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A Review on Adaptive Hierarchy Segmentation of Bone Cancer Using Neural Network in MATLAB

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Abstract: Medical imaging is critical in the diagnosis and treatment of illness, the detection of tumours and the early detection of malignant cells. Microscopic pictures have traditionally been used to detect bone characteristics as a conventional technique. Using micro radiography, which requires several exposures and is labor-intensive, these pictures were captured. This method is unable to distinguish between malignant and non-cancerous cells since the pictures are filled with noise. Image processing analysis has to be automated and dependable in order to be effective. Denoising is the initial step in image processing, and it must be done without interfering with the diagnostic information in the process. Noise and blur are introduced in the picture during the earlier step. We've built soft and hard threshold with a variety of coefficients and measured the threshold in order to obtain exact picture processing. Pre-processing approaches for removing noise and obtaining smooth pictures were discussed throughout our presentation. The picture quality will be improved and false segments will be removed as a result of this procedure. The K-means method was used to identify the presence of bone cancer and to assess its stage, while edge segmentation was employed to smooth out the image. GA analysis relies heavily on the ability to discriminate between benign and malignant bone tumour development. The primary goal of our study was to accurately forecast or identify bone tumours at the appropriate time and stage. Using our image processing and genetic method, we were able to accurately identify bone tumours, which would then aid in the right treatment of therapy.
Keywords: Cancer, bone cancer, osteosarcoma, Ewing, image segmentation, edge based segmentation, region based segmentation

I. INTRODUCTION

Any organ in the body may develop a tumour, which is defined as an abnormal proliferation of new tissue. Tumors of the brain, bones, lungs, and other organs have become more common in recent years. Using image processing techniques, tumours may be identified and classified. When it comes to improving health, the results of medical image processing are invaluable. Whenever cells inside a bone divide uncontrolled, a lump or mass of aberrant tissue is formed, we call it a bony tumour. Numerous subtypes of bone tumour exist, each with its own unique set of features. There are two forms of bone tumours, Noncancerous (Benign) and Cancerous (Malignant) (Malignant). We may focus on picture segmentation and classification for bone images in our study. To begin, the input image was segmented and features extracted, and then the images were classified as either benign or malignant using the Support Vector Machine (SVM) and the Artificial Neural Network (ANN) classifiers. The trained image was then stored in the database and sent to the server via IOT (Internet of Things) for the doctor to assess. An easy-to-use approach for detecting and classifying bone tumours was suggested in this study. In image segmentation, the shadows and highlights of an image are located and the data they contain is extracted. Smaller images may be created by using the process of segmentation. This method may be used, among other things, in computer vision applications to compress images, detect objects, and find their boundary lines. A label or category may only be allocated to pixels in a part of an image that have the same attributes and features[1].Cancer is defined as abnormal cell proliferation that is prone to assault and spread to any organ in the human body. There are about 2.5 million Indians living with cancer, as determined by a study conducted by the National Institute for Cancer Prevention and Research (NICPR). Every year, more than 7 million new cancer patients are diagnosed and more than 556,400 people die as a result of cancer. According to the International Agency for Cancer Research (IARC), there would be 21.7 million new cancer diagnoses and 13 million deaths from cancer in the year 2030. Osteosarcoma and Ewing tumours are two of the 75 forms of cancer that affect the bones, and osteosarcoma is the most prevalent. A lower death rate may be achieved by discovering and diagnosing cancer at an early stage, as well as initiating the appropriate therapy at the proper time.An x-ray, often known as a radiograph, is a noninvasive medical procedure that uses radiation to reveal the inner workings of the body to a radiologist.Resonance in Space Using strong magnets and radio waves, imaging shows the same object in much more detail. The output of both methods is a grayscale image. Image segmentation algorithms may be used to identify benign (not cancerous) or malignant bone growths on X-ray or MRI images (cancer).

