Bone Cancer Detection using AlexNet and VGG16

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Abstract – *In bio- medical field the discernment of tumor in premature stages is a hot research theme while most of the malignancy specifies the tumor untimely. Encountering and spotting the tumor requires loads of determined attempts. The controversial debate is to perceive out the identification and the detection framework which has to be rapid and authentic. Utilizing the distinct Machine Learning techniques and the CT scan images of bone this work has been used to communicate a point of view for bone cancer detection. This writing is particularly devoted to discover bone cancer/tumor by making use of AlexNet and VGG16.*

Key Words*: *Bone Tumor, AlexNet, VGG-16, Smoothing Filter, Averaging Filter, Canny Edge

1. INTRODUCTION

Body's hollow helping skeleton is the bone. In contemplation to avert calcium salts from been laid down, the exterior surface of bone is comprised if rigid tissues. The trabecular bone on the inside of the firm external layer is masked by cortical bone, while the external of the bone is guarded of the bone is guarded by periosteum. The mushy tissues known as bone marrow is founded in the medullary cavity of certain bones which are supposed to be hollow. As a tissue barrier, endosteum serves. A patch of cartilage, a milder type of bone-like tissue, can be found through each end of the bone. Cartilage is a component of the bone that has been constituted of a fibrous tissue framework blended with a substance that resembles gel but contains less calcium than that of bone. The majority of bone ends as cartilage. After then, the body deposits calcium mostly on cartilage to become bone. A few cartilage may remain somewhere at extremities following bone evolution to assist like a bridge connecting bones. A joint is formed when all this cartilage, together with ligaments and additional structures, combines two bones. Bone is a fairly muscular and rigid element. 12,000 pounds per square inch is the maximum load capacity of bone. The thigh bone must be compressed between 1,200 and 1,800 pounds in order to break it. Two types of cells are available with in bone. The osteoclast is a variety of cell that not only produces new bone and weakens existing bone. Several bones have oily tissue mostly in marrow. Other bones' marrow accommodates a blend of fat cells and blood-forming cells. Uncontrolled cell multiplication caused by cancer can partition the cells, multiply erratically, form evil tumours, and attack adjacent organs. The digestive, neurological, and circulatory systems can become obstructed by such a tumour as it grows, and then they can also release hormones which alter how the body processes.

Cells some of which are regarded cancerous since they damage DNA. Whenever DNA is broken in a typical cell, the cell must repair the damage or it will die. If the injured DNA isn't fixed, the cells will continue to divide needlessly until they die.

The body's cancerous cells frequently spread to other regions where they start to form tumours that revert to healthy tissue. We refer to this phenomenon as metastasis. Tumor cells then enter the body's lymphatic system or bloodstream. The human body can harbour several distinct kinds of cancer. Bone tumor is indeed the term for a condition where a tumour directly influences a bone.

The majority of bone cancers are either primary or secondary. The bone is the site of primary bone cancer. On the other hand, secondary bone cancer can develop elsewhere within the body.

2. LITERATURE SURVEY

Mokhled S. Al-Tarawneh [1] proposed Lung Cancer determination technique. The noise in the image was removed by utilizing Gabor filter and segmentation of image was carried out in two strategies they are threshold technique and marker controlled watershed. Utilization of Binarization the features were extracted to identify the disease.

MaduriAvula [2] proposed methodology to discover bone ailment in the MR images by applying mean pixel power. The noise removal in the informative MR image is done inorder to set apart the tumor section and also the computation of K- means clustering is carried out. To characterizr whether the tumor is benign or malignant mean pixel power comes into service.

Kishor Kumar Reddy [3] offered a new approach using a local evolving computation to estimate tumour measurements and bone malignant expansion organisation. The procedure used locale establishing calculations to divide the subject of concern. The size of the tumour is determined by the amount of pixels in the recovered tumour section. The actual pixel value is used to accept the illness pattern. It's really challenging to select an accurate seed location while using the image.

Abdulmuhssin Binhssan [4], This suggested procedure outlines a strategy to spot enchondroma tumours. Image data is denoised by using a two-sided filter in addition to a standard filter. The two-sided filter seems to have a number of issues. Removal of noise in Denoising the image requires a higher outlay of funds. The regular filter achieves better performance than the reciprocal filter. Threshold segmentation is employed to divide the image, and morphological actions are connected to enhance the tumour area.

