Brain Tumor Detection in MRI Brain Scans

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Problem Statement

Diagnosing a brain tumor takes multiple steps:

1. Neurological Examination
2. **Imaging Tests**
3. Biopsy of Brain Tissue

Step 2 can be automated to save time and energy

GOAL: Correctly detect brain tumors in MRI scans with a classification rate of at least 80%

Data

Kaggle Dataset of Upper-Axial MRI Brain Images

<u>Includes</u>:

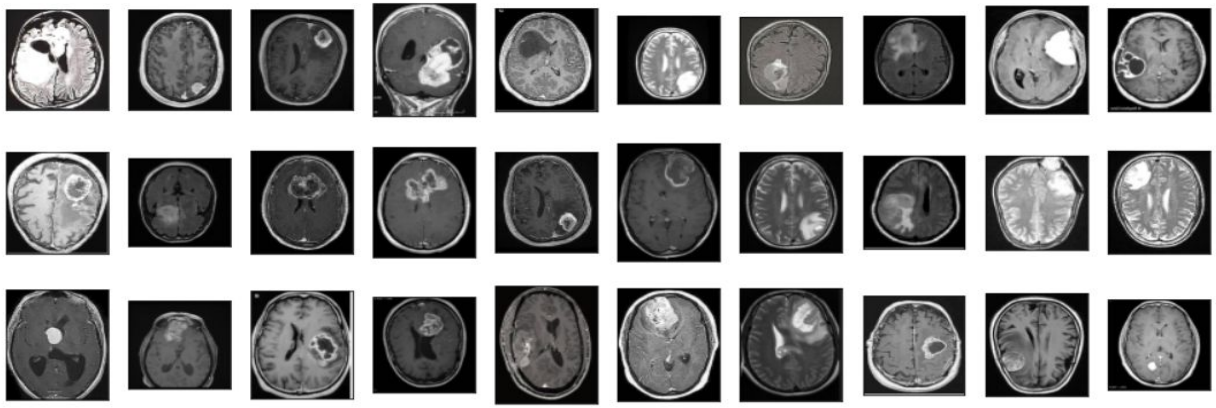
1500 Positive Samples

1500 Negative Samples