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Bone cancer type may also be determined based on the tumor's size, shape, and other characteristics.So, the goal here is to combine picture segmentation with x-ray or MRI technologies in order to treat a very dangerous medical disease, such as cancer. The aberrant development of the bone has been studied in this work by analysing several image segmentation methods on x-ray or MRI reports. Different picture segmentation approaches are shown, and the optimal strategy for certain conditions is proposed.

II. LITERATURE SURVEY

Enchondroma bone tumours may be detected from MRI images utilising image processing, segmentation clustering approaches, such as K-means combined with Fuzzy C-means clustering, according to Krupali D. Mistry et al (2017).
On the basis of the size of the tumour, the stage of the malignancy may be determined according to C. Kishor Kumar Reddy et al. (2016), Scan pictures from a variety of diagnostic laboratories are used in this process, which uses photos taken at various points on the body.
Mean Pixel Power (MPP) may be used to distinguish bone cancer from normal tissue, according to Vula and colleagues (MPP). Ranjitha et al. (2019) [7] utilised MRI scans to distinguish between cancerous and benign tumours. After obtaining textural data, scientists employed the -means clustering approach to distinguish the tumour from the surrounding tissue. Analyzing how many pixels and how much power were lost once the tumour is removed yields an average pixel value. Using the mean pixel value, it is possible to distinguish between benign and cancerous growths. If the median pixel value exceeds the predetermined threshold, malignancy is assumed.
Jose et al. (2014) reported a new method for segmenting brain tumours. When it comes to their methodology, they employ fuzzy - and -means methods. With the use of several division algorithms on MRI and CT data, Patel and Doshi (2014) came up with an incredible technique. Reddy et al. (2015) [9] offered a unique method for assessing the size of a tumour and the stage of bone malignancy using standard area estimates. The district's joy was crushed when this method used the area-developed calculation. The total tumour size is determined by the number of pixels in the surgically excised tumour area. If you don't have absolute pixel respect, you've got cancer. Choosing a seed point might be tricky since it relies on the picture being used.
To detect and stage bone cancer, Reddy et al. (2016) [9] used an MRI image [10]. Using pixel properties to generate clusters, the denoising technique eliminates noise from the image. The number 245 and the average pixel intensity may be used to determine the stage of cancer. A ROI (region of interest) is extracted from the image and compared to a specified threshold value in order to estimate the tumor's size. It is possible to calculate the volume of disease tumours in a similar manner to that used by Kaushik and Sharma [10]. The ROI sectioning approach they developed may be utilised to build a tumour volume estimation strategy when applied to the malignant region. The -means clustering technique and edge detection methodology may be employed in a novel way to identify bone malignancy growth, according to the researchers. This approach utilises Sobel edge identification to identify the edge. The Sobel edge finder only picks up pixels on the image's borders. - Mean grouping calculations are used in order to locate the tumor's primary growth zone.
Asuntha et al. (2017 [12]) developed a medical image processing strategy for detecting bone cancer in MRI images in a similar manner. Gabor filters are employed in the preprocessing method to smooth the image and remove noise. During the segmentation stage, techniques such as superpixel and multilayer segmentation are used. This is followed by the detection of the edges and morphological processes. Superpixels are then used to extract some of the images' most important features [13]. The retrieved properties are used in the detection of bone cancer Shafat et al. are now investigating fundamental restorative techniques. It is the purpose of this research to coordinate the removal of hazardous stem cells or forebear cells The results of these studies suggest that focusing on BM anomalies may be worthwhile. Proliferation and differentiation of new restorative methods for the most current issues may be possible via their ideas and methods bone cancer, according to Asuntha and Srinivasan (2018) [5], is a condition that kills many people. To diagnose cancer in its earliest stages, the detection and classification approach must be easily accessible. Cancer patients who are diagnosed early tend to have a better chance of surviving. In clinical diagnosis, cancer classification is a difficult and time-consuming task. Image processing approaches are used in this study to detect tumours and classify malignancy. The time required to diagnose and categorise cancer has been greatly reduced by the use of this approach. Image enhancement techniques were used by Nisthula and Yadhu (2013) [15] to boost the picture's intensity in order to find a cancer image edge. The method of edge detection was used. Using this technique, researchers were able to quickly and accurately detect bone cancerous tissue. For example, a tumour was recognised as one of the most common medical problems by Torki (2019). They've devised a system for spotting bone diseases. It's possible that it foretells the previous satiate's malignant growth. Exploratory organisation and execution in MATLAB are used to evaluate their prediction framework.

