

Abstract

For Tuberculosis (TB) detection beside the more expensive diagnosis solutions such as culture or sputum smear analysis one could consider the automatic analysis of the chest X-ray (CXR). This could mimic the lung region reading by the radiologist and it could provide an inexpensive solution to analyze and diagnose pulmonary abnormalities such as TB, a disease which often co-occurs with HIV. This software based pulmonary screening can be a reliable and affordable alternative solution for rural populations in different parts of the world such as the Indian subcontinent, Africa, etc. The fully automatic system we are proposing is processing the incoming CXR image by applying image processing techniques to detect the region of interest (ROI) followed by a computationally cheap feature extraction involving edge detection using Laplacian of Gaussian which we enrich by counting the local distribution of the intensities. The choice to "zoom in" the ROI and look for abnormalities locally is motivated by the fact that some pulmonary abnormalities are localized in specific regions of the lungs. Later on the classifiers can decide about the normal or abnormal nature of each lung X-ray. Our goal is to find a simple feature descriptor, instead of a combination of several ones, -proposed and promoted in recent years' literature, which can properly and simply describe the different pathological alterations in the lungs. Our experiments report results on two publicly available benchmark data collections^a, namely the Shenzhen and the Montgomery collection. For performance evaluation, measures such as area under the curve (AUC), and accuracy (ACC) were considered, achieving AUC = 0.81 (ACC = 83.33%) and AUC = 0.96 (ACC = 96.35%) for the Montgomery and Shenzhen collections, respectively. Several comparisons are also provided to other state-of-the-art systems reported recently in the field.

^ahttps://ceb.nlm.nih.gov/repos/chestImages.php

Introduction

Facts about Tuberculosis:

- One of the major life threats (WHO, 2019)
- Mortality rate of 1.5 million/year
- 9.6 million people developing the disease/year

Medical solutions to detect Tuberculosis:

- Pros:
- Sputum spear microscopy
- Culture methods (developed countries only)
- Chest x-ray analysis (radiologist)
- Cons:
- Elevated medical costs
- Lack of trained personnel
- Unreliable human readings (fatigue, visual impairment)

Digital solutions to detect Tuberculosis:

- Pros:
- Image feature based classification
- Automatic feature based classification
- Cons:
- Lack of large data collections
- Adaptability issues for out of scope data



Automatic Tuberculosis Detection Using Chest X-ray Analysis With Position Enhanced **Structural Information**

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Database	Montgomery	
ROI extraction	1.98 (sec/img)	12.
Image resize	$1.46 \; (sec/img)$	8.3
LoG extraction	25 (msec/img)	122
RF classification	1.34 (msec/img)	0.3



Experiments

Results

Montgomery	Shenzhen	Shenzhen
AUC	ACC (%)	AUC
0.681	97.26	0.973
0.707	91.32	0.914
0.500	74.89	0.749
0.815	96.35	0.964

omery	Montgomery	Shenzhen	Shenzhen
(%)	AUC	ACC (%)	AUC
33	0.81	96.35	0.96
3	0.87	95.57	0.99
3	0.86	84.10	0.88
	0.99	_	0.97
0	0.81	84.4	0.90

Conclusion

• Local analysis of LoG characteristics (intensity changes) with "zoom in" functionality. • Comparable/better results than other current state-of-the-art systems available in the literature.

