DAYANANDA SAGAR UNIVERSITY

KUDLU GATE, BANGALORE – 560068

Bachelor of Technology
in
COMPUTER SCIENCE AND ENGINEERING

Major Project Phase-II Report

(BRAIN TUMOR CLASSIFICATION USING DEEP LEARNING)

By
C Prithvi Raj - ENG18CS0063
Ebin Jacob - ENG18CS0097
Creflo Asir Joel - ENG18CS0115
Pranav Sharan - ENG18CS0121
Sri Srinivasan - ENG18CS0123

Under the supervision of

Prof. Ranjini K
Assistant Professor, Department of CSE

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING,
SCHOOL OF ENGINEERING
DAYANANDA SAGAR UNIVERSITY,

(2021-2022)

DAYANANDA SAGAR UNIVERSITY

School of Engineering
Department of Computer Science & Engineering
Kudlu Gate, Bangalore – 560068
Karnataka, India

CERTIFICATE

This is to certify that the project work titled **"BRAIN TUMOR CLASSIFICATION USING DEEP LEARNING"** is carried out by **C Prithvi Raj (ENG18CS0063), Ebin Jacob (ENG18CS0097), Creflo Asir Joel (ENG18CS0115), Pranav Sharan - (ENG18CS0121), Sri Srinivasan - (ENG18CS0123),** bonafide students of Bachelor of Technology in Computer Science and Engineering at the School of Engineering, Dayananda Sagar University, Bangalore in partial fulfillment for the award of degree in Bachelor of Technology in Computer Science and Engineering, during the year **2021-2022**.

Prof. Ranjini K	**Dr Girisha G S**	**Dr. A Srinivas**
Assistant Professor Dept. of CS&E, School of Engineering Dayananda Sagar University Date:	Chairman CSE School of Engineering Dayananda Sagar University Date:	Dean School of Engineering Dayananda Sagar University Date:

Name of the Examiner **Signature of Examiner**

1.

2.

DECLARATION

We, **C Prithvi Raj (ENG18CS0063), Ebin Jacob (ENG18CS0097), Creflo Asir Joel (ENG18CS0115), Pranav Sharan - (ENG18CS0121), Sri Srinivasan - (ENG18CS0123),** are students of the eighth semester B.Tech in **Computer Science and Engineering**, at School of Engineering, **Dayananda Sagar University**, hereby declare that the project titled **"Brain Tumor Classification Using Deep Learning"** has been carried out by us and submitted in partial fulfillment for the award of degree in **Bachelor of Technology in Computer Science and Engineering** during the academic year **2021-2022**.

Student **Signature**

Name1: C Prithvi Raj
USN: ENG18CS0063

Name2: Ebin Jacob
USN: ENG18CS0097

Name3: Creflo Asir Joel
USN: ENG18CS0115

Name4: Pranav Sharan
USN: ENG18CS0121

Name5: Sri Srinivasan
USN: ENG18CS0123

Place : Bangalore
Date :

ACKNOWLEDGEMENT

It is a great pleasure for us to acknowledge the assistance and support of many individuals who have been responsible for the successful completion of this project work.

First, we take this opportunity to express our sincere gratitude to the School of Engineering & Technology, Dayananda Sagar University for providing us with a great opportunity to pursue our Bachelor’s degree in this institution.

We would like to thank **Dr. A Srinivas. Dean**, **School of Engineering & Technology**, **Dayananda Sagar University** for his constant encouragement and expert advice. It is a matter of immense pleasure to express our sincere thanks to **Dr. Girisha G S, Department Chairman**, **Computer Science, and Engineering**, **Dayananda Sagar University,** for providing the right academic guidance that made our task possible.

We would like to thank our guide **Prof. Ranjini K Assistant Professor**, **Dept. of Computer Science and Engineering**, **Dayananda Sagar University**, for sparing his/her valuable time to extend help in every step of our project work, which paved the way for smooth progress and the fruitful culmination of the project.

We would like to thank our Project Coordinator Dr. Meenakshi Malhotra and all the staff members of Computer Science and Engineering for their support.

We are also grateful to our family and friends who provided us with every requirement throughout the course. We would like to thank one and all who directly or indirectly helped us in the Project work.

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

AI	Artificial Intelligence
DL	Deep Learning
GUI	Graphical User Interface
PHP	Preprocessor Hypertext
MySQL	My Structured Query Language
ResNet	Residual Neural Network
CNN	Convolutional Neural Network
VGG	Visual Geometry Group

LIST OF FIGURES

ABSTRACT

Brain tumors are the most destructive disease, leading to a very short life expectancy in their highest grade. The computer-aided tumor detection systems and convolutional neural networks provided success stories and have made important strides in the field of machine learning. The data augmentation techniques are applied to the MRI slices for generalization of results, increasing the data-set samples and reducing the chance of over-fitting. The aim is to build a web-based application so as to help doctors and others be aware about brain tumors.

CHAPTER 1

INTRODUCTION

CHAPTER 1 INTRODUCTION

According to the results of the Global Cancer Registry in 2018, there were 18,078,957 registered cases of cancer in both sexes, of which 29,681 were related to brain cancer. The highest incidence (102,260 cases, 34.4%) and mortality (77,815 cases, 32.3%) belonged to very high HDI regions however most people don't recognize the symptoms or its effect and end up having severe brain damage. The proposed project will help in people being aware about the various brain tumors and its existence.

Each study then explores the transfer learning techniques, i.e., fine-tune and freeze using MRIslices of brain tumor dataset. Brain tumor image classification is an important part of medical image processing.

It assists doctors to make accurate diagnosis and treatment plans. Doctors also use Hematoxylin and eosin stains as principal tissue stains in histology. Magnetic resonance (MR) imaging is one of the main imaging tools to study brain tissue.

In this article, we propose a brain tumor MR image classification method using convolutional dictionary learning with local constraint (CDLLC). Our method integrates the multi-layer dictionary learning into a convolutional neural network (CNN) structure to explore the discriminative information. The evaluation results demonstrate that our method is effective for brain tumor MR image classification, and it could outperform other comparisons.

1.1 SOCIAL ENVIRONMENTAL IMPACT

- To help society know more about brain tumor
- Spread awareness about the various brain tumor effects.
- Reduce the number of deaths caused due to brain tumor by predicting the disease in its early stages as there is scope for better treatment options.

1.2 DELIVERABLES

A Web based Application is made using technologies such as Js, jQuery, Html5, CSS3 and Python flask and MySQL that will be able to classify whether a person is diagnosed with Brain tumor and provides assistance to the doctor to make his decision.

CHAPTER 2

PROBLEM STATEMENT

CHAPTER 2 PROBLEM STATEMENT

Using CNN (Convolutional Neural Network) we are creating the classification of Brain tumors and building a web-based application to help doctors and non-medical members in recognizing and diagnosing brain tumors.

The convolutional layers extract important and robust features automatically from the input space as compared to traditional predecessor neural network layers.

CHAPTER 3
LITERATURE REVIEW

CHAPTER 3 LITERATURE REVIEW

Paper Title	Conference Name and year	Technology used	Results	What you infer
[1] Multi-Classification of Brain Tumor MRI Images Using Deep Convolutional Neural Network with Fully Optimized Framework	Springer link 22nd April 2021	convolutional neural network (CNN)	Brain Tumor is able to be classified with 97% accuracy	The proposed CNN models can be employed to assist physicians and radiologists in validating their initial screening for brain tumor multi-classification purposes.
[2] Classification of Brain Tumors from MRI Images Using a Convolutional Neural Network	frontiers in neuroscience15 March 2020	A machine-learning algorithm that has achieved substantial results in image segmentation and classification is the convolutional neural network (CNN)	The best result for the 10-fold cross-validation method was obtained for the record-wise cross-validation for the augmented dataset, and, in that case, the accuracy was 96.56%	Detecting the tumors in the operating room should be performed in real-time and real-world conditions; thus, in that case, the improvement would also involve adapting the network to a 3D system

[3] Brain Tumor MRI Image Classification Using Convolutional Dictionary Learning With Local Constraint	Journal of Physics: conference 28 May 2021	the method integrates the multi-layer dictionary learning into a convolutional neural network (CNN) structure to explore the discriminative information.	Classification of types of meningiomas, gliomas, and pituitary tumors on the Cheng dataset and types of AST, OLI, and GBM on the REMBRANDT dataset is carried out with high performance in accuracy, recall, precision, F1-score, and balance loss	This proposed method CDLLC uses the locality constraint of atoms to preserve the manifold structure of the codes. extracts the useful CNN features automatically in the architecture of deep learning.
[4] Brain Tumor Classification Using Convolutional Neural Network	ICCCEBS 2021	MRI; CNN; transfer learning; inception; resnet brain tumor; VGG deep learning	this concept is able to detect the images using Keras, by building an artificial convolutional neural network	Our proposed system is for binary classification problems, however, in future work, the proposed method can be extended for classification problems such

[5] Brain tumor classification in MRI image using convolutional neural network	AIIMS 15 September 2020	CNN model with pre- trained VGG-16, ResNet-50, and Inception-v3 models.	we can attain full accuracy and our accuracy rate is very fine as compared to VGG-16, ResNet-50, and Inception-v3 model. Our model average training time per epoch is 205 sec while the VGG-16 takes 456 sec, ResNet-50 takes 606 sec and Inception-v3 takes 375 sec average training time per epoch	The proposed system is for binary classification problems, however, in future work, the proposed method can be extended for categorical classification problems such as identification of brain tumor may be used to detect other brain abnormalities

[6] Brain Tumor Detection and Classification n from Multi-Channel MRIs using Deep Learning and Transfer Learning	IEEE Computational Intelligence Society Graduate Student Research Grant 2017	Deep Convolutional Neural Networks (ConvNets)	The proposed a scheme for incorporating volumetric tumor information using multi-planar MRI slices, that achieved the best testing accuracy 97.19%	We infer that deep ConvNets could be a feasible alternative to surgical biopsy for brain tumors.

