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Amalgamation of Deep Learning, Genetic Algorithm & KNN method for feature optimization in early Lung cancer detection– A Review.

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Abstract
In present world, lung cancer considers as the deadlier disease and a primary concern of high mortality. It affects human being at a greater extent. Treatment of lung cancer involves surgery, chemotherapy, radiation therapy, Immune therapy etc. Therefore, it is highly necessary to take early precautions at the initial stage such that its symptoms and effect can be found at early stage for better diagnosis. Machine learning now days has a great influence to health care sector because of its high computational capability for early prediction of the diseases with accurate data analysis. So in this paper we review the work done so far in this field by analysing the various techniques used in past researches.
Key words-*KNN method, Genetic Algorithm, Deep Learning etc.*

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I. Introduction

In today's world, lung cancer stands out as a highly fatal illness and a significant contributor to global death rates. It has a profound impact on human health and is currently ranked seventh in the global mortality index, accounting for 1.5% of all deaths worldwide [1][2]. It originates from lung and spreads up to brain .There are two types of lung cancer. One is non-small cell lung cancer and another is small cell lung cancer, is further divided into types: Squamous cell carcinomas, Adeno carcinoma and Carcinoma, [12].

In nature, lung disease plays a major role in health issue. In any form of lung disease mainly the breathing gets affected, here are some common forms of lung diseases. Acute bronchitis, asthma, Chronic Obstructive Pulmonary Disease. Dry cough,weight loss, breathlessness & severe chest pain are the commom symptoms which lung cancer patients experience.

Looking in to the cultivation of cancer and its causes doctors give stress more on smoking and second-hand smoking as if the primary causes of lung cancer [3]. Treatment of lung cancer involves surgery, chemotherapy, radiation therapy, Immune therapy etc. Therefore it is highly necessary to take early precautions at the initial stage such that its symptoms and effect can be found at early stage for better diagnosis. Machine learning now days has a great influence to health care sector because of its high computational capability for early prediction of the diseases with accurate data analysis. Due to covid pandemic this problem becomes even more severe as we all know corona virus and its different mutant directly harm the lungs and affects the lungs capacity [4].

II. Amalgamation of Deep Learning, Genetic Algorithm & KNN method

Combining Deep Learning (DL), Genetic Algorithms (GA), and the k-Nearest Neighbours (KNN) method creates a powerful, multi-layered approach for solving complex optimization and classification problems. Here's how these techniques can work together:

1. Genetic Algorithm for Hyperparameter Optimization

- In deep learning, choosing the right hyperparameters (e.g., learning rate, batch size, and network architecture parameters) significantly impacts model performance. A Genetic Algorithm can be used to search through the hyperparameter space, evolving the parameters by mutation and crossover to select the best-performing configurations over multiple generations.
- This application leverages GA's strength in exploring complex search spaces, optimizing the DL model's settings more effectively than grid or random search.

2. Deep Learning for Feature Extraction

- A deep neural network, often a Convolutional Neural Network (CNN) for images or a Recurrent Neural Network (RNN) for sequences, can be used to automatically extract complex features from raw data.
- Instead of using raw data, we pass the output of intermediate deep learning layers (i.e., feature representations) as input to a KNN model. This transfer leverages DL's powerful feature extraction capability while allowing KNN to use those features for high-accuracy classification.

3. Using KNN as a Classifier on Extracted Features

- After extracting high-level features with a DL model, the KNN algorithm can classify new data based on these features. Since KNN is a non-parametric method, it can be useful in cases where the DL model's learned features are highly discriminative but don't necessarily fit into a specific parametric form.
- KNN can serve as a robust classifier in situations where instance-based learning (e.g., finding the nearest neighbours) is particularly advantageous.

4. Combining KNN with Deep Learning Predictions

- An alternative approach is to use KNN alongside the deep learning model's predictions as part of an ensemble. For example, a majority voting scheme between KNN and the DL model can enhance overall robustness.
- KNN can help correct DL errors by focusing on instance-based similarities, which might be overlooked by the DL model's training patterns.

5. GA for Feature Selection and Model Pruning

- Genetic Algorithms can also be used to select the most relevant features output by the DL model. GA can evolve to select only the most informative features, potentially improving KNN's accuracy and reducing computation.
- Similarly, GA can prune redundant or less important neurons or layers in a deep learning model, reducing model complexity and improving inference speed while maintaining classification accuracy.

Example Workflow

1. **Deep Learning Phase**: Train a deep neural network to learn a set of feature representations.
2. **Feature Optimization via GA**: Use GA to fine-tune the DL model's hyperparameters and select the optimal subset of features for classification.
3. **KNN Phase**: Feed the selected features into a KNN classifier to classify new data or form part of an ensemble.
4. **Evaluation and Tuning**: Evaluate performance, and iteratively optimize each component until the desired performance is achieved.

