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A NOVEL APPROACH TO DETECT BONE CANCER USING K-MEANS CLUSTERING ALGORITHM AND EDGE DETECTION METHOD

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ABSTRACT

Medical Image Processing is one of the most challenging topics in research areas. This paper proposes an approach to detect bone tumour in MRI images. A proposed approach integrates some pre-processing techniques such as the average filter and the bilateral filter in order to remove noise and to smooth images. This will increase the quality of the image so that they are suitable for segmentation as well as morphological operations that will be used to eliminate false segments. The MRI bone cancer images are analyzed to detect the presence of bone cancer and to determine its stage based on the computations of mean intensity and tumour size using k-means algorithm. The exploratory results demonstrate, the proposed system could get the smooth picture with edge demonstrating the ailment influenced part without the spatial and spectral noises.

Keywords: medical image processing, edge detection, k-means algorithm, tumour size.

1. INTRODUCTION

A bone tumour, (likewise spelled bone tumour), is a neoplastic development of tissue in bone. Strange developments found in the bone can be either favourable (noncancerous) or dangerous (carcinogenic). Bone tumours may be named "essential tumours", which start in bone or from bone derived cells and tissues, and "auxiliary tumours" which begin in different destinations and spread (metastasize) to the skeleton. Carcinomas of the prostate, bosoms, lungs, thyroid and kidneys are the essential carcinomas that most ordinarily metastasize deep down. Optional harmful bone tumours are evaluated to be 50 to 100 times as regular as essential bone growths. Essential tumours of bone can be isolated into kind tumours and malignancies. Basic benevolent bone tumours may be neoplastic, formative, traumatic, irresistible, or incendiary in etiology. Some favourable tumours are not genuine neoplasm's, yet rather, speak to hematomas, in particular the osteochondroma. The most well known areas for some essential tumours, both favourable and harmful incorporate the distal femur and proximal tibia. Since, by definition, kind bone tumours don't metastasize, all optional bone tumours are metastatic sores which have spread from different organs, most regularly carcinomas of the bosom, lung, and prostate. Solid and legitimate measurements on the frequency, commonness, and mortality of threatening bone tumours are hard to get a hold of, especially in the most established (those more than 75 years old), in light of the fact that carcinomas that are generally metastatic to bone are once in a while ever reparable, biopsies to decide the birthplace of the tumour in cases like this are once in a while done.

1.1 Staging the bone cancer

The investigation of disease, called oncology, is the work of endless specialists and researchers around the globe whose revelations in life systems, physiology, science, the study of disease transmission, and other related fields made oncology what it is today. In spite of progressive advances in medication and its practice in the course of recent hundreds of years, growth treatment has experienced a nearly moderate procedure of improvement [1] [2] [4-6]. About the same, this paper contributes a methodology to compute mean intensity, tumour size; helps in detecting the cancer and its stage. This process is carried out in four stages namely seed point selection, collection of additional image data, Determination of thresholding value, checking the similarity threshold value.

Bone disease has diverse stages which portrays its level of progression.

- Stage I: the malignancy has not spread out of the bone. The tumour is not a forceful one.
- Stage II: same as Stage I, yet it is a forceful tumour.
- Stage III: Tumours exist in various spots of the same bone (no less than two).
- Stage IV: The growth has spread to different parts of the body.

Since the careful reason for bone tumour is ineffectively comprehended, there are no way of life changes or propensities that can keep this phenomenal malignancy. The most ideal method for confronting it is to recognize it at the soonest organize and take fitting measure. The American Cancer Society's appraisals for disease of the bones and joints for 2015 are:

- About 2,970 new cases will be analyzed
- About 1,490 passing's from these tumours

Estimated cancer cases and deaths across USA is tabulated in Table-1 and Estimated cancer cases and deaths across globe is shown in Table-2.

Table-1. Estimated cancer cases and deaths across USA.

