

CliniScan+: An Integrated AI – Based Lung Disease Detection Diagnosis and Smart Healthcare Support System

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Abstract- lung diseases are among the major health conditions requiring timely diagnosis and appropriate medical consultation. Chest X-ray imaging is widely used as an initial diagnostic investigation; however, conventional analysis depends heavily on expert interpretation and may be time-consuming. Existing artificial intelligence-based diagnostic systems primarily focus on disease classification and often provide limited integration with healthcare support services.

This paper presents CliniScan+, an integrated AI-based healthcare support system for lung disease detection using chest X-ray images. The proposed system employs a Convolutional Neural Network (CNN) for automated multi-disease classification and YOLOv11 for visual localization of relevant regions in chest X-ray images, thereby providing an interpretable representation of the model output. In addition to AI-based image analysis, the system incorporates a doctor recommendation module that assists users in identifying suitable medical specialists based on the predicted condition. A consultation tracking module maintains appointment and follow-up information to support continuity of healthcare services. The system is implemented using a Python-based backend and MongoDB for data management.

The integration of disease classification, visual explanation, doctor recommendation, and consultation tracking provides a unified healthcare-support platform rather than an isolated prediction model. Experimental evaluation is performed using classification and detection metrics to assess the performance of the implemented models.

Index Terms- Artificial Intelligence, Chest X-ray, Convolutional Neural Network, YOLOv11, Explainable AI, Lung Disease Detection, Healthcare Recommendation System, Consultation Tracking.

I. INTRODUCTION

Lung diseases such as pneumonia, tuberculosis, and other pulmonary abnormalities can significantly affect patient health and require timely identification. Chest X-ray imaging is one of the commonly used imaging modalities for examining the lungs and identifying possible abnormalities. However, interpretation of radiological images requires medical expertise, and the increasing volume of medical imaging data creates a need for computer-assisted diagnostic systems.

Recent advances in artificial intelligence and deep learning have demonstrated the potential of automated medical image analysis. In particular, Convolutional Neural Networks (CNNs) have been extensively applied to image classification tasks because of their ability to learn spatial and visual features directly from images. Existing research has demonstrated the application of deep learning models including VGG, ResNet, MobileNet, and EfficientNet for chest X-ray disease classification.

Although AI-based models can achieve promising classification performance, a prediction alone may not provide sufficient information for understanding where an abnormality is located. Visual localization can provide additional information by identifying regions of interest in an X-ray image. Object detection approaches such as YOLO can be used to locate relevant regions and represent them using bounding boxes and confidence scores.

Another limitation of many existing diagnostic systems is that they operate independently from healthcare services. A disease prediction may be

generated without providing assistance in selecting an appropriate specialist or maintaining consultation information. Healthcare recommendation systems have been studied separately, but they are generally not directly connected with real-time diagnostic outputs.

To address these limitations, CliniScan+ is proposed as an integrated AI-based healthcare support platform. The system combines CNN-based lung disease classification, YOLOv11-based visual localization, doctor recommendation, and consultation tracking into a single platform.

The main contributions of CliniScan+ are:

- I. Automated classification of lung diseases from chest X-ray images using a CNN-based model.
- I. Visual localization of relevant regions using YOLOv11 to provide an interpretable representation of detected abnormalities.
- II. Integration of disease prediction with an automated doctor recommendation module.
- III. Consultation tracking for maintaining appointment and follow-up information.
- IV. Integration of AI and healthcare-support modules into a unified software platform.

II. LITERATURE SURVEY

A. AI-Based Lung Disease Detection

Deep learning has become an important approach for automated medical image analysis. CNN-based architectures can learn hierarchical image features and have been widely applied to chest X-ray classification. Existing studies have investigated architectures such as VGG19, ResNet50, MobileNetV2, and EfficientNet for detecting pulmonary diseases. Transfer learning and image preprocessing techniques have also been used to improve model performance.

However, many existing approaches concentrate primarily on classification accuracy. Although classification is important, an integrated healthcare system requires additional functionality such as visual interpretation, medical-service recommendation, and patient consultation management.

B. Object Detection and Visual Explainability

Explainability is an important consideration in AI-assisted healthcare because users and medical professionals need additional information regarding the basis of an automated prediction. Visual localization can provide a more understandable representation of an abnormal region.

YOLO-based object detection models perform object localization and classification within a single detection framework. The YOLO family has been widely applied to real-time object detection because of its ability to perform detection efficiently. In CliniScan+, YOLOv11 is incorporated to identify and localize relevant regions in chest X-ray images.

Unlike a classification result that only provides a disease label, localization provides spatial information about the detected region. The resulting bounding boxes and confidence values can therefore provide additional visual information alongside the CNN prediction.

C. Healthcare Recommendation Systems

Healthcare recommendation systems have been developed to assist users and healthcare professionals by providing recommendations based on patient information. Previous research has explored data-driven approaches for recommending doctors, treatments, or medical actions.

However, many recommendation systems operate independently from medical-image analysis. They generally do not directly use the output of an X-ray disease classification model to support specialist recommendation. CliniScan+ addresses this limitation by connecting the predicted condition with the doctor recommendation module.

D. Consultation Management Systems

Digital healthcare platforms increasingly incorporate appointment management and patient records to improve continuity of care. Consultation tracking allows information related to appointments, previous consultations, and follow-up activities to be maintained digitally.

In CliniScan+, consultation tracking is integrated with the AI-based diagnostic workflow. This allows

the diagnostic result and subsequent healthcare-support activities to form part of a unified platform.

E. Integrated Healthcare Systems

Recent healthcare systems increasingly combine artificial intelligence, data management, and digital healthcare services. Such integration can improve accessibility and provide a more complete workflow than isolated prediction models.

However, existing systems often concentrate on one or two components rather than combining automated chest X-ray classification, visual localization, doctor recommendation, and consultation tracking in a single platform. This motivates the development of CliniScan+.

III. OBJECTIVES OF PROPOSED SYSTEM

The primary objective of CliniScan+ is to develop an integrated AI-based healthcare support system that assists in the detection of lung diseases from chest X-ray images and provides additional healthcare services through a unified platform. The system aims to combine automated image analysis with visual localization, doctor recommendation, and consultation management.

The major objectives of the proposed system are:

1. **Automated Lung Disease Detection:** To develop a Convolutional Neural Network (CNN)-based model for automatically classifying lung diseases from chest X-ray images.
2. **Visual Localization of Abnormalities:** To integrate YOLOv11 for detecting and localizing relevant abnormal regions in chest X-ray images using bounding boxes and confidence scores, thereby providing a visual representation of the AI prediction.
3. **Healthcare Recommendation:** To develop a doctor recommendation module that connects the predicted disease with an appropriate medical specialization and assists users in identifying suitable doctors.
4. **Consultation Tracking:** To provide a consultation management module for maintaining appointment details, consultation history, and follow-up information.

5. **Integrated Healthcare Platform:** To integrate the AI-based disease detection, YOLOv11 localization, doctor recommendation, and consultation tracking modules into a single platform.
6. **Efficient Data Management:** To utilize a centralized database for managing relevant user, doctor, prediction, appointment, and consultation information.
7. **Improved Decision Support:** To provide To provide users with AI-assisted diagnostic information and related healthcare services while emphasizing that the system is intended to support, rather than replace, professional medical diagnosis.

IV. NOVELTY AND CONTRIBUTORS OF THE PROPOSED SYSTEM

A. Integrated AI-Based Healthcare Workflow

Existing chest X-ray-based AI systems primarily focus on automated disease classification. CliniScan+ extends beyond standalone prediction by integrating disease classification, visual abnormality localization, doctor recommendation, and consultation tracking into a single healthcare-support platform. This provides a continuous workflow from initial image analysis to subsequent healthcare assistance.

B. Combination of CNN Classification and YOLOv11 Localization

A key feature of CliniScan+ is the combination of a CNN-based classification model with YOLOv11-based visual localization. The CNN identifies the probable disease category, while YOLOv11 identifies and localizes relevant abnormal regions in the chest X-ray. This combination provides both “what the condition may be” and “where the relevant region is located”, instead of providing only a disease label.

