**AI in Medical Science: Lung Cancer Cell Detection Using Deep learning**

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**ABSTRACT**

Artificial Intelligence is playing a vital and crucial role now a days in medical science. It is the evolution which is leading to drastically change the face of medical field. This chapter mainly contributes the work enhancement done in lung cancer. Lung carcinoma is the major cause of death throughout the world, nearly 18% deaths are due to cancer as the survival rate is very low. The rise of Artificial Intelligence (AI) and Machine Learning (ML) techniques and their applications in various fields have brought immense value in providing insights into advancement in support of cancer control. Deep learning is a significant and emerging AI strategy for the innovative change in healthcare domain. Deep learning is a type of machine learning that uses a layered algorithmic architecture for analyzing data. Deep learning algorithms are applied for detecting lung cancer cell in its early stages. This will be helpful for radiologist and doctors for proper treatment of the patients to cure. Advancement in the DL decreasing the mortality of the lung cancer. CNN is playing the vital role and enhancing the performance of the system. The recent development in Deep learning helps to early detect lung cancer finally beneficial to the society.

**I INTRODUCTION**

1. **Artificial intelligence**

Artificial intelligence (AI) has recently made significant strides in computer science and informatics, and it is now becoming a crucial component of contemporary healthcare. Medical practitioners are supported by AI algorithms and other applications powered by AI in clinical settings and current research. The medical sciences make substantial use of computer systems with artificial intelligence. Common uses include remote patient treatment, prescription transcription, increasing doctor-patient communication, medication discovery and development from beginning to end, and patient diagnosis. Modern computer algorithms have lately achieved accuracy levels that are comparable to those of human experts in the field of medical sciences, despite the fact that computer systems frequently perform jobs more quickly than humans do. Some believe that humans will soon be fully replaced by machines. The goal of this essay is to examine how artificial intelligence is altering the field of medical science and to distinguish marketing hype from fact. AI is a broad concept that lacks a clear definition. An AI programme uses historical data to forecast or categorise objects [8].

1. **Lung cancer:**

Cancer is still viewed as a hazardous disease with high mortality rates. Comparing all cancers, lung cancer has the greatest mortality rate or death rate [1, 2], and it is thought to be the deadliest carcinoma globally [3]. As a result, numerous researchers are concentrating on approaches for exploiting digital pictures, particularly Computed Tomography (CT), to detect lung cancer nodules. The use of X-rays in CT scans produces many pictures, making it difficult for radiologists to identify minute nodules from these images [4]. The fundamental task carried out by the radiologist for the diagnosis of lung cancer is the analysis and interpretation of nodules.

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**Fig 1:- Lung cancer cell**

Cancer risk can be calculated based on nodule classification and other data. The primary level identification and categorization of distinct cancer kinds is where AI approaches play a significant role [10–14]. In recent years, deep learning (DL) models have been applied in a variety of industries, such as games, agriculture, and medical [15].

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| S. No.  | Type of Cancer | Total cases (in millions) |
| 1 | Breast | 2.26 |
| 2 | Lung | 2.21 |
| 3 | Colon and rectum | 1.93 |
| 4 | Prostate | 1.41 |
| 5 | skin (non-melanoma) | 1.20 |
| 6 | stomach | 1.0 |

 **Table 1:- Cancer cases**

Due to evolution and different treatments lung cancer is classified in 2 categories:

• Non small cell carcinoma (NSCC): Most of the people who are having lung cancer have NSCC. Peoples having more than 65 years age and who smoke or who breathe a lot of smoke are most likely to get non small cell carcinoma.

• Small cell carcinoma (SCC): In small cell carcinoma cells of the lung start growing rapidly in an uncontrolled manner

A multi-stage method called radiomics makes use of standard medical images to help with clinical diagnosis and prognosis. Gillies et al. [21] described high-throughput quantitative feature extraction as "the conversion of images into mineable data and the subsequent analysis of these data for decision support." A tool called computer-aided diagnosis (CAD) helps doctors and radiologists evaluate diagnostic image data in order to identify or monitor a condition.