When it comes to the most basic kind of bone tumour, Vandana et al. They've improved the graph cut-based clustering method for detecting the cancerous area and the healthy component of the tumour. Multiclass irregular texture may be used to quantify risk and categorise it as normal, pleasant, and malignant. In the most recent investigation, Shrivastava et al. (2020) [18] explored a variety of methods for determining which bones were cancerous and which ones were healthy. Bone CT datasets in DICOM format are used in this investigation. There are a variety of AI methods presented in this study for the identification and classification of tumours. Medical image processing is one of the most important areas of research in artificial intelligence (AI). Image processing made the work of establishing the specific reason and the best arrangement of ulcers, breaks, tumours, and so forth much simpler. For irregularity detection, AI algorithms are used in the restoration of pictures. As can be seen, the use of machine learning procedures has resulted in a sufficient level of development. Many AI grouping methods are described in this work.

In order to gain a return on investment, the segmentation techniques indicated above are used. After that, the model is trained using texture and shape attributes. There are a variety of feature optimization procedures [19, 20] that may be used to improve the model's performance. Following extensive testing, a number of texture and form elements have been selected for inclusion in the proposed investigation. These characteristics are excellent in distinguishing between healthy and cancerous bone.

Since a result of this study, it is essential that feature extraction be carried out in order to acquire a proper segmentation and to locate the core bone, as these characteristics are all important for determining whether or not a bone is malignant, such as bone density, colour and texture. You must utilise machine learning technology to identify and categorise healthy bone from malignant bone, in order to get the right feature First, we looked at how segmentation techniques like Canny, Prewitt, and Sobel may help us uncover ROI. For the second step, a set of features called "HOG" and "Entropy", "Energy," "Gini Index," "Skewness," "Contrast," "Correlation," "Homogeneity Product of E(X) and D(X)" are ready for model training. With these criteria in mind, we compared the Random Forest and SVM's performance. To get better results than Random Forest, the SVM employs the feature set 'HOG': entropy; energy; Gini index; skewness; contrast; correlation; homogeneity product of E(X) and D(X).

III. METHODOLOGY

There are 206 bones in the human body. Support for the body's motions is provided by the bones that are joined to the muscles. Bone ligaments are made up of connective tissue and a spongy substance called bone marrow. A bone cancer begins when a tumour grows out of healthy cells in the bone. There is a bone tumour as the most common sign of bone cancer. The tumour develops over time, and it may spread to other parts of the body as well. It has the potential to damage bone tissue, making bones more brittle. Bone cancer impacted 3500 persons in the United States in 2018, and around 47% of those diagnosed with the disease died. Many tests are used by the doctor to determine whether or not a patient has cancer. Bone cancer may be detected with an X-ray imaging diagnostic. The X-ray assimilation rates of normal and malignant bone are distinct. Consequently, the surface of a malignant bone looks jagged in a picture. The severity of bone cancer is determined by a stage and grade. Doctors utilise tumour growth rate (the rate of regional bone damage) to forecast the progression of illness. Bone cancer diagnosis need specialised knowledge. Diagnosing bone cancer by a doctor is labor-intensive and prone to mistake since it is done by hand. Cancer patients who are diagnosed early have the best chance of survival, according to the latest research. SVM, a machine learning algorithm, and image processing methods are used in this work to identify tumours and categorise malignancy. Researchers have conducted similar studies in this area in order to create an automated system that aids doctors. Automated systems are efficient and error-free. SVM and digital image processing techniques, such as preprocessing, edge detection, and feature extraction, have been applied to construct an automated system for the diagnosis of human bone. They've used a sophisticated neural network to distinguish between bone in good condition and bone in distress. The big enhanced picture dataset is used to train the model. A duplicate of each picture that appears in the training and test datasets is created throughout the augmentation phase. To prevent performance bias, employ a -fold cross-validation.

