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A LITERATURE REVIEW ON LUNG CANCER DETECTION USING DIFFERENT MACHINE LEARNING APPROACH

Ketaki Patidar[1], Prof. Sumit Sharma[2]
[1]PG Scholar CSE, [2] Head of department
[1,2]Department of Computer Science Engineering *(CSE)*
[1,2] Vaishnavi Institute of Technology and Science *(VITS), Bhopal, (M.P.), INDIA*
ketkipatidar17@gmail.com[1]

***Abstract*—Cancer is a disease that is becoming increasingly prevalent around the world. Researchers have conducted numerous studies to determine where on the human body cancer is most common. In this survey paper, we discuss the different machine learning approach for lung cancer detection. Also discuss the comparison of different previous studies presented. Machine leaning play an important role for detection of lung cancer, different the different type of machine learning approach for the detection of lung cancer. In the review also discuss the different type of lung cancer. In the last but not least dicuss the various steps of lung cancer detection using machine leaning approach.**

Keywords - K-Nearest Neighbor (KNN),Non-small cell Lung cancer (NSCLC),High-Resolution Computed Tomography (HRCT),Computer-aided diagnosis (CADx),Support Vector Machines (SVM), etc.

I. INTRODUCTION

Lung cancer is diagnosed in the United States at a rate second only to that of breast cancer. Lung cancer patients have a survival rate of only 15% five years after their diagnosis. Survival analysis is a common topic in medical research. The survival rate of cancer patients can be predicted using a predictor variable that indicates whether or not certain events, such as death or recurrence of a disease, have occurred over a specified time period. A patient's prognosis after a cancer diagnosis must be predicted by the predictor models. You have two sponge-like organs in your chest, the lungs, which are responsible for breathing. He has three lobes in each of his proper lungs. The left lung has two lobes on each side. The left lung is reduced in size to compensate for the increased size of the heart. Air enters your lungs when you inhale through your nose or mouth and travels down your trachea (windpipe). The trachea in the lungs divides into several smaller bronchi.

Smaller branches, known as bronchioles, branch out from the main bronchial tree and are called bronchial branches. The bronchial tubes culminate in little air sacs called alveoli. Carbon dioxide is expelled from the blood as you inhale oxygen via the alveoli. Your lungs are responsible for taking in oxygen and exchanging carbon dioxide. The lining of the bronchi and other parts of the lung, such as the bronchioles or alveoli, are common places for lung cancer to begin.

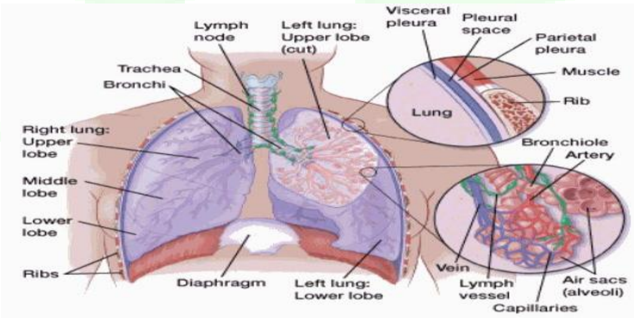

Fig. 1 Normal structure and function of the lungs

The lungs are protected from the outside world by the pleura, a thin layer of lining. The pleura acts as a cushion between human lungs and the chest wall, allowing them to expand as well as contract when you breathe.

This dome-shaped diaphragm divides the upper and lower torsos by forming a barrier between the two areas. When you inhale and exhale, the diaphragm rises and falls, causing the lungs to fill and empty.

Lung cancer is the leading cause of death in the United States. In 2012, there were 1.6 million deaths and 1.8 million new cases reported. Among both men and women, it is the leading cause of cancer-related death in the United States, accounting for more deaths than all other cancers combined.

Cancers of the lungs have a 17.8% five-year survival rate, but that number would be much higher if the disease had been discovered earlier. Only 15% of the cases were caught

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in the early stages, however. This shows that early detection of lung cancer is critical to the success of treatment. Lung cancer is the leading cause of cancer death in smokers.

