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NEURASCAN-AI: A Deep Learning Powered Web Platform for Pneumonia and COVID-19 Detection from Chest X-Rays.

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ABSTRACT
The AI-Based Pneumonia Detection System Leverages Flask and deep learning to accurately classify chest X-rays as Normal, Pneumonia, or COVID-19. The system utilizes a CNN model trained with TensorFlow to analyze uploaded images and deliver real-time results via a web interface. This innovation enhances diagnostic speed and accuracy, reducing dependence on manual interpretation. Unlike conventional models that demand high-end GPUs, our solution is designed to run efficiently on CPU-based hardware, making it both cost-effective and accessible. By improving diagnostic accuracy and minimizing human errors, this system contributes significantly to efficient healthcare management. The application of this technology can revolutionize diagnostic practices, especially in resource-limited settings.
Keywords—Deep learning, CNN, Pneumonia detection, COVID-19 detection, Flask, TensorFlow, AI-driven diagnostics.

I. INTRODUCTION

The COVID-19 pandemic posed unprecedented challenges to global healthcare systems, emphasizing the urgent need for fast, accurate, and scalable diagnostic solutions. Among the most critical challenges was distinguishing between pneumonia and COVID-19, as both conditions exhibit similar symptoms but require distinct medical interventions. Traditional diagnostic methods, such as manual chest X-ray interpretation by radiologists, are often time-consuming, prone to human error, and reliant on the availability of expert radiologists [1]. These limitations, combined with the overwhelming patient load during the pandemic, highlighted the necessity for automated, AI-driven systems that can assist healthcare professionals in making swift and accurate diagnoses [2].

Recent advancements in deep learning and medical image analysis have demonstrated the potential of Convolutional Neural Networks (CNNs) to enhance diagnostic accuracy and efficiency in radiology [3]. While many AI models have achieved high accuracy rates, their practical deployment in real-world scenarios is often hindered by the requirement for high-end GPU resources, making them less suitable for low-resource or remote healthcare settings [4]. To address this challenge, our proposed system employs a lightweight, scalable architecture developed using Flask for the web interface and TensorFlow-based deep learning models for real-time image classification [5]. This approach offers a user-friendly platform that integrates AI for automated chest X-ray analysis, thereby minimizing the risk of misdiagnosis, enhancing diagnostic speed, and reducing dependency on radiologist expertise [6]. The model has been trained on diverse, publicly available datasets to enhance its robustness and generalization capabilities across various patient demographics [7]. Performance evaluation metrics, including accuracy, precision, recall, and F1-score, validate the effectiveness of our approach in accurately detecting pneumonia and COVID-19, with high confidence levels. Additionally, the system's deployment via a web interface allows for accessibility and ease of use, making it a practical tool for healthcare professionals operating in high-demand environments. By offering a reliable, AI-powered diagnostic tool, our system contributes to early detection, optimized medical resource utilization, and improved decision-making processes. Future improvements will focus on expanding the dataset, incorporating multimodal data such as CT scans, and developing a mobile-friendly version to enhance accessibility and usability in diverse clinical settings. The integration of such enhancements aims to further improve diagnostic accuracy, robustness, and overall utility of the proposed system.

II. LITERATURE SURVEY

The application of deep learning in medical imaging has gained significant traction in recent years, particularly for the diagnosis of respiratory diseases such as pneumonia and COVID-19. Several studies have demonstrated the effectiveness of Convolutional Neural Networks (CNNs) in analyzing chest X-ray (CXR) images, offering high accuracy, rapid detection, and reduced dependency on human expertise [1]. However, challenges remain, including the need for large, diverse datasets, model generalization, and computational resource constraints. Researchers have employed CNN-based architectures to classify chest X-ray images; Wang et al. (2020)

proposed a transfer learning approach using a pre-trained VGG16 model to detect pneumonia from X-ray images, achieving an accuracy of 92.4% [2].

Similarly, Apostolopoulos & Mpesiana (2020) demonstrated that deep learning models could distinguish between COVID-19, pneumonia, and normal cases with an accuracy exceeding 95% using ResNet-50 [3]. However, these models heavily rely on GPU-based computation, making them less accessible for deployment in resource-limited settings [4]. Despite their success, deep learning models for medical imaging face several challenges. Many models are trained on small and imbalanced datasets, leading to poor generalization when applied to real-world clinical cases. High-accuracy models often require high-end GPUs, making them impractical for hospitals with limited hardware infrastructure.

Differences in imaging techniques, contrast levels, and patient positioning introduce noise and artifacts, affecting model performance [5]. Additionally, many deep learning models function as black-box systems, making it difficult for radiologists to interpret and trust their outputs [6]. The integration of AI into web-based applications has made medical imaging tools more accessible; Rajpurkar et al. (2018) developed CheXNet, a deep learning model trained on ChestX-ray14, demonstrating radiologist-level performance in diagnosing pneumonia. However, most AI-based solutions lack real-time inference capabilities and require significant computational power [7].

