IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 7.047 ⁜ Vol. 10, Issue 5, May 2022

DOI: 10.17148/IJIREEICE.2022.10566

# NODULE SEGMENTATION OF LUNG CT SCAN IMAGE USING META-HEURISTIC SEARCH ALGORITHM

**Dr. Shanthi Mahesh[1], Sri Raksha M R[2], Rachitha A[3], Vachan Honnudike[4]**

Head of Department, Department of Information Science & Engineering, Atria Institute of Technology, Bangalore, India[1]

Student, Department of Information Science & Engineering, Atria Institute of Technology, Bangalore, India[2,3,4]

**Abstract**: Lung cancer is one of the leading causes of death worldwide. Cancer detection in its early stages is critical and a big concern. To locate the lung nodule in CT images, we combine the cuckoo search algorithm with the levy flight method. For nodule segmentation, we use active contouring, and for post-processing, we use MRF (Markov Random Field). For nodule segmentation, we use active contouring.

**Keywords**: Cuckoo search , CT scan , MRFs, Active Contour, Segmentation.

## I. INTRODUCTION

Lung cancer is the most frequent type of cancer, and it is also the deadliest. According to World Health Organization statistics issued in 2012, 1.59 million people died because of lung cancer. Lung cancer has caused two times as many fatalities as liver cancer and is the second greatest cause of death. The mortality ratio caused by lung cancer is 0.87 to incidence in different world regions, according to statistics. Treatment in the early stages can reduce mortality if discovered early. Computed tomography (CT) has been the most extensively used tool for detecting cancer in its early stages for the past 20 years. Lung nodules segmentation is used to prevent and diagnose abnormalities.
Lung nodules segmentation is an important step in the prevention and identification of lesions. A computer-aided diagnosis (CAD) system improves the detection of nodules and can assist in identifying nodules as cancerous or benign. The content-based medical image retrieval system (CBMIR)finds a set of photos from a large database with characteristics that are like the lung nodule. The benefit is that both malignant and benign cancers can be treated. Lesions can be diagnosed, and prompt treatment can be offered as a result. As a result, the outlook is improved. Segmentation occurs after a pre-processing phase. It is carried out prior to feature extraction and quantifies Characteristics of nodules. These functionalities will be implemented in the CAD system. Classification. These characteristics are the input for CBMIR.

The project proposes a new methodology for the segmentation of the lung nodules using the lung CT scan image. For the initial lung segmentation, we use the adaptive thresholding along with the cuckoo search algorithm. For post processing and image enhancing the Markov random field is employed. The heterogeneity in the intensity of the image is used to identify the lung nodule which is done by the levy flight or the snake model.

## II. LITERATURE SURVEY

In order to inspect the malignancy of lung cancer, lung nodule's accuracy assessment is required. To expedite radiologists, there are various efforts to develop a scalable and robust nodule segmentation system. The efforts are in two categories: deep learning and classical image process based techniques. The brief overview of the techniques which are proposed recently in each category are provided in this section.
Jamshid et al. [3] created one algorithm to perform nodule segmentation. For performing segmentation of the nodule the algorithm utilized two-region method of growing which are contrast-based growing region and fuzzy connectivity. For identifying foreground and background regions within the defined window size the local adaptive segmentation algorithm is used. This method performed finer for the separated nodule but failed to segment attached nodules.
Threshold and morphological techniques are used by Elmar et al. [7] for eliminating the background and other information from the surrounding region of interest. The researchers used the support vector machines for classifying each pixel in detected space. Stefano et al. [6] proposed an algorithm which adopted geodesic influence zone in image of the multithreshold representation and allows fusion segmentation criteria which is based on the object nodule segmentation

IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 7.047 ⁜ Vol. 10, Issue 5, May 2022

DOI: 10.17148/IJIREEICE.2022.10566

itself. Wang et al. [8] segmented solitary pulmonary nodules in the digital radiography images and achieved by incorporating the sequential filter for the construction of new representations of weight and matrices of probability. This is limited to digital radiography images which limits the use of CT images. Similarly, Julip et all. [9] worked on the ground glass noduled segmentation. Researchers used asymmetric multiphase deformable model. In this, robustness was constraint for addressing requirements of segmentation for the other types of nodules.

