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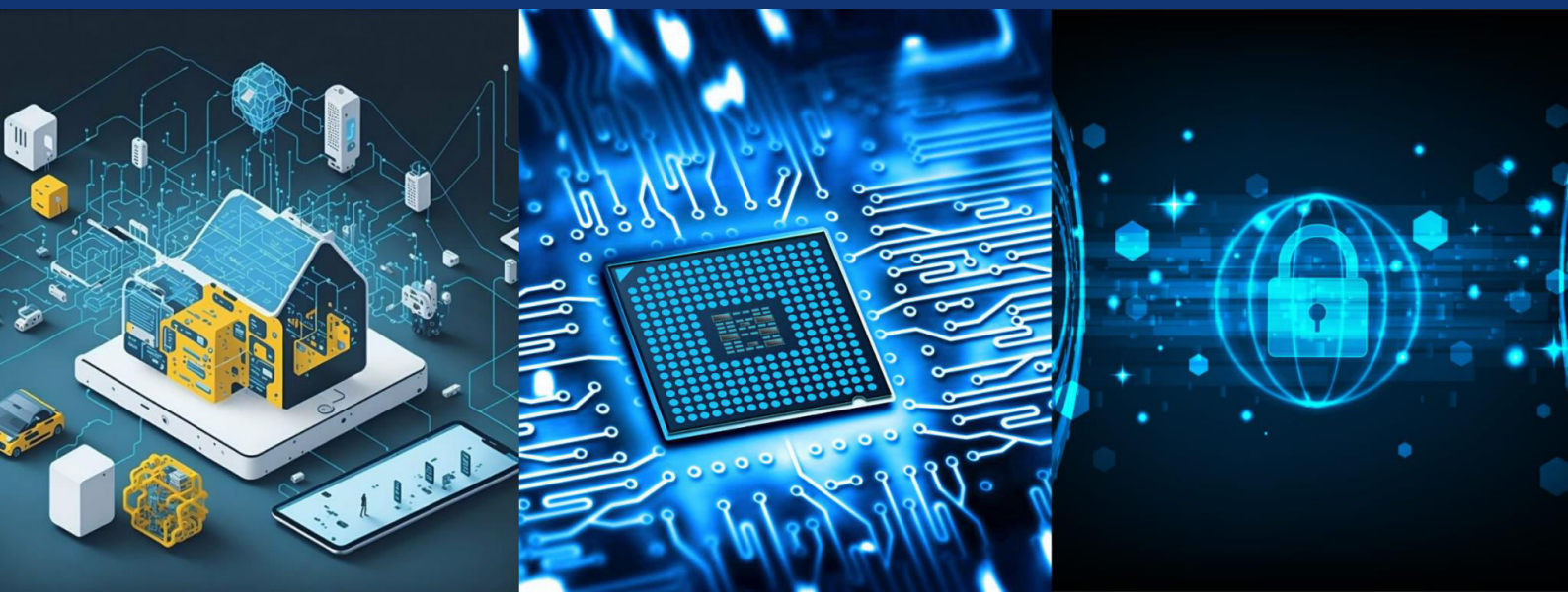

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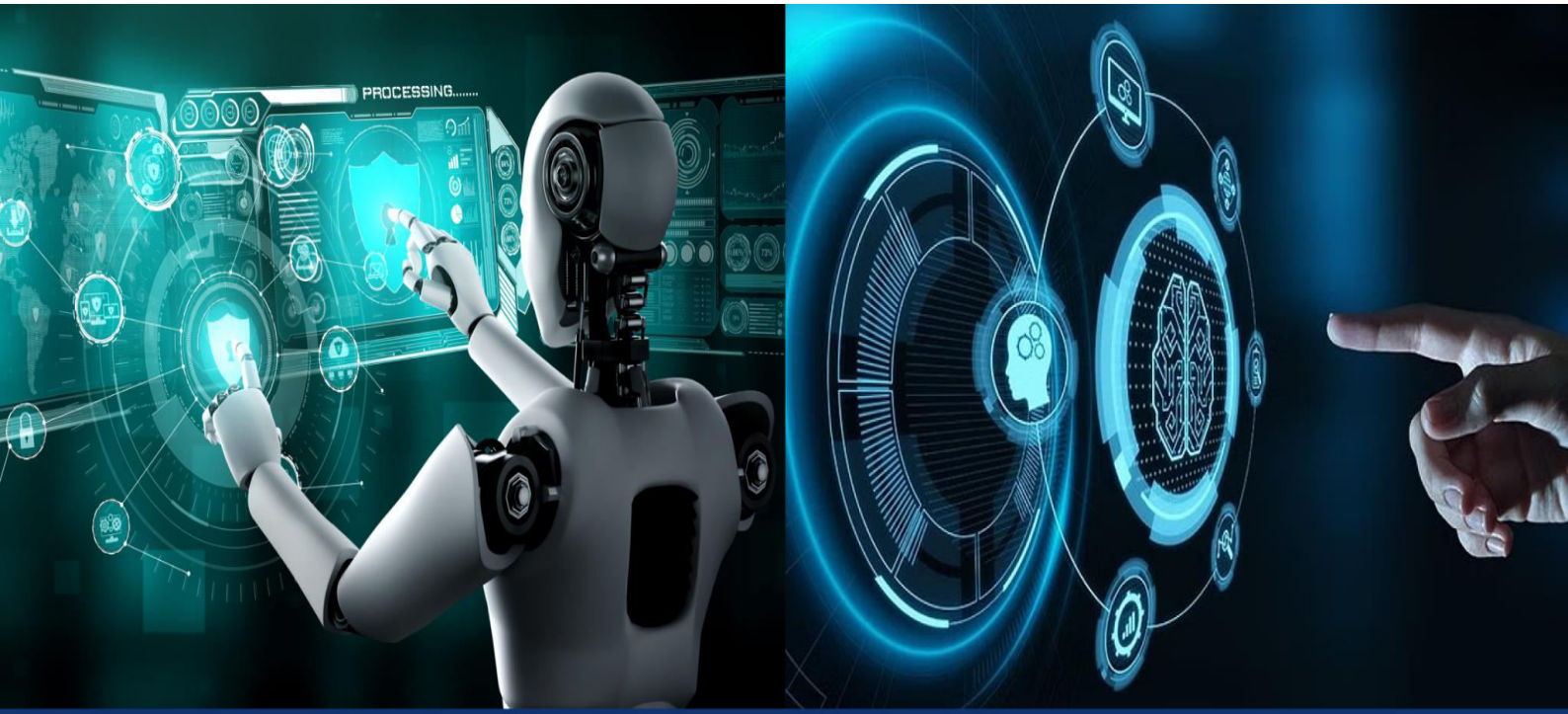

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AI-Based Medical Image Disease Detection System

Somashekar N S, Pooja Taragar

PG Student, Dept. of MCA, City Engineering College, Bangaluru, India

Assisstant Professor, Dept. of MCA, City Engineering College, Bangaluru, India

ABSTRACT: Medical imaging plays a vital part in disease diagnosis, but interpreting chest X-ray images accurately and on time remains difficult due to the shortage of skilled radiologists in many areas. This study proposes an AI-based medical imaging system capable of automatically detect multiple diseases, including cardiomegaly (CMVD), cardiac conditions, and rickets, chest x-ray. The system uses deep-learning model built on DenseNet121, applying transfer learning to improve the effectiveness of feature extraction and classification. To produce the predictions more understandable and trustworthy, the model incorporates Grad-CAM, which visually highlights the important regions in the X-ray that influence the decision. The answer is used as a Flask-based online application that enables people to submit pictures and get instant diagnostic results. Experimental results indicate that the system is capable of effectively identify disease patterns while maintaining efficient processing speed. Overall, The suggested system acts as a supportive tool for medical practitioners by enabling faster screening, improving access to diagnosis, and reducing reliance on expensive medical procedures, especially in resource-limited settings.

KEYWORDS: Deep Learning, Medical Imaging, Chest X-ray Analysis, Disease Detection.

