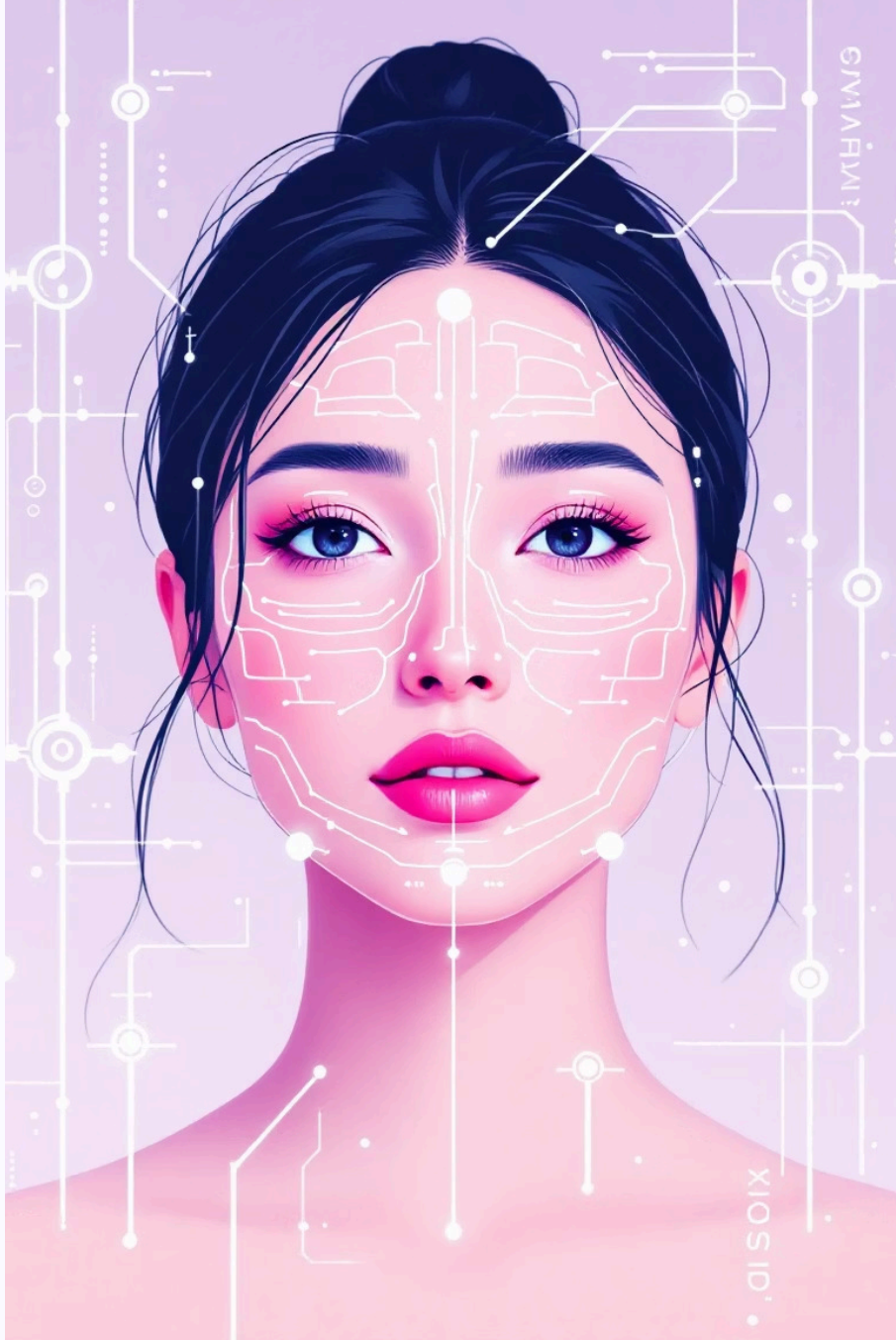
DermalScan: AI Facial Skin Detection App

An innovative app leveraging EfficientNet-B0 for automated facial skin analysis.