Shakir et al. [11] created a scheme based on voxel intensity segmentation. It incorporates the mean intensity based thresholding in Geodesic Active contour model and was validated on the limited set of scans, so the robustness of proposed technique was dubious [12]. Shakibapour et al. [10] designed the concept of optimally clustering set of feature vectors. Process involved extraction of intensity related features and shape in a given feature data space. Proposed work with cuckoo search was hybridized with clustering algorithm. This algorithm was introduced to understand protein cell machinery activities. This helped in detecting protein complexes, which is difficult with traditional algorithms. Authors have detected protein complex cores. After the construction of dynamic protein network this was achieved [13]. The authors have worked on CS algorithm on satellite images with aim of contrast enhancement. This work was focusing on enlargement of virtual effects of satellite images. New enhancement algorithm was used which helps in enhancing satellite stills. In three different threads this work was moved. At the initial pass, adaption of the chaotic initialization was finished and this resulted in image's premature convergence. During second pass, fitness value was adapted which turned on the strategy of the adaptive Levy Flight, to seek result of the improvement in CSA convergence rate. During final pass, they introduced mutation randomization technique for felicitation, and ensured with best feasible optimum solution [14].

The authors worked on active contour module for the effective fragmentation of biometric image. In this work, to segment biomedical images authors have presented one model by considering the intensity inhomogeneity, that imposes Local Mean and variance (LMV). This technique is called as Local Mean Variance (LMV) Active Contour. [15].
The authors have proposed theory on the automated 3-D lung segmentation that was formulated with the help of active-contour model, on lung CT images. Proposed system was integrated active contour model. The mean squared errors have been used in accommodation in homogeneous CT images. Finally detected and fragmented the tumor region. CT images were exposed to Multiscale Gaussian Distribution for the smoothening of this process and this leads to features determination of image.

## III. PROPOSED METHODOLOGY

This paper uses new technique for segmentation of the lung nodule. Firstly, the initial lung contour is segmented from the lung image. This uses adaptive thresholding optimized with Cuckoo search algorithm. Then, it uses Active contouring to identify the nodule from the segmented lung contour. Finally, MRFs is used for post processing and for enhancement of the image.

### 1.Cuckoo search Algorithm.

This algorithm is a nature inspired algorithm developed by Yang and Deb. The working of the algorithm has been exploited out of nature by observing the behavior of the Cuckoo bird. It assures reduced time complexity.

The Cuckoo bird lays its eggs in the other species bird`s nest and leaves, there are two possibilities after this 1.the foreign bird can identify the cuckoo bird`s egg and throw it out of the nest, 2. The foreign bird can nurture the cuckoo bird`s egg. If the cuckoo bird`s eggs hatches then the cuckoo bird pushes the foreign bird`s egg out of the nest. This ensures the cuckoo bird a more better possibility of getting a feed and survival. The cuckoo search algorithm works based on the same principle.

The same way how the cuckoo bird's behavior follows the algorithm flows. The algorithm works on a fitness value which acts as a threshold. Based on comparison of the fitness values the algorithm decides weather to retain the solution or throw it. After the best fit solution is found the other unwanted solutions are thrown out. The same principle works in the cuckoo search algorithm. It finds the best fit solution for the problem.

### 2.Active contour.

This algorithm is used to find the curve structures in the image that can identify the boundaries of a curve structure in the image. The energy function can be minimized by this method by various internal and external forces. The surfaces of the curve are considered as internal force and the actual image data is considered as the external force. This algorithm is widely used in medical imaging for locating object boundaries. External energy is identified by certain gradient features. The internal energy controls the shape modification of the curve and maintains the search within the spatial domain of the image.

IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 7.047 ⁜ Vol. 10, Issue 5, May 2022

DOI: 10.17148/IJIREEICE.2022.10566

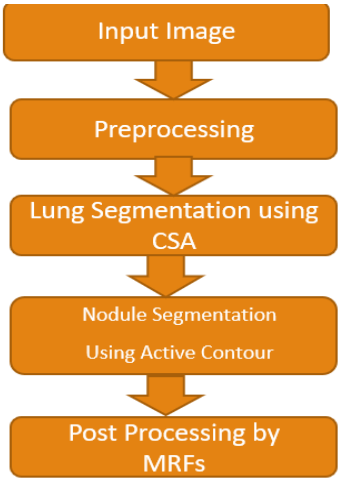


**Fig. 1.** Workflow of the Proposed Technique

At last the segmentation of the image is converted to obtain the minimum energy function. Morphological operations are performed on the image to fine tune the image in the post processing stage.

The above figure shows the flowchart for the segmentation of the lung nodule from the image. First the image is preprocessed to remove any discrepancies in the image. Then the image is segmented based on a fitness algorithm to separate the lung region from the external image. This segmented lung image is fed into the levy flight algorithm with the cuckoo search algorithm to find out the best fit region where the lung cancer is present. The best fit region is found and the nodules are segmented using the active contour method. Finally Markov Random fields are applied for the enhancement of the image.

## IV. EXPERIMENTS AND RESULTS

To evaluate the performance of the segmentation we applied few segmentation methods, they are Cany differential operator, Otsu thresholding algorithm, Region growing watershed to focus different kinds of nodules respectively.
The results shows that the segmentation techniques have a High quality in terms of nodules. Our proposed algorithms could efficiently segment the lung and the lung nodule.

**Table 1.** Comparison of LBP and proposed method

| | LBP (avg) | Proposed (avg) |
|---|---|---|
| Coefficient of similarity | 0.009 | 0.789 |
| Spatial Overlap | 0.358 | 0.456 |

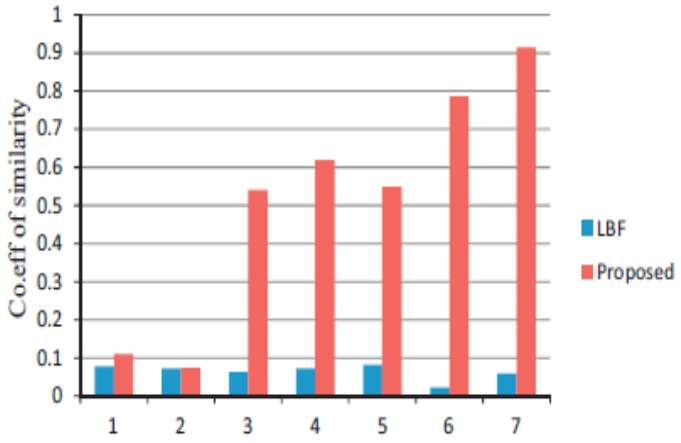


**Fig. 2.** Coeff of Similarity

IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 7.047 ⁜ Vol. 10, Issue 5, May 2022

DOI: 10.17148/IJIREEICE.2022.10566

The co-efficient of similarity which shows the difference between the segmented and ground truth images. The apt co-efficient of similarity is 0.914 and the worst is 0.074.

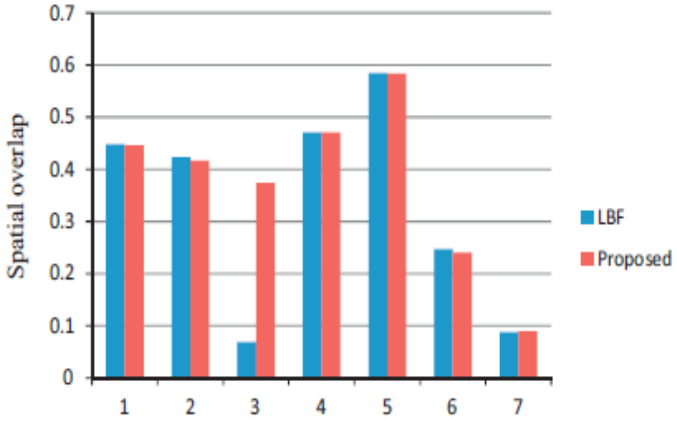


**Fig. 3.** Spat. Overlap

Spatial overlap is the accurate measure of the spatial properties of segmented images. The apt overlap fraction is 0.584 and worst is 0.089. The experimental work shows a spatial overlap fraction of 0.584 that lies within specified range. The experimental result shows that increased performance when compared with the LBF model.

