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Performance Analysis Of Brain Tumor Detection Using Deep Learning And Machine Learning Models

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Abstract

Now A Days For Identifying Or Predict Any Diseases On Human Beings, We Should Have Proper Diagnosis For Predicting The Disease Which Is Present In That Human Body. In General For Prediction Of Diseases We Try To Use Either Ct Or Mri Scan Techniques For Taking Decision On That Appropriate Disease. In General Medical Person Need Complete Knowledge On That Appropriate Domain To Find Out The Abnormality Which Is Present In Human Beings. In This Present Article We Try To Discuss About The Brain Tumor Detection By Using Deep Learning And Machine Learning Models And Try To Find Out Which Mri Image Is Having Benign And Which Images Are Having Malignant . In Recent Days There Was Tremendous Success Of Ml Algorithms At Image Recognition Tasks And This Is Increasing Day By Day Because Of Electronic Medical Records And Diagnostic Imaging. If We Use Basic Ml Algorithms To Predict The Abnormality, This May Take Lot Of Time Complexity And Accuracy May Be Very Less. Hence In Our Current Application We Try To Develop The Model Using Cnn Deep Learning Architecture And Try To Show That Proposed Cnn Model Has High Efficiency And Accuracy Compared With Previous Ml Models. In This Current Article We Try To Discuss About The Key Research Areas And Applications Of Medical Image Classification, Localization, Detection, Segmentation. We Conclude By Discussing Research Obstacles, Emerging Trends, And Possible Future Directions For Improving Some More Advancement.

Keywords:
Machine Learning Algorithms, Deep Learning, Mri Images, Ct Scan, Segmentation, Localization, Image Classification.

1. Introduction

In Recent Days, The Introduction Of It And E-Health Care System In The Medical Field Try To Provide Medical Experts To Give Proper Treatment For The Patients Who Are In Emergency. In General For Finding Any Abnormality Present In The Human Brain, We Need To Address The Problems Which Are Arise While Segmentation Of Abnormal Brain Tissues And Normal Tissues Such As Gray Matter (Gm), White Matter (Wm), And Cerebrospinal Fluid (Csf) From Magnetic Resonance Images (Mri).These Are Mainly Extracted By Using Proper Segmentation Techniques On That Medical Images In Order To Extract The Main Features Which Are Required To Identify The Benign And Malignant Status Of The Human Brain[1].

In General A Tumor Is Basically An Uncontrolled Growth Of Cancer Cells Which Is Formed In Some Region On Brain And This Tumor Part May Be Some Times Benign Or Malignant. The Benign Brain Tumor Is One Which Does Not Contain Any Active (Cancer) Cells And This Is Harmless For That Human Being. Whereas Malignant Brain Tumors Have A

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Heterogeneous Structure And This Is Always A Problematic For The Human Being. For Example The Gliomas And Meningiomas Are The Examples Of Low-Grade Tumors, Classified As Benign Tumors And Glioblastoma And Astrocytomas Are A Class Of High-Grade Tumors, Classified As Malignant Tumors[2].

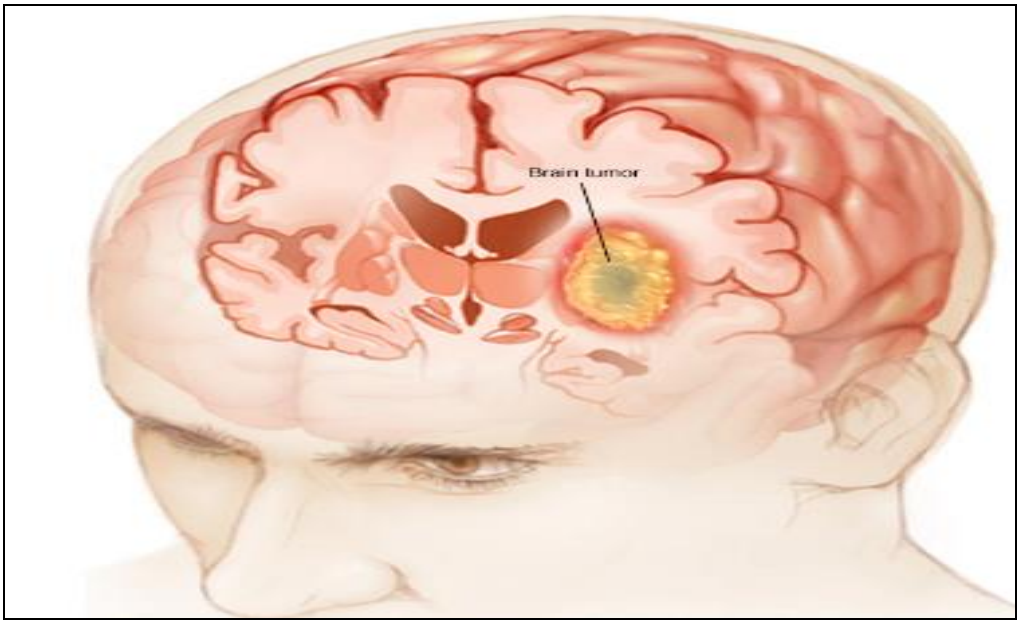

Figure 1. Represent The Brain Tumor Detection In Human Brain

From The Above Figure 1,We Can Clearly Identify Tumor Is Present Inside The Human Brain And This Is Seen With Some Yellow Or Gold Color Oval Shape And This Will Create Some Sort Of Disadvantages For The Human Being. In General Almost All Ml Algorithms Have The Potential To Be Invested Deeply In All Fields Of Medicine, Such As Drug Discovery To Making Surgeries By Taking Proper Decision From The Health Reports[3]. In Order To Perform Any Ml Algorithm On Medical Data, The Ml Will Use The Computer Vision Package (Cv) To Diagnosis The Medical Data In Very Accurate Manner. Since The Use Of Electronic Health Records (Ehr) Are Doubled From 12 Percent To 40 Percent And This Is Recorded In The Usa From 2008 To 2012, Which Is Seen In Below Figure 2. In General For Identifying The Problem Present Inside The Medical Images, Only Radiologists Can Able To Identify The Problem. If The Radiologist Don't Have Proper Knowledge Or Experience, It Is Very Difficult To Identify That Problem And In Order To Train The Radiologist It Is Very Financial Cost And Time Taken. Hence Many Countries Are Using Tele-Radiology Techniques To Increase The Result Analysis And This Can Be Formed By Training The System With All The Accurate Inputs And Then Find Out The Outcome Based On The User Inputs. If There Is Delay In Diagnosis, This May Create Harm For The Patient And Even This Is The Main Limitation For The Current Medical Image Analysis[4]. This Motivated Me To Design The Current Application In Which We Try To Diagnosis The Brain Tumor From Mri Images Using Deep Learning Model And Increase The Accuracy Compared With Primitive Ml Models.

