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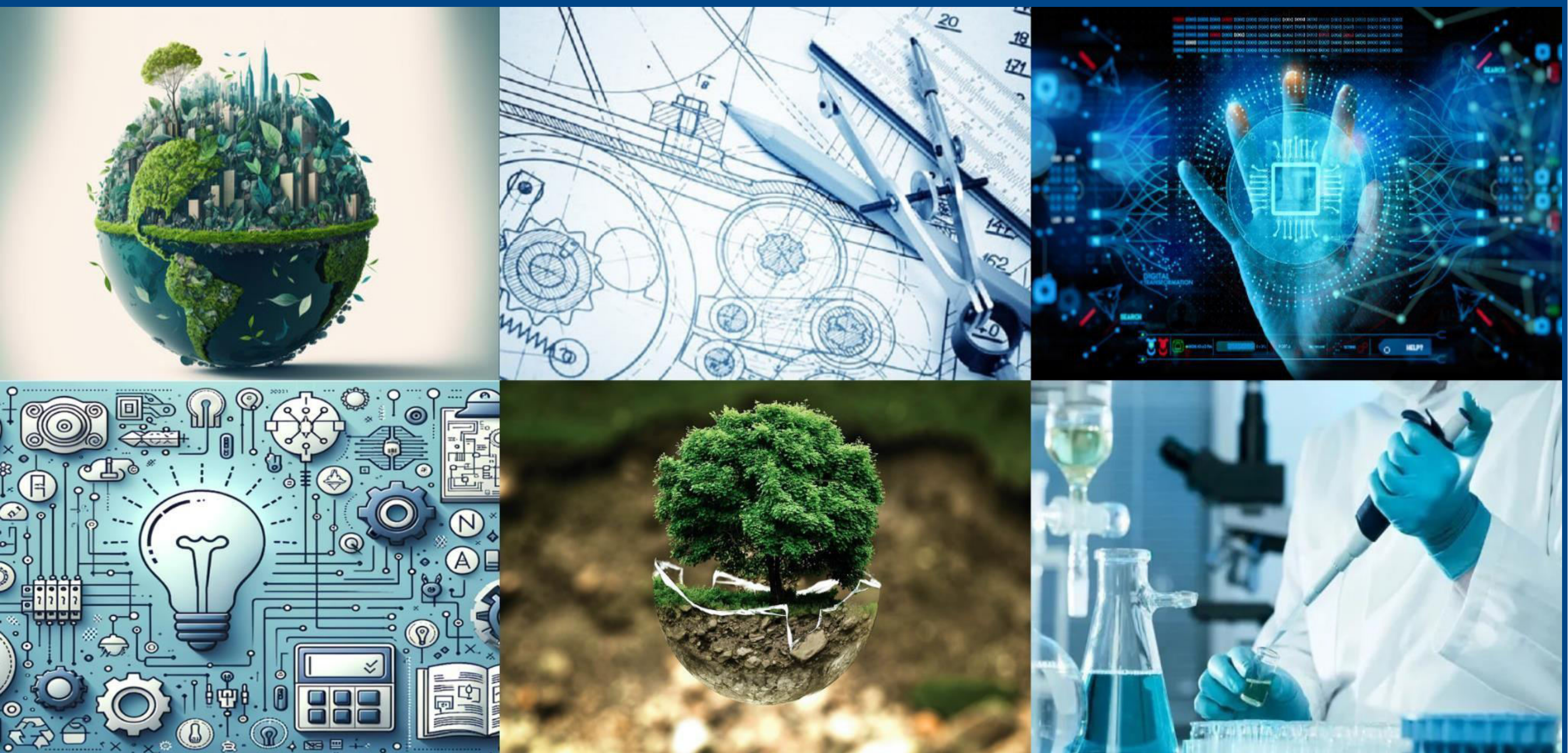

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AIRNOSIS: A NEW FRONTIER IN RESPIRATORY DIAGNOSIS

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ABSTRACT: Airnosis is an intelligent respiratory diagnosis system that utilizes deep learning for providing early-stage diagnosis & analyses of lung disease. The system consists of a Convolutional Neural Network (CNN) which is pretrained on a few thousand chest X-ray images, which are stored via hdf5 format. The CNN can provide respiratory condition diagnoses with high degrees of accuracy and reliability. Importantly, Grad-CAM graphs are constructed to provide clinicians with heatmaps that direct their attention in accordance with the region of the image the model was highlighting as influential in its predictions. Lung segmentation is a prominent feature of Airnosis to ensure that localization of the lung region from the X-ray image is distinguishing and consistent. The backend of the system is structured as a lightweight Flask API for image processing and predicting. The UI will also be created using React.js and provide a pleasant experience for the user to upload images and observe the diagnostic results, confidence scores, & visual explanation variable. Airnosis aims to be a facilitating force between AI innovation and healthcare by producing an accessible, explainable & efficient service to support respiratory diagnostics.