The below figure shows the obtained results after applying the proposed methodologies on the CT image.

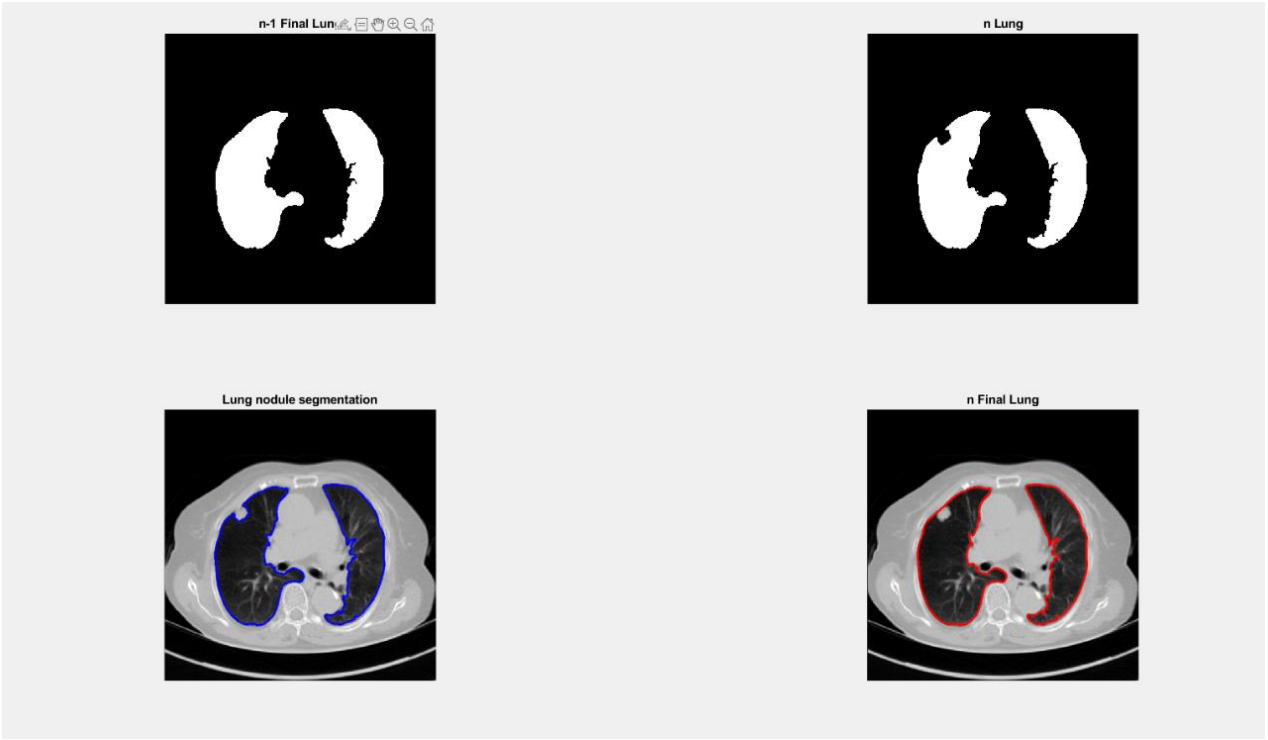


Fig. 4. Obtained output image

## V. CONCLUSION

In this paper, new methodology of the lung nodule segmentation has been proposed and performed experimentation on few medical CT lung images. our project helps in the early detection of the lung cancer using the aid of digital image processing and engineering. We hope that our project serves as a good solution for the early detection of lung cancer. Early detection of the lung cancer will help the doctors find the cure in feasible amount time to prevent the patient from life threat.

