positive is TP, True Negative is TN, False positive is FP and False Negative is FN.

For CNN an input size of the batch is given 128 ,the observation is accompanied with 5 epochs.

Epoch	Accuracy(%)
1	86.63
2	97.03
3	99.03
4	97.90
5	98.50

Table 3 : CNN classifier precision at varied epochs

The mentioned tumour sorting has acquired the maximum precision nearly 99.5%. This model is highly capable in sorting of given pictures as malignant or benign. The effectiveness of the study is represented as its precision of discovery. The design is applied for identification of only input.

5. CONCLUSIONS

Detecting brain tumors is a difficult task, and treating them is even more challenging. Early detection is crucial for successful treatment and saving lives. As a result, an effective diagnostic method is required for tumor detection. In this model, we proposed the use of CNN algorithm for training. Experimental outcomes show that our technique attains high accuracy, with brain tumor classification accuracy getting 99.4%. Our proposed model is particularly efficient in classifying images as Malignant and benign, achieving precision rate of 99.2%. The Convolution Neural Network model is kept, and application has been established allowing users to upload MRI images for seperation. Our outcomes show that the binary classification performed by the application is more accurate than previous procedures. In the future, we plan to extend our goal by exploring deep and machine learning & hybrid models of deep and machine learning algorithms.

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