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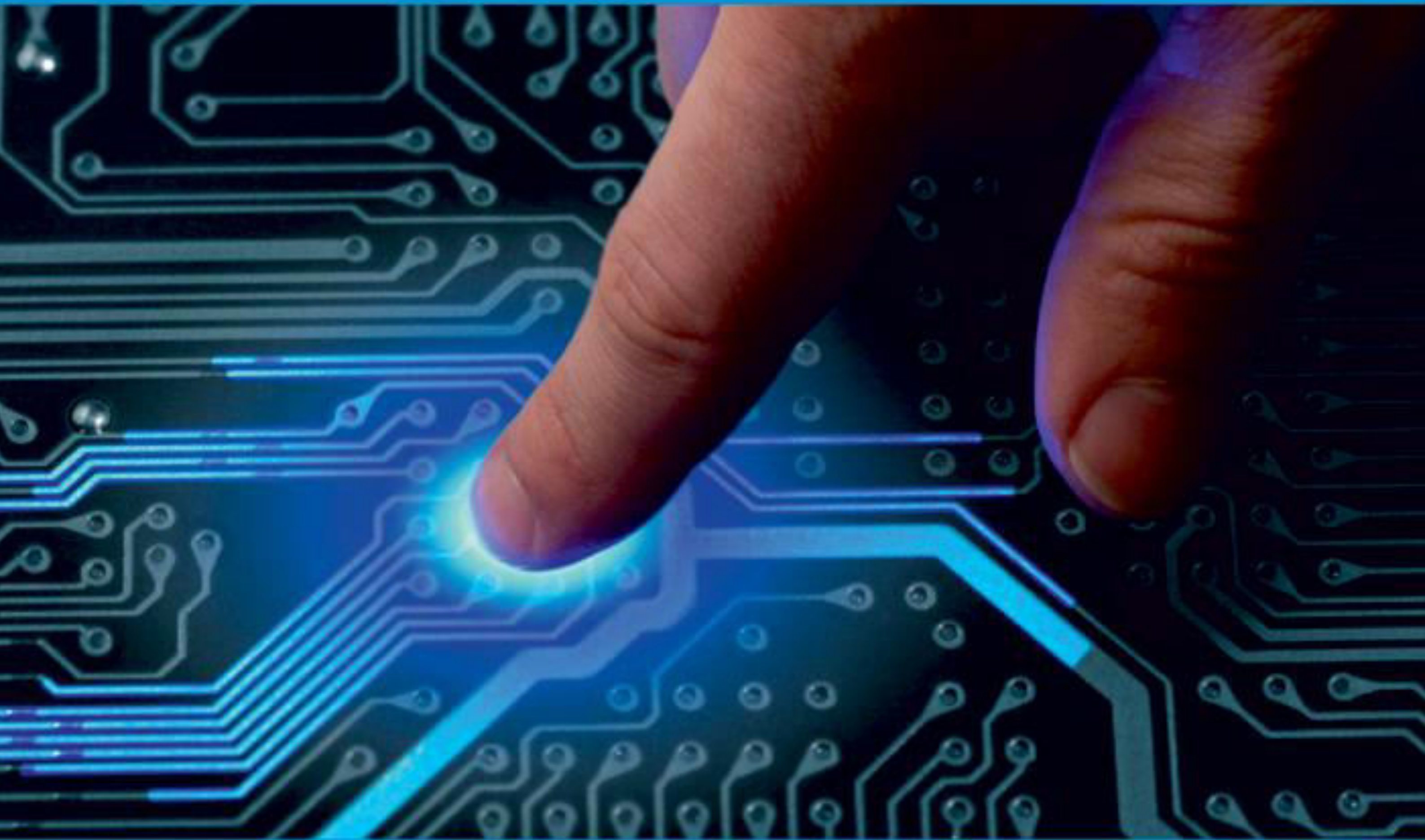

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A Review on Recent Medical Applications of Image Processing

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ABSTRACT: In sciences and technology, image processing is becoming more widely recognized as a critical component of scientific study and development. It is no exaggeration to say that image processing has countless applications in almost every field known to mankind. Image processing has various applications in remote sensing, medical imaging, non-destructive evaluation, forensic studies, textile industry, material science, military, film industry, document processing, and printing industry, just to name a few. In the present work, we sketch some of the recent medical applications of image processing.