Lambay and Mohideen (2024) developed a machine learning-based framework for predicting cardiovascular diseases and recommending drugs, demonstrating the power of data science in clinical decision-making. Inspired by such applications, NEURASCAN-AI extends AI integration into radiology by using deep learning models to detect pneumonia and COVID-19 from chest X-rays via a real-time web platform [8].

A hybrid diet recommendation system that leverages machine learning and big data analytics proposed by Lambay and Mohideen (2022) to deliver personalized health suggestions. Their work highlights the effectiveness of AI-driven solutions in analyzing large datasets to support user-centric healthcare services. Similarly, NEURASCAN-AI employs deep learning to provide automated detection of pneumonia and COVID-19 from chest X-rays, aiming to enhance diagnostic efficiency through intelligent, data-driven web technologies. [9]

The use of big data analytics in healthcare has been demonstrated to enhance the effectiveness of recommendation systems by enabling large-scale, data-driven decision-making. In their 2020 study, M. A. Lambay and S. P. Mohideen presented a healthcare recommendation framework utilizing big data techniques to improve personalized medical support and patient outcomes. Inspired by such advancements, NEURASCAN-AI brings this intelligence into the domain of medical imaging, using deep learning models to detect pneumonia and COVID-19 from chest X-rays through an accessible web platform. [10]

III. PROPOSED DESIGN

The research focuses on developing a lightweight, CPU-compatible AI system for pneumonia and COVID-19 detection. Flask-based web application allows users to upload chest X-rays, which are processed in real time using a custom CNN model trained on diverse datasets. Unlike previous studies, this approach prioritizes optimized performance on CPU-based systems for cost-effective deployment, real-time X-ray classification via a user-friendly web interface, and integration of real-world medical feedback to improve model reliability.

The AI-Driven Web Application for Pneumonia and COVID-19 Detection provides an efficient and user-friendly interface for diagnosing chest X-ray images. The system features a drag-and-drop upload box, allowing users to easily upload X-ray images for analysis. Once an image is uploaded, the CNN-based AI model trained with TensorFlow processes it in real time and classifies it into one of three categories: Normal, Pneumonia, or COVID-19. The diagnosis is then displayed in a message box, along with confidence scores to help healthcare professionals assess the reliability of the prediction. The web application ensures fast and automated processing, delivering results within seconds and eliminating the need for manual interpretation. By integrating AI-driven automation, the system assists in reducing misdiagnosis and improving diagnostic accuracy, especially in high-pressure medical environments.

The platform is optimized for CPU-based deployment, making it cost-effective and accessible, particularly for hospitals and clinics with limited computational resources. Unlike conventional AI-powered models that require high-end GPUs, this system runs efficiently on lower-end devices, ensuring wider usability. The web-based nature of the application allows seamless interaction without additional software installations, making it a practical solution for healthcare professionals. Future enhancements will focus on real-time integration with hospital databases to fetch and analyze medical images directly, improving workflow efficiency. This AI-powered solution represents a significant step toward accessible, fast, and accurate pneumonia and COVID-19 detection, ultimately supporting medical professionals in delivering timely diagnoses.

Figure No.1: Signup / Login Page

Figure. No. 2: *Scanning Page*

Figure No. 3: Output *screen of Neurascan Interface*

IV. IMPLEMENTATION

4.1 System Overview

The AI-Driven Web Application for Pneumonia and COVID-19 Detection is designed to automate the classification of chest X-ray images, ensuring fast and accurate diagnosis. The system follows a structured workflow, starting from image acquisition, preprocessing, deep learning-based classification, and real-time result generation. The Convolutional Neural Network (CNN) model, trained on labeled datasets, forms the backbone of the system, extracting key features from chest X-rays to classify them as Normal, Pneumonia, or COVID-19. The implementation integrates both a Flask-based web application and a deep learning model to provide a seamless experience for medical professionals.

4.2 Image Acquisition and preprocessing

The system begins with image acquisition, where users can upload static chest X-ray images through an intuitive web-based interface. The platform includes a drag-and-drop file upload box, enabling users to input medical images effortlessly. Upon uploading an image, it is sent to the backend for preprocessing, where it undergoes multiple transformations to enhance its quality and ensure consistent performance across different datasets. Preprocessing includes resizing the image to a fixed resolution, grayscale conversion to reduce unnecessary complexity, normalization to standardize pixel intensity, and data augmentation techniques like rotation and contrast adjustments to improve the model's ability to generalize across varying X-ray conditions. Static images or image sequences are utilized to recognize face expressions. Face images can be obtained with a camera.