Sunitha M. R. [5], proposed a system to segment the region of interest based on hierarchical graph based method. This method segments the region of interest efficiently.

Sunitha M.R. et. al. presented bone sarcoma detection method to detect irregular growth of tissue within bone using different preprocessing technique and detection using VGG16 method and obtained good accuracy.

3. METHODOLOGY

Figure 1 shows the methodology for Detection of Bone Tumor using AlexNet and VGG-16.

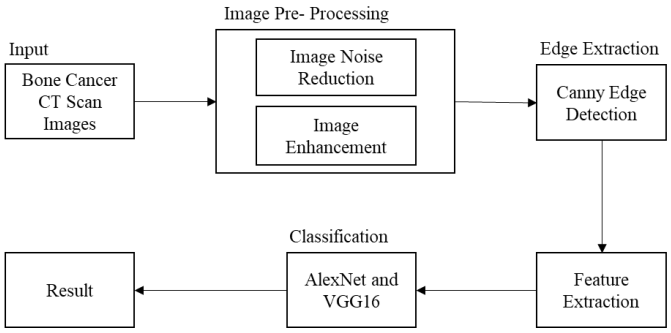

Figure 1 Methodology for Detection of Bone Tumor using AlexNet and VGG-16

Image Acquisition

In any image analysis system, collecting the images is the most important step. CT scans, MRIs, ultrasounds, and X-rays are examples of different image modalities. CT scan images are used as input to the defined model.

Preprocessing

An optical inquiry of unwavering consistency. Pre-processing is a crucial step in improving the quality of an image. The sifting process kicks off the image preparation phase. Smoothing, honing, and removing clamor are some of the applications for image sifting. Sifting eliminates noise and other minor variations in the image. As a result, these sounds should be denoised. The middle filter is used in this method to eliminate noise and smooth out damaged images. As compared to other filters, the main advantage about the filter is that it achieves amazing noise reduction with less disorientation. Following sifting, the dim change is the next stage. This is the procedure for converting RGB-level pixels to the dim dimension. The procedure for shading an image is more complicated. As a result, the grayscale picture must be modified. By keeping the luminance, the modification primarily removes the tint and immersion data.

For noise removal smoothing and averaging filters are used. Smoothing is sometimes used to minimize image noise. Image smoothing is a primary image enhancement technique for removing noise from images. As a result, it is required in many image-processing processes. Image smoothing is a technique for enhancing image quality. Filter2D () is the smoothing filter used.

Image softening is accomplished using the average filtering methodology by reducing the contrast between nearby pixels. As it advances pixel by pixel throughout the image, the average filter substitutes every item also with the average item of its neighbours, including itself. The average filter employed is blur ().

After filtering, the image is transformed to gray image.

Then, the morphological operator's dilation and erosion are applied. Dilation includes pixels to the limits of object in an image, whereas erosion eliminates pixels on object limits. The size and structure of the constructing factor used to improve the image quality determines the amount of pixels included or excluded from the objects in the image.

Edge Detection

A limitation among two regions with slightly specific dim dimension properties is obtained using an edge indicator. Edge detection is a technique for removing important features that aid in the identification of malignant development. A clever edge indicator is used in this suggested methodology to discern an image's edge. The edges are known and distinguished as the points where picture brilliance shifts. Great identification, great restriction, and negligible reaction are all features of the vigilant edge indicator.

Canny Edge Detection is used in which the first step is to smoothen the image to eliminate the noise. Then, image gradient is calculated to highlight the areas with higher spatial derivatives. Using non- maximum suppression the pixels that are not at maximum are suppressed. Hysteresis is used to minimize the gradient array even further, removing streaking and thinning the edges.

Feature Extraction

In image processing, image feature extraction is a critical system. It plays a significant role in disease detection by utilizing image processing. To detect malignancy, features from the portioned image are segregated. The final result is to predict malignancy and not malignancy of an image are referred to as feature extraction. Feature extraction reduces the number of assets needed to represent a complex arrangement of data. It's the process of identifying and extracting specific elements of interest from an image for further processing. The element is shown as the image's most delegated data. Each component represents a measurable feature of an entity and is documented with the intention of evaluating the object's essential characteristics.

