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Artificial Intelligence Assisted Brain Tumor Diagnosis

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Abstract: *As we know deep learning has been proven to be superior in detecting diseases which could significantly improve the accuracy and speed of the diagnosis. Our team will collect brain MRI scans and will approach to develop a model that could detect and localize tumors. Our project is going to set layered deep learning pipeline to perform classification and segmentation. In this process an input of image Brain MRI scan will be feeded into Resnet deep learning classifier model this model will give you two outputs one where the tumor is detected and other where it is not detected. If the tumor is detected it would be send to Resunet segmentation model where the detection of the tumor will be located on pixel level, and if the tumor is not detected the patient is healthy.*

Keywords: Assisted Brain Tumor Diagnosis

I. INTRODUCTION

In today's world Artificial Intelligence is revolutionizing Healthcare in many areas such as: Disease Diagnosis with medical imaging, Surgical Robots and Maximizing Hospital Efficiency. Deep learning has been proven to be superior in detecting diseases from X-rays, MRI scans and CT scans which could significantly improve the speed and accuracy of diagnosis. The MRI Scans are collected and the model is developed. This would drastically reduce the cost of cancer diagnosis & help in early diagnosis of tumors which would essentially be a life saver. A tumor is a collection of aberrant cells that form a tissue. These aberrant cells consume regular body cells, kill them, and continue to expand in size.

Brain tumor is one of these tumors. Nerve cells, brain cells, glands, and membranes that surround the brain are all affected. Imaging and pathology can both be used to diagnose a tumor. An MRI (Magnetic Resonance Imaging) scan of a brain tumor produces a cross-section picture of the brain. In this report, we provide two models based on Artificial Convolutional Neural Networks that uses mathematical formulae and algebraic operations to analyze and predict if the tumor exists and to localize the area of tumor on MRI Images.

1.1 Prediction

Prediction can be used to automatically sort the ".cv" file. Prediction is used in situations where there are multiple possibilities to a single problem. There are many types of algorithm that can be used k-means, agglomerative algorithm.

1.2 Classification

When the data are being used to predict a category, supervised learning is also called classification. When there are only two choices, it's called two-class or binomial classification. That is clustering of the nearest approximate value

1.3 Regression

When a value is being predicted, as with stock prices, supervised learning is called regression.

1.4 Aim

The main aim of our project is to help doctors to improve speed and accuracy of detecting and localizing the brain tumor based on MRI scan. This would drastically reduce Tumor Diagnosis and help in early diagnosis of tumor which would essentially be a life saver.

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1.5 Objective

Deep learning has been proven to be superior in detecting diseases from X-rays, MRI scans and CT scans which could significantly improve the speed and accuracy of diagnosis. Time consumption is less for detecting and localizing tumor. Our project is going to set layered deep learning pipeline to perform classification and segmentation.

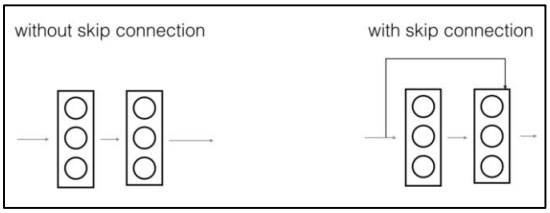
II. Related Work

2.1 ResNet

ResNet, or Residual Networks, is a type of classic neural network that is used in many computer vision applications. The main innovation with ResNet was that it enabled us to effectively train incredibly deep neural networks with 150+ layers. However, just stacking layers together does not work to increase network depth. Because of the well-known vanishing gradient problem, deep networks are difficult to train. When gradients are back-propagated to older layers, repeated multiplication can result in exceedingly tiny gradients. When a result, as the network penetrates deeper, its performance becomes saturated or even begins to degrade fast.

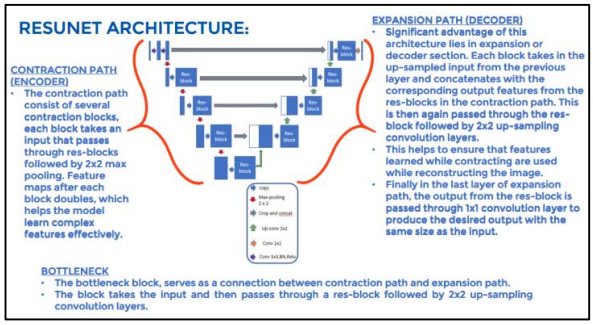
2.2 Skip Connection: The Strength of ResNet

The notion of skip connection was initially presented by ResNet. The skip connection is depicted in the diagram below. The graphic on the left shows convolution layers being stacked one on top of the other. On the right, we continue to build convolution layers as previously, but now we additionally include the original input in the convolution block's output. This is referred to as a skip connection. To add the output from an earlier layer to a later layer, ResNet employs skip connections. This aids in resolving the vanishing gradient issue.



2.3 ResUNet

To avoid the vanishing gradients difficulties that deep architectures have, the ResUNet design combines the UNet backbone architecture with residual blocks. Unet's architecture is based on Fully Convolutional Networks and has been tweaked to function well with segmentation tasks. Like a U-Net, the RESUNET has an encoding network, a decoding network, and a bridge linking the two networks. Each 3 x 3 convolution in the U-Net is followed by a ReLU activation function. In the case of RESUNET, these layers are replaced by a residual block that has been pre-activated.