I. INTRODUCTION

Medical imaging, particularly chest X-rays, is an essential tool for diagnosing a variety of diseases at an early stage. But precise understanding of these images requires specialized expertise, which is not always available in many healthcare environments, especially in rural or under-resourced regions. As a result, delays in diagnosis can occur, leading to complications and higher treatment costs. Recent Advances Regarding artificial intelligence (AI) have opened up new possibilities for automation medical image analysis. Convolutional Neural Networks (CNNs), a type of deep learning technology, have proven effective in image features extraction and high disease pattern identification reliability. We present in this study, a deep learning model that is based on DenseNet121 is utilized because of its strong feature reuse capability and improved classification performance. The proposed system is created to detect multiple diseases, including cardiomegaly (CMVD), cardiac conditions, and rickets, from chest X-ray images. In contrast to conventional diagnostic methods that focus on a single disease, this system offers a unified framework for multi-disease detection. To improve transparency and call the calls on the model more understandable, Grad-CAM is incorporated to underscore the regions in the X-ray image that influence the prediction. furthermore, the system is implemented as a Flask-based web application, allow users to upload pictures of X-rays and obtain predictions instantly. The primary aim of this research is to develop an efficient, accurate, and interpretable AI-based system that assists healthcare professionals in early diagnosis and informed decision-making.

II. LITERATURE SURVEY

1. **Title: Deep Learning-Based Multi-Label Classification of Chest X-Ray Images (2023)**
Authors: Various Researchers
Summary: This study describes a multi-label Applying Deep Learning to Identify Several Thoracic Diseases in X-ray pictures of the chest using CNN-based architectures. The model is capable of detecting multiple diseases in a single image, improving diagnostic efficiency. However, the system requires large annotated datasets and lacks effective interpretability mechanisms for clinical validation.
2. **Title: Methods of Transfer Learning for Chest X-Ray Disease Identification (2023)**
Authors: Multiple Authors
Summary: This research explores the use of transfer learning techniques with pretrained CNN models such as DenseNet and ResNet for disease detection in chest X-rays. The study shows improved accuracy and reduced training time. However, it primarily focuses on model performance and does not emphasize deployment or real-time usability.

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3. **Title: Explainable Deep Learning Models for Analysing Medical Images (2024)**
Authors: Various Researchers
Summary: This work focuses on improving Deep Learning Model Interpretability in healthcare using techniques like Grad-CAM. The study highlights how visual explanations help clinicians understand model decisions. Despite improving transparency, the approach is not always integrated into complete diagnostic systems.
4. **Title: AI-Based Detection of Cardiovascular Abnormalities from Chest X-Rays (2024)**
Authors: Multiple Authors
Summary: In this work, we propose a deep learning method for determining cardiovascular diseases, including cardiomegaly, from chest radiographs. The results show high classification accuracy. However, the system is limited to cardiovascular conditions and does not support multi-disease classification.
5. **Title: Deep Learning for Multi-Disease Identification in Medical Imaging (2025)**
Authors: Recent Researchers
Summary: Recent research focuses on developing AI systems capable of detecting multiple diseases simultaneously from medical imaging. These systems aim to reduce the necessity of several diagnostic procedures.

III. METHODOLOGY

Existing Problem
The present method of diagnosing diseases from medical imaging, especially chest X-rays, mainly depends on manual evaluation by radiologists. This approach demands high expertise and considerable time, making it challenging to manage the growing number of imaging cases in healthcare systems. In many areas, particularly rural and resource-limited regions, the shortage of skilled radiologists leads delays in diagnosis and treatment. Moreover, most traditional diagnostic systems are intended to detect only one disease at a time, which often requires patients to undergo multiple tests for complete evaluation. These methods also lack automated support for identifying subtle patterns in images, increasing the risk of missed abnormalities or incorrect diagnosis. The absence of intelligent and integrated systems further limits early detection and reduces the efficiency of clinical decision-making.

Disadvantage
- Diagnosis mainly relies on manual interpretation that can cause delays and increase the man's possibilities error.
- Most existing systems focus on detecting a single disease, making multiple tests necessary for complete diagnosis.
- The absence of automated tools limits efficiency when handling large volumes of medical images.
- The shortage of skilled radiologists in rural and low-resource areas affects timely and accurate diagnosis.

Proposed Solution
The proposed system presents an AI-enabled medical imaging framework utilizing deep learning methods to automatically identify different diseases from X-ray pictures of the chest. It is created a neural network with convolution using built on DenseNet121, which effectively extracts features relevant and performs accurate image classification. The model trained to detect conditions such as cardiomegaly (CMVD), cardiac abnormalities, and rickets by learning patterns present in X-ray images. To increase reliability and understanding of the results, the system incorporates Grad-CAM, which visually highlights the regions that affect the model's predictions. Furthermore, the system is deployed as a Flask-based online application that allows people to upload X-ray images and acquire predictions instantly. This solution supports early-stage disease detection, minimizes dependence on manual interpretation, and assists Making health-related decisions with knowledge professionals

Proposed Methodology
The suggested system adopts a well-defined deep learning pipeline to ensure accurate and efficient disease detection. The process starts with collecting chest X-ray images, followed by preprocessing steps such as augmentation, normalization, and resizing to enhance image quality and consistency. After processing, these pictures are utilized to instruct a model based on DenseNet121, which is able to learning complex features for effective classification. The model's performance is evaluated using standard metrics to ensure consistent and reliable predictions. To enhance interpretability, Grad-CAM is incorporated to highlight the regions in the X-ray images that influence the model's decisions. Finally, The trained model is used via a web application built on Flask, allowing users to submit photos and get real-time predictions with scalability and ease of use.

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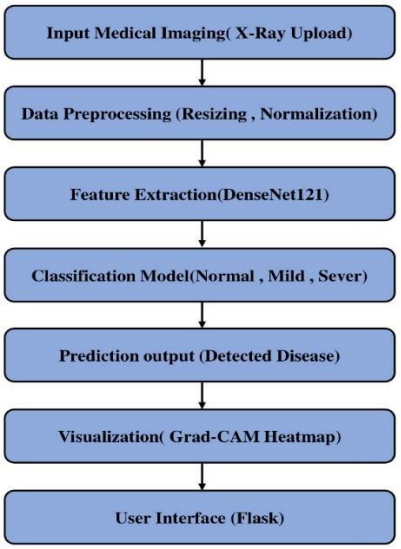

Fig 1: Proposed Methodology

IV. SYSTEM ARCHITECTURE & DESIGN

To ensure accurate and efficient identification of illness via a chest X-ray images, the suggested system is created using a multi-layered architecture that integrates the user interface, backend processing, in addition to deep learning components. A user-friendly Flask-built web interface allows users to upload X-ray images for analysis in a simple and accessible manner. Once an image is uploaded, it is handled by the backend module, where preprocessing operations like normalization, scaling, and formatting are performed to prepare the data for model input. The processed image is then forwarded to the deep learning layer, which uses a trained DenseNet121 model to identify characteristics and categorize the image. The model analyses the input and predicts the existence of diseases such as cardiomegaly, cardiac abnormalities, or rickets. To enhance transparency and understanding, Grad-CAM is integrated to highlight the regions in the X-ray image that influence the prediction. The final results, along with the visual explanation, are sent back to the frontend and displayed instantly to the user. The system is able to also store prediction outcomes for further analysis and performance evaluation. This structured architecture ensures smooth data flow, consistent performance, scalability, and flexibility for future enhancements, making it suitable for practical healthcare applications.

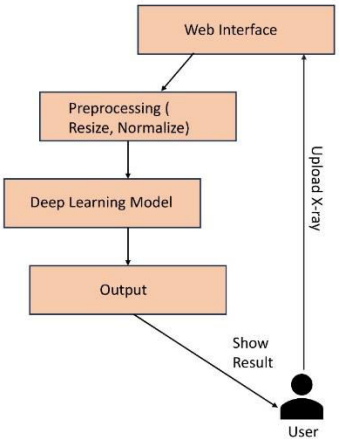

Fig 2: System Architecture and Design of Diabetes Diagnosis

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V. IMPLEMENTATION

To ensure efficient and precise diagnosis of illness using a chest X-ray images, the proposed system is implemented using an integrated framework that combines frontend, backend, and deep learning modules. The backend is developed using Python with the Flask framework, which is in charge of responding to user queries, processing uploaded images, and executing the model that was trained to produce predictions. The frontend is built using HTML, CSS, and JavaScript, providing a responsive and easy-to-use interface. It allows users or healthcare professionals to upload X-ray pictures of the chest without difficulty. Once an image is submitted, it is transferred to the backend, where preprocessing operations like normalization, scaling, and formatting are performed to prepare the data for model input. The deep learning module, based on DenseNet121, is embedded within the backend to analyse the processed image and classify it into groups like cardiomegaly, cardiac abnormalities, or rickets. To enhance the clarity of predictions, Grad-CAM is incorporated to highlight the areas within the X-ray picture that influences the model's choice. The final prediction results, additionally to the visual explanation, are then sent returning to the frontend and displayed immediately to the user. This integrated implementation ensures quick processing, dependable predictions, and seamless interaction between system components, making it suitable for real-time medical analysis and decision support.