Shape, size, margin, speculation, boundary, and external characteristics, such as pleural attachment and fissure attachment, all appear to be characterised in terms of semantic elements; shape characteristics include lobulation, concavity, and the like; size characteristics include long-axis diameter and short-axis diameter. An expert radiologist described semantic features of the ROI that provide important details about tumour characteristics [23].

1. **IDENTIFICATION OF LUNG CARCINOMA**

The identification of lung cancer is made in the following ways:

 • History and Physical examination

• Diagnostic tests

• Staging tests

Among the diagnostic procedures is sputum cytology. During sputum cytology, sputum samples are collected and examined under a microscope to check for any cancer cells. A biopsy (bronchoscopy, needle biopsy, surgery) is the removal of a tiny sample of tissue from a suspected site for examination and analysis under a microscope.

* chest X-ray It is the first imaging technique to look for lung cancer. Nodules greater than 1 cm are frequently visible on X-ray images. In the event that the chest X-ray exhibits any irregularities, patients may be advised to undergo staging testing.
* X-rays X-rays are produced by the radiation emitted by electromagnetic waves. As the images are being created, X-rays are used to highlight interior body regions. Radiation varies in different places of the body because different tissues absorb radiation in different ways.
* Computed tomography, or CT Computed tomography, commonly known as CAT or computerised axial tomography (CT), is frequently used in image processing techniques. The benefits of CT are numerous.
* Radiography Similar to X-rays, radiography is a highly general term. The two radiographic image types employed in medical imaging are fluoroscopy and projection radiography. This imaging technique, the first one offered in modern medicine, takes pictures using a wide x-ray beam.
* Magnetic-resonance imaging A big magnet is used in MRI scans to create 3-D images. Any region in particular that could not be well interpreted on a CT scan can be studied using MRI. Examining the participation of cancer cells with MRI is helpful. Brain tumour identification often involves the use of a magnetic resonance imaging technique. When a nuclear magnetic resonance (NMR)
* Sonographic images Medical imaging creates images by using high-frequency, wide-band sound waves in the Megahertz (MHz) range that are reflected differently by tissue.

Identification of the Lung Carcinoma Problem Radiologists retrospectively review lung scans for indications of cancer. The region of interest that is not suspicious enough to recall can be used to spot an anomaly in photos. When radiologists handle lung pictures, there are two basic issues that arise. The radiologist may have overlooked the symptom and not given it any attention, which is the first potential issue.

**II ROLE OF DEEP LEARNING**

Artificial intelligence (AI) is the process of using computers and technology to mimic human-like intelligent behaviour and critical thought. The term was first used by John McCarthy in 1956 [1]. Additionally, it gives us the ability to assess and grasp complex medical data, aiding in diagnosis, management, and the prediction of treatment outcomes across a range of clinical presentations. The medical sector could undergo a fundamental transformation thanks to artificial intelligence. Because of the accessibility of digital data, machine learning, and computer infrastructure, AI applications have been able to expand into fields that were previously believed to be unachievable with

Radiography is a key area for the early use of AI techniques in the medical industry, claims Tang. It is anticipated that the use of AI will considerably increase the breadth, quality, and value of radiology's contribution to patient care and public health over the coming ten years. Workflow for radiologists is anticipated to alter and evolve significantly. One class of representation learning methods called deep learning uses picture data to learn hierarchical feature representation. Deep learning has the benefit of being able to produce high level feature representations straight from the original image data.

**Deep learning Approaches**

According to reports, a deep learning-based CAD system holds great promise for the accurate automatic identification of lung illness in medical imaging [19] A neural network model with numerous levels of data representation makes up the deep learning model. Unsupervised, reinforcement-based, and supervised learning are the three subcategories of deep learning methodologies.

Unsupervised learning, which analyses the data and then organises intrinsic similarities between the input data, does not require user instruction. As a result, semi-supervised learning is a mixed model that, despite various difficulties, can produce a win-win situation. Techniques for semi-supervised learning employ both labelled and unlabeled data. Both labelled and unlabeled data are used to increase the decision boundary's accuracy. In terms of clustering and nonlinear dimensionality reduction, Auto-Encoders (AE), Restricted Boltzmann Machines (RBM), and Generative Adversarial Networks (GAN) excel. Training typically requires a lot of labelled data, which increases cost, effort, and difficulty. To eliminate labelling and create a more reliable model, researchers have used deep clustering [39,40].

The most popular unsupervised learning algorithms in medical pictures are convolutional neural networks (CNN), deep convolutional neural networks (DCNN), and recurrent neural networks (RNN). Because less pre-processing is needed, CNN architecture is one of the most used supervised deep learning methods for lesion segmentation and classification. Recently, CNN architectures have been used to classify and segment medical pictures, such as Mask R-CNN and AlexNet and VGGNet. More layers with complicated nonlinear interactions are typically found in DCNN designs, which have shown to perform regression and classification with respectable accuracy [44,45,46]. A higher-order neural network with RNN design can accommodate network output to re-input [20]

Due to their exceptional performance, convolutional neural networks (CNNs) have lately grown in prominence in the machine learning sector. Neurons with programmable weights and biases make up CNNs. This method is based on the artificial neural network (ANN) structure, which was modelled after the biological neuron. The fact that CNNs learn filters on their own gives them an advantage over conventional neural networks. The learnable filters that make up the CNN layer parameters enable the system to adapt to new problems. These filters use a convolutional method to extract spatial information from the incoming data. Because of this, CNNs excel at a variety of tasks, including object detection, video analysis, speech recognition, natural language processing, and medical image analysis. But in order to prevent overfitting,

**Convolutional Neural Networks :**A CNN has been arranged in the form of the layers.

• ReLU layers

• Convolutional layers

 • Pooling layers

• a Fully connected layer



**Fig 2:- Convolutional Neural Networks**

* Convolutional layer The primary goal of this convolution phase is to concentrate the highlights in the data image. Consistently, CNN starts with the convolutionary layer. The features are extracted from the input image in this procedure, and a feature map is created.
* ReLU The straight redressed unit layer comes after the convolution layer. Here, the feature maps are used to implement the enactment function, which increases the non-linearity in the network and makes it simple to remove negative values.
* Pooling layer The size of the input can gradually be decreased by the pooling process. The pooling stage can reduce overfitting. By increasing the amount of parameters required, it will quickly identify the necessary ones.
* Fully connected layer Here are all the traits and their matched attributes. It is possible to use the classification approach with significant percentile imprecision. The primary methods of measuring and recording the inaccuracy
* Softmax layer:-To convert the abnormal network activity over expected performance groups to a probability distribution in neural grids, softmax is also used. The Softmax has been used to solve numerous problems in numerous academic domains. The decimal's probability will imply 1.0. Consider the related Softmax versions, such as Full Softmax, which has the ability to determine the chance of each potential class. To categorise the images, CNN employs successive convolutional and pooling layers.

The CNN's pooling layer decreases the dimension and categorises the object without respect to its spatial information, or where the object is actually situated in the image. The benefit and the disadvantage of CNN's pooling feature are both present. Some crucial information that is crucial for object detection and image segmentation is lost during the pooling operation.

**CONCLUSION**: This chapter covers the importance of AI in medical science related to detecting lung nodule in early stages. The traditional methods for lung cancer cell detection and their pitfalls.The advancement of AI like Machine learning, Deep Learning how these approaches helping the radiologist, doctors and finally to the patients to survive. Deep Learning approaches like Convolutional Neaural Networks, Recurrent Neural Network, LSTM has a great impact in medical field. CNN is preferred most for lung cancer cell detection and classification process, whether the cell is benignant or malignant.

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