SRKR ENGINEERING COLLEGE (A)

Diagnosis of Brain Tumour Using YOLO

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CONTENTS

ABSTRACT

- Brain cancer is a rare and deadly disease with a slim chance of survival.
- One of the most important tasks for neurologists and radiologists is to detect brain tumors early.
- Early detection of brain tumors is critical in a patient's treatment and makes it possible to save his or her life.
- Manually detecting brain tumors from brain magnetic resonance imaging (MRI) scans can be difficult and inaccurate.

- Due to this, an automatic brain tumor detection and segmentation system built with some of the world's most popular deep learning-based object detection algorithms.
- Usage of transfer learning approaches for a deep learning model to detect malignant tumors such as glioblastoma using MRI scans.
- A deep learning-based approach for brain tumor identification and classification, utilizing the cutting-edge object detection framework YOLO (You Only Look Once).

INTRODUCTION

- Brain tumors are one of the leading causes of death and disability worldwide because they invade the most vital organ of the human body.
- Brain cancer is currently the tenth leading cause of death from tumors in both men and women .
- Brain tumors can be fatal, affecting patients' and their loved ones' quality of life and changing everything as shown in figure 1.
- A cutting-edge object detection framework YOLO to identify and classify brain tumors using a deep learning-based approach.

- A deep learning-based approach for brain tumor identification and classification, utilizing the cutting-edge object detection framework YOLOv4 (You Only Look Once).

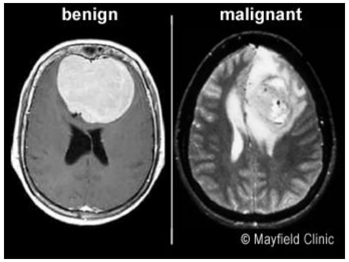


Fig 1. Types of Brain Tumour

LITERATURE SURVEY

S.No	Author	Paper Name	Key Findings	Year of Publication
1	Amran Hossain,et.al	A YOLOv3 Deep Neural Network Model to Detect Brain Tumor in Portable Electromagnetic Imaging System	The researchers collected fifty sample images from various head regions and augmented them to create a dataset. The dataset included fifty samples with either single or double tumours. The researchers used 80% of the images for training, 10% for validation, and the remaining 10% for testing the network's performance.	2021
2	Sethuram Rao.Grishi , et.al	Brain Tumor Detection Approaches: A Review using Artificial Neural Network (ANN) and Support Vector Machine (SVM).	Tumor can be detected using medical imaging techniques like Magnetic Resonance Imaging (MRI) .Hence for accurate analysis of Brain tumor, so this paper proposes the use of Segmentation which is Brain Tumor Detection .	2018
3	Sunil Kumar, et.al	Brain Tumor Detection Analysis Using CNN: A Review using CNN classification technique and has been used to disregard the dataset picture algorithm error	The implementation of the Image Restoration and Image Enhancement is applied in the Python and TensorFlow environment and Algorithms and methodologies used to solve specific research problems.	2021
4	Mohammad Omid Khairandish Vydeki.D , et.al	The Performance of Brain Tumor Diagnosis Based on Machine Learning Techniques.	the methodology of this study was to answer the real performance of brain tumors, and with help of different approaches and study of research studies with varied criteria.	2020

S.No	Author	Paper Name	Key Findings	Year of Publication
5	Parveen, et.al	Detection of brain tumor in MRI images, using combination of fuzzy c-means and SVM.	A new hybrid technique based on the support vector machine (SVM) and fuzzy c-means for brain tumor classification the image is enhanced using enhancement techniques such as contrast improvement, and mid-range stretch	2015
6	Mohammad Shahjahan Majib , et.al	VGG-SCNet: A VGG Net-Based Deep Learning Framework for Brain Tumor Detection on MRI Images	The proposed VGG-SCNet's (VGG Stacked Classifier Network) precision, recall, and f1 scores were found to be 99.2%, 99.1%, and 99.2% respectively .	2021
7	M.O. Khairandish , et.al	A Hybrid CNN-SVM Threshold Segmentation Approach for Tumor Detection and Classification of MRI Brain Images.	The proposed hybrid model, with consideration of both CNN and SVM model advantages which is alternate approach of other [1-5], shows significant improvement.	2022
8	Simon Podnar, et.al	Diagnosing brain tumors by routine blood tests using machine learning	Using routine blood tests from 15,176 neurological patients we built a machine learning predictive model for the diagnosis of brain tumors. The sensitivity and specificity of the adapted tumor model in the validation group were 96% and 74%, respectively.	2019

PROBLEM STATEMENT

- Health care sector is totally different from other industry. It is on high priority sector and people demand the best care and service regardless of cost.
- Deep learning is now giving innovative solutions with high accuracy for medical imaging and is a significant technique for upcoming applications in the health sector as a result of its success in other real-world applications..
- Because of its complex position and size variations, detecting an automated brain tumor in an MRI is difficult.

- Brain tumors are identified using YOLO (You Only Look Once), a cutting-edge object recognition framework, and are classified using CNN.

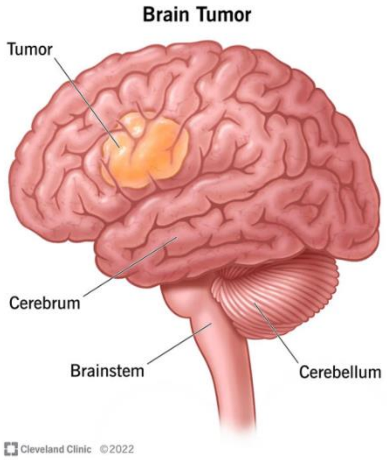


Fig 2. Brain Tumour

EXISITING SOLUTION

- In recent years, machine learning (ML) algorithms have been developed to help detect and diagnose brain tumors. These methods use data from imaging studies, such as CT scans and MRI, to create models that can identify the presence and characteristics of brain tumors
- One example of an ML method for brain tumor detection is using a convolutional neural network (CNN) to analyze images of the brain and classify them as either normal or containing a tumor.

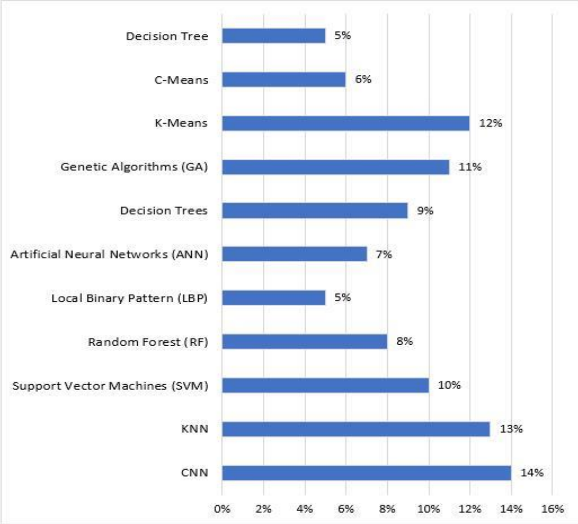


Fig 3. Method wise trends since 2012–2019

PROPOSED SOLUTION

- A combination of the YOLOv4 (You Only Look Once version 4) object detection algorithm and a Convolutional Neural Network (CNN) for classification. YOLOv4 is a state-of-the-art object detection algorithm that can detect objects in images and video in real-time. It works by dividing an image into a grid and predicting the presence and class of objects in each grid cell.