The following are some of the manuscript's most important contributions:

There is a strong correlation between the pixel distribution patterns of malignant bone scans and healthy bone images in a dataset that we examined. Because of this, it is difficult to categorise. In order to categorise them with high precision and accuracy even on a short dataset, an optimal feature set was selected following a series of trials.

Two well-known machine learning algorithms, SVM and Random Forest, are compared in a feature comparison research. The best method for bone diagnostics that we've identified is SVM.

A third advantage of the suggested approach is that it is more sensitive to bone malignancy. This means that a second opinion may be given in real time to the doctor

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IV. PROPOSED WORK

A. Segmentation and morphological procedures follow the pre-processing of the X-RAY picture in the algorithm's initial step.
B. Pre-processing is the first phase in the segmentation process, and it seeks to enhance picture quality by eliminating noise, decreasing artefacts, and improving contrast.
C. Many pre-processing methods exist, including picture correction and histogram equalisation. In preprocessing, noise reduction, object edge enhancement, and defect smoothing are all achieved by filtering, which is a key component of MR imaging.
D. Averaging and bilateral filters were chosen. Input an X-RAY picture of a bone. Make a grayscale picture out of it.
E. For noise reduction, use an average and bilateral filter. The bilateral filter has a higher noise removal rate than the average filter, which improves the picture quality. Compute the segmentation threshold.
F. Perform morphological computations. The final product will be a tumorous area." Since bone MRI pictures are difficult and cancers can only be spotted by professional doctors, radiologist have been manually detecting bone tumours for many years. Computers have become an essential aspect in medical image capture, enhancement, segmentation, labelling, and analysis due to the fast growth of computer technology.
G. In spite of this, radiographic pictures are still evaluated by medical professionals manually. Examining photos like this is a tedious, time-consuming task.
H. It is also important to note that manual evaluation of photographs typically yields subjective conclusions that are heavily reliant on the examiner.
I. Using computers to analyse and interpret medical pictures not only saves time and money, but also ensures the accuracy of the findings. This ensures that findings may be compared without the influence of human bias or inaccuracy.
J. Methodical analysis of photos will provide more quantifiable information, which is useful for a deeper comprehension of images and may not be immediately obvious to the medical examiner in a raw or enhanced image.

V. BLOCK DIAGRAM

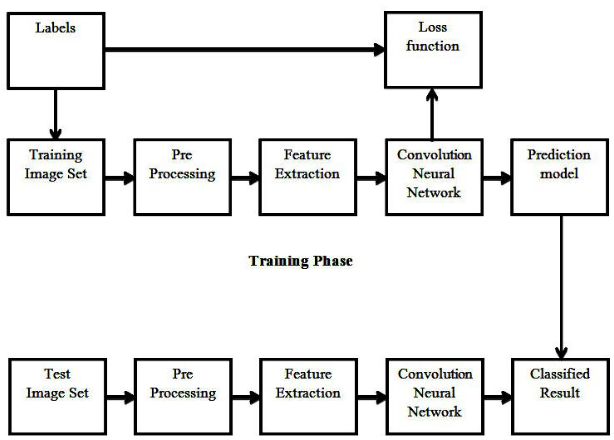

Fig. 6.1 Proposed System Process Diagram

VI. IMAGE PROCESSING

For example, image processing may be used to improve an already-digitized picture or to extract important information from it by converting it to digital form and performing various operations on it. Input may be an image, such as a video frame or a snapshot, and output can be an image or features linked with that image, making this a signal dispensation type.

Images are often processed as two-dimensional signals and then processed using well established signal processing techniques. In general, image processing consists of the following three stages:.

