Neural Network based Earlier Stage Lung Cancer Prediction Scheme with Differential Learning Assistance

Dr. P Shyamala Bharathi, and Praveen Kumar Reddy.T

Dept. of Electronics and Communication Engineering, Saveetha University, Chennai, India.
E-mail : shyamalabharathi.sse@saveetha.com preddyt@gmail.com

Abstract- **Cancer estimate and prediction are a difficult problem to examine and correct in the image processing arena. In comparison to tumor predictions, cancer initial estimates seem to be more complicated due to the fact that they are entirely cell-based perspectives that are spatially difficult to interpret; this model, in particular, focuses on lung cancer and also its treatment techniques. To categories various types of cancer cells, a new approach is necessary. The Learning Assisted Morphological Neural Network (LAMNN) with Image Pruning Strategy is developed to effectively identify the cancer cells as well as point out the afflicted region in proper way. Lung cancer is among the most common cancers in humans and may be detected through a variety of procedures, including Computed-Tomography (CT) scans, Magnetic-Resonance-Imaging (MRI) scans and biopsy. The application of Deep Learning and Artificial-Intelligence (AI) approaches has revolutionized the identification process lung cancer during the last decade. However, accurately classifying cancer cells remains a medical difficulty. Challenges are frequently encountered while attempting to identify sets of traits that give the necessary uniqueness for categorizing malignant tumors into normal and pathological categories. Thus, the main objective of this method is to demonstrate that the LAMNN algorithm is more convenient at diagnosingand forecasting lung structural abnormalities, in which it is derived from two conventional learning based algorithms known as Morphological-Neural-Network assisted Image Processing and Artificial-Neural-Network (ANN) with Digital Image Pruning logic. The resulting section of this paper provides proper classification outcome, prediction results and the performance metrics of the proposed approach in clear manner with graphical emulations.**

Index Terms—Artificial Intelligence, Artificial Neural Network, ANN, Deep Learning, Morphological Neural Network, LAMNN, Lung Cancer

I.INTRODUCTION

Lung cancer is now one of the highly frequent as well as dangerous diseases in past decades has resulted of widespread cigarettes and environmental damage [1][2]. This frequently takes a lot of time to emerge and the majority of persons are identified between the ages of 55-and-65. Prevention and treatment are the greatest options accessible to afflicted individuals. To accurately diagnose and classify lung cancer, pathologic tests, specifically injection based biopsy specimens and examination by trained pathologist, are required [3].

Furthermore, since it requires human judgment based on a mix of circumstances and expertise, a prescriptive analytics is appropriate in this scenario. Significant advancements in digital image analysis, pattern classification, wavelet transform and several classification algorithms have given rise to new techniques to lung cancer identification and therapy. Leveraging the logic of digital image processing and pathologic identification, a variety of deep learning approaches, namely Artificial-Neural-Network (ANN), Support-Vector-Machines (SVM), Discriminating-Analysis (DA), Decision-Trees (DT) and many ensemble methods, tackle the identification and categorization of lung malignancies. Along with these neural network models, deep learning using limited Markov machines in the format of automatic encoders has exhibited improved results in a variety of classification techniques, spanning acoustic, subjectivity analysis and imagery and language processing. Encouraged by the development of deep learning in related disciplines, this research explores a categorization approach based on deep learning [4]. This process made two contributions. To begin, it is recently demonstrated that deep learning algorithms can improve prior work for lung cancer diagnosis on a small number of features [5]. Furthermore, a deep automatic encoder conceptual model is suggested for lung cancer identification, in which it outperforms existing approaches and furthermore demonstrates a statically meaningful increase in efficiency.

2022 International Conference on Advances in Computing, Communication and Applied Informatics (ACCAI) | 978-1-6654-9529-5/22/$31.00 ©2022 IEEE | DOI: 10.1109/ACCAI53970.2022.9752490

A. Objectives of the System

- The primary objective of this framework is to discover and identify cancerous tissue using MRI or CT images.
- The fundamental goal is to assess statistical procedures and also to identify image features through probabilistic and structural properties.
- Throughout the last several attempts, all scholars have made use of the Ensemble Learning Theory.
- In the stated scenario, a Learning Assisted Morphological Neural Network (LAMNN) with an Image Pruning Scheme is utilized to increase the process performance.

