# BONE TUMOUR DETECTION USING IMAGE PROCESSING

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**Abstract -** Cancer is one kind of dangerous disease which can cause by the growth of unwanted cell. There are many different types of cancer and bone tumor is one of the part of it and this has to be detected at earlier stage. Here, Magnetic Resonance Images will be used as input data and then preprocessing operations will be done and then features will be extracted and given to the convolution neural network which is an algorithm used in order to classify the images as tumor and non tumor. This algorithm gives best accuracy and performance with minimum loss.

***Keywords***—*convolution, network, tumor, accuracy, benign, malignant*

## 1. INTRODUCTION

This Cancer, which causes unlimited cell multiplication, will divide the cells and grow out of control, forming malignant tumors and targeting nearby body components. This tumor has the ability to develop and impede the digestive, neurological, and circulatory systems, as well as release hormones that can cause body function to change. Cells are classified as cancer cells when their DNA has been damaged. In a normal cell, when DNA is broken, the cell either fixes the damage or it may die. If the DNA which has been damaged is not repaired before a person dies, the body will make unnecessary new cells as a result of the broken DNA.

Cells in the body frequently travel to all the other parts of body, forming tumors that eventually turn back into normal tissue. Metastasis is the medical term for this. Cancer cells then reach the circulation or lymph arteries of the human body.
Bone cancer is of two types that is benign which is non cancerous and malignant which is most cancerous. They are frequently treated with surgical surgery. Bone tumours are dangerous because they can spread and endanger one's life.
Bone cancer is a complicated disease that can result from a number of hereditary and physiological factors. It promotes uncontrolled cell proliferation, which leads to demonic bone tumours that spread throughout the body. At any joints there is a possibility of the bone that can turn to cancerous. Hemipelvectony, often known as a hindquarter removal, is a treatment that involves removing the complete leg.
Magnetic resonance Imaging is better than other scanning images because this gives better accuracy. The term "segmentation" refers to the partition of an image into many parts and the subsequent extraction of usable data from these areas. A variety of segmentation approaches have been applied on the MR images.

Tumors are abnormal new tissue growths that can appear in any organ of the body. Various types of cancer include lung cancer, brain cancer, and bone cancer. When cells in the body go rogue, cancer occurs, and bone cancer develops in the bone. Other bodily tissues may be damaged as well. As a result, other parts of the body will be affected by these tissues.
Bone cancer is today considered one of the most serious and lethal tumors in the world, with the lowest survival rate after diagnosis. It is impossible to stress the importance of early detection of the cancer-prone area in an MRI scan for successful diagnosis and treatment of bone cancer.
Despite the fact that the specific cause of bone cancer is unknown, scientists have determined that some factors are associated to a higher risk. When the bone is subjected to therapy for more times then, lot of radiations will be passed into the bones so this may lead to the bone cancer in future.

When cells in the body go rogue, cancer occurs, and bone cancer develops in the bone. Other bodily tissues may be damaged as well. As a result, other parts of the body will be affected by these tissues. Based on MRI scans, this method attempts to classify tumors as non-cancerous or malignant.

In this paper, to develop the model we will be using bone region Magnetic resonance imaging in order to identify the bone tumor. This collection of MRI images from the different sources is called dataset. We have collected four

different types of bone dataset that is normal bone, Stage 1 tumor bone, Stage 2 tumor bone and Stage 3 tumor bone MRI images. In total we have 300 bone images. These images will be splitted for the training and testing purpose. For training, the dataset is splitted to 70% and for testing this will be splitted to 30%. Tumor can be identified or classified by using the convolution neural network algorithm which takes the image as input. In order to give the input to the model, first it should be preprocessed that is converting the RGB scale image to the grey scale image and then forming the array by the pixel in the grey scale image and then normalizing the array that is dividing each value of array with the maximum value of the array so that the values will be between -1 and 1.

