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BONE CANCER DETECTION USING CONVOLUTIONAL NEURAL NETWORK

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Abstract: **- Bone cancer is a dreadful disease that claims the lives of numerous people. The detection and classification system must be easily available in order to identify cancer at an early stage. Early detection seems to merely boost the patient's chance of surviving cancer. The categorization of cancer is one of the most challenging tasks in clinical diagnosis. This study focuses on a system that analyses magnetic resonance images (MRI) of various people to spot cancers and classify cancer using convolutional neural networks. The proposed approach uses automatic feature extraction, classification, and image processing techniques to detect bone cancer. The process required for cancer detection and classification will be greatly accelerated by the suggested method. Using CNN for classification is better than the existing methods which uses Artificial neural networks.**

Index Terms– Bone cancer, Preprocessing Techniques, Feature Extraction, Convolutional neural network etc.

1. INTRODUCTION

For both men and women, reason for the most common cause of death is cancer. Today the most important problem in health and medicine context is cancer. Earlier diagnosis and timely treatment are very effective to improve and survival so image processing as a decisive tool can help the physician to diagnose cancer early [1]. Bone cancer is a condition that develops as a result of uncontrolled growth in the bone's tissues. Curing the sickness totally is possible through the early discovery of cancer. The necessity of procedures for recognizing the presence of cancerous nodule in beginning phase is getting attention these days. In a phase known as metastasis, growth that extends beyond the bone and to other parts of the body.

When uncontrolled growth is detected early on, it opens the door to a variety of treatment choices, reducing the chances of unnecessary surgery and increasing the chance of survival. Surgery, chemotherapy, and radiotherapy are also options for treatment. Survival rates differ based on many factors. The stage of the disease, general health, and other factors all play a role, but only 14% of people diagnosed with bone cancer survive five years after their diagnosis. Often it's impossible to tell what stage of illness you're in because the symptoms aren't visible. There are three modalities regularly utilized for bone imaging: MRI, CT scan, and X-ray. A potential sarcoma appears as an opening within the bone on an X-ray. To create a gray scale representation of the body, electromagnetic radiations are used in x-rays which are of high-energy. CT imaging, which works similarly to an X-ray, is used to produce images of the body which is cross-sectional. Magnetic Resonance Imaging (MRI) is a technique that uses powerful magnets and radio waves to create an accurate picture of a specific body part. More data and resolution are available with X-ray and CT imaging. As a result, hybrid imaging modalities are often used to incorporate the benefits of various techniques while addressing their shortcomings. In 2009-2013, in England 55% Survive bone sarcoma for 10 or more years, and bone sarcoma survival is highest at age limit 15-59 years. In last 25 years, survival rate of bone sarcoma survival rate has not changed in England [2].

In this paper, we propose bone cancer detection method at low cost using MRI images. Utilizing a proficient preparing method is considered as a fundamental step to improve the in general visual representation of clinical pictures, and as an outcome gives better results. We use various image processing techniques such as contrast enhancement, classification and edge detection using CNN(Convolution Neural Network) to detect cancerous tissue in the bone in a simple, fast, and reliable way.

The organizational framework of this study divides the research work in the different sections. The Literature survey is presented in section 2. Further, in section 3 shown the Existing system, in section 4 shown the proposed system, In section 5 Simulation Results work is shown. Conclusion and future work are presented by last sections 6.

2. LITERATURE SURVEY

Sinthia P and K. Sujatha [1] proposed a novel approach to detect the bone cancer using K-means algorithm and edge detection method. This methodology used Sobel edge detection to detect the edge. Sobel edge detector detects only the border pixels. K-Means clustering algorithm is

used to detect the tumor area. Defining the number of clusters is the difficult step in K-Means clustering algorithm.

Kishor Kumar Reddy [2] proposed a novel approach for detecting the tumor size and bone cancer stage using region growing algorithm. This methodology segmented the region of interest by using region growing algorithm. Tumor size is calculated according to the number of pixel in the extracted tumor part. Depending upon the total pixel value cancer stage is identified. Selection of seed point depends on the image and it is difficult to select accurately.

