Combined Detection of Retinal Diseases, Brain Tumor and Lung Cancer Using Image Processing

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Abstract- *In this project, we are going to integrate three detection methods as retinal disease, brain tumor and lung cancer into single processing unit. Initially, detection of diabetic retinopathy by using blood vessels features from retinal fundus images is done to avoid early blindness. Detection is performed by using Graph Trace Algorithm. The results are analyzed with respect to actual measurements of Blood vessel morphology. And also, in our proposed project, we can detect the Brain Tumor by splitting the MRI brain image into various regions. These regions are ranked in a way with the defected region in the highest priority. Likewise the clustering is followed for the normal brain image too. Now this is compared with the defected brain image and selecting the particular region that is defected. Finally, we propose a method that can detect lung lesion regions from Ultrasonic and CT images more effectively and efficiently for early detection of lung cancer, which is important for successful treatment. Instead of processing each pixel, the image was divided uniformly. Both brain tumor and lung cancer image segmentation is based on Particle Swarm Optimization (PSO) algorithm. PSO is an optimization based computational method which is used to optimize a problem by iteratively. At last Genetic algorithm is performed to get required information. The Overall project is designed in such a way that the presence of retinal disease, brain tumor and lung cancer is detected and result is displayed.*

Keywords- Diabetic retinopathy, Graph Trace Algorithm, Brain tumor, Lung cancer, Particle Swarm Optimization.

I. INTRODUCTION

iabetic retinopathy is a medical condition where the retina is damage because fluid leaks from blood vessels into the retina. It is recognized by examining the features of blood vessel area. Due to diabetic retinopathy different parts of the retina get damaged and lead to vision loss. It is a frequent complication of diabetes and we can automatically detect blood vessel features by using green trace algorithm.

The detection of brain tumor is quite difficult because of diverse shape, size, location and appearance. Detection is very hard in beginning stage because it can't find the accurate measurement of tumor. After identification of tumor, it gives to start the proper treatment and it may be curable, we can't surely say about this. Therefore, the treatments depend on tumor like; chemotherapy, radiotherapy and surgery. In the field of medical diagnosis systems (MDS), Magnetic resonance Imaging (MRI) gives the better than CT images, because MRI provides greater contrast between different soft tissues of human body.

Lung cancer is a disease that occurs because of unwanted growth in tissues of the lung. If detected in early stages, helps to proceed with many treatment options, which reduces risk of invasive surgery and increased survival rate. Here, the original image is transformed to gray scale image. After that, removal of the noises and contrast enhancement is done. The Gaussian filter is applied to remove the salt and the pepper noises and the pre processed images are given as input for feature extraction where the useful features of the images are extracted and the extracted features are selected by the genetic algorithm method, the classifiers are used to classify the datasets into relevant datasets.

The remainder of this paper is organized as follows. In Section II, the literature review is presented. In Section III block diagram is presented. The data bases used for evaluation and the methodology are detailed in Section IV. Results are presented and discussed in Section V. Then advantages of our system are briefly explained in section VI. Finally, the conclusions are presented in Section VII.

II. LITERATURE REVIEW

Minal B. Wankhade, Dr. A. A. Gurjar, "ANALYSIS OF DISEASE USING RETINAL BLOOD VESSELS DETECTION", IJECS.,Vol. 5. Iss. 12. pp. 19644-19647, Dec. 2016.

This paper provides analysis of disease using retinal blood vessels detection, Where we find out the disease such as

diabetes, glaucoma, and hemorrhage on the basis of their segmentation. We use segmentation technique for image, After that we set an input image for the recognition of the disease and extract the features, then it matches with the database images and find the disease.

Sérgio Pereira, Adriano Pinto, Victor Alves, and Carlos A. Silva, "BRAIN TUMOR SEGMENTATION USING CONVOLUTIONAL NEURAL NETWORKS IN MRI IMAGES", IEEE Trans. Med. Img., Vol. 35, No. 5, pp. 1240-1251, May. 2016.

We propose an automatic segmentation method based on Convolutional Neural Networks (CNN), exploring small 3*3 kernels, which allow deeper architectures. Brain tumors are highly variable in their spatial localization and structural composition, so we have investigated the use of data augmentation to cope with such variability. Comparing with the best generative model, we were able to reduce the computation time approximately by ten-fold.