Outline

1. Problem Statements
2. Motivation
3. Introduction
4. Dataset
5. Preprocessing and Augmentation
6. Proposed Model
7. Implementation and Results
8. Conclusion
9. Real-Time Applications and Use Cases

Problem Statements

Main objective: Develop a deep learning-based system that can detect and classify facial aging signs—such as wrinkles, dark spots, puffy eyes, and clear skin—using a pretrained EfficientNet-B0 model.

Key components to highlight:

- Custom preprocessing and data augmentation
- Classification with percentage predictions
- Web-based frontend for user interaction
- Image upload functionality
- Visualization with annotated bounding boxes and labels

Motivation

Enhanced Accessibility

Addressing the growing demand for accessible and professional dermatological services worldwide.

Objective Assessment

Overcoming the subjectivity and inconsistencies of manual skin evaluations with reliable AI-powered analysis.

Technological Advancements

Leveraging deep learning and computer vision breakthroughs for rapid, accurate, and automated skin detection.

Proactive Care

Enabling early detection of skin conditions, fostering timely intervention and improved long-term health outcomes.

Introduction

- Many people worry about skin issues like wrinkles and dark spots. Getting an accurate assessment of these conditions is crucial for effective skincare, but manual checks can be inconsistent.
- Artificial Intelligence (AI) provides a powerful solution, making skin analysis faster, more reliable, and objective compared to traditional methods.
- Our project uses advanced AI to accurately identify and categorize specific facial skin conditions, including wrinkles, dark spots, puffy eyes, and clear skin.
- This technology empowers individuals and skincare professionals with quick, precise insights, leading to better-informed decisions and improved skin health outcomes.

Dataset

Our comprehensive dataset comprises 1200 high-quality facial images, meticulously categorized into four distinct classes to train and validate the DermalScan AI model. Each class contains 300 images, ensuring balanced representation for robust model training.

Wrinkles

300 Images

Dark Spots

300 Images

Puffy Eyes

300 Images

Clear Skin

300 Images

Sample Images

Wrinkles

Dark Spots

Puffy Eyes

Clear Skin

Preprocessing and Augmentation

Preprocessing

- Standardized images to 224x224x3 resolution
- Normalized pixel values
- Removed duplicate images from dataset

Augmentation

- Rotation: ±20°
- Width and height shifts: 0.1
- Zooming: up to 0.1
- Horizontal flipping
- Brightness adjustment: 0.8 to 1.2
- Nearest-fill mode for pixel gaps