MaduriAvula [3] proposed a method to detect the bone cancer from MR images using Mean pixel intensity. The input MR image is denoised and K-Means clustering algorithm is applied to extract the tumor part. From the extracted tumor part the total number of pixel is computed and the sum of pixel intensity is calculated for the extracted tumor part to calculate the mean pixel intensity. Mean pixel intensity is calculated to identify cancer. If the mean pixel intensity value is above the threshold value it is considered as cancer.

Abdulmuhssin Binhssan [4] proposed a method to detect the enchondroma tumor. The input image is denoised using the bilateral filter and average filter. The bilateral filter has certain disadvantage It takes more time to denoise the image. The average filter provides better result compare to bilateral filter. Thresholding segmentation is carried out to segment the image and morphological operations are applied to enhance the tumor area.

EzhilE.Nithila and S.S Kumar [5] proposed Automatic detection of solitary pulmonary nodules using swarm intelligence optimized neural networks on CT images. This methodology used the Gaussian filter to remove the noise and contour model to segment the image. Leakage problem arises due to the weak boundary. The nodule is detected from the segmented image. Borders of the nodule are corrected to recover the lung nodule. Various features are extracted to find the tumor accurately. The extracted feature is applied to back propagation neural network to train the data and to classify the tumor.

Mokhled S. Al-Tarawneh [6] proposed a method of Lung Cancer Detection Using Image Processing Techniques. This methodology used Gabor filter to denoise the image. Gabor filter has the best results. To segment the image two segmentation methods are used. Thresholding approach and marker-controlled watershed segmentation are the two algorithms. Marker-controlled segmentation technique provides better result compare to thresholding approach. The image features are extracted using binarization and masking approach to identify cancer.

Fatma Taher and NaoufelWerghi [7] proposed a method to detect lung cancer by using an artificial neural network and fuzzy clustering methods. This methodology used two segmentation methods Hopfield neural network and a fuzzy c-means clustering to segment the image. Computer Aided Diagnosis system is developed to identify cancer at its early stages. In this paper, 1000 sample images are tested using both the segmentation techniques. HNN has shown a better classification compare to fuzzy clustering technique.

Anita chaudhary [8] has developed a method of lung cancer detection on CT images by using image processing. In this methodology, Gabor filter is used for noise reduction. Segmentation is done by using two segmentation methods thresholding and marker-controlled watershed segmentation. Features are extracted to identify the tumor. Area, perimeter and roundness are the three features extracted in this paper.

Md. BadrulAlam Miah and Mohammad Abu Yousuf [9] proposed a technique to detect the lung cancer from CT image using image processing and neural network. In this methodology, several preprocessing techniques are used to enhance the image. Segmentation technique is carried out after preprocessing to segment the image. Features are extracted and applied to the neural network to train and classify cancer.

NooshinHadavi and Md.JanNordin[10] proposed a method for Lung Cancer Diagnosis Using CT-Scan Images Based on Cellular Learning Automata. This methodology used Gabor filter to remove the noise present in the input image. Region growing algorithm is used to segment the image. Various features are extracted from the segmented image and applied to the new algorithm cellular automata to identify cancer.

K. Jalal Deen and Dr. R. Ganesan [11] proposed An Automated Lung Cancer Detection from CT Images Based on Using Artificial Neural Network and Fuzzy Clustering Methods. Preprocessing techniques are applied to enhance the image. Dilation and erosion operation is applied to the preprocessed image. Lung border is extracted using edge detection technique. Lung regions and various features are extracted. Artificial neural network and Fuzzy C-Means clustering technique are used to identify the tumor from the extracted lung region. This proposed methodology used Artificial Neural Network for classification and to detect the tumor area accurately

3. EXISTING METHOD

Artificial Neural Network is an information processing paradigm that is inspired by the way biological nervous system such as brain process information. Neural Network is composed of a large number of highly interconnected processing elements which is called neurons. Feed forward neural network travels in one way input to output. There are no feedback loops present in the feed forward neural network

The aim of pre-processing is to improve the quality of the image so that we can analyze it in a better way. By preprocessing we can suppress undesired distortions and enhance some features which are necessary for the particular application we are working for. Those features might vary for different applications. For extracting features of the bone using MRI image, we need to apply different image processing techniques like image

enhancement, image segmentation then we go for feature extraction and thereafter we go classifying the bone cancer using Artificial Neural Network.

The image feature extraction is an important technique in image processing. It plays a major role in the cancer detection using image processing. Features are extracted from the segmented image to detect cancer. Feature extraction helps to represent the final results to predict cancer and non-cancer of an image. Feature extraction reduces the number of resources required to describe a large set of data. It is the process by which certain features of interest within an image are detected and extracted for further processing. The feature is described as a most representative information of the image. Each feature specifies some quantifiable property of an object and is computed such that it quantifies some significant characteristics of the object.

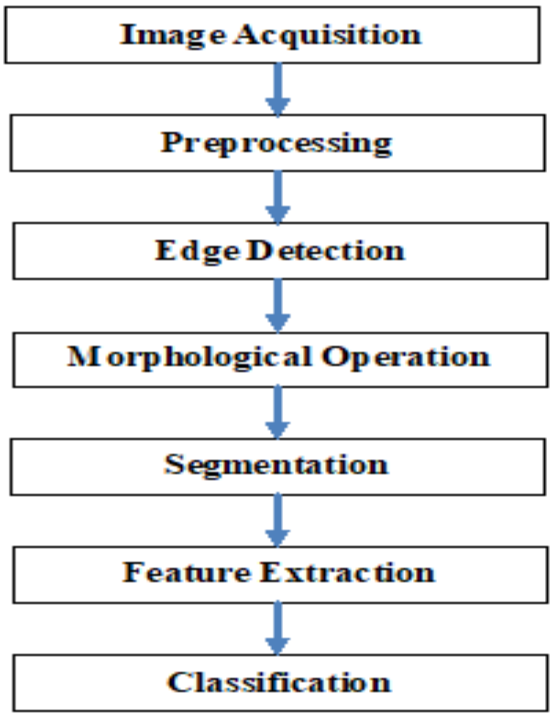

Fig.1: Existing Block Diagram of Existing Method

- **Edge Detection** is a method of segmenting an image into regions of discontinuity.Edge detection allows users to observe the features of an image for a significant change in the gray level. This texture indicating the end of one region in the image and the beginning of another. It reduces the amount of data in an image and preserves the structural properties of an image.
- **Morphological Operations** is a broad set of image processing operations that process digital images based on their shapes. In a morphological operation, each image pixel is corresponding to the value of other pixel in its neighborhood. By choosing the shape and size of the neighborhood pixel, you can construct a morphological operation that is sensitive to specific shapes in the input image. Morphological operations apply a structuring element called **strel** in Matlab, to an input image, creating an output image of the same size.
- **Image Segmentation**
  Image segmentation is a method in which a digital image is broken down into various subgroups called Image segments which helps in reducing the complexity of the image to make further processing or analysis of the image simpler. Segmentation in easy words is assigning labels to pixels. All picture elements or pixels belonging to the same category have a common label assigned to them.
- **Feature Extraction**is a part of the dimensionality reduction process, in which, an initial set of the raw data is divided and reduced to more manageable groups. So when you want to process it will be easier. The most important characteristic of these large data sets is that they have a large number of variables. These variables require a lot of computing resources to process. So Feature extraction helps to get the best feature from those big data sets by selecting and combining variables into features, thus, effectively reducing the amount of data. These features are easy to process, but still able to describe the actual data set with accuracy and originality.

4. PROPOSED SYSTEM

Bone cancer can begin in any bone in the body, but it most commonly affects the pelvis or the long bones in the arms and legs. Bone cancer is rare, making up less than 1 percent of all cancers. In fact, noncancerous bone tumors are much more common than cancerous ones.

The term "bone cancer" doesn't include cancers that begin elsewhere in the body and spread (metastasize) to the bone. Instead, those cancers are named for where they began, such as breast cancer that has metastasized to the bone.In this project we are classifying the bone cancer using convolutional neural networks. First, we creating a network using with CNN layers. Then we will take dataset of bone CT scan imagesof normal and abnormal images into a folder and some of the images into folder as test images. After setting layers and dataset then we will be defining some of the training options so that the training of dataset through the layers with training options will be done and then by testing with a random image which can be classified as abnormal or normal.