Cancer	Estimated cases		Estimated deaths	
	Male	Female	Male	Female
Pancreas	23,530	22,890	20,170	19,420
Stomach	13,730	8,490	6,720	4,270
Liver	24,600	8,590	15,870	7,130
Lung	116,000	108,210	86,930	72,330
Breast	2,360	232,670	430	40,000
Thyroid	15,190	47,790	830	1,060
Eye	1,440	1,290	130	180
Intestine	4,880	4,280	640	570
Brain	12,820	10,560	8,090	6,230
Bone	1,680	1,340	830	630

Table-2. Estimated cancer cases and deaths across globe.

Cancer type	Estimated cases	Estimated deaths
Prostate	233,000	29,480
Breast	232,670	40,000
Lung	224,210	159,260
Colon	136,830	50,310
Melanoma	76,100	9,710
Bladder	74,690	15,580
Lymphoma	70,800	18,990
Kidney	63,920	13,860
Thyroid	62,980	1,890
Endometrial	52,630	8,590
Leukemia	52,380	24,090

1.2 Bone cancer formation

Bones are not strong, but rather are comprised of two particular districts. The external, weight-bearing range is hard, reduced, and calcium-based, encompassed by cross section work of sinewy bone known as cancellous tissue. The internal district, or marrow, which is one of the biggest organs of the body, is situated inside of the bones. It fills the poles of the long bones, the trabeculae (spaces inside cancellous tissue), and stretches out into the hard channels that hold the veins. Bone marrow might contain fat cells, liquid, stringy tissue, veins, and blood-framing (hematopoietic) cells. Marrow seems yellow in shading when it holds numerous fat cells and red when it has more blood-shaping material. The marrow is the foremost site for blood arrangement (hematopoietic), which happens essentially in the bones of the legs, arms, ribs, breastbone (sternum), and spine (vertebrae). Bone growth is an uncommon sort of disease that structures as an excruciating protuberance ('tumour') in bone. It is otherwise called bone sarcoma. At the point when a bone malignancy starts to develop, the disease cells increase and begin to demolish the bone. The influenced bone gets to be powerless and begins to bring about issues. The most widely recognized spots where bone growth creates are around the knee, the wrist, the shoulder and the pelvis. There are more than 30 sorts of bone growths. The most widely recognized sort is osteosarcoma, which is comprised of a great many unusual bone delivering cells.

1.3 Outline of this paper

The rest of the paper is organized in the following manner: Section 2 gives a brief glimpse of the relevant work that was carried out all in various fields of research. Section 3 explains various algorithms used for detecting bone cancer. Section 4 presents the edge detection technique with experimental results. Section 5 illustrates the proposed method with results and discussion. Section 6 puts forward the conclusions followed by future enhancements and references.

2. REVIEW OF LITERATURE

Pabitra Roy and Sudipta Roy [1] proposed an automated method for detection of brain abnormalities from MRI scan images. The methodology introduced the segmentation of tumour tissue, location of abnormal region. Leela G A and H.M VeenaKumari [2] proposed a Morphological methodology for the location of Brain Tumor and malignancy cells. Rohit S. Kabade and M. S. Gaikwad [3] implemented a method for calculating the brain tumour shape and tumour area and its stages. Detection resists the accurate determination of stage and size of tumour. The investigation made utilization of PC helped strategy for division of brain tumour taking into account the blend of two calculations that is k-means and Fuzzy c-means calculations. This method gives the segmentation of tumour tissue with accuracy comparable to manual segmentation.

Navneet Kaur and Mamta Juneja [4], explains how the gradient differential plays an indivisible part in marking the tumour in effect areas. Ashwini S. Zade and Mangesh Wanjari [5], proposed a method for early detection of breast cancer from mammograms using Seeded Region Growing Algorithm. Manoj K Kowar and Sourabh Yadav [6], proposed a strategy for Brain Tumor Detection and Segmentation utilizing Histogram thresholding. The proposed strategy can be effectively connected to identify the framework of the tumour and its geometrical measurement. Alan Jose and M. Sambath [7] proposed a new method for Brain Tumor Segmentation using K-Means Clustering and Fuzzy C-Means Algorithms for segmenting the cancer tumour and remove the noise by pre-processing the images. Jay Patel and Kaushal Doshi [8], applied different segmentation

methods for segmenting the brain tumour from MRI and CT scan images. Thresholding methods like region growing, mean- shift and clustering methods like k-means and Fuzzy c-means were used with the help of image processing techniques for segmenting the tumour

Aman Chandra Kaushik and Vandana Sharma [9], proposed a method for volume calculation of cancer tumour. Region growing method is used for segmenting Region of Interest (ROI), and by using Edge detection method .boundary of tumour part is identified by edge detection method and volume of the tumour is calculated. Nikhil R Talegaonkar et al., [10], proposed a method for automatic brain tumour detection in Magnetic resonance images. The experimentation detected the location, position and size of the tumour in brain automatically. Adele P. Peskin et al., [11], proposed a robust volume calculation for lung CT images. The investigation presented a calculation that weight and watched pixel appropriations for tumour, their experience and edge pixel intensities, and the extent of the slope of the pixel power to survey the parameters required for volume estimation. D.NarainPonraj et al., [12], gave review on existing pre-processing approach of mammographic images of breast. Sasikala and Vasanthakumar [13], utilized k-implies bunching calculation to distinguish tumour in a multi determination representation of the first MRI, ultrasound, and mammogram pictures. Rajan and Prakash [14] depicted another system that utilized information digging for foreseeing lung tumour at an early stage. The system created and actualized another information mining instrument that is compelling for diagnosing lung malignancy in the early stages. This instrument is developed utilizing manufactured neural systems. Rajeswari and Reena [15], proposed another technique for arranging tumour ranges from liver growth cell. Arrangement is performed utilizing a bolster vector component and fluffy neural system classifiers. MAPSTD is connected to give affiliation positioning; this technique is connected to liver tumour understanding datasets. Feldman *et al*. [16] presented a boosted Bayesian multi determination (BBMR) classifier for mechanized acknowledgment of prostate cancer (CaP) from digitized histopathology, a required antecedent of robotized Gleason evaluating. Ganesan *et al.* [17] proposed a PC supported conclusion from mind disease picture division and actualized a system for sectioning the cerebrum tumour region for which k-implies calculation is connected. This technique enhances exactness and decreases computational time. A traditional choice tree methodology is utilized for dataset examination. Bandyopadhyay and Paul [18] connected K-means algorithm and DBSCAN for portioning a tumour in MRI pictures of the human mind.

3. ALGORITHM USED

3.1 The sobel edge detector

An edge [8], in a picture, is an accumulation of joined high recurrence focuses. Outwardly, an edge is a district in a picture where there is a sharp change in force of the picture. Edge identification alludes to the operation(s) performed on a picture to recognize the edges in a picture. The yield of edge discovery is typically thresholded to hold just the edge. Edge discovery assumes a crucial part in article identification and highlight extraction and assumes significant part in machine vision. There are diverse sorts of edges - step edges, rooftop edges, line edges, shading edges, dim level edges, composition edges and so forth. Not all edges are identified by all edge location administrators. Every operation has its particular claim to fame in edges and better the edge discovery, normally, more mind boggling and exorbitant is the operation. An edge has both size and heading. The course is utilized to distinguish the following conceivable edge point. At long last, all the edge focuses are connected together to frame an item limit. In a perfect situation, all edges are joined and we get a flawless limit, yet this is from time to time the case because of different reasons, for example, contrast in enlightenment, mostly unmistakable items, surface variety, wastefulness of the edge identification administrator and so on. Some of the time, the edge location operation may even result in false edges. To determine these issues, there have been various edge location administrators characterized all through the historical backdrop of Image Processing. All the edge discovery strategies are based upon the portrayal of „changes of consistent capacities utilizing derivatives‟ given by analytics. Basically, all administrators are inclination administrators.

Gradiant edge finders are those which depict edges by method for fractional subordinates. An adjustment in the picture capacity can be depicted by a slope that focuses toward the biggest development of the picture capacity. They are of three sorts: Operators performing subsidiaries by utilizing contrasts. Eg: Sobel, Operators in view of the zero intersections of the second subsidiaries. Eg: Canny edge finder. , Operators that match the picture capacity to a known parametric model of the edges. The understood and before Sobel edge indicator processes the 2-D spatial inclination estimation on a picture. It comprises of a couple of 3×3 convolution kernel:

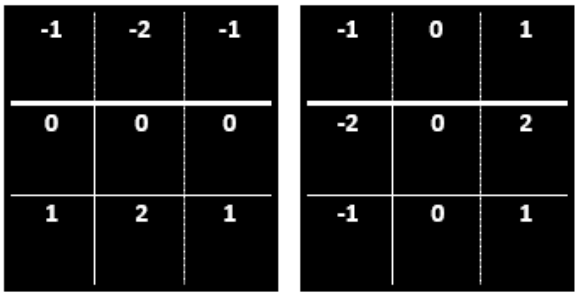


Figure-1. The convolution kernel for the sobel edge detector. Note the emphasis on the horizontal and vertical edges.

The detector responds maximally to vertical and horizontal edges, as can be observed from the values of the

masking kernel. It gives gradient magnitude in both horizontal and vertical direction.

The gradient component of Sobel edge operator:

$$G_x = (Z_7 + 2Z_8 + Z_9) - (Z_1 + 2Z_2 + Z_3)$$

$$G_y = (Z_3 + 2Z_6 + Z_9) - (Z_1 + 2Z_4 + Z_7)$$

3.2 K-means clustering segmentation

K-Means is the one of the unsupervised learning calculation for groups. Clustering the picture is gathering the pixels as per the same qualities. In the k-means algorithm at first we need to characterize the quantity of clusters k. At that point k-cluster focus are picked haphazardly. The separation between the every pixel to every group focuses are ascertained. The separation may be of basic Euclidean capacity. Single pixel is contrasted with every single bunch focus utilizing the separation recipe. The pixel is moved to specific group which has most brief separation among all. At that point the centroid is re-assessed. Again every pixel is contrasted with all centroids. The procedure constant until the inside meets.

Calculation for k-means clustering:

Step 1:

Give the number of cluster worth as k.

Step 2:

Arbitrarily pick the k group focuses.

Step 3:

Ascertain mean or focal point of the group.

Step 4:

Ascertain the separation between every pixel to every group focus.

Step 5:

On the off chance that the separation is close to the inside then move to that bunch.

Step 6:

Generally move to next bunch.

Step 7:

Re-appraise the inside.

Step 8:

Rehash the procedure until the inside doesn't move.

4. EDGE DETECTION

Edge detection [19] is one of the major strides in image processing, image analysis, image pattern recognition and so forth. Edge can plot the objective articles profile, which is an essential property of concentrate from the pictures acknowledgment. Edge data in CT picture is an essential trademark on the grounds that lung area contains a wealth of edges like vessels, air tree, air sacs, supply route branches and so on. In genuine applications, medicinal pictures contain object limits and protest shadows and commotion. Along these lines, they may hard to recognize the precise edge from commotion or minor geometric elements.

Edge detection steps include:

Step 1:

The data picture is initially convoluted with the even and vertical segments of Sobel administrator and second subordinate of Sobel administrator.

Step 2:

At that point take the separation capacity between the yields of Sobel and Second subordinate since second subsidiary administrator upgrades just littler edges and sobel administrator improves a wide range of edges.

Step 3:

At that point taking the convolution of even and vertical parts.

4.1 Experimental results

The proposed edge detection method can visualize the disease affected part well and which is shown below.

Input Image

Figure-2. Input image.

The following Figure-3 shows the detection of images of bone using sobel edge detector algorithm.

Figure-3. Edge detected images of bone.

5. PROPOSED ARCHITECTURE

The input image is taken as a noisy image then that image is transformed into various levels with the help of wavelet transform. Then boundaries of objects are found with the help of edge detection algorithm. This edge detection is used for image segmentation and data extraction in the area of image processing, computer vision and machine vision.

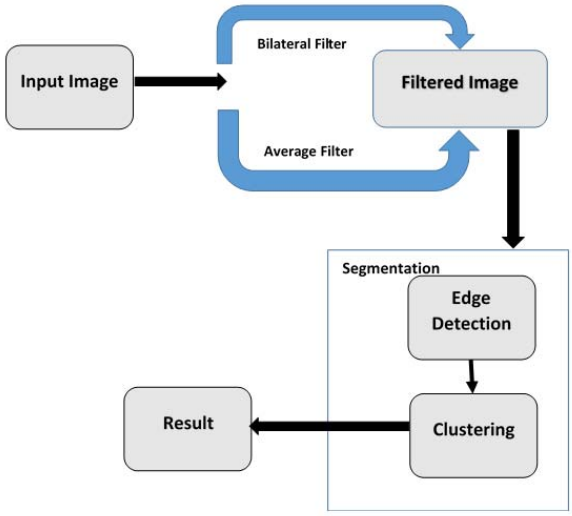
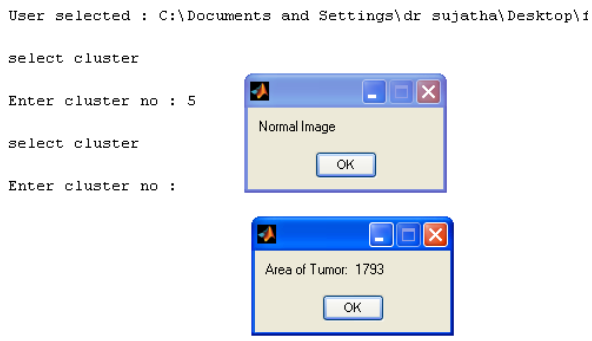


Figure-4. Proposed architecture.

5.1 Experimental results

The following screenshot explains to check whether the given input image is normal or abnormal image and also finding the area of tumour.



6. CONCLUSIONS

The detection of Bone cancer from MRI images and takes away the images that do not have a tumour or an unrelated image requires two main steps. In the pre-processing step, average filter and bilateral filter smooth the area of interest and remove noise. We combined thresholding segmentation and edge detection to get precise segmentation. In addition, the objects which are found in the margin area of the image will be removed by finding the centroid of each object. We developed an application to assess the performance of the proposed method.

REFERENCES

[1] Pabitra Roy and Sudipta Roy. 2013. An Automated Method for Detection of Brain Abnormalities and Tumor from MRI Images. International Journal of Advanced Research in Computer Science and Software Engineering. pp. 1528-1589.

[2] Leela G A and H.M VeenaKumari. 2014. Morphological Approach for the Detection of Brain Tumour and Cancer Cells. Journal of Electronics and Communication Engineering Research. pp. 07-12.

[3] Rohit S. Kabade and M. S. Gaikwad. 2013. Segmentation of Brain Tumour and Its Area Calculation in Brain MR Images using K-Mean Clustering and Fuzzy C-Mean Algorithm. International Journal of Computer Science and Engineering Technology. pp. 524-531.

[4] Navneet Kaur and Mamta Juneja. 2014. A Novel Approach of Brain Tumor Detection Using Hybrid Filtering. Journal of Engineering Research and Applications. pp. 100-104.

[5] Ashwini S. Zade and MangeshWanjari. 2014. Detection of Cancer Cells in Mammogram Using Seeded Region Growing Method and Genetic Algorithm. Journal of Science and Technology. pp. 15-20.

[6] Manoj K Kowar and Sourabh Yadav. 2012. Brain Tumor Detction and Segmentation Using Histogram Thresholding. International Journal of Engineering and Advanced Technology. pp. 16-20.

