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Brain Tumor Prediction Using Neural Network

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Abstract: ***Brain Tumor is a disease in which there is an abnormal growth of mass that occurs inside human brain that can led to death also. The detection of brain tumor takes places through MRI scan images. For doctors sometimes it becomes difficult to differentiate between tumour cells and nerve cells. Even sometimes what happens is that unstructured shape of tumours led it make difficult for doctors to identify tumours in brain. Artificial intelligence is one of the most trending technologies now a day through which machines gets the power to think and take decisions on its own. This paper uses the power of Artificial Intelligence to detect Brain tumour in human brain.***
Index Terms: Brain Tumor, Deep learning, CNN..

I. INTRODUCTION

Brain Tumour is a disease in which there is an abnormal growth of mass that occurs inside human brain that can led to death also. Its medication includes surgery, chemotrophic and radiations. In India, according to International Association of Cancer Registries (IACR) reported 28000 brain tumour cases in INDIA. Also it says that nearly 24000 people in our country dies due to brain tumour which makes it a serious concern.

Detection of Brain tumour takes place through MRI scanned images. Magnetic Resource Image or MRI is a medical imaging technique used in medical science which can detect physiological process in our body. MRI is used to scan variety conditions of brain like tumours, blooding, clotting or several injuries.

MRI images are mostly used in diagnosing brain tumours in human body. Although MRI images is efficient ways to detect tumours in brain but sometimes it also become difficult for doctors to detect tumours in brain as sometimes they found it difficult to differentiate between brain cells and tumours cells. Also sometime tumours have unstructured shapes in human brain which led it too difficult sometimes for doctor to detect tumour cells in human brain.

Technology is evolving and specially in the field of machine learning, deep learning and Artificial Intelligence numerous research is going on. Internet of things is another field which is booming and devices are getting to each other with
the help of network. It is predicted that there will be around 20 billion IOT devices that will connect over a network which gives an idea of the trend that how this technology is evolving and booming in the world.

Deep learning is boarder field machine learning which is based upon neural networks. It tries to work as the human neurons while training the model.

II. RELATED WORK

The research work of Gopal and Karnan [1] uses image processing and clustering algorithms to classify images into a group that has a brain tumour or not. Pan & Yang 2010‘s [2] survey focused on categorizing and reviewing the current progress on transfer learning for classification, regression and clustering problems. In this survey, they discussed the relationship between transfer learning and other related machine learning techniques such as domain adaptation, multitask learning and sample selection bias, as well as co-variate shift. They also explored some potential future issues in transfer learning research. In this survey article, they reviewed several current trends of transfer learning. The research paper [2] Machine Learning Approach for Brain Tumour Detection from professors of Jordan University has proposed image processing by MATLAB to detect brain tumours. Najadat at al. [3] design a classifier to detect abnormalities in CT brain images caused by the following diseases/cases: Atrophic, Hemorrhage, Hematoma, Infract and Craniotomy.Othman and Ariffanan propose a new system for brain tumour automatic diagnosis. The Probabilistic Neural Network (PNN) provides a solution to pattern classification problems [4]

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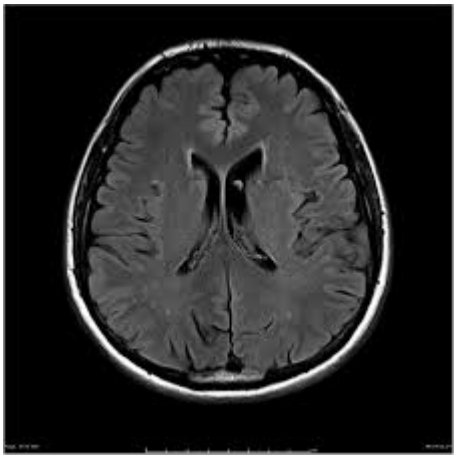
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III. DATASET

Dataset of brain tumour prediction consist of MRI scanned images of brain in which tumours are detected or not. The images in which brain tumour have detected there we can see to have a white spot(Figure-1) on it whereas no such spot can be seen in the MRI scanned images of the brain in which tumours are not detected(Figure-2).