KEYWORDS: Image Processing, medical, imaging, applications

I. INTRODUCTION

In the sciences and technology, image processing is becoming more widely recognized as a critical component of scientific study and development.A digital image is an image function f(x,y) that has been discretised both in spatial coordinates and brightness. It is represented by a series of 2D arrays. Each element of this array is called "pixel" [14]. Image processing allows for the improvement of information available in these images for human interpretation and for autonomous machine perception [8]. It is no exaggeration to say that image processing has countless applications in almost every field known to mankind. Image processing has various applications in remote sensing, medical imaging, non-destructive evaluation, forensic studies, textile industry, material science, military, film industry, document processing, and printing industry, just to name a few [4]. Researchers are continuously striving to improve the image processing techniques and further expand the impact of image processing in this computer era.

Medical image processing comprises of techniques and processes that are used to create images of human body for clinical purposes and medical procedures [19]. The use of image processing techniques in medical field strengthens the quantitative analysis. Generally, human observers analyse the medical images.This type of analysis has limitations caused by interobserver variations and errors due to fatigue and limited experience. But by the use of image processing techniques and computer analysis, it is possible to highly improve the diagnostic accuracy and confidence of medical personnel [7].

A very interesting review of the medical applications of image processing can be found in [12]. Another research found on image processing systems for medical applications is [16]. Trends and analysis of medical images using image processing techniques can be found in [6]. In the present work, we sketch some of the recent medical applications of image processing.

II. IMAGE PROCESSING

The complete image processing system consists of both hardware and software. This system is capable of acquiring the image, storing the image, processing the image according to the user's requirement and then finally displays the image on suitable medium such as television or monitor. Image processing is not a single-step process. Generally many operations are performed sequentially to gain the desired output. The image processing operations which are used to manipulate the acquired image can be grouped into five categories [7]:

1. Image enhancement: It helps to make the image better by adjusting the brightness or contrast, smoothing the image or sharpening it.
2. Image restoration: It is used to reverse the degradation caused by uneven illumination, distortion, unwanted noise, movement of the abject etc.
3. Image analysis: It is mainly used for classifying images into groups by recognizing patterns.
4. Image compression: It is used to reduce the size of the image by eliminating the redundant information used to store the image.
5. Image synthesis: This technique helps in creating new images from other images and non-image data.

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These image processing operations and techniques when combined with the knowledge of the application area, solutions to many problems can be obtained.

III. RECENT MEDICAL APPLICATIONS OF IMAGE PROCESSING

A. *EUS - FNAB Specimen Evaluation:*

Endoscopic ultrasound (EUS) is used for detecting pancreatobiliary diseases, for visualizing lesions etc. Endoscopic ultrasound-guided fine needle aspiration biopsy (EUS-FNAB) gives extra pathological information. Thisenhances the diagnostic capabilities of EUS [21]. Using a needle, a EUS-FNAB sample is collected from the patient and then studied. In [13], Okuwaki et al., used automated multiband imaging system (AMUS) to study the sample. The multiband image data is obtained using automated multiband imaging device provided by Olympus Corporation as shown in Fig 1. Then whitish core quantity is calculated using image segmentation techniques. The quantity calculated using AMUS strongly correlates with manual assessments.Since this method is cost-effective, this type of evaluation can be introduced at any facility to obtain objective assessments.

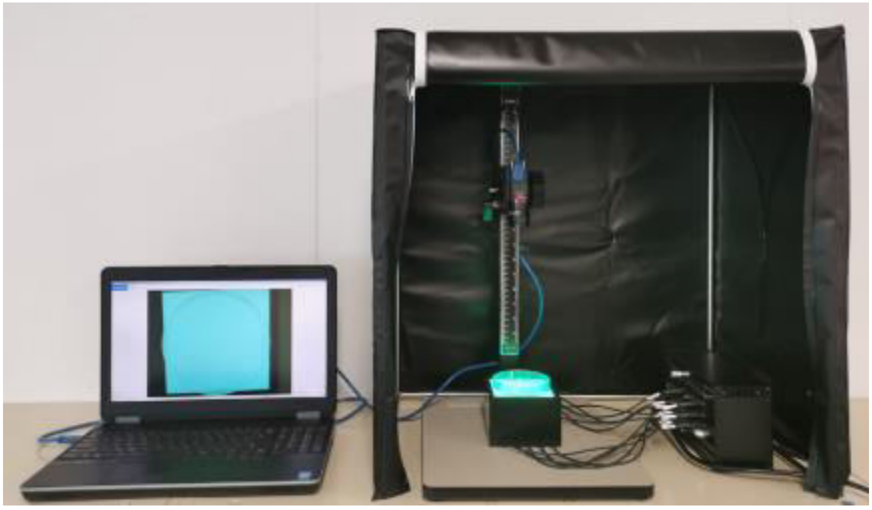

Fig.1: Set-up of automated multiband imaging device [13]