CHAPTER 4

PROJECT DESCRIPTION

CHAPTER 4 PROJECT DESCRIPTION

A brain tumor is a mass or growth of abnormal cells in the brain.

In India, every year 40,000- 50,000 patients are diagnosed with a brain tumor. Of these 20 percent are children.

Treatment for a brain tumor depends on the type, size, and location of the tumor, as well as overall health and preferences. Surgery is the usual first treatment for most brain tumors.

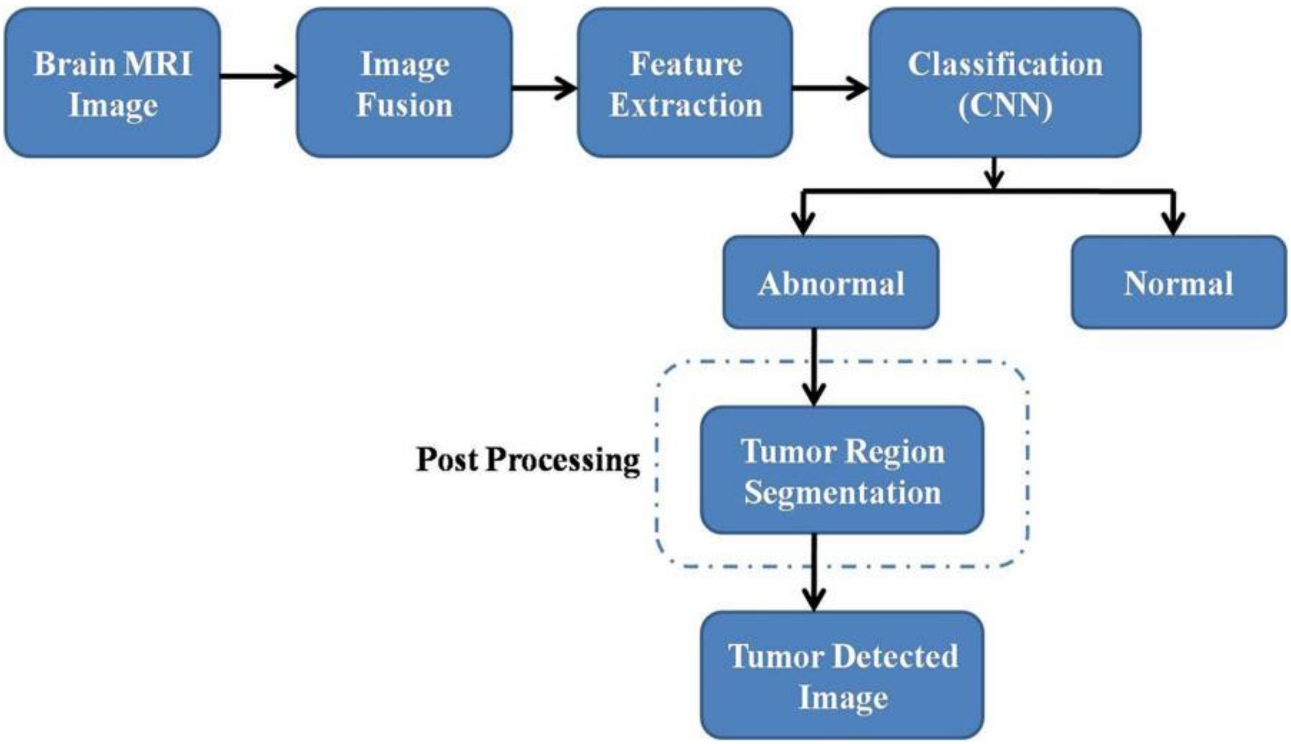
The ability to detect a tumor earlier, when it is smaller, reduces the impact of surgery and treatment, improving the prognosis for many patients.

We have used Deep learning algorithms like CNN to detect the presence of tumor cells from the scanned images of the brain[MRI]. The system can be used through a frontend web application where the user can upload a brain scan image and the model makes a prediction with a reliable amount of accuracy.

Our Focus is by spreading awareness on the effects of brain tumor and its causes

4.1 Proposed Design

Fig:1-Classification flow chart



4.2 Assumptions and Dependencies

Assumptions:

1.The Collected Dataset is only MRI Scans of the human brain.

2.The processed data is 90%clean.

3.The image is processed 100% by VGG-16.

4.The Needed gets the output in binary format.

Dependencies:

1.The file is dependent on the model Resnet.

2.Data set values contain only Human brain MRI Scans

CHAPTER 5

REQUIREMENTS

CHAPTER 5 REQUIREMENTS

5.1 FUNCTIONAL REQUIREMENTS

The online web application should provide the following functions:

· The user shall be able to input features from the patient's examination and make predictions which will aid in final diagnosis.

· The system shall generate reports of the Machine Learning models used. The doctor will also be able to cross-check the prediction with other Machine Learning models

· The user can use the Webapp to perform exploratory data analysis on the Brain Tumor dataset.

5.2 Software Requirements

User Interfaces
● Python IDE (Pycharm/VScode/Jupyter)

Hardware requirements

● Minimum 4GB RAM

● Minimum i3 processor

CHAPTER 6
METHODOLOGY

CHAPTER 6 METHODOLOGY

Brain tumor Classification using Deep Learning we use VGG16 model to classify the different brain tumor.

Tools we have used are tensor flow and keras to help in classification.

Step 1 : Finding the datasets of brain tumor data via researching different papers we used kaggle to find and assess different models.

Step 2: Searching for various CNN models for best use ResNet LeNet VGG-16 AlexNet

GoogleNet/InceptionNet.

Step 3: We decided that VGG16 is a better option in terms of CNN Classification models.

Step 4: We split the data into 76% for training and 10 images for testing.

Step 5: Processing of the image is done by taking 224x224 as the image size for the model to scan and analyze.

Step 6: Output is the classification level of determining whether the given MRI image has a tumor or not.