(FIGURE-1 Brain Tumor Detected MRI Scanned Image)



(FIGURE-2 Brain Tumor Detected MRI Scanned Images)

IV. TRAINING MODEL

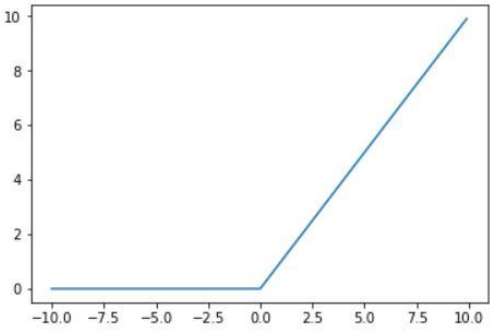
To prepare model for brain tumour detection we have used convolution neural network. CNN or Convolution neural network is a class of deep neural network which is used for analysing visual imaginary. CNN consist of 2 layers. One is Convolution layer and other is pooling layer.

Convolution layer is the first layer in CNN architecture which is used to extract features of image. This layer preserves the relationship between pixels by learning features using small squares of input data. It is a mathematical operation(Figure-1) in which two inputs that is input image and kernel or filter is taken. Convolution of an image with different filters can perform operations such as edge detection, blur and sharpen by applying filters. Second layer is pooling layer which is used to reduce the number of parameters when images are of too large size. It extracts the useful features from the convolved image and then flattening is done that is to convert that is to convert 2D vector image to 1D vector and pushed into neural network to get trained.

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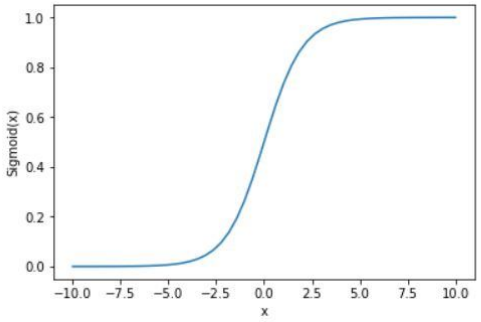
For training of model dataset is prepared of brain MRI Scanned Image and a proper labelling is done. Each image of different category is putted in different folder to have categorization of each image. Since the images can be of different sizes hence it becomes necessary to put all the images in the same size otherwise it may give error or different results. Hence to do that Image Data Generator is used and the image is resized into 1/.255 ratio.

For making neural network relu activation function for the hidden layers and sigmoid activation function for the output layer is used. Activation functions is used to decide that whether a neuron should be activated or not by calculating the weighted sum and adding bias in it. The main purpose of activation function is bringing nonlinearity in the neural network. Relu or Rectified linear unit(Figure-2) is the most popular activation function that is used for hidden layers in neural network. It is detected by max (0, x) i.e. it gives output x if x is positive and 0 otherwise.



(Figure-3 Relu Activation Function)

Sigmoid activation(Figure-3) function is mainly used for classification function.



(Figure-4 Sigmoid Activation Function)

For Compilation of model Adam optimizer is used. Optimizer are algorithms which are used train model. It changes attributes such as weight while training of neural network so that minimum loss occurs. Adam optimizer works with momentum of first and second order. First moment M(t) is mean of gradient whereas second moment V(t) is variance. (Figure-5)

$$\hat{m}_t = \frac{m_t}{1 - \beta_1^t}$$

$$\hat{v}_t = \frac{v_t}{1 - \beta_2^t}$$

Loss function tells the error for the current state of model. Here we have used categorical cross entropy as our loss function as there will be more than 2 categories.

With this parameter a convolution neural network is trained with 15 hidden layers. The model is trained by taking batch size of 4, epochs is taken to be 10 and steps per epoch is taken to be 14.