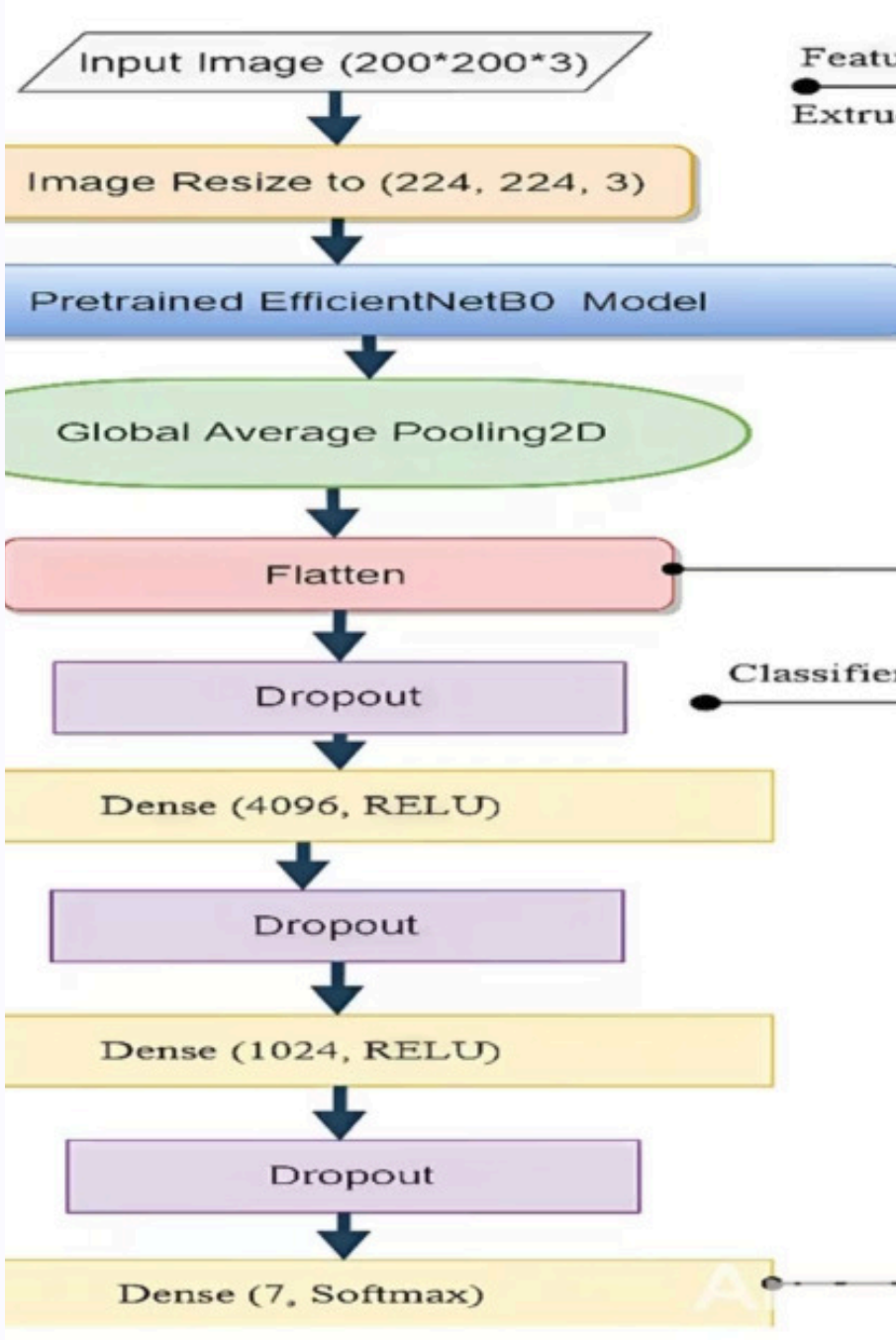
Purpose: Helps model generalize to real-world scenarios by simulating variations in facial orientation, lighting, skin tone, and image resolution

Result

- Created a balanced dataset
- Improved model robustness and reliability for detecting facial skin conditions

Proposed Model

- EfficientNet-B0 as feature extractor for rich facial feature extraction
- Pre-trained on ImageNet weights, fine-tuned on custom dataset
- Custom classification head with fully connected layers
- SoftMax activation for 4-class probability output (Wrinkles, Dark Spots, Puffy Eyes, Clear Skin)
- Loss function: Categorical Cross-Entropy
- Optimizer: Adam
- Training techniques: Early stopping and learning-rate scheduling
- Prevents overfitting and ensures stable convergence
- Achieves strong accuracy across all skin-condition classes



Implementation and Results - Training Phase

DATASET SPLIT:

- Training set: 80% (960 images) at 224×224×3 resolution
- Testing set: 20% (240 images)

TWO STAGE TRAINING APPROACH:

Stage 1 - Classification Head Training:

- Only the classification head on top of EfficientNet-B0 was trained
- Pre-trained layers remained frozen
- Allowed newly added layers to learn task-specific patterns

Stage 2 - Fine-tuning:

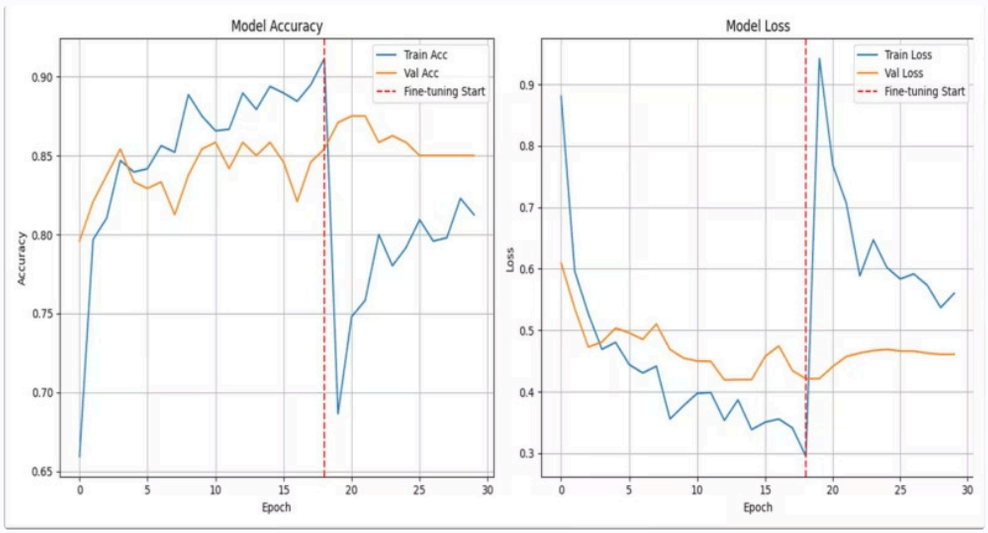
- Unfroze selected upper layers of EfficientNet-B0
- Model adapted to subtle skin features
- Benefited from pre-trained ImageNet features

TRAINING CONFIGURATION:

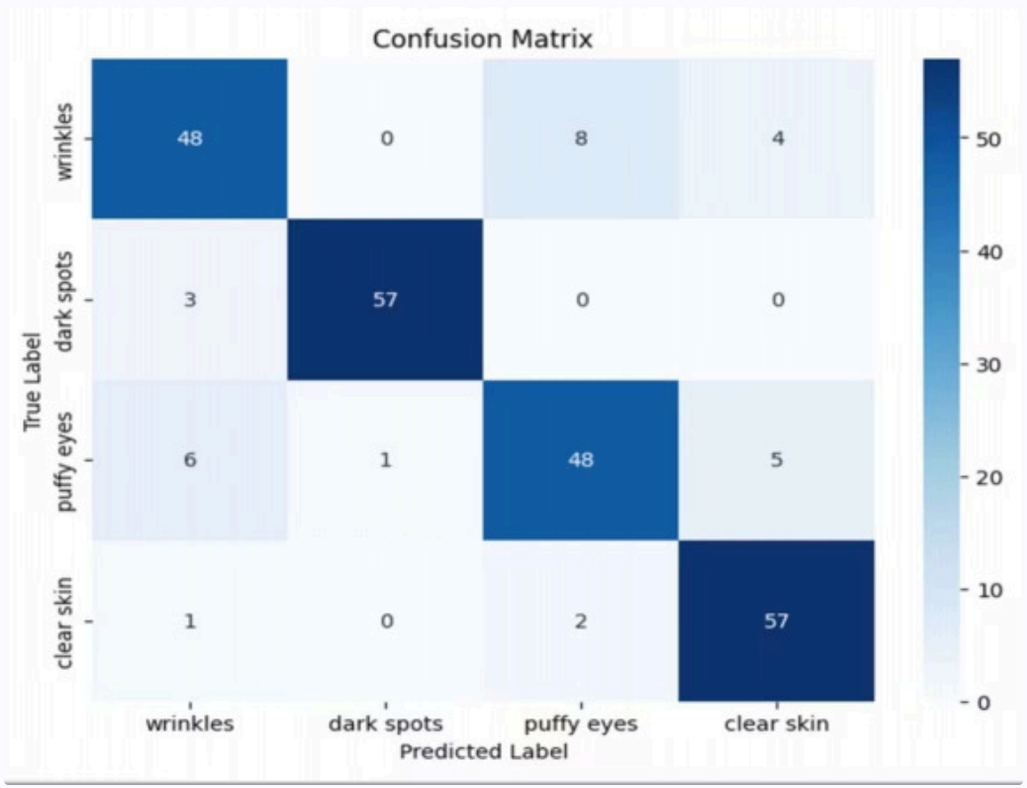
- Total epochs: 40
- Optimizer: Adam
- Ensured stable and efficient convergence
- Two-stage approach enabled effective learning of facial skin-condition classification

Training Results and Performance Metrics

Model Accuracy and Loss Progression



Classification Performance



- The accuracy and loss curves show the model's learning progression over 40 epochs.
- The confusion matrix demonstrates the model's classification performance on the test set.
- Strong diagonal values indicate accurate predictions for each skin condition class.