[7] Alan Jose, S. Ravi and M. Sambath. 2014. Brain Tumor Segmentation Using K-Means Clustering and Fuzzy C-Means Algorithms and Its Area Calculation. International Journal of Innovative Research in Computer and Communication Engineering. 2(3): 3496-3501.

[8] Jay Patel and Kaushal Doshi. 2014. A Study of Segmentation Methods for Detection of Tumor in Brain MRI. Advance in Electronic and Electric Engineering. 4(3): 279-284.

[9] Aman Chandra Kaushik and Vandana Sharma. 2013. Brain Tumor Segmentation from MRI images and volume calculation of Tumor. International Journal of Pharmaceutical Science Invention. 2(7): 23-26.

[10] Nikhil R Talegaonkar and Prashant N Shinde. 2014. An approach to automatic brain tumour detection in magnetic resonance images. Proceedings of IRF International Conference, Pune, India, 17-19.

[11] Adele P. Peskin and Karen Kafadar. Robust Volume Calculations of Tumours of Various Sizes. Scientific Application and Visualization Group National Institute of Standards and Technology, Boulder, Colorado 80305 USA.

[12] D. NarainPonraj and M. Evangelin Jenifer. 2011. A Survey on the Preprocessing Techniques of Mammogram for the Detection of Breast Cancer. Journal of Emerging Trends in Computing and Information Sciences. 2: 656-664.

[13] Sasikala and Vasanthakumar. 2012. Breast Cancer-Classification and Analysis using Different Scanned Images. International Journal of Image Processing and Visual Communication. pp. 1-7.

[14] Juliet R Rajan and Jefrin J Prakash. 2013. Early Diagnosis of Lung Cancer using a Mining Tool. International Journal of Emerging Trends and Technology in Computer Science.

[15] P. Rajeswari and G. Sophia Reena. 2011. Human Liver Cancer Classification using Microarray Gene Expression Data. International Journal of Computer Applications. pp. 25-37.

[16] Michael Feldman, John Tomaszewski and Anant Madabhushi. 2012. A Boosted Bayesian Multi resolution Classifier for Prostate Cancer Detection from Digitized Needle Biopsies. IEEE Transactions on Biomedical Engineering. pp. 1205-1218.

[17] Karthikeyan Ganesan, U. Rajendra Acharya, Chua Kuang Chua, Lim Choo Min, K. Thomas Abraham and KwanHoong Ng. 2013. Computer- Aided Breast Cancer Detection Recent Researches in Applied Computer Science ISBN: 978-1-61804-307-8 170 Using Mammograms: A Review. IEEE Review in Biomedical Engineering. pp.77-98.

[18] Samir Kumar Bandyopadhyay and TuhinUtsab Paul. 2013. Segmentation of Brain Tumour from MRI image Analysis of k-means and DBSCAN Clustering. International Journal of Research in Engineering and Science. pp. 77-98.

[19] MA Jing, BI Qiang. 2012. Processing practise of remote sensing image based on spatial modeller. The National Natural Science Foundation of China, IEEE.

[20] Milligan G.W., Soon S.C. and Sokol M. 1983. The Effect of Cluster Size, Dimensionality and the Number of Clusters on Recovery of True Cluster Structure. IEEE Transactions on Pattern Analysis and Machine Intelligence. pp. 40-47.

[21] Guralnik V. and Karypis, G. 2001. A Scalable Algorithm for Clustering Sequential Data. Proceedings of the IEEE International Conference on Data Mining Series. pp. 179-186.

[22] Jarvis R.A. and Patrick E.A. 1973. Clustering Using a Similarity Measure Based on Shared Nearest Neighbors. IEEE Transactions on Computers. pp. 1025-1034.

[23] Modha D. and Spangler W. 2002. Feature Weighting in k-means Clustering. Machine Learning, Springer. pp. 217-237.

[24] Adams Bischof. 1994. Seeded Region Growing. IEEE Transactions on Pattern Analysis and Machine Intelligence. pp. 641-647.