

# Pneumonia Detection from Chest X-ray

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**Abstract** - Respiratory diseases—pneumonia (2.5M deaths/year), TB (1.3M), COVID-19 sequelae, lung cancer (1.8M)—cripple global health, worst in LMICs like rural Maharashtra where 1 radiologist serves 50,000 people. We present Medi Scan-PWA, an offline-first Progressive Web App using novel YOLOv8-C2fCNN hybrid: YOLOv8n segments lungs (mAP<sub>50</sub>=96.2%), feeding ROI features to 14-layer CNN (94.8% accuracy, 93.7% recall, 94.2% F1 across 4 classes). Trained on 18K curated X-rays, it runs at 42ms/image on mid-tier Androids via TensorFlow.js. Security includes AES-256, JWT+biometrics, zero-knowledge proofs. Field-tested in 5 Pune clinics (n=240 scans, 92% user satisfaction). Outperforms CheXNet (+4.2%), YOLOv5 (+7.1%). Federated learning-ready for privacy-preserving evolution. Deployable now via single URL—no app stores.

**Keywords** - YOLOv8, CNN fusion, PWA, chest X-ray, federated learning, edge AI, HIPAA-compliant.

## I. Introduction

Lower respiratory infections rank #4 in global mortality (WHO 2025), killing 3.2M annually. India bears 25% pneumonia deaths despite 17% population. TB claims 480K Indians yearly; post-COVID fibrosis mimics it. Early lung cancer hides in 30% routine CXRs.

Manual chest X-ray (CXR) reading varies 15–25% inter-radiologist ( $\kappa=0.62$ ). Rural PHCs lack experts; urban overload delays diagnosis by 48+ hours. Mobile X-rays exist, but analysis doesn't.

CNNs reach 90%+ pneumonia accuracy (Rajpurkar 2017), YOLOv8 hits 95% lung detection (Jocher 2023). However, most models are single-disease focused, cloud-dependent, lack security, and are rejected by clinicians due to black-box behavior.

This paper introduces:

- YOLOv8-C2fCNN hybrid architecture
- 18K balanced dataset from NIH, Montgomery, PadChest, and Pune PHCs

- Secure offline-first PWA with biometric login and federated learning
- Clinical validation across 5 facilities

## 2. BODY OF PAPER

The proposed system fuses YOLOv8 segmentation with CNN classification via C2f blocks and attention gates. The dataset includes 18,432 X-rays balanced across four classes. Preprocessing involves CLAHE, resizing, normalization, and augmentation.

The architecture includes:

- YOLOv8 backbone (CSPDarkNet53 + PANet)
- C2f neck for multi-scale feature fusion
- CNN classifier with dropout and softmax output

The PWA is built using React, TensorFlow.js, and ONNXRuntime-Web. It supports offline caching, background sync, AES-256 encryption, and WebAuthn-based authentication.

Training used RTX 3060 GPU, 75 epochs, cosine annealing, and 5-fold cross-validation.

Table -1: Architecture Ablation Results

Variant	Fusion	C2f Blocks	Acc %	mAP	FPS
YOLOv8-only	-	-	87.2	89.4	68
CNN-only	-	-	89.6	-	12
YOLO+CNN (concert)	No	No	91.3	92.1	48
YOLO+C2fCNN (attn)	Yes	4	94.8	96.2	52

Fig -1: Disease Prevalence vs Detection Methods Manual (72%), CNN-only (88%), Ours (94%)

**Fig -2: Architecture Diagram** YOLO → C2f → CNN with attention gates

**Fig -3: Dual Loss Curves** Train/Val loss: 0.42→0.11; Accuracy: 72%→94.8% @ epoch 58

**Fig -4: Ablation Impact** Bar chart comparing model variants

**Fig -5: Confusion Matrix** 4×4 grid showing true/false predictions

**Fig -6: GradCAM Heatmaps** True positives: pneumonia consolidation lit up red

### 3. CONCLUSIONS

MediScan-PWA achieves 94.8% accuracy across four respiratory diseases, outperforming prior models. It runs offline, supports secure inference, and builds clinician trust via heatmaps. Deployment in 5 PHCs showed 93% sensitivity and 92% satisfaction.

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