B. *Detection of Tuberculosis Disease*

Tuberculosis (TB), commonly known as consumption, is a long-term infection caused by the Mycobacterium tuberculosis bacteria. The bacteria are most commonly found in the lungs, but they can potentially harm other organs in the human body. It is preventable and curable if identified early; else, it may result in the patient's death.To determine if a person has TB disease, tests such as a chest X-ray or a sputum sample culture can be performed. [15] Mohammad Alsaffar et al., proposed a method to detect the presence of TB in medical X-ray imaging (see Fig.2) using image processing techniques.KERAS, an open source neural networks library is used to extract the picture properties from the medical images that are used as classification attributes. Support Vector Machines (SVMs), Logistic Regression (LR) and KNN, K-Neighbors Classifier are the three classification methods used. Their proposed CNN architecture could automatically categorize the medical images by visual modality and anatomic location. An excellent overall classification accuracy (> 99.5%) is achieved using this method.

C. *Glaucoma Diagnosis*

Glaucoma is a common eye disease that, if left untreated, can result in irreversible blindness. Glaucoma is one of the most common causes of blindness [10].To examine the pattern of rim loss, estimate quantitative parameters, and discover morphological symptoms of glaucoma in the eyeball, an efficient and correct segmentation of the OD and optic cup is required [18].Recent studies show that the CAD system can improve diagnostic accuracy while also reducing fatigue, reducing the number of diseases missed owing to exhaustion or disregarded data, and increasing

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reader variability.In [18] Shubham Joshi et al., proposed a computer-aided design (CAD) system to help in the early identification of glaucoma as well as the screening and treatment of the disease using fundus camera. The proposed CAD system would help ophthalmologists diagnose ocular disorders by offering a second opinion in the form of a verdict made by human professionals in a controlled setting. It uses three pretrained CNNs for the categorization of glaucoma viz., residual network (ResNet), visual geometry group network (VGGNet) and GoogLeNet.

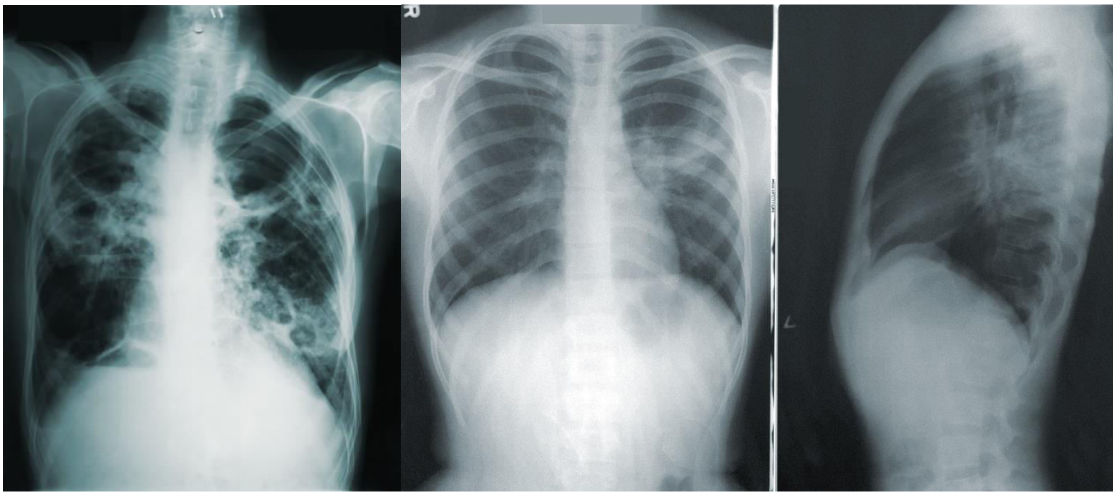

Fig.2: Chest X-ray images

D. ***Analysis of Blood Cancer***

Blood cancer, often known as leukaemia, is a type of cancer in which the blood marrow produces abnormal white blood cells in the bloodstream [9]. Blood cancers affect the blood cells, bone marrow, lymph nodes, as well as other parts of the lymphatic system [17].In [9] Harisudha K et al., developed a method to identify all types of blood cancer using image processing techniques like segmentation and feature extraction. Microscopic photographs of blood are taken and lymphocytes are extracted. Different classification techniques like SVM, LDA are used to detect healthy or cancerous cells and KNN algorithm is used to detect the type of cancer. This method is accurate, fast and cheap.

