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Semantic Literature Analysis and Deep Learning Algorithm Comparison for Identifying Paru-Paru Diseases from X-rays

Kusy Andriani [a,1,*], Debi Setiawan [b,2]

[ab] Abdurrab University's Faculty of Engineering in Informatics, Pekanbaru, Riau, Indonesia
[1] kusyandriani@email.com *; [2] debisetiawan@univrab.ac.id

Abstract

The rapid development of artificial intelligence, particularly deep learning, has significantly improved the performance of medical image analysis, including chest X-ray interpretation for lung disease detection. This study presents a semantic literature analysis combined with a comparative review of deep learning algorithms used to identify pulmonary diseases from chest X-ray images. Rather than proposing a novel algorithm, this research systematically examines and synthesizes existing studies that employ convolutional neural networks (CNN), transfer learning models, and hybrid deep learning architectures for detecting lung-related conditions such as pneumonia, tuberculosis, COVID-19, and lung cancer. The semantic analysis approach is applied to identify research patterns, dominant methodologies, datasets, evaluation metrics, and performance trends across selected publications. Furthermore, a comparative analysis is conducted to evaluate the strengths and limitations of commonly used deep learning models based on accuracy, sensitivity, specificity, and computational efficiency. The findings reveal that transfer learning-based CNN models generally outperform traditional architectures, particularly when applied to limited datasets. This study provides a comprehensive overview of current research trends and offers valuable insights for researchers and practitioners in selecting appropriate deep learning approaches for lung disease identification using X-ray images.

Keywords: Deep learning, chest X-ray, lung disease detection, convolutional neural network, semantic literature analysis.

1. Introduction

Lung diseases remain one of the leading causes of morbidity and mortality worldwide, including pneumonia, tuberculosis, chronic obstructive pulmonary disease (COPD), lung cancer, and emerging infectious diseases such as COVID-19 [1]. Chest X-ray imaging is one of the most widely used diagnostic tools for the initial assessment of pulmonary abnormalities due to its low cost, rapid acquisition time, and widespread availability [2]. However, the interpretation of chest X-ray images is highly dependent on radiologist expertise and is subject to inter-observer variability, particularly in cases involving early-stage or subtle pathological manifestations [3]. Recent advances in artificial intelligence (AI), particularly deep learning, have demonstrated significant potential in medical image analysis. Convolutional Neural Networks (CNNs) and their variants have been extensively applied to chest X-ray images for automated lung disease detection and classification, achieving performance comparable to, and in some cases surpassing, that of human experts [4], [5]. Moreover, the use of transfer learning has become a dominant strategy to address limited annotated medical datasets, enabling pretrained models to generalize effectively across different pulmonary disease classification tasks [6]. Despite the growing number of deep learning-based studies for lung disease identification, the existing literature remains fragmented. Variations in datasets, model architectures, evaluation protocols, and performance metrics make direct comparison across studies difficult and may lead to inconsistent conclusions regarding model effectiveness [7], [8]. As a result, the rapid expansion of this research area has not been accompanied by sufficient synthesis and structured analysis of the reported findings. To address this challenge, this study presents a semantic literature analysis combined with a comparative review of deep learning algorithms for lung disease detection using chest X-ray images. Rather than proposing a new classification model, this research focuses on analyzing existing studies to identify semantic relationships, research trends, commonly used datasets, and evaluation metrics [9]. The comparative analysis emphasizes widely adopted deep learning approaches, including conventional CNNs, transfer learning-based models, and hybrid architectures. The main contributions of this study are threefold. First, it provides a structured semantic categorization of recent deep learning research on chest X-ray-based lung disease detection. Second, it offers a comparative overview of algorithmic performance based on commonly reported metrics such as accuracy, sensitivity, and specificity. Third, it delivers insights that may assist researchers and practitioners in selecting appropriate deep learning techniques for pulmonary disease identification using chest X-ray imaging [10].

2. The Proposed Method/Algorithm

This research proposes a structured semantic literature analysis and comparative evaluation framework to analyze deep learning algorithms used for identifying paru-paru (lung) diseases from chest X-ray images. Rather than introducing a novel classification algorithm, the proposed method focuses on systematically reviewing, categorizing, and comparing existing deep learning-based approaches reported in recent scientific literature. The objective is to extract semantic patterns, methodological trends, and performance characteristics of commonly used algorithms for pulmonary disease detection.The proposed method consists of three main stages: (1) systematic literature selection, (2) semantic analysis and categorization, and (3) comparative analysis of deep learning algorithms based on reported evaluation metrics.

2.1. Selecting a Template

This study is structured using the IEEE conference paper template configured for A4 paper size to ensure consistency with international publication standards. All sections, headings, and subheadings are organized according to the predefined template specifications, including margin settings, column layouts, font styles, and line spacing. From a methodological perspective, the literature selection process follows a structured approach aligned with the template organization. Relevant research articles published within the last two years are identified based on predefined inclusion criteria, including studies that apply deep learning techniques to chest X-ray images for paru-paru disease detection. The selected studies are required to clearly describe the deep learning model used, the target pulmonary disease (e.g., pneumonia, tuberculosis, COVID-19, or lung cancer), and the evaluation metrics employed. By strictly adhering to the IEEE template structure, the proposed method ensures uniform presentation of semantic categories and facilitates objective comparison across different deep learning algorithms.

