Automatic Detection of Tuberculosis using Image Processing and KNN Classifier

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Abstract— Tuberculosis is the biggest infectious disease in human that mainly affects lungs, this tuberculosis is one the top ten prominent cause of death for human. When any patient is suffer from the tuberculosis firstly the person is not aware about he/she is affected with tuberculosis or not because it is a type of disease whose maximum symptoms are very much normal and related to other disease also. So without testing it is not sure that patient has TB. But, it is curable or not a untreated problem. We can overcome from this problem if we can detect it at their earlier stage and save the number of lives because at higher stage medicine getting more costly and patients require to treat and observe more carefully. In this paper proposed a technique of image segmentation and machine learning to diagnosis and classify the types of the tuberculosis (TB). These tools and techniques are used to prior expose of tuberculosis (TB) disease. Also classify the type of TB. The type and the stage of tuberculosis show accuracy 88% of system.

Keywords- Tuberculosis, types of Tuberculosis cell detection, enhancement, classification

I. INTRODUCTION

In the medical industries we required many different types of engineering tools, which help doctors to access, stores and reused the relevant medical data to understand the main problem and give the proper diagnosis and medicine for treatment of the disease. The computer system and Expert Interface System (EIS) is a tool that use the different rules and facts for finding the solution of real life problems based on information or knowledge obtained from different human expert in the specific location [2].

Healthcare is top demands of generation. So different methods are used to improve the method of treatment of the patients. One of the method is used by the doctors is Clinical Diagnostic Decision Support System (CDSS). CDSS is the computer based program that helps the professional for making the clinical related decisions. In that we provide the relevant pre-diagnosis data and that information CDSS can provide the output that helps the decision by the physician [4].

TB was assumed to be completely in control, but once TB was assumed to be completely in control, but once again TB becomes a dangerous problem world-wide. TB is an infection which is happen because of bacterium whose named as mycobacterium tuberculosis. This infection can spread from human to human, and patients which are experiencing tuberculosis may kick the bucket except if they get the right treatment. This microorganism for the most part exists on different species like people, creatures and winged animals. Each organ in the body can be influenced by this sickness, yet for the most part the tuberculosis happens in lungs [6].

As it is transferable sickness it tends to be transmitted through the air when the contaminated individual hack, sniffle or from spit. Pneumonic tuberculosis is an infectious bacterial disease that includes lungs, however may spread to different organs. TB illness happens under different phase of life in grown-ups and youngsters. At the point when the principal meeting occurs with bacillus that is chiefly occurs in the youth period of an individual, lymphatic organs which are positioned at the beginning stage of the lungs are picked by this microorganism for the primary establishing point on the body. Because of this occasion, those organs extend (hilar lymphadenopathy) and this called as essential tuberculosis. The grown-up sort (optional) tuberculosis is unique in relation to this situation. In those cases, the individual's lung is polluted with the microorganism previously. In the event that the safe framework is sufficient, microorganism can't cause any affliction yet can keep itself alive. At the point when the safe arrangement of the individual debilitates for an explanation, microorganism gets actuated and starts to make disorder. Average outward signs of pneumonic tuberculosis incorporate diligent hack, chest agony, haemoptysis, and infrequent fever, loss of craving, smoke compulsion, BCG antibody, disquietude and Weight decrease. The relations among analyses and their side effects are barely ever balanced, in this manner, separation of findings that offer a covering scope of side effects is accordingly naturally troublesome [7].

Image processing is a method in which digital images are used for extraction of helpful information from image. Image processing involved various others subjects like recognition of Character, pattern recognition and extract information from digital Medical images to improve the method of diagnostic for various diseases [8]. Tuberculosis is a lung based disease which can nowadays threaten people’s life. The basic microscopy methods that are utilized for tuberculosis detection that includes Ziehl-Neelsen and fluorescence microscopy. Fluorescence microscopy is expensive method so detection that includes Ziehl-
Neelsen and fluorescence microscopy. Fluorescence microscopy is expensive method so mainly Ziehl-Neelsen sputum smear microscopy is used. Ziehl-Neelsen method that uses the sputum sample of the person to perform a TB test and according to that this test tells that person is affected with TB or not [9]. Tuberculosis has many types and these types are:

II. TYPES OF TUBERCULOSIS

Tuberculosis can be classified into the following categories:

A. Pulmonary Tuberculosis (PTB)

PTB is the maximum commonplace and potentially maximum contagious sort of active TB and constitutes about eighty-five percent of total instances of TB. Small areas inside the lungs infected with bacilli steadily shape a larger lesion packed with inflamed cloth. This material can emerge as liquid, that's then coughed out, leaving a hollow space inside the lung. The method maintains causing good sized damage to lung tissues and blood vessels, generating greater infectious fabric and inflammations. Damage to blood vessels can also cause Haemoptysis (coughing out blood) which can be deadly [32].