H. Mahersia, M. Zaroug L. Gabralla, "LUNG CANCER DETECTION ON CT SCAN IMAGES: A REVIEW ON THE ANALYSIS TECHNIQUES", IJARAI., Vol. 4. No. 4. pp. 38-45, Mar. 2015.

This review gives an overview of the current detection techniques for CT images that may help researchers when choosing a given method. Certainly, lung analysis techniques have been improved over the last decade. However, there still are issues to be solved such as developing new and better techniques of contrast enhancement and selecting better criteria for performance evaluation is also needed.

Salim Lahmiri, "HIGH FREQUENCY BASED FEATURES FOR LOW AND HIGH RETINA HAEMORRHAGE CLASSIFICATION", IET Health Care Tech. Ltrs., Vol. 4, Iss. 1, pp. 20-24, Oct. 2016.

The conclusion is that automatic classification of fundus HAs for evaluation of DR is possible by using EMD-based statistical features and SVM classifier. Indeed, EMD-based approach is superior to VMD and DWT approaches in terms of accuracy, sensitivity, and specificity.

III. BLOCK DIAGRAM

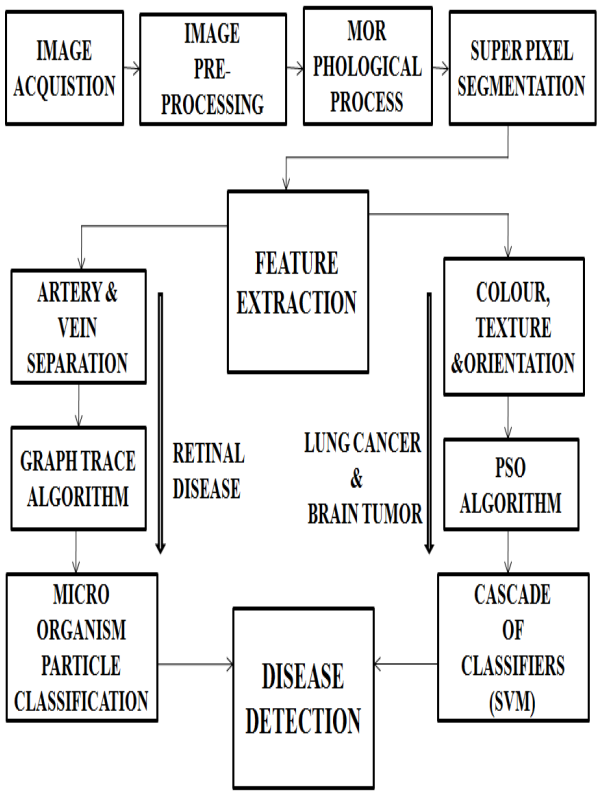

Fig.1 Block Diagram

IV. METHODOLOGY

The number of stages involved in the working principle as follows:

- Image Acquisition
- Image Pre Processing
- Morphological Process
- Super pixel Segmentation
- Feature Extraction – LBP
- Feature Selection
- Retinal Disease Section
  - ✓ Artery & Vein Separation
  - ✓ Graph Trace Algorithm
  - ✓ Micro organism particle Classification
- ❖ Brain Tumor & Lung Cancer Section
  - ✓ Colour, Texture and orientation Separation
  - ✓ Particle Swarm Optimization
  - ✓ Genetic Algorithm
- ❖ Disease Finding

1. Image Acquisition

A digital image is produced by cameras, range sensors, tomography devices, radar, ultra-sonic cameras, etc. Generally an image is a two-dimensional function(here x and

y are plane coordinates). These x and y values are converted to finite discrete values to form a digital image.

For retinal disease, vessels patterns, invisible to the naked eye, can be viewed through an image sensor sensitive to infrared light. So, IR light passes through the tissues of the human body and is blocked by pigments. Haemoglobin presents in blood vessels, soIR light shining through causes the vessels to appear as dark shadow.