In a world where respiratory diseases kill millions of people every year, Airnosis represents a significant step toward smarter, faster, and more equitable access to care. The AI-based system was developed to support practitioners by investigating chest x-rays with a Cad-based convolution neural network (CNN) framework. Furthermore, Airnosis does not merely detect - it provides explanations. This is accomplished by both lung segmentation and Grad-CAM visualizations.

KEYWORDS: Respiratory Diagnosis, Chest X-ray, Deep Learning, Convolutional Neural Network (CNN), Pulmonary Segmentation, Grad-CAM, Explainable AI (XAI), Medical Imaging, Flask API, React.js, AI in Healthcare, HDF5 Model, Computer Vision, Remote Diagnosis, Image Classification

I. INTRODUCTION

Breathing becomes hard for countless patients suffering from respiratory illnesses, such as pneumonia, tuberculosis, and COVID-19. While many respiratory diseases can be effectively treated, strategies for early detection of these diseases usually unduly depend on a specialist's interpretation of lousy chest X-rays, which we cannot rely on in every corner of the world. This is the problem that Airnosis aims to solve.

Airnosis is more than another AI product (anti-product); it is an empathy-driven innovation that helps bring strength into diagnostic support to deliver value where it is needed most. At its heart, Airnosis's AI technology uses a deep learning model to assess chest X-rays to identify respiratory disease with speed and accuracy (usually more than a chest radiographer). But unlike other AI diagnostic tools, Airnosis has established itself on the premise of forming an explanatory narrative behind its predictions as visual cues, justified with evidence and openly shareable, thus rendering the findings easier to share, consider, and perhaps understand for the doctors - and even the patients - who practice on the inside.

The project brings together some of the most advanced technologies available today: a CNN model for classification, a segmentation module to identify the lung parts being analyzed, & Grad-CAM to visualize our model's "thinking". Our backend powered by Flask handles the predictions and processing, and our frontend developed in React and Material UI makes the entire experience understandable and simple for the user.

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By marrying artificial intelligence with human-centered design, Airnosis hopes to become a trustworthy partner in the fight against respiratory illness: a partner that does not simply diagnose, but inform, enable, & ultimately, save lives.

II. LITERATURE SYRVEY

[1] Rajpurkar et al. (2017) developed CheXNet, a 121-layer Convolutional Neural Network that performed pneumonia detection from chest X-ray images. The model achieved accuracy levels comparable to radiologists, but it was restricted to mainly pneumonia detection in X-ray images. CheXNet also lacked a web-based user interface and a larger rollout plan for implementing and using in rural clinics and/or mobile capacities. The research also did not incorporate visualize-based transparency into the predictions (i.e. Grad-CAM), additionally hampering clinical interpretability.

[2] Ronneberger et al. (2015) introduced the U-Net architecture for biomedical image segmentation, which was shown to be very effective at segmenting lung regions in chest X-ray images. U-Net was very basic, however, being only anatomical segmentation, and wasn't linked to any classification or diagnostics models. There was no real-time diagnostic model or user interface with U-Net and its portability or usability with real world datasets was not elaborated.

[3] Selvaraju et al. (2017) presented Grad-CAM (Gradient-weighted Class Activation Mapping) as a new way to see how deep learning models are making decisions. The introduction of an overlaid heatmap on important parts of input images greatly enhances model interpretability, but Grad-CAM was shown in the context of research only and not operationalized and implemented into the system where doctors or patients could gain visual feedback.

[4] Esteva et al. (2019) examined AI-based diagnostics in low-resource settings, They established that AI models could help healthcare workers who were not specialists. Although significant, the AI models by Esteva lacked a user-friendly scalable web-based interface or a seamless cloud API with real time uploads and a visual explanation of model feedback. The integration of user experience and design and dependent frontend/backend interface use was also limited.

While each of these technologies helped pave the way for the incorporation of artificial intelligence into medical imaging, most either remained prototype only or did not have a full suite of user-facing apps. Airnosis advances these technologies by providing CNN-based classification, UNet lung segmentation, and Grad-CAM explanation in a clinical, web-based tool consisting of a React.js frontend (user interface) and Flask API backend. This allows for a real-time respiratory diagnostic tool that is not only accurate but explainable and easy to access.

EXISTING SYSTEM

The current diagnostic process for respiratory diseases is reliant on radiologists undertaking manual interpretation of chest X-ray reports. The process is effective but is also time-consuming, takes a specialist's knowledge or experience, and may not be available in rural or resource poor areas of the world. Some automated systems have been developed using either machine learning or deep learning but still remained limited for one or more important reasons.