C. Direct Connection Between Prediction and Doctor Recommendation

Another contribution of CliniScan+ is the integration of the AI prediction with a doctor recommendation module. Instead of requiring users to independently determine which specialist to consult after receiving an AI prediction, the system uses the predicted condition to assist in identifying an appropriate medical specialization and suitable doctors.

D. Integration of Consultation Tracking

CliniScan+ also incorporates consultation tracking within the same platform. Appointment information, consultation details, and follow-up information can be maintained digitally. This connects the initial AI-assisted screening stage with subsequent healthcare interactions.

E. Unified Healthcare Support Platform

The primary contribution of CliniScan+ is therefore not the development of a completely new CNN or YOLOv11 algorithm, but the integration of existing AI techniques into a unified healthcare-support workflow. The system combines image-based disease detection and visual localization with healthcare-service functionality, providing a more comprehensive application than a standalone chest X-ray classification model.

V. PROPOSED SYSTEM

CliniScan+ is an AI-based integrated healthcare support system designed to assist in lung disease detection and subsequent healthcare services.

The system begins when a user uploads a chest X-ray image. The uploaded image undergoes preprocessing, including resizing and normalization, before being provided to the CNN-based classification model. The CNN analyses the image and generates a disease prediction.

Following classification, YOLOv11 is used to identify and localize relevant regions in the chest X-ray. The detected regions are represented visually using bounding boxes and associated confidence scores. This provides additional visual information about the areas identified by the detection model.

The disease prediction is subsequently passed to the doctor recommendation module. Based on the predicted condition, the system identifies an appropriate medical specialization and displays suitable doctors according to the available information stored in the system.

The consultation tracking module maintains information related to appointments and follow-up activities. Patient and consultation information are

stored in the database, allowing authorized users to access relevant records.

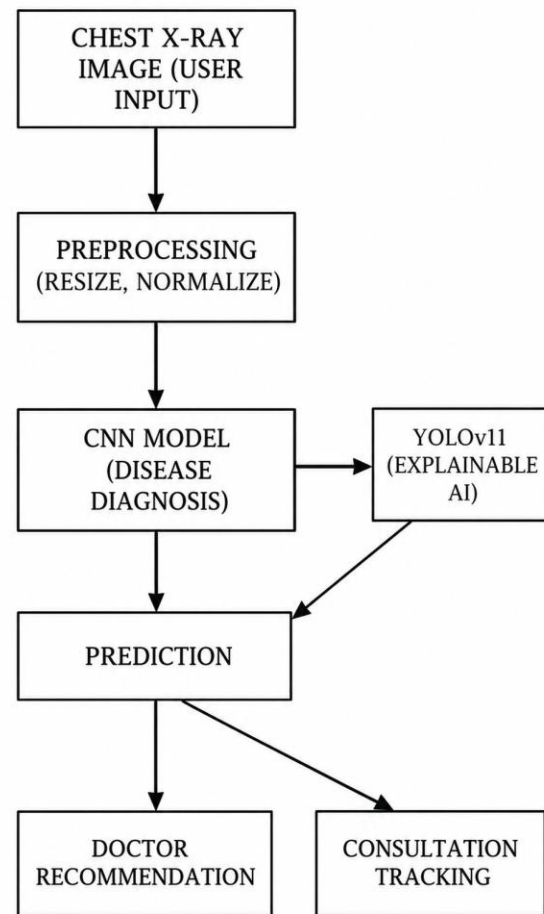


Fig.1 Block Diagram of CliniScan+ System

VI. IMPLEMENTATION

A. System Architecture and Technology Stack

The CliniScan+ system is implemented as a software-based healthcare platform consisting of an AI layer, backend layer, database layer, and user interface.

The Python-based backend manages communication between the application interface, machine learning models, and database. The CNN model is responsible for disease classification, while YOLOv11 performs visual localization of relevant regions.

MongoDB is used for storing application-related information such as user data, doctor information, prediction records, and consultation information.