1) Primary Tuberculosis Pneumonia: This is rare form of TB which named as pneumonia & is highly infectious. In this case patients suffered from intense fever and dynamic cough. It mostly happens in children and the elders. It is also present in patients with immune suppression, like people who affected with HIV/AIDS and using term corticosteroid therapy for a long time [32].

2) Tuberculosis Pleurisy: This typically grows not long after beginning contamination. Granuloma situated at the border of the lung bursts into the pleural cavity which is the space in between the lungs and the chest divider. Normally, two or three tablespoons of liquid can be enacting in the pleural cavity. When the microscopic organisms attack this space, the measure of liquid expands drastically and pack the lung, which cause brevity of breath (dyspnea) and sharp chest torment that intensifies with a full breath (pleurisy). Chest x-beam demonstrates noteworthy measures of liquid. Gentle or poor quality fever generally is available. Tuberculosis pleurisy for the most part settle without treatment; in any case, 66% patients with tb pleurisy create dynamic pnemonic TB inside 5 years [32].

3) Cavitary Tuberculosis: Cavitary TB incorporates the higher projections of lung. The miniaturized scale living being reason progressive lung decimation by methods for shaping pits, or developed air spaces. In this case of TB happens in renewal affliction. The top projections of lung are influenced due to the reality they're massively oxygenated (a situation where M. Tuberculosis prospers). This TB can, seldom, happen rapidly after essential contamination. Indications incorporate powerful hack, evening time sweats, weight decrease, fever & shaky area. Hemoptysis (hacking up blood) can be present there. Patients with this type of TB are fairly infectious Occasionally, scatter expands into the pleural zone and which can cause TB empyema [32].

4) Miliary TB: Miliary TB is scattered TB. "Miliary" portrays the appear on chest x-beam of exceptionally little knobs all through the lungs that resemble millet seeds. Miliary TB can happen rapidly after number one contamination. The influenced individual turns out to be intensely unwell with inordinate fever and is in possibility of death. The malady additionally may likewise bring about incessant pollution and languid decline. Symptoms may incorporate evening time sweats, fever and weight decrease. It very well may be difficult to analyze in light of the fact that the underlying chest x-beam can be typical. Patients who're resistant smothered and youths who've been presented to the microscopic organisms are at more chances for creating miliary TB [32].

5) Laryngeal TB: In this case TB can mainly affect the larynx or the vocal chord area. It is infectious level is high [32].

B. Extra Pulmonary Tuberculosis:

Extra aspiratory tuberculosis (EPTB) is a disease because of M. Tuberculosis, which impacts tissues & organs out of entryways the lungs. The AIDS pandemic has underlined the significance of EPTB. TB can influence almost every organ in our body. The most extreme typical sorts of more prominent aspiratory TB are lymph hub TB, gastrointestinal TB, spinal TB and joint TB. In greater part of these extra pneumonic sites, without aspiratory or laryngeal contribution, TB is normally not infectious. Nonetheless, in some cases water system of tuberculous injuries can create irresistible bead cores bringing about expansion of M. Tuberculosis. EPTB might be irresistible while demonstrative or remedial procedures are finished on aroused sores [32].

1) Lymph Node Disease: Lymph hubs fuse macrophages that catch the microscopic organisms. Any lymph hub can harbor uncontrolled replication of microscopic organisms, making the lymph hub develop to be broadened. The tainting can widen a fistula (path) from the lymph hub to the pores and skin v [32].