In general, most existing AI-based systems are either classification or segmentation systems but they do not do both at the same time. As an example, some models can detect if there is pneumonia visible on a chest X-ray, but they fail to tell you why and are very limited on interpretability. Other systems used for lung segmentation can reduce the area of interest but fail to provide anything diagnostic.

PROPOSED SYSTEM

The proposed system, Airnosis, is an AI-powered web application that is intended to support early & accurate diagnosis of respiratory diseases using chest X-ray images. In contrast to existing systems, Airnosis integrates deep learning classification, lung segmentation, and visual explainability, all into one interface, whilst still being user-friendly. Airnosis is not intended as a solution to the decline of radiology as a profession, but to bridge the gap between medical expertise & accessibility, particularly in locations where radiology services are limited.

The model includes a Convolutional Neural Network (CNN), which has learned from labelled chest X-ray datasets to identify pathology such as pneumonia or other respiratory-related conditions. In order to ensure that diagnostic focus remains on the lung, a segmentation model, of UNet architecture, identifies the lung region, so that the classifier only includes the anatomical region of interest .

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III. SYSTEM ARCHITECTURE

The platform has a web frontend based on React.js and a mobile application that utilizes The Airnosis system architecture is composed of a React.js frontend that supports image upload and result viewing, along with a Flask API backend that coordinates the processing. When the user uploads an X-ray image, it first goes through a UNet-based lung segmentation model to get rid of any irrelevant portions of the image. After the lung image is separated, a CNN model analyzes it to classify respiratory disease. Grad-CAM is used to generate a heatmap showing which areas had the strongest influence on the diagnosis. The complete prediction, confidence score, and heatmap were then returned to the user through the frontend UI.

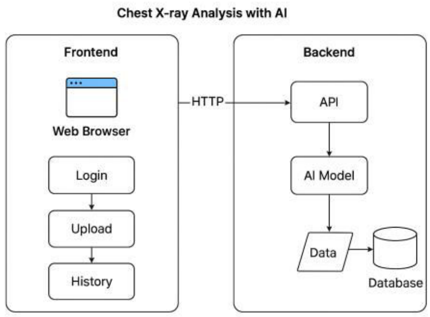

Fig 4.1 System Architecture

IV. METHODOLOGY

The process for "Airnosis: A New Frontier in Respiratory Diagnosis" follows a technical workflow integrating deep learning & medical imaging for detecting respiratory diseases. First, the chest X-ray images were downloaded from public datasets, and preprocessing (e.g. normalizing and resizing) and data augmentation steps were conducted.

There were two deep learning models created: a CNN-based classification model (cnn_model.h5) for detecting diseases (pneumonia, tuberculosis, etc.), and a U-Net model (unet_model.h5) for segmenting the lung region. The models were trained, validated, & tested with common metrics, such as accuracy and F1-score. Also, Grad-CAMs were implemented and provided to increase model explainability and allow the clinician to understand what the model is focusing on during prediction.

V. DESIGN AND IMPLEMENTATION

In the design of the Airnosis system we start with a modular and scalable architecture that aims to realize the separation of concerns over the frontend, backend and model layers. The backend is designed using Flask which handles routing to different endpoints, file handling, model interfacing, and database interactions. The URL for the frontend allows the user to upload a chest X-ray image file and is processed by two image-based deep learning models: Convolutional Neural Network (CNN) for classification and U-Net for sssssegmenting the lungs. The deep learning models are preloaded during the startup of the Flask server to ensure rapid inference capabilities. The use of Grad-CAM on the X-ray images provides visual explanations so allowing the user to observe the specific areas in the images that inspired the diagnosis. The overall structure of the backend is made up of logical compartments; app.py contains routing and handlers for the endpoints, utils.py contains functions for interfacing with the models, and db.py contains logging and history.

The frontend of the application is built in React.js to create an intuitive, responsive user interface using Material UI components. The user interface contains pages like Home, Upload, Results, Login, and History, all connected through React Router. Users can upload X-ray images using either a drag and drop interface, or a file selector, and see the predicted classification results updated in real-time on screen with a Grad-CAM visualization corresponding to the X-ray image and predicted results. The frontend communicates with the Flask backend through a series of RESTful API calls and sends images and receives prediction results that are reported with confidence scores. The entire system was

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tested and deployed in an isolated environment, and since the system is built in a decoupled fashion, it can be upgraded, containerized, or deployed on platforms such as AWS or Heroku.