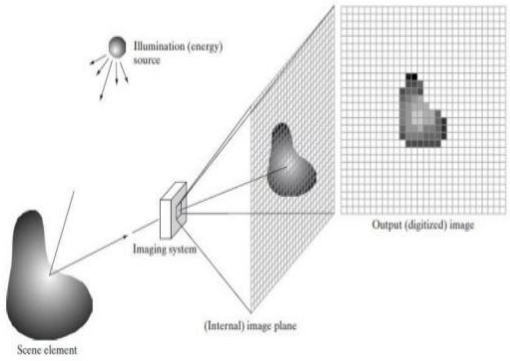

Fig.2 Image acquisition

For brain tumor and lung cancer, the input images are MRI images, CT images and ultrasonic images. Normally, in image acquisition, conversion of images to required format is done. Each images called as frame. Each frame contain 2 layers named as Base layer and detail layer.

2. Image Pre-processing

Pre-processing is used to remove noise and eliminate irrelevant, visually unnecessary information.

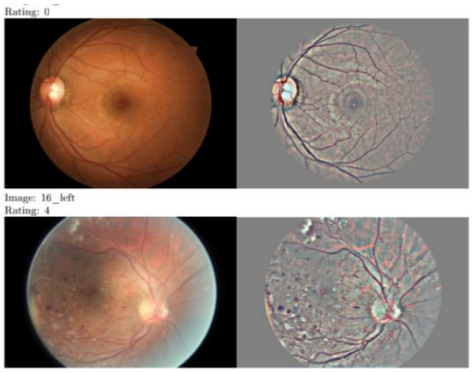

Fig.3 Original images on the left and pre processed images on the right

In retinal disease, Noise reduction in order to assure that sensor noise does not introduce false information. Fig 3.3 shows the original fundus images on the left and pre processed images on the right. The first processing step consists in locating the inner and outer boundaries and second step to normalize and third step to enhance the original image respectively. Contrast enhancement to assure that relevant information can be detected.

In brain tumor, the MRI image consists of patient's name, medical details about that patient. To avoid such inefficiency, pre processing can be carried out. The correction results in maximum quality of feature templates from images.

In lung cancer, the CT image quality is influenced a lot by the radiation dose. To prevent the human body from all kind of risk, radiologists are obliged to reduce the radiation dose, which affects the quality of image and is responsible for noises in lung CT images. The Gaussian filter provides better performances for pre-processing medical images. The filtering approach to use must preserve object boundaries and detailed structures, Sharpen the discontinuities to enhance morphological structures and efficiently remove noise in homogeneous physical regions.

Canny Edge Detection

In previous pre-processing stage, image was smoothened with a Gaussian filter and optimizes the trade-off between noise filtering and edge localization. The canny edge detection computes Gradient magnitude using approximations of partial derivatives by using 2x2 filters. Thin edges can be obtained by applying non-maxima suppression to the gradient magnitude. Finally, edges can be detected by double thresholding method.

3. Morphological Processing

Morphological processing is the field of mathematical morphology, which contributes a wide range of operators to image processing. Analysis of binary images and common usages include edge detection, noise removal, image enhancement and image segmentation was very useful. It typically probes an image with a small shape or template known as a structuring element.

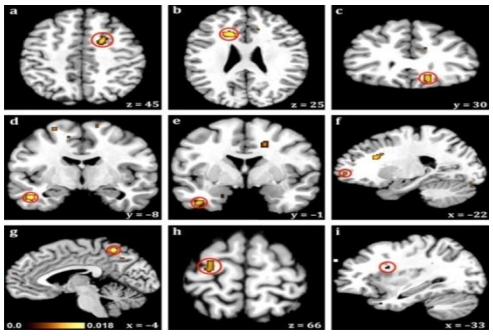

Fig.4 Morphological Processed Image with Structuring Element

In fig.4, we can see that structuring element in the morphological processed image. The structuring element is positioned at all possible locations in the image.

4. Super Pixel Segmentation

Image segmentation is the authorized process of dividing an image into multiple parts. Super pixel separate the image through the all the pixel value. The goal of segmentation is to simplify something that is more meaningful and easier to analyze. It is also the technique which is used to extract the particular region from an image. It is used to detect affected region.

Fundus image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. Fig.5 shows the segmented retinal image. Including the background reduced the accuracy of the original image, it is necessary to image segmentation in region of interest (ROI) before feature extraction and matching with database.