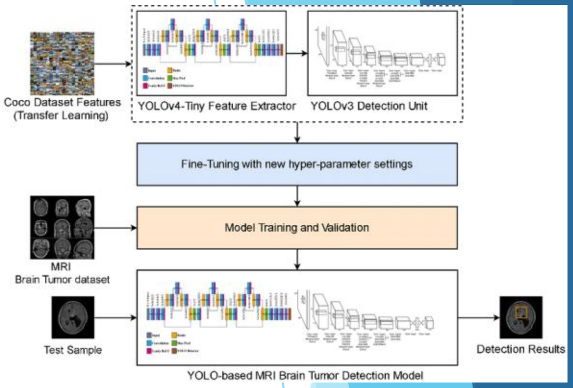


Fig 4. YOLO V4 Model

METHODOLOGY

- Data Acquisition
- Data Pre-processing
- Training Model using YOLO Model
- Classifying using CNN Model

DATA ACQUISITION

- There is an manual dataset which consists of Images of different MRI taken from different datasets, and of different sizes.
- The data in this dataset is less efficient for performing the detection and classification of brain tumours.
- It requires multiple pre-processing steps to get all images to a efficient format for training a model.

Training Model using YOLO Model

- ❑ Pre-process the MRI image
- ❑ Object detection
- ❑ Non-maximal suppression
- ❑ Postprocess the output
- ❑ Classify the detected objects

Pre-process the MRI image

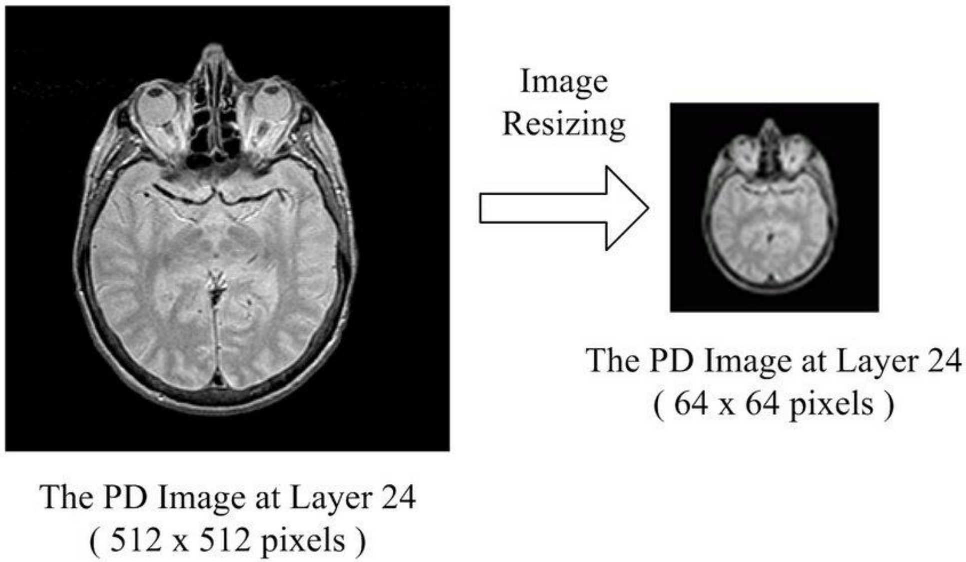


Fig 5. Image Resizing

Object detection

- The formula for the softmax function is as follows:

$$\text{softmax}(x) = \exp(x) / \text{sum}(\exp(x))$$

Non-maximal suppression

- Non-maximal suppression is also called Masking
- Masking acts as a filter and also as instance segmentation (real-time segmentation).

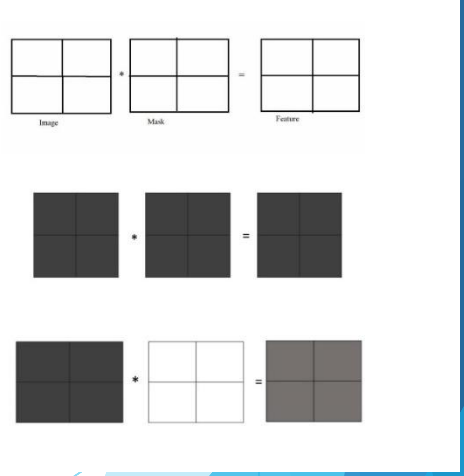


Fig.6. MASKING

Postprocess the output

- ❑ The IoU of these two boxes is calculated as follows:

IoU = (overlap area) / (union area)

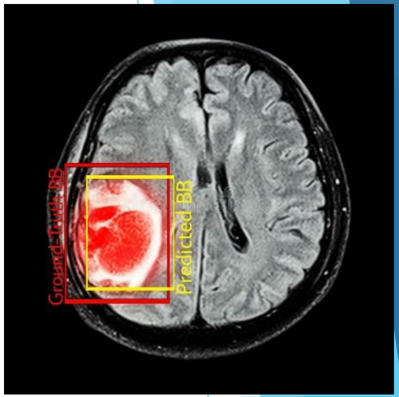


Fig.7. Intersection Over Union

Classifying using CNN Model

- ❑ A CNN is a type of neural network specifically designed for image classification tasks. It can learn features from images and use them to classify the images into different categories.

