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FEATURE EXTRACTION AND CLASSIFICATION OF BONE TUMOR USING IMAGE PROCESSING

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1. ABSTRACT

A tumor is an abnormal growth of new tissues that can occur in any of the body organs. In recent years, there are many kinds of tumors in human body like brain tumor, bone tumor, lung tumor, etc. Image processing plays a vital role in analysis and classification of tumor. Medical image processing is an important field of research as its outcomes are used for the betterment of health issues. Bone tumors develop when cells within a bone divide uncontrollably, forming a lump or mass of abnormal tissue. There is a large class of bone tumor types which have different characteristics. There are two types of bone tumors, Noncancerous (Benign) and Cancerous (Malignant). In our project we can mainly concentrate on image segmentation for bone image and their classification. In the first module input image was segmented and the features are extracted, in the second module with the use of Support Vector Machine (SVM) and Artificial Neural Network(ANN) classifiers, the images are classified as Benign or malignant, and then trained image stored in database after that corresponding report should sent to automatically send to the server through IOT(Internet of Things) and doctor should assess . This project proposed a simple and easy method to detect and classify the bone tumor.

2. INTRODUCTION

Medical image processing is an important field of research as its outcomes are used for the betterment of health issues. A tumor is an abnormal growth of tissues. As the tumor grows, the abnormal tissue displaces healthy tissue. Bone tumors develop when cells within a bone divide uncontrollably, forming a lump or mass of abnormal tissue . There is a large class of bone tumor types which have different characteristics. There are two types of bone tumors, Noncancerous (Benign) and Cancerous (Malignant) .

Accurate bone tumor detection procedure is very important in many medical imaging applications. It helps in planning for early treatment, evaluation of therapy, etc. Because sometimes doctors cannot identify the diseases quickly, which can create problems that make the human life very hazardous and patients suffer from many difficulties. Therefore, doctor needs great accuracy in the diagnosis of bone tumor from imaging investigations. Accurate analysis may help to solve the problems.

X-rays are important medical tool for doctors. X-rays are ionized forms of radiation which capture the image using rays. Doctors found that they could not get a detailed view of patient's body. Thus different technology like MRI or CT scans are used which are more expensive for viewing the detailed information. X-rays images do not give any medical data for organs or tissues, only an image of bones. MRI and CT scans can give more bone details than traditional X-rays. CT scan has ability of creating a 3-D image of bone structures while an X-ray creates a 2-Dimage bone structure. But MRI and CT scans are more costly which not affordable to the patients. So that digital x-ray technology is solution for the x-ray which shows 3D digital image structure. Digital x-ray is also called as digital radiography.

The X-ray is capture for many reasons to diagnosis the disease. Therefore the accurate diagnosis of bone fracture is important aspects to the doctors in medical field. So digital x-ray images help to provide appropriate treatment. Normally X-ray images are used for bone fracture analysis. This project is to develop an digital x-ray based on image processing system which gives a quick and accurate classification of disease based on the information gained from the digital x-ray images which are saved in computer image format like jpeg, png etc. Digital X-ray images are provide the accurate result. This image are recorded digitally and characterized by large size, wide

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dynamic range and high resolution.The Internet of Things (IoT) is the network of physical objects – devices, vehicles, buildings and other items embedded with electronics, software, sensors, and network connectivity- that enables these objects to collect and exchange data. Internet of Things allows objects to be sensed and/or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit.

3 . METHODOLOGY

The algorithm has two stages, first is pre-processing of given X-RAY image and after that segmentation and then performs morphological operations. Pre-processing is a primary step, which aims to improve the quality of images by removing noise, reducing artefacts, and increasing contrast to make the segmentation step precise. There are several pre-processing techniques such as image adjustment, histogram equalization, and filtering etc. Filtering is one of the most important pre-processing techniques because it reduces noise, sharpens the edges of an object, preserves the edges, and smooth defective images created by the MR imaging system. We chose the average filter and bilateral filter. Give X-RAY image of bone as input. Convert it to gray scale image. Apply average and bilateral filter for noise removal. By comparing average filter, bilateral contains high noise removal and enhance the quality of image. Compute threshold segmentation. Compute morphological operation. Finally output will be a tumour region. For many years, radiologist detects bone tumors manually, as bone MRI images are complicated and tumors can only be identified by expert physicians.with the rapid development of computer technology, computers have become an integral part in medical image acquisition, enhancement, segmentation, labeling, and analysis. However, radiographic images are still examined by medical experts manually. Examination of such images is usually a repetitive and labor intensive process. Further, manual examination of images often produces subjective results that are highly dependent on the knowledge and experience of the examiner. Computerized analysis and interpretation of medical images will not only be time and cost effective, but will also allow objective and reproducible results to be obtained. This allows comparison of results to be independent of human bias and error. Quantitative information, which can be beneficial for in-depth understanding of images and which may not be immediately apparent to the medical examiner in a raw or enhanced image, will be more effectively obtained with a systematic approach. Manual Segmentation is superior quality but has two drawbacks. The first drawback is that producing manual segmentations is extremely time consuming. The second problem with manual segmentations is that the segmentation is subject to variations both between observers and within the same observer. So bone tumor segmentation and detection are highly required in order to generate quickly satisfactory result. This will be very useful for fresher doctor to detect tumor easily.

