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DermAI: An AI-Powered Mobile Application for Real-Time Skin Disease Detection and Personalized Wellness Management

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Abstract: *Skin diseases affect over 1.9 billion people globally, yet access to timely and accurate dermatological diagnosis remains a significant challenge, especially in developing regions. This paper presents DermAI, a cross-platform mobile application built using the Flutter framework that leverages Artificial Intelligence (AI) for real-time skin disease detection, personalized wellness tracking, and skincare routine management. The system integrates the LLaMA-4 Maverick large language model (LLM) via the Groq API for image-based and text-based skin analysis, Firebase Firestore for cloud-based data persistence, and Google Firebase Authentication for secure user management. DermAI offers three distinct analysis modalities: camera-based real-time scanning, gallery image upload with interactive zoom and pan, and a symptom description interface with voice recognition via the Speech-to-Text API. The application further incorporates a community review system, an AI-driven skin routine builder with personalized reminders, a wellness module featuring guided meditation and breathing exercises, and a report generation system with PDF export capability. Preliminary evaluations demonstrate the system's potential to deliver accurate skin condition assessments with confidence scores, actionable treatment recommendations, and referrals to dermatologists for high-severity cases. DermAI represents a significant step towards democratizing dermatological care through mobile technology and AI integration.*

Keywords: Skin Disease Detection, Artificial Intelligence, Flutter, Mobile Application, LLaMA, Groq API, Firebase, Dermatology, Computer Vision, Speech Recognition, Wellness Management, mHealth

I. INTRODUCTION

Skin diseases represent one of the most prevalent categories of medical conditions worldwide, affecting individuals across all age groups and geographic regions. According to the World Health Organization (WHO), dermatological conditions account for nearly one-third of all physician consultations globally. However, the availability of trained dermatologists remains critically low, particularly in rural and semi-urban areas of developing countries such as India, where the doctor-to-patient ratio in dermatology is approximately 1:1,60,000.

The rapid proliferation of smartphones and mobile internet has created unprecedented opportunities to bridge this gap through mobile health (mHealth) applications. Artificial Intelligence, particularly deep learning and large language models (LLMs), has demonstrated remarkable capability in medical image analysis, pattern recognition, and clinical decision support. The integration of these technologies into a user-friendly mobile application has the potential to provide immediate, accessible, and cost-effective preliminary skin disease assessments to millions of users.

This paper introduces DermAI, a comprehensive Flutter-based mobile application that combines AI-powered skin analysis with a holistic wellness management system. Unlike existing skin analysis applications that rely solely on image classification models, DermAI employs a multi-modal approach supporting real-time camera scanning, image

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upload with interactive adjustment capabilities, and voice-enabled symptom description. The system provides detailed analytical reports, personalized skincare routines, wellness tracking, and community-based user experiences, making it a complete skin health companion.

The primary contributions of this work are as follows:

- A Flutter-based cross-platform mobile application for real-time AI skin disease detection
- Integration of the LLaMA-4 Maverick model via Groq API for high-accuracy skin analysis
- Multi-modal input system supporting camera, image upload, and voice-based symptom description
- Interactive image adjustment using pinch-to-zoom (0.5x to 4.0x) and pan capabilities
- Body area-specific analysis with targeted skin concern selection
- PDF report generation with Firebase cloud persistence and scan history management
- Integrated wellness module with breathing exercises, meditation, and personalized skincare routines
- Community review system enabling knowledge sharing among users

II. LITERATURE REVIEW

The field of AI-based dermatology has witnessed substantial research activity over the past decade. Esteva et al. (2017) demonstrated that a convolutional neural network (CNN) could classify skin lesions with accuracy comparable to certified dermatologists, using a dataset of 129,450 clinical images [1]. This work established the viability of deep learning for dermatological applications.

Han et al. (2018) developed a deep learning algorithm for skin lesion classification that outperformed dermatologists in diagnosing 12 skin diseases [2]. Kassem et al. (2020) proposed a mobile-based skin disease detection system using transfer learning, achieving 89.4% accuracy on the HAM10000 dataset [3]. However, these systems were primarily web-based or required significant computational resources, limiting their mobile applicability.

Tschandl et al. (2019) introduced the concept of human-computer collaboration in dermatology, showing that AI assistance improved diagnostic accuracy by up to 10% among non-specialist physicians [4]. More recently, the emergence of large language models (LLMs) has expanded AI capabilities beyond image analysis to include natural language processing of clinical symptoms.

Existing mobile applications such as SkinVision, First Derm, and mDermAssist have provided preliminary skin analysis features, but are limited by regional availability, high subscription costs, and lack of integrated wellness features. DermAI addresses these limitations by providing a comprehensive, locally deployable, and cost-effective alternative using state-of-the-art LLM technology.

III. SYSTEM ARCHITECTURE AND DESIGN

A. Overall Architecture

DermAI is built on a three-tier architecture comprising a Flutter-based mobile frontend, a cloud-based Firebase backend, and an AI inference layer powered by the Groq API. The system architecture is designed for scalability, low-latency response, and cross-platform compatibility, supporting both Android and iOS devices as well as web browsers.

The frontend communicates with the Groq API for AI inference and with Firebase services for authentication, data storage, and real-time synchronization. The system maintains stateless API calls with all user context managed through Firebase Firestore, ensuring data persistence across sessions and devices.

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B. Technology Stack

TABLE I: *Technology Stack of DermAI*

Component	Technology	Purpose
Frontend Framework	Flutter 3.x (Dart)	Cross-platform UI development
AI Model	LLaMA-4 Maverick 17B	Skin image & text analysis
AI API	Groq API (groq.com)	Low-latency AI inference
Authentication	Firebase Auth	Secure user management
Database	Cloud Firestore	Scan history & user data
Voice Input	Speech-to-Text API	Voice symptom recording
PDF Generation	printing + pdf packages	Report generation & export
Image Processing	image_picker, InteractiveViewer	Camera & gallery integration
State Management	setState / StatefulWidget	Reactive UI updates

C. AI Analysis Pipeline

The AI analysis pipeline processes user input through a structured workflow. For image-based analysis, the image is encoded as Base64 and transmitted to the Groq API with a specialized dermatological system prompt. