UNIVERSITY OF THE WESTERN CAPE

Private Bag X17, Bellville 7535, South Africa
Tel: +27 21 959 2911 | www.uwc.ac.za

Literature Review Summary

ML-Driven Diagnostic Imaging for TB Screening

Student: Thabo Molefe (3847291)

Programme: PhD Computer Science

Supervisor: Prof. Sarah van der Berg

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1. OVERVIEW

This literature review synthesises 87 peer-reviewed publications spanning the fields of computer-aided detection (CAD), deep learning for medical imaging, and tuberculosis diagnostics. The review is structured thematically, covering: (a) the epidemiology and diagnostic challenges of TB in sub-Saharan Africa, (b) the evolution of CAD systems from traditional feature extraction to deep learning approaches, (c) specific CNN architectures applied to chest radiography, and (d) deployment considerations for resource-constrained settings.

2. KEY THEMES

2.1 TB Diagnostic Gap in Africa

WHO (2024) reports that only 61% of estimated TB cases in sub-Saharan Africa are diagnosed. The shortage of trained radiologists (estimated at 1 per 500,000 population in rural areas) creates a critical need for automated screening tools. Studies by Qin et al. (2023) demonstrate that CAD systems can match radiologist sensitivity in high-burden settings.

2.2 Deep Learning for Chest Radiography

The field has evolved from early feature-based approaches (Jaeger et al., 2014) to deep CNNs. CheXNet (Rajpurkar et al., 2017) established radiologist-level performance. Recent work focuses on attention mechanisms (Wang et al., 2023) and multi-task learning (Li et al., 2024) for improved localisation and classification.

2.3 Transfer Learning and Model Efficiency

EfficientNet (Tan & Le, 2019) and knowledge distillation (Hinton et al., 2015) techniques enable deployment on edge devices. The trade-off between model size and diagnostic accuracy is well-documented, with pruned models retaining 95%+ of full model performance while reducing inference time by 60%.

2.4 Deployment in Resource-Constrained Settings

Recent pilots in India (Mahajan et al., 2022) and South Africa (Allen et al., 2021) demonstrate feasibility but highlight challenges: intermittent connectivity, power supply reliability, integration with existing clinical workflows, and the need for culturally appropriate privacy frameworks (POPIA compliance in SA).

3. IDENTIFIED GAP

While existing CAD systems show promise, no study has combined attention-enhanced architectures with edge-optimised deployment specifically validated in South African clinical settings. This research addresses this gap by developing and validating a lightweight model tailored for Western Cape healthcare facilities.