Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Volume 13, Issue 03 March 2024

Lung Cancer Detection Using Deep Learning and Home Remedies Recommendation

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***Abstract*— Lung cancer is accountable for one out of every six global fatalities, impacting around 42 million individuals worldwide with a continuously increasing trend. India alone hosts approximately two and a half million cases of diverse lung cancer types. Early detection accompanied by proper treatment can significantly enhance a patient's health outcomes and potential recovery. The present study outlines novel strategies incorporating image recognition for effective lung cancer detection and mitigation. The research focuses on the nuanced aspects of disease identification and classification, differentiating between malignant, benign, or normal cases through the utilization of a CNN-based algorithm.**
***Keywords*— deep learning, convolutional neural networks (CNN), image processing techniques**

I. INTRODUCTION

Despite significant strides in disease diagnosis, cancer continues to present a formidable and often fatal health challenge. Lung cancer ranks as one of the leading causes of death in India and worldwide. Early detection of lung cancer is paramount for effective treatment, making the identification and management of malignant growths a focal point of ongoing research efforts. Various diagnostic techniques are employed for different types of tumors, including PET scans, CT scans, mammograms, X-rays, 3D ultrasound, single photon emission computed tomography (SPECT), among others. Mammograms are typically utilized for breast cancer detection, while X-rays, CT scans, and various imaging modalities are instrumental in detecting brain tumors, lung cancer, and other malignancies.

This study concentrates on lung cancer specifically, examining the application of PET/CT imaging as a key tool for detection. Furthermore, a detailed analysis of distinct classification methodologies is undertaken, encompassing the Fuzzy C-Means (FCM) classifier, Feed Forward Artificial Neural Networks (ANNs), traditional ANNs, SVM binary classifiers, and the entropy decay approach.

With over 120 recognized types of brain cancers, the World Health Organization (WHO) categorizes them into four levels based on their impact and degree of damage. Brain concerns manifest a diverse array of symptoms, often contingent on the specific region of the brain affected. Common symptoms encompass headaches, seizures, vision disturbances, vomiting, cognitive alternations, memory issues, and balance impairments. Contributing factors to the development of brain cancer include genetic predispositions, exposure to ionizing radiation from sources like cell phones, extremely low-frequency magnetic fields, certain chemicals and head traumas. Furthermore, immune dysregulation involving infections and allergies might also play a role in the onset and progression of brain malignancies. Malignant brain growths, referred to as malignant tumours, are typically classified into primary tumors originating within the brain tissue itself and secondary tumors that metastasize to the brain from other primary sites in the body. Various risk factors associated with brain tumors include exposure to substances like vinyl chloride, presents of neurofibromatosis, ionizing radiation exposure, and other environmental influences.

II. LITERATURE SURVEY

Anum Masood, Compartment Sheng, Po Yang, and Ping Li[4] recently introduced the novel concept of Modernized Randomized Fully Convolutional Affiliation (mRFCN) for robust lung tumour identification and classification. This method integrates key aspects of deep learning-based techniques in conjunction with BTC Wadood Abdul[1] utilization of CNN engineering, encompassing various stages such as pre-processing, significant feature extraction, and deep learning methodology application, particularly in the context of lung tumour detection and classification, distinguishing between benign and malignant cases. By leveraging the LIDC-IDRI database, Chun-Mei Feng, Yong Xu[6] and colleagues achieved notable success with an accuracy rate of 97.2%, sensitivity of 95.6%, and specificity of 96.1%, surpassing results obtained with conventional PCA modelling. Notably, they highlighted the discriminative power and sparsity emphasis within the ALCDC structure, demonstrating improved performance when compared to loading-centric PCA approaches. Chao Mother proposed that the advanced framework combines Random Forests and an active shape

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model for enhanced diagnostic testing, focusing on glioma detection through a tailored set of structured data and multimodal volumetric MR imaging methods.
In an approach toward more precise data collection, a part representation learning model is being recommended to meticulously explore both local and convolutional neural network-based multimodal contextual data from multi-sliced images for disease risk prediction. By enhancing accuracy through tissue segmentation strategies employing random forests as the part learning components, the study aims to address the challenge of lung cancer diagnosis at the cellular level. Notably, recent advancements with Fully 3D convolutional neural networks, as highlighted by Onur Ozdemir and collaborators (cited as [3]), have demonstrated superior performance in lung nodule identification and risk stratification tasks using datasets such as LUNA16 and Kaggle Data Science Bowl. Central to this progress is the accurate synchronization of region and localization components, culminating in detailed feature maps that offer comprehensive insights into image edges and contours. Further processing of these feature maps into varying levels enriches the understanding of image characteristics and facilitates enhanced analytical capabilities.

