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Lung Cancer Detection using CT Scan Images

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Abstract

Lung cancer is one of the dangerous and life taking disease in the world. However, early diagnosis and treatment can save life. Although, CT scan imaging is best imaging technique in medical field, it is difficult for doctors to interpret and identify the cancer from CT scan images. Therefore computer aided diagnosis can be helpful for doctors to identify the cancerous cells accurately. Many computer aided techniques using image processing and machine learning has been researched and implemented. The main aim of this research is to evaluate the various computer-aided techniques, analyzing the current best technique and finding out their limitation and drawbacks and finally proposing the new model with improvements in the current best model. The method used was that lung cancer detection techniques were sorted and listed on the basis of their detection accuracy. The techniques were analyzed on each step and overall limitation, drawbacks were pointed out. It is found that some has low accuracy and some has higher accuracy but not nearer to 100%. Therefore, our research targets to increase the accuracy towards 100%.

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1. Introduction

Lung cancer is one of the causes of cancer deaths. It is difficult to detect because it arises and shows symptoms in final stage. However, mortality rate and probability can be reduced by early detection and treatment of the disease. Best imaging technique CT imaging are reliable for lung cancer diagnosis because it can disclose every suspected and unsuspected lung cancer nodules [1]. However, variance of intensity in CT scan images and anatomical structure misjudgment by doctors and radiologists might cause difficulty in marking the cancerous cell [2]. Recently, to assist radiologists and doctors detect the cancer accurately computer Aided Diagnosis has become supplement and promising tool [3]. There has been many system developed and research going on detection of lung cancer. However, some systems do not have satisfactory accuracy of detection and some systems still has to be improved to achieve highest accuracy tending to 100%. Image processing techniques and machine learning techniques has been implemented to detect and classify the lung cancer. We studied recent systems developed for cancer detection based on CT scan images of lungs to choose the recent best systems and analysis was conducted on them and new model was proposed.

2. Literature Review

Several researchers has proposed and implemented detection of lung cancer using different approaches of image processing and machine learning. Aggarwal, Furquan and Kalra [4] proposed a model that provides classification between nodules and normal lung anatomy structure. The method extracts geometrical, statistical and gray level characteristics. LDA is used as classifier and optimal thresholding for segmentation. The system has 84% accuracy, 97.14% sensitivity and 53.33% specificity. Although the system detects the cancer nodule, its accuracy is still unacceptable. No any machine learning techniques has been used to classify and simple segmentation techniques is used. Therefore, combination of any of its steps in our new model does not provide probability of improvement.

Jin, Zhang and Jin [5] used convolution neural network as classifier in his CAD system to detect the lung cancer. The system has 84.6% of accuracy, 82.5% of sensitivity and 86.7% of specificity. The advantage of this model is that it uses circular filter in Region of interest (ROI) extraction phase which reduces the cost of training and recognition steps. Although, implementation cost is reduced, it has still unsatisfactory accuracy.

Sangamithraa and Govindaraju [6] uses K mean unsupervised learning algorithm for clustering or segmentation. It groups the pixel dataset according to certain characteristics. For classification this model implements back propagation network. Features like entropy, correlation, homogeneity, PSNR, SSIM are extracted using gray-level co-occurrence matrix (GLCM) method. The system has accuracy of about 90.7%. Image pre processing median filter is used for noise removal which can be useful for our new model to remove the noise and improve the accuracy.

Roy, Sirohi, and Patle [7] developed a system to detect lung cancer nodule using fuzzy interference system and active contour model. This system uses gray transformation for image contrast enhancement. Image binarization is performed before segmentation and resulted image is segmented using active contour model. Cancer classification is performed using fuzzy inference method. Features like area, mean, entropy, correlation, major axis length, minor axis length are extracted to train the classifier. Overall, accuracy of the system is 94.12%. Counting its limitation it does not classify the cancer as benign or malignant which is future scope of this proposed model.

Ignatious and Joseph [8] developed a system using watershed segmentation. In pre processing it uses Gabor filter to enhance the image quality. It compares the accuracy with neural fuzzy model and region growing method. Accuracy of the proposed is 90.1% which is comparatively higher than the model with segmentation using neural fuzzy model and region growing method. The advantage of this model is that it uses marker controlled watershed segmentation which solves over segmentation problem. As a limitation it does not classify the cancer as benign or malignant and accuracy is high but still not satisfactory. Some changes and contribution in this model has probability of increasing the accuracy to satisfactory level.

Gonzalez and Ponomaryvo [9] proposed a system that classifies lung cancer as benign or malignant. The system uses the priori information and HousefieldUnit(HU) to calculate the Region of Interest(ROI). Shape features like area, eccentricity, circularity, fractal dimension and textural features like mean, variance, energy, entropy, skewness, contrast, and smoothness are extracted to train and classify the support vector machine to identify whether the nodule is benign or malignant. The advantage of this model is that it classifies cancer as benign or malignant,

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