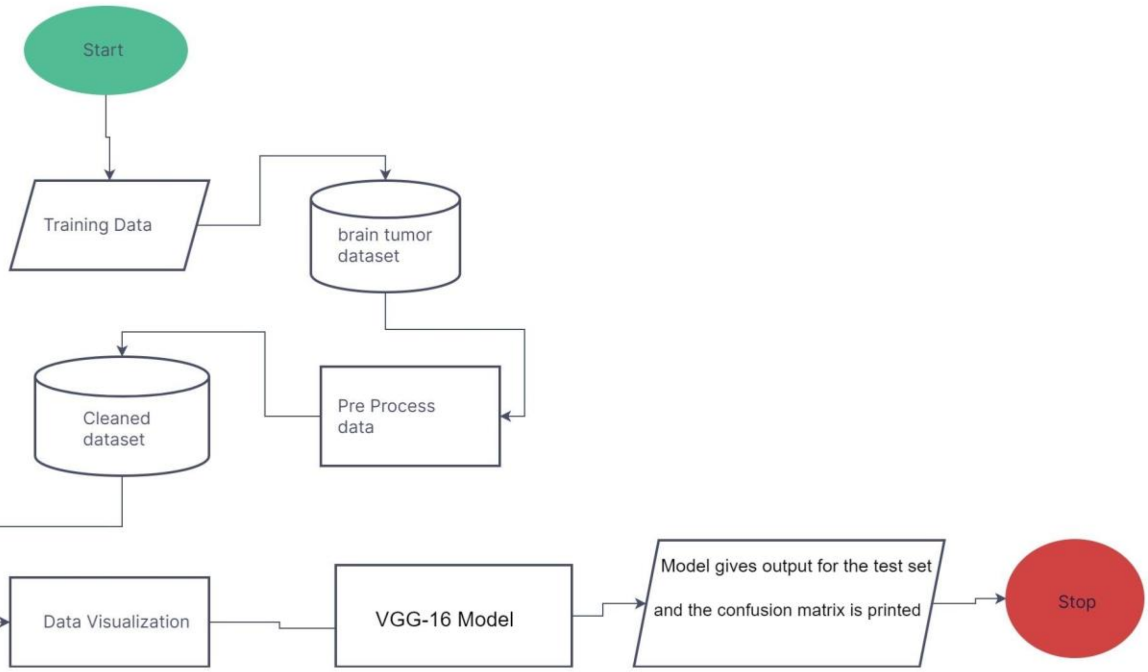


Fig2(a):Brain Tumor Flowchart

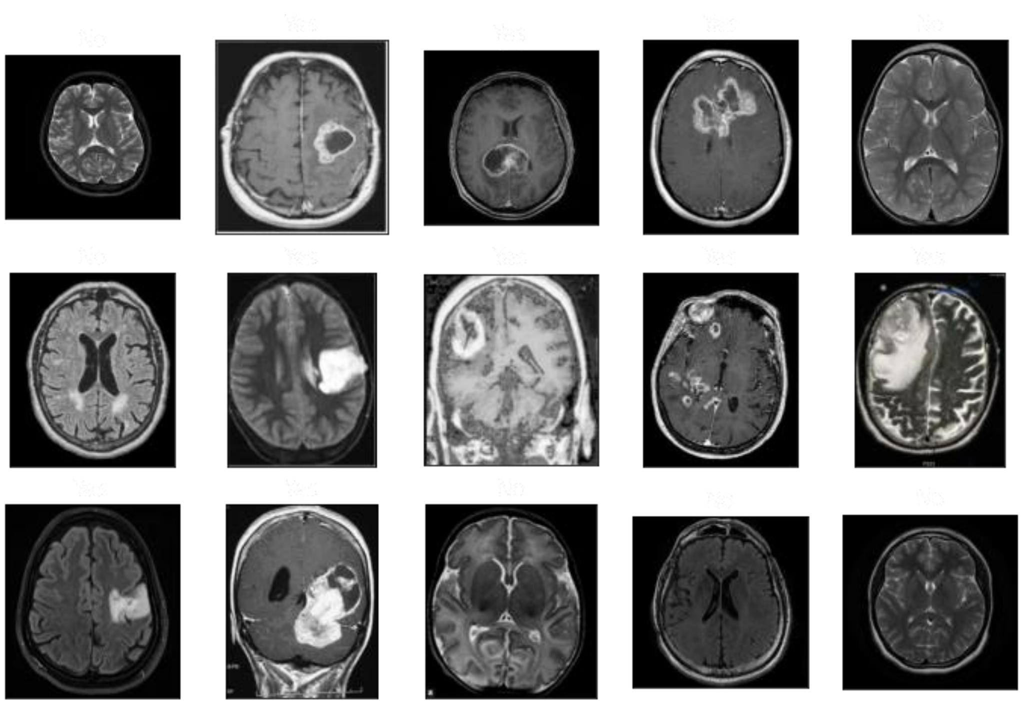


Fig2(b)-MRI Scans of Brain Tumor Images

CHAPTER 7
EXPERIMENTATION

CHAPTER 7 EXPERIMENTATION

- The models used here are Resnet50 Inception V3,,VGG16. These models consist of an input layer followed by a combination of layers like 2D convolution, max pooling, batch normalization, activation, pooling, flatten, drop out and dense. These models were trained independently on a dataset of 2,000 images. Using Scikit-Learn the dataset was split into training, testing and validation sets. Initially, a 90:10 split was made, 10% of which was used for testing . The remaining 90% was further split in the ratio 80:20. 80% of the split was used for training and the remaining 20% for testing. We evaluate our models independently using the same training and test samples, this ensures that the model's accuracy can be verified on equal grounds.
- Low accuracy of models. This was due to incorrect model fitting. This was easily fixed by making minor adjustments to how the model was using the dataset.
- Dataset Split. Initially, the dataset split was not random. The last few image samples were used for validation (which were taken under darker lighting conditions compared to the rest of the set), which resulted in a very low validation accuracy.By running more number of epochs this issue was solved and the model was able to achieve a high accuracy.
- Involving the Front end implementation, we faced the hurdle of presenting the working of model. Unlike a normal website we are unable to load the model in the backend and make it function.

CHAPTER 8
TESTING AND RESULTS

CHAPTER 8 TESTING AND RESULTS

Test Case#1:

Name of the Test	Checking images if tumors exist
Expected result	Brain Tumors Exist
Output	Brain Tumor yes
Remarks	Successful

Test Case #2

Name of the Test	Checking in images if tumor does not exist
Expected result	Brain tumor non existent
Output	Brain tumor not found
Remarks	Successful