To conduct a comparative study of the listed works, I'll categorize the papers based on their key focus areas and methodologies: lung cancer detection, machine learning (ML) approaches, deep learning (DL), fuzzy/soft set theory, and healthcare applications with IoT and blockchain. Here's a breakdown:

1. Fuzzy and Soft Set Theory in Surgical Decision-Making

- **Alcantud et al. (2019):** This paper uses fuzzy and soft set theory to analyze lung cancer survival following resections. It focuses on surgical decision-making using these mathematical tools to account for uncertainty in patient data and outcomes.
- **Key Aspect:** Decision-making in surgery through mathematical modeling, addressing the uncertainty in lung cancer cases.

2. Deep Learning for Lung Cancer Detection

- **Asuntha & Srinivasan (2020):** Focuses on deep learning for detecting and classifying lung cancer. This study demonstrates how multimedia tools can be utilized to enhance the accuracy of diagnosis.
- **Bhatia et al. (2019):** Uses a deep learning approach specifically for lung cancer detection, discussing models and algorithms in the context of soft computing.
- **Chaubey & Jayanthi (2020):** Extends deep learning techniques for broader disease diagnosis, covering not only lung cancer but a variety of healthcare conditions.
- **Key Aspect:** All three studies emphasize the use of deep learning techniques, but with varying scopes—specific to lung cancer (Asuntha, Bhatia) and broader healthcare (Chaubey).

3. Machine Learning and Genetic Algorithm Approaches

- **Bhuvaneswari & Therese (2015):** Propose a K-nearest neighbor (KNN) classifier coupled with a genetic algorithm to detect lung cancer. This paper showcases a hybrid approach combining traditional machine learning with evolutionary algorithms.
- **Key Aspect:** Combining ML and genetic algorithms for optimized lung cancer detection.

4. Machine Learning in Predicting Survival

- **Ganggayah et al. (2019):** Focuses on using machine learning to predict survival factors in breast cancer, offering insights into survival analysis using ML techniques.
- **Key Aspect:** While focused on breast cancer, it provides a comparative perspective on the application of ML in survival prediction similar to Alcantud et al.

5. IoT and Machine Learning for Healthcare

- **Pratik Kumar et al. (2021):** Discusses how IoT, ML, and blockchain amalgamation can transform healthcare services, specifically in personalized medicine.
- **Bogala Mallikharjuna Reddy (2023):** Reviews the role of IoT and ML in smart healthcare applications, providing a broad overview of IoT in healthcare.
- **Key Aspect:** Integrating IoT and ML to create a more efficient and personalized healthcare system, extending beyond cancer to broader medical applications.

6. Swarm Intelligence and Bio-Inspired Optimization

- **Li Cao et al. (2023):** Focuses on swarm intelligence optimization techniques to aid hybrid localization methods. Although not specific to lung cancer, it highlights optimization methods that could be applied in healthcare algorithms.
- **Banerjee & Nath (2022):** Discusses swarm intelligence techniques in optimization, adding a different ML approach to healthcare problems.
- **Key Aspect:** Using bio-inspired optimization for healthcare, potentially applicable to cancer detection models.

7. Image Processing Techniques for Lung Cancer Detection

- **Udeshani et al. (2011):** Uses a statistical feature-based neural network for detecting lung cancer from chest X-rays. It's an early exploration of neural networks applied in image processing.
- **Mokhled S. Al-Tarawneh (2012):** Explores various image processing techniques for lung cancer detection, offering a detailed overview of methodologies involving imaging technology.
- **Key Aspect:** Both focus on image processing techniques, relevant to the evolution of DL-based imaging in later studies.

III. Comparison

Sr.No.	Paper	Key Findings
1.	Alcantud et al. (2019)	Utilized fuzzy and soft set theory to analyze survival rates in lung cancer resections; showed that these methods can aid in decision-making processes for surgical treatments of lung cancer cases.
2.	Asuntha & Srinivasan (2020)	Applied deep learning for lung cancer detection and classification, demonstrating high accuracy in identifying and classifying cancer stages using imaging data.
3.	Bhatia, Sinha, & Goel (2019)	Proposed a deep learning-based model for lung cancer detection, focusing on soft computing techniques for accurate and efficient diagnosis.
4.	Bhuvaneswari & Therese (2015)	Employed K-Nearest Neighbours (KNN) classification with a genetic algorithm for lung cancer detection, achieving improvements in the sensitivity and accuracy of diagnostic results.
5.	Chaubey & Jayanthi (2020)	Discussed the use of deep learning in disease diagnosis and personalized treatment, emphasizing the potential for deep learning to improve decision-making in healthcare, particularly for personalized lung cancer care.
6.	Ganggayah et al. (2019)	Explored survival prediction for breast cancer patients using machine learning, highlighting key survival factors and showing the potential of ML techniques to aid in prognosis and treatment planning in oncology.
7.	Kumar et al. (2021)	Reviewed the integration of IoT, machine learning, and block chain for healthcare applications, emphasizing the role of these technologies in improving healthcare monitoring, data security, and patient outcomes.
8.	Reddy (2023)	Reviewed smart healthcare applications that combine IoT and machine learning, underscoring the role of AI in enabling real-time health monitoring and data-driven treatment recommendations.
9.	Cao et al. (2023)	Investigated a hybrid TDOA/AOA-based localization algorithm using bio-inspired swarm intelligence, demonstrating improved accuracy in healthcare applications requiring precise location tracking.
10.	Banerjee & Nath (2022)	Analyzed swarm intelligence techniques for optimization tasks in healthcare, finding that these algorithms can enhance the efficiency and accuracy of data processing and resource allocation in healthcare systems.

