Hematovision: Advanced Skin Lesion Classification Using Transfer Learning

1. Introduction

Skin cancer is among the most common types of cancer globally, and early detection is critical to effective treatment. However, accurate diagnosis typically requires dermatological expertise and specialized tools. Hematovision is an AI-powered solution designed to classify skin lesions using advanced deep learning techniques, particularly transfer learning. This project aims to make skin lesion analysis more accessible and accurate by leveraging pretrained CNN models integrated into a user-friendly web interface.

2. Project Objectives

- Develop a high-accuracy skin lesion classification model.
- Utilize pre-trained CNNs (e.g., Efficient Net) for efficient training and robust performance.
- Build a responsive web application for real-time lesion diagnosis.
- Support dermatological diagnostics in remote areas and resource-constrained settings.
- Enhance medical training tools with visual recognition models.

3. Literature Review

Research in medical imaging has shown that deep learning models can match or even exceed human performance in certain diagnostic tasks. Projects like ISIC (International Skin Imaging Collaboration) and datasets like HAM10000 have been central in benchmarking classification systems. Transfer learning has emerged as a practical approach due to limited labeled medical data and high computational demands of training deep CNNs from scratch.

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4. Methodology

4.1 Data Collection and Preparation

- Dataset Used: HAM10000 Dataset (Kaggle)
- Total Images: ~10,015 dermatoscopic images
- Classes: Melanocytic Nevi, Melanoma, and Seborrheic Keratoses
- Data Augmentation: Rotation, Flipping, Brightness
- Preprocessing: Resizing to 224×224, Normalization, Train/Validation/Test Split

4.2 Model Building Using EfficientNetB0

- Architecture: EfficientNetB0 pre-trained on ImageNet
- Layers: GlobalAveragePooling2D, Dense(3, softmax)
- Training: Adam optimizer, Categorical Crossentropy, 15 Epochs
- Fine-tuning and Callbacks: EarlyStopping and ModelCheckpoint used

4.3 Model Evaluation

- Test Accuracy: 91.7%- Precision & Recall:

  Melanoma: 89%/86%, Nevi: 94%/97%, Keratoses: 90%/85%

- Macro F1 Score: 90%
- Confusion Matrix used for performance analysis

5. Web Application Development

5.1 Application Components

- upload.html: Interface for uploading lesion images
- result.html: Page showing prediction results
- app.py: Handles image processing, prediction, and result rendering

5.2 Technologies Used

- Backend: Python, Flask
- Frontend: HTML5, CSS3, Bootstrap
- Deployment: Localhost, Render, Streamlit

6. Results and Discussion

- Validation Accuracy: 91.7%
- Training Time: ~12 minutes on GPU (Colab)
- Inference Time: ~1 second per image
- Challenges: Class imbalance, visual similarity
- Solutions: Data augmentation, focal loss, stratified split

7. Future Scope

- Extend classification to all 7 HAM10000 classes
- Use metadata (e.g., age, gender, location)

- Develop mobile app
- Collaborate with hospitals
- Publish as CDSS tool

8. Conclusion

DermaVision successfully demonstrates the effectiveness of transfer learning in medical imaging. The project achieves high accuracy in classifying skin lesions and offers a practical, web-based diagnostic tool. By reducing diagnostic delays and aiding early detection, DermaVision has potential to significantly impact teledermatology, medical education, and cancer awareness.

9. References

1. Tschandl, P., Rosendahl, C., & Kittler, H. (2018). The HAM10000 dataset. Scientific Data.
2. Tan, M., & Le, Q. V. (2019). EfficientNet. ICML.
3. Kaggle: https://www.kaggle.com/kmader/skin-cancer-mnist-ham10000