Implementation and Results - Testing Phase

TESTING PHASE OVERVIEW:

- Model evaluated on unseen test data
- Metrics used: Precision, Recall, and F1-Score
- Assessment of generalization capability

KEY FINDINGS:

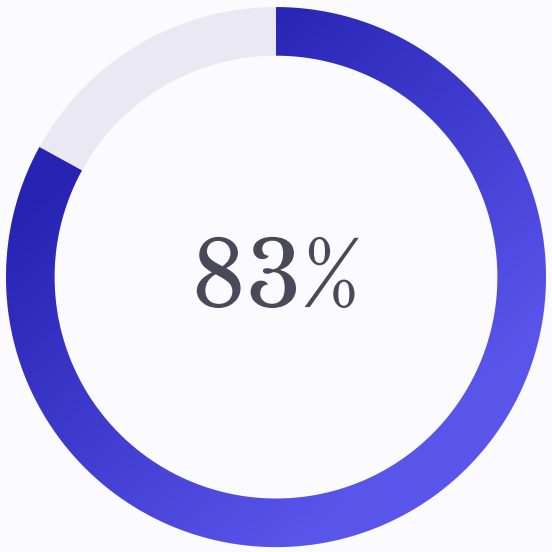
Consistently strong scores across all four classes (Wrinkles, Dark Spots, Puffy Eyes, Clear Skin)

Model effectively identifies fine-grained skin-condition features

Performs well even on challenging test images

OVERALL TEST ACCURACY:

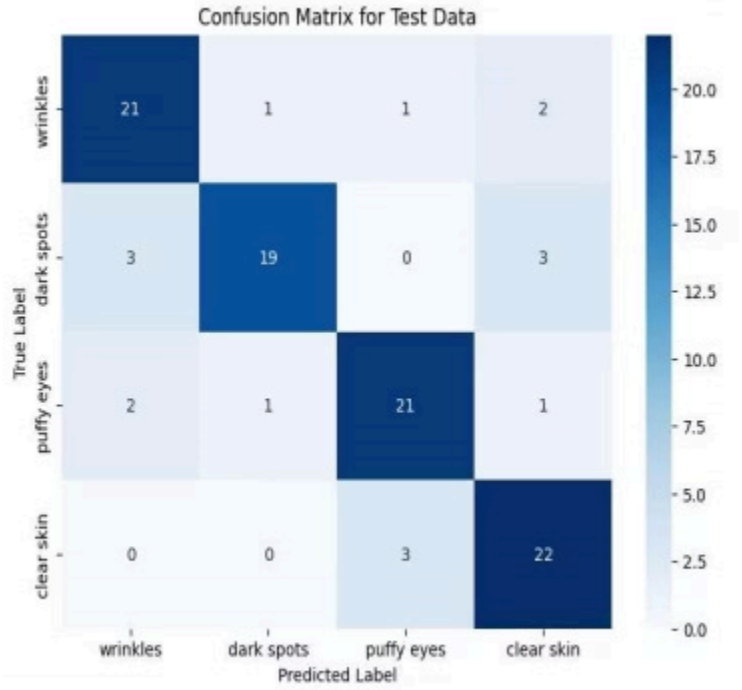
- Good balance between precision and recall
- Slightly lower than training accuracy (expected due to overfitting prevention)
- Solid improvement over traditional approaches
- Retains strong predictive capability during real-world evaluation
- Validated on 100 additional unseen sample images
- Consistent performance across diverse facial features and skin tones
- Demonstrates robustness to variations in lighting and image quality
- Model shows reliable detection of subtle skin condition indicators
- High confidence scores indicate strong model certainty in predictions
- Ready for deployment in real-world dermatological applications