Then this normalized array will be given as input to the model. There will be three layers in the Convolution Neural Network that is input layer, output layer and the hidden layer. The normalized array will be given as input to the input layer and then the processing carries out in the hidden layer with the array, predefined weights ad bias. After every epoch, the pooling operation will be done to the image which is nothing but resizing the image so that it will be sufficient enough for providing the input in the next epoch. There are different types of pooling like max pooling, average pooling etc. In this paper, to develop the model we will be using max pooling layer where maximum value will be taken from each of the segmented image matrix. We can segment the matrix by different strides but we should make sure that all the segmented matrix should be same. We will also be using activation layer in order to classify the image.

There are different types of activation functions like relu activation function, sigmoid activation function, softmax activation function, exponential linear functions, Tanh functions and so on. In this paper, we used two activation functions that is relu and the sigmoid. In relu activation function, the vector (which is obtained by resizing the input matrix) will be converted to the values of 0 and 1 and this will be used in all the layers except the output layer because at last if the classified output is malignant then the stage of the bone tumor must be known.

So, in order to classify the classes that 3 classes(First stage, Second stage and third stage) with if the bone is benign so totally there are 4 classes so to get the values like this, in this paper we will be using the sigmoid function at last.

Then the classification is done and the result will be displayed accordingly how the model has been classified. In each epoch, the accuracy will be increasing and the loss will be minimized because over and over we will be giving same image as the input.

## 2. RELATED WORK

- R. M. M., T. N. L., A. C. N., and C. K. Subramanian done a survey called bone malicious growth identification which uses CNN algorithm for image processing steps like image segmentation, pre processing. Here ultra sound resemble is used which are of bones. The results will be outputted with a precision of 98.11 % or up to it.In this survey paper, it contains process like pre processing, edge detection, segmentation and also feature extraction. Here by using feature extraction process the resulted features of the images will be evaluated with training dataset. This is efficiently highlights bone tumours[1].
- The study by E. Hussein and M. A. Rahman employs a connected component labelling algorithm to detect bone tumours. The artificial neural network (ANN) is employed in this study to classify bone tumours. In this study up to 220 bones of MRI scans are under evaluation .with texture properties of these pictures being used to instruct and test the neuronal network. The classification results show that the neural network has a success rate of 92.50 percent when it comes to bone tumour classification. This study focuses on bone tumour identification is done using element labelling process .where in this process tumour size and category is identified easily. The proposed categorization approach has a 92.5 percent accuracy rate, which is acceptable. The goal of this project is to create a tool that can distinguish between malignant and benign bone cancers and thereby help with clinical diagnosis[2].
- M. Aula, N. P. Lukaku, and M. P. Raja: For bone image segmentation, this paper used the CNN approach. By measuring the mean intensity of the selected area, the resulted image have to under go that process for bone cancer analysis. For the categorization of medical images with the appearance or non-appearance of tumor, and where threshold values have been

proposed. This approach yields 95 percent accuracy while requiring less computational time.

- The focus of this article was on the early diagnosis of tumor. It will also used for determining the different phases. Bone Cancer is a significant contributor to the worldwide illness burden. By 2025, the predicted number of new cases per year will have risen from 10 million in 2002 to 15 million. This study proposes a formal technique for selecting average pixel potency values in images which differentiates the cancer and non-cancer. For extraction of a bone tumour portion, a method for segmenting a tumour from a picture using pixels based on the CNN algorithm. The identification process of bone cancer is more accurate when the mean pixel intensity value thresholding is used. This paper proposes a computer-aided featured system for detecting bone cancer through computed tomography scan or magnetic resonance imaging pictures, which is also relevant to DICOM actual format (digital imaging communication of medicine) medical photos[3].

- M. A. Rehman and E. Hossain: This research uses fuzzy C-mean clustering to develop a method for detecting bone cancer. For the accuracy testing of the suggested approach, a total of 120 validated victim MRI scans of bones were used. The adaptive neuro fuzzy inference system (ANFIS) is used in this work to classify benign and malignant tumours.

  The ANFIS network was trained and tested using grey level co-occurrence matrix (GLCM) data extracted from MR images. The gathered bone pictures were properly cross validated to divide them. The precision, responsiveness, and specificity performance matrices are to be used to check the categorization outcome. In this case of bone cancer, the proposed categorization technique has a 93.75 percent accuracy rate. The developed technique can be used to detect and classify tumours in MR images of the bones[4].