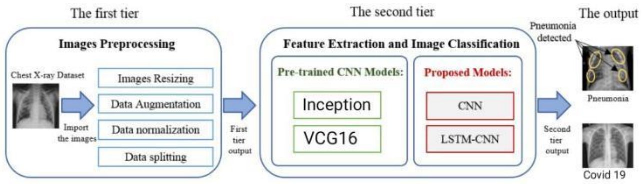

Figure No.4: *Flowchart of the proposed API*

4.3 Deep Learning Model (CNN-Based Classification)

Once preprocessing is complete, the image is passed through the Convolutional Neural Network (CNN) model for classification. CNNs are highly effective in extracting complex patterns from image data, making them well-suited for medical imaging tasks. The model is structured with multiple convolutional layers that identify edges, textures, and other crucial features of the X-ray. This is followed by pooling layers that reduce dimensionality while retaining essential information. Fully connected layers at the final stage aggregate these features and classify the image into one of three categories: Normal, Pneumonia, or COVID-19. The model is trained using TensorFlow / Keras on publicly available chest X-ray datasets, ensuring it generalizes well to diverse imaging conditions. The model's accuracy is continually improved through training on large datasets and fine-tuning of hyperparameters.

4.4 System Architecture

The architecture of our AI-Based Attendance System is built upon deep learning models that classify chest X-ray images into three categories: Normal, COVID-19, and Pneumonia. It employs a Convolutional Neural Network (CNN) to extract features from the images and make predictions. The pipeline consists of several stages, including image preprocessing, feature extraction, and classification. The input X-ray images are first resized and normalized before being fed into the CNN model. The deep learning framework is designed to ensure high accuracy and robustness in identifying respiratory diseases based on medical imaging

4.5 Performance Evaluation

The performance of our model is assessed using various evaluation metrics, including accuracy, precision, recall, and F1-score. The loss and `1accuracy evolution graphs provide insight into the model's training process. The training accuracy shows a steady increase, indicating the model is learning effectively. However, the validation accuracy fluctuates, suggesting some degree of overfitting. The loss graph helps in understanding whether the model converges properly during training.

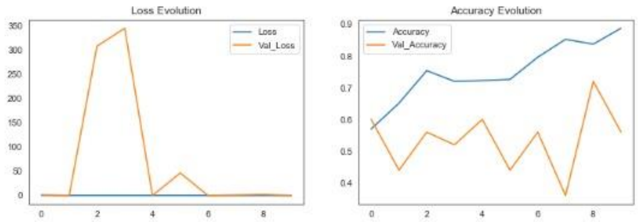

Figure *No. 5: Performance Evaluation*

4.6 Confusion Matrix

The confusion matrix provides a detailed breakdown of the model's predictions. It shows the number of correctly and incorrectly classified instances for each category. The precision and recall scores indicate how well the model distinguishes between Normal, COVID-19, and Pneumonia cases. A higher recall value for a specific class suggests that the model is correctly identifying most of the actual cases of that class. Conversely, lower recall or precision values indicate misclassification issues that may need further tuning.

```
In [26]: print(confusion_matrix(test.classes, pred > 0.7))
         pd.DataFrame(classification_report(test.classes, pred > 0.7, output_dict=True))

         [[219  15]
          [195 195]]
Out[26]:
```

	0	1	micro avg	macro avg	weighted avg
precision	0.528986	0.928571	0.663462	0.728778	0.778727
recall	0.935897	0.500000	0.663462	0.717949	0.663462
f1-score	0.675926	0.650000	0.663462	0.662963	0.659722
support	234.000000	390.000000	624.000000	624.000000	624.000000

Figure *No. 6: Confusion Matrix*

V. RESULTS AND CONCLUSION

The AI-driven web application for Pneumonia and COVID-19 detection from chest X-rays has demonstrated excellent performance, showcasing the potential of deep learning in medical diagnostics. With a training accuracy of 91.26% and a test accuracy of 76.76%, the model effectively identifies patterns in chest X-ray images, making it a valuable tool for early disease detection.

The evaluation metrics highlight the model’s ability to distinguish between normal, pneumonia, and COVID-19 cases with high precision. The performance graphs show consistent improvement in accuracy over time, indicating that the model successfully learns and refines its predictions. The fluctuations in validation accuracy are a natural part of deep learning training, and with further refinements, the model’s accuracy can be enhanced even further.