2) Tuberculosis Meningitis: M. Tuberculosis can infect the meninges (the primary membrane surrounding the brain and spinal twine). This can be devastating, main to everlasting impairment and dying. TB may be hard to discern from a mind tumor because it could present as a focal mass in the mind with focal neurological symptoms. Headache, sleepiness, and coma are common symptoms. The patient may appear to have had a stroke [32].
3) Tuberculosis of bones and joints: Spinal TB, additionally referred to as Pott ailment, become first reported via Percivall Pott in 1779. One-1/3 of kids inflamed with Mycobacterium tuberculosis have more pulmonary involvement. Skeletal TB happens in 1–6% of them with vertebra being the most typical web page in India. Pure tubercular osteomyelitis without joint involvement occurs in best 2–three% of instances of osteoarticular TB. Commonly websites are the femur, tibia, and fibula. Announced skeletal involve may be very rare in kids (7%), and calvarial osteomyelitis is even rarer (1%) [32].

4) Genitourinary Tuberculosis: (Genitourinary (GU) TB illness alludes to TB infection anyplace inside the genitourinary tract, alongside the renal parenchyma. Genitourinary TB includes 6–7% of EPTB cases based absolutely at the US and European epidemiologic records, however has been referenced to symbolize up to forty % of EPTB cases in explicit zones. It is thought that most extreme cases of GU TB result from hematogenous dispersal during essential tainting. Dysuria, hematuria, clean pyuria, or potentially flank hurt isn’t strange restorative signs identified with renal TB, despite the fact that renal component is ordinarily safeguarded and sufferers can be asymptomatic [32].

5) Tuberculosis pleural effusion: Tuberculosis serous membrane effusion is one in all the utmost common sorts of a lot of respiratory organ TB, the moment reason behind the effusion could be a not on time hyper more sensitivity reaction response to mycobacterium antigens within the serous membrane space. For this purpose microbiological analyses are often dangerous and more confined via the prolonged table in getting effects. In regions with high TB incidence, serous membrane fluid ADA (ADA) levels additional than forty U/l argue pow erfully for TB [32].

6) Tuberculosis Pericardial: TB cords will expand thanks to contiguous unfold from adjacent systems (mediastinal nodes, respiratory organ tissue, or backbone), as a results of dissemination to the serosa (as is visible in cases of miliary TB) or, less sometimes, due to reactivation in serous membrane tissue. Globally, mortality related to TB carditis is as high as twenty six nada, and even higher among those with HIV coinfection. Clinical capabilities are constant with carditis and might embrace chest ache, dyspnea, and obstruction physiology once excessive; fever and cough also can be visible [32].

7) Cutaneous Tuberculosis: Cutaneous tuberculosis occurs not often, despite a high and increasing incidence of tuberculosis worldwide. Mycobacterium tuberculosis, Mycobacterium bovis, and the Bacille Calmette-Guérin vaccine can cause tuberculosis related to the pores and skin. Cutaneous tuberculosis may be obtained exogenously or endogenously and gift as a large number of differing clinical morphologies. Diagnosis of these lesions can be difficult, as they resemble many different dermatological conditions which might be often on the whole taken into consideration [32].

III. LITERATURE REVIEW

Kant S. et al. [10] proposed a methodology that uses to diagnosis TB disease with the help of the new deep neural network. According to the author this system need microscopy image of sputum which is properly magnified as the input to the system and after the processing it provides the position of suspicious Mycobacterium tuberculosis bacilli. This proposed system with the help of microscopic image of sputum for detection of TB achieved 83.78% and 67.55% of recall and precision respectively. Payasi Y et al. [14] proposed a system which used the digital image processing with ZN-stained sputum smear images for diagnoses TB. For detecting and counting of bacilli of TB MATLAB software is used. By thresholding the hue range the segmentation of bacilli is achieved by Hue color component based approach. By thresholding the particular area, perimeter and characterizations of shape the unwanted artifacts were removed. Counting process is complete after clumps and segmentation of bacilli. In this method results show with the help of many different images taken from several patients that represented that the system detects the existence of TB accurately and efficiently. R.S. Chithra et al. [15] proposed a system named fractional crow search-based support vector neural network which is used to automatic classifying the TB. This proposed method is used sputum images of the patients. The classification method is integration of fractional theory in the crow search algorithm that increases the computational speed and reduces the cost and time spent on analyzing the test samples. These methods require minimum manual power. The Ziehl–Neelsen sputum smear microscopy image database is used that proves that classifier is highly accurate and provides better performance. The accuracy rate, TPR and FPR is found to be 0.9487, 0.96, and 0.04 respectively.

Methodology: After studying the literature, review of the following general methodology for the Tuberculosis detection by sputum smears slides has been done.