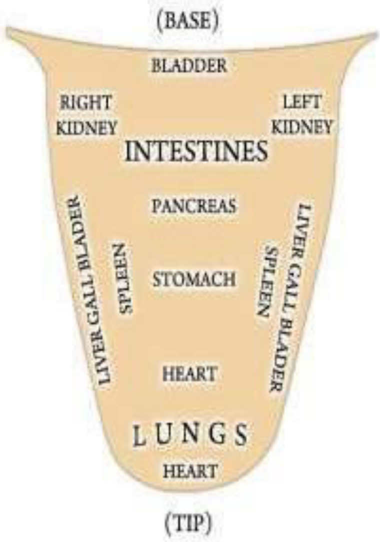

Fig.3: Reflex zones of tongue [1]

E. ***Tongue Diagnosis***

The tongue is an organ that is a reflection of the body's physiological and clinicopathological state. Tongue inspection makes use of visual information. The major criteria to evaluate for diagnosis are the colour, form, motility, substance, and coating of the tongue. The geometric shape of the tongue also aids in the diagnosis of one's health. [3] By describing differences in tongue features, a system for analyzing and classifying tongue images for disease diagnosis was developed by Shreya Devkar et al., in [5]. Images of the tongue captured by a good resolution smartphone camera can be used. Using an algorithm, required part of the tongue from the image is identified and features are extracted. They used four techniques employing Gabor filter, energy, color histogram and geometrical figures. Energy method has an accurate rate of 95% and gives good results for normal and diabetes images.

F. ***Breast Cancer Prediction and Trail***

Other than nonmelanoma skin cancer, breast cancer is the most frequent cancer among women [2]. It is one of the most prevalent cancers in women in India. It can strike at any age, but it is most common in the early thirties and peaks between the ages of 50 and 64.Patients' survival rates are improved when this condition is detected early. Y Venugeetha et al., developed a method to identify the cancer using Machine learning and image processing techniques in [20]. Mammogram images are used in this method. Using Fuzzy C-Means (FCM) technique, image segmentation is carried out and features are extracted using Gray-Level Co-occurrence Matrix (GLCM), Multi-level Discrete Wavelet Transform and Principal Component Analysis (PCA). KNN algorithm is employed for classification of images. Finally, the tumor affected areas are marked and can be shown to the doctor.

IV. CONCLUSION

In this paper we have tried to discuss the recent medical applications of image processing techniques. The findings can be formulated as follows:

Application	Techniques Used	Database Used	Accuracy
EUS-FNAB specimen evaluation [13]	AMUS	Images obtained using automated multiband imaging device	When the cutoff value was more than 8 mm^2, the AMUS had a high diagnostic sensitivity.
Detection of TB disease [11]	KERAS, SVM, LR, KNN, RESNET50 neural network	Montgomery database	99.5% classification accuracy
Glaucoma diagnosis [18]	Contrast limited histogram equalization (CLAHE), VGGNet-16, ResNet-50, GoogLeNet, MATLAB	PSGIMSR, DRIONS-DB, HRF, DRISHTI-GS	88.96% accuracy, 93.95% precision
Analysis of blood cancer [9]	SVM, LR, LDA, KNN, DT, GB and PCA.	ALLDB-1 dataset, images from Kaggle.	KNN algorithm detects the type of cancer with 97% accuracy.
Tongue diagnosis [5]	MATLAB, Gabor filter, color histogram, Fourier transform to find pixel density	Private database	Energy method has 95% accuracy on normal and diabetes images.

The use of image processing techniques in medical field strengthens the quantitative analysis. EUS-FNAB specimen evaluation for pancreatic diseases, detection of TB disease, Glaucoma diagnosis, Analysis of blood cancer, tongue diagnosis and breast cancer prediction are the applications discussed. In future, image processing techniques can be used to identify and diagnose many other diseases.

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