B. Dataset

The whole physical tissue, in which it is highly dependent on a consistent and appropriate oxygen supply to operate correctly, may be harmed by an interruption in oxygen input. The lung is where essential oxygen is absorbed in and additional carbon dioxide is expelled, in which it may be hazardous to the health. Lungs cleanse incoming air by the use of purification processes that remove hazardous chemicals into the atmosphere. To segregate lung cancers, a moderately Computer Aided Detection technique is employed. In summary, the cancer location and circumference were employed as the first classification seeding in this Machine Vision assisted Classification algorithm because they were already indicated by a physician during the early diagnostic automatic segmentation based image reading. For every example, the system's image processing began by classifying the source images from the CT scan using the radiologist's markings. The cancer spawn was projected onto subsequent supplementary CT imaging slices in classifying the tumour region seen on the subsequent slices. This segmentation procedure was repeated repeatedly until the technique achieved a segment without detecting any leftover tumor region.

Specifically, for each image slice included, the CAD technique performed a typical region expanding technique with such an experimentally chosen CT number cutoff. Typically, this process works effectively for segmenting well-circumscribed lung lesions. The statistical technique being considered in this research appears to allow for reconfiguration. Additionally, if new biomarkers and mutation data become available, we will be able to include more genetic variants as well as other genetic problems into the decision support systems. The obtained CT and MRI pictures of the lungs are in the required format, which includes a collection of distinct proportion-based human lung image standards. The following figure, Fig-1 illustrates the perception of lung image dataset samples in clear manner.

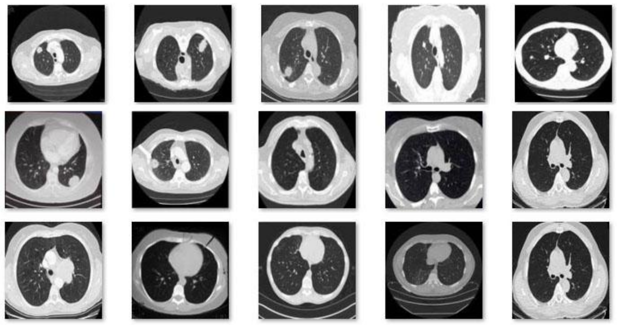

Fig.1 Samples of Lung Image Dataset

The following table, Table-1 illustrates the perception of dataset attribute samples with respect to certain health oriented metrics such as Age, gender, Smoking Habit, Drinking Habit, Yellowish Fingers, Anxiety, Pressure in Peers, Chronic Disease, Fatigue and so on. All these constraints are specified in below table with exact ratio indications.

Table-1: Dataset Attribute Specifications

S.No.	Dataset Attributes	Ratio
1.	Age	Respective Individual's Age
2.	Gender	F (Female), M (Male)
3.	Smoking-Habit	T←2, F←1
4.	Drinking Habit	T←2, F←1
5.	Yellowish-Fingers	T←2, F←1
6.	Anxiety	T←2, F←1
7.	Pressure in Peers	T←2, F←1
8.	Chronic Disease	T←2, F←1
9.	Fatigue	T←2, F←1
10.	Allergy	T←2, F←1
11.	Wheezing	T←2, F←1
12.	Cough	T←2, F←1
13.	Breath Issues	T←2, F←1
14.	Swallow Issues	T←2, F←1
15.	Pain in Chest Region	T←2, F←1
16.	Lung-Cancer	TRUE (T) and FALSE (F)

II. RELATED STUDY

In last few decades, image enhancement methodologies have been commonly used in a number of medical fields for image enhancement in early diagnosis and therapy stages, where time is critical for detecting abnormalities in target images, most notably in various types of cancer including such lung and breast cancers. The research's primary determinants are quality of the image as well as its reliability. Furthermore, the approach of localized resource structure spectrum based feature extraction was aimed for diagnosis of lung cancer. Researchers extended the research to include the use of Local-Energy based Shape-Histogram and risk assessment in the detection of lung cancer. For the purpose of research, the JSRT and clinical datasets are chosen and this procedure culminates in a more generic technique applicable to all types of datasets and this strategy may lead to better outcomes than the previous one [6].

Melanoma is a relatively frequent illness category around the world and the cancer comes in a variety of forms. The much more frequent kind of malignancy is lung cancer. This type of melanoma, which occurs often in both male and female, is often deadly. The diagnosis of cancer is critical for initiating therapy and lowering the chance of death. Identification of lung melanoma is performed in this article [7] utilizing Medical images from SPIEAAPM Lung-X information. In recent decades, supervised learning has become a prominent alternative for categorization. This is particularly useful for implementing tensor-Flow and three-dimensional Convolutional-Neural-Network (CNN) architectures using such deep learning frameworks [7].