1) Importing the image with optical scanner or by digital photography
2) Analyzing and manipulating the image which includes data compression and image enhancement and spotting patterns that are not to human eyes like satellite photographs.
3) Output is the last stage in which result can be altered image or report that is based on image analysis.

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The SVM model is trained using two kinds of features vectors in the proposed study. To begin with, we looked at the homogeneity product of E(X) and D(X) as well as HOG, Entropy, Energy, Gini Index, Skewness, Contrast, and Correlation in the first trial, while we used these same metrics in the second.

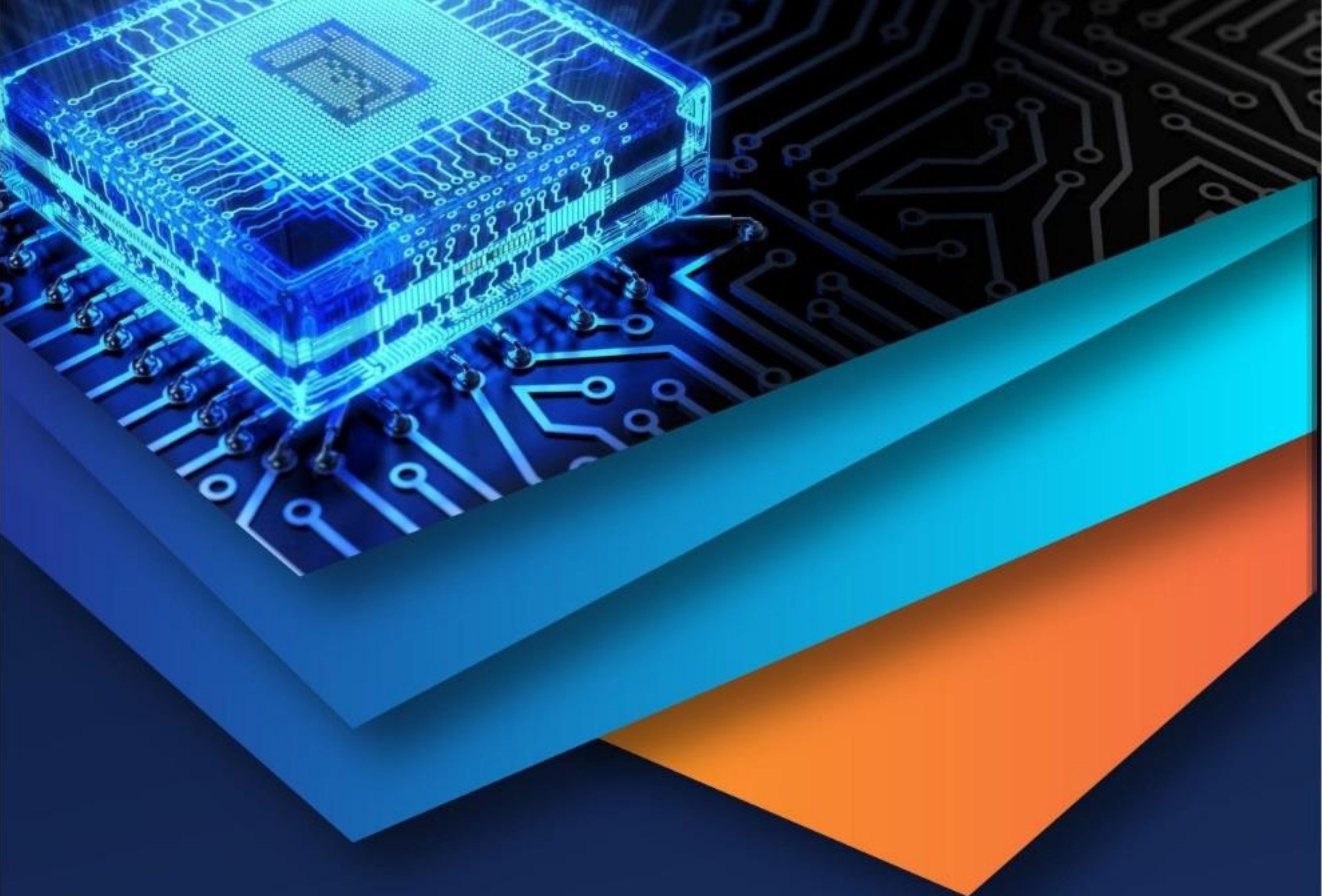
VII. CONCLUSION

Neural Networks using Image processing in MATLAB is used to develop the suggested bone tumour detection system using super pixel segmentation. The pictures provided may also be used to diagnose brain tumours. Brain tumour identification is the primary focus of the proposed method. The same approach may be used to determine the different stages of cancer... A unique technique for locating bone tumours has been presented and planned in this project, which will be used to reduce the computational time and cost associated with tumour detection. Detecting a bone tumour is a complex and delicate task, and the need for accuracy and reliability remains paramount. There is a smart way to visualise the handling operation with an inspection to find a bone tumour using this technique..

REFERENCES

[1] Integrated approach for bone tumor detection from MRI scan imagery ttps://ieeexplore.ieee.org/abstract/document/6340479 2017
[2] A Novel Approach for Detecting the Tumor Size and Bone Cancer Stage Using Region Growing Algorithm ttps://ieeexplore.ieee.org/document/7546088/ 2016
[3] Bone Cancer Detection from MRI Scan Imagery Using Mean Pixel IEEE 2015
[4] A study of UWB imaging for bone cancer detection
[5] https://ieeexplore.ieee.org/abstract/document/6340479/ 2012
[6] M.WelsB. M.Kelm (2012) "Multi-Stage Osteolytic Spinal Bone Lession Detection from Ct Data with Internal Sensitivity Control", Proceedings of Medical Science, vol .12, no.5