Classification

The final and most critical stage of our proposed scheme is classification. The classifier distinguishes between different stages of bone tumor that is stage 0, stage 1 or stage 2. For the classification AlexNet and VGG-16 is used. AlexNet and VGG-16 is a name for Convolutional Neural Network (CNN).

AlexNet

The resolution of the input image to be fed into the AlexNet network is 227x227 pixels in RGB format. The first layer in the AlexNet network is the convolution layer. There are 96 different types of kernels in the first layer, each of which is 11x11 and has a stride of 4. Since there are 96 different kernels and each feature map includes features of size 55 x 55, the performance of the first layer yields 96 different channels or feature maps.

The second layer is a Max Pool Layer, with stride equal to 2 and max-pooling performed over a 3 x 3 window. The feature map's size is decreased to 27 x 27 after this pooling, but the number of feature channels is retained at 96.

The third layer is a Convolution Layer with a kernel size of 5 x 5 and a padding of 2 to ensure that the performance of the convolution layer matches the input feature size. As a result, the size of feature maps created by this convolution layer is 27 x 27, and the number of kernels included in this scenario is 256, so 256 different channels or feature maps are obtained from this convolution layer's output, each of which will be 27 x 27 in size.

The fourth layer is another Max Pool Layer, this time with max-pooling performed over a window of 3 x 3, stride equal to 2, and result of this pool is 13 x 13 feature maps and 256 channels are obtained.

Then, there are three continuous Convolution Layers. In that the first convolution layer has a kernel size of 3 x 3 with padding of 1 and 384 kernels, resulting in 384 feature maps with a size of 13 x 13 that move through the next convolution layer. The performance of the second convolution layer will have 384 channels or 384 feature maps, each of which is 13 x 13 pixels in size. Since the padding is equal to 1 for a 3 x 3 kernel size, the size of any feature map at the result of this convolution layer remains the same as the size of the feature maps that are fed into the convolution layer.

VGG16

For the conv1 layer 224x224 RGB image is fed as input. There are considerable convolutional layers onto which the images have been fed. Following certain convolution layers dimentional pooling is carried out by the five layers layers of max- pooling.

After subsequent convolutional layer stacks are succeeded with 3 fully connected layers. Last layer comprises of soft-max layer. Then the layers in the network are fully connected and which also has a hidden ReLU layer.

4. RESULTS AND DISCUSSIONS

The discussion of results is that same image is taken as input for both AlexNet and VGG16 and eventually it can be concluded that which method has good accuracy.