Results#1

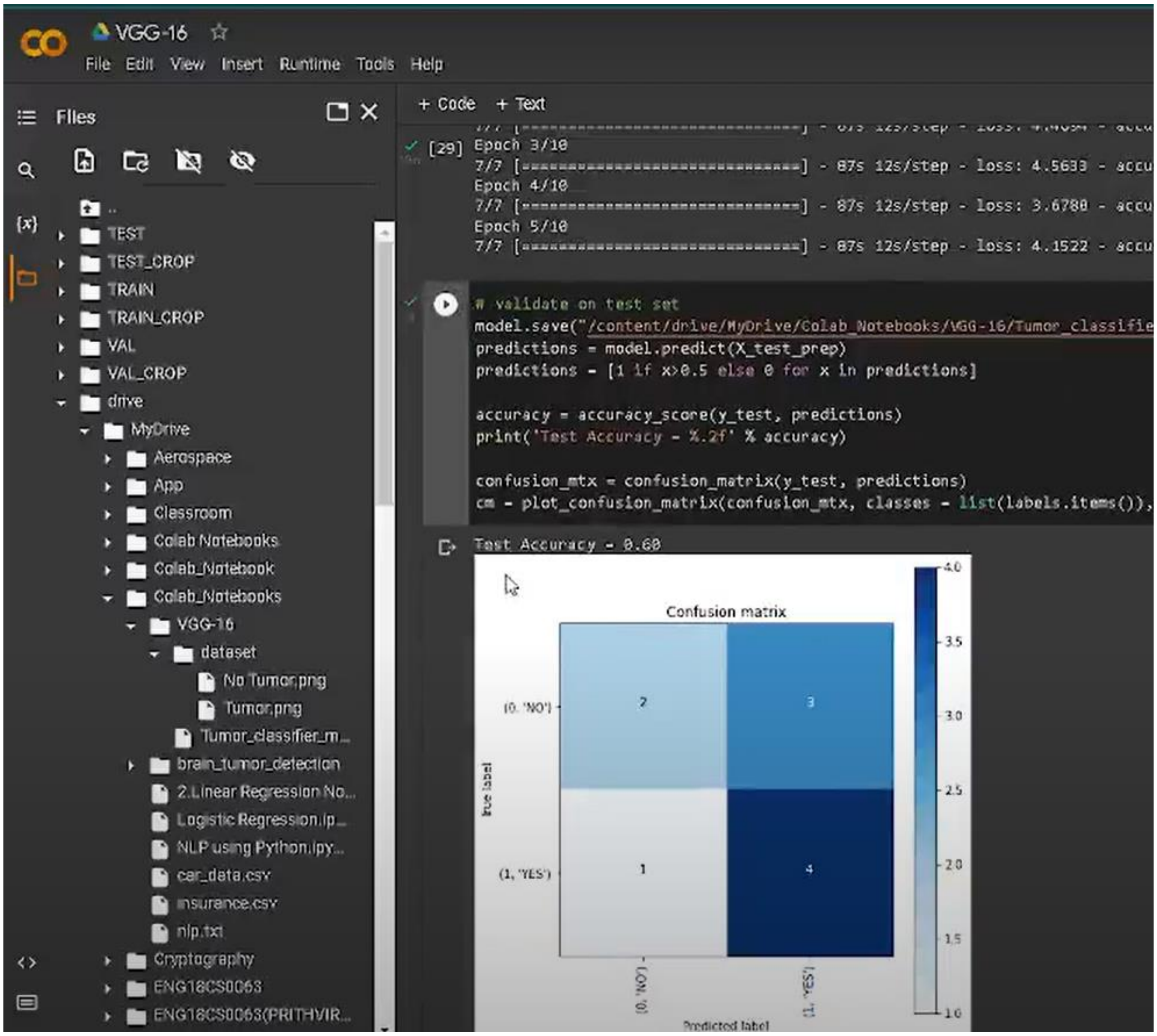


Fig3:Confusion Matrix for our VGG-16 model with 68% accuracy

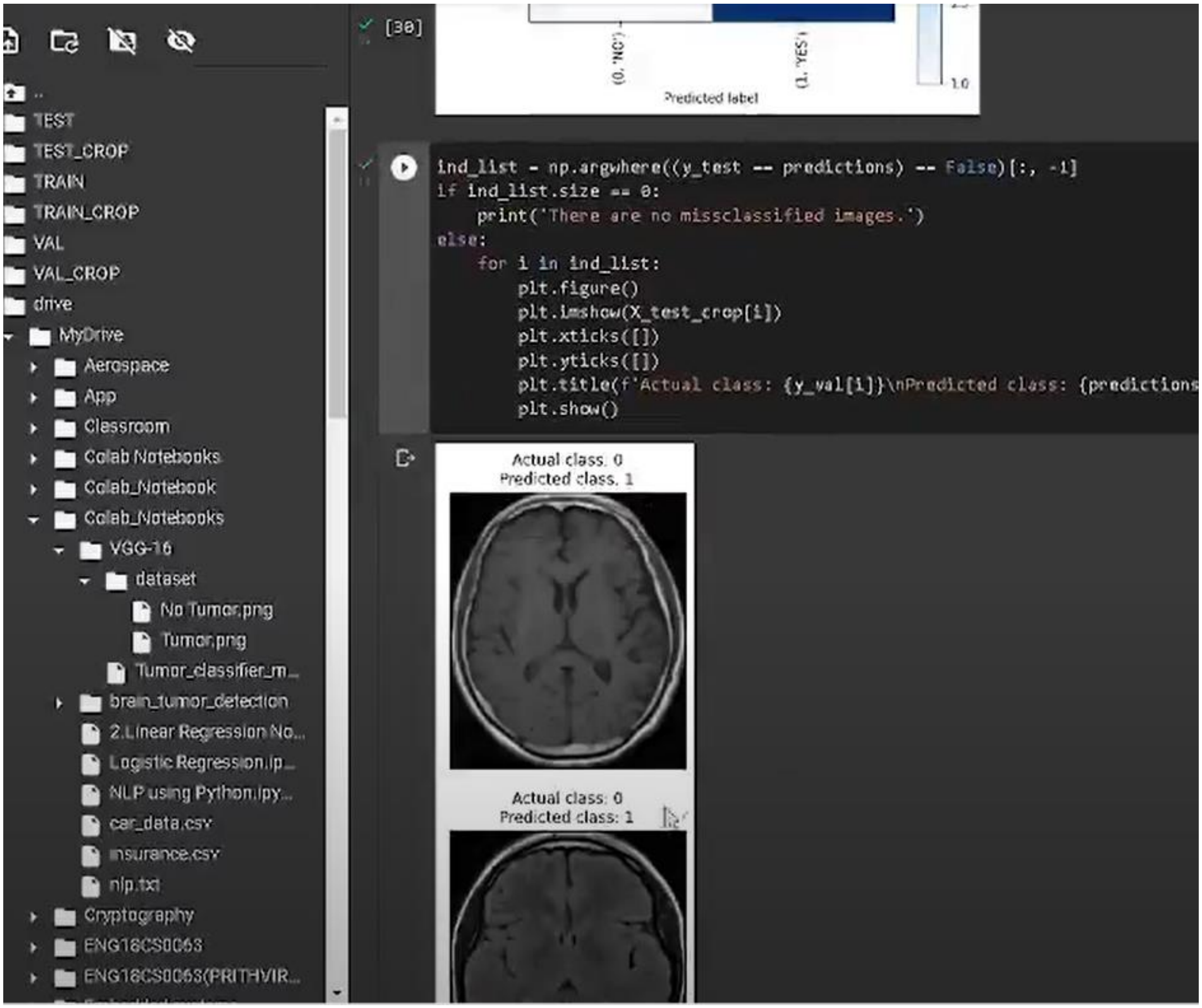


Fig 4:Difference between Actual class and Predicted class

Results #2

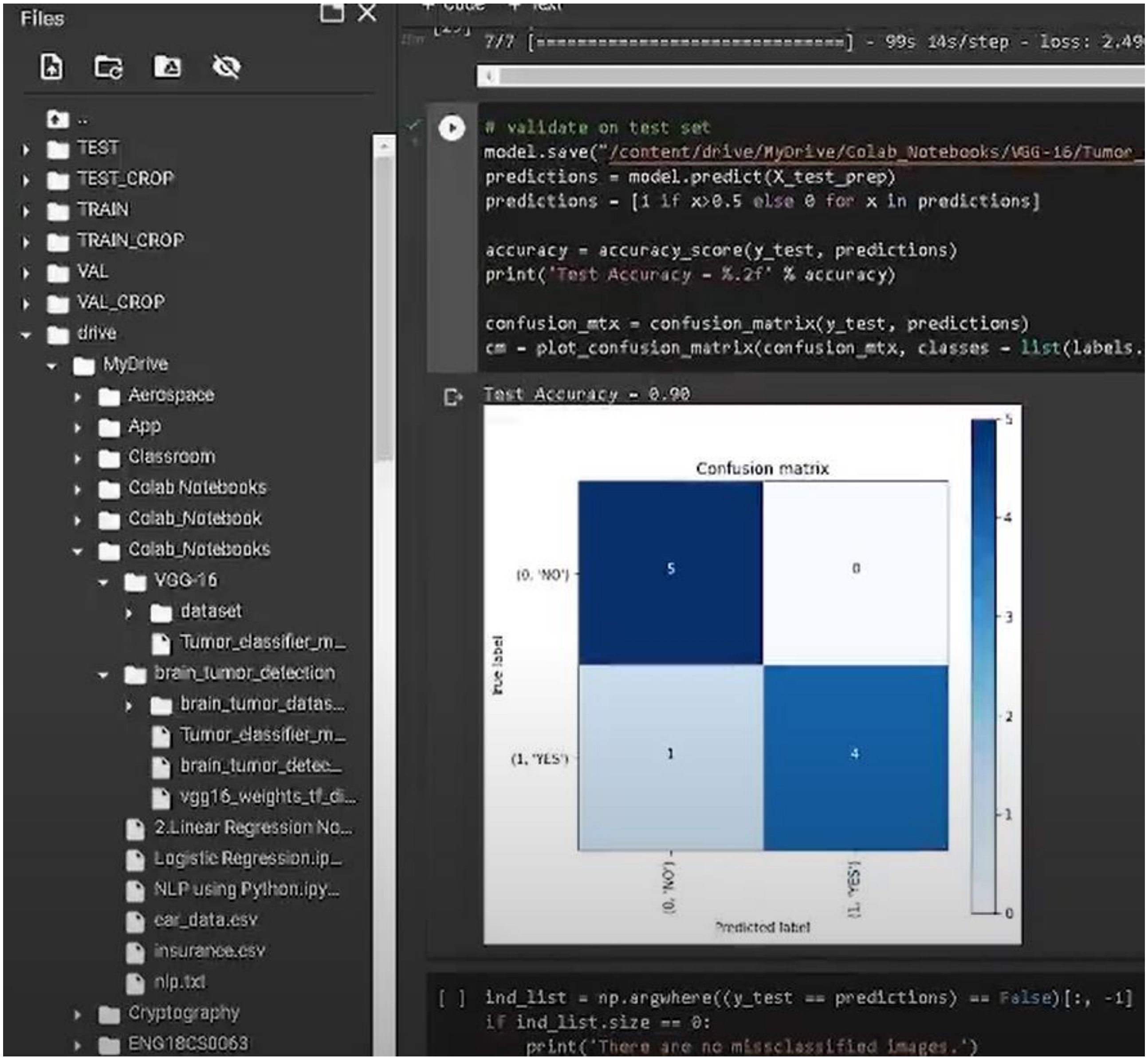


Fig 5: Confusion matrix when higher accuracy

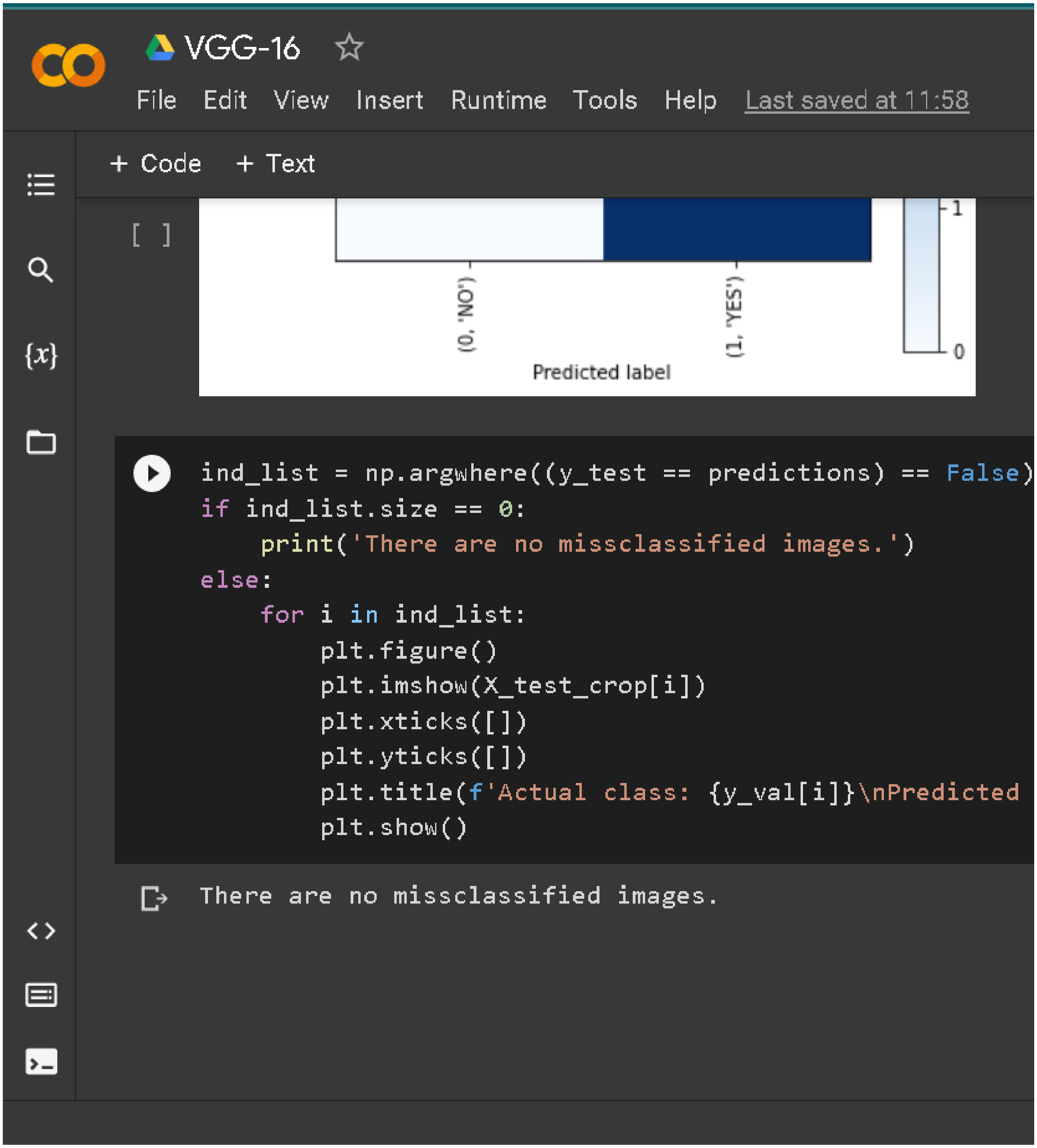


Fig 6: No misclassified image

REFERENCES

[1] Multi-Classification of Brain Tumor MRI Images Using Deep Convolutional Neural Network with Fully Optimized Framework conference: Iranian Journal of Science and Technology, Transactions of Electrical Engineering volume 45, pages1015–1036 (2021) :link:

[2] Classification of Brain Tumors from MRI Images Using a Convolutional Neural Network Conference name:https://www.frontiersin.org/articles/10.3389/fnins.2021.679847/full

[3] Brain Tumor MRI Image Classification Using Convolutional Dictionary Learning With Local Constraint Conference name: journal of physics

[4] Brain Tumor Classification Using Convolutional Neural Network. conference name: ICCCEBS 2021

[5] Brain tumor classification in MRI image using convolutional neural network Conference name :AIIMS 15 September 2020

[6] Brain Tumor Detection and Classification from Multi- Channel MRIs using Deep Learning and Transfer Learning. Conference Name:IEEE Computational Intelligence Society Graduate Student Research Grant 2017

[7] ChengBraintumordataset.figshare.Dataset https://figshare.com/articles/dataset/brain_tumor_dataset/1512427/5

[8] J. Deng, W. Dong, R. Socher, L.-J. Li, K. Li, L. Fei-Fei, ImageNet: a large-scale hierarchical image database. In IEEE Conference on Computer Vision and Pattern Recognition, 2009 CVPR 2009, pp. 248–255. IEEE (2009).

[9] S. Naz, A.I. Umar, R. Ahmad, I. Siddiqi, S.B. Ahmed, M.I. Razzak, F. Shafait, Urdu Nastaliq Recognition using convolutional–recursive deep learning. Neurocomputing 243, 80–87(2017) https://www.sciencedirect.com/science/article/abs/pii/S0925231217304654?via%3Dihub

[10] Brain Tumor Classification Using Convolutional Neural Network ICCCEBS 2021 MRI; CNN; transfer learning; inception; resnet brain tumor; VGG deep learning

[11] Brain tumor classification in MRI image using convolutional neural network AIIMS 15 September 2020 CNN model with pre- trained VGG-16, ResNet-50, and Inception-v3 models.

[12] A Survey on Transfer Learning Date of Publication: 16 October 2009 In this survey, we discuss the relationship between transfer learning and other related machine learning techniques such as domain adaptation, multitask learning and sample selection bias, as well as covariate shift. We also explore some potential future issues in transfer learning research

APPENDIX A

CODE

Import the Libraries

```
import numpy as np
from tqdm import tqdm
import cv2
import os
import shutil
import itertools
import imutils
import matplotlib.pyplot as plt
from sklearn.preprocessing import LabelBinarizer
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score, confusion_matrix
import plotly.graph_objs as go
from plotly.offline import init_notebook_mode, iplot
from plotly import tools
from keras.preprocessing.image import ImageDataGenerator
from keras.applications.vgg16 import VGG16, preprocess_input
from keras import layers
from keras.models import Model, Sequential
from tensorflow.keras.optimizers import Adam, RMSprop
from keras.callbacks import EarlyStopping
```

Defining the path for the model classifier

```
IMG_PATH = '/content/drive/MyDrive/Colab_Notebooks/brain_tumor_detection/brain_tumor_dataset/'
# split the data by train/val/test
for CLASS in os.listdir(IMG_PATH):
    if not CLASS.startswith('.'):