[7] P.Sinthia, Dr.K.Sujatha, and M. Malathi (2015) "Wavelet Based Decomposition and Approximation for Bone Cancer Image", Proceedings of Basic and Applied Sciences and Biomedical Engineering, vol. 23, no. 3, pp. 344-350.
[8] Shukla S.P. and GulhareKajal Kiran (2013), "Review of Intelligent Techniques Applied for Classification and PreProcessing of Medical Image Data ", IJCSI International Research in Computer Science, vol. 10, no. 3, pp.267-242 .
[9] Abdulmuhssin Binhssan (2015) "Enchondroma Tumor Detection", International Proceedings of Advanced Research in Electronics and Communication Engineering, vol. 4, no. 6, pp. 1-4.
[10] Markus Harmsen, Benedikt Fischer, Hauke Schramm and Thomas Seidl (2013), "Support Vector Machine Classification Based on Correlation Prototypes Applied to Bone Age Assessment", Proceedings of Biomedical and Health Informatics, vol. 17, no. 1,pp 190-197
[11] Hubert H. Chuang, Beth A. Chasen and TinsuPan(2013) "Bone Cancer Detection from MRI Scan Imagery Using Mean Pixel Intensity", Proceedings of Advanced Research in Computer and Software Engineering , vol.1 , no .5, pp .1-7.
[12] K. Jalal Deen and Dr. R. Ganesan, "An automated lung cancer detection from CT images based on using artificial neural network and fuzzy clustering methods", International journal of applied engineering research, 9(22), 17327-17343,2014.
[13] Krupali D. Mistry, Bijal J. Talati, "An approach to detect bone tumor using comparative analysis of segmentation technique", International journal of innovative research in computer and communication engineering, 4(5), 2016.
[14] Bhagyashri G. Patil, "Cancer Cells Detection Using Digital Image Processing Methods", International Journal of Latest Trends in Engineering and Technology, 3(4), 2014.
[15] Amit Verma and Gayatri Khanna, "A Survey on Digital Image Processing Techniques for Tumor Detection", Indian journal of science and technology, 9(14), 2016.
[16] Glenn w. Milligan, S. C. Soon, Lisa m. sokol. "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, 5(1). .
