

Detection of Tuberculosis using Lung Segmentation Technique

Raisa Mujawar¹, Shashikant Hippargi²

P.G. Student, Department of Electronics & Telecommunication Engineering, NBNSCOE Engineering College,
Kegaon, Maharashtra, India¹

Associate Professor, Department of Electronics & Telecommunication Engineering, NBNSCOE Engineering College,
Kegaon, Maharashtra, India²

ABSTRACT: Tuberculosis is a major health problem in many regions of the world. This infection in weak immune HIV/AIDS patients and multi-drug-resistant bacterial strains has severed the problem. Also diagnosing tuberculosis still is a challenge. When left undiagnosed and thus untreated, mortality rates of patients with tuberculosis are high. Standard diagnostics still rely on old methods of the last century. They are slow and often unreliable. In an effort to reduce the burden of the disease, this project presents our automated approach for detecting tuberculosis using chest radiographs. In this project system first extracts the lung region using segmentation method then features are extracted using filters and then the selection of features is done. Selected features are given as input to the classifier, which gives output as TB positive or negative.

KEYWORDS: Computer-aided detection and diagnosis, lung, pattern recognition and classification, segmentation, tuberculosis(TB), X-ray imaging.

I. INTRODUCTION

TUBERCULOSIS (TB) is the second leading cause of death from an infectious disease worldwide, after HIV, with a mortality rate of over 1.2 million people in 2010. With about one-third of the world's population having latent TB, and an estimated nine million new cases occurring every year, TB is a major global health problem. TB is an infectious disease caused by the bacillus *Mycobacterium tuberculosis*, which typically affects the lungs. It spreads through the air when people with active TB cough, sneeze, or otherwise expel infectious bacteria. TB is most prevalent in sub-Saharan Africa and Southeast Asia, where widespread poverty and malnutrition reduce resistance to the disease. Moreover, opportunistic infections in immune compromised HIV/AIDS patients have exacerbated the problem. The increasing appearance of multi-drug resistant TB has further created an urgent need for a cost effective screening technology to monitor progress during treatment. Several antibiotics exist for treating TB. While mortality rates are high when left untreated, treatment with antibiotics greatly improves the chances of survival. In clinical trials, cure rates over 90% have been documented. Unfortunately, diagnosing TB is still a major challenge. The definitive test for TB is the identification of *Mycobacterium tuberculosis* in a clinical sputum or pus sample, which is the current gold standard. However, it may take several months to identify this slow-growing organism in the laboratory. Another technique is sputum smear microscopy, in which bacteria in sputum samples are observed under a microscope. This technique was developed more than 100 years ago. In addition, several skin tests based on immune response are available for determining whether an individual has contracted TB. However, skin tests are not always reliable. The latest development for detection is molecular diagnostic tests that are fast and accurate, and that are highly sensitive and specific. However, further financial support is required for these tests to become common place. This project presents an automated approach for detecting TB manifestations in chest X-rays (CXR). An automated approach to X-ray reading allows mass screening of large populations that could not be managed manually. A poster anterior radiograph (X-ray) of a patient's chest is a mandatory part of every evaluation for TB. The chest radiograph includes all thoracic anatomy and provides a high yield, given the low cost and single source. In this project first the lung segmentation is done then its

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 7, July 2016

features are extracted using filters. Required features are selected using feature selection method. The selected features are classified using a binary classifier, which outputs result as TB positive or negative.

II. RELATED WORK

“Graph Cut Based Automatic Lung Boundary Detection in Chest Radiographs” By Sema Candemi [1]. In this paper a graph cut based robust lung segmentation method is presented that detects the lungs with high accuracy.

“Automatic Detection of Abnormalities in Chest Radiographs Using Local Texture Analysis” By Bram van Ginneken [2]. In this paper a fully automatic method is presented to detect abnormalities in frontal chest radiographs which are aggregated into an overall abnormality score.