4. BLOCK DIAGRAM

The Figure 4.1 shows that Block Diagram of Tumor Detection

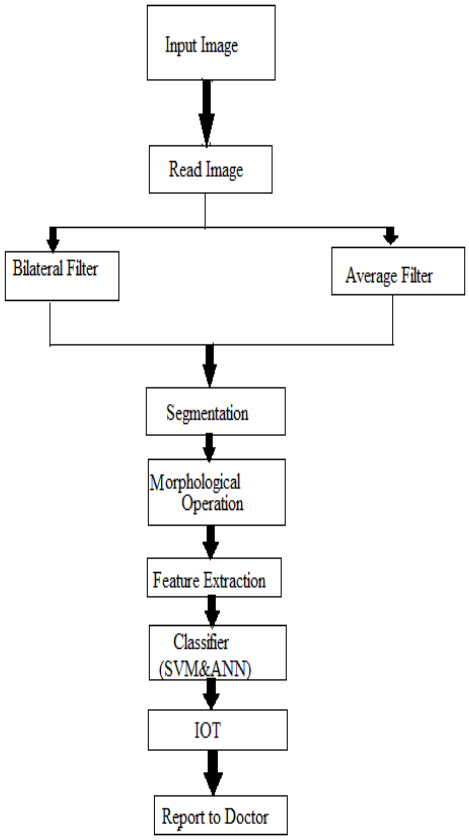

Figure 4.1 Block Diagram of Tumor Detection

5. MATLAB SIMULATION

Image Processing

Image processing is a method to convert an image into digital form and perform some operations on it, in order to get an enhanced image or to extract some useful information from it. It is a type of signal dispensation in which input is image, like video frame or photograph and output may be image or characteristics associated with that image. Usually Image Processing system includes treating images as two dimensional signals while applying already set signal processing methods to them.

Image processing basically includes the following three steps.

- Importing the image with optical scanner or by digital photography.

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- Analyzing and manipulating the image which includes data compression and image enhancement and spotting patterns that are not to human eyes like satellite photographs.

- Output is the last stage in which result can be altered image or report that is based on image analysis.

Filtering Techniques

5.2.1 Bilateral Filter

Bilateral filter is a non-iterative, local and simple method for removing Gaussian noise while preserving edges. As the name implies Bilateral filter is combination of range and domain filtering. Traditional filtering is domain filtering, and enforces closeness by weighing pixel value with coefficients that fall off with distance. Similarly, range filtering can be defined as which averages image values with weights that decay with dissimilarity. Range filters are nonlinear because their weights depend on image intensity or color. Computationally, they are no more complex than standard non-separable filters. Most importantly, they preserve edges.

The bilateral filter is defined as

( ) = —∑ ( ) (‖I ( ) -I ( ) ‖) (‖ -)

Where the normalized term

=∑ (‖I( )-I( )‖) (‖ -)

Ensures that the filter preserves image energy and

- is the filtered image;
- is the original input image to be filtered;
- are the coordinates of the current pixel to be filtered;
- is the window centered in ;
- is the range kernel for smoothing differences in intensities. This function can be a Gaussian function;
- is the kernel for smoothing differences in intensities. This function can be a Gaussian function;

5.2.2 Average Filter

The mean filter is a simple sliding-window spatial filter that replaces the centre value in the window with the average (mean) of all the pixel values in the window. The window, or kernel, is usually square but can be any shape. An example of mean filtering of a single 3x3 window of values .

Image Segmentation

Image segmentation means the partitioning, image into multiple regions. Segmentation aims to extract useful information from images in medical imaging applications as well. Image segmentation algorithms are based on one of the two fundamental properties of image intensity values: discontinuity and similarity. In the formal category, the segmentation approach is based on partitioning the processed image based on changes in intensity. It includes methods such as edge detection which segments an image which have varied in intensity between the dissimilar regions. The second one is based on partitioning an image into regions that are similar due to a set of predefined criteria. Bone tumour segmentation means segregating tumor from non tumors tissues. Image segmentation is very challenging as it is difficult to select appropriate technique for a particular kind of image. Thus, there is no universally accepted method for image segmentation. Each technique has its own advantages as well its drawbacks, so it depends on the user which technique he uses to solve his problem to the best extent. Segmentation techniques – Thresholding segmentation and morphological operation.