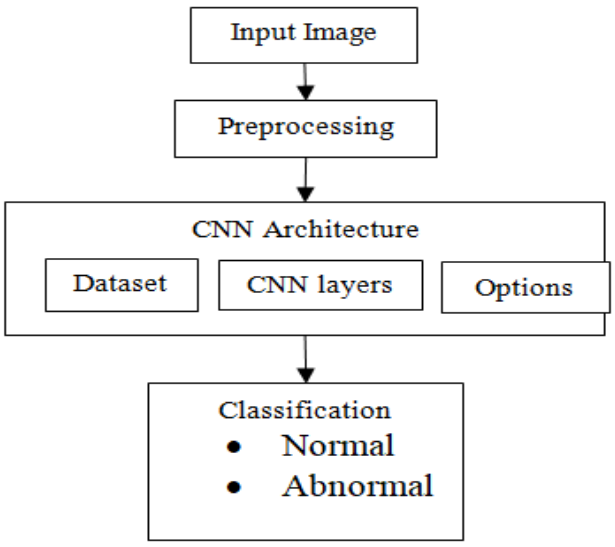

Fig.2: Block Diagram of Proposed Method

IMPLEMENTATION

1. Dataset Preparation:

- Collect a dataset of bone cancer images. Divide the dataset into training, validation, and testing sets.
- Ensure that your dataset is properly labeled as "normal" or "abnormal."

2. Preprocessing:

- Load the dataset images into MATLAB.
- Perform preprocessing steps such as resizing, normalization, and augmentation (if required) to enhance the dataset's quality and variability.
- Split the dataset into training, validation, and testing sets.

3. CNN Model Creation:

- Define the architecture of your CNN model in MATLAB using the Deep Learning Toolbox.
- Typically, a CNN for image classification includes multiple convolutional layers, followed by pooling layers and fully connected layers. You can experiment with different architectures and layer configurations.
- Specify appropriate activation functions, such as ReLU, and consider using regularization techniques like dropout or batch normalization to prevent overfitting.

4. Training:

- Configure the training options, such as the learning rate, number of epochs, and mini-batch size.
- Train the CNN model using the training set. Use the "trainNetwork" function in MATLAB's Deep Learning Toolbox.
- Monitor the training process and evaluate the model's performance using the validation set. Adjust the model architecture or training parameters as needed.

5. Testing:

- Once the model is trained, evaluate its performance on the testing set.
- Load the testing set images and preprocess them in a similar manner as done during training.
- Use the "classify" function to predict the classes (normal or abnormal) for the testing set images.

6. Performance Evaluation:

- Compare the predicted labels with the ground truth labels of the testing set to calculate metrics such as accuracy.
- Analyze the performance of the model and iterate on the design if necessary.

5. SIMULATION RESULTS

The work was tested on MRI images of bone cancer patients in both existing and proposed methods. In existing methods use ANN Classifier and in proposed method use CNN Classifier. The corresponding results shown in below figure.

Fig.3: Input Image

The Input image shown in fig.3 is common for Existing method and proposed method.