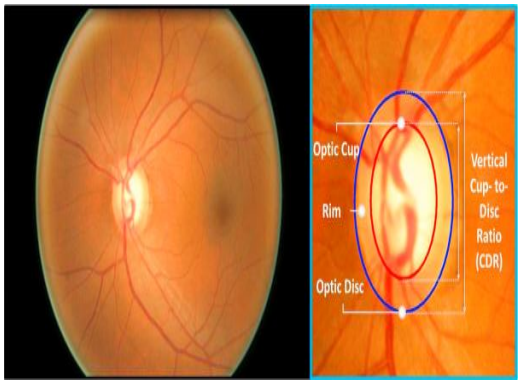

Fig.5 Segmented Retinal Image

In lung cancer, segmentation refers to the process of partitioning the pre-processed CT image into multiple regions to separate the pixels.

In Part of Brain tumor detection, the result of MRI image segmentation is a set of segments that collectively cover the entire image or a set of contours extracted from the image.

5. Feature Extraction

Image features at various levels of complexity are extracted from the image data. Typical examples of such features are:

- ✓ Lines, edges and ridges.
- ✓ Localized interest points such as corners, blobs or points.

More complex features may be related to texture, shape or motion. The most important step in automatic recognition is the ability of extracting some unique attributes from image. Linear binary pattern is the feature extraction method used here.

Linear binary pattern

The LBP feature describes the spatial structure of local image texture, and can be easily configured to be multi-resolution and rotation invariant. It might capture too many image details, and introduce large degree of unnecessary feature variations within the same tissue category.

6. Feature Selection

Feature Selection (FS) algorithm is a process of choosing a reduced and relevant features that improves classification by searching for the best feature subset. We use this method to find out the region that is affected in the highest way. We propose a new feature selection method based on FIsher criterion and genetic optimization.

7. Retinal Disease Section

After finding the area of interest in the image, structure is obtained.

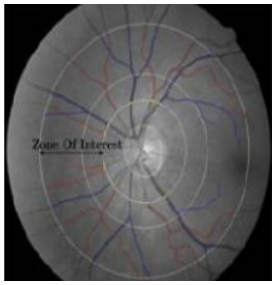

Fig.6

Fig.7

The lines present in the acquired line image and connectivity of the structure of the blood vessel in topological level is shown in fig.6 and fig.7.

(a) Artery Vein Separation

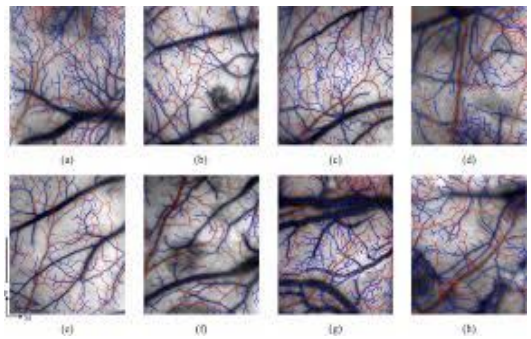

Fig.8 Artery and Vein Separation

We present a method for automatic separation and classification of pulmonary arteries and veins. Artery-vein classification is performed on these grouped subgraphs based on the volumetric difference between arteries and veins. In all scans, two observers manually annotated randomly selected vessels as artery or vein. The separated images of artery and vein are shown in fig.8.Our method was able to separate and classify arteries and veins with a median accuracy of 93%. This operation is performed in an iterative fashion.

b) Graph Trace Algorithm

Graphs are typically visualized as node-link diagrams. A growing number of empirical studies have shown that graph layout affects not only readability, but also the understanding of the underlying data.

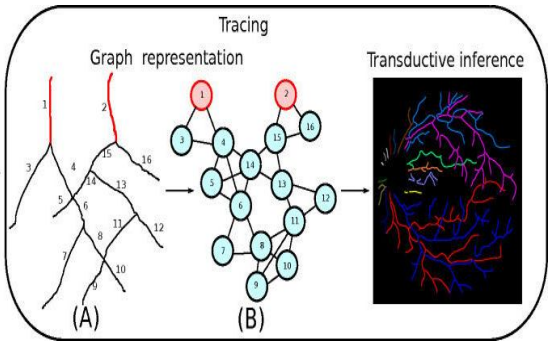

Fig.9 Tracing Graph Representation

Here by using this process we must overcome the problems in the set of vessel trees that occur due to the crossover points and bifurcations. As a preliminary step first we have to identify the cross over points because the blood vessels in retinal image cross each other very frequently. So it is necessary to identify the crossovers.

