DermAI - AI-Powered Dermatology Diagnosis System

🚀 Overview

DermAI is an AI-powered dermatological assistant designed to provide users with a preliminary diagnosis of skin conditions before visiting a dermatologist. By leveraging deep learning and chatbot technology, DermAI allows users to upload images of their skin concerns, classifies the condition using advanced models, and offers medical insights along with urgency levels.

This tool aims to reduce waiting times, optimize dermatologists' workloads, and improve healthcare efficiency. Given the shortage of dermatologists and long wait times for appointments, DermAI provides a scalable solution for faster preliminary diagnoses and patient prioritization.

🔹 Key Features

- **Early Diagnosis:** Provides users with an initial assessment of skin conditions for timely action.
- **AI-Powered Efficiency:** Deep learning models offer instant and accurate classifications.
- **Reduced Healthcare Bottlenecks:** Helps dermatologists focus on complex cases.
- **Accessibility:** Useful for individuals in areas with limited dermatology access.
- **Smart Prioritization:** Determines urgency, ensuring critical cases receive prompt attention.

🔹 Technical Overview

- **Platform:** Web application (Next.js for frontend, Flask API for backend) with potential mobile integration.
- **Model:** Convolutional Neural Network (CNN) trained on a multi-class dataset of skin diseases.
- **User Input:** Image upload + chatbot Q&A for symptom analysis.
- **Output:** Skin disease classification + probability score + medical recommendations.

🔹 Dataset Preparation

- **Inclusion of Diverse Skin Tones:** Training on datasets that represent different ethnicities.
- **Target Conditions:**
  - **Cancerous Lesions:** Melanoma, Basal Cell Carcinoma
  - **Chronic Skin Diseases:** Psoriasis, Eczema, Rosacea
  - **Infections:** Fungal Infections, Impetigo, Cellulitis
  - **Other Conditions:** Acne, Vitiligo, Seborrheic Keratosis
- **Data Processing:**
  - Resize images to 224x224 pixels for efficiency.
  - Normalize images (RGB processing, grayscale conversions where needed).
  - Augment data (rotation, brightness shift, contrast variation).
  - Split dataset: 80% training, 10% validation, 10% testing.

🔹 Model Development

- **Transfer Learning Approach:** Using pre-trained models such as VGG-16, EfficientNet, or MobileNetV3.
- **Optimization Techniques:**

- Hyperparameter tuning (learning rate, batch size, number of epochs).
- Early stopping and dropout regularization to prevent overfitting.
- Achieve >85% accuracy before deployment.

🔹 Backend Development

- **API Framework:** Flask for handling image classification requests.
- **Processing Pipeline:**
  - Image upload handling.
  - Model inference for classification.
  - Data storage in Supabase database.
- **JSON Response Structure:**

```
{

  "diagnosis": "Psoriasis",

  "confidence": 92.5,

  "recommendation": "Consult a dermatologist if irritation persists."

}
```

🔹 Frontend Development

- **Web Interface:** Next.js-based UI for seamless user interaction.
- **Features:**
  - Image upload capability.
  - Display classification results with probability scores.
  - AI-powered chatbot (Google Gemini) for medical insights and symptom analysis.

🔹 Challenges & Solutions

- **Bias in Skin Tone Representation:**
  - Use Fitzpatrick 17K dataset for diverse training.
  - Test real-world images from different ethnicities.
- **Model Accuracy & Reliability:**
  - Augment training data for better generalization.
  - Balance dataset to prevent class imbalance.
- **Latency & Speed Optimization:**
  - Deploy using FastAPI & TensorRT for performance improvement.
  - Utilize cloud computing for scalable inference handling.