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V. MODEL ACCURACY

Model is trained and the result found to have loss=17% and accuracy =83%. To increase speed of model we can also do Principal of component analysis(PCA) which basically compress image size but it will cost with the accuracy of model.

```
Epoch 1/10
14/14 [==============================] - 1s 102ms/step - loss: 0.4206 - accuracy: 0.7772 - val_loss: 0.1950 - val_accuracy: 0.7
255
Epoch 2/10
14/14 [==============================] - 1s 105ms/step - loss: 0.4336 - accuracy: 0.8119 - val_loss: 0.3383 - val_accuracy: 0.6
863
Epoch 3/10
14/14 [==============================] - 2s 108ms/step - loss: 0.4655 - accuracy: 0.7822 - val_loss: 0.5701 - val_accuracy: 0.7
255 loss: 0.4627 - accuracy: 0.
Epoch 4/10
14/14 [==============================] - 1s 106ms/step - loss: 0.4645 - accuracy: 0.7871 - val_loss: 0.3402 - val_accuracy: 0.7
255
Epoch 5/10
14/14 [==============================] - 1s 103ms/step - loss: 0.4120 - accuracy: 0.8069 - val_loss: 0.6641 - val_accuracy: 0.7
451
Epoch 6/10
14/14 [==============================] - 1s 98ms/step - loss: 0.4304 - accuracy: 0.8515 - val_loss: 0.7331 - val_accuracy: 0.70
59
Epoch 7/10
14/14 [==============================] - 2s 108ms/step - loss: 0.4241 - accuracy: 0.8168 - val_loss: 0.5056 - val_accuracy: 0.6
863
Epoch 8/10
14/14 [==============================] - 2s 108ms/step - loss: 0.3959 - accuracy: 0.7822 - val_loss: 0.1792 - val_accuracy: 0.7
059
Epoch 9/10
14/14 [==============================] - 2s 109ms/step - loss: 0.3659 - accuracy: 0.8416 - val_loss: 0.3307 - val_accuracy: 0.7
451
Epoch 10/10
14/14 [==============================] - 1s 103ms/step - loss: 0.4074 - accuracy: 0.8366 - val_loss: 0.4013 - val_accuracy: 0.7
451
Out[11]: <keras.callbacks.callbacks.History at 0x26b684cc748>
```

VI. FINAL RESULT

After training of model it becomes very important to test the model that is trained of different images consisting brain tumor or not. So to test the model first the model is feed with image which consist brain tumor. (Figure-7) and the result it shows is correct result(Figure-8) and then we had feed them images in which brain tumor is not detected.(Figure-9) and in this case also the result comes out to be true.(Figure-10).



(FIG-7 Brain Tumor Detected)

```
import numpy as np
from keras.preprocessing import image

test_image = image.load_img('E:\Brain Tumor Detection\Brain\Single\Y52.jpg', target_size = (32, 32))
test_image = image.img_to_array(test_image)

test_image = np.expand_dims(test_image, axis = 0)
result = classifier.predict(test_image)

training_set.class_indices

{'no': 0, 'yes': 1}

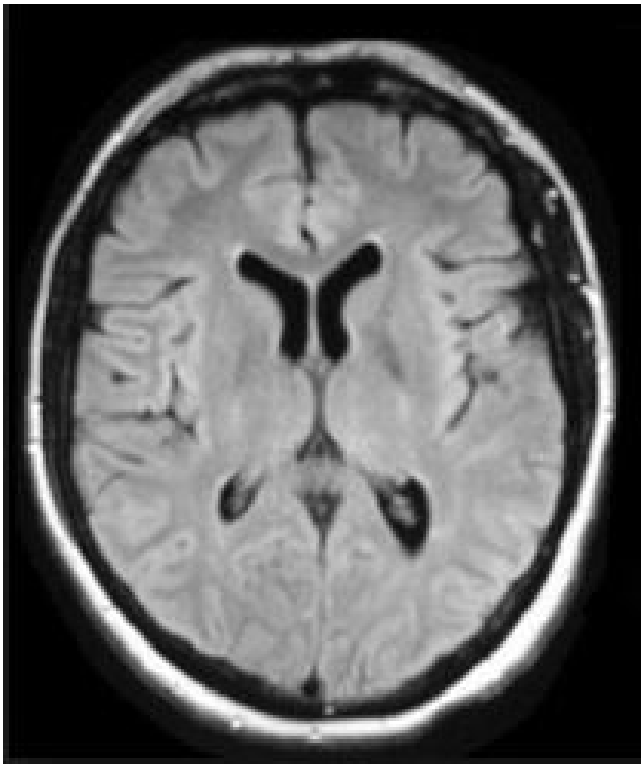
if result[0][0] == 1:
    prediction = 'Brain Tumor Detected'
else:
    prediction = 'Brain Tumor Not Detected'

print(prediction)

Brain Tumor Detected
```

(FIG-8 RESULT OF ABOVE IMAGE AS PER MODEL)