[17] D. Blackledge, D. J. Collins, N. Tunariu et al., "Assessment of treatment response by total tumor volume and global apparent diffusion coefficient using diffusion-weighted MRI in patients with metastatic bone disease: a feasibility study," PLoS One, vol. 9, no. 4, article e91779, pp. 1–10, 2014.View at: Publisher Site | Google Scholar
[18] O. Bandyopadhyay, A. Biswas, and B. B. Bhattacharya, "Bone-cancer assessment and destruction pattern analysis in long-bone X-ray image," Journal of Digital Imaging, vol. 32, no. 2, pp. 300–313, 2019.View at: Publisher Site | Google Scholar
[19] W. Chen, M. L. Giger, H. Li, U. Bick, and G. M. Newstead, "Volumetric texture analysis of breast lesions on contrast-enhanced magnetic resonance images," Magnetic Resonance in Medicine: An Official Journal of the International Society for Magnetic Resonance in Medicine, vol. 58, no. 3, pp. 562–571, 2007.View at: Publisher Site | Google Scholar
[20] D. P. Yadav and S. Rathor, "Bone fracture detection and classification using deep learning approach," in 2020 International Conference on Power Electronics & IoT Applications in Renewable Energy and its Control (PARC), pp. 282–285, Mathura, India, 2020.View at: Publisher Site | Google Scholar
[21] A. Asuntha and A. Srinivasan, "Bone cancer detection using artificial neural network," Indian Journal of Science and Research, vol. 17, no. 2, pp. 56–63, 2018.View at: Google Scholar
[22] M. Avula, N. P. Lakkakula, and M. P. Raja, "Bone cancer detection from mri scan imagery using mean pixel intensity," in 2014 8th Asia Modelling Symposium, pp. 141–146, Taipei, Taiwan, 2014.View at: Publisher Site | Google Scholar
[23] M. M. Ranjitha, N. L. Taranath, C. N. Arpitha, and C. K. Subbaraya, "Bone cancer detection using K-means segmentation and Knn classification," in 2019 1st International Conference on Advances in Information Technology (ICAIT), pp. 76–80, Chikmagalur, India, 2019.View at: Publisher Site | Google Scholar
[24] A. Jose, S. Ravi, and M. Sambath, "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, vol. 2, no. 3, pp. 3496–3501, 2014.View at: Google Scholar