1. Microscopic images: The sputum mobile information have been amassed the use of virtual microscope this is attached to a digital camera, connected to a PC and runs with devoted software program for image collection.

2. Enhancement: Images may contain some artifacts starting, so there is a need to enhance the taken images. Many pictures have some lot of noise, so before processing further these problems should be discard with the help of image enhancement method like to remove noise usage types of operators i.e. peewit and sober, canny etc.
3. Segmentation: Segmentation is a process of dividing an image into sub parts, so that each and every part is scanned completely. Microscopic images collection of different kind of sputum cell can easily detect the TB from appearance of cells. So, with the use of segmentation process separation of the affected and non-affected cell has been done. Various method used for segmentation are region-based segmentation, k-means etc.

4. Feature Selection: In this part extraction of some of the properties from the processed image has been done. Feature extraction is the process of replace the image into data so that results can be verified with the standard values and finally we can differentiate between the regular and irregular data. Some of the features which are necessary to be calculated are listed below.
   - Color Features
   - Geometric Features
   - Texture Features
   - Statistical Features

   Radius –measured by averaging the length of the cell and their length.

5. Classifier: In this final step, the finding features are used to provide the final answer. All feature extracted are listed into the different columns with their values. When we give any image as an input to the proposed system then we 1st calculate the feature values. The cost of the test image features are cross checked with the lastly calculated values which are Based on the input image. And the classifier classifies that microscopic appearance and concludes the result cells are normal or not.

IV. PROPOSED SYSTEM

The proposed system became execute with the aid of “MATLAB 2017b” on “Windows 7 (64bit). The dataset changed into supplied via Department of Pulmonologist [9]. The dataset become fascinated by an optical labs microscope coupled with HD digital camera . All photos are in JPG , tiff format with 24-bit colour intensity. The pictures have been catch with a variety magnification of microscope limit from three hundred to 500. The ZNSM-iDB database has two distinct variations ZNSM-iDB 1 and ZNSM-iDB 2). The proposed system worked on the ZNSM-iDB1 model which has been designed for trying out the performances of type structures. The ZNSM-iDB1 is a assortment of clip element of hobby of balanced and burst cells that belongs to the ZNSM-iDB1 dataset. It consists of a couple of pics, of sputum smear slides. The accuracy (Eq. Nine) became used to test the classification overall performance of the proposed machine:

\[
\text{Accuracy} = \frac{TP + TN}{TP + TN + FP + FN}
\]

where
- TP (True positives) is the counting of components that are absolutely classified as perfect by the test.[7]
- TN (True negatives) is the counting of components that are correctly classified as anti positive by the test.[7]
- FP (False positive) is also known as type I error, it is the number of components that are classified as positive by the test, but they are not.[7]
- FN (True positive) is well-known as type II error, it is the counting of components that are classified as anti positive by the test, but they are not.[7]

A. BLOCK DIAGRAM

B. FLOW CHART
1. Take the microscopic image
2. do the pre-processing on the image with the help of enhancement technique
3. do the segmentation of the image
4. Feature selection is done on the parameters.
5. Finally, the classification is done on the data obtained whether the image has problem or not.

V. EXPERIMENTAL RESULTS

In Proposed device has two factors schooling and checking out. Both the factors undergo following steps. Image preprocessed is the initial step gathers snap shots of the blood from microscope with full magnification from ZNSM-iDB1. Next step is photo preprocessing and alternate the coloration of image in to gray scale. Followed by using the use of filtering the appearance, discard of noise from the image and subsequently is accomplished to upward thrust the fee of photo in phrases of evaluation. Third step is detected the effected circle and highlights the cells. Next step technique the use of algorithm, in which k is taken into consideration 3 and nucleus is focused for the analysis technique. In the training component capabilities of natural most cancers cell is stored in expertise base. In the checking out component, the cell which desires to be tested is taken as input. And ultimately knn classifier with using records in the know-how base is used for class, where selection is finished whether or not the mobile is everyday or no longer.

In the proposed approach microscopic photograph is better using pre-processing steps, accompanied by means of segmentation Fig. Four suggests gray Scale photograph. The proposed approach is implemented to microscopic snap shots. Fig. 3 suggests the microscopic enter photograph.
There is a vast scope of improvement in KNN classifier which has higher complexity due to which execution time is high for the analysing the system. So the system can be improved by using effective classifier to reduce the complexity.

REFERENCES


