Towards Equitable and Accessible Dermatology: Developing a Lightweight and Interpretable FCDS-CNN for Edge-Based Melanoma Detection

PhD Research Proposal

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1. Introduction

Melanoma, a highly lethal skin cancer, is treatable if detected early, yet late diagnoses contribute to poor outcomes. The FCDS-CNN model achieves 96% accuracy on the HAM10000 dataset but faces barriers to real-world use: (1) its large size limits deployment on mobile devices; and (2) its lack of transparency reduces clinician trust.

Figure 1: Example of melanoma showing asymmetric borders and color variation that requires early detection

This research proposes a **Lightweight and Interpretable FCDS-CNN (LI-FCDS-CNN)** to enable practical and trustworthy melanoma screening for clinical and telemedicine applications.

2. Research Background

The FCDS-CNN offers high accuracy but is not optimized for practical deployment. Its limitations include:

- **Size**: With approximately 22 million parameters, it is too resource-intensive for edge devices.
- **Transparency**: The model's decisions lack explanations, hindering clinical adoption.

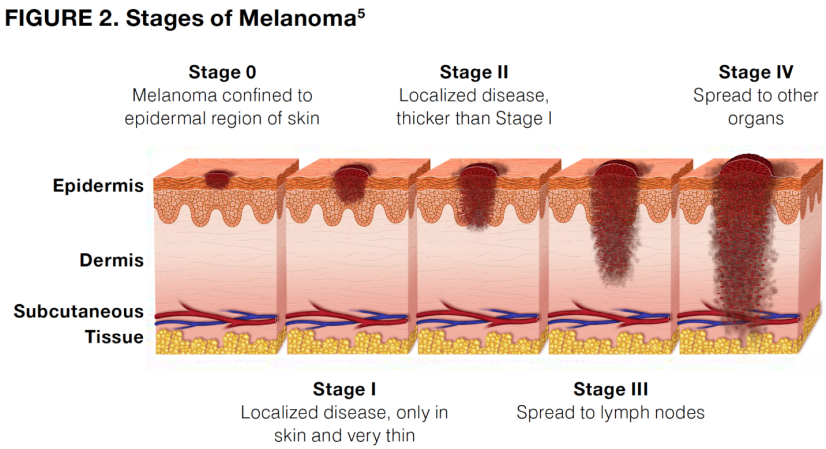

Figure 2: Skin anatomy showing layers where melanoma develops

This research addresses these challenges by simplifying the model and enhancing interpretability for clinical adoption.

3. Research Aim and Objectives

Aim: To develop a lightweight and interpretable FCDS-CNN for edge-based melanoma detection.

Objectives:

1. Reduce the model's size to enable efficient operation on mobile devices with minimal accuracy loss.
2. Add explainable AI methods to make diagnostic decisions clear to clinicians.
3. Test the model in a mobile app prototype to assess real-world usability.

4. Methodology

The research will proceed in three phases:

4.1 Data Preparation

- Collect datasets, including HAM10000 and Diverse Dermatology Images (DDI).
- Utilize the Split Skin Cancer Dataset from Kaggle for validation.
- Standardize images and preprocess for model training.

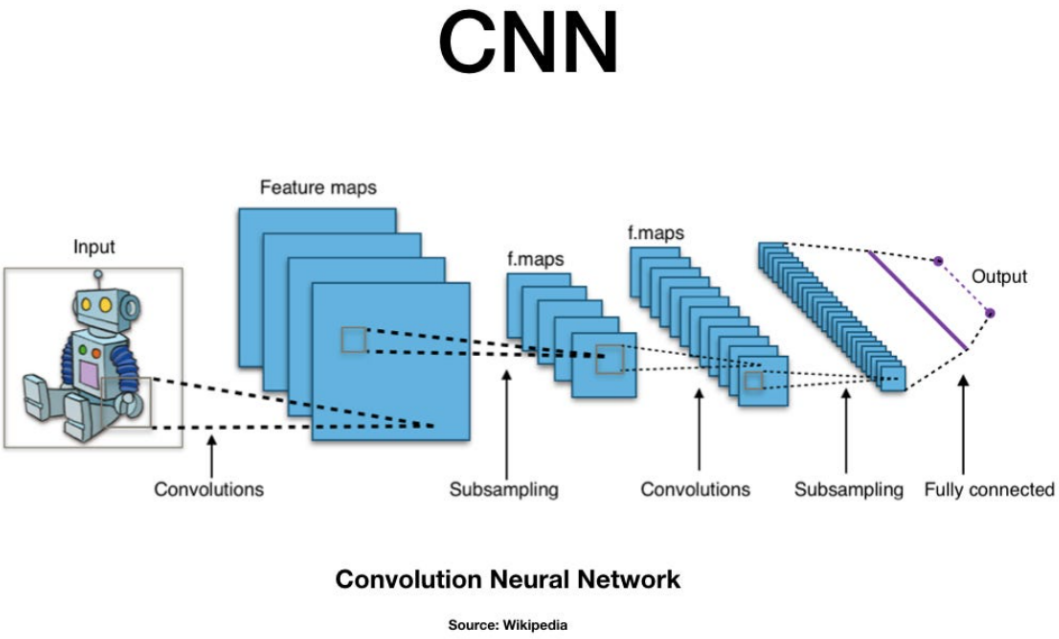

Figure 3: Data collection and preparation pipeline for model training

4.2 Model Optimization

- Use techniques like pruning or quantization to reduce model size.
- Ensure the model retains acceptable accuracy for melanoma detection.
- Implement visual tools, such as heatmaps, to highlight key image areas in decisions.

4.3 Validation and Testing

- Test the model on a mobile device, measuring accuracy and speed.
- Collect clinician feedback on the model's explanations and usability.
- Verify that explanations are understandable to clinicians.

5. Research Timeline

Table 1: PhD Research Timeline

Phase	**Year 1**	**Year 2**	**Year 3**
Data Preparation	Months 1–6		
Model Optimization	Months 7–12	Months 1–6	
Validation and Testing		Months 7–12	Months 1–6
Thesis Writing			Months 7–12

6. Expected Outcomes

This research will deliver:

- A compact and interpretable LI-FCDS-CNN model.
- A mobile app prototype for accessible melanoma screening.
- Improved diagnostic tools for clinical and telemedicine applications.

7. Conclusion

This research will transform the FCDS-CNN into a Lightweight and Interpretable model, making melanoma detection practical and transparent for global healthcare settings.

References

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[2] Khan, A. (2023). Dataset of Split Skin Cancer. Kaggle. `https://www.kaggle.com/datasets/abdulwadoodkhan199/dataset-of-split-skin-cancer`