VI. RESULTS & DISCUSSION

The proposed system, *"*AI-Based Medical Image Disease Detection System" applies deep learning methods to accurately identify several illnesses from X-ray pictures of the chest. By using a model based on DenseNet121, the system shows strong performance in identifying circumstances such cardiomegaly, cardiac abnormalities, and rickets. The experimental findings indicate that the model effectively captures crucial elements from medical pictures and delivers dependable classification results. During the evaluation phase, the system processed different X-ray images efficiently and produced predictions in real time with minimal delay. The preprocessing module ensured that every image input was standardized before being analyzed, while the Flask-based backend enabled smooth execution of the model. The frontend interface provided a simple way for users to submit images and see the forecast results along with visual explanations. The model's Parameters were used to evaluate performance like recall, accuracy, and precision. showing stable and consistent results across all disease categories. The use of Grad-CAM further enhanced the system by visually highlighting the regions of the X-ray that influenced the predictions, improving interpretability and user confidence. The results demonstrate that integrating deep learning with a web-based application can significantly improve medical image analysis. The system facilitates early detection of diseases, reduces reliance on manual diagnosis, it aids medical professionals in making wise choices. Overall, the study confirms that combining advanced AI techniques with efficient system design can enhance diagnostic accuracy and contribute to improved healthcare outcomes.