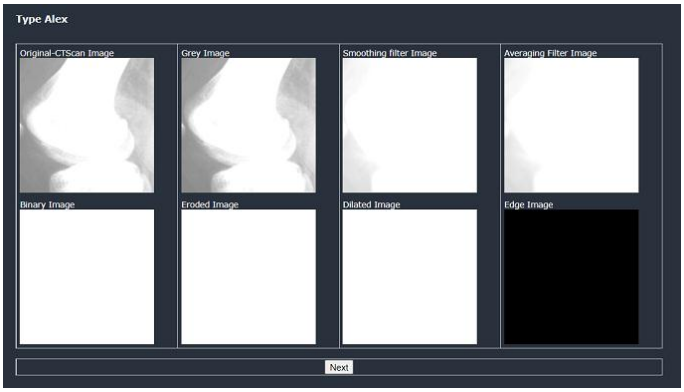

Figure 2: Preparation steps in AlexNet for Stage 0

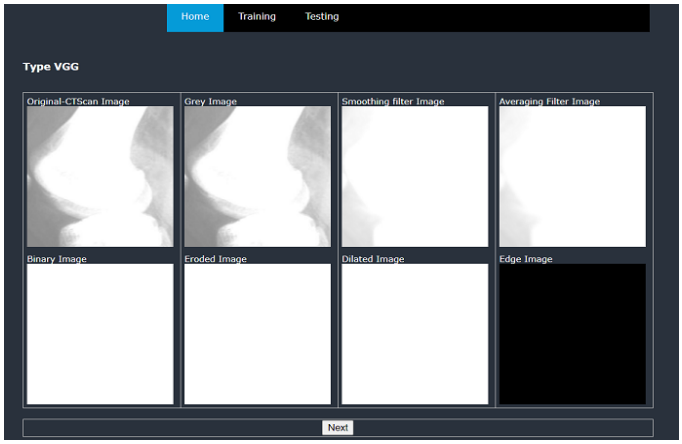

Figure 3: Preparation steps in VGG16 for Stage 0

Figure 2 and Figure 3 depicts the preparation steps before the classification. The result is classified as non- cancerous. The accuracy for AlexNet is 88.34% and for VGG16 is 99.995%.

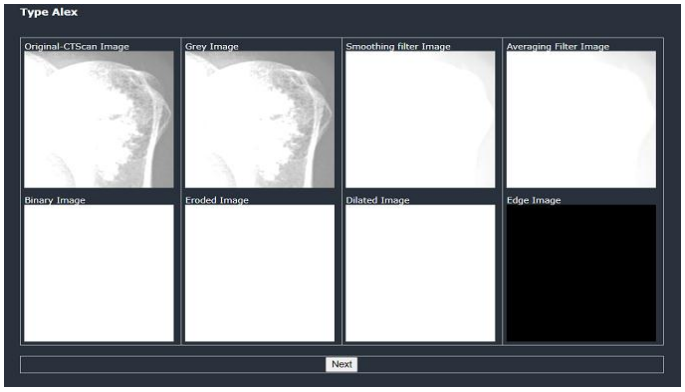

Figure 4: Preparing steps in AlexNet for Stage 1

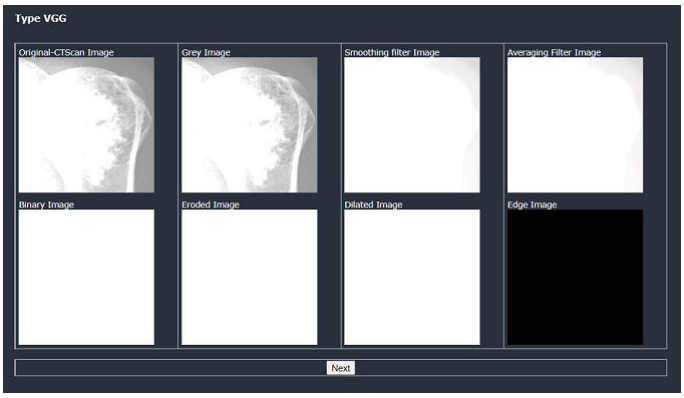

Figure 5: Preparing steps in VGG16 for Stage 1

Figure 4 and Figure 5 depicts the preparation steps before the classification. The results of this step is same in both VGG16 and AlexNet.

Figure 6: Result in AlexNet for Stage1

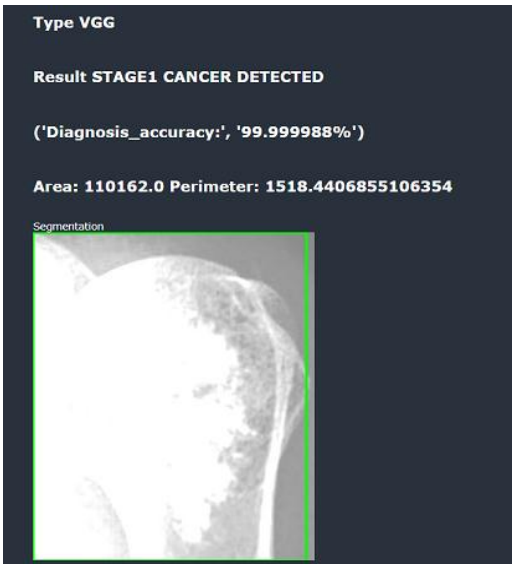

Figure 7: Result in VGG16 for Stage1

Figure 6 and Figure 7 depicts the result as cancerous at stage 1. The accuracy for AlexNet is 72.28% and for VGG16 is 99.998%. VGG16 has great accuracy in comparison with AlexNet.