        IMG_NUM = len(os.listdir(IMG_PATH + CLASS))
        for (n, FILE_NAME) in enumerate(os.listdir(IMG_PATH + CLASS)):
            img = IMG_PATH + CLASS + '/' + FILE_NAME
            if n < 5:
                shutil.copy(img, 'TEST/' + CLASS.upper() + '/' + FILE_NAME)
            elif n < 0.8*IMG_NUM:
                shutil.copy(img, 'TRAIN/'+ CLASS.upper() + '/' + FILE_NAME)
            else:
                shutil.copy(img, 'VAL/'+ CLASS.upper() + '/' + FILE_NAME)
```

Loading the resized images into the model

```
plt.figure(figsize = (6,6))
plt.imshow(cm, interpolation='nearest', cmap=cmap)
plt.title(title)
plt.colorbar()
tick_marks = np.arange(len(classes))
plt.xticks(tick_marks, classes, rotation=90)
plt.yticks(tick_marks, classes)
if normalize:
    cm = cm.astype('float') / cm.sum(axis=1)[:, np.newaxis]

thresh = cm.max() / 2.
cm = np.round(cm,2)
for i, j in itertools.product(range(cm.shape[0]), range(cm.shape[1])):
    plt.text(j, i, cm[i, j],
             horizontalalignment="center",
             color="white" if cm[i, j] > thresh else "black")
plt.tight_layout()
plt.ylabel('True label')
plt.xlabel('Predicted label')
plt.show()
```

Plotting the trained set

```
for index in range(len(labels_dict)):
    imgs = X[np.argwhere(y == index)][:n]
    j = 10
    i = int(n/j)

    plt.figure(figsize=(15,6))
    c = 1
    for img in imgs:
        plt.subplot(i,j,c)
        plt.imshow(img[0])

        plt.xticks([])
        plt.yticks([])
        c += 1
    plt.suptitle('Tumor: {}'.format(labels_dict[index]))
    plt.show()
```

Training the dataset with less number of epochs

```
EPOCHS = 15
es = EarlyStopping(
    monitor='val_accuracy',
    mode='max',
    patience=3
)

history = model.fit_generator(
    train_generator,
    steps_per_epoch=7,
    epochs=EPOCHS,
    #validation_data=validation_generator,
    #validation_steps=25,
    callbacks=[es]
)
```

Showcasing the output

```
ind_list = np.argwhere((y_test == predictions) == False)[:, -1]
if ind_list.size == 0:
    print('There are no missclassified images.')
else:
    for i in ind_list:
        plt.figure()
        plt.imshow(X_test_crop[i])
        plt.xticks([])
        plt.yticks([])
        plt.title(f'Actual class: {y_val[i]}\nPredicted class: {predictions[i]}')
        plt.show()
```

GitHub Link: https://github.com/Prithviraj1217/Brain-tumor-detection-using-VGG-16

FUNDING AND PAPER PUBLISHING DETAILS

Paper Title	Brain Tumor Classification Using Deep Learning
Journal	IJRASET, Volume 10, Issue V, May 2022
Year of Publication	2022
Abstract	Brain tumor is one of the deadliest diseases existing on our planet today. Brain tumor along with other disorders associated with the Central Nervous System, results in a huge number of deaths around the world every year. The main problem is that in most cases the symptoms are mild and are most often ignored. And finally, the disease is detected in its final stage where the treatment options are limited and the chances of death of the patient becomes very high. The only solution that can be suggested to this problem is to use an automated system with high accuracy in detecting the disease in its early stages. We intend to create a tool which can be used to detect the disease in its early stages using deep learning techniques like Convolution Neural Network (CNN). The algorithm analyses the brain's MRI (Magnetic Resonance Imaging) scan images and makes a prediction with a decent amount of accuracy. The test is made accessible through a web application which can be used as a simple tool. Thus, doctors can make a more confident diagnosis of the disease.
Authors	C Prithviraj Ebin Jacob Creflo Asir Joel Pranav Sharan K Sri Srinivasan


