Bone Tumor Detection from MRI Images Using Machine Learning: A Review

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Abstract - *Image processing have a vast area under research, in which Medical Imaging is the most significant area to work in. As in biological cases such as fractures, tumors, ulcers, etc image processing made it more easy to find out the exact cause and the best fitted solution. Specifically in tumor detection medical imaging achieved a benchmark by resolving various complexities. Basically Medical Imaging can be explained as the process of creating human body images for medical and research work. For tumor detection various techniques such as MRI(Magnetic Resonance Imaging), CT(Computerised tomography) scan and Microwave are available among mentioned techniques MRI delivers the best images as it has higher resolution. In this paper the tumor detection have been proposed using machine learning.*

Key Words: Image processing, tumors, medical imaging, MRI, CT scan, machine learning.

1. INTRODUCTION

Cancer is the most sacrificed disease all over the globe. Which is clinically referred as a malevolent neoplasm, it is a multifarious genetic disease that is caused primarily by the environmental factors. As the proper treatment is not available most of the patient get died but the number of deaths can be reduced by means of early detection of cancer so as to proceed for controlling methods. Unfettered cell growth is the symptom of cancer leading to form the malevolent tumors, which assaults the nearby body tissues. These tumors further grows and impede the circulatory system, nervous and digestive system and also can liberate hormones that leads to amend the proper body function. The unfettered cell growth isn't necessarily harmful unless and until it affect the DNA. If the affected DNA cant be repaired within the early time it may lead to DNA to die leads to production of unnecessary new cells. Cancer often become severe in ones case due to property of 'Metastatis'. The process of metastatis can be defined as the process of movement of cancer cells from one part of the body to another part leading to produce tumors that reinstate to regular tissue. There are nearly 200 types of cancer causing tumors. The primary symptoms of cancer are the a new lump, abnormal bleeding, a prolonged cough, unexplained weight loss, change in bowel movement etc. Basically tumors are of two types cancerous and non-cancerous, clinically can be termed as malignant and benign. Benign tumor can be removed by the surgery and at most it doesn't grow again. In general malignant tumor can be identified the tumor with larger nucleus compared with the normal cell nuclei. Clinically the bone cancer is termed as the Sarcomas, which initiates in the muscle, bone, fibrous tissue, blood vessels, some tissues. Some of the most common types of bone cancer are osteosarcoma, chondrosarcoma, ewings sarcoma, pleomorphic sarcoma, fibrosarcoma. In bone cancer the tumor gets formed into the bone and affect the bone growth, bone movement. Specifically in the bone tumor consideration, Enchondroma is a type of benign tumor found inside the bone which begins at the cartilage. In most of the cases Enchondroma found in the small bones of hand, possible susceptible bone areas for Enchondroma are the femur (thigh bone), tibia (shin bone), humerus (upper arm bone).

Bone cancer occurred in four stages:

Stage 1	Only tumor detected and not spread out of the bone.
Stage 2	In aggressive stage.
Stage 3	Tumor started growing in another multiple places.
Stage4	Cancer has reached other parts of the body.

2. METHODOLOGY

In this paper a method is introduced to detect bone cancer by using machine learning algorithm. The main objective is to detect the tumor present in the bone, but most of the times it happens that in methods of tumor detection the images obtained comes up with the greater noise factor which restrict the area to operate as it doesn't give the exact location of tumor and the affected tissues. Hence in this paper a novel approach have been proposed which will comprised of the number of stages which will ultimately lead to the proper detection of enchondroma tumor i.e. bone tumor. A simple flow chart for the proposed system as follows:

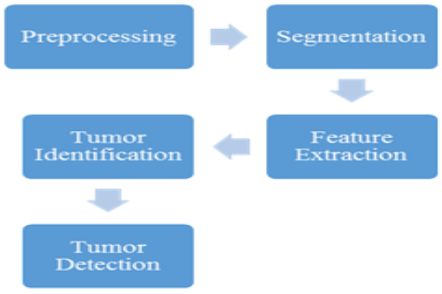

Fig. Process Flow Chart

2.1 Preprocessing

As most of the times the captured images are degraded with the noise leads to poor quality hence to extract exact and important information from the image preprocessing is very much important. Preprocessing is done by denoising the image. Main steps in preprocessing are:

- RGB to Grayscale Conversion
- Bilateral Filtering

The filtering operation can be mathematically formulated as follows:

$$I_b(x,y) = \frac{\sum_{n=-N}^{N}\sum_{m=-N}^{N} W(x,y,n,m)\, I_g(x-n,y-m)}{\sum_{n=-N}^{N}\sum_{m=-N}^{N} W(x,y,n,m)}$$

Where,

$I_g(x,y)$ is a grayscale image ranging values in the range [0,1].