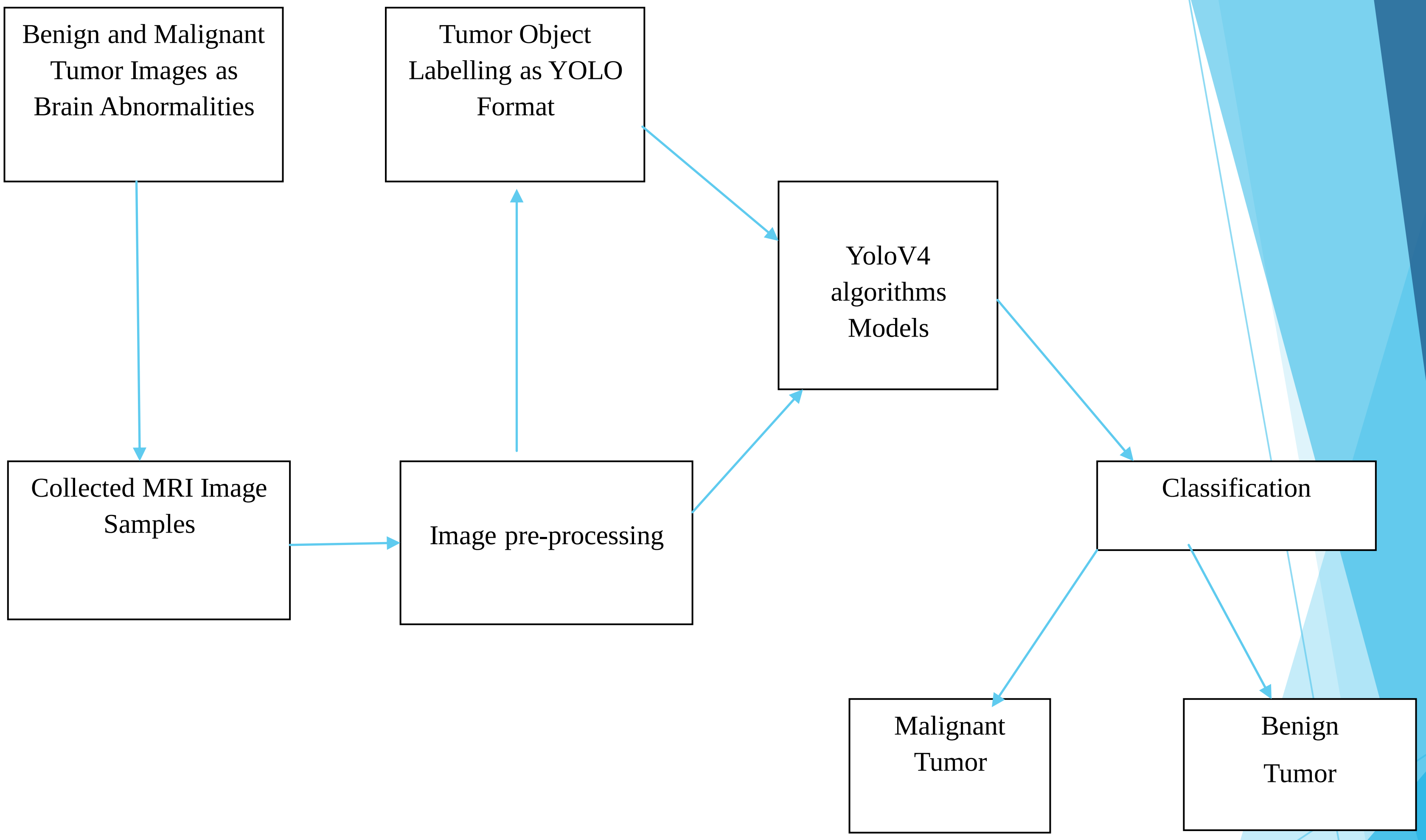


Fig 8.SYSTEM ARCHITECTURE

YOLO algorithm works using the following three techniques:

- ❑ Residual blocks
- ❑ Bounding box regression
- ❑ Intersection Over Union (IOU)

Residual blocks:

First, the image is divided into various grids. Each grid has a dimension of S x S.

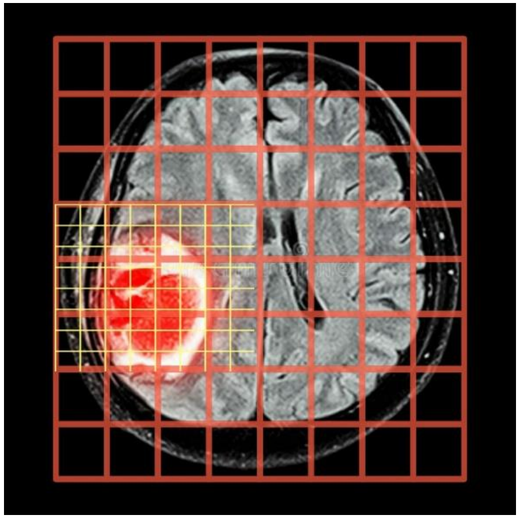


Fig 9. Residual Blocks

Bounding box regression:

A bounding box is an outline that highlights an object in an image.

Every bounding box in the image consists of the following attributes:

- ❑ Width (bw)
- ❑ Height (bh)
- ❑ Class
- ❑ Bounding box center (bx,by)

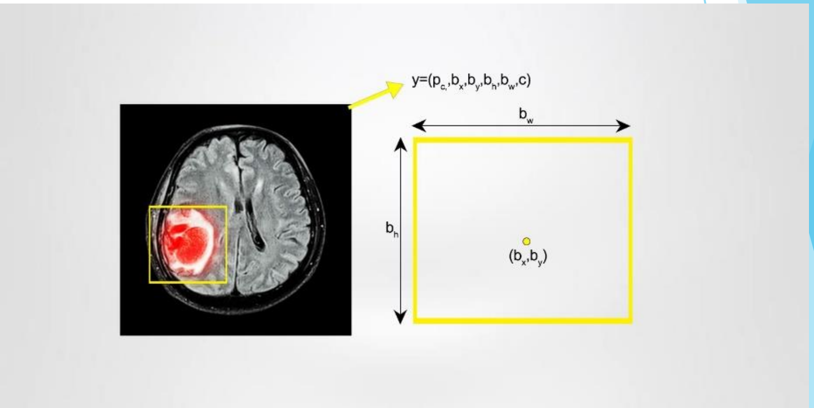


Fig 12.Bounding Box regression

Intersection over union (IOU):

Intersection over union (IOU) is a phenomenon in object detection that describes how boxes overlap as shown in figure 8. YOLO uses IOU to provide an output box that surrounds the objects perfectly. Each grid cell is responsible for predicting the bounding boxes and their confidence scores.

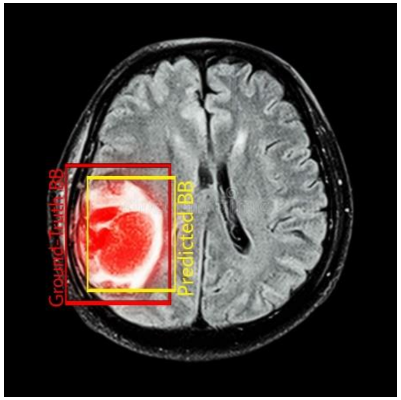


Fig 13. Intersection over union

Combination of Three Techniques

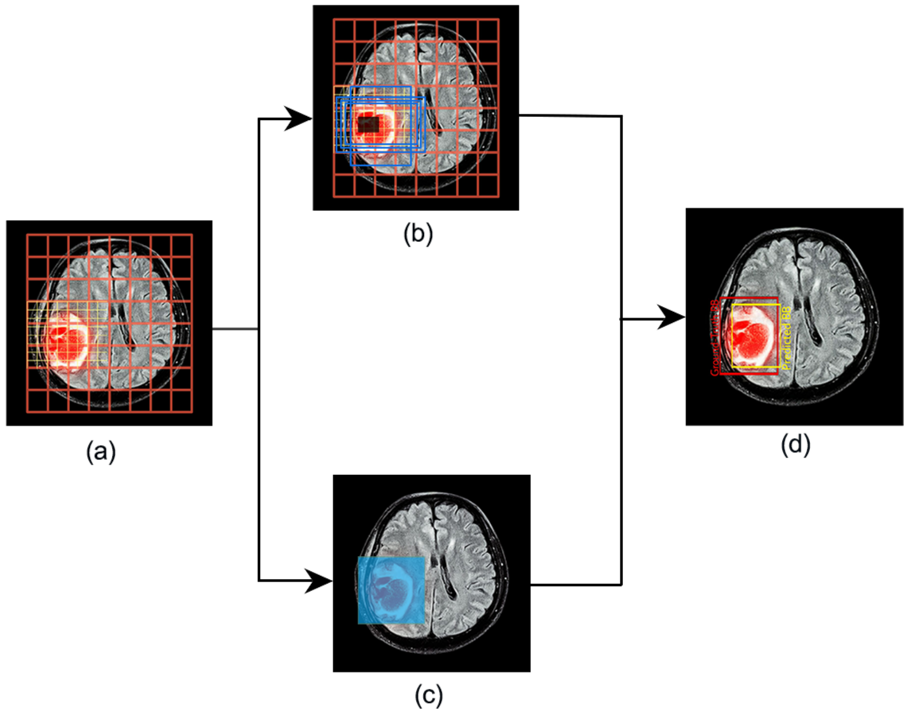
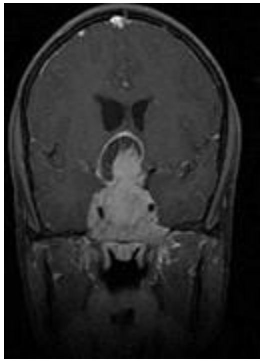