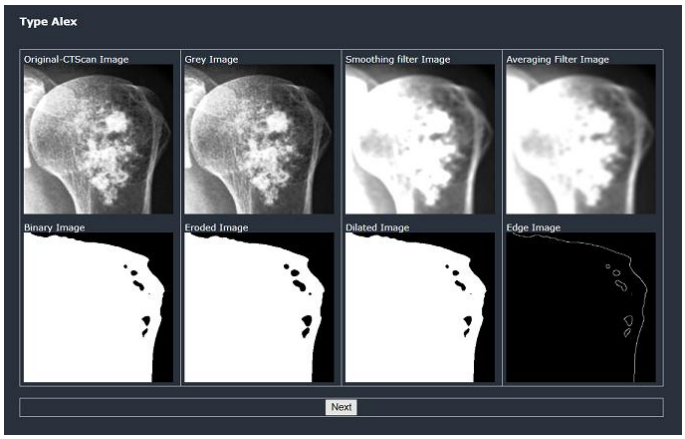

Figure 8: Preparing steps in AlexNet for Stage2

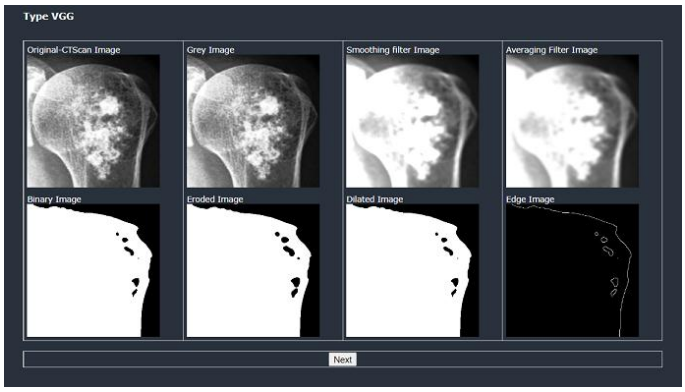

Figure 9: Preparing steps in VGG16 for Stage2

Figure 8 and Figure 9 depicts the preparation steps before the classification. The results of this step is same in both VGG16 and AlexNet.

Figure 10: Result in AlexNet for Stage2

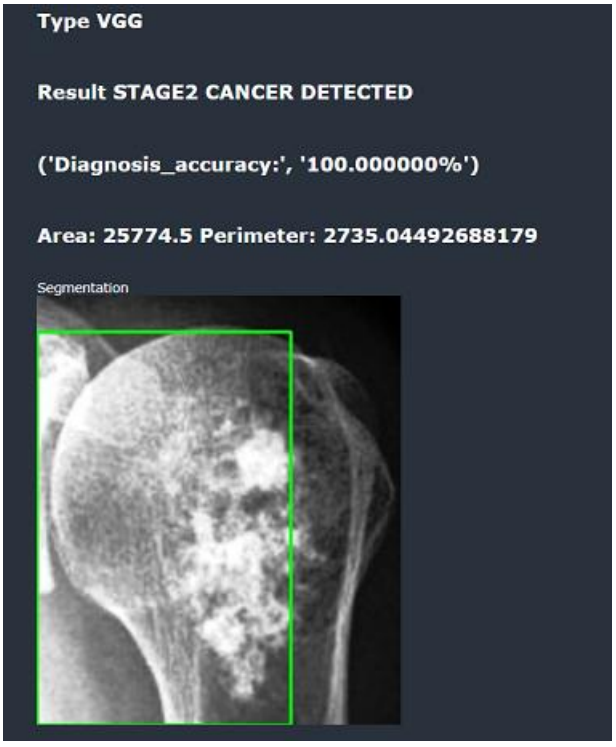

Figure 11: Result in VGG16 for Stage2

Figure 10 and Figure 11 depicts the result as cancerous at stage 2. The accuracy for AlexNet is 100% and for VGG16 is 100%. Both VGG16 and AlexNet have same accuracy.