“Automatic screening for tuberculosis in chest radiographs: a survey” By Stefan Jaeger [3]. This paper describes the medical background of TB detection in chest X-rays and presents a survey of the recent approaches using computer-aided detection.

“Detecting Tuberculosis in Radiographs Using Combined Lung Masks” By Stefan Jaeger [4]. This paper presents results produced by TB screening system. It combines a lung shape model, a segmentation mask, and a simple intensity model to achieve a better segmentation mask for the lung.

“Fusion of local and global detection systems to detect tuberculosis in chest radiographs” By Hogeweg L¹, van Ginneken B [5]. This paper presents a combination of detection systems for abnormalities and normal anatomy to improve detection performance.

“Computer-Aided Diagnosis in Medical Imaging: Historical Review Current Status and Future Potential” By Kunio Doi, Ph.D. [6]. This article, the motivation and philosophy for early development of CAD schemes are presented together with the current status and future potential of CAD in a PACS environment.

“Computer-aided diagnosis in chest radiography: beyond nodules” By van Ginneken B [7]. In this survey it identifies a number of areas beyond pulmonary nodules that could benefit from computer-aided detection and diagnosis (CAD) in chest radiography.

The work in this paper is divided into three stages. 1) Lung Segmentation 2) Feature extraction 3) Classification.

Lung segmentation is done using Chan Vese. This model begins with a contour in the image plane defining an initial segmentation, and then it evolves this contour according to some evolution equation. The goal is to evolve the contour in such a way that it stops on the boundaries of the foreground region. The Chan-Vese algorithm evolves this contour via a level set method. Thereafter, features of the image are extracted. For feature extraction texture features are selected. Finally, the set of selection criteria is applied to a classifier who separates out TB positive and negative cases. The paper is organized as follows. Section II describes the problem statement. Section III describes the methodology of the system with a flow diagram of the system. The flow diagram represents the steps of the algorithm. Section IV presents experimental results showing results of images tested; it shows results after segmentation and feature extraction. Finally, Section V presents the conclusion.

III. PROBLEM STATEMENT

Currently the existing systems for automatic detection of Tuberculosis have an accuracy of about 80-90%, which is below human accuracy. So by using a different segmentation algorithm the proposed system will discriminate between normal and abnormal Chest X-Rays for detection of Tuberculosis. The system will improve the performance of the existing systems and achieve accuracy close to human accuracy.

IV. METHODOLOGY

To fulfill the objective i.e. to detect TB from CXRs, some steps have to be followed. Steps or the overview of the proposed system is as shown in the following figure.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 7, July 2016

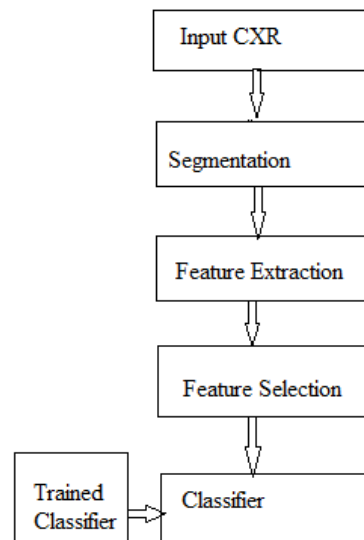


Fig.1 Proposed System

The proposed system will segment the lung region using segmentation algorithm. For getting good segmentation active contour method is used. Active contours is a powerful and flexible method which is able to segment many types of images, including some that would be quite difficult to segment in means of "classical" segmentation i.e., using thresholding or gradient based methods.