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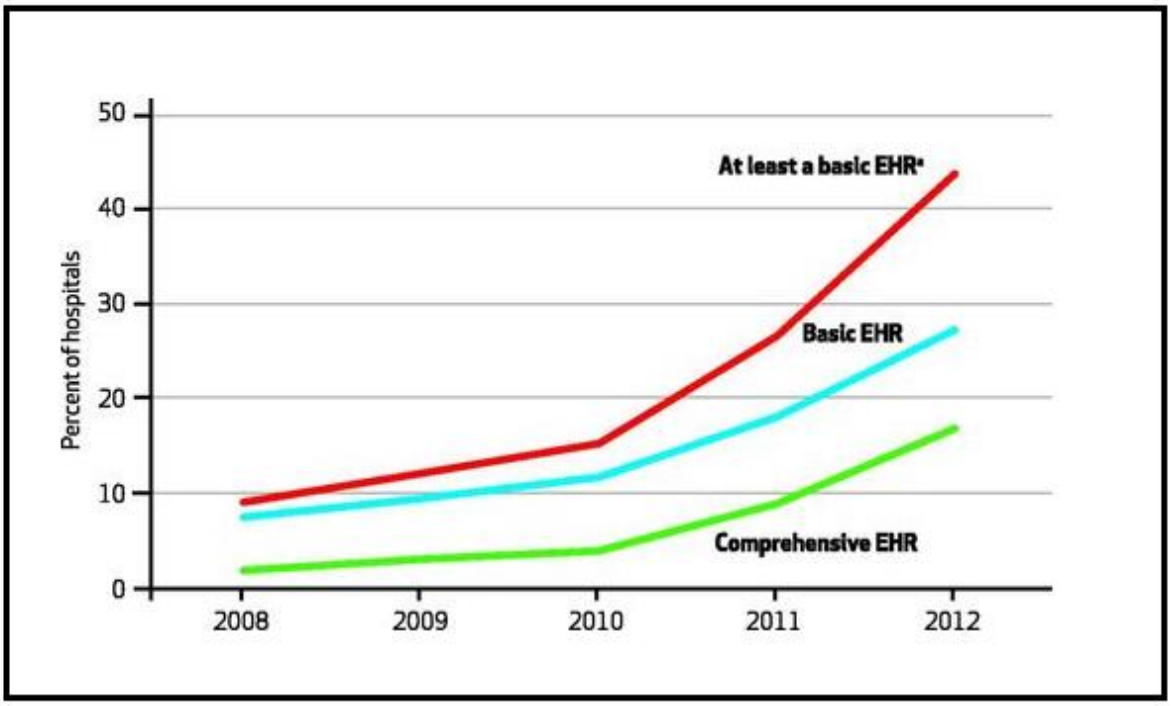

Figure 2. Represent The Rise Of Her Usage From 2008 To 2012

From The Above Figure 2, We Can Clearly Identify The Increase Of Ehrs By Several Hospitals From 2008 To 2012.Initially The Usage Of Ehr Is Only Less Than 10 Percent And This Has Gradually Increased More Than 5 Times In Very Short Period Of Time.

2. Literature Survey

Literature Survey Is That The Most Vital Step In The Software Development Process. Before Developing The New Application Or Model, It's Necessary To Work Out The Time Factor, Economy, And Company Strength. Once All These Factors Are Confirmed And Got Approval Then We Can Start Building The Application. The Literature Survey Is One That Mainly Deals With All The Previous Work Which Is Done By Several Users And What Are The Advantages And Limitations Of Those Previous Models. This Literature Survey Is Mainly Used For Identifying The List Of Resources To Construct This Proposed Application.

Motivation

1) A Review On Brain Tumor Segmentation Of Ct Images.
Authors: Anjali Wadhwa And Anuj Bhardwaj

In This Paper, The Authors Mainly Concentrated On The Brain Tumor Segmentation And Diagnosis On Ct Images. The Process Of Segmenting Tumor From Ct Or Mri Image Of A

Brain Is One Of The Highly Focused Areas In The Community Of Medical Science As Ct Is Noninvasive Imaging. This Paper Discusses A Thorough Literature Review Of Recent Methods Of Brain Tumor Segmentation From Brain Ct Images. It Includes The Performance And Quantitative Analysis Of State-Of-The-Art Methods. Different Methods Of Image Segmentation Are Briefly Explained With The Recent Contribution Of Various Researchers.

2) Niftynet: A Deep-Learning Platform For Medical Imaging
Authors: Eli Gibson And Wenqi Li

In This Paper, The Authors Mainly Discussed About A New Deep Learning Model Platform For Medical Imaging And They Termed It As Niftynet. Medical Image Analysis And Computer-Assisted Intervention Problems Are Increasingly Being Addressed With Deep-Learning-Based Solutions. Established Deep-Learning Platforms Are Flexible But Do Not Provide Specific Functionality For Medical Image Analysis And Adapting Them For This Domain Of Application Requires Substantial Implementation Effort. Consequently, There Has Been Substantial Duplication Of Effort And Incompatible Infrastructure Developed Across Many Research Groups[5].

3) A Review Of Deep-Learning-Based Medical Image Segmentation Methods.
Authors: Xiangbin Liu And Liping Song

In This Paper, The Authors Mainly Discussed The Review Of Several Deep Learning Based Image Segmentation Methods. This Paper Focuses On The Research Of Medical Image Segmentation Based On Deep Learning. First, The Basic Ideas And Characteristics Of Medical Image Segmentation Based On Deep Learning Are Introduced. By Explaining Its Research Status And Summarizing The Three Main Methods Of Medical Image Segmentation And Their Own Limitations, The Future Development Direction Is Expanded[6]-[7].

3. Existing System And Its Limitations

In The Existing System We Try To Use The General Ml Algorithms For Image Processing Techniques Technique For Finding The Abnormality Present In The Image. Accurate Diagnoses Of Disease Depend Upon Image Acquisition And Image Interpretation. Image Acquisition Devices Has Improved Substantially Over The Recent Few Years I.E. Currently We Are Getting Radiological Images ((X-Ray, Ct And Mri Scans Etc.) With Much Higher Resolution. However, We Just Started To Get Benefits For Automated Image Interpretation. One Of The Best Machine Learning Application Is Computer Vision, Though Traditional Machine Learning Algorithms For Image Interpretation Rely Heavily On Expert Crafted Features I.E. Brain Tumor Detection Requires Structure Features To Be Extracted. Due To The Extensive Variation From Patient To Patient Data, Traditional Learning Methods Are Not Reliable. Machine Learning Has Evolved Over The Last Few Years By Its Ability To Shift Through Complex And Big Data.

Limitations Of The Existing System

1. The Existing System Didn’t Concentrate On The Property Of Deep Learning.
2. Machine Learning Works With Large Amounts Of Data. It Is Useful For Small Amounts Of Data Too. Deep Learning On The Other Hand Works Efficiently If The Amount Of Data Increases Rapidly.

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3. For Applications Using Image Analysis ,Machine Learning Uses Cv But This May Take A Lot Of Effort And Data To Extract The Image Features.
4. By Using Ml Approach We Can't Able To Choose Our Own Parameters For Finding The Solution And Accuracy Of The Application.

4. Proposed System And Its Advantages

In The Proposed System We Try To Design A Cnn Model For Image Analysis. Cnns Are Well-Suited To Perform Image Recognition Tasks. Cnns Have Been Put To Work In Many Ways, Including Image Classification, Localization, Detection, Segmentation And Registration. Cnns Are The Most Popular Machine Learning Algorithm In Image Recognition And Visual Learning Tasks, Due To Its Unique Characteristic Of Preserving Local Image Relations, While Performing Dimensionality Reduction. This Captures Important Feature Relationships In An Image (Such As How Pixels On An Edge Join To Form A Line), And Reduces The Number Of Parameters The Algorithm Has To Compute, Increasing Computational Efficiency.Cnn Separable To Take As Inputs And Process Both 2-Dimensional Images, As Well As 3-Dimensional Images With Minor Medications. This Is A Useful Advantage In Designing A System For Hospital Use, As Some Modalities Like X-Rays Are 2-Dimensional While Others Like Ct Or Mri Scans Are 3-Dimensional Volumes. Cnns And Recurrent Neural Networks (Rnns) Are Examples Of Supervised Machine Learning Algorithms, Which Require Significant Amounts Of Training Data. Unsupervised Learning Algorithms Have Also Been Studied For Use In Medical Image Analysis.

