Computer Aided Diagnosis Model for Lung Cancer Prediction using Gabor Filtering with Artificial Neural Networks

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Abstract*— Lung cancer becomes a critical disease in human nowadays, and it leads to mortality in many cases. However, the early diagnosis can save the life and increases the patient's life significantly. Thus, the CT scan is one of the techniques which are used in vital field of imaging in medical areas. This paper provides the novel computer aided diagnosis (CAD) method for finding the lung cancer in the early stages both in male and female. The presented model undergoes Gabor filtering (GF) technique to preprocess the input images to remove the noise exist in it. In addition, watershed based segmentation technique is employed to determine the harmful areas of the lungs from the CT images. At last, gray level co-occurrence matrix (GLCM) is used for feature extraction and artificial neural networks (ANN) is utilized as a classification. The proposed method is tested and implemented by the use of CT scans image of lungs and it shows the Gabor filter shows the better results and the GLCM-ANN model has led to enhanced diagnostic outcome with higher accuracy of 92.89%.

***Index Terms*— Computer aided diagnosis, Gabor Filter, CT scan, Lung Cancer, artificial neural networks.**

I. INTRODUCTION

Cancer is one of the severe medical challenge exist all over the globe. The death rate of lung cancer is the most elevated among every single other kind of cancer. The troubles for distinguishing lung knobs in radiographs are given as follows. Nodule sizes will differ broadly: Commonly a knob distance across can take any an incentive between couples of millimeters up to a few centimeters. Nodules show a huge variety in thickness – and subsequently perceivability on a radiograph – a few knobs are just marginally denser than the encompassing lung tissue. Finally, the knobs can show up anyplace in the lung field. They can be clouded by ribs, and structures below the stomach, bringing about a huge variety of complexity to the foundation. To conquer these issues, the creator proposed a Computer Aided Diagnosing (CAD) framework for Identification of lung knobs [1-2].

Ginneken has characterize the lung locales extraction approaches into two unique classifications; either rule-based or pixel arrangement based class. The vast majority of the proposed approaches have a place with principle based class, where an arrangement of steps, tests and standards are utilized in the extraction process. Classifiers are different sorts of neural systems, or markov arbitrary field displaying, prepared with an assortment of nearby highlights including force, area, also, surface measures [3].

Lowlifes can be partitioned into two bunches [4]: thickness based and model-based methodologies. For example, various thresholding, area developing, locally versatile thresholding in blend with locale developing, opening and shutting, utilizing the histogram, the top 20% gray qualities considered as introductory cancerous competitor districts, utilizing the histogram the ordinary tissues are evacuated, at that point circular formed areas, which is in general speak to variations from the norm, are distinguished, and fluffy bunching used to recognize knob hopefuls in the lungs. False-positive outcomes would then be able to be decreased from the recognized knob applicants by utilizing from the earlier knowledge of little lung knobs.

Morphological filter and the anatomy based conventional technique is developed to distinguish circle molded little knobs in the lung [5]. Knob competitors are distinguished utilizing format coordinating or a changed Hough change in which edge pixels vote in favor of circles which could results in edges. Subsequent to getting the division results, various highlights ought to be removed to be utilized in the finding stage where sets of guidelines are detailed to recognize genuine and wrong cancerous applicants. Various highlights were separated in various papers contingent upon the techniques utilized by the creators in the conclusion stage [6].

In certain methodologies consistency, availability, and position highlights were separated in [7]. The basic thought of building up a Computer aided design framework isn't to appoint the conclusion to a machine, yet Or maybe that a machine calculation goes about as a help to the radiologists and brings up areas of doubtful articles, so that the general sensitivity is increased. CAD frameworks meet four principle destinations, which are improving the quality and precision of finding, expanding treatment accomplishment by early identification of cancer, staying away from superfluous biopsies and diminishing radiologist elucidation time [8]. Some other diagnosis models are available in the literature [9-10].

This paper devises the novel computer aided diagnosis (CAD) method for finding the lung cancer in the early stages both in male and female. The presented model undergoes Gabor filtering (GF) technique to preprocess the input images to remove the noise exist in it. In addition, watershed based segmentation technique is employed to determine the harmful areas of the lungs from the CT images. At last, graylevel cooccurrence matrix (GLCM) is used for feature extraction and artificial neural networks (ANN) is utilized as a classification. The proposed method is tested and implemented by the use of CT scans image of lungs.

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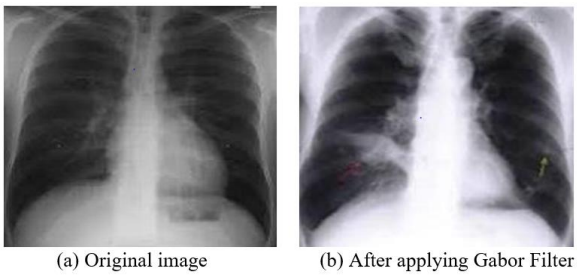
II. Proposed Methodology

The proposed method involves major processes namely GF based preprocessing, image enhancement, watershed based segmentation, GLCM based feature extraction, and ANN based classification, which are discussed as follows.

A. GF based Preprocessing

The Gabor filter was initially presented by Dennis Gabor; we utilized it for CT pictures. In picture preparing a Gabor filter, named after a dennis gabor, is a direct filter utilized for surface investigation, which implies that it fundamentally examinations regardless of whether there are a particular recurrence content in the picture in explicit ways in a limited district around the point or area of examination In the spatial space, a 2D Gabor filter is a Gaussian bit work regulated by a sinusoidal plane wave. The Gabor work is a very basic device in PC perceivability and picture preparing, particularly for surface investigation, because of its ideal localization property in both spatial and recurrence domain. Image portrayal dependent on the Gabor work produce a superb neighborhood and multi scale disintegration as far as logons that are at the same time confinement in space and recurrence domains.

A Gabor filter is straight filter whose drive reaction is characterized by a symphonious capacity increased by a Gaussian capacity. On account of the duplication convolution property, the Fourier change of Gabor filter's motivation reaction is the convolution of Fourier change of the symphonious capacity and the Fourier change of Gaussian function. It has a genuine and a fanciful segment speaking to symmetrical bearings. The two segments might be framed into a mind boggling number or utilized exclusively. Auto enhancement methods are based on the subjective observation and statistical operation. In this operation such as mean and variance are calculated.



(a) Original image (b) After applying Gabor Filter

Fig. 1. The Sample preprocessed output

Fig.1 shows the comparison of the original image of the lungs and then by applying the Gabor filter the differences are been seen that the color shows the effect of the cancer.

B. Image Enhancement

Image enhancement processes the image with the goal that it is more qualified for further preparing or examination. Image enhancement techniques characterized into two primary parts:

1. Spatial domain techniques which legitimately works on a pixel of a computerized image.

2. Frequency domain approaches operate on a Fourier transform of an image. it is the low dimension preparing procedure. Image enhancement strategies are based on image quality. No numerical criteria are utilized for advancing handling results. In the image enhancement arrange following three methods are utilized: Gabor filter, Auto-enhancement and Fast Fourier transform methods.

C. Marker-Controlled Watershed Segmentation

Marker watershed segmentation strategy demonstrate the nearness of items or foundation at explicit image areas Marker-Controlled Watershed Segmentation Approach has two sorts: External related with the foundation and Interior related with the object of interest. Image segmentation utilizing the Watershed transform functions admirably if we can discover or "mark" closer view items and foundation areas, to discover "catchment bowls" and "watershed edge lines" in an image by regarding it as a surface where the light pixels are high and dull pixels are low. From the given input image, the initial step is to read the particular image and from the image the thresholding value are been fixed in such a way that they are greater than the threshold value means they falls under the abnormal if they are lesser then threshold value means it falls under the normal condition.