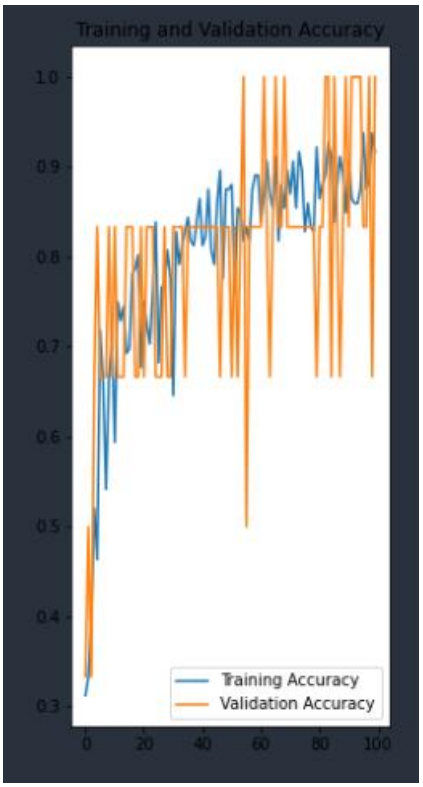

Figure 12: AlexNet Accuracy Graph

Figure 12 shows the training and validation accuracy graph of AlexNet. In X-axis the training data are taken and in the Y-axis validation data is taken. The accuracy of the system is 97.3%%. The graph has been plotted with train and test data. The model has been tested with validation set of data and to train the model training data is utilized.

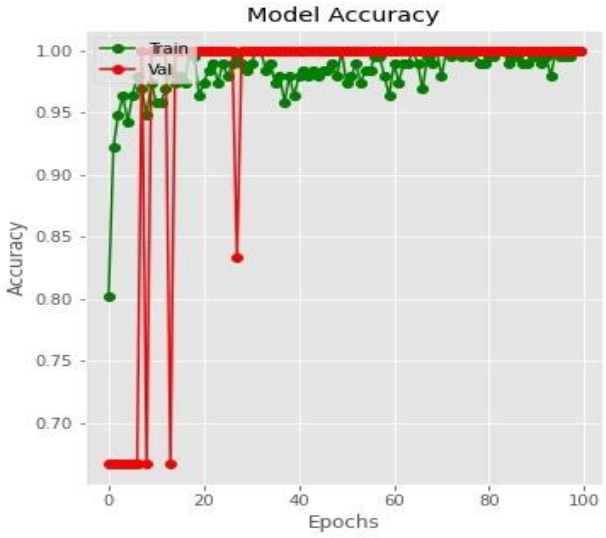

Figure 13: VGG16 Accuracy Graph

Figure 13 depicts VGG16 graph with model accuracy. The X-axis follows Epochs and Y-axis follows Accuracy. The graph has been plotted with train and test data. The model has been tested with validation set of data and to train the model training data is utilized.

5. CONCLUSION

The most life- threatening ailment is bone cancer in which the signs are unnoticed in the pre-mature stages. To overcome the fatality rate detection in the early stages is very important.

In comparison with AlexNet, VGG16 yields better results as discussed earlier in section 4 by looking into the various results.

REFERENCES

Mokhled S. Al-tarawneh, "Lung cancer detection using image processing techniques", Leonardo electronic journal of practices and technologies, 20, 147-158, 2012.

[1] Maduri Avula, Narasimha Prasad Lakkakula, Murali Prasad raja, "Bone cancer detection from MRI scan imagery using Mean Pixel Intensity, Asia modeling symposium,2014

[2] Kishor Kumar Reddy, Anisha P R, Raju G V S, "A novel approach for detecting the tumor size and bone cancer stage using region growing algorithm", International Conference on Computational Intelligence and Communication Networks, 2015.

[3] Abdulmuhssin Binhssan, "Enchondroma tumor Detection", International journal of advanced research in computer and communication Engineering, 4(6), june 2015.

[4] Sunitha Madasi Ramachandra, Haradagere Siddaramaiah Jayanna, Ramegowda, "Hierarchical graph based segmentation and consensusbased human tracking technique" Journal of information processing systems, Vol. 15, No. 1, pp.67-90, Feb 2019.

[5] Sunitha M.R., Huda Rahman, Varun E, "Bone Sarcoma Detection using VGG16", Vol. 8, No. 8, JETIR, 2021