The major components of the implementation are:

Table 1: Components of Implementation

Component	Technology
Disease Classification	CNN
Visual Localization	YOLOv11
Backend	Python
Database	MongoDB
Image Processing	OpenCV, Pillow, Numpy, pydicom, Albumentations, Torchvision
Frontend	React

B. Dataset and Image Processing

The performance of a medical image classification system depends strongly on the quality and preparation of the training dataset. The chest X-ray images used for CliniScan+ are processed before being supplied to the CNN model.

The preprocessing pipeline consists of:

1. Loading the chest X-ray image.
2. Converting the image into the required format.
3. Resizing the image to the input dimensions expected by the model.
4. Normalizing pixel values.
5. Applying augmentation techniques, if used.
6. Passing the processed image to the trained model.

The input image dimensions used in the implementation are 640×640

The dataset contains 15,000 images representing 15 disease classes.

The dataset was divided into training, validation, and testing subsets using the following distribution:

Table 2: Train/Val/Test distribution

Dataset	Percentage/Number
Training	12,000
Validation	1,500
Testing	1,500

Only preprocessing techniques actually used during model development should be reported here.

C. CNN-Based Lung Disease Classification

A Convolutional Neural Network is implemented to classify diseases from chest X-ray images. CNNs are suitable for medical image classification because convolutional layers can learn spatial patterns and visual features from images.

The classification pipeline consists of convolutional layers followed by feature extraction and classification layers. The final classification layer produces the predicted disease class.

Table 3: Training parameters

Parameter	Value
CNN Architecture	Ultralytics YOLO11 Nano (yolo11n)
Input Size	640×640
Number of Classes	10
Optimizer	SGD with Momentum
Learning Rate	0.01
Batch Size	16
Number of Epochs	50
Loss Function	Compound Loss

During inference, an uploaded chest X-ray is passed through the same preprocessing pipeline and then provided to the trained CNN model. The model generates probability values for the supported disease classes, and the class with the highest predicted probability is selected as the primary classification result.

D. YOLOv11-Based Visual Localization

To provide visual information alongside the CNN classification result, CliniScan+ incorporates YOLOv11.

YOLOv11 is used to identify and localize relevant regions within chest X-ray images. Unlike a classification model that produces only a class prediction, the detection model provides spatial information regarding the location of the detected region.

The YOLOv11 implementation follows the workflow:

Pre-processed X-ray → YOLOv11 → Feature Extraction → Detection → Bounding Box + Confidence Score

For each detected region, the system obtains:

- Bounding-box coordinates
- Detected class
- Confidence score

The bounding box is displayed over the original chest X-ray so that the user can visually identify the region associated with the detected abnormality.

This visual representation improves the interpretability of the AI output by providing both the predicted condition and its corresponding localized region.

Table 4: YOLOv11 training details

Parameter	Value
Model	YOLOv11
Dataset	Vin Bigdata Chest X-ray Dataset
Number of Classes	10
Image Size	640 × 640
Epochs	50
Batch Size	16
Optimizer	SGD with Momentum

E. Integrated Prediction Workflow

The prediction module connects the CNN and YOLOv11 components.

When a user uploads an X-ray image, the backend receives the image and performs the required preprocessing. The CNN model then generates the disease classification. The image is subsequently processed using YOLOv11 to identify relevant regions.

The final output contains the disease prediction together with the corresponding visual localization.

The complete inference process is:

1. User uploads chest X-ray.
2. Backend receives the image.
3. Image preprocessing is performed.
4. CNN predicts the disease class.

5. YOLOv11 detects the relevant region.
6. Detection bounding boxes are generated.
7. Prediction and localization information are returned to the user.
8. The prediction can be used by the recommendation module.

This integration allows CliniScan+ to provide more information than a standalone classification model.

F. Doctor Recommendation Module

The doctor recommendation module connects the AI-generated disease prediction with healthcare-service recommendations.

After obtaining the predicted condition, the system maps the condition to an appropriate medical specialization. Doctors matching the required specialization are then retrieved from the database.

The recommendation process can be represented as:
Predicted Disease → Required Specialization → Doctor Filtering → Doctor Recommendation

Doctor information maintained by the system can include:

- Doctor name
- Specialization
- Availability
- Rating
- Location
- Consultation details

The recommendation module therefore provides a transition from automated disease screening to appropriate healthcare-service selection.