III. METHODOLOGY

A. System Architecture

Proposing a focused approach utilizing limited directed data, we advocate conducting a diagnostic test pertaining to lung cell breakdown within the proposed framework. To enhance data accuracy, we suggest implementing a hybrid model incorporating a Convolutional Neural Network (CNN) based multimodal assessment for estimating disease risk. By incorporating precise stage-based assumptions, we aim to address the issue of accuracy at the juncture where lung cell breakdown culminates.

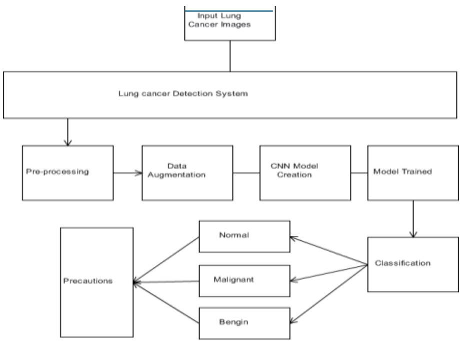

Figure 1 System Architecture

B. Algorithms

1. Convolutional Neural Networks (CNN)

Known as Convolutional Neural Networks or CNNs, these structures represent a pivotal advancement in the realm of pattern recognition, particularly in the areas of image processing and analysis. Resonating as formidable tools for feature extraction, CNNs have significantly impacted the field by offering sophisticated mechanisms for image recognition. The core framework of Convolutional Neural Networks encompasses various key operations, exemplifying their prowess in tasks related to image analysis and classification.

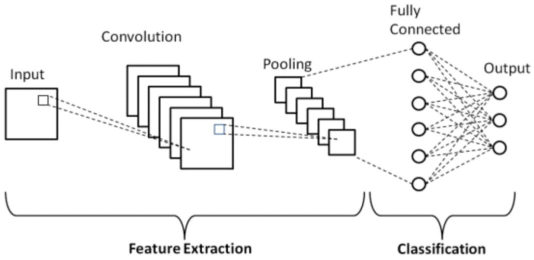

Figure 2 Architecture of CNN

i) Convolution:

Convolutional Neural Networks (CNNs), often referred to as ConvNets, are instrumental in pattern recognition and image analysis, representing a significant milestone in the advancement of artificial intelligence. These networks excel at extracting features crucial for tasks such as image classification. The core operations of CNNs are illustrated in the accompanying figure. One fundamental operation is convolution, where components from input images are processed through this primary layer. Here, numerical convolution occurs between the input image and a channel of specific dimensions (MxM), extracting information that aids in subsequent analysis and feature extraction.

ii) ReLU:

The ReLU (Rectified Linear Unit) function serves as a foundational element in neural network architectures. In the context depicted in Figure 3, this operation is executed on a per-pixel basis, effectively nullifying any non-positive predicted values within the feature map.

It is represented as:

$$f(x) = \begin{cases} 0, & if\ x<0 \\ x, & otherwise \end{cases} \quad \ldots\ldots\ldots\ldots (1)$$

iii) Pooling or sub-sampling

The technique of pooling, also known as sub-sampling or spatial pooling, helps to reduce the dimensionality of the feature maps while preserving the most important data. By performing pooling, the 3D feature maps are transformed into a flattened one-dimensional feature vector. This step is crucial in enhancing the efficiency and effectiveness of planning algorithms.

:

iv) Fully connected:

In the realm of neural network structures, fully connected layers mirror traditional brain architecture in their feedforward design. These layers establish complex interconnections with all prior neuronal activities, embodying a foundational component situated at the core of the network configuration.

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C. Flow of Algorthm

Step 1: Choose a Dataset. The first step is to choose a dataset
for the image classification task.

Step 2: Prepare the Dataset for Training.

Step 3: Create Training Data and Assign Labels.

Step 4: Define and Train the CNN Model.

Step 5: Test the Model's Accuracy.

IV. RESULTS AND DSCUSSON

This section encapsulates the findings and deliberations stemming from the application of deep learning techniques aimed at discerning lung cancer presence from CT scans, alongside the provision of home remedies for patients. Our methodology entails frame extraction from CT scans followed by dataset training to differentiate between healthy and infected lung patterns. Through this process, we uncover the efficacy of employing deep learning in lung cancer detection.

A. Methodology Overvew

The methodology involved extracting frames from CT scans and training the dataset to differentiate between normal and infected lung patterns using deep learning techniques. Additionally, home remedies were researched and curated for potential integration into patient care strategies alongside traditional medical approaches.