  In this study, H. Watanabe, T. Ogawa, and M. Hillman propose using CT scans to identify bone cancer. Bone cancer can spread from the main cancer to other organs, causing excruciating pain. As a result, in addition to primary cancer, it is critical to detect metastatic tumours early. In this scenario, the concept of anomaly detection may be regarded appropriate.

  The suggested method, which is form on aoriginating adversarial network representation, is unsupervised machine learning model which teaches with non-metastasis bone cancer pictures. The peculiarity score for each exam CT image is then determined. The pecuilarity scores between the non-metastasis pictures and metastasis are completely processed, according to the results of the experiments. The anomaly detection method could be useful for detecting bone metastatic tumours in CT scans[5].

- M. A. Rehman and E. Hossain: This paper compares and contrasts living bone tumor separation techniques and proposes a device labelling process for bone tumour segmentation using MRI scans. On the basis of quantitative approaches, the living bone tumour separation algorithms are distinguished with the other one. Over the other segmentation approaches, the device labelling algorithm delivers the hugest average of the DSC 96.05 percent and average of the SSIM 97.33 percent, According to the comparative evaluation. On the basis of MR scans, this study compares and contrasts existing bone tumour segmentation approaches. This article also looked at an object labelling algorithm for bone tumour segmentation and evaluated it. The results of each algorithm's segmentation are also reported in this publication. The object labelling method performs well in terms. According to the comparison results. The region growth algorithm is shown to be the most efficient of the three techniques[6].

- **S**. K. Shrivastava and A. Pandey: They are using a Computer Aided Diagnosing (CAD) system to analyse Computed Tomography images in this paper. Canny edge detector is to be used in image edge detection. though the Canny edge detector has significant drawbacks, such as the inability to differentiate edges that occur around objects, it is still superior than other standard edge detector approaches[7].

- **K. Sujatha:** Our proposed study was coupled with pre-processing approaches in order to reduce noise and obtain smooth photos during the session. This procedure will help to increase the image's quality while also removing the false portions. The K-means method was used to detect the presence of bone cancer and assess its stage, and then edge

segmentation was utilised to provide a smooth image. Our main goal in this study was to predict or detect a bone tumour at the proper time and stage. With our method, which included image processing and genetic algorithms, we were able to detect bone tumours successfully without any incorrect interpretations, allowing therapists to provide suitable treatment[8].

### 3. PROPOSED WORK

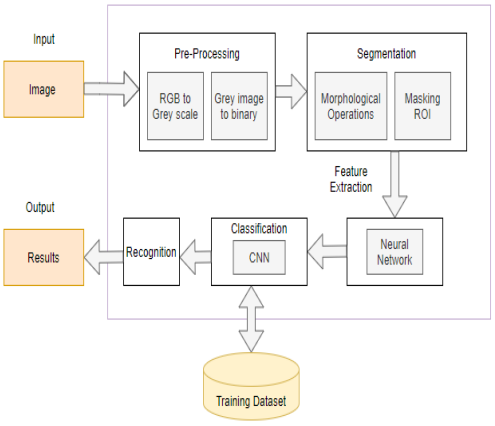
The entire technique for detecting bone cancer has three main components: MRI images are given as input and processed in three stages: image processing, image segmentation, and feature extraction and classification.

The datasets are MRI pictures that are utilized for both training and testing. In the training set, we offer photographs of patients with bone cancer pneumonia and photos of persons who do not have bone cancer pneumonia.

The Convolution Neural Network technique is used to train the model. Dicot is a technology that displays a two-dimensional depiction of bone density and detects all supplements in the bone.

For detecting the degree of malignancy and bone fractures, MRI images provide excellent resolution. Our suggested system's main goal is to establish a quick accurate method for detecting bone cancer in its early stages.

The diagram below shows the system architecture.




SYSTEM ARCHITECTURE

Pre-Processing: This is the first stage in improving the image's quality. The filtering technique is used to begin the picture processing stage. Noises such as occlusions, fluctuations in illuminations, and so on are common in images. As a result, these sounds must be eradicated. The Gabor filter is used to smooth out the pictures and eliminate noise.