11.	Udeshani, Meegama, & Fernando (2011)	Presented a neural network approach based on statistical features to detect lung cancer in chest X-ray images, showing significant improvements in early-stage cancer detection accuracy.
12.	Al-Tarawneh (2012)	Developed an image processing technique for lung cancer detection, demonstrating the effectiveness of image processing in identifying lung cancer signs in medical imaging, contributing to improved early detection rates.

IV. Conclusion

This comparison highlights a wide range of approaches, from classical ML models to cutting-edge deep learning and optimization techniques. Each paper brings a unique contribution to detection, classification, or predictive analysis in healthcare, with various degrees of specificity to lung cancer.

Optimizing features using intelligent learning techniques presents a promising avenue for early cancer detection. Ongoing research is improving model accuracy and interpretability, while also addressing challenges related to data imbalance and integration into clinical workflows. Future studies should focus on refining these techniques and validating their effectiveness in real-world settings to enhance cancer diagnosis and treatment outcomes. This review summarizes key developments in the field and highlights the importance of continued research in optimizing features for effective early cancer detection.

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References:

[1]. Alcantud, J.C.R., Varela, G., Santos-Buitrago, B., Santos-Garcia, G., Jimenez, M.F.: Analysisof survival for lung cancer resections cases with fuzzy and soft set theory in surgical ssdecisionmaking. PLoS ONE 14(6), e0218283 (2019)
[2]. Asuntha, A., Srinivasan, A.: Deep learning for lung cancer detection and classification. Multimedia Tools Appl. 79, 1–32 (2020)
[3]. Bhatia, S., Sinha, Y., Goel, L.: Lung cancer detection: a deep learning approach. In: Bansal,J.C., Das, K.N., Nagar, A., Deep, K., Ojha, A.K. (eds.) Soft Computing for Problem Solving.AISC, vol. 817, pp. 699–705. Springer, Singapore (2019).
[4]. Bhuvaneswari, P., Therese, A.B.: Detection of cancer in lung with KNN classification usinggenetic algorithm. Procedia Mater. Sci. 10, 433–440 (2015)
[5]. Chaubey, N.K., Jayanthi, P.: Disease diagnosis and treatment using deep learning algorithms for the healthcare system. In: Applications of Deep Learning and Big IoT on Personalized Healthcare Services, pp. 99–114. IGI Global (2020)
[6]. Ganggayah,M.D., Taib, N.A., Har, Y.C., Lio, P., Dhillon, S.K.: Predicting factors for survival of breast cancer patients using machine learning techniques. BMC Med. Inform. Decision Making 19(1), 48 (2019)
[7]. Pratik Kumar, Piyush Yadav, Rajeev Agrawal, Krishna Kant Singh .Book Editor(s):Krishna Kant Singh, Akansha Singh, Sharma: Amalgamation of IoT, ML, and Block chain in the Healthcare Regime**.** First published: 23 July 2021.Wiley Publication.
[8]. Bogala Mallikharjuna Reddy: Amalgamation of Internet of Things and Machine Learning for Smart Healthcare Applications – A Review, May Jun 2023.
[9]. Li Cao,Haishao Chen,Yaodan Chen,Xin Zhang:Bio-Inspired Swarm Intelligence Optimization Algorithm-Aided Hybrid TDOA/AOA-Based Localization, Journals Biomimetics Volume 8 10.3390/biomimetics8020186 , Published: 29 April 2023.
[10]. Abhishek Banerjee, Ira Nath: Implication of the swarm intelligence techniques in optimization, May 2022.
[11]. K.A.G.Udeshani,R.G.N.Meegama,T.G.I.Fernando 2011 Statistical Feature –based Neural Network Approach for the Detection of Lung Cancer in Chest X-Ray Images, International Journal of Image Processing.Vol 5 .Issue 4.pp 425-434
[12]. Mokhled S. Al-Tarawneh 2012 Lung Cancer Detection Using Image Processing Techniques Leonardo Electronic Journal of Practices and Technologies Issue 20. pp. 147-158