Thersholding Operations

Thresholding technique in segmentation is easy and effective. It converts the gray scale image into binary image which contains two values 0 and 1. So, accordingly the threshold values (min and max) are decided to detect tumors. It is very effective with the images which have high levels of contrast. So, we will take high contrast bone tumor images.

The threshold value based on maximum pixel value in the image is as follows:

Algorithm:

1.) Take maximum vector from the image.

2.) If max>0.8 then T=max*0.7

3.) Else if max<0.6 %

This means this image tends to be in dark range, so it is not related T=0.6

4.) Else T=max*0.6

5.) If bw(x,y) is the threshold version of I(x,y) then,1 if I(x,y)> Tbw(x,y)0 otherwise

Thresholding technique alone is not enough for accurate segmentation as in most cases the images have artifacts or false segmentation. So, two elementary morphological operations such as erosion and dilation are applied to the output image of thresholding.

Morphological Operation

Morphology is a broad set of image processing operations that process images based on shapes. Morphological operations apply a structuring element to an input image, creating an output image of the same size. In a morphological operation, the value of each pixel in the output image is based on a comparison of the corresponding pixel in the input image with its neighbours. By choosing the size and shape of the neighbourhood, you can construct a morphological

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operation that is sensitive to specific shapes in the input image. The most basic morphological operations are dilation and erosion. Dilation adds pixels to the boundaries of objects in an image, while erosion removes pixels on object boundaries. The number of pixels added or removed from the objects in an image depends on the size and shape of the structuring element used to process the image. In the morphological dilation and erosion operations, the state of any given pixel in the output image is determined by applying a rule to the corresponding pixel and its neighbours in the input image. The rule used to process the pixels defines the operation as dilation or erosion. [3] discussed about efficient content-based medical image retrieval, dignified according to the Patterns for Next generation Database systems (PANDA) framework for pattern representation and management.

Erosion operation is used to shrink or eliminate small objects and command used in MATLAB is imerode. Dilation operation is used to expand regions and edges and the command used in MATLAB is imdilate.

Dilation

Dilation is one of the two basic operators in the area of mathematical morphology, the other being erosion. It is typically applied to binary images, but there are versions that work on grayscale images. The basic effect of the operator on a binary image is to gradually enlarge the boundaries of regions of foreground pixels (*i.e.* white pixels, typically). Thus areas of foreground pixels grow in size while holes within those regions become smaller. The dilation operator takes two pieces of data as inputs. The first is the image which is to be dilated. The second is a (usually small) set of coordinate points known as a structuring element (also known as a kernel). It is this structuring element that determines**.**

Erosion

The value of the output pixel is the minimum value of all the pixels in the input pixel's neighbourhood. In a binary image, if any of the pixels is set to 0, the output pixel is set to 0. Pixels beyond the image border are assigned the maximum value afforded by the data type. For binary images, these pixels are assumed to be set to 1. For gray scale images, the maximum value for uint8 images is 255.

Opening

Opening ids defined as the erosion followed by the dilation using the same structuring element for the both operation. The opening operator therefore requires two input an image to be opened and a structuring element. Gray level opening consists simply of gray level erosion followed by gray level dilation. Opening is the dual of closing.

Segmentation

Segmentation phase mainly concentrates on tumor detection. An image segmentation technique such as thresholding and morphological operation is used and the results are compared. In detection of tumor segmentation technique is applied to the image.

Tumor Detection

The clusters with high intensity pixels are isolated from the X ray image which forms the tumor image. Some of the features like as area, mean, entropy, standard deviation and can be calculated from the tumor image.

Thresholding and Morphological Operations

Thresholding technique in segmentation is easy and effective. It converts the gray scale image into binary image which contains two values 0 and 1. So, accordingly the threshold values (min and max) are decided to detect tumors. It is very effective with the images which have high levels of contrast. So, we will take high contrast bone tumor images. The threshold value based on maximum pixel value in the image

Support Vector Machine

Support Vector Machine(SVM) is a machine learning tool that is based on the idea of large margin data classification. The tool has strong theoretical foundation and the classification algorithms based on it give good generalization performance. Standard implementations, though provide good classification accuracy, are slow and do not scale well. Hence they cannot be applied to large-scale data mining applications. They typically need large number of support vectors. Recently, particular attention has been dedicated to Support Vector Machines as a classification method. SVMs have often been found to provide better classification results that other widely used pattern recognition methods Hence the training as well as the classification times.