For image segmentation here Chan-Vese algorithm is used. This models begin with a contour in the image plane defining an initial segmentation, and then it evolve this contour according to some evolution equation. The goal is to evolve the contour in such a way that it stops on the boundaries of the foreground region. The Chan-Vese algorithm evolves this contour via a level set method. Level set define some function $\phi(i, j, t)$ (the level-set function), where (i, j) are coordinates in the image plane and t is an artificial "time." At any given time, the level set function simultaneously defines an edge contour and a segmentation of the image. The edge contour is taken to be the zero level set $\{(i, j) | \phi(i, j, t) = 0\}$, and the segmentation is given by the two regions $\{\phi \geq 0\}$ and $\{\phi < 0\}$. The level set function will be evolved according to some partial differential equation, and hopefully will reach a steady state limit $t \rightarrow \infty$ that gives a useful segmentation of the image. Here MATLAB code for segmentation using Chan-vee is

```
bw = activecontour(BI, mask, 100, 'Chan-Vese')
```

2. Feature Extraction:

Extraction of feature means use of unique features such as color, edge, shape, and texture to detect. A set of filters with different frequencies and orientations will be used for extracting yuseful features from an image.

3. Feature Selection :

Feature selection methods provides us a way of reducing computation time, improving prediction performance, and a better understanding of the data in machine learning or pattern recognition applications. It identifies the subset of features by preserving only the most important predictors and filtering or excluding all others.

4. Classification :

To detect abnormal CXRs with TB, system use a support vector machine (SVM), which classifies the computed feature vectors into either normal or abnormal

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 7, July 2016

V. RESULT

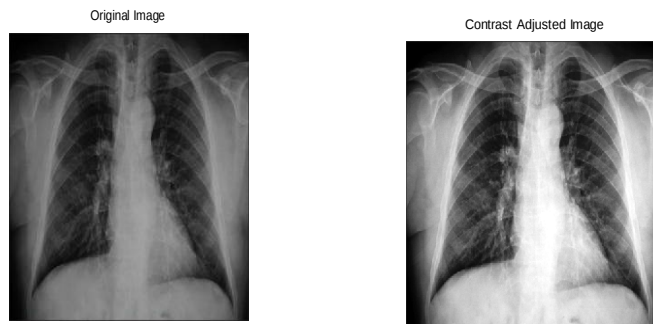


Fig.(a)

Fig.(b)

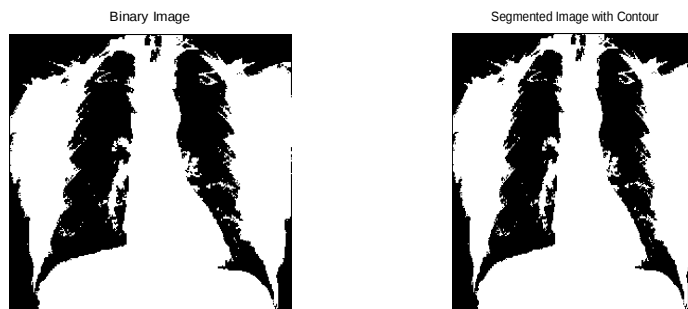


Fig.(c)

Fig.(d)

Fig.2 Segemntation(a)Original image(b)Contrast adjusted image
(c)Binary image(d)Segmented image with contour