A. Existing Method

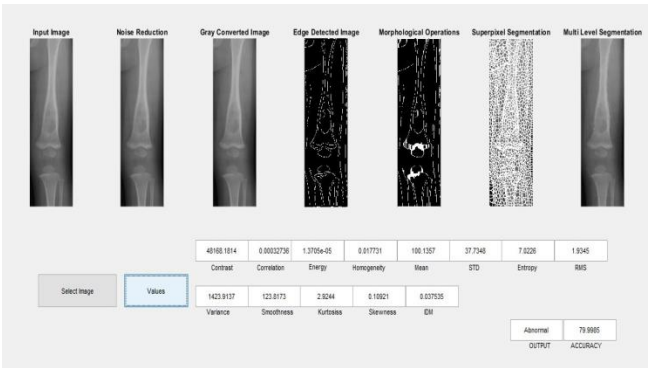

Fig.4: GUI display of Bone cancer classification using ANN

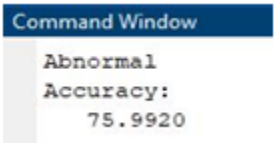

Fig.5: Accuracy display in command window using ANN

B. Proposed Method

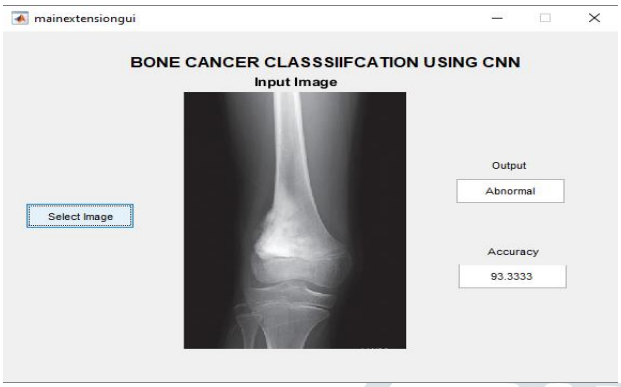

Fig.6: GUI display of Bone cancer classification using CNN

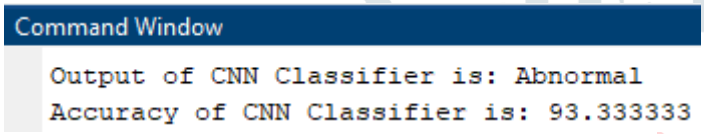

Fig 7: Classification Output of Command window

C. *Comparison Table*

S.NO.	Parameter	Existing Method	Proposed Method
1	Classifier	ANN	CNN
2	Dataset	MRI images	MRI images
3	Accuracy	75.99	93.33
4	Performance	Low	High

Based on the provided information, the proposed method utilizing a CNN classifier outperforms the existing method that employs an ANN classifier. The proposed method achieves a significantly higher accuracy of 93.33% compared to the existing method's accuracy of 75.99%. Additionally, the proposed method is described as having high performance, indicating that it likely performs tasks more efficiently or effectively than the existing method.

D.Performance Graph

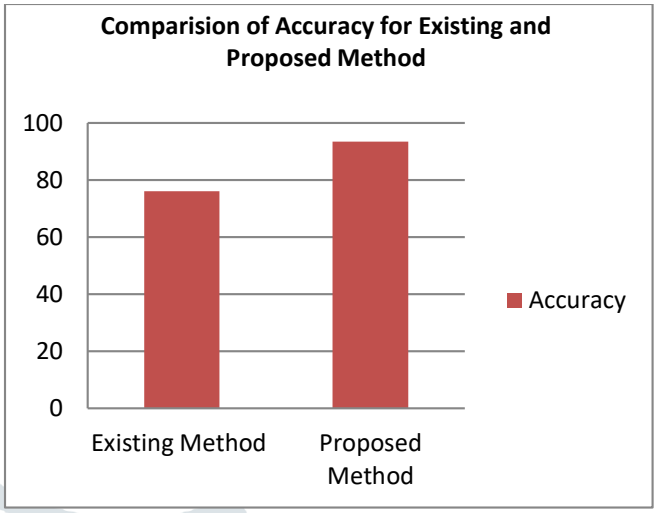

Fig.8: Performance comparison graph

6. CONCLUSION AND FUTURE SCOPE

Bone cancer is one kind of dangerous diseases, so it is necessary to detect cancer in its early stages. But the detection of bone cancer is the most difficult task. There are many techniques which researchers used for the detection of bone cancer but they have some limitations. The proposed system successfully detects the bone cancer from CT scan images. The system achieves its desired expectation at the end of the system. The proposed system will be successfully classifying the images as abnormal or normal. The proposed system bone cancer classification using convolutional neural networks is better than existing system which is using artificial neural networks with improved accuracy and classification.

Future Scope

In future the proposed method can be extended with incorporating multiple imaging modalities, such as X-rays, MRI, CT scans, and histopathological images, can provide a more comprehensive analysis of bone cancer. Developing CNN models that can effectively integrate and analyze information from different modalities could lead to improved accuracy and diagnostic capabilities.

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