D. Feature Extraction and Classification

GLCM is used for the extraction of features from the segmented image, followed by, ANN based classification process is carried out. ANNs is a new mathematical device utilized in approximately every domain of science and in practice. The ANN allocates modeling of difficult models based on several factors. It can be an alternative model for statistical models and their benefit is that, unlike statistical processes, they do not need several theoretical assumptions. The ANNs frequently permit the progress of optimal processes of phenomenon than statistical methods and are characterized by resistance for damaging and is enhanced as novel data to network training is obtained. Drawback of ANNs is the need of an explicit model and require for collecting a massive dataset. The ANNs are utilized for solving several difficult problems connected to: prediction, classification, and identification of group elements, optimization, matching, analysis and filtering of signals and several other problems.

III. Performance Validation

The performance of the GLCM-ANN model is validated using benchmark lung CT images. Some sample test images are shown in Fig. 2. The comparative results analysis of the proposed GLCM-ANN model is tabulated in Fig. 3.

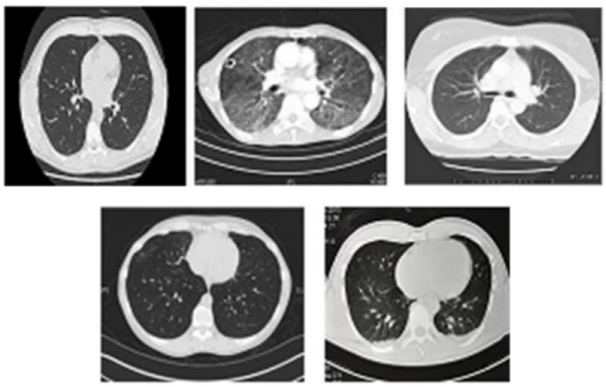


Fig. 2. The Sample Images

From the obtained results, it is ensured that the linear

model has resulted to the ineffective results with the least performance over the compared methods. Besides, the MLP model has attained slightly better result over the linear model, but not than other methods. In addition, the RBF model has attained even higher results over MLP model. Followed by, the ANN and DNN models have showcased closer and moderate results. Furthermore, the KNN model has showcased competitive results over the earlier models. However, the proposed method has attained superior performance with the maximum sensitivity of 93.98%, specificity of 92.65%, and accuracy of 92.89%.

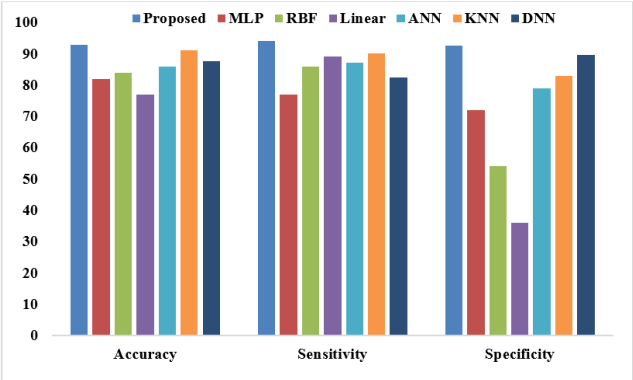


Fig. 3. Comparative results analysis of different methods

IV. Conclusion

This paper has developed a novel CAD model for lung cancer detection and classification. The proposed method involves major processes namely GF based preprocessing, image enhancement, watershed based segmentation, GLCM based feature extraction, and ANN based classification. Primarily, the presented model undergoes GF technique to preprocess the input images to remove the noise exist in it. Followed by, watershed based segmentation technique is employed to determine the harmful areas of the lungs from the CT images. At last, GLCM is used for feature extraction and ANN is utilized as a classification. The proposed method is tested and implemented by the use of CT scans image of lungs. The experimental results indicated that the GLCM-ANN model has resulted to superior performance over the other methods.

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