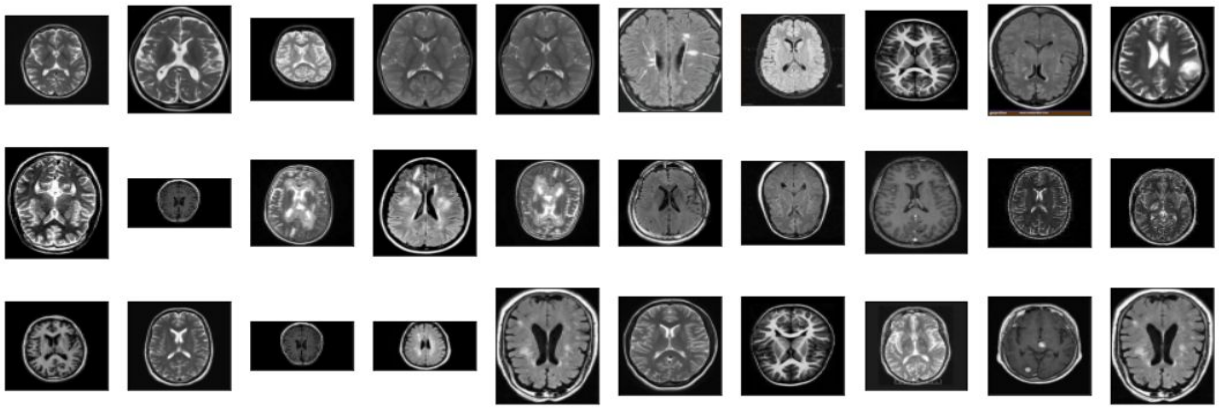
*60 Unlabeled Samples**

*Not used in our model

Tumor: Yes



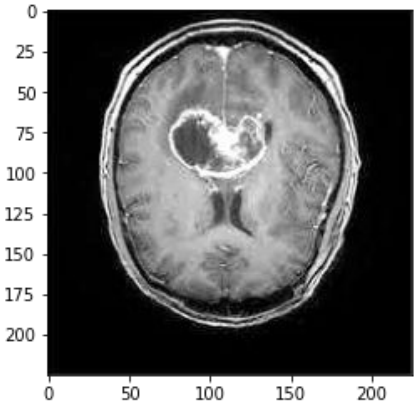
Tumor: No



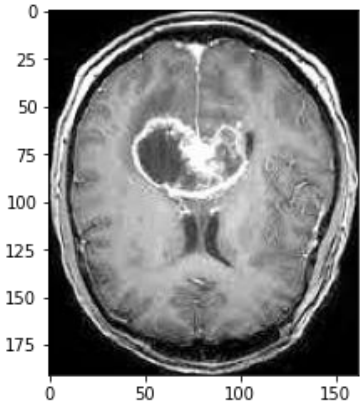
Algorithm

Preprocess

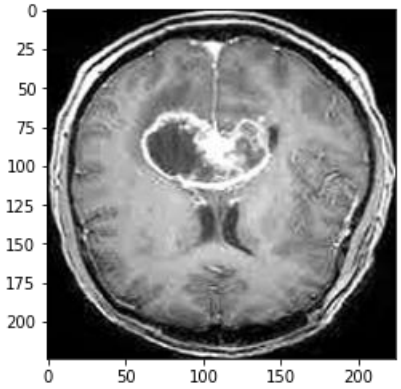
a. Crop images to the outer skull contours
b. Resize images (from various dimensions) to uniform dimensions (224x224)



Non-cropped, Non-resized



Cropped, Non-resized



Cropped, Resized

Algorithm

CNN Model:

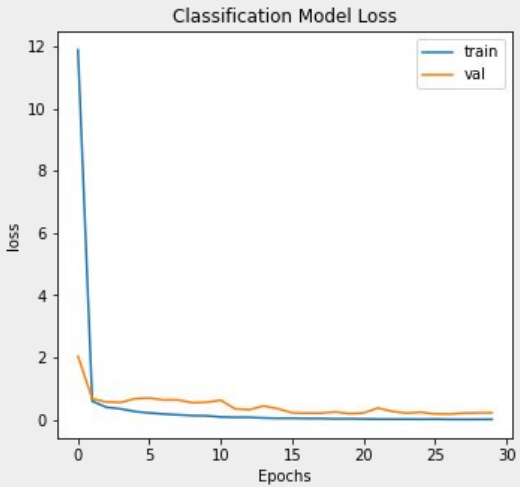
Adapted from Akshit Madan's model found on Kaggle