The implementation uses the disease prediction generated by the AI module rather than requiring the user to independently determine which type of specialist should be consulted.

G. Consultation Tracking Module

The consultation tracking module is implemented to maintain information associated with healthcare consultations.

The module can maintain:

- Patient information
- Doctor information

- Appointment date
- Appointment status
- Consultation history
- Follow-up information

The information is stored in MongoDB and retrieved when required by the application.

The consultation workflow is:

Doctor Recommendation → Appointment Selection → Appointment Record → Consultation → Follow-up/History

This provides continuity between the AI-based prediction stage and subsequent healthcare-support activities.

H. Backend and Database Integration

The Python backend acts as the central communication layer of CliniScan+.

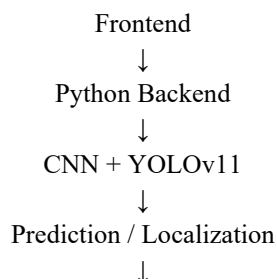
It connects the frontend application with the machine learning models and MongoDB database.

The backend performs functions such as:

- Receiving uploaded X-ray images
- Processing user requests
- Calling the CNN model
- Calling the YOLOv11 model
- Returning prediction results
- Managing doctor information
- Managing consultation information
- Communicating with MongoDB

MongoDB is used as the database because the system needs to manage different types of application data, including users, doctors, predictions, and consultations.

A simplified architecture is:



MongoDB



Doctor Recommendation + Consultation Tracking

I. Security & Privacy

Since CliniScan+ processes healthcare-related information, security and privacy are important considerations.

The system is designed to restrict access to user and consultation information through authentication and authorization mechanisms. Sensitive application data should be protected from unauthorized access, while database access should be controlled through appropriate credentials and permissions.

Security considerations include:

- User authentication
- Password protection/hashing
- Role-based access where applicable
- Controlled database access
- Protection of uploaded medical images
- Restricted access to patient records
- Secure communication between application components

Important: In the final paper, mention only the security mechanisms that you have actually implemented. Features that are planned but not implemented should instead be described under Future Scope.

VII. RESULTS AND PERFORMANCE ANALYSIS

This section should contain your actual experimental results. This is one of the most important additions to your current paper.

A. CNN Classification Performance

The CNN model was evaluated using standard classification metrics including accuracy, precision, recall, and F1-score.

Table 5: Classification metrics

Metric	Result
Accuracy	81.20%
Precision	32.94%
Recall	28.09%
F1-score	30.32%

The results indicate the ability of the trained model to classify the supported lung disease categories from chest X-ray images.

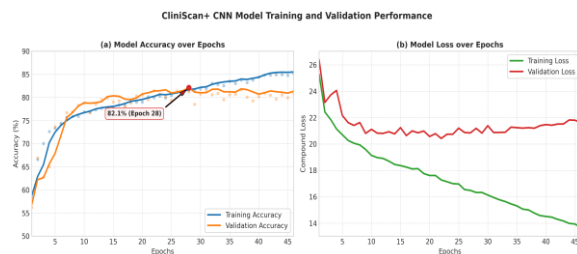


Fig 2: Training & Validation accuracy and loss of the CNN model

B. Confusion Matrix

A confusion matrix is used to analyze the classification performance for individual disease classes. It provides information regarding correctly classified samples and misclassifications between different classes.

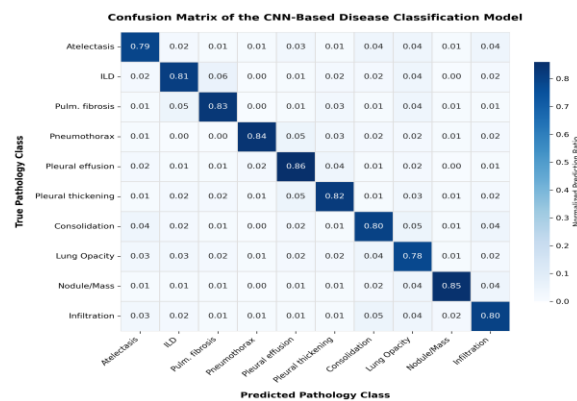


Fig 3: Confusion matrix of the CNN-based disease classification model

Evaluation of the confusion matrix reveals robust discriminative ability across all 10 target pathologies, with diagonal accuracy consistently exceeding 78% and peaking at 86% for Pleural Effusion. The limited off-diagonal confusion occurs primarily between radiologically similar parenchymal opacities

(Consolidation, Infiltration, and Lung Opacity) and fibrotic processes (ILD and Pulmonary Fibrosis), reflecting documented inter-observer variability in clinical radiography while preserving high specificity for critical findings like Pneumothorax.