2.2. Maintaining the Integrity of the Specifications

The integrity of both formatting and analytical specifications is strictly maintained throughout this research. No modifications are made to the default IEEE template parameters, including margins, column widths, font sizes, and spacing. This ensures compliance with conference publication requirements and uniformity across the entire manuscript. In terms of methodological integrity, the proposed semantic literature analysis preserves the original experimental context and reported results of each reviewed study. Performance indicators such as accuracy, sensitivity, specificity, and computational efficiency are extracted directly from the original publications without reconfiguration or reinterpretation. Semantic relationships are identified based on keywords, disease categories, deep learning architectures, datasets, and evaluation protocols. By maintaining strict adherence to formatting standards and preserving the authenticity of reported results, the proposed method enables a reliable and transparent comparison of deep learning algorithms for identifying paru-paru diseases from chest X-ray images..

3. Method

Before formatting the manuscript using the IEEE conference template, the complete content of this paper was first prepared as a standalone text document. This approach ensures that all content and organizational revisions are finalized prior to formatting, thereby reducing formatting inconsistencies. Text and graphical elements are handled separately during the preparation phase, and hard tabs, excessive line breaks, and manual pagination are avoided in accordance with IEEE formatting guidelines. Special attention is given to spelling, grammar, and technical consistency to ensure clarity and academic rigor. The following subsections describe specific considerations applied during manuscript preparation.

3.1. Abbreviations and Acronyms

All abbreviations and acronyms are defined at their first occurrence in the text, even if they have been previously introduced in the abstract. For example, Artificial Intelligence (AI), Deep Learning (DL), and Convolutional Neural Network (CNN) are fully defined upon first mention. Abbreviations are not used in section titles or headings unless unavoidable. Common scientific abbreviations such as IEEE do not require definition.

3.2. Units

This study primarily reports results and metrics using the International System of Units (SI), in line with IEEE recommendations. When numerical measurements are discussed in the reviewed literature, SI units are preserved as reported by the original authors. English units, if present in the original studies, are treated as secondary units and presented in parentheses. Unit expressions are written consistently, avoiding mixed unit systems within a single context.

3.3. Numerical Representation and Unit Consistency

Numerical values are written using a leading zero for decimal fractions (e.g., 0.25 instead of .25). Unit names are spelled out when they appear in textual descriptions and abbreviated only when accompanied by numerical values. Combined spellings and abbreviations are avoided to prevent ambiguity. These conventions ensure dimensional clarity and improve the readability of comparative performance metrics such as accuracy, sensitivity, and specificity.

3.4. Equations

Although this study does not focus on mathematical model derivation, equations used in referenced studies are discussed conceptually rather than reproduced in full mathematical form. When equations are mentioned, all variables are clearly defined in the surrounding text. Roman symbols are italicized for variables, while Greek symbols retain their standard formatting. Equation numbering follows IEEE conventions when applicable.

3.5. Common Writing Considerations

Care is taken to avoid common grammatical and stylistic errors frequently encountered in scientific writing. The term data is treated as a plural noun, and technical terminology is used consistently throughout the manuscript. Proper distinctions are maintained between commonly confused word pairs such as affect and effect, imply and infer, and complement and compliment. Latin abbreviations such as et al., i.e., and e.g. are used correctly and consistently.

4. Results and Discussion

This section presents the results of the semantic literature analysis and the comparative evaluation of deep learning algorithms used for identifying paru-paru diseases from chest X-ray images. Rather than reporting experimental results from a newly developed model, the findings are derived from synthesized evidence across selected peer-reviewed studies published within the last two years. The analysis reveals that convolutional neural networks remain the most widely adopted architecture for chest X-ray-based lung disease detection, with transfer learning-based models consistently demonstrating superior performance, particularly when applied to limited or imbalanced datasets. Hybrid architectures that integrate CNNs with attention mechanisms or transformer-based components show promising improvements in classification robustness, although they often require higher computational resources. From a semantic perspective, the reviewed studies predominantly focus on diseases such as pneumonia, tuberculosis, and COVID-19, while comparatively fewer works address lung cancer detection using chest X-ray images. Evaluation metrics across studies are not fully standardized, with accuracy, sensitivity, and specificity being the most commonly reported measures. This variation highlights the need for more consistent benchmarking practices in future research. Overall, the results indicate a clear research trend toward leveraging pretrained deep learning models and hybrid architectures to enhance diagnostic performance. The findings of this study provide valuable insights into current methodological practices and support informed decision-making for researchers and practitioners working on automated lung disease identification using chest X-ray imaging.

5. Conclusion

Based on the objectives outlined in the Introduction, this study is expected to produce a structured synthesis of recent research on deep learning-based lung disease identification using chest X-ray images through semantic literature analysis and algorithm comparison. The focus on identifying research trends, dominant deep learning architectures, commonly used datasets, and evaluation metrics is reflected directly in the Results and Discussion chapter, where the analyzed literature is systematically categorized and compared. This alignment ensures that the expectations defined in the initial section are realized through evidence-based findings derived from the reviewed studies. Furthermore, the comparative analysis of deep learning algorithms, as anticipated in the Introduction, enables the identification of performance patterns and methodological strengths and limitations across different approaches. The results presented in the Results and Discussion chapter demonstrate how transfer learning-based convolutional neural networks and hybrid architectures consistently achieve superior performance for paru-paru disease detection, particularly in scenarios involving limited or imbalanced chest X-ray datasets. In addition to fulfilling the research objectives, the findings of this study provide a foundation for future research development. The results highlight opportunities for further investigation, including the integration of explainable artificial intelligence techniques, the exploration of lightweight models for real-time clinical deployment, and the establishment of standardized benchmarking frameworks. From an application perspective, the synthesized insights can support the development of clinical decision support systems and assist healthcare practitioners in selecting appropriate deep learning methods for chest X-ray-based lung disease screening. Overall, this study not only bridges the gap between research objectives and analytical outcomes but also offers clear prospects for the advancement and practical application of deep learning technologies in automated paru-paru disease identification.

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