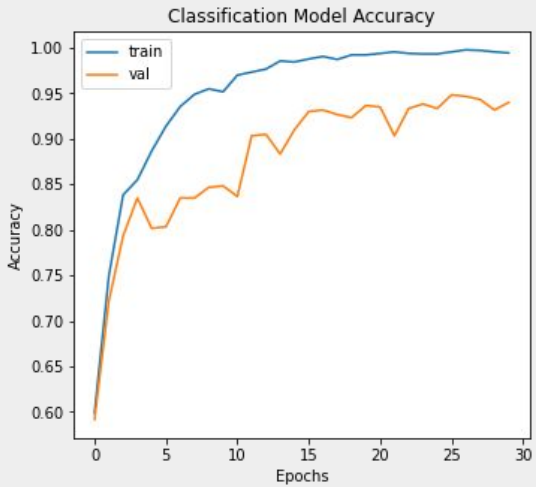
Similar to VGG16 but on a smaller scale

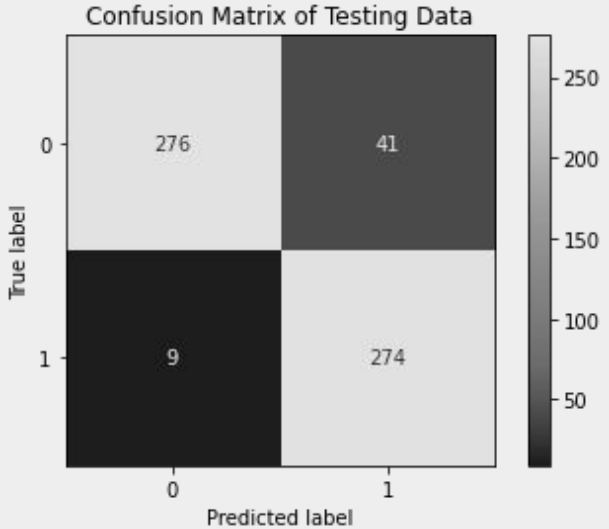
Input: 128 x 128 Image

```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d (Conv2D)              (None, 128, 128, 32)      416
_________________________________________________________________
conv2d_1 (Conv2D)            (None, 128, 128, 32)      4128
_________________________________________________________________
batch_normalization (BatchNo (None, 128, 128, 32)      128
_________________________________________________________________
max_pooling2d (MaxPooling2D) (None, 64, 64, 32)        0
_________________________________________________________________
dropout (Dropout)            (None, 64, 64, 32)        0
_________________________________________________________________
conv2d_2 (Conv2D)            (None, 64, 64, 64)        8256
_________________________________________________________________
conv2d_3 (Conv2D)            (None, 64, 64, 64)        16448
_________________________________________________________________
batch_normalization_1 (Batch (None, 64, 64, 64)        256
_________________________________________________________________
max_pooling2d_1 (MaxPooling2 (None, 32, 32, 64)        0
_________________________________________________________________
dropout_1 (Dropout)          (None, 32, 32, 64)        0
_________________________________________________________________
flatten (Flatten)            (None, 65536)             0
_________________________________________________________________
dense (Dense)                (None, 512)               33554944
_________________________________________________________________
dropout_2 (Dropout)          (None, 512)               0
_________________________________________________________________
dense_1 (Dense)              (None, 2)                 1026
=================================================================
Total params: 33,585,602
Trainable params: 33,585,410
Non-trainable params: 192
```

Results and Discussions







Validation Classification Rate (after 30 epochs): 94.00%

Final Testing Classification Rate: 91.67%

Results and Discussions

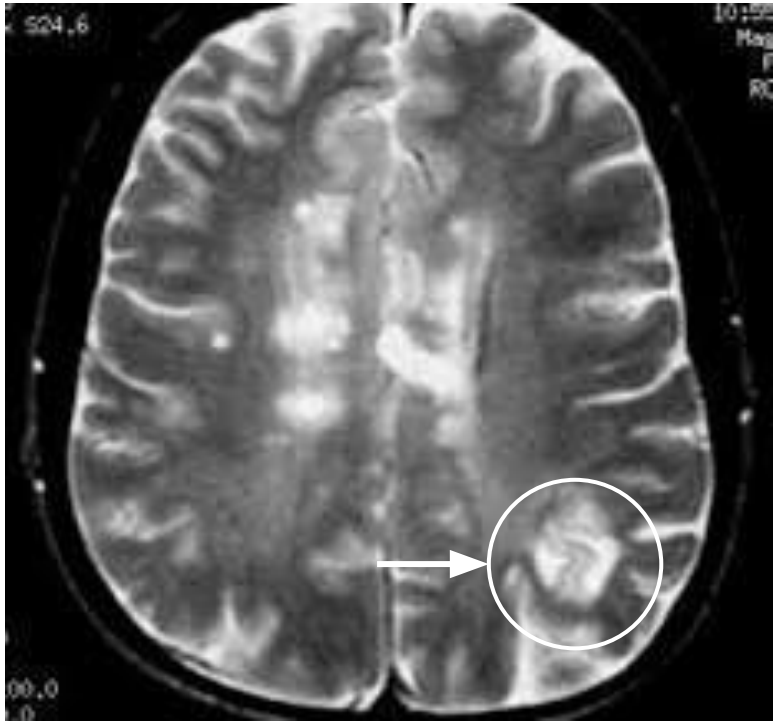


Figure. Past head trauma in a 'No Tumor' sample

***SUCCESS!* Reached testing accuracy of 80% or higher**

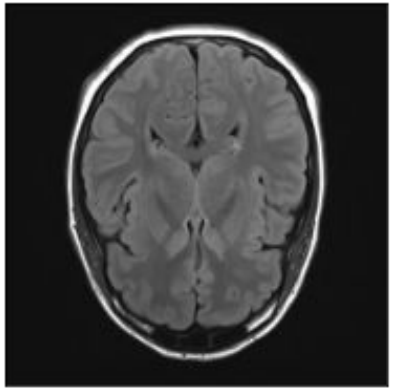
Future Improvements:

- Implement transfer learning
- Post-process data to separate samples containing scar tissue due to past head trauma

