Capstone Final Report

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Introduction

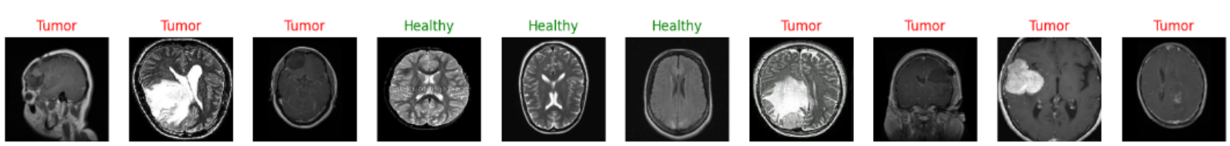
My capstone project is to create a neural network model that can diagnose a brain tumor from an MRI image of the brain. This diagnostics tool would assist doctors in making speedy and accurate diagnosis, and could help speed up treatment timelines which improves the effectiveness of treatment.

Data

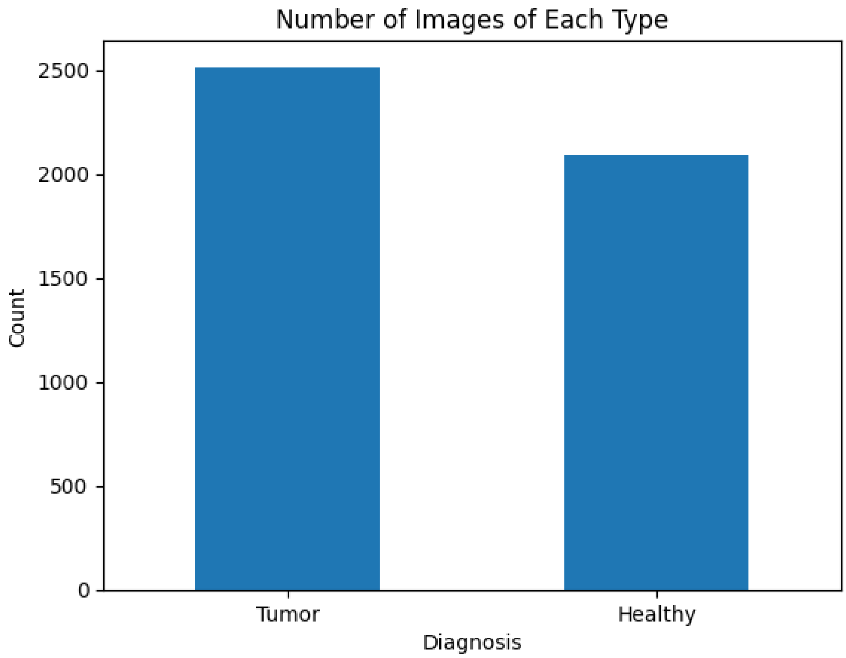
I used a database of pre-diagnosed images found on kaggle: https://www.kaggle.com/datasets/preetviradiya/brian-tumor-dataset. This data set has 4600 MRI images of brains. About half of the images are of healthy brains, and the other half are brains with tumors. From this dataset I will create a model that can be used as a diagnostic tool to assist doctors. I will present this model to the head of a hospital imaging team or chief medical officer.

Exploratory Data Analysis

For the purposes of this model I used data augmentation techniques. By using keras' ImageDataGenerator I can create an augmented data set of the images, I then took a look at some example images:



As we can see some images are looking at the brain from top down, and some images are profile views of the head, while some more are front on views of the head. The tumors in the image range in size from quite large to quite small. About 2600 of the original images are images of brains with tumors, while about 2000 are of healthy brains.

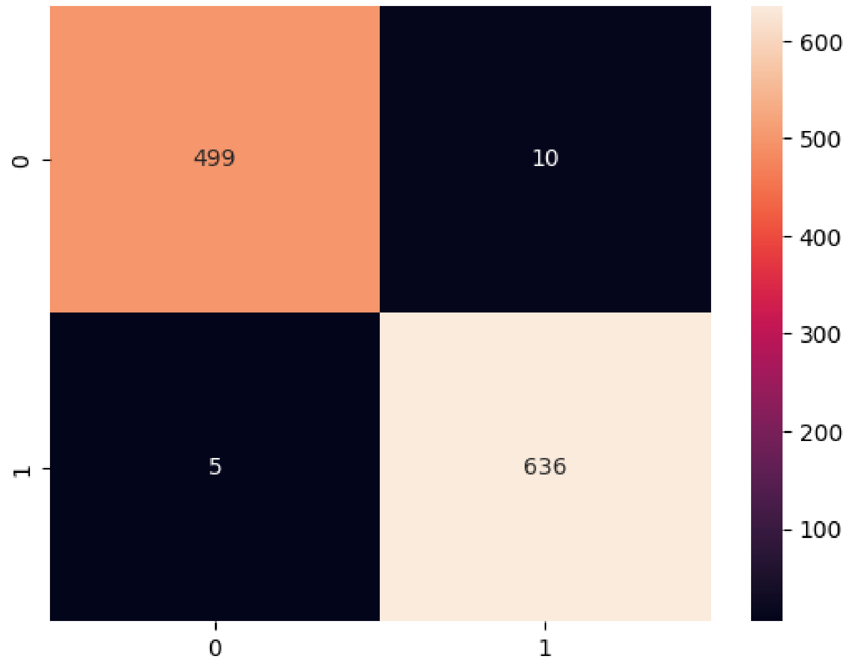


Model Selection

For this project I designed and trained a neural network capable of diagnosing brain tumors. The shape of the neural network is as follows. A convolutional 2D layer to start, with 32 nodes, a 5x5 kernel and strides of 2. This is followed by a MaxPooling 2D layer. Next I added another convolutional 2D layer with 64 nodes, and a 3x3 kernel. This is followed by another MaxPooling 2D step and a flattening. Next, came a Dense layer of 1024 nodes and a dropout layer with a dropout rate of .3. Following this another Dense layer of 512 nodes, before the output layer of 2 Dense nodes. Every layer's activation function was relu until the output which had an activation function of sigmoid. After trial and error this design struck a good balance between accuracy and speed of training.

Recommendation

When this model was tested it performed very well. It had an average precision and recall score of .99. Its accuracy was .99 as well, as was its F-1 score.



On the test set over about 1100 examples there were 5 false positives and 10 false negatives, a successful result.

Future Models and Conclusion

In the future more neural network models can be made that can perform more image scanning diagnostic tests in the medical setting. A similar tool would look at brain MRI's to test for Alzheimer's disease. A tool could be made diagnosing lung infections from chest X-rays. Such a tool could also be used to help diagnose diseases like COVID-19.

As for the brain tumor diagnosis tool, the model was a success with 99% accuracy in diagnosing brain tumors.