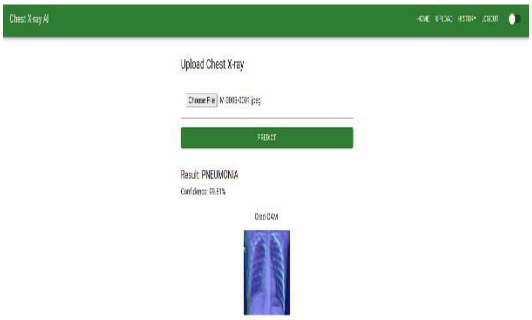

Fig 4.2 Working detection of disease

VI. OUTCOME OF RESEARCH

The research resulted in an intelligent, AI-enabled system that can classify & interpret chest X-ray images to provide diagnosis of respiratory disease, either with pneumonia or tuberculosis, on a real-time basis. The classification aspect of the system was based on a CNN model, which performed well in detecting various conditions, The segmentation model used U-Net deep learning algorithm which provided an effective way to segment out the lung regions from the compositional image which potentially improve predictions. Grad-CAM provided increased explainability to give users (informally and professionally) an additional layer of comfort to appreciate users which parts of the X-ray were highlighted or influenced the AI recommendation. Overall the system was dependable in respect to speed, performance, & interpretability during local tests.

In addition, the AI designated functionalities, the research yielded a functioning end-to-end web application built with Flask as the backend and React.js as the client. The web application allows a user to upload their own chest X-rays, receive a diagnostic recommendation with feedback, and revisit any relevant visual information provided to inform their diagnosis history.

VII. RESULT AND DISCUSSION

The system developed was tested on a diverse set of chest X-ray images and the CNN classification saw very strong performance metrics, good accuracy, precision and recall, correctly identifying normal cases and abnormal cases such pneumonia and tuberculosis. The U-Net segmentation model also successfully segmented the lung regions of interest, which improved further relevance & focus of the classification results.

Grad-CAM visualizations provided additional support that the model's decisions were indeed reliable by confirming relevant regions of the lungs being highlighted in the visualizations providing & glimpse of the model's transparent decision-making in a medical context. These results indicate that the system is not only sound on a technical basis, & but clinically useful as decision-support tool.

Throughout testing and user evaluation, the integrated web application performed well, providing users with fast inference & a straightforward user experience. The frontend (React-based) connected seamlessly to the backend (Flask-based), and users received real-time results and visuals from the application.

Users expressed disbelief when they learned that the Grad-CAM heatmaps were included in the data as they found them quite useful for establishing trust in the AI. Without detailed explanations, & the user evaluation exposed some shortcomings of the system. For example, low-quality X-rays or ones that were heavily obstructed could yield gross

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misclassification. The results suggest strengthening the robustness of Airnosis is needed,& Even with reasonable success under typical scenarios, data (more multi-varied data) and training progressions (dedicated to the three data rooms) will likely be discussed during ongoing and future developments of Airnosis. Incorporating advanced preprocessing steps toward a detailed analysis with Airnosis may also yield further revelations of performance gains.

VIII. CONCLUSION

In conclusion, Airnosis illustrates the upcoming potential for deep learning and medical imaging when combined to aid in the automation of diagnostic processes for respiratory disease using a chest x-ray, & With the combination of a CNN-based classification model, a u-net segmentation implementation, and a qualitative Grad-CAM based interpretation model into a web application backed by Flask (for Python) and React, Airnosis system supports clinicians by providing an accurate, interpretable, and integrated real-time diagnostic second opinion on patient chest x-rays. As with any project, Airnosis could be improved if implemented in the real world, this project includes the technical feasibility of the idea but significantly illustrates how this type of AI could have real uses in clinical decision making. We have demonstrated that the model's results are promising, however to ensure it has real applicability in a real world healthcare environment, we believe utilizing larger datasets, better preprocessing, & deploying the model into the cloud for practitioners would improve its broader scope in terms of applicability.

REFERENCES

[1] Wang, X., Peng, Y., Lu, L., Lu, Z., Bagheri, M., & Summers, R. M. (2017). ChestX-ray8: Hospital-scale chest X-ray database and benchmarks on weakly-supervised classification and localization of common thorax diseases. In Proceedings of the IEEE Conference on Computer Vision & Pattern Recognition (CVPR) (pp. 2097–2106).
[2] Ronneberger, O., Fischer, P., & Brox, T. (2015). U-Net: Convolutional networks for biomedical image segmentation. In Medical Image Computing and Computer-Assisted Intervention (MICCAI), (Springer) (pp. 234–241).
[3] Selvaraju, R. R., Cogswell, M., Das, A., Vedantam, R., Parikh, D., & Batra, D. (2017). Grad-CAM: Visual explanations from deep networks via gradient-based localization. In Proceedings of the IEEE International Conference on Computer Vision (ICCV) (pp. 618–626).
[4] Simonyan, K., & Zisserman, A., "Very Deep Convolutional Networks for Large-Scale Image Recognition," arXiv preprint arXiv:1409.1556, 2014.
[5] He, K., Zhang, X., Ren, S., & Sun, J., "Deep residual learning for image recognition," Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2016, pp. 770–778.
[6] Flask Documentation: https://flask.palletsprojects.com/

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