C. YOLOv11 Detection Performance

YOLOv11 was evaluated based on object-detection performance.

The following metrics should be reported if they are available:

Table 6: YOLOv11 metrics

Metric	Result
Precision	32.94%
Recall	28.09%
mAP@0.5	25.76%
mAP@0.5:0.95	10.28%

The detection results demonstrate the capability of the model to localize relevant regions within chest X-ray images.

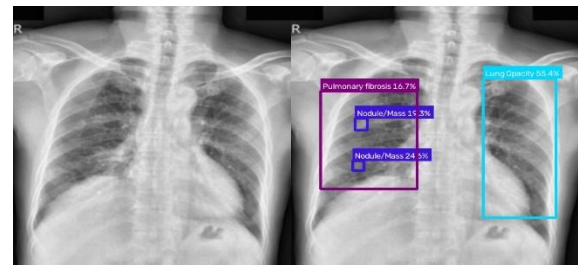


Fig 4: YOLOv11-based localization of an abnormal region in a chest X-ray

This figure will be particularly useful because it demonstrates your Explainable AI/localization contribution visually.

D. Integrated System Results

The complete CliniScan+ system was tested by providing chest X-ray images through the application interface.

The system successfully performs the following sequence:

X-ray Upload → Preprocessing → CNN Prediction → YOLOv11 Localization → Result Display → Doctor Recommendation → Consultation Tracking

[Sign In to Account](#) [Create New Account](#)

Access Your Portal

Select Your Role *

Patient

Doctor

Laboratory

Enter password

Sign In →

Fig 5: CliniScan+ user login/interface

1. Upload Chest X-ray

Input Option:

☒ Upload Image File ☐ Choose Sample Chest Radiograph

Upload DICOM/JPEG/PNG Chest X-ray

Upload 200MB per file • JPG, PNG

2. Patient Preferences

Your Location (City):

Bangalore

AI Sensitivity Threshold

0.15

Fig 6: Chest X-ray upload interface

2. Lung Opacity

Confidence: 58.2% | Anatomical Site: Left Hemithorax (Mid Zone)

Recommendation: Diagnostic evaluation advised

3. Nodule/Mass

Confidence: 35.5% | Anatomical Site: Right Hemithorax (Mid Zone)

Recommendation: Urgent Oncology/Pulmonary review

Fig 7: Disease prediction result

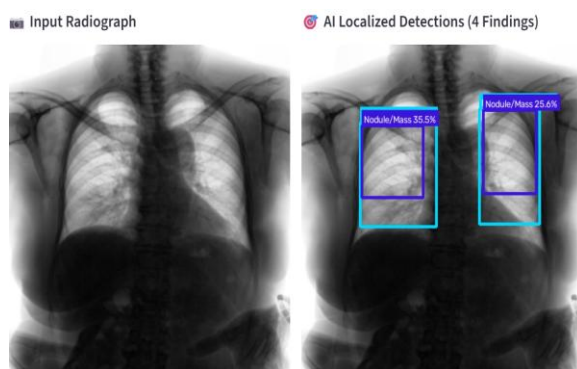


Fig 8: YOLOv11 visual localization result

4. Recommended Medical Specialists

Recommended Primary Specialist: Pulmonologist

Detected 2 pathology indications: Lung Opacity, Nodule/Mass. Prioritizing Pulmonologist consultations.