Test Accuracy

Demonstrates reliable performance

Implementation and Results - Testing Phase



Classification Report:

	precision	recall	f1-score	support
wrinkles	0.81	0.84	0.82	25
dark spots	0.90	0.76	0.83	25
puffy eyes	0.84	0.84	0.84	25
clear skin	0.79	0.88	0.83	25
accuracy			0.83	100
macro avg	0.83	0.83	0.83	100
weighted avg	0.83	0.83	0.83	100

- The confusion matrix shows the model's predictions vs actual labels for each class.
- The classification report provides detailed metrics for each skin condition class.
- High precision and recall values indicate strong model performance.
- The model validates the effectiveness of the two-stage training strategy.
- Confirms suitability for real-world skin-condition classification.

Conclusion

The DermalScan project successfully developed an AI-based facial skin detection system utilizing the EfficientNet-B0 architecture with an innovative two-stage training approach. It achieved an impressive 83% test accuracy, effectively identifying wrinkles, dark spots, puffy eyes, and clear skin. This technology offers significant practical impact, enhancing dermatological care through rapid, reliable, and objective skin assessments. DermalScan improves accessibility to expert skin analysis and lays a strong foundation for future AI-driven health diagnostics.

Real-Time Applications and Use Cases

DermalScan extends beyond research, offering diverse real-world applications across multiple sectors, revolutionizing skin health assessment and care.

Dermatology Clinics

Professional skin assessment and diagnosis support for enhanced patient care.

Cosmetic & Beauty Industry

Personalized skincare product recommendations based on individual skin analysis.

Telemedicine Platforms

Remote skin consultations and continuous monitoring for accessible healthcare.

Mobile Applications

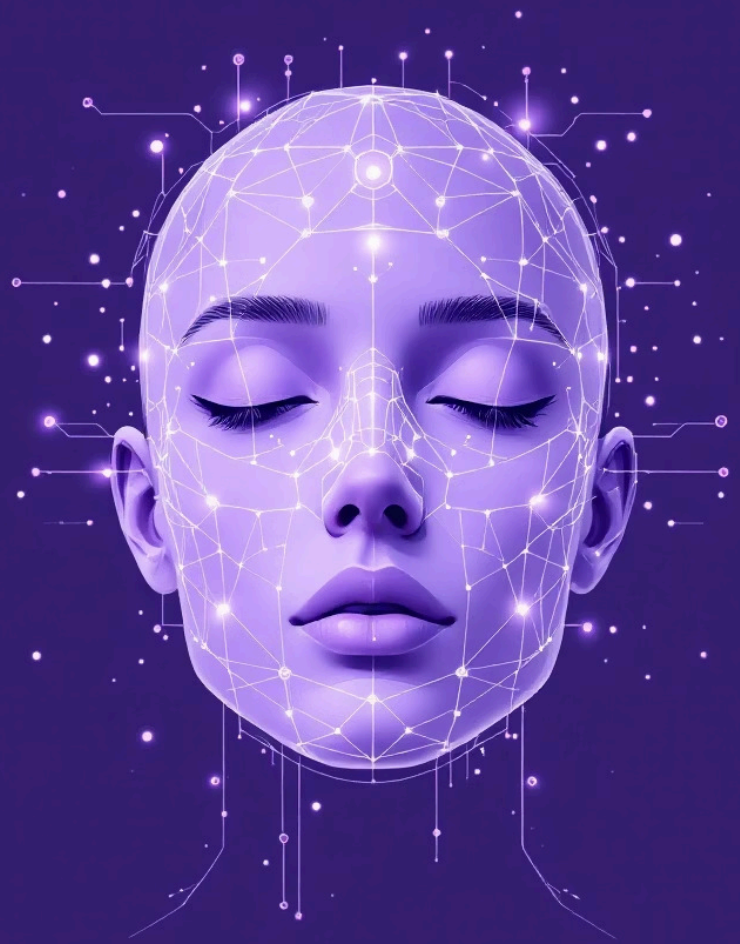
Consumer-facing skin health tracking apps for personal wellness management.

Skincare Brands

Integration with e-commerce platforms for precise product suggestions and sales.

Wellness Centers

Proactive skin health screenings for early detection and preventive care.



Thank You