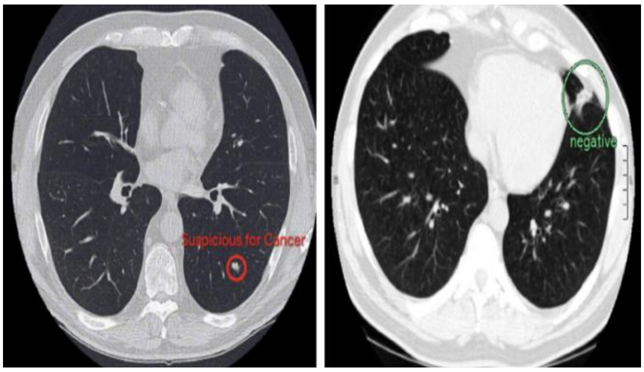

Fig. 2 less noisy as compared to MRI lung cancer

As a result, it has been suggested that cancer may be a result of an individual genetic disposition inherited from family members. In other words, some people are genetically predisposed to developing lung cancer because of genetic mutations or flaws in a gene. Lung cancer is more likely to strike relatives of those who've had it, according to research.

A. Classification of Lung Cancer

Epithelial cell tumours, known as carcinomas, account for the majority of lung cancer cases. The size and presence of the malignant tumour can differentiate among non-small cell lung cancer (80%) and small cell lung cancer (20%). cells under the microscope (16.8 percent). In terms of therapy and prognosis, this categorization is quite important.

B. Non-small cell Lung cancer (NSCLC)

They form a cluster because of their similar prognosis and treatment. The three most common lung cancers are squamous cell carcinoma, adenocarcinoma, and large cell lung carcinoma. Squamous cell carcinoma is the most common form of lung cancer in the central bronchus. The tumor's core is filled with necrosis and cavitation. As a result, well-differentiated squamous cell carcinomas are exceedingly rare in comparison to other types of cancer.

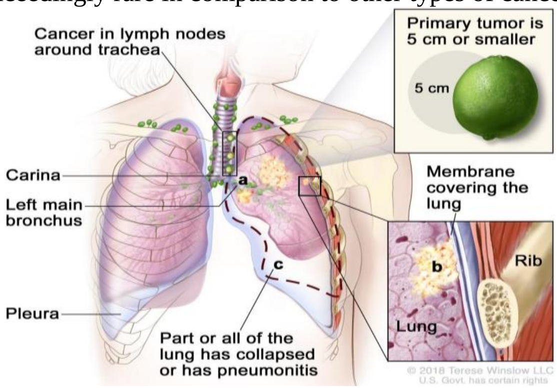

Fig. 3 Non-small cell Lung cancer

Non-small cell lung cancer and small cell lung cancer are the two most common forms of lung cancer (NSCLC). Both of these subtypes are given different treatments. Information on NSCLC can be found in this resource. A different resource can provide you with more information on small cell lung cancer. Lung neuroendocrine tumours are also discussed at length on this site.

Types of NSCLC

Epithelial cells are the origin of NSCLC. When it comes to diagnosing lung cancer, clinicians must distinguish between squamous cell carcinoma and other types of the disease. This data is then used to decide the best course of action for a patient.

Your doctor will use a microscope to determine the type of NSCLC that you have.

- Adenocarcinoma
- Squamous cell carcinoma
- Carcinoma of the large cell
- NSCLC-NOS(nototherwisespecified) or NSCLC undifferentiated

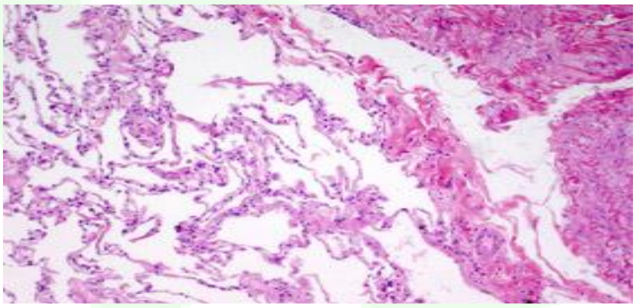

Fig. 4 Normal lung tissue [157].