Lung cancer is among the most dangerous forms of cancer and the ability to diagnose it early can save a significant number of patient lives globally. This article discusses techniques for developing an automated diagnosis model dependent on the challenge of diagnosing lung cancer. On the basis of recent development [8], three-dimensional convolutional and Recurrent-Neural-Network (RNN) are mostly studied. Furthermore, these networks' assess overall performance in identifying lung cancer [8].

The identification and characterization of computed tomography is critical for diagnostic techniques. The purpose of this paper [9] is to present a method for detecting and segmenting lung nodules that is based on a Fully-Convolution-Neural-Network (FCNN), the template matching approach and other feature extraction techniques. To begin, Computed Tomography scans of the lungs are imported into the Fully-Convolution-Neural-Network for lung fragmentation. Secondly, to use the threshold approach as well as other feature extraction techniques, lung abnormalities are recognized within the lung region. Subsequently, depending on the reference frame transformation, the identified lung nodules and associated assumptions are segregated using the level set and threshold methods. The simulation results indicated that the suggested technique is capable of accurately detecting and segmenting lung nodules, with a detection performance of 100% as well as a dice overlapping ratio of 0.9 for classification. As a result, this strategy may give useful references for lung cancer diagnostic techniques [9].

Computerized cancer identification is a challenging and fascinating field of diagnostic imaging study. In cancer treatment, lesion definition must be exact for therapy planning and delivery. Computed-Tomography images can aid in the early diagnosis of lung cancer. The Computed tomography images are processed using this method by segmenting the pulmonary function, lung abnormalities, extracting features and classifying them. The contents of the lungs were divided using a background subtraction approach, whilst the lesions of the lungs were classified using k-means cluster analysis. Pixel Value Co-occurrence Model was used to extract features. Intensity, incongruence, uniformity, Angular-Second-Moment, power, average and confidence interval were derived from the surface texture to depict a non-tumor and tumor images, respectively. Furthermore, the Multiple Layer Perceptron as well as K Nearest Neighbor algorithms are used to train and evaluate the attributes. The suggested technique obtained 98.30% of classification accuracy with k-NN and 98.31% with MLP. The tests used the NSCLC-and LIDC-Datasets [10].

III. METHODOLOGY

Historically, system researchers struggled to build a unified strategy applicable to all sorts of medical imaging and operations including such lung cancer estimate and tumour assessment. As yet, selecting an effective approach for a specific type of medical imaging is a challenge. As a result, there is no universally approved approach for segmenting medical images. As a result, it continues to be a difficult subject in the various image processing fields. The most frequently used approach to measuring tumors and cancerous cells is clustering, however the forecasts fall within a prescribed value rather than a multilateral mean, posing another challenge for researchers. As a consequence, experts mix two distinct algorithms in order to accomplish the goal for cancer cell estimate and predictions. There are three different phases compose the proposed scheme: preprocessing, feature extraction and classification. Preprocessing techniques include noise reduction, image enhancements and classification of MRI and CT image data. Several processes comprise the extracting features phase: harmonic segmentation, extraction of wavelet transform, normalization, resource computation and coefficients minimization.

Finally, the classification stage employs a combinatorial approach that combines Learning Assisted Morphological Neural Network based Digital Image Processing scheme with respect to Artificial Neural Network strategies in association Image Pruning concepts. These techniques are associated together to identify lung tissue as normal or cancer. Computer systems or software centered on Artificial Intelligence (AI) can be used to assist physicians to make decisions without requiring direct consultation with specialists. The programme was not meant to replace an expert or physician, but to assist in diagnosing and forecasting patients' conditions based on specified rules or "knowledge." Persons with elevated characteristics or illnesses, or those who are genetically prone to certain diseases or illnesses, may be referred to a specialist for additional treatment. Utilizing technology, especially Artificial Intelligence based approaches, in medical diagnostics may lead to reduced costs, time savings, increased human competency and a reduction in medication mistakes. For all of these reasons, the suggested technique of LAMNN intends to give a comprehensive solution for medical image processing strategies using lung cancer estimate and prediction models. The following figure, Fig-2 illustrates the perception of proposed Learning Assisted Morphological Neural Network (LAMNN) model architectural flow diagram in clear manner with proper specification.

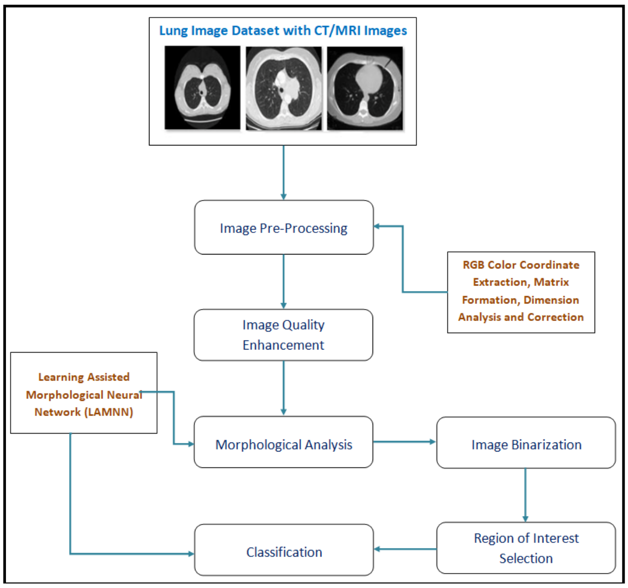

Fig.2 LAMNN Architecture Design

IV. RESULTS AND DISCUSSIONS

The Learning Assisted Morphological Neural Network (LAMNN) classification model in this research categorizes an input new genetic feature representation into one of many classifications in order to predict the occurrence of certain cancer cells in the lung area. For the purpose of handling the digital image, both ensemble and non-ensemble aided Artificial Neural Network models are considered and contrasted in order to determine the best effective classification model and to validate the findings. A Learning Assisted Morphological Neural Network model replicates the appearance and function of the biological cell system seen in the image, and is mostly built of ordered linked artificial neurons. The construction and functional components of artificial neuron, the basic unit of all LAMNN systems and the proposed model is developed by using the powerful image processing tool called MATLAB and attain the best prediction outcome from that. The following figure, Fig-3 illustrates the perception of input lung image to the proposed approach and the figure, Fig-4 illustrates the perception of image pre-processing stages in clear manner.

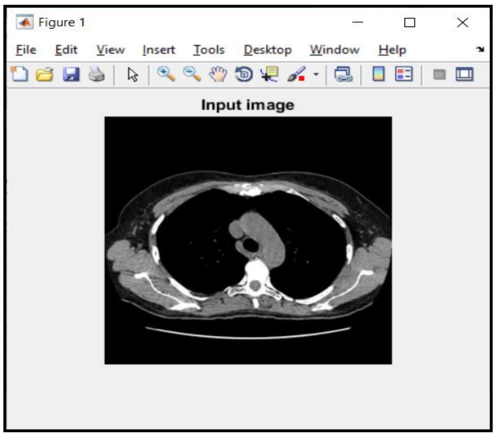

Fig.3 Query Lung Image

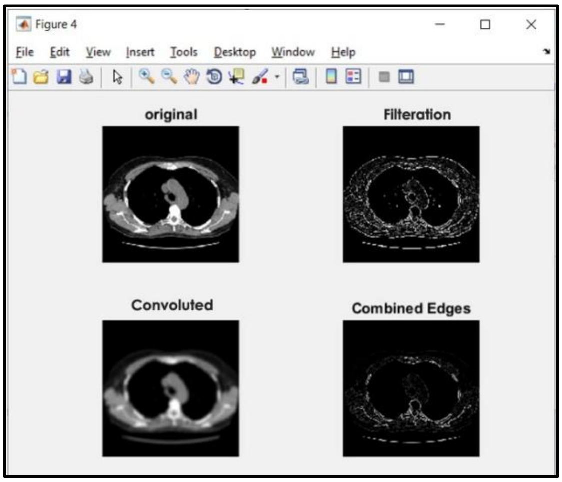

Fig.4 Pre-Processing Stages

The following figure, Fig-5 illustrates the perception of Region-of-Interest (ROI) selected image and the subsequent figure; fig-6 illustrates the image features segmented view of the input image using the proposed approach of LAMNN.

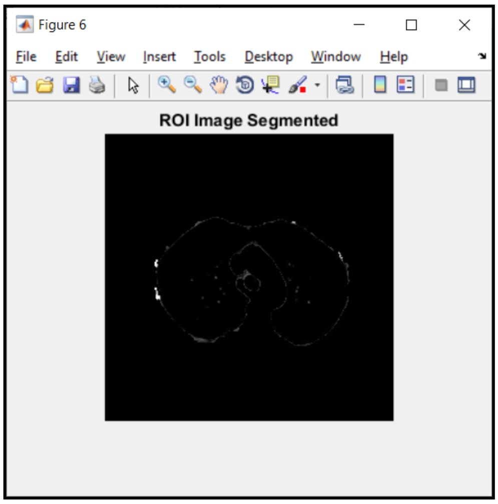

Fig.5 Region-of-Interest

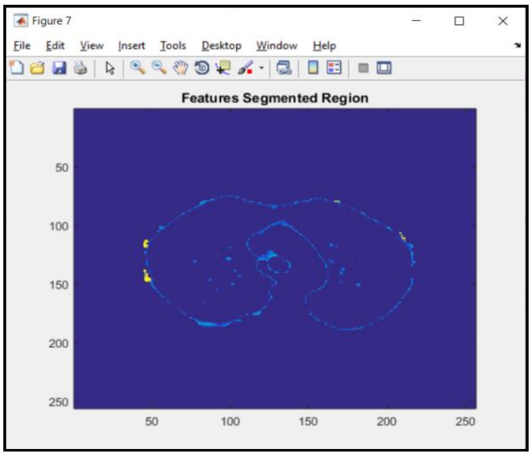

Fig.6 Segmented Features based on RoI

The following figure, Fig-7 illustrates the perception of selected image weighted value factor calculations and the subsequent figure; fig-8 illustrates the Score Similarity Matrix view of the image using the proposed approach of LAMNN.

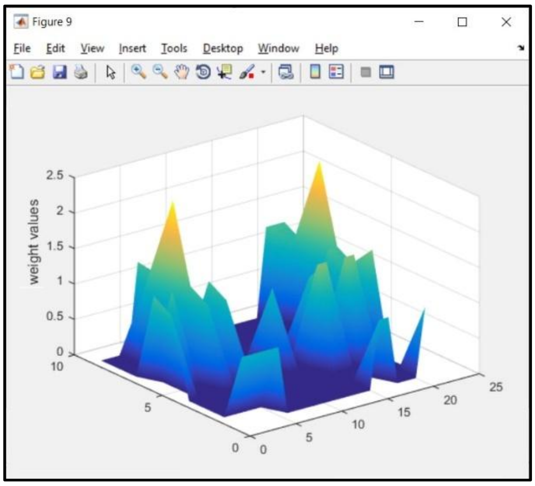

Fig.7 Weight Factor

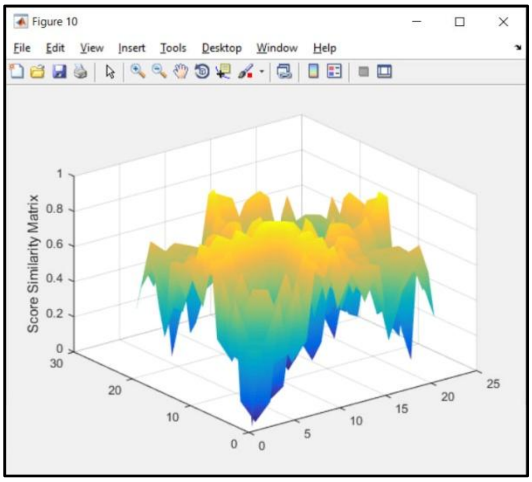

Fig.8 Score Similarity Matrix

V. Conclusion and Future Scope

Precision medicine, or the development of a more effective individualized approach for treating and managing patients, involves the development of a more accurate clinical marker and evaluation tool for cancer prognosis prediction. Current research focuses mostly on the identification of more effective genetic biomarkers, demographic characteristics and other clinical variables. We developed a novel quantitative image feature analysis technique employing chest computed tomography images in this work and exhibited two new study outcomes using LAMNN. To begin, an image feature-based classifier outperformed two widely used genetic indicators in predicting cancer recurrence risk. Second, the visual characteristics and genetic biomarkers are not highly associated and hence serve as a source of additional information. As a consequence, combining these two types of characteristics and biomarkers enhanced prediction performance even more. Despite its limitations, this preliminary study establishes a sound foundation for us to continue working in this emerging and promising field of system design to develop and optimise highly accurate and robust risk prediction schemes that may eventually aid clinicians in more accurately identifying patients at increased risk of lung cancer recurrence following surgery. Thus, post-surgery chemotherapy is essential for these high-risk individuals in order to avoid or limit the chance of cancer recurrence and thus enhance their disease-free survival and overall survival time.

In future, the work can further be enhanced by means of adding some integrated classification logic such as Support Vector Machine (SVM) to the proposed logic to improve the classification efficiency in rich manner.

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