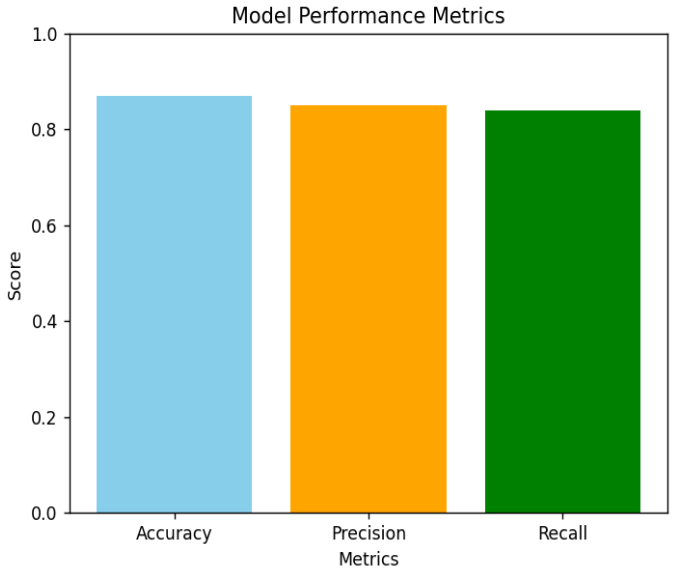

Fig 3: Model Performance Metrics

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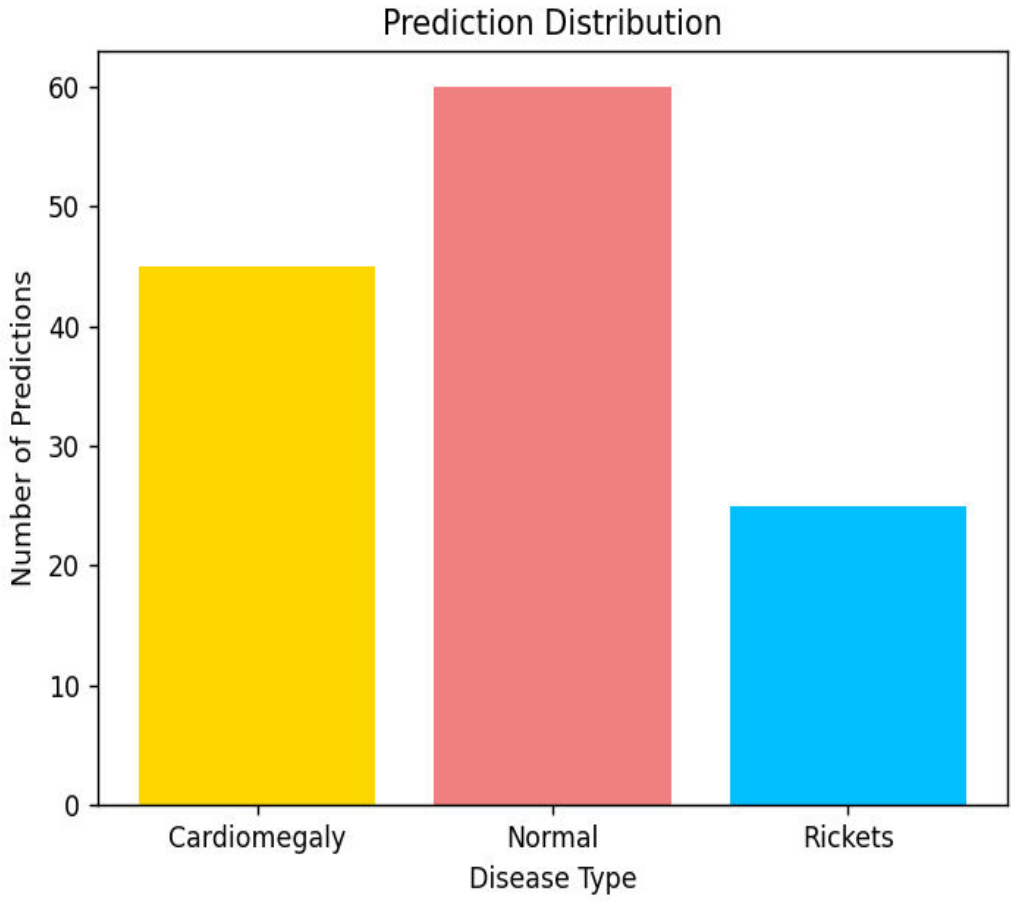

Fig 4: Prediction Distribution

V. CONCLUSION

The project "AI-Based Medical Image Disease Detection System" effectively integrates deep learning with a web-based platform to provide reliable identification of illness via a chest X-ray image. By utilizing a model founded on DenseNet121, the system achieves accurate classification of circumstances like cardiomegaly, cardiac abnormalities, and rickets. The frontend offers a simple and user-friendly interface for uploading images and viewing results, while the backend built with Flask efficiently manages preprocessing and model execution. The inclusion of Grad-CAM enhances interpretability by visually highlighting the regions that influence the model's predictions, thereby improving transparency and user trust. Through real-time image analysis, the system supports early identification of illness and assists healthcare practitioners in making knowledgeable clinical decisions. Identification of Pneumonia on Chest X-Rays shows that AI-based medical imaging systems can increase the precision of diagnosis, decrease reliance on manual interpretation, and contribute to more accessible and data-driven healthcare solutions.

VI. FUTURE ENHANCEMENTS

The "AI-Based Medical Image Disease Detection System" offers a number of chances for additional improvement to enhance accuracy, scalability, and usability. One important enhancement is the integration of hospital systems such as Picture Archiving and Communication Systems (PACS), which would allow automatic retrieval and analysis of medical images, improve workflow efficiency and reduce diagnosis time. The system can also be enhanced by Using cutting-edge deep learning architectures beyond DenseNet121, including hybrid and ensemble models, to achieve better accuracy and

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improved performance across diverse datasets. Training the model using large-scale and region-specific datasets, particularly Indian medical data, can further increase reliability and practical applicability. In addition, expanding the system to detect a wider range of diseases would make it more comprehensive. The integration of advanced explainable AI techniques along with Grad-CAM can further improve transparency and build trust among healthcare professionals. Real-time alert mechanisms can also be implemented to notify doctors or users when high-risk conditions are identified. Developing a mobile-based application would make the system more accessible, allowing users to view predictions and reports conveniently. Moreover, integrating cloud-based storage and processing can support large-scale data management, improve system performance, and enable continuous updates of the model. These enhancements will make the system more intelligent, scalable, and effective, contributing to improved diagnostic accuracy and more accessible healthcare solutions.

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