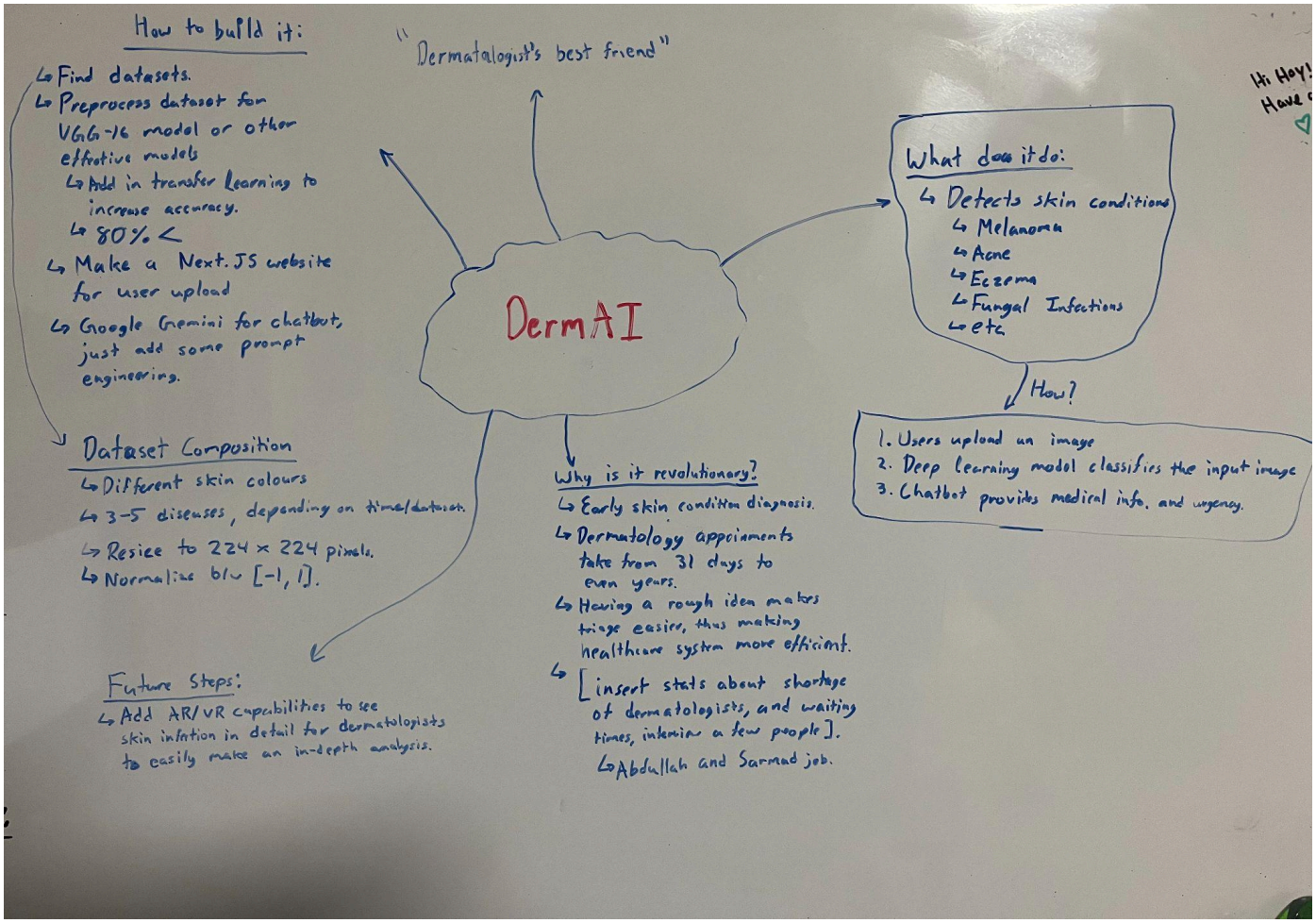
📌 Future Enhancements

- **AR-Based Skin Analysis:** Real-time tracking and visualization.
- **Teledermatology Integration:** Connecting users directly with dermatologists.
- **Mobile App Development:** Ensuring wider accessibility and ease of use.
- **Continuous Model Improvement:** Crowdsourcing user data for enhanced accuracy.
- **Expanded Disease Database:** Improving classification across more conditions.

📌 Summary

DermAI is an AI-powered skin disease detection platform utilizing CNN-based models like VGG16/EfficientNet. The system includes image classification, chatbot integration, and a web interface to provide users with an accessible dermatological assistant. Future plans involve mobile integration, telemedicine services, and AR-based skin analysis to further enhance accuracy and accessibility.

Project Plan Composed by Rishi's Whiteboard:



Possible Datasets:

Skin Disease Classification Datasets

1. **HAM10000 (Human Against Machine)**
   - **Size:** 10,015 images
   - **Conditions:** Melanoma, basal cell carcinoma, benign keratosis, dermatofibroma, and more
   - **Use Case:** Excellent for multi-class classification, widely used in dermatology AI research
   - Skin Cancer MNIST: HAM10000
2. **ISIC Archive (International Skin Imaging Collaboration)**
   - **Size:** 25,000+ dermoscopic images
   - **Conditions:** Melanoma, basal cell carcinoma, actinic keratosis, and other skin cancers
   - **Use Case:** Highly reliable for cancer detection, includes metadata like age and skin type
3. **Fitzpatrick 17K**
   - **Size:** 16,577 images
   - **Conditions:** 114 skin conditions (eczema, psoriasis, vitiligo, fungal infections, etc.)
   - **Use Case:** Best for ensuring inclusivity by covering different Fitzpatrick skin types
   - Evaluating Deep Neural Networks Trained on Clinical Images in Dermatology With the Fitzpatrick 17k Dataset

4. **DermNet NZ Image Dataset**
    - **Size:** 10,000+ images
    - **Conditions:** Wide variety, including acne, rosacea, and fungal infections
    - **Use Case:** Good for supplementing training data with real-world clinical images
    - Has 23 classes
    - Dermnet
    - densenet121 fc layer
        i. Paper from this set: https://openaccess.thecvf.com/content/CVPR2021W/ISIC/papers/Groh_Evaluating_Deep_Neural_Networks_Trained_on_Clinical_Images_in_Dermatology_CVPRW_2021_paper.pdf
    - Possible datasets:
        i. Densenet
        ii. ResNet50

RAG for chatbot perplexity sources:

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https://www.aad.org/member/clinical-quality/guidelines

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