$I_b(x,y)$ will be a bilateral filtered version of $I_g(x,y)$ [1]

2.2 Segmentation

Image segmentation is the process of dividing the image into the partitions on the basis of regions with similarities. In this paper the use of K-Means clustering algorithm and the Fuzzy C-Means algorithm have been proposed.

K-means Clustering algorithm:

Basically the clustering can be defined as the grouping pixels of an image such that pixels possessing similarities belongs to the same cluster.

Mathematically,

$$M = \frac{\sum_{I:c(i)=k} x_i}{N_k}$$,k=1,2,.....k

Where M is a specific cluster. [2]

Fuzzy C-Means Segmentation algorithm.

Fuzzy stands for the probabilistic logic or a multi-values logic. In fizzy C-means the main prime features are: Support, Boundary and the core. They are varied in the cluster membership as the support is non-membership value of the set whereas the boundary is the intermediate membership with value ranging from [0,1] and the core is fully member of the fuzzy set.

Fuzzy C-Means is the clustering algorithm which allows one piece of data to be the part of another cluster.

It is based on the reducing the following function:

$$J_m = \sum_{i=1}^{n}\sum_{j=1}^{c} u_{ij}^{m}\left||x_i - C_j\right||^2$$

Where, m>1,

U_{ij} is the deree of membership of x_i in the cluster j, x_i is the *i*th of d-dimensional measured data, c_j is the d-dimensional center of the cluster, and ||*|| is any norm expressing the similarity between any measured data and centre. [2]

2.3 Feature Extraction

The feature extraction from the captured images can be carried out with the number of techniques available. In this paper we are going to use the machine learning algorithm so as to make the system more robust. In machine learning algorithm there are several algorithms which are classified based on their performance. Specifically in supervised learning the Random forest and the nearest neighbor algorithm are worth useful, as these algorithms generates a function that maps inputs to desired outputs.

2.4 Tumor Identification

The bone tumor is identified by simply calculating the mean pixel intensity of segmented image.

Mathematically, the mean pixel intensity can be calculated as:

$$Mean\ pixel\ intensity = \frac{\sum intensities\ for\ extracted\ tumor\ part(s)}{No.\ of\ pixels\ for\ extracted\ tumor\ part(N)}$$

2.5 Tumor Detection

After the tumor identification process it is last step to detect the tumor which can be carried out by using the MATLAB function for connected components which will simply select out the area with maximum connected component and the remaining area will be discarded.

3. CONCLUSION

In this paper we have studied the basic mechanism for tumor detection. In this review article we have specifically focused on the bone tumor detection. An algorithm comprised of the various stages have been compiled to study the result.

REFERENCES

[1] Krupali D. Mistry, Bijal J. Talati " Integrated Approach for Bone Tumor Detection from MRI Scan Imagery "on International conference on signal and Information Processing (IconSIP) 2016

[2] Afshan, Nailah, Shaima Qureshi, and Syed Mujtiba Hussain, "Comparative study of tumor detection algorithms", Medical Imaging, m-Health and Emerging Communication Systems (MedCom), 2014 International Conference on. IEEE, 2014.

[3] Kishor Kumar Reddy C, Anisha P R, Narasimha Prasad L V, "A Novel Approach for Detecting the Bone Cancer and its Stage based on Mean Intensity and Tumor Size", Recent research in applied computer science ,2015

[4] Abdulmuhssin Binhssan, "Enchondroma tumor Detection", International Journal of Advanced Research in Computer and Communication Engineering Vol. 4, Issue 6, June 2015.

[5] Avula, Madhuri, Narasimha Prasad Lakkakula, and Murali Prasad Raja, "Bone Cancer Detection from MRI Scan Imagery Using Mean Pixel Intensity", Modelling Symposium (AMS), 2014 8th Asia. IEEE, 2014.

[6] Taiwo Oladipupo Ayodele, "Types of Machine Learning Algorithms", University of Portsmouth, United Kingdom