First we define it as cross over points then later as crossover segments. We must first know the crossover location then we can identify the problems and challenges that are caused by the crossover points.

Our next step, model was segmented as graph segment and we use some optimization technique to select the best set of vessels from the graph. We obtain the true blood vessels from the retinal image using the graph tracing algorithm.

(c) Micro Organism Particle Separation

Object classification is achieved on the basis of cells size, and energy texture parameters. After that, relevant parameters of each cell size can be obtained: area, perimeter, diameter, and radius. The process of classification is unsupervised and based on two fundamental features: cell size, and cell texture.

8. Brain Tumor and Lung Cancer Section

The MRI image consists of some film artifacts such as patient details, image information, and some of the unwanted information in it.

Common Ultrasonic and CT imaging signs of lung diseases (CISLs) are defined as the imaging signs that frequently appear in lung CT images from patients and play important roles in the diagnosis of lung diseases.

(a) Color Texture and Orientation

Perception of surface orientation is an essential step for the reconstruction of the two-dimensional structure of an object. Human lesion and functional neuro imaging studies have demonstrated the importance of the parietal lobe in this task. In the primate single-unit studies, neurons in the caudal part of the intraparietalsulcus were found to be active during the extraction of surface orientation through monocular cues such as texture gradients and linear perspective as well as binocular cues such as disparity gradient and orientation disparity.

(b) Particle Swarm Optimization

Particle Swarm Optimization is an optimization based computational method which is used to optimize a problem by iteratively. In PSO randomly generated solutions called initial swarms propagates in the search space towards the best optimal solution. The basic concept of PSO lies in accelerating each particle towards its random weighted acceleration at each iterations.

In brain tumor, segmentation is based on Particle Swarm Optimization (PSO). It shares many similarities with

evolutionary computation techniques such as for example Genetic Algorithms (GA).

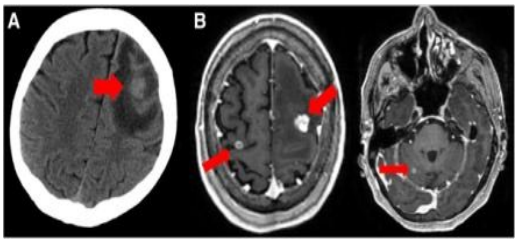

Fig.10 MRI optimization

(c) Genetic Algorithm

Genetic algorithm is a population based search methods and it moves from one set of points (population) to another set of points in a single iteration with likely improvement using set of control operators. GA is viewed as function optimizer, though problem ranges to which GA is applied are quite extensive features. It improved fitness through evolution.

(d) SVM - Cascade of Classifiers

Support vector machines known as cascade of classifiers are supervised learning models with associated learning algorithms that analyze data and recognize patterns, used for classification.

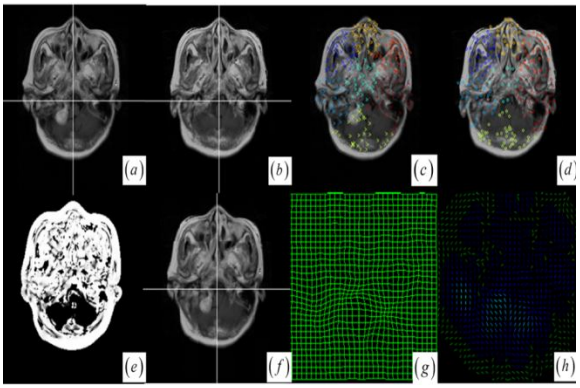

Fig.11 Classification of MRI image

In the proposed method for brain tumor, we are using linear classifier because it will give the accurate result. The extracted features need to be classified based on their tumor cell growth, based on it stages will be identified which will be useful to physician to plan the treatment. The classifier is a separating hyperplane. Most "important" training points are support vectors, they define the hyperplane.