[25] C. K. K. Reddy, P. R. Anisha, and L. N. Prasad, “A novel approach for detecting the bone cancer and its stage based on mean intensity and tumor size,” Recent Researches in Applied Computer Science, vol. 20, no. 1, pp. 162–171, 2016.View at: Google Scholar
A. C. Kaushik and V. Sharma, “Brain tumor segmentation from MRI images and volume calculation of tumor,” International Journal of Pharmaceutical Science Invention, vol. 2, no. 2, pp. 23–26, 2013.View at: Google Scholar
[26] P. Sinthia and K. Sujatha, “A novel approach to detect bone cancer using k-means clustering algorithm and edge detection method,” Asian Research Publishing Network, ARPN Journal of Engineering and Applied Sciences, vol. 11, no. 13, pp. 8002–8007, 2016.View at: Google Scholar
[27] A. Asuntha, P. A. Banu, K. Ainthaviarasi, B. S. Kumar, and A. Srinivasan, “Feature extraction to detect bone cancer using image processing,” Research Journal of Pharmaceutical Biological and Chemical Sciences, vol. 8, no. 3, pp. 434–442, 2017.View at: Google Scholar
[28] J. Patel and K. Doshi, “A study of segmentation methods for detection of tumor in brain MRI,” Advance in Electronic and Electric Engineering, vol. 4, no. 3, pp. 279–284, 2014.View at: Google Scholar
[29] M. S. Shafat, B. Gnaneswaran, K. M. Bowles, and S. A. Rushworth, “The bone marrow microenvironment - home of the leukemic blasts,” Blood Reviews, vol. 31, no. 5, pp. 277–286, 2017.View at: Publisher Site | Google Scholar
[30] P. Nisthula and R. B. Yadhu, “A novel method to detect bone cancer using image fusion and edge detection,” International Journal of Engineering and Computer Science, vol. 2, no. 6, pp. 2012–2201, 2013.View at: Google Scholar
[31] A. Torki, “Fuzzy rank correlation-based segmentation method and deep neural network for bone cancer identification,” Neural Computing and Applications, vol. 32, no. 3, pp. 805–815, 2020.View at: Publisher Site | Google Scholar
[32] B. S. Vandana, P. J. Antony, and R. A. Sathyavathi, “Analysis of malignancy using enhanced graphcut-based clustering for diagnosis of bone cancer,” in Information and Communication Technology for Sustainable Development, pp. 453–462, Springer, 2020.View at: Google Scholar
[33] D. Shrivastava, S. Sanyal, A. K. Maji, and D. Kandar, “Bone cancer detection using machine learning techniques,” in Smart Healthcare for Disease Diagnosis and Prevention, vol. 20, pp. 175–183, Academic Press, 2020.View at: Google Scholar
[34] W. Li, G. G. Wang, and A. H. Gandomi, “A survey of learning-based intelligent optimization algorithms,” Archives of Computational Methods in Engineering, vol. 28, no. 5, pp. 3781–3799, 2021.View at: Publisher Site | Google Scholar
[35] G. G. Wang, A. H. Gandomi, A. H. Alavi, and D. Gong, “A comprehensive review of krill herd algorithm: variants, hybrids and applications,” Artificial Intelligence Review, vol. 51, no. 1, pp. 119–148, 2019.View at: Publisher Site | Google Scholar
[36] O. Stark, J. E. Taylor, and S. Yitzhaki, “Migration, remittances and inequality: a sensitivity analysis using the extended Gini index,” Journal of Development Economics, vol. 28, no. 3, pp. 309–322, 1988.View at: Publisher Site | Google Scholar
[37] J. Cao, L. Chen, M. Wang, and Y. Tian, “Implementing a parallel image edge detection algorithm based on the Otsu-canny operator on the Hadoop platform,” Computational Intelligence and Neuroscience, vol. 2018, Article ID 3598284, 12 pages, 2018.View at: Publisher Site | Google Scholar
[38] D. Koundal and B. Sharma, “Challenges and future directions in neutrosophic set-based medical image analysis,” in Neutrosophic Set in Medical Image Analysis, pp. 313–343, Academic Press, 2019.View at: Google Scholar
[39] D. Koundal, B. Sharma, and E. Gandotra, “Spatial intuitionistic fuzzy set based image segmentation,” Imaging in Medicine, vol. 9, no. 4, pp. 95–101, 2017.View at: Google Scholar
[40] R. M. Haralick, K. Shanmugam, and I. H. Dinstein, “Textural features for image classification,” IEEE Transactions on Systems, Man, and Cybernetics, vol. SMC-3, no. 6, pp. 610–621, 1973.View at: Publisher Site | Google Scholar
[41] C. Reischauer, R. Patzwahl, D. M. Koh, J. M. Froehlich, and A. Gutzeit, “Texture analysis of apparent diffusion coefficient maps for treatment response assessment in prostate cancer bone metastases--a pilot study,” European Journal of Radiology, vol. 101, no. 1, pp. 184–190, 2018.View at: Publisher Site | Google Scholar
[42] C. K. K. Reddy, P. R. Anisha, and G. V. S. Raju, “A novel approach for detecting the tumor size and bone cancer stage using region growing algorithm,” in 2015 International Conference on Computational Intelligence and Communication Networks (CICN), pp. 228–233, Jabalpur, India, 2015.View at: Publisher Site | Google Scholar



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