Advantages Of The Proposed System

1) Machine Learning Works With Large Amounts Of Data. It Is Useful For Small Amounts Of Data Too. Deep Learning On The Other Hand Works Efficiently If The Amount Of Data Increases Rapidly.
2) Deep Learning Algorithms Are Designed To Heavily Depend On High-End Machines Unlike The Traditional Machine Learning Algorithms. Deep Learning Algorithms Perform A Number Of Matrix Multiplication Operations, Which Require A Large Amount Of Hardware Support.
3) Feature Engineering Is The Process Of Putting Domain Knowledge Into Specified Features To Reduce The Complexity Of Data And Make Patterns That Are Visible To Learning Algorithms It Works.
4) The Traditional Machine Learning Algorithms Follow A Standard Procedure To Solve The Problem. It Breaks The Problem Into Parts, Solve Each One Of Them And Combine Them To Get The Required Result. Deep Learning Focusses In Solving The Problem From End To End Instead Of Breaking Them Into Divisions.
5) Interpretability Is The Major Factor For Comparison Of Machine Learning And Deep Learning Algorithms. The Main Reason Is That Deep Learning Is Still Given A Second Thought Before Its Usage In Industry.

5. Proposed Cnn Model For Brain Tumor Detection

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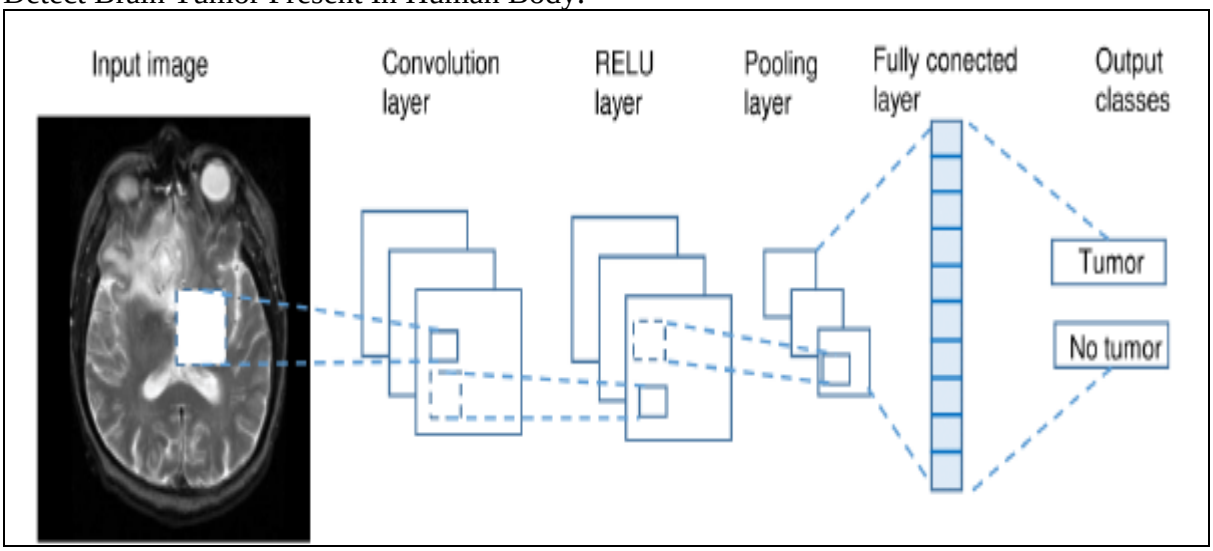
In This Section We Try To Discuss About Proposed Cnn Model Which Is Used To Detect Brain Tumor Present In Human Body.