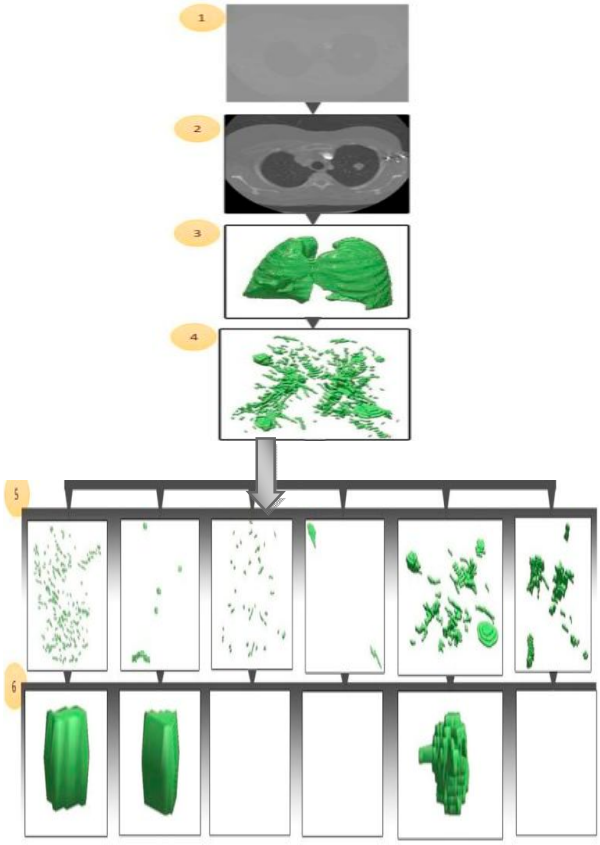

Fig.12 Lung cancer Classification

In lung cancer, we achieve this by framing the problem as a constructing classifier task and exploit data in the form of classifier to learn a mapping from raw dat a to object classification. In order to validate our approach, we use a synthetic database to mimic the task of detecting pulmonary nodule automatically from CT images, which shows that classifier can automatically detect pulmonary nodules from the lungs CT images accurately. The method is able to achieve an overall accuracy of 97.01%.

9. Disease Finding

After finalizing each and every modules and algorithm at the end of the project output comes with finding out the diseases.

V. RESULT

The result shows that output for the analysis of diseases like diabetic retinopathy, brain tumor and lung cancer and its condition is displayed with normal or abnormal statements.

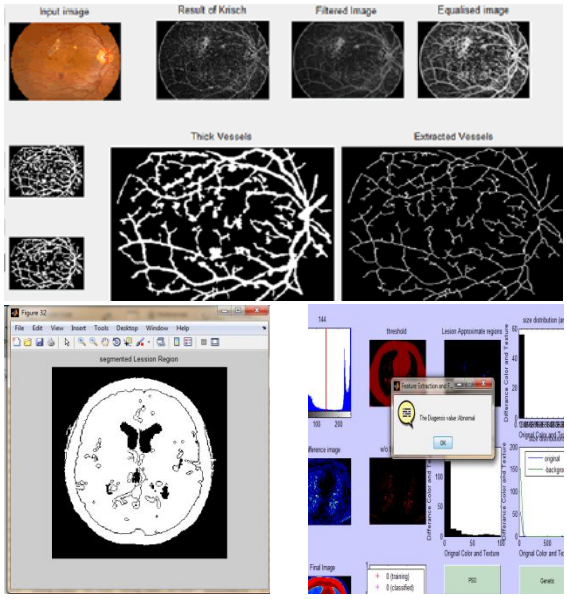

Fig.13 Simulation Output Samples

VI. ADVANTAGES

- Less complexity in methodology,
- More accuracy than other available techniques,
- Get the result with more ease and
- The overall highlight of our project is combined detection.

VII. CONCLUSION

This methodology produces effective results with more accuracy for degraded images also. To the best of our knowledge, no such method exists for combined detection of retinal disease, brain tumor and lung cancer.

VIII. ACKNOWLEDGEMENT

We would like to thank all those who provide us the possibility to propose this project. A special gratitude to our Project Guide Mr. V. Satheesh kumar, Associate professor and Project coordinator Mrs. S. Jeya Anusuya, Associate professor, whose contribution in giving suggestions and encouragement helped us for this project to complete.

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