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 7, July 2016

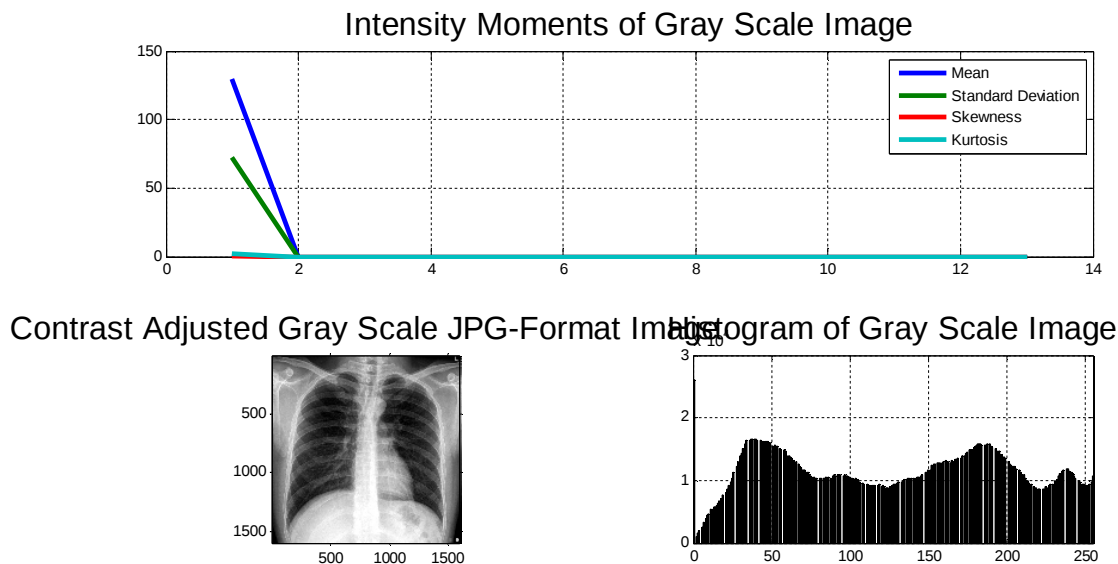


Fig.3

Fig.3.It shows intensity moment of gray scale image with contrast adjusted gray scale and histogram of gray scale image.

Here result after features extraction is as shown in fig.(e).It returns the values as mean ,standard deviation,skewness, kurbosis Result of classifier is positive case or negative case.

VI. CONCLUSION

We have implemented an automatic TB detection system from X-ray. Our algorithm successfully segments lung region from the X-ray and then its features are extracted and using SVM classifier we get TB positive or negative case. We have applied our algorithm on many images and found that it successfully detect the TB with performance closer to human performance.

REFERENCES

- [1] Sema Candemi " Graph Cut Based Automatic Lung Boundary Detection in Chest Radiographs". in Proc. IEEE Healthcare Technol. Conf.: Translat. Eng.Health Med., 2012, pp. 31–34.
- [2] B. van Ginneken, S. Katsuragawa, B. ter Haar Romeny, K. Doi, and M. Viergever, "Automatic detection of abnormalities in chest radiographs using local texture analysis," *IEEE Trans. Med. Imag.*, vol. 21, no. 2, pp. 139–149, Feb. 2002.
- [3] S. Jaeger, A. Karargyris, S. Candemir, J. Siegelman, L. Folio, S. Antani, and G. Thoma, "Automatic screening for tuberculosis in chest radiographs: A survey," *Quant. Imag. Med. Surg.*, vol. 3, no. 2, pp. 89–99, 2013.
- [4] S. Jaeger, A. Karargyris, S. Antani, and G. Thoma, "Detecting tuberculosis in radiographs using combined lung masks," in *Proc. Int. Conf. IEEE Eng. Med. Biol. Soc.*, 2012, pp. 4978–4981.
- [5] L. Hogeweg, C. Mol, P. de Jong, R. Dawson, H. Ayles, and B. van Ginneken, "Fusion of local and global detection systems to detect tuberculosis in chest radiographs," in *Proc. MICCAI*, 2010, pp. 650–657.
- [6] A. Leung, "Pulmonary tuberculosis: The essentials," *Radiology*, vol. 210, no. 2, pp. 307–322, 1999.
- [7] B. van Ginneken, L. Hogeweg, and M. Prokop, "Computer-aided diagnosis in chest radiography: Beyond nodules," *Eur. J. Radiol.*, vol. 72, no. 2, pp. 226–230, 2009.
- [8] World Health Org., Global tuberculosis report 2012.
- [9] World Health Org., Global tuberculosis control 2011 2011.
- [10] Stop TB Partnership, World Health Org. , The Global Plan to Stop TB 2011–2015 2011.
- [11] J. Burrill, C. Williams, G. Bain, G. Conder, A. Hine, and R. Misra, "T uberculosis: A radiologic review," *Radiographics*, vol. 27, no. 5, pp. 1255–1273, 2007.
- [12] R. Gie, Diagnostic Atlas of Intrathoracic Tuberculosis in Children. : International Union Against Tuberculosis and Lung Disease (IUATLD), 2003.