The Application Is Mainly Divided Into 4 Modules. They Are As Follows:

1. Convolution Layer
2. Rectified Linear Unit (Relu) Layer
3. Pooling Layer
4. Fully Connected Layer

A) Convolution Layer

A Convolution Is Defined As An Operation On Two Functions. In Image Analysis, One Function Consists Of Input Values (E.G. Pixel Values) At A Position In The Image, And The Second Function Is A Filter (Or Kernel) Each Can Be Represented As Array Of Numbers. Computing The Dot Product Between The Two Functions Gives An Output. The Filter Is Then Shifted To The Next Position In The Image As Defined By The Stride Length. The Computation Is Repeated Until The Entire Image Is Covered, Producing A Feature (Or Activation) Map. This Is A Map Of Where The Filter Is Strongly Activated And 'Sees' A Feature Such As A Straight Line, A Dot, Or A Curved Edge. If A Photograph Of A Face Was Fed Into A Cnn, Initially Low-Level Features Such As Lines And Edges Are Discovered By The Filters. These Build Up To Progressively Higher Features In Subsequent Layers, Such As A Nose, Eye Or Ear, As The Feature Maps Become Inputs For The Next Layer In The Cnn Architecture[8]-[10].

B) Rectified Linear Unit (Relu) Layer

The Relu Layer Is An Activation Function That Sets Negative Input Values To Zero. This Simplifies And Accelerates Calculations And Training, And Helps To Avoid The Vanishing Gradient Problem. Mathematically It Is Defined As:

$$F(X)=Max(0,X).$$

Where X Is The Input To The Neuron. Other Activation Functions Include The Sigmoid, Tanh, Leaky Relus, Randomized Relus And Parametric Relus.

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C) Pooling Layer

The Pooling Layer Is Inserted Between The Convolution And Relu Layers To Reduce The Number Of Parameters To Be Calculated, As Well As The Size Of The Image (Width And Height, But Not Depth). Max-Pooling Is Most Commonly Used; Other Pooling Layers Include Average Pooling And L2-Normalization Pooling. Max-Pooling Simply Takes The Largest Input Value Within A Filter And Discards The Other Values; Effectively It Summarizes The Strongest Activations Over A Neighborhood. The Rationale Is That The Relative Location Of A Strongly Activated Feature To Another Is More Important Than Its Exact Location.

D) Fully Connected Layer

The Final Layer In A Cnn Is The Fully Connected Layer, Meaning That Every Neuron In The Preceding Layer Is Connected To Every Neuron In The Fully Connected Layer. Like The Convolution, Relu And Pooling Layers, There Can Be 1 Or More Fully Connected Layers Depending On The Level Of Feature Abstraction Desired. This Layer Takes The Output From The Preceding Layer (Convolutional, Relu Or Pooling) As Its Input, And Computes A Probability Score For Classification Into The Different Available Classes. In Essence, This Layer Looks At The Combination Of The Most Strongly Activated Features That Would Indicate The Image Belongs To A Particular Class. For Example, On Histology Glass Slides, Cancer Cells Have A High Dna To Cytoplasm Ratio Compared To Normal Cells. If Features Of Dna Were Strongly Detected From The Preceding Layer, The Cnn Would Be More Likely To Predict The Presence Of Cancer Cells.

6. Experimental Results

Implementation Is A Stage Where The Theoretical Design Is Converted Into A Programmatic Manner. In This Proposed Application We Try To Use Python As A Programming Language In Which Google Collaboratory Or Jupiter Notebook As A Working Platform To Process The Current Application.

Step 1: Importing All Neccesary Libraries

```
import tensorflow as tf
import keras
from keras.models import Sequential
from keras.layers import Conv2D
from keras.layers import MaxPooling2D
from keras.layers import Flatten
from keras.layers import Dense
```

Step 2: Load Train And Test Data Into Separate Variables

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```
training_set = train_datagen.flow_from_directory('/home/telraswa/Desktop/Swapnil/manju_project/Brain_tumor/train/',
                                                 target_size = (64, 64),
                                                 batch_size = 32,
                                                 class_mode = 'binary')

test_set = test_datagen.flow_from_directory('/home/telraswa/Desktop/Swapnil/manju_project/Brain_tumor/test/',
                                            target_size = (64, 64),
                                            batch_size = 32,
                                            class_mode = 'binary')
```

Step 3: Data Pre-Processing