When compared to other filters, the key advantage of this filter is that it delivers great noise reduction with minimal blurring. The grey conversion is the next stage in the pre-processing. This is the process of transforming RGB-level pixels to gray-level pixels. This is done because, in comparison to a colour image, the grey level image is easier to process. The purpose of this conversion is to keep the brightness while removing the hue and saturation information.

Edge Detection: A type of edge detector that is used to determine the boundary between two areas with differentgrey level attributes. In cancer photos, edge detection was employed to extract important features for pattern identification. The Canny edge detector is used to identify an image's edge. It blurs the image first, then uses an algorithm to effectively thin the edges down to one pixel. This canny detector has the advantages of good detection, localisation, and reaction time.

Morphological operation: Morphological operations are used to determine the form, size, and connectedness of an object. The morphological technique's two main procedures are dilatation and erosion.

To extend the zone, a dilation procedure is employed. Erosion is a technique for removing or destroying tiny items.

Segmentation: The technique of splitting a picture into several segments is known as segmentation. Super pixel segmentation and multilayer segmentation were employed in this approach. In comparison to previous segmentation approaches, this approach divides the picture into larger pixels.

Feature Extraction: The most significant approach in image processing is picture feature extraction. It is crucial in the early identification of cancer. To identify cancer, visual characteristics are taken from the picture after segmentation. Feature extraction is a crucial stage that reflects the final findings in predicting whether a picture is cancerous or not.

The quantity of resources needed to explain a huge quantity of data is reduced via feature extraction. It is the technique of detecting and representing particular elements of interest inside a picture for subsequent processing.

## 4. EXPERIMENTATION AND RESULTS

Once we collect all the dataset which is nothing but Magnetic Resonance images of bones which containing tumor and which are not having any tumour. These MRI images will be given for pre processing purpose. In this Step, the image will be converted from RGB level to grey level and then according to this gray scale image, the numpy array will be created. These numpy array will be normalized by taking the each and every array value and dividing it by the number which is largest in the array. Then these will be given for edge segmentation in order to identify smooth edges and then segmentation is done that is making few parts or making small segments of images so that it will be easy for processing. Then the required features will be extracted and then given to the CNN algorithm and thereby predicting the proper result. The most dense component among these related components is removed and designated as a tumour part. Following segmentation, a total of 12 characteristics are collected from the segmented tumour for categorization purposes.

A total of 220 bone MR photos were gathered from various tumour and orthopaedics websites, with 110 photos for each category of bone tumour.

There are different layers in the CNN model and those layers which we use for experimentation are,

Sequential layer: This is one of the machine learning model which takes the input and produces the output which is sequential. This may contain the information like text, any audio records, video records and so on. This acts as the input for the models like recurrent neural network and convolution neural network.

Batch Normalization: Batch normalization is a separate layer which we will be using in order to normalize the output values of the previous layer the input for this layer is the output from any of the activation layers.

Convolution 2D layer: In the convolution two Dimension layer, the image will be taken as input and then we will take another matrix which will be used as multiplier matrix for multiplying the initial or the input matrix then the multiplication of these two will be done and finally we will include the result in the other matrix as the summation of first result matrix. For multiplying, we can take any strides in input matrix but whatever the size of the stride is taken, that must match with the multiplier size. The multiplier will be the subset of the original matrix.

Max Pooling Layer: In this type of pooling, we will be taking or dividing the array into smaller sizes and then we will check the maximum number in each of the smaller matrix, then this larger number or the maximum value will be placed in other matrix of same size.

Activation layer: Activation functions are the functions that we will use in various neural network methods to compute based on the weights of the input and the bias that we will provide in each layer. In order to compute and minimize the loss and acquire the outcome in the desired manner, this employs methods such as gradient descent.

Sigmoid activation function: This is a non-linear function, and it's common in feed forward networks. This is where you'll find the curve that looks like a S. We'll use the vector as input in this case. When we restructure the matrix, this vector will appear. This vector will be used as an input, and output values will be produced based on the formula, with values ranging from 0 to 1.