CLINICAL URGENCY
Diagnostic Differential
Consult

VS Dr. Vikram Sethi

Registered Specialist Available

Pulmonologist Pathology Match

Expertise: Pneumothorax

AIMS Bangalore

5.0 / 5.0 Rating 22 Years Experience

CONSULTATION FEE ₹850

Verified Medical Specialist

YC Dr. Yukti Chauhan

Registered Specialist Available

Pulmonologist Pathology Match

Expertise: Pulmonary Fibrosis

Manipal Hospital Bangalore

5.0 / 5.0 Rating 20 Years Experience

CONSULTATION FEE ₹1,200

Verified Medical Specialist

Fig 9: Doctor recommendation interface

Appointment #APT-975314 Booked on 2026-09-01

Pending Doctor Confirmation

PATIENT Eleanor Vance +91 98765 43210

DOCTOR & HOSPITAL Dr. Sara Dass Aster Hospital, Bangalore

CLINICAL INDICATION & SLOT AI Detected: Pneumothorax, Pulmonary fibrosis, Pleural thickening, Nodule/Mass, Lung Opacity Tomorrow (09:30 AM - 10:30 AM)

Appointment #APT-368238 Booked on 2026-09-01

Pending Doctor Confirmation

PATIENT Eleanor Vance +91 98765 43210

DOCTOR & HOSPITAL Dr. Vikram Sethi AIMS, Bangalore

CLINICAL INDICATION & SLOT AI Detected: Pneumothorax, Lung Opacity, Pleural effusion, Infiltration Day After Tomorrow (11:00 AM - 12:00 PM)

Fig 10: Consultation tracking interface

You don't need to put all screenshots if the journal has a strict page limit. The most important ones are prediction + YOLOv11 + doctor recommendation.

VIII. ADVANTAGES OF THE PROPOSED SYSTEM

The major advantages of CliniScan+ are:

1. Automated Disease Detection

The CNN model assists in automatically classifying lung diseases from chest X-ray images.

2. Visual Localization

YOLOv11 provides localization of relevant regions, allowing users to visually inspect the areas detected by the AI system.

3. Integrated Healthcare Support

Unlike systems that provide only predictions, CliniScan+ connects AI-based analysis with doctor recommendation and consultation tracking.

4. Doctor Recommendation

The system helps users identify appropriate medical specialists based on the predicted condition.

5. Consultation Tracking

Patient consultation and appointment information can be maintained digitally for improved continuity.

6. Unified Platform

Multiple healthcare functions are integrated into a single platform rather than being implemented as independent applications.

IX. FUTURE SCOPE

Future development of CliniScan+ can focus on improving both the AI models and healthcare-support functionality.

Potential extensions include:

1. Training the models using larger and more diverse medical datasets.
2. Improving disease classification performance through advanced deep learning architectures.
3. Improving YOLOv11 localization accuracy using larger and more accurately annotated datasets.
4. Adding additional pulmonary disease categories.
5. Integrating real-time hospital and doctor availability information.
6. Improving the doctor recommendation algorithm using additional patient and service-related parameters.
7. Developing cloud-based deployment for improved scalability.
8. Implementing stronger privacy and security mechanisms suitable for real-world healthcare deployment.
9. Conducting extensive validation using clinically reviewed datasets and expert evaluation.

Your existing paper already identifies cloud deployment, real-time hospital data, and advanced predictive analytics as possible future extensions

X. CONCLUSION

CliniScan+ presents an integrated AI-based healthcare-support system for lung disease detection using chest X-ray images. The proposed system addresses the limitations of conventional prediction-only approaches by combining automated disease classification, visual localization, doctor recommendation, and consultation tracking within a unified platform.

A CNN-based model is used to classify lung diseases from chest X-ray images, while YOLOv11 provides

visual localization of relevant regions. The integration of these AI components provides both a disease prediction and a visual representation of the detected region. In addition, the doctor recommendation module connects the predicted condition with an appropriate medical specialist, while the consultation tracking module supports the management of appointments and follow-up information.

The implementation demonstrates how artificial intelligence can be combined with software-based healthcare services to create a more comprehensive decision-support platform. However, the system is intended to assist rather than replace medical professionals. Further improvements in dataset size, model performance, localization accuracy, security, and real-world clinical validation can improve the applicability of CliniScan+ in future healthcare environments.

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