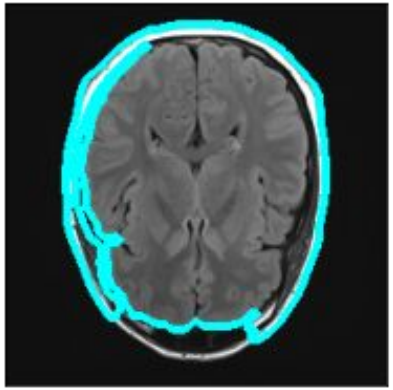
Appendix

Appendix - *Cropping Images using OpenCV*

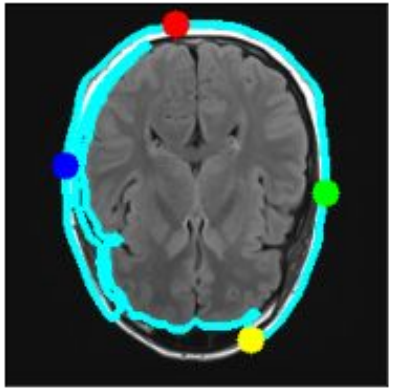
Step 1. Get the original image



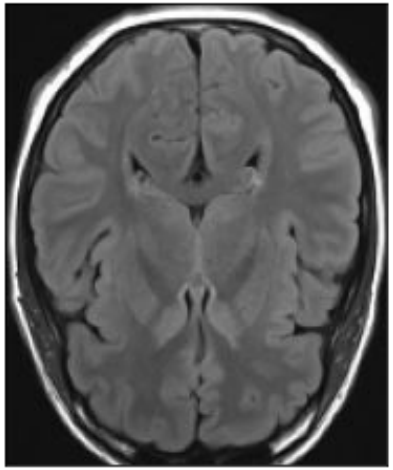
Step 2. Find the biggest contour



Step 3. Find the extreme points

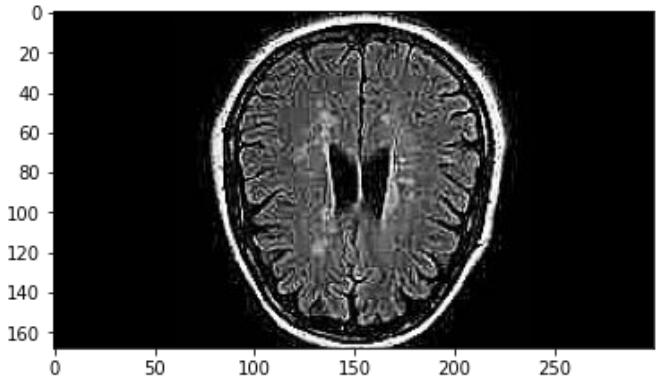


Step 4. Crop the image

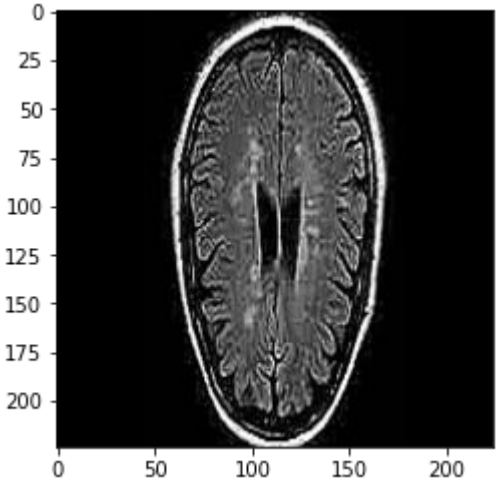


Appendix - *Resizing No Cropping vs Resizing w/ Cropping*

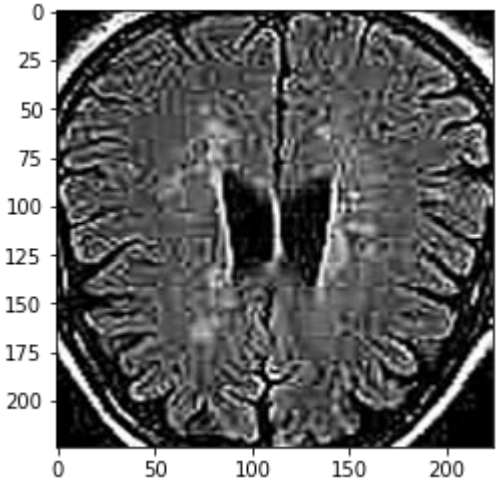
Sample: *No Tumor #115*



Non-cropped, Non-resized



Non-Cropped, Resized



Cropped, Resized