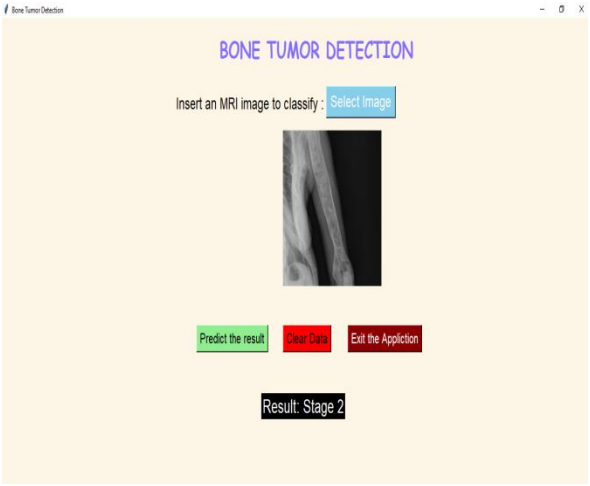
RELU**:** This is a linear unit that has been rectified. This function is utilized in virtually all neural network models, and it is the most popular activation function in the deep learning concept since it is considerably faster than the other activation functions, and it also has a very high performance. Because this function is extremely similar to a linear function, finding the gradient descent becomes quite simple and the loss is minimal when using any linear model. All of the negative values in the matrix will be set to zero, making all of the values positive only. As a result, calculating becomes simple.

Flattening image**:** This is the layer we'll use to acquire our result. Following the pooling operation, the image must be flattened, which can be accomplished by transforming the matrix created after pooling into an input. As a result, this layer flattens the matrix values and outputs the vector.

Dropout: This approach is quite useful when we are primarily concerned with performance or quickness. Dropping out the neurons will be very helpful in this case since certain neurons may act useless when we conduct many iterations, that is, when the precision of each back propagation increases, thus all of the

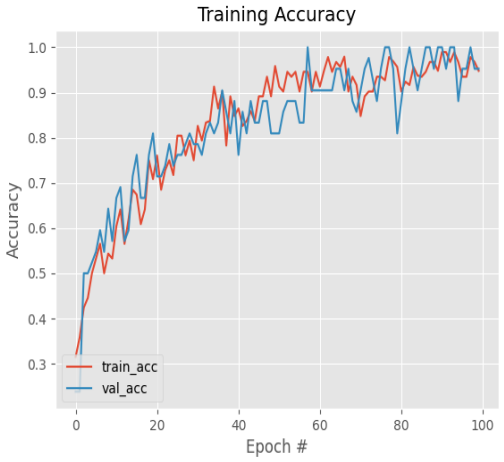
neurons may not be useful. If we don't do any neurons dropout, the unwanted neurons will participate as well, requiring a significant amount of time. The dropout will be used because of this. Each back propagation has its own set of rules. It is possible to remove a small percentage of neurons and yet get good performance.

Dense: The dense layer is a deep-connected neural network layer, meaning that each neuron in the dense layer receives input from all neurons in the previous layer. It has been discovered that this is the most regularly used layer in models. The dense layer executes matrix vector multiplication in the background. The values in the matrix are actually parameters that can be learned and modified using the back propagation technique. The dense layer produces an m-dimensional vector as its output. As a result, the dense layer is mostly employed to change the vector's dimension. Dense layers also apply operations to the vector, such as rotation, scaling, and translation.




DEVELOPED MODEL

The above figure shows the developed model. Where we will input the image then that image will be displayed after this will be given as input to model there by it predicts for the above image as tumor is in Stage 2




ACCURACY OF THE MODEL

Accuracy is nothing but how proper the model is going to work. As number of epochs increases then the accuracy will be increased as shown in the above figure.


LOSS OF THE MODEL

As the epochs are more then the loss will be decreased as we can see in the above figure.

## 5. CONCLUSIONS

The Bone Cancer is one of the most dangerous cancer so this must be taken care in the early stages only. In this model Magnetic resonance images will be used as the input. Our proposed system detects whether the cancer is present or

not also if the cancer is present then it detects at what stage the cancer is that is either it is first or second or third stage. If the image have no tumor segments then this model gives the result as normal.

This model achieves expected desired result at the end of the model. The extracted features from the image contain some specific information to understand the details of the image. The main purpose of extracting the features is to reduce the process complication and also to isolate various desired shape of the image. The accuracy of the classification stage depends on extracted features.

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