```
[ ]  from keras.preprocessing.image import ImageDataGenerator

     train_datagen = ImageDataGenerator(rescale = 1./255,
                                        shear_range = 0.2,
                                        zoom_range = 0.2,
                                        horizontal_flip = True)

     test_datagen = ImageDataGenerator(rescale = 1./255)
```

Step 4: Building Cnn Model

```
classifier.add(MaxPooling2D(pool_size = (2, 2)))

classifier.add(Conv2D(32, (3, 3), activation = 'relu'))
classifier.add(MaxPooling2D(pool_size = (2, 2)))

classifier.add(Flatten())

classifier.add(Dense(activation = 'relu',units=128))
classifier.add(Dense(activation = 'sigmoid',units=1))

classifier.compile(optimizer = 'adam', loss = 'binary_crossentropy', metrics = ['accuracy'])

classifier.summary()
```

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```
classifier.summary()
```

```
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d_1 (Conv2D)            (None, 62, 62, 32)        896
_________________________________________________________________
max_pooling2d_1 (MaxPooling2 (None, 31, 31, 32)        0
_________________________________________________________________
conv2d_2 (Conv2D)            (None, 29, 29, 32)        9248
_________________________________________________________________
max_pooling2d_2 (MaxPooling2 (None, 14, 14, 32)        0
_________________________________________________________________
flatten_1 (Flatten)          (None, 6272)              0
_________________________________________________________________
dense_1 (Dense)              (None, 128)               802944
_________________________________________________________________
dense_2 (Dense)              (None, 1)                 129
=================================================================
Total params: 813,217
Trainable params: 813,217
Non-trainable params: 0
_________________________________________________________________
```

Step 5: Start Training Cnn With Parameters And Fit The Model.

```
Epoch 93/100
1/1 [==============================] - 0s 97ms/step - loss: 0.1661 - acc: 0.9545
Epoch 94/100
1/1 [==============================] - 0s 99ms/step - loss: 0.1103 - acc: 0.9545
Epoch 95/100
1/1 [==============================] - 0s 100ms/step - loss: 0.0623 - acc: 0.9545
Epoch 96/100
1/1 [==============================] - 0s 99ms/step - loss: 0.1440 - acc: 0.9545
Epoch 97/100
1/1 [==============================] - 0s 98ms/step - loss: 0.0680 - acc: 0.9545
Epoch 98/100
1/1 [==============================] - 0s 98ms/step - loss: 0.0230 - acc: 1.0000
Epoch 99/100
1/1 [==============================] - 0s 100ms/step - loss: 0.1330 - acc: 0.9091
Epoch 100/100
1/1 [==============================] - 0s 101ms/step - loss: 0.0841 - acc: 0.9545
<keras.callbacks.History at 0x7f2ac2703cd0>
```

After Training The Model We Got Classification Accuracy Of 95.6 %

Step 6 : Test Sample Mri Image

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Step 7 : Predictions

```
if result[0][0] == 0:
    prediction = 'Benign'
else:
    prediction = 'Malignent'
print("Detected tumor type is %s"%prediction)
```

```
Detected tumor type is Malignent
```

Report Analysis

Number Of Epochs	Re-Lu		Sigmoid	
	Accuracy	Time	Accuracy	Time
90	81.08	100.116	49.69	112.112
80	79.65	100.117	49.65	112.115
70	78.77	100.116	49.40	112.114
60	79.46	100.114	49.52	112.115
50	77.76	100.115	49.82	112.116
40	76.82	100.120	49.93	112.116
30	75.45	100.116	49.42	112.116