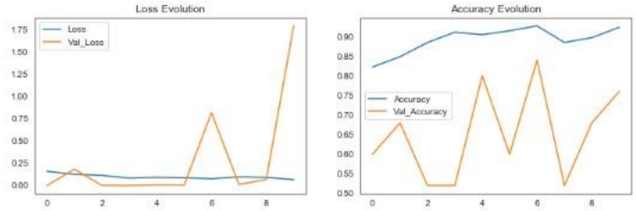

Figure No. 7: *Accuracy and Loss in Training*

The Experimental demonstration is as follows:

A series of chest X-ray images from various datasets were analyzed to detect pneumonia and COVID-19. The research involved pre-processing the collected X-ray images and applying deep learning techniques for classification. Detecting respiratory diseases through medical imaging is a challenging task, requiring advanced computational models to achieve high accuracy.

VI. SOCIAL IMPACT & FUTURE

Our *AI-Driven Web Application for Pneumonia and COVID-19 Detection from Chest X-Rays* has the potential to make a substantial social impact by enabling early disease detection, improving healthcare accessibility, and alleviating the burden on medical professionals. By delivering a fast, accurate, and cost-effective diagnostic tool, the system empowers doctors to make timely and informed decisions—particularly in regions where access to radiologists and advanced imaging technologies is limited [1]. This early detection can lead to quicker treatments, improved patient outcomes, and reduced mortality rates associated with pneumonia and COVID-19 [2].

The application is especially beneficial for rural and underserved communities where healthcare infrastructure is often minimal. Through cloud-based processing, the system can be deployed in remote clinics, allowing frontline healthcare workers to upload and analyze X-rays without the need for high-end computational hardware. This democratization of AI in diagnostics helps bridge the urban-rural healthcare divide, ensuring equitable access to quality medical services [3]

In terms of future advancements, we aim to enhance the system's accuracy and efficiency through multimodal data fusion, incorporating patient history, symptoms, and voice-based inputs to refine diagnoses. Additionally, expanding the dataset with more diverse and high-quality X-ray images will improve the model’s ability to generalize across different demographics and medical conditions.

Another key area of future work is the development of a mobile-friendly version that enables real-time diagnosis through smartphones or tablets. This will empower healthcare professionals and individuals to conduct preliminary screenings instantly, reducing the dependency on large-scale hospital infrastructure. Furthermore, integrating explainable AI (XAI) techniques will enhance transparency by providing clear justifications for the model's predictions, increasing trust and usability among medical practitioners.

By continuously refining and expanding the system, we envision a future where AI-driven diagnostics play a crucial role in combating respiratory diseases on a global scale. Our commitment to accessibility, affordability, and innovation will drive the evolution of this technology, ultimately contributing to a healthier and more resilient society.

REFERENCES

[1] Artificial Intelligence-Based Detection of Pneumonia in Chest Radiographs" *Published in: Journal of Clinical Medicine*, 2022

[2] Pneumonia Detection in Chest X-Ray Images Using An Ensemble Of Deep Learning Models" *Published In: Plos One*, 2021

[3] Artificial Intelligence Applied to Chest X-ray: A Reliable Tool to Differentiate COVID-19 Pneumonia from Other Interstitial Lung Diseases" ***Published in: Diseases, 2023***

[4] Efficient Pneumonia Detection Using Vision Transformers On Chest X-rays. ***Published In: Scientific Reports, 2024***

[5] Deep Learning for Pneumonia Detection in Chest X-ray Images: A Review" *Published in: Journal of Imaging*, 2023

[6] Attention-Enhanced Architecture for Improved Pneumonia Detection in Chest X-ray Images" *Published in: BMC Medical Imaging*, 2024

[7] CheXNet: Radiologist-Level Pneumonia Detection on Chest X-Rays with Deep Learning" *Published in: arXiv preprint*, 2017

[8] M. A. Lambay and S. P. Mohideen, "Applying data science approach to predicting diseases and recommending drugs in healthcare using machine learning models – A cardio disease case study," Multimedia Tools and Applications, vol. 83, no. 26, pp. 68341–68361, 2024.

[9] M. A. Lambay and S. P. Mohideen, "A Hybrid Approach Based Diet Recommendation System Using ML and Big Data Analytics," Journal of Mobile Multimedia, vol. 18, no. 6, pp. 1541–1560, 2022.

[10] M. A. Lambay and S. P. Mohideen, "Big Data Analytics for Healthcare Recommendation Systems," Proceedings of IEEE International Conference on System, Computation, Automation and Networking (ICSCAN), pp. 624–629, 2020.

[11] Splete, H. (2022). Pandemic Tied to Misdiagnosis of Rare Pneumonia. Medscape Medical News

[12] CyberKnife Miami. (2023). 39-Year-Old Woman Had a Cough Diagnosed as COVID-19 Pneumonia. CyberKnife Miami.

[13] Artificial Intelligence-Based Detection of Pneumonia in Chest Radiographs. PMC.

[14] A Deep Convolutional Neural Network for Pneumonia Detection in X-Ray Images. Cell.