The Support Vector Machine is a theoretically superior machine learning methodology with great results in classification of high dimensional datasets and has been found competitive with the best machine learning algorithms. In the past, SVMs have been tested and evaluated only as pixel-based image classifiers.

Artificial Neural Network

Artificial neural networks (ANN) consider classification as one of the most dynamic research and application areas. The major disadvantage in using ANN is to find the most appropriate grouping of training, learning and transfer function for classifying the data sets with growing number of features and classified sets. The different combinations of functions and its effect while using ANN as a classifier is studied and the correctness of these functions are analyzed for various kinds of datasets.The neural network was trained by back propagation algorithm. The different combinations

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of functions and its effect while using ANN as a classifier is studied and the correctness of these functions are analyzed for various kinds of datasets.

7. FEATURE EXTRACTION

After analyzing the experimental results, we conclude that bilateral filter gives more accurate results and takes less computation time. Thus, Bilateral can be used further for Medical Imaging field and it predicts the tumor cells accurately in less computation time. There is much scope for further research work. The features such as area, entropy, mean, standard deviation can be calculated.

8. MATLAB SIMULATION RESULT

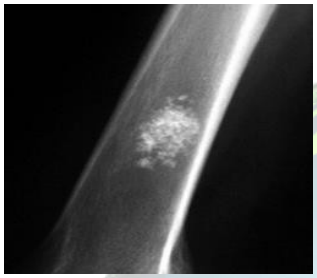


Figure 8.1 Input Image

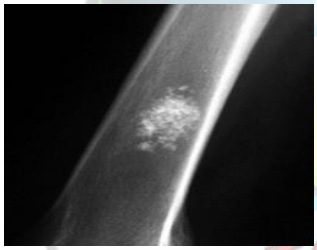


Figure 8.2 Resized Image

Figure 8.3 Average Filter

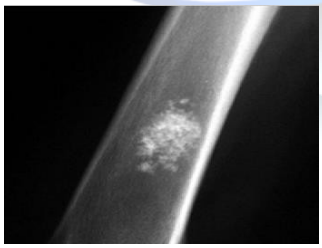
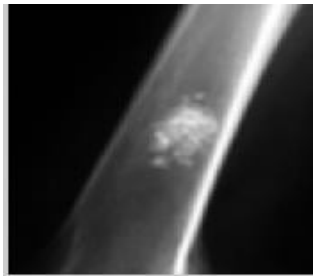


Figure 8.4 Bilateral filter



The resulting images of input image, resized image and bilateral image is shown in Figure 8.1, Figure 8.2 and Figure 8.3**.**

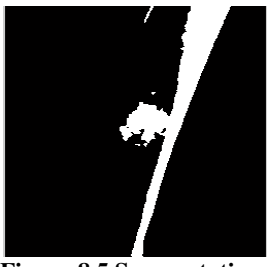


Figure 8.5 Segmentation

Figure 8.6 Morphology Erosion

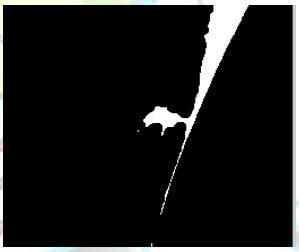


Figure 8.7 Morphology Dilation

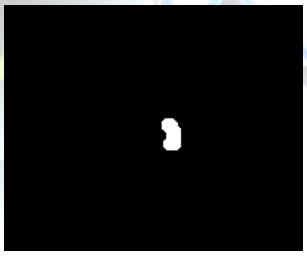


Figure 8.8 Morphology Opening

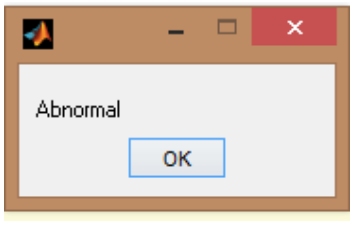


Figure 8.9 Result

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9. CONCLUSION

When the input image is loaded, segmented the image and then Classification operation is done to detect the Bone tumour. Hence the dialog box will be applied which displays the result of the bone image. Therefore by making a Feature extraction and classification using Internet of Things, it is possible for the patients to classify themselves. And the report will automatically send to the server as well as it gets stored in the cloud as a database for future reference. Such a system may help the doctor or people in the family can get detailed report from patients. This is very useful for future analysis and review of patient's report. For more versatile medical applications, this project can be improvised, by incorporating sensors and annunciation systems, thereby making it useful in hospitals, by continuously monitoring the patient, is a very efficient and dedicated patient care system

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