Comparison Of Activation Performance On The Basis Of Number Of Epoches

	Re-Lu	Sigmoid	Softmax

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Number Of Layers	Accuracy	Time	Accuracy	Time	Accuracy	Time
1	76.21	98.125	50.00	110.124	50.00	88.354
2	79.86	100.114	49.75	112.112	50.00	103.411
3	80.13	103.108	50.00	113.108	49.98	105.418
4	79.21	105.106	49.77	115.108	48.90	106.442

Comparison Of Activation Performance On The Basis Of Number Of Layers

Performance Analysis Of Cnn & Ml Models For Brain Tumor Detection

Accuracy	Method		
	Deep Learning	Machine Learning	
	Cnn	Logistic Regression	Svm
	95.6	33.33	33.33

From The Above Table We Can Clearly Identify The Accuracy Of Proposed Cnn Model Is Almost 95.6 Percent When Compared With Other Existing Ml Algorithms Which Are Used In Existing Papers.

7. Conclusion

In This Current Work We For The First Time Designed And Implemented An Application Using Deep Learning Cnn Model In The Medical Field For Tumor Detection From Mri Or Ct Brain Images.We Try To Design An Application Which Can Able To Identify The Abnormality Present In The Human Brain From The Affected Part Of Brain Image And Then Find Out The Abnormality. At Present, It Is Very Interesting To Design The Deep Intricate Neural Network (Cnn) Is The Latest Image Recognition Solution. Here We Try To Gather Several Infected Brain Images As Well As Normal Brain Images And Then Try To Train The System With All These Images.Once The Model Is Trained Then We Try To Give A Sample Mri Brain Image As Input And Check Whether That Image Is Having Abnormality Or Not. To Solve The Above Problem, We Developed A Deep Learning Model Using A Cnn Algorithm To Detect The Abnormality Present In Human Brain. By Conducting Various Experiments On Our Proposed Model, We Achieved A Classification Accuracy Of 95.6% When Applied To The Test Dataset.

8. References

1) Heba Mohsen Et Al, “Classification Using Deep Learning Neural Networks For Brain Tumors”, Published In Future Computing And Informatics, Pp 1-4 (2017).
2) Stefan Bauer Et Al, “Multiscale Modeling For Image Analysis Of Brain Tumor Studies”, Published In Ieee Transactions On Biomedical Engineering, 59(1): (2012).
3) Atiq Islam Et Al, “Multi-Fractal Texture Estimation For Detection And Segmentation Of Brain Tumors”, Published In Ieee, (2013).

4) Meiyan Huang Et Al, “Brain Tumor Segmentation Based On Local Independent Projectionbased Classification”, Published In Ieee Transactions On Biomedical Engineering, Ieee, (2013).
5) Andachamamci Et Al, “Tumor-Cut: Segmentation Of Brain Tumors On Contrast Enhanced Mr Images For Radiosurgery Applications”, Published In Ieee Transactions On Medical Imaging, 31(3): (2012).
6) Bjoern H. Menze Et Al, “The Multimodal Brain Tumor Image Segmentation Benchmark (Brats)”, Published In Ieee Transactions On Medical Imaging, (2014).
7) Jin Liu Et Al, “A Survey Of Mri-Based Brain Tumor Segmentation Methods”, Published In Tsinghua Science And Technology, 19(6) (2011).
8) Shamsul Huda Et Al, “A Hybrid Feature Selection With Ensemble Classification For Imbalanced Healthcare Data: A Case Study For Brain Tumor Diagnosis”, Published In Ieee Access, 4: (2017).
9) R. Karuppathal And V. Palanisamy, “Fuzzy Based Automatic Detection And Classification Approach For Mri-Brain Tumor”, Published In Arpn Journal Of Engineering And Applied Sciences, 9(12): (2014).
10) Janani And P. Meena, “Image Segmentation For Tumor Detection Using Fuzzy Inference System”, Published In International Journal Of Computer Science And Mobile Computing, 2(5): 244 – 248 (2013).