DOI: 10.17148/IJIREEICE.2022.10566

**ACKNOWLEDGMENT**

We would like to take this opportunity to thank our guide **Dr. Shanthi Mahesh**, for giving us all the help and guidance needed.We are grateful to him for his kind support and valuable suggestions.

**REFERENCES**

[1] World Health Organization. Cancer. Fact sheet Fact sheet N°297. Available: http://www.who.int/mediacentre /factsheets/fs297/en/, 2014.
[2] I. Sluimer, A. Schilham, M. Prokop, B van Ginneken, Computer analysis of computed tomography scans of the lung: a survey, IEEE Trans. Med. Imaging 25(2006) 385-405.
[3] J. Dehmeshi, H. Admin, M. Valdivieso, X. Ye, Segmentation of pulmonary nodules in thoracic CT scans: a region growing approach, IEEE Trans, Med. Imaging 27 (4) (2008) 467-480.
[4] B.D. Parameshachari, H.T. Pandruranga, S.L. Ullo, Analysis and computation of encryption technique to enhance security of medical images, in: Proceeding of the IOP Conference Series: Materials Science and Engineering, 925, IOP Publishing, 2020.
[5] S. Prabu, V. Balamurugan, K. Vengatesan, Design of cognitive image filters for suppression of noise level in medical images, Measurement 141 (2019) 296–301
[6] S. Diciotti, G. Picozzi, M. Falchini, M. Mascalchi, N. Villari, G. Valli, 3-d segmentation algorithm of small lung nodules in spiral CT images, IEEE Trans. Inf. Technol. Biomed. 12 (1) (2008) 7–19.
[7] E. Rendon-Gonzalez, V. Ponomaryov, Automatic lung nodule segmentation and classification in CT images based on SVM, in: Proceedings of the 9th International Kharkiv Symposium on Physics and Engineering of Microwaves, Millimeter and Submillimeter Waves (MSMW), IEEE, 2016, pp. 1–4.
[8] J. Wang, Y. Du, P. Tang, Adaptive solitary pulmonary nodule segmentation for digital radiography images based on random walks and sequential filter, IEEE Access 5 (2017) 1460–1468.
[9] J. Jung, H. Hong, J.M. Goo, Ground-glass nodule segmentation in chest CT images using asymmetric multi-phase deformable model and pulmonary vessel removal, Comput. Biol. Med. 92 (2018) 128–138.
[10] H. Shakir, T.M.R. Khan, H. Rasheed, 3-d segmentation of lung nodules using hybrid level sets, Comput. Biol. Med. 96 (2018) 214–226.
[11] S. Latif, M. Usman, R. Rana, J. Qadir, Phonocardiographic sensing using deep learning for abnormal heartbeat detection, IEEE Sens. J. 18 (22) (2018) 9393–9400.
[12] S. Latif, M.Y. Khan, A. Qayyum, J. Qadir, M. Usman, S.M. Ali, Q.H. Abbasi, M.A. Imran, Mobile technologies for managing noncommunicable diseases in developing countries, in: Mobile Applications and Solutions for Social Inclusion, IGI Global, 2018, pp. 261–287.
[13] J. Zhao, L. Xiujuan, F. Xiang Wu, Identifying protein complexes in dynamic protein-protein interaction networks based on cuckoo search algorithm, in: Proceedings of the IEEE International Conference on Bioinformatics and Biomedicine (BIBM), 2016 978-1-5090- 1610-5/16 ©2016 IEEE.
[14] S. Suresh, A novel adaptive Cuckoo search algorithm for contrast enhancement of satellite images, IEEE J. Sel. Top. Appl. Earth Observ. Remote Sens. (2017) 1939-1404 ©IEEE.
[15] Y. Peng, S. Liu, Y. Qiang, X.J. Wu, L. Hong , in: A Local Mean and Variance Active Contour Model for Biomedical Image Segmentation, 33, Elsevier, 2019, pp. 11–19. Pages.