Surgical treatment for non-small cell lung tumours is more common than for the more rapidly spreading small cell lung cancers. When small cell lung cancer has spread to other organs, it is frequently treated with chemotherapy drugs, which circulate throughout the body. For patients whose tumours have only spread to the lungs or other parts of the chest, chemotherapy and radiation therapy are common treatment options. Radiation therapy can be used to treat or prevent the spread of small cell lung cancer to the brain (metastasis). If cancer cells are to be eradicated, they must be targeted and destroyed in specific locations. Treatment of tumours that can't be surgically removed, prevention of tumours from recurring, or treatment of symptoms in other parts of the body can all be done with radiation.

II. LITERATURE SURVEY

Bharti, Meenakshi,et.al. (2022) - Lung Cancer is a disease that mainly rises cancer death. Early detection and accurate diagnosis can enrich the patient's life. Precise cancer segmentation assists specialists in comprehending the position as well as magnitude of cancer and henceforth take worthwhile diagnostic judgment. However, manual segmentation among numerous cancer-related medical images is a very weariness task. A deep learning architecture V-net is provided in the proposed study for detecting the nodule with fewer false positives (FP).

Following the detection of candidate nodules, the data is prepared for 3D ResNet to determine whether a candidate nodule is an FP candidate or a genuine nodule. The Hounsfield u nit(HU) preprocesses t he input CT scans. Since the process of computation of the raw CT scans are expensive and difficult, t hey a re separated into numerous patches of size 96X96X16 after preprocessing. This proposed approach gave the precision and recall of 98.7% and 98.2 % respectively when applied on LUNA16 data-set**[01].**

Halder, Amitava et.al. (2022) - Early-stage detection and identification of malignant pulmonary nodules can allow proper medication and increase the survival rate of lung cancer patients. High-Resolution Computed Tomography (HRCT) image slices are in use for the screening of lung cancer. However, appropriate identification of lung nodules at the early stage of the disease is challenging owing to similar morphological properties of benign and malignant nodules. Introduction of computer vision and advanced image analysis techniques for the development of Computer-aided diagnosis (CADx) systems have significantly improved the classification performance and increase the speed the interpreting lung CT images for the identification of lung cancer. Deep learning-based techniques have recently emerged as an efficient tool for the improved characterization of lung nodules. In this research work, a deep learning (DL) based framework has been introduced using the concept of adaptive morphology-based operations combined with Gabor filter (GF) for accurate lung nodule classification. The new framework, 2-Pathway Morphology-based Convolutional Neural Network (2PMorphCNN) with its two trainable paths can capture both textural and morphological features of the lung nodules that results in better classification accuracy. The proposed system has been trained and evaluated on LIDC-IDRI dataset and achieved sensitivity, specificity, accuracy of 96.85%, 95.17%, and 96.10% with an Area under the ROC Curve (AUC) of 0.9936 for lung nodule characterization. It has been observed that the reported automatic lung nodule classification framework outperforms other state-of-the-art nodule classification methodologies by capturing and combining textural and morphological features from the HRCT lung nodule image**[02].**

Gnanavel, S. (2021) -This study explains how to accurately diagnose and predict a person's prognosis for lung cancer in its early stages. A Deep Learning System and Morphological Implementation strategies are used to make lung definitive diagnosis and categorization, while the segmentation but rather recognition mechanisms are decided to carry out using brightness calculations, GLCM, and visual quality evaluation, among other methodologies. The Search Algorithm is an effective tool for early detection of lung cancer because it improves overall images by reducing noise. Data from an earlier collection is used to test the classifier's accuracy. Moreover, the accuracy of the forecast has improved as a result. Early detection of lung cancer led to the diagnosis of the patient **[03].**

Abdullah, D. M., et. al (2021) - Lung cancer is one of the most deadly and common diseases in the world, according to this study. The disease's severity is exacerbated by the difficulty in detecting it early on. Three different classifiers are being tested in this study in order to find the best one for detecting lung cancer at an early stage." Using data from UCI's lung cancer patient databases, this study generated its informative indices. This research focuses on categorization methods using the WEKA Tool. K-Nearest Neighbor (KNN) and Support Vector Machines (SVM) were found to be the most accurate early detection methods for lung cancer (SVM). 86.41% of the time, the answer was incorrect. **[04].**

Sujitha, R., et. al. (2021) - It is described in this paper. When it comes to coming up with new ideas, Hadoop is taking a dive into the deep end. As a leading big data platform, Apache Spark can perform at a high level when the conditions are ideal. In terms of raw data storage, Pyspark beats the competition hands down. The severity of nodules was rated in a new way in the study described here. The method uses T-BM SVM in conjunction with binary classification and multi-class classification in order to better classify the stages of lung cancer. A variety of features with values aimed at improving the classifier's performance are extracted using SVM. T-BM SVM produces better results than other methods. All studies utilised sputum colour images. It is obvious that both classifiers are good at determining the severity of the disease and the number of stages of lung cancer. As a result, the proposed method aids in medical diagnosis by providing accurate results for early detection of stages of lung cancer. **[05].**

Shanthi, S., et. al. (2021) -Lung cancer has been found to be a very dangerous and widespread disease, and it is also the leading cause of death in the United States. Classifiers with the best features will be used in this effort to predict early detection. Feature selection has been used to identify subsets of cancer cells that can be used to kill the cancer cells. The system's performance improves when certain features are disabled. All relevant subsets were selected for classification using the SDS, which was also implemented. For this approach, an acceptable feature subset was selected for the SDS. Classification techniques were used to deal with massive amounts of data. The Naive Bayes classifier makes the assumption that the variables that go into classification are linked. After training and testing neural networks on the database, they will be used to solve other problems. Oncologists were able to use NN effectively in the diagnosis of lung cancer, as demonstrated by the results of this study. SDS-decision tree classification accuracy increased by 2.51%, while SDS-Naive Bayes using an SDS-NN increased classification accuracy by 1.250%. Further investigation is needed to optimise the classifier, as feature selection has been shown to improve the classification of images. Feature selection was the focus of this study, but preliminary processing methods such as noise removal and investigating the most effective classifiers can be investigated further. **[06].**

TABLE – 2.1 Comparison of Various Machine Learning Approach based Lung Cancer Detection

Ref./year	Topic	Method	Tools	Application
[01]/2021	"Identification and Classification of Lung Nodules Using Neural Networks.	Deep Learning with RGB color model	-----	-------
[02]/2021	Lung cancer prediction and classification based on correlation selection method using machine learning techniques	SVM based KNN Machine Learning Methods	WEKA Tool	Convolutional Neural Network (CNN)
[03]/2021	Classification of lung cancer stages with machine learning over big data healthcare framework	gray-level co-occurrence matrix (GLCM) method)	promising tool	deep learning applications
[04]/2021	Lung cancer prediction using stochastic diffusion search (SDS) based feature selection and machine learning methods	Stochastic Difusion Search (SDS) Algorithm	--	clinical applications.
[09]/2020	Automatic lung cancer detection from CT image using improved deep neural network and ensemble classifier	Improved deep neural network (IDNN) method	MATLAB tool	------
[10]/2020	"Detection of lung cancer on chest CT images using minimum redundancy maximum relevance feature selection method with convolutional neural networks	Maximum relevance (mRMR) feature selection method	CNNs tools	LDA applications
[13]/2019	Comparison of lung cancer detection algorithms	Artificial Neural Networks machine learning Method	-----	--------
[14]/2019	Predicting radiation pneumonitis in locally advanced stage II–III non-small cell lung cancer using machine learning	Machine learning methods	Random Forest tool	application of a machine learning
[15]/2019	Investigation of Low-Dose CT Lung Cancer Screening Scan "Over-Range" Issue Using Machine Learning Methods	Machine learning methods	Machine learning is a powerful tool	python-based, software application.

III. Machine Learning Artificial Intelligence In Cancer Detection

It is essential to have a solid comprehension of what machine learning is, as well as what it is not, before beginning a detailed analysis of which types of machine learning methods work best for which kinds of scenarios. Specifically, it is important to have an understanding of what machine learning is not. The field of artificial intelligence research known as machine learning employs statistical, probabilistic, and optimization techniques in order to "learn" how to classify new data, discover new patterns, or forecast new trends based on previous examples (Mitchell 1997). Utilizing statistical methods and machine learning strategies, it is possible to perform data analysis and interpretation. By utilising logical constructs such as AND/OR/NOT and absolute conditionality, machine learning techniques are now able to model data or classify patterns in novel ways. This was not possible in the past (IF, THEN, ELSE). These more recent methods are more comparable to those that people employ in order to learn and organise information. Nevertheless, machine learning is still heavily dependent on statistics and probability; however, it is inherently more powerful because it can make conclusions or judgments that are impossible to reach using standard statistical approaches [55].

Natural language processing (NLP) methods are being used to assess the representation of the information in unstructured data such as medical records, clinical articles, and magazines. These data types include: health records, clinical articles, and magazines. In the beginning, natural language processing methods are used to convert the collected input text into a binary format. However, machine learning methods are then used to analyse this binary data in order to produce the appropriate output and decisions.

- The areas of oncology, neurology, and cardiology are the ones that make the most use of artificial intelligence in terms of medical research. As a direct consequence of this, the disease has a higher mortality rate. In addition to these diseases, artificial intelligence is currently being applied in a number of different areas of medicine for the purposes of forecasting, analysing, and treating patients. The healthcare industry has made use of a variety of machine learning algorithms, including SVM, NN, random forest, logistic regression, discriminant analysis, decision trees, linear regression, closest neighbour, naive bayes, and others. Some of the more well-known machine learning algorithms include those listed above.
- The following is a list of some of the most cutting-edge applications of artificial intelligence (AI) that are currently being researched and developed for use in the medical industry:
- The procedure for identifying variations together in tumours is going to be detailed down below.
- "Images of hearts are categorised based on the shape of the heart itself."
- The method is proposed for use in predicting issues related to the heart.
- Dermatologists would be able to make accurate diagnoses of tumours if they used artificial intelligence.
- A framework for the application of artificial intelligence in the intensive care unit.
- Identifying individuals who are at risk of developing cervical cancer using algorithms is currently being researched and developed.
- It has been shown that AI can be helpful in the diagnosis of breast cancer.

IV. Machine Learning Steps

Deep learning algorithms, in particular CNN, Fully Connected Convolutional Networks (FCN's), and Deep Belief Networks (DBN's), had swiftly evolved techniques and strategies to study and examine/analyze the imaging in the medical area, such as MRI, X-Ray, and computed tomography (CT) images, etc., in a short amount of time. Image classification, the classification and detection of lesions, organ and lesion segmentation, enhancement, and image generation are all examples of applications for deep learning approaches. These approaches can also be used to combine image data with reports.

A. Data Prepossessing

The process of machine learning includes the integration of data preprocessing. After being processed, photographs taken at a 20 equivalent magnification (0.5 m/pixel) were used to ensure that both the global perspective and the localised details were maintained. The ASAP technology was developed by the medical professionals in order to meet the requirements of documenting the WSIs in TIFF format using distinctive coloured roughness polygons that identify a particular histological lung tissue type. Certain portions were obscured in order to define tumorous and inflammatory parts, and ordinary portions were determined by removing the background of lung tissue slides using Otsu's method in order to differentiate between them. This was done in order to differentiate between the two types of parts. Certain disease sites that were difficult to precisely localise may have been damaged as a result of the tagging process. This is because the identification process ensured that neither non-lesion cells nor the lesion itself would be included in the identified region. Annotated are in fact the individuals whose titles or descriptions include categories such as LUAD, LUSC, SCLC, and PTB in addition to OP.

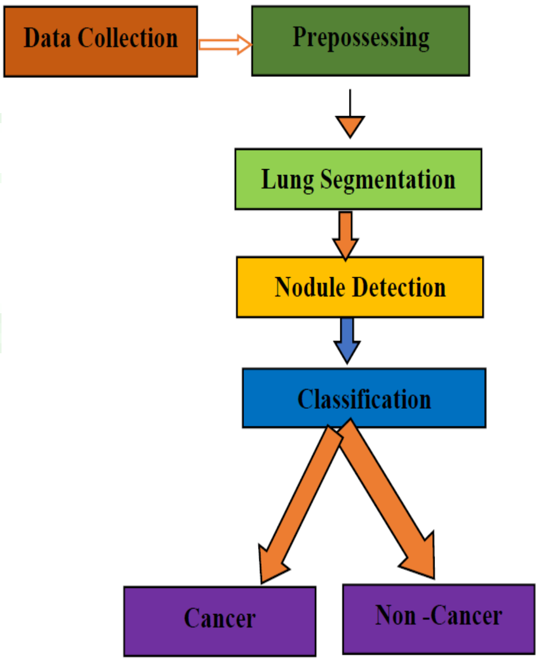

Fig. 5 Block Diagram for Machine Learning based Lung Cancer Detection

B. Deep Neural Networks (DNN)

Our ideal framework would have been a CNN that had both a high level of accuracy and a low amount of tuning time required. The Efficient Net systems received a performance boost, which assisted them in achieving state-of-the-art accuracyperformance levels, as a result of the use of compound scaling in conjunction with auto architecture search. PictureNet has a lower number of operations per second that are performed in floating point (FLOPs). MATLAB and Python, up to version B5, were both supported on the Efficient Net network at the time that this study was conducted. In order to improve and fine-tune the systems, the slides were arbitrarily split up into training, validation, and testing sets at the slide level. Academic papers frequently make use of the CNN architecture known as Res Net. A growing number of industries, from academia to industry, are using deep learning techniques. With today's cutting-edge technology, learning machines can now process large amounts of data thanks to new algorithms and increased parallel computing approaches. These deep learning architectures can be used to build more efficient and accurate models. If you have more data, deep learning is a better option than traditional machine learning algorithms. It's not uncommon for biological systems to be nonlinear and parameter-dependent in nature. In algorithms like Support Vector Machines (SVM), Random Forests (RF), and others, increasing the amount of data generates a performance plateau. Fig. 4.1 depicts the current state of affairs. Due to our extensive dataset, my Deep Learning Neural Networks are able to perform effectively in my research on lung cancer diagnosis. When an action potential is strong enough, a neuron sends out nerve impulses to other cells. The nucleus, dendrites, axon, and axon terminal are all typical components of neurons.

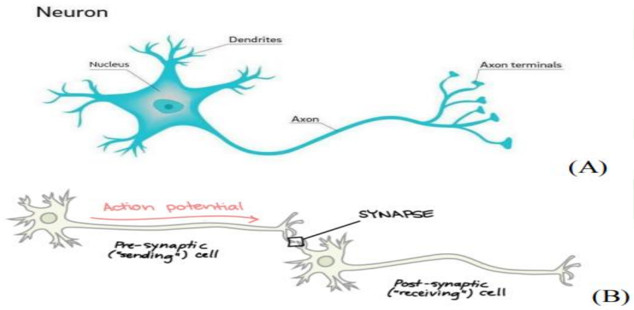

Fig. 6 Deep Learning Neural Networks

C. Network Training (NT)

A significant barrier to medical research is the restrictive privacy rules as well as disorganised management systems that apply to most medical materials, particularly labelled ones. Thus, because of our limited training data set, transfer learning methods were used to train the Efficient Net-B5 system.Two stages were involved in the training procedure. To begin, we used default weights from the Image Net data set to create the network, then we froze all but the final fully connected layer before training it with our own data. Second, we thawed out the frozen layers and fine-tuned the entire network to best meet the goal. It was determined that cross-entropy values may be utilised to compare forecasts with real-world data. We used Adam's optimizer with momentum and decay set at 0.9 and a starting learning rate of 0.0005. Several additional manipulations were used to enhance the data during processing, including horizontal and vertical flips, uniform brightness and contrast alterations, gamma changes, zooming, and slid. Most of the time, 0.3 or 0.5 was used for a chance of adding something, except for horizontal flipping[18].

V.CONCLUSION

Various Cancer is a disease that is becoming increasingly prevalent around the world. Numerous researchers have conducted a variety of studies in an effort to determine the areas of the human body that are most commonly affected by cancer. The results of one study like this one motivated us to carry out this research in the field of detecting lung cancer. The most common cause of death attributable to cancer in both men and women is lung cancer. The likelihood of a favourable prognosis for lung cancer patients who undergo early detection is increased. The utilisation of image processing systems makes it possible to detect and diagnose abnormalities earlier and more quickly than is possible with the use of other screening tests. When developing a method for the early diagnosis and treatment of disease, taking into account the passage of time is one of the considerations that goes into the process.

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