ISSN No. : 2321-9653
iJRASET
International Journal for Research in Applied Science & Engineering Technology
IJRASET is indexed with Crossref for DOI-DOI : 10.22214
Website : www.ijraset.com, E-mail : ijraset@gmail.com
Certificate
It is here by certified that the paper ID : IJRASET43517, entitled
Brain Tumour Classification Using Deep Learning
by
C Prithviraj
after review is found suitable and has been published in
Volume 10, Issue V, May 2022
in
International Journal for Research in Applied Science & Engineering Technology
Good luck for your future endeavors
Editor in Chief, iJRASET
ISRA Journal Impact Factor: 7.429
45.98
INDEX COPERNICUS
THOMSON REUTERS
doi
crossref
TOGETHER WE REACH THE GOAL
SJIF 7.429


ISSN No. : 2321-9653
iJRASET
International Journal for Research in Applied Science & Engineering Technology
IJRASET is indexed with Crossref for DOI-DOI : 10.22214
Website : www.ijraset.com, E-mail : ijraset@gmail.com
Certificate
It is here by certified that the paper ID : IJRASET43517, entitled
Brain Tumour Classification Using Deep Learning
by
Ebin Jacob
after review is found suitable and has been published in
Volume 10, Issue V, May 2022
in
International Journal for Research in Applied Science & Engineering Technology
Good luck for your future endeavors
Editor in Chief, iJRASET
ISRA Journal Impact Factor: 7.429
45.98
INDEX COPERNICUS
THOMSON REUTERS
doi
crossref
TOGETHER WE REACH THE GOAL
SJIF 7.429


ISSN No. : 2321-9653
iJRASET
International Journal for Research in Applied Science & Engineering Technology
IJRASET is indexed with Crossref for DOI-DOI : 10.22214
Website : www.ijraset.com, E-mail : ijraset@gmail.com
Certificate
It is here by certified that the paper ID : IJRASET43517, entitled
Brain Tumour Classification Using Deep Learning
by
Creflo Asir Joel
after review is found suitable and has been published in
Volume 10, Issue V, May 2022
in
International Journal for Research in Applied Science & Engineering Technology
Good luck for your future endeavors
Editor in Chief, iJRASET
ISRA Journal Impact Factor: 7.429
45.98
INDEX COPERNICUS
THOMSON REUTERS
TOGETHER WE REACH THE GOAL
SJIF 7.429

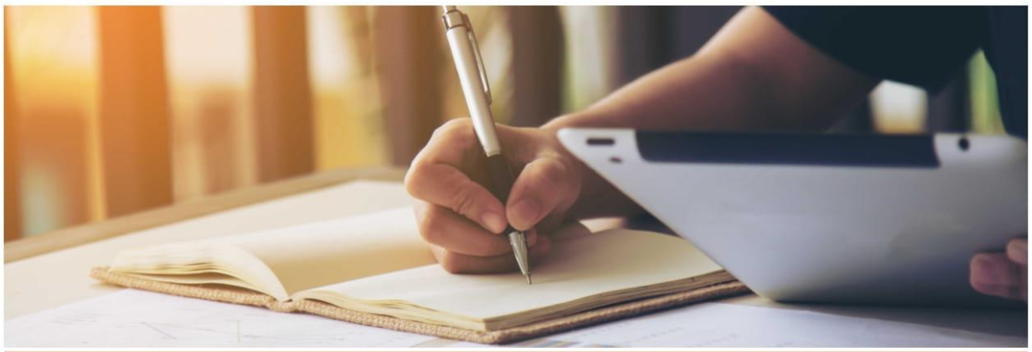

ISSN No. : 2321-9653
iJRASET
International Journal for Research in Applied Science & Engineering Technology
IJRASET is indexed with Crossref for DOI-DOI : 10.22214
Website : www.ijraset.com, E-mail : ijraset@gmail.com
Certificate
It is here by certified that the paper ID : IJRASET43517, entitled
Brain Tumour Classification Using Deep Learning
by
Pranav Sharan
after review is found suitable and has been published in
Volume 10, Issue V, May 2022
in
International Journal for Research in Applied Science & Engineering Technology
Good luck for your future endeavors
Editor in Chief, iJRASET
ISRA Journal Impact Factor: 7.429
45.98
INDEX COPERNICUS
THOMSON REUTERS
TOGETHER WE REACH THE GOAL
SJIF 7.429

ISSN No. : 2321-9653
iJRASET
International Journal for Research in Applied Science & Engineering Technology
IJRASET is indexed with Crossref for DOI-DOI : 10.22214
Website : www.ijraset.com, E-mail : ijraset@gmail.com
Certificate
It is here by certified that the paper ID : IJRASET43517, entitled
Brain Tumour Classification Using Deep Learning
by
K Sri Srinivasan
after review is found suitable and has been published in
Volume 10, Issue V, May 2022
in
International Journal for Research in Applied Science & Engineering Technology
Good luck for your future endeavors
Editor in Chief, iJRASET
ISRA Journal Impact Factor: 7.429
45.98
INDEX COPERNICUS
THOMSON REUTERS
doi
crossref
TOGETHER WE REACH THE GOAL
SJIF 7.429

Paper Accepted- IJRASET43517

noreply@ijraset.com <noreply@ijraset.com> Tue, May 31, 2022 at 7:18 PM
Reply-To: NoReply@server.ijraset.info
To: ebinjacob1999@gmail.com, ijraset@gmail.com

iJRASET
International Journal For Research in
Applied Science and Engineering Technology



PAPER ACCEPTED

About Us | **Aim & Scope** | **Check Paper Status**

Dear Author/Research Scholar,

I am pleased to inform you that IJRASET would like to publish your manuscript **"Brain Tumour Classification Using Deep Learning"** in Volume 10 Issue V May 2022 . Acceptance for the paper is sent on the recommendation of experts after peer review.

In order to proceed to publish your submission we will need you to follow below process:

1. Paper will be published within 48 Hours (Guaranteed Publication within given time) after the submission of publication fee.
2. Soft Copy of the certificates will be provided immediately (within 04 hours) after paying the fee for accepted papers. You can download your certificates/check paper status online through this link- https://www.ijraset.com/status.php
3. Submit Copyright form online. Link to submit Copyright online: Click here
4. Please find the Publication fee details, Account Details & Payment Methods in below table.

Brain Tumour Classification Using Deep Learning

C Prithviraj[1], Ebin Jacob[2], Creflo Asir Joel[3], Pranav Sharan[4], K Sri Srinivasan[5]

Department of Computer Science & Engineering, Dayananda Sagar University, Bangalore, Karnataka, India.

[1]prithviprv10@gmail.com [2]ebinjacob1999@gmail.com [3]crefloasirjoel@gmail.com

[4]eng18cs0121.pranavsharan@gmail.com [5]eng18cs0121.pranavsharan@gmail.com

***Abstract*— Brain tumour is one of the deadliest diseases existing on our planet today. Brain tumour along with other disorders associated with the Central Nervous System, results in a huge number of deaths around the world every year. The main problem is that in most cases the symptoms are mild and are most often ignored. And finally, the disease is detected in its final stage where the treatment options are limited and the chances of death of the patient becomes very high. The only solution that can be suggested to this problem is to use an automated system with high accuracy in detecting the disease in its early stages. We intend to create a tool which can be used to detect the disease in its early stages using deep learning techniques like Convolution Neural Network (CNN). The algorithm analyses the brain's MRI (Magnetic Resonance Imaging) scan images and makes a prediction with a decent amount of accuracy. The test is made accessible through a web application which can be used as a simple tool. Thus, doctors can make a more confident diagnosis of the disease.**

***Keywords*— Central Nervous System, Convolution Neural Network, Deep Learning, Malignant, Benign, Magnetic Resonance Imaging.**

I. INTRODUCTION

The use of technology has influenced every aspect of human life. Using technology has made human lives easy. Technology also paved the way to many new facilities which were not possible before. While making use of technology to achieve the otherwise impossible tasks, one area where we can expand this use case is in the field of medicine.

Most deadly diseases like cancers and tumours can be cured thus saving millions of lives every year provided they are diagnosed in early stages. Diagnosis during early stages of the disease is really important because the choice of treatment options, survival rate etc. is considerable. The tumour or cancer cells can be operated out and the patient then undergoes radiation and chemotherapy. But during later stages of the disease the cancerous cells become so widespread that it becomes almost impossible to surgically remove the cancerous cells without damaging the organ where the cancer is located. As far as brain tumours are concerned, it is considered nearly impossible to remove these cells because it has affected one of the most vital parts of the human body – The Brain.

Another challenge faced while treating brain tumours is that the membrane of the nerve endings in the brain is a selectively permeable membrane. It becomes difficult for medicines to produce any effects because the medicine molecules are stopped by this membrane making the treatment further complicated. This highlights the importance of diagnosing a brain tumour in its early stages so that the chances of survival of the patient is higher.

The goal is to develop a brain tumour prediction tool. It takes the MRI scan images of the brain as an input and provides the results with a good amount of accuracy. Deep learning algorithms like Convolutional Neural Networks trained with brain scan image datasets will analyse the image to make the prediction. The tool is accessed through a frontend web application. The web application provides the detection feature along with some awareness about the various forms of brain tumours and abnormalities that can occur to the central nervous system.

This web application is designed to be used by physicians and doctors to help themselves make a more confident diagnosis of the disease. This tool is also accessible to common man to make a self-analysis of the brain scanned images

II. MAIN OBJECTIVE

The main objective of the system designed here is to take an MRI scan image of the brain as the input and using deep learning algorithms like CNN VGG-16 running at the backend. The system makes a prediction with a reliable amount of accuracy such that the doctors and other lab technicians can refer to the system before making their final diagnosis of the disease. The system is made accessible through a frontend web application where the user can interact with the backend algorithm thus making it an easily accessible tool for a confident diagnosis of the disease.

III. RELATED WORKS

Multi-Classification of Brain Tumor MRI Images Using Deep Convolutional Neural Network with Fully Optimized Framework). The paper was published on 22nd April 2021 at the Springer link conference. The algorithm used was CNN (convolution neural network). The model they trained was capable of predicting the presence of tumour cells with up to 97% accuracy. From here the main takeaway is that the proposed CNN models can be actually employed to assist doctors in the real-world use cases. As a scope for future work the application should be able to perform multi-classification.

Classification of Brain Tumours from MRI images using a Convolution Neural Network. The paper was published in frontiers in neuroscience on 15th March 2020. They made use of a machine learning algorithm that achieved a substantial result in image segmentation and classification. The accuracy was measured using the 10-fold cross validation method and the accuracy was close to 96%. In future, the prediction systems must be accurate and fast such that they can be used in operation theatres to perform real-time analysis of the brain and may extend to improving the system to even support 3D images which contain more data and hence has the scope to produce more accurate results

Brain Tumor MRI Image Classification Using Convolutional Dictionary Learning with Local Constraint. The paper was published in the Journal of Physics: conference, dated 28 May 2021. Here we could notice that the method integrates the multi-layer dictionary learning into a convolutional neural network (CNN) structure to explore the discriminative information. The main highlight is that Classification of types of meningiomas, gliomas, and pituitary tumours on the Cheng dataset and types of AST, OLI, and GBM on the REMBRANDT dataset is carried out with high performance in accuracy, recall, precision, F1-score, and balance loss. This proposed method CDLLC uses the locality constraint of atoms to preserve the manifold structure of the codes. Different from the traditional dictionary learning that uses manual feature extraction, CDLLC extracts the useful CNN features automatically in the architecture of deep learning.

Brain Tumor Classification Using Convolutional Neural Network. The paper was published with ICCCEBS 2021. The algorithm used is CNN, modified to be a transfer learning technique like inception, resnet, VGG, deep learning etc. This concept is able to detect the images using Keras, by building an artificial convolutional neural network. Our proposed system is for binary classification problems, however, in future work, the proposed method can be extended for categorical classification problems such as identification of brain tumour types such as Glioma, Meningioma, and Pituitary or may be used to detect other brain abnormalities.

IV. METHODOLOGY

A. The Dataset

The data set for training, validating and testing the predictive models include MRI scanned images of the brain. The data set comprises of brain's scan images both with and without tumour. They are segregated into separate sub datasets for the training purpose. The images in the dataset are then divided into training, testing and validation sets.

B. Data Pre-processing

Data pre-processing is a very crucial part of the methodology because the raw image data obtained from various publicly available sources needs to be transformed into a common form. There are various pre-processing techniques that we have implemented.

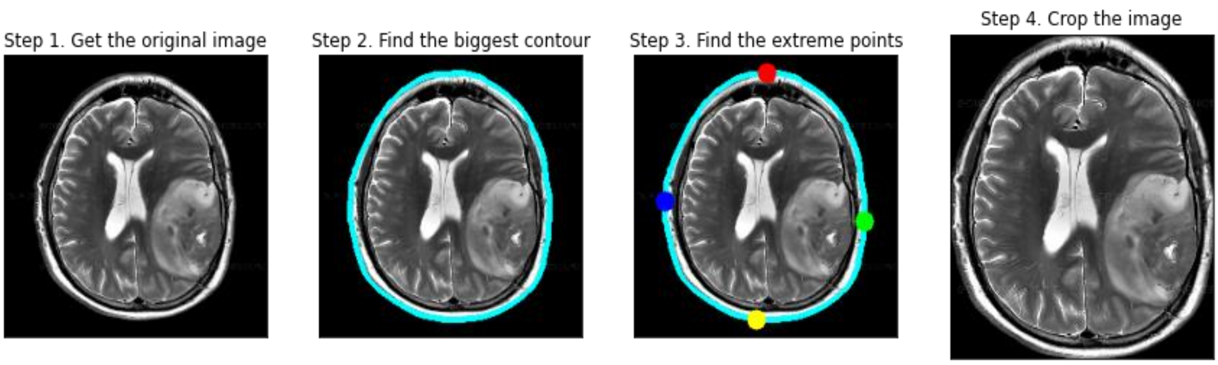


Fig 1: Cropping the MRI scan image

1. Cropping

The MRI scanned images have some amount of black area around the image of the brain. The size of the brain image within the surrounding black area varies from image to image and from patient to patient, this it is required to crop out the extra region around the brain image such that the boundaries of the brain meet the boundaries of the whole image.

Cropping the image to the required form happens in a stepwise manner. Firstly, we take an uncropped image from the dataset. Then the biggest contour or the edge of the brain is found. To find the biggest contours, some of the noise which exists in the black region around the brain is removed using dilations with a specified threshold value. and then the detection actually takes place. Four markers are placed on the four sides of the contour. The image is cropped in such a way that the edges of the whole image align with the extreme points. The same procedure is followed for all images in an iterative manner.

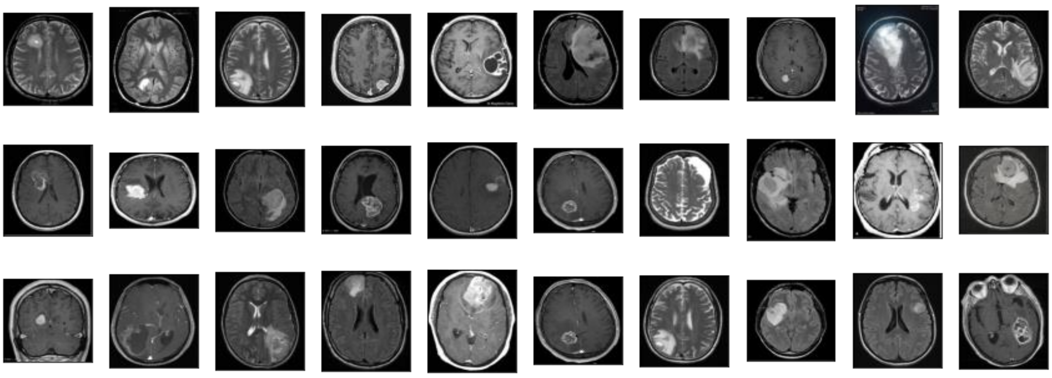


Fig 2: Sample dataset before cropping

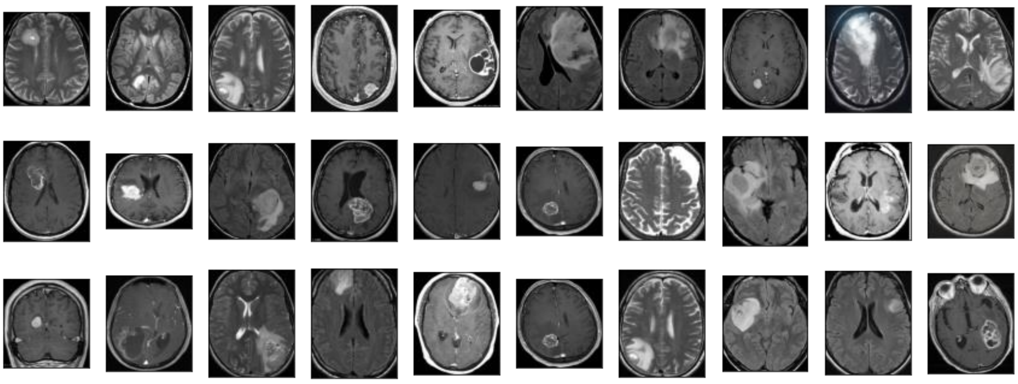


Fig 3: Sample dataset after cropping

2. Resizing

Resizing the image is mandatory because we are using the VGG16 variant of CNN. VGG16 layers support images of resolution 224x224. Thus, all the images in the dataset (train, test and validation) are resized to the given resolution for better results.

3. VGG15 Pre-processing

An extra stage of pre-processing is done to make the features in the scanned image more evident. The images undergo VGG15 pre-processing where the images are converted into an RGB format image in which the features of the tumour cells are more evident. This helps in better feature extraction, which in turn improves model accuracy.

C. Image Augmentation

Since the scan of the brain is taken from different individuals at different labs, the scanned images can never have the same orientation. Thus, all the images undergo an augmentation stage where the angle of inclination of the brain is made uniform for all the images in the dataset.

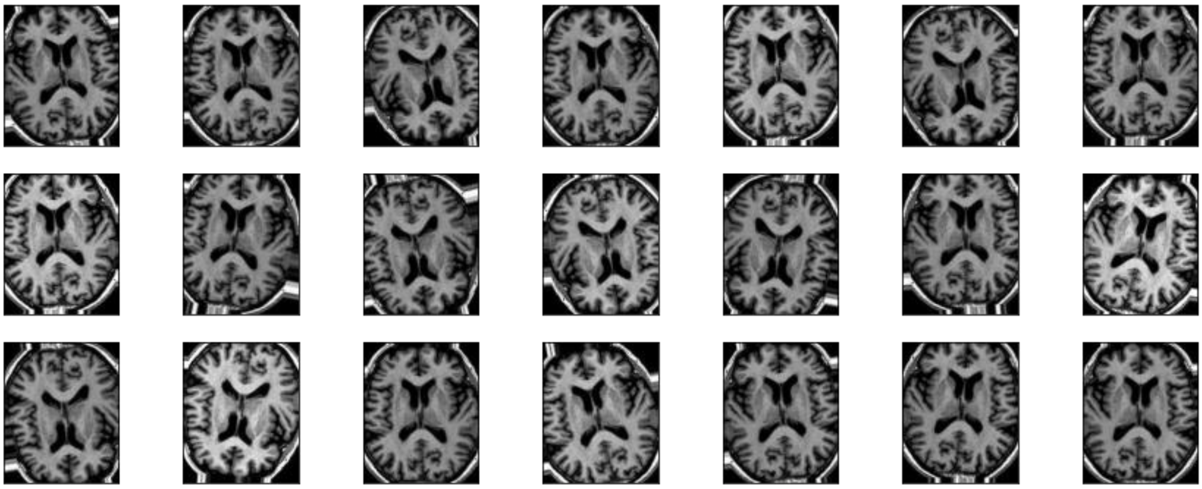


Fig 4: Data set after augmentation

D. Custom VGG Layers

Apart from the standard layers typically used in VGG algorithms, a few custom layers are also added for better extraction of maximum number of features from the images. The other layers include flatten layer, dropout layer and dense layer. This yields 14,739,777 parameters of which 25,089 are trainable parameters.

V. WORKING PROCEDURE

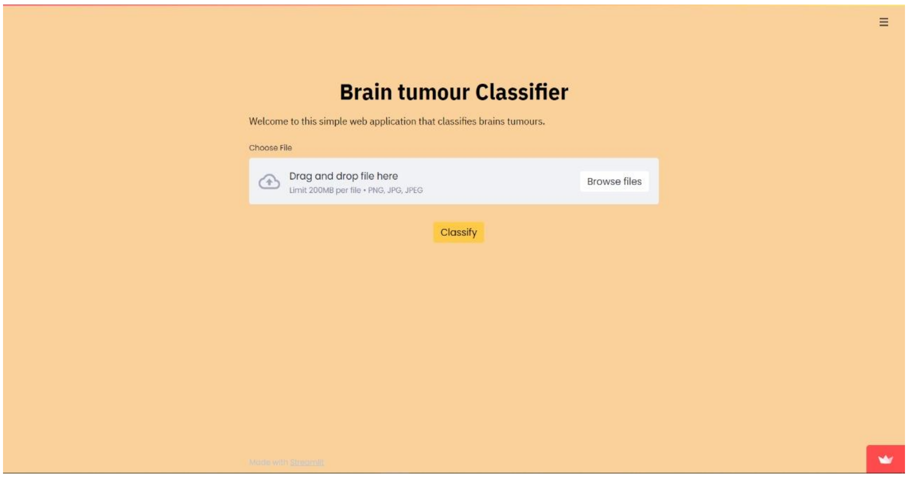


Fig 5: Page to upload image

1. *Step 1:* The user opens up the frontend web application. There are two major panes. One pane is used to perform the detection of tumour cells in a scanned brain image. The other pane aims to provide the user some level of awareness about the symptoms and possible risks involved with different types of brain tumours.
2. *Step 2:* The user heads over to the prediction pane of the web page and uploads an image of the MRI scan of a human brain.
3. *Step 3:* The image is fed as an input to our previously trained CNN model which makes a prediction based on the detected features from the image.
4. *Step 4:* The prediction made by the algorithm is presented to the user.

VI. RESULTS

The algorithm detects the presence of tumours in the image with an accuracy rate close to 90%. The accuracy is further improved by expanding the dataset. This can be hence used as a reliable tool to detect the presence of the disease which when done in an early stage can improve the scope of treatment options and can reduce the death rate to some extent.

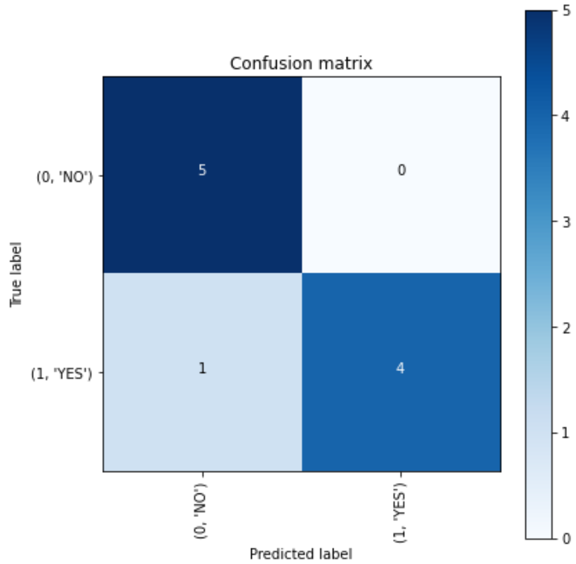


Fig 6: Confusion matrix for a small test set of 10 random scan images

VII. CONCLUSIONS

Through the web application we are able to detect the presence of brain tumour cells in a given image of the brain. We can therefore conclude that algorithms like CNN when trained with the required amount of data can be used as an efficient and reliable method. With a prediction accuracy close to 90%, the doctors and physicians can make a more confident diagnosis of the presence of tumour cells by using this web app. Even common men can use this to make a prediction as much technical or domain knowledge is not required to use the app. However, this is not advised as a false positive case can cause huge amounts of panic and distress.

VIII. FUTURE SCOPE

The work that we have discussed here is one with great scope for development in the future. Brain tumour detection can be done in real time if we have the required real time scanners and powerful computers. Similar systems may be implemented to detect diseases other than brain tumours like cancers and other internal abnormalities.

The accuracy of prediction can be further improved if 3-dimensional scan images are provided. The computation power required for it is quite high but this can be of great use.

REFERENCES

[1] Multi-Classification of Brain Tumour MRI Images Using Deep Convolutional Neural Network with Fully Optimized Framework conference: Iranian Journal of Science and Technology, Transactions of Electrical Engineering volume 45, pages 1015–1036 (2021)

[2] Classification of Brain Tumours from MRI Images Using a Convolutional Neural Network. Conference name:https://www.frontiersin.org/articles/10.3389/fnins.2021.679847/full

[3] Brain Tumour MRI Image Classification Using Convolutional Dictionary Learning with Local Constraint Conference name: journal of physics

[4] Brain Tumour Classification Using Convolutional Neural Networks. conference name: ICCCEBS 2021.

[5] Brain tumour classification in MRI image using convolutional neural network Conference name: AIIMS 15 September 2020

[6] Brain Tumour Detection and Classification from Multi- Channel MRIs using Deep Learning and Transfer Learning. Conference Name: IEEE Computational Intelligence Society Graduate Student Research Grant 2017

[7] J. Deng, W. Dong, R. Socher, L.-J. Li, K. Li, L. Fei-Fei, ImageNet: a large-scale hierarchical image database. In IEEE Conference on Computer Vision and Pattern Recognition, 2009 CVPR 2009, pp. 248–255. IEEE (2009).

[9] S. Naz, A.I. Umar, R. Ahmad, I. Siddiqi, S.B. Ahmed, M.I. Razzak, F. Shafait, Urdu Nastaliq Recognition using convolutional–recursive deep learning. Neurocomputing 243, 80–87(2017) https://www.sciencedirect.com/science/article/abs/pii/S0925231217304654?via%3Dihub

[10] Brain Tumour Classification Using Convolutional Neural Network ICCCEBS 2021 MRI; CNN; transfer learning; inception; resnet brain tumour; VGG deep learning

[11] Brain tumour classification in MRI image using convolutional neural network AIIMS 15 September 2020 CNN model with pre- trained VGG-16, ResNet-50, and Inception-v3 models.

[12] A Survey on Transfer Learning Date of Publication: 16 October 2009 in this survey, we discuss the relationship between transfer learning and other related machine learning techniques such as domain adaptation, multitask learning and sample selection bias, as well as covariate shift. We also explore some potential future issues in transfer learning research.