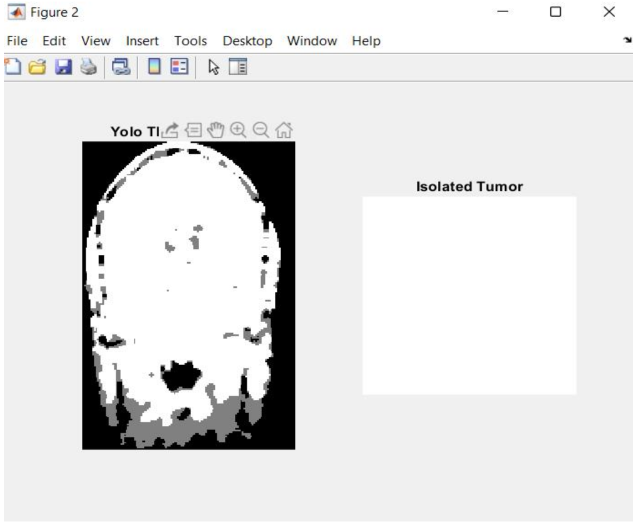
Fig 14. Combination of three techniques

IMPLEMENTATION

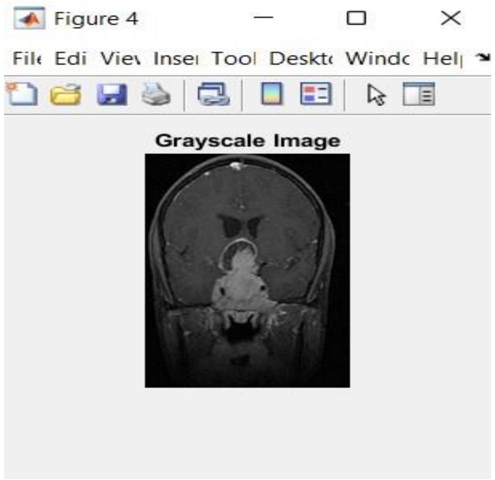
DATA COLLECTION:



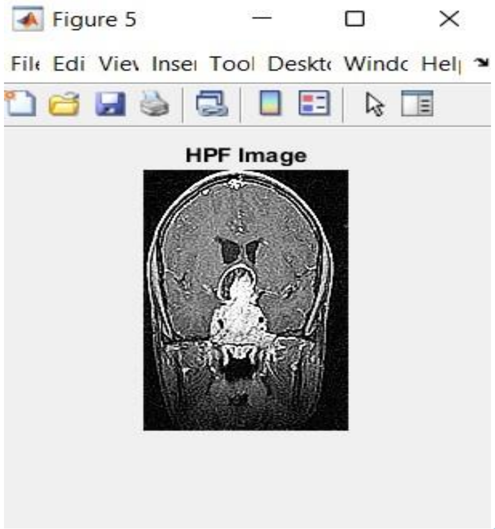
THRESHOLDING:



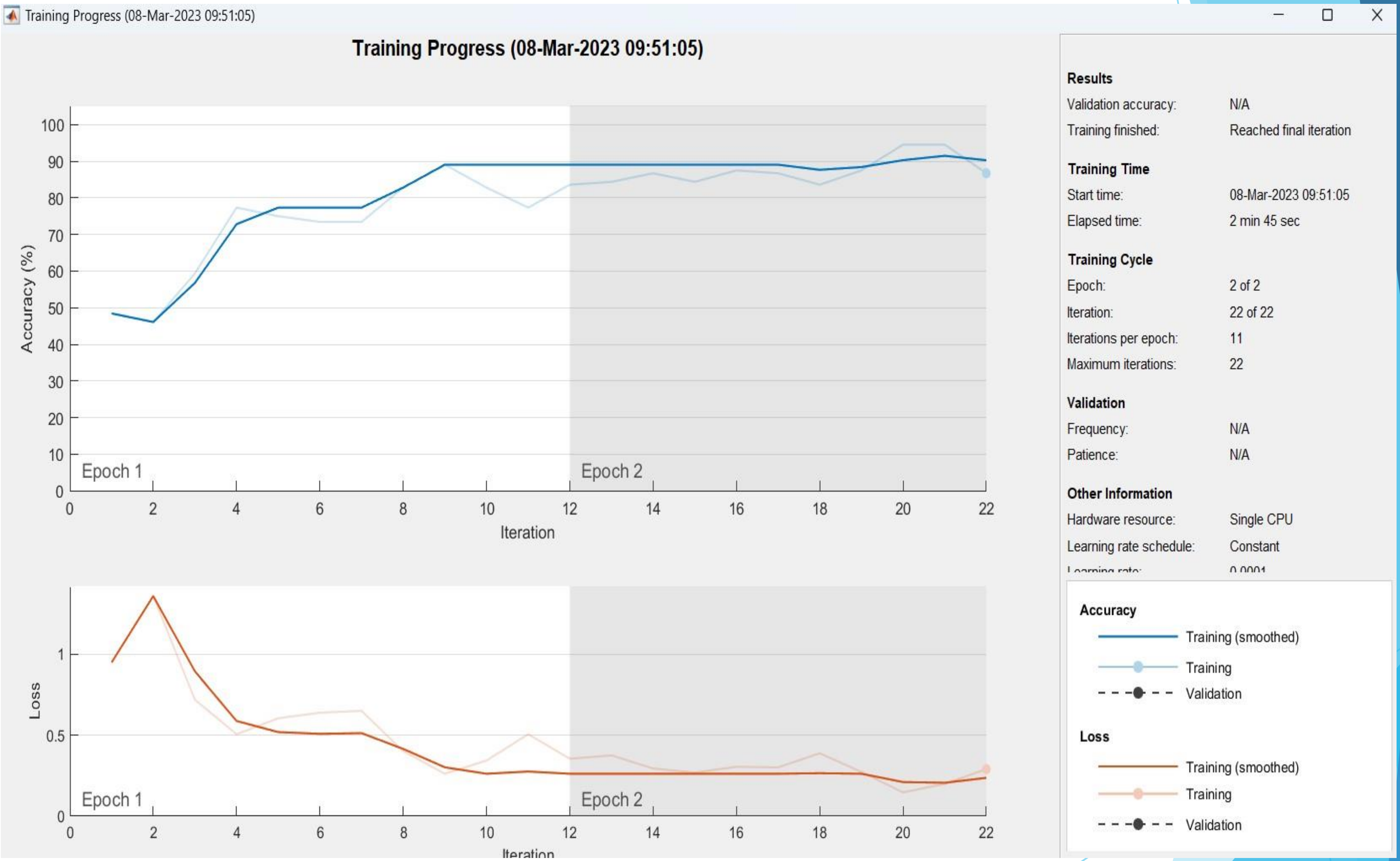
GREY SCALE CONVERSION:



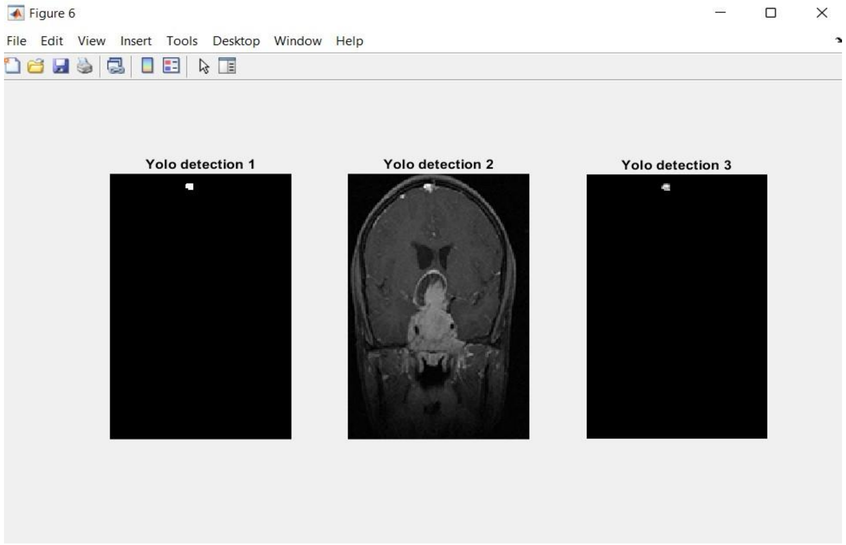
HIGH PASS FILTER:



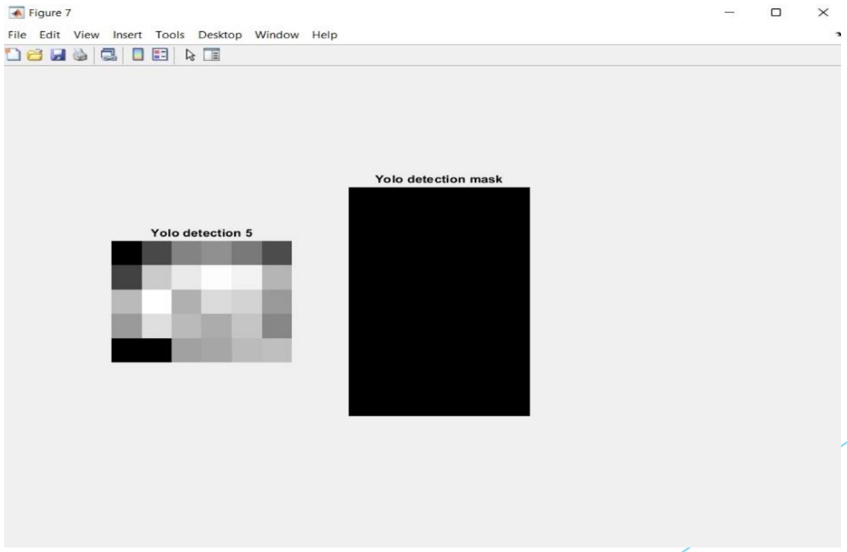
TRAINING PROGRESS:



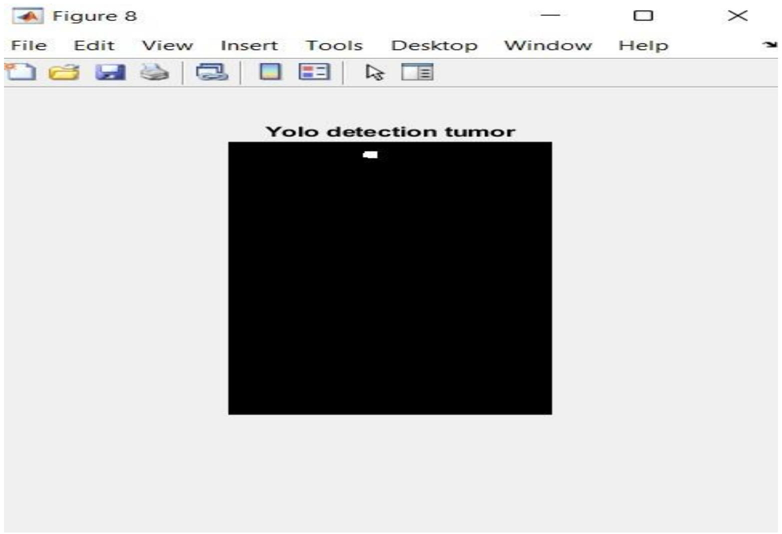
YOLO DETECTION:



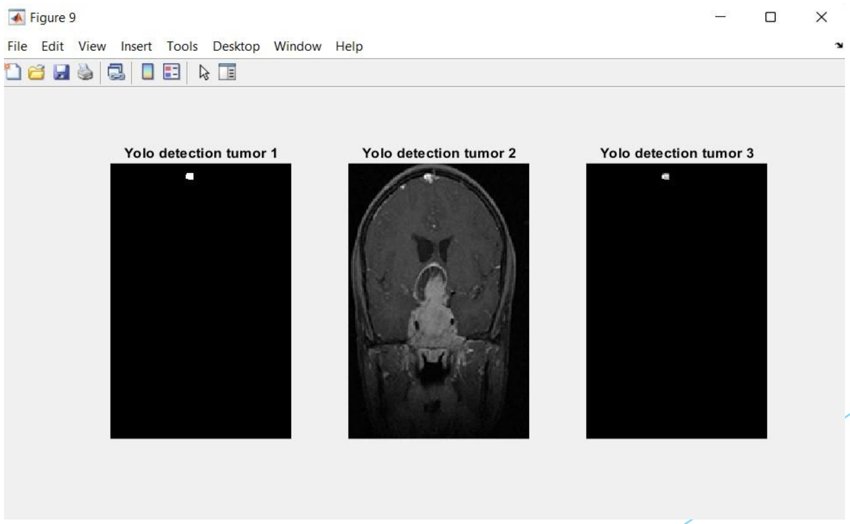
MASKING:



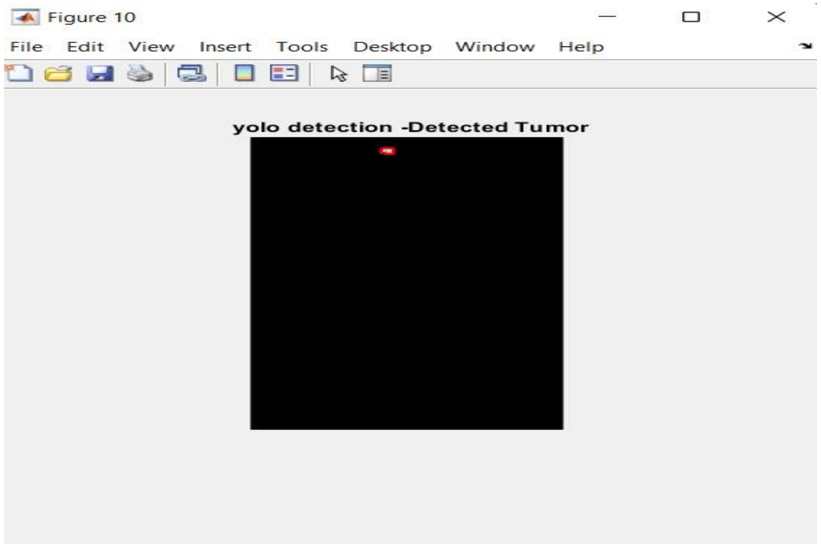
YOLO DETECTED TUMOUR AFTER MASKING:



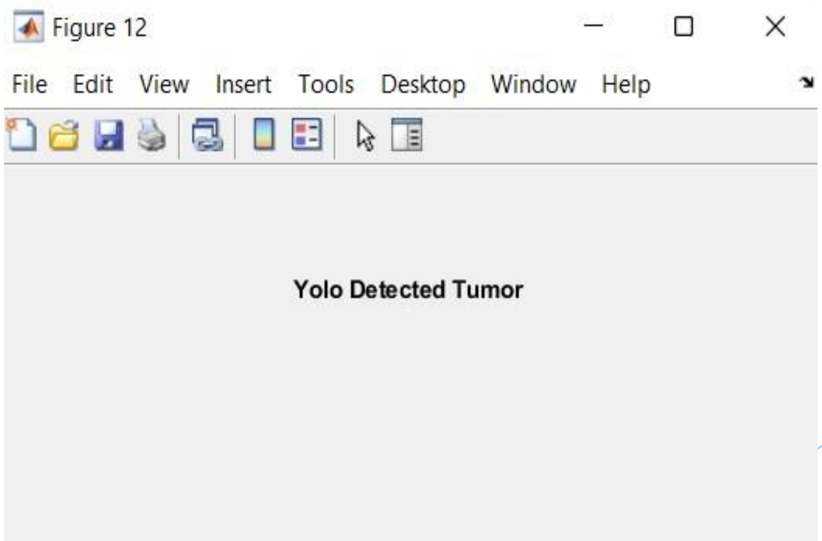
YOLO DETECTORS AFTER MASKING:



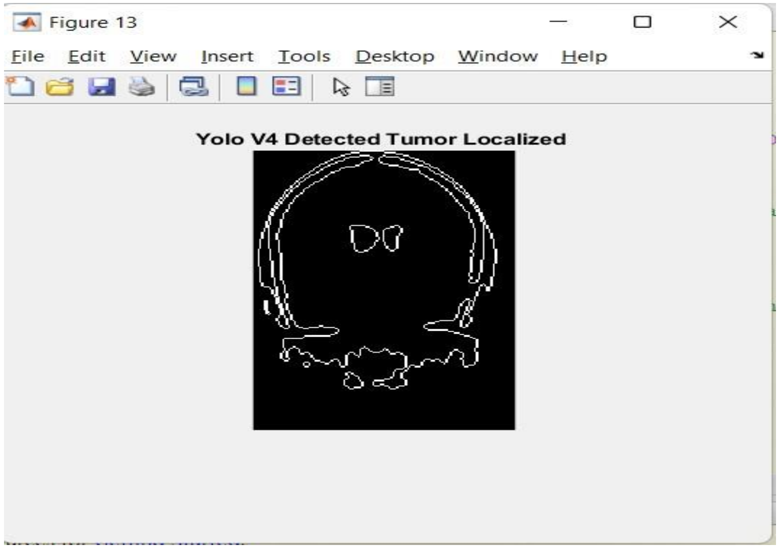
DETECTED TUMOUR WITH BOUNDARY:



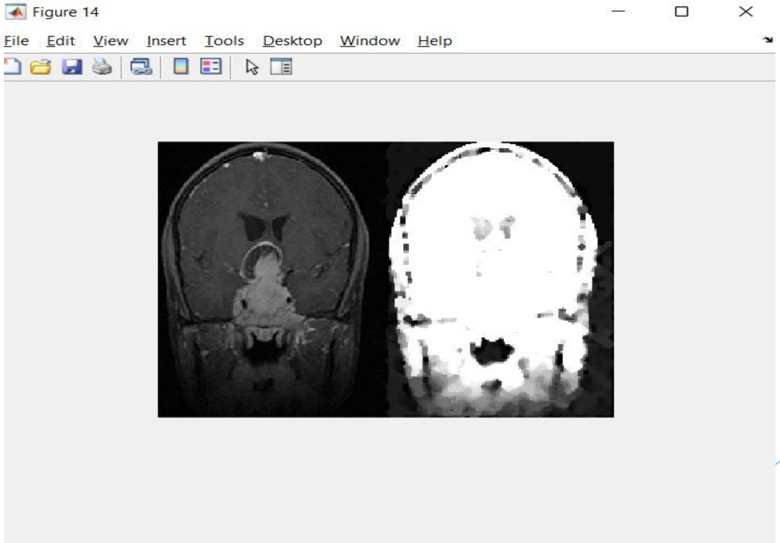
TUMOUR DETECTED USING YOLO:



LOCALIZATION:

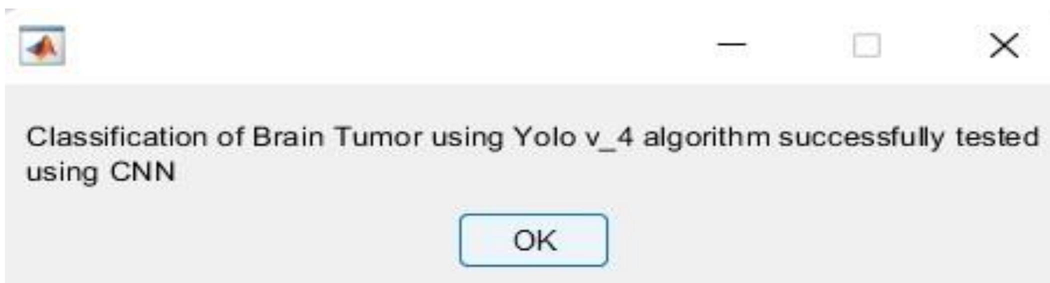


CNN CLASSIFICATION:



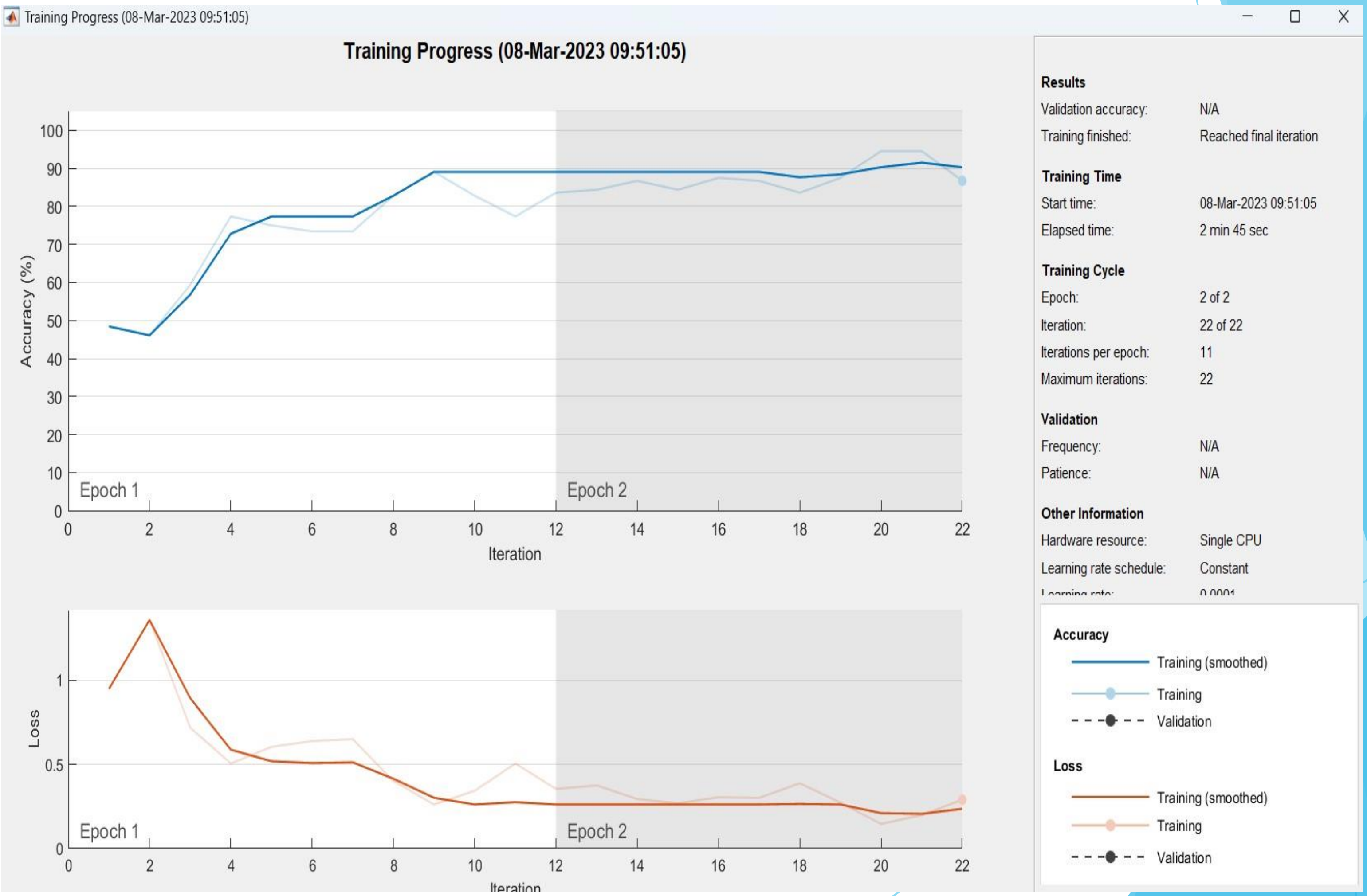
BENIGN TUMOUR:

CLASSIFIED USING CNN AND DETECED USING YOLO:



RESULT ANALYSIS

Training Progress of YOLO+CNN:



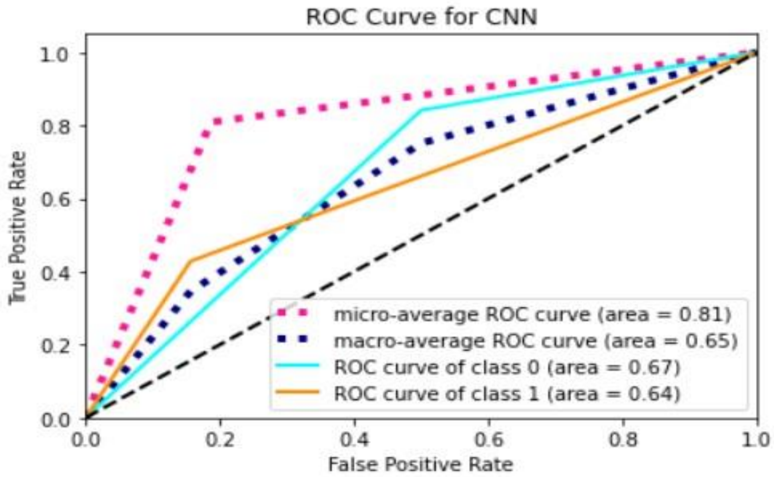
Accuracy for YOLO-CNN:

Command Window

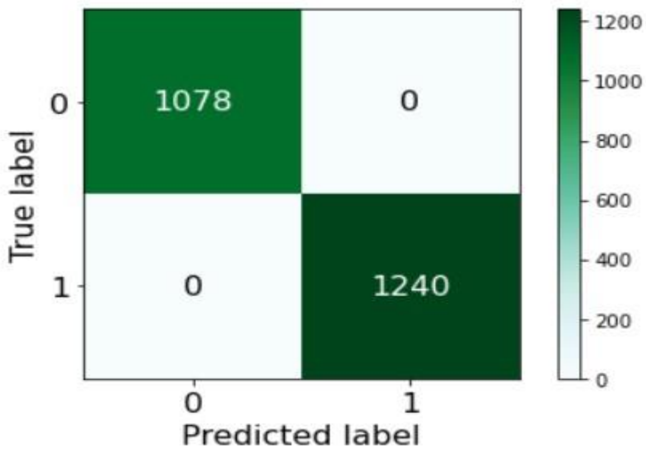
New to MATLAB? See resources for Getting Started.

```
Accuracy =
   94.2886


Perimeter =

     0


Perim =

        1276

fx >>
```

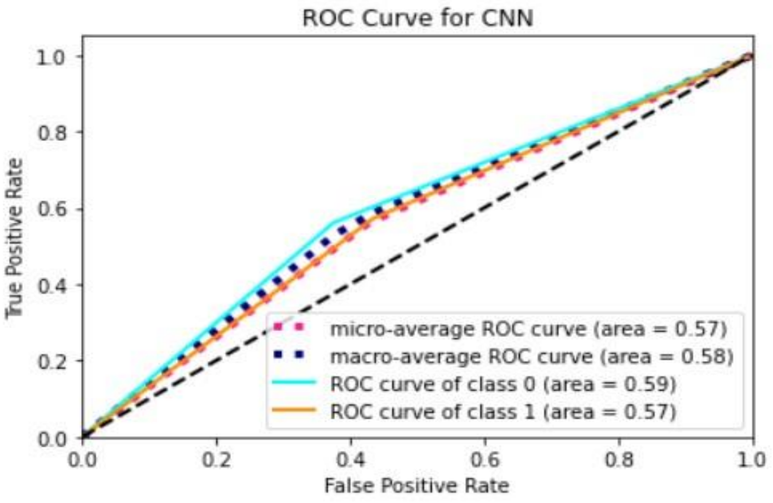
ROC Curve for Random Forest:



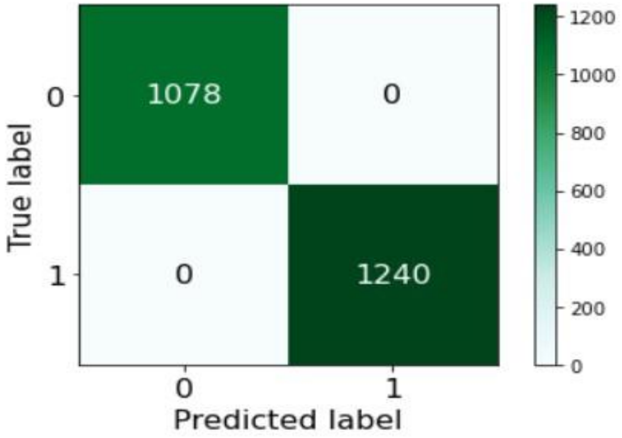
Confusion Matrix for Random Forest:



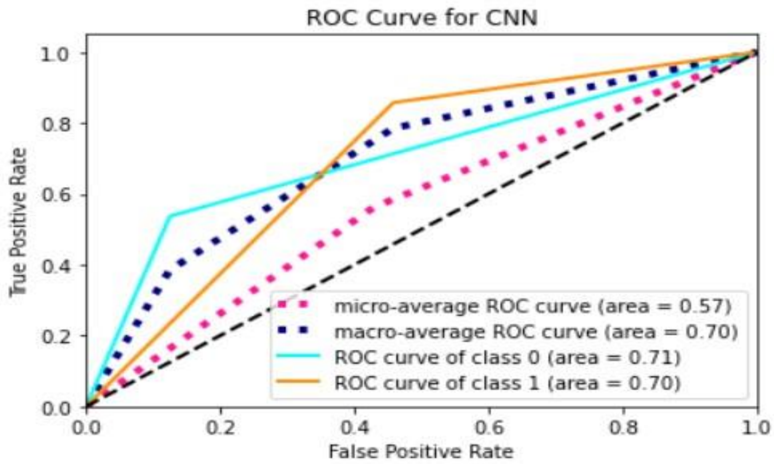
ROC Curve for KNN:



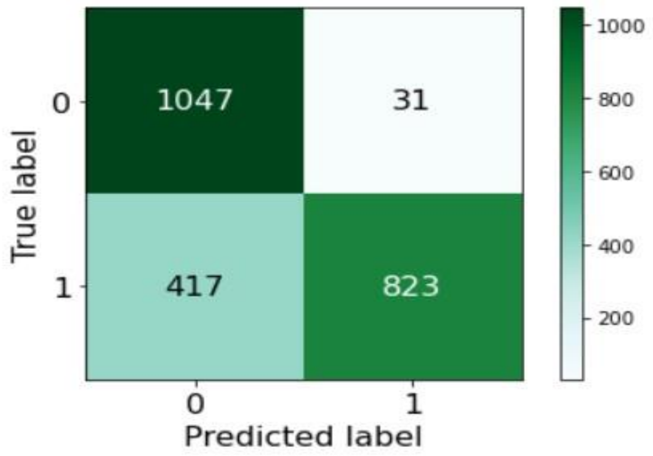
Confusion Matrix for KNN:



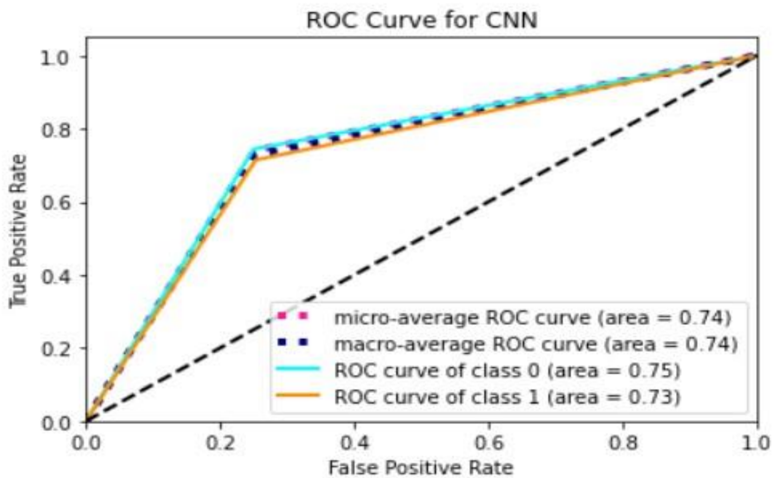
ROC Curve for ANN:



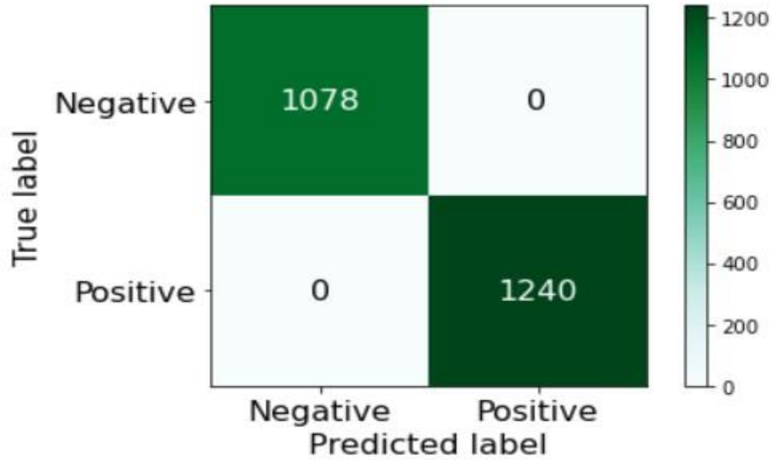
Confusion Matrix for ANN:



ROC Curve for Decision Tree:



Confusion Matrix for Decision Tree:



S.No	Model	Accuracy
1	YOLO-CNN	94-96
2	Random Forest	86
3	Decision Tree	75
4	KNN	73
5	ANN	72

CONCLUSION

In conclusion, the use of YOLO and CNN in brain tumour detection and classification has shown promising results. YOLO can accurately locate the tumour within a medical image, while CNN can classify the tumour into different categories based on its characteristics.

REFERENCES

1) Amran Hossain, Mohammad Tariqul Islam, Mohammad Shahidul Islam, Muhammed E. H. Chowdhury, ALI F. Almutairi, Norbahiah Misran,” A YOLOv3 Deep Neural Network Model to Detect Brain Tumor in Portable Electromagnetic Imaging System”. Published in 2021 Digital Object Identifier 10.1109/ACCESS.2021.3086624
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3) Sunil Kumar, Renu Dhir, Nisha Chaurasia ,” Brain Tumor Detection Analysis Using CNN: A Review using CNN classification technique and has been used to disregard the dataset picture algorithm error”.
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thank
you