2.4 Classification Model

A classification model tries to derive some conclusion from the training input data. It will anticipate the class labels/categories of the fresh data. In order for a classification model to perform well, it must be trained on a large amount of data. Image data genrator from the keras library is being utilised to deliver data at such a large scale. By altering the variables, new sorts of data will be created from current photographs. Some operations are performed by the proposed convolutional neural network model, which are listed below:

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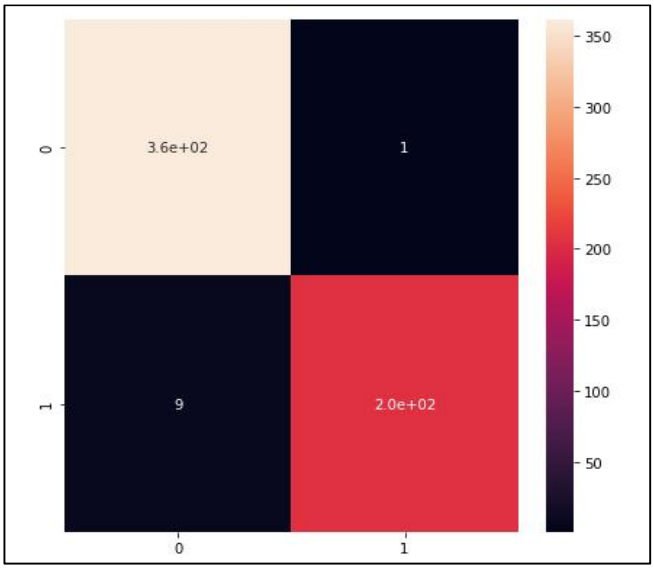
- Convolution operation
- Max pooling
- Flattening
- Full Connection

2.5 Image Segmentation

Humans are able to see pictures by catching reflected light rays, which is a challenging process. So, how can machines be designed to accomplish the same thing? The pictures are seen by the computer as matrices that must be processed in order to gain significance. Image segmentation is the process of dividing an image into separate segments, each with its own entity. Convolutional Neural Networks have performed well for basic pictures, but not so well for complicated ones. Other algorithms, such as Res-Net and ResU-Net, come into play here.

2.6 Confusion Matrix

The Confusion Matrix is a machine learning classification performance metric. It is a performance metric for machine learning classification problems with two or more classes as output. There are four different combinations of projected and actual values in this table. It's great for assessing things like recall, precision, specificity, accuracy, and, most crucially, AUC-ROC curves.



III. Implementation and Design

As we know deep learning has been proven to be superior in detecting diseases which could significantly improve the accuracy and speed of the diagnosis. Our team will collect brain MRI scans and will approach to develop a model that could detect and localize tumors.

Our project is going to set layered deep learning pipeline to perform classification and segmentation. In this process an input of image Brain MRI scan will be feeded into ResNet deep learning classifier model this model will give you two outputs one where the tumor is detected and other where it is not detected.

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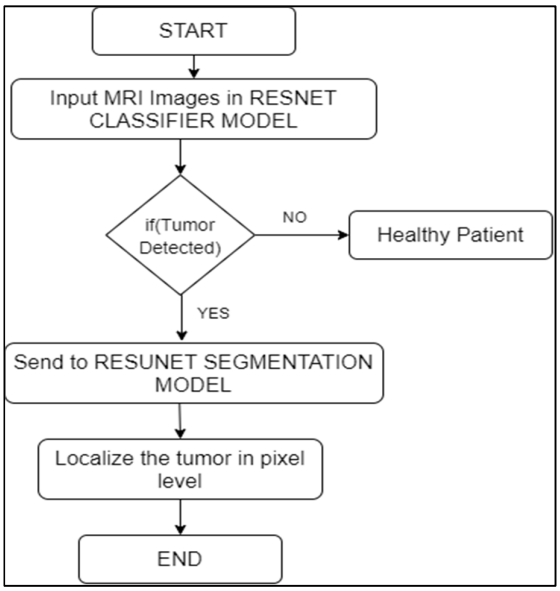

Figure: Flowchart Diagram

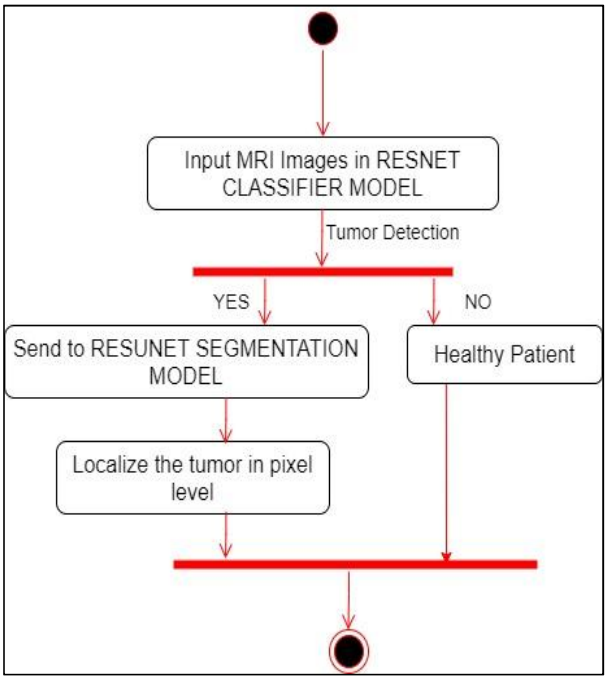

Figure: Activity Diagram

IV. CONCLUSION

Tumors are a life-threatening menace to humanity. The neurological system, circulatory system, organ function, and so on are all affected by a brain tumour. There are several approaches for detecting cancers. Magnetic resonance imaging (MRI) is one way. The MRI produces cross-sectional pictures of the brain, which aids us in uncovering new areas of the brain. In our project, we used a dataset that we compiled from several sources. We had obtained 3929 brain MRI images in total. We created a Resnet Classifier Model to categorise MRI images as positive (label 1 = tumour) or negative (label 0 = no tumour) (i.e. do not have tumor). By evaluating our classifier model using a test set, we were able to achieve a test accuracy of 98 percent.

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