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(FIG-9 BRAIN TUMOR NOT DETECTED)

```
import numpy as np
from keras.preprocessing import image

test_image = image.load_img('E:\\Brain Tumor Detection\\Brain\\Single\\no.jpg', target_size = (32, 32))
test_image = image.img_to_array(test_image)

test_image = np.expand_dims(test_image, axis = 0)
result = classifier.predict(test_image)

training_set.class_indices
```

```
{'no': 0, 'yes': 1}
```

```
if result[0][0] == 1:
    prediction = 'Brain Tumor Detected'
else:
    prediction = 'Brain Tumor Not Detected'

print(prediction)
```

```
Brain Tumor Not Detected
```

(FIG-10 RESULT OF ABOVE IMAGE AS PER MODEL)

REFERENCES

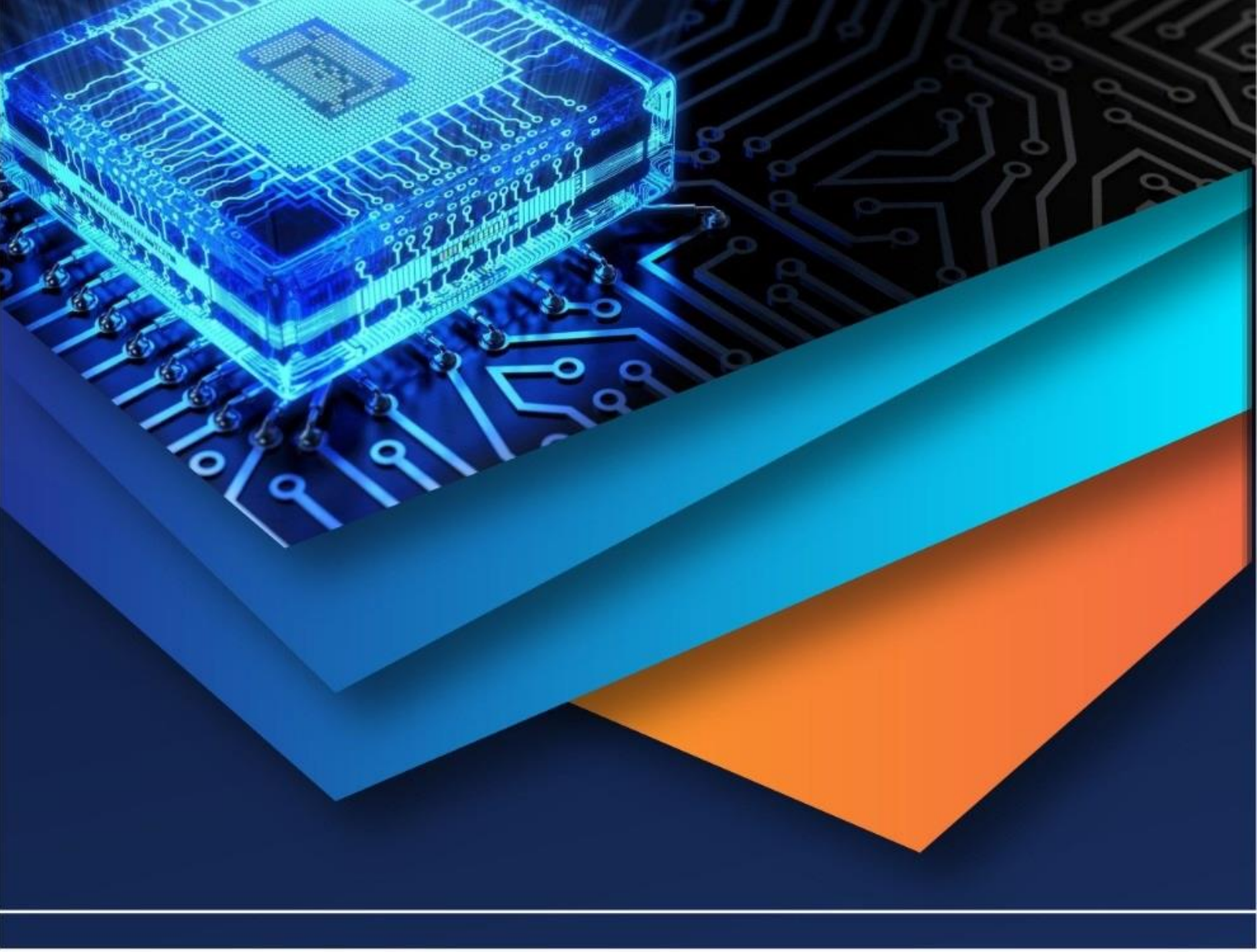
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