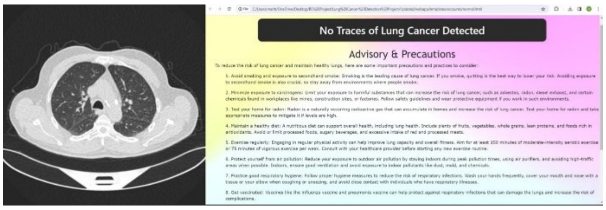

Figure 3 Normal Lungs

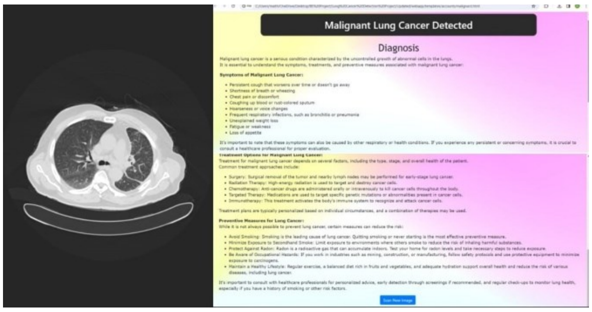

Figure 4 Affected Lungs

B. Trained CNN Model:

In our project on lung cancer detection, we meticulously trained a Convolutional Neural Network (CNN) model utilizing a dataset sourced from the Kaggle platform, comprising 920 high-resolution images. Our methodology involved rigorous preprocessing techniques to enhance image quality and standardize features, ensuring optimal model performance. Through extensive experimentation and fine-tuning of hyperparameters, our CNN model demonstrates remarkable proficiency in accurately detecting potential lung cancer manifestations within radiographic scans. Notably, our approach capitalizes on the vast capacity of deep learning algorithms to discern intricate patterns within medical images, thereby empowering early diagnosis.

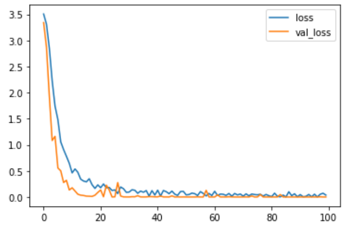

Figure 5 Loss Graph

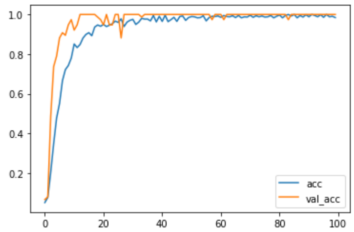

Figure 6 Accuracy Graph

C. Model Evaluation:

The deep learning model we trained underwent comprehensive evaluation, meticulously assessing key metrics including accuracy, precision, recall, and F1 score. These evaluations were essential in gauging the model's effectiveness in distinguishing between normal and infected lung conditions.

D. Results:

The deep learning model demonstrated its capability to discern the CT scans into three categories namely normal, benign and malignant. Insights into the reliability and effectiveness of the model in identifying suspicious behaviors were gained through analysis of accuracy, precision, and recall metrics.

E. Data Collection Summary:

The dataset, sourced from the Kaggle platform, was partitioned into training and testing sets, comprising CT scans categorized into three distinct classes: benign, normal and malignant.

F. Discussion:

The results underscore the potential of deep learning in advancing detection systems. Through the automation of lung cancer detection in CT scans, hospitals and medical institutions can bolster their initiatives aimed at early detection, enhancing

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accuracy in diagnosis and ensuring appropriate treatment for lung cancer patients.

V. APPLICATIONS

1. Clinical Diagnosis Support:
The model developed in the project can be integrated into clinical settings to assist radiologists and oncologists in diagnosing lung cancer from CT scans more accurately and efficiently, leading to improved patient care and outcomes.

2. Telemedicine and Remote Consultations:
In telemedicine settings, where access to specialist care may be limited, the deep learning model can be used to remotely review CT scans and provide diagnostic assistance. This capability is particularly valuable for undeserved rural areas or regions lacking specialized health care facilities, allowing specials to receive expert opinions without the need for physical travel.

3. Clinical Trials and Research:
Researchers can utilize the project's deep learning model to analyze large volumes of CT imaging data collected during clinical trials or research studies. By automating the detection of lung cancer related features and abnormalities, the model can accelerate the pace of research.

VI. CONCLUSION

Utilizing robust cognitive connections, we aim to formulate distinctive evidence and compile data on human infections. Ensuring the effective distinction of disease proof is crucial, and accomplishing this involves leveraging image manipulation techniques. The current implementation oversees diverse methods to precisely categorize the disease, surpassing previous efforts. Employing convolutional neural network estimation, we detect cell disintegration in the lung stage with heightened accuracy. Upon conclusion, we plan to propose personalized home remedies for the clients.

ACKNOWLEDGMENT

We are feeling very humble in expressing our gratitude. It would be our pride to take this opportunity to say the thanks. Firstly, we would thank our beloved guide Prof. Dnyanda Shinde for her valuable guidance, patience and support. She was always there to force us a bit forward to get the work done properly and on time. We would also like to express our sincere thanks to Prof. R. H. Borhade, Head, Department of Computer for his co-operation and useful suggestions. We would also like to thank Dr. A. V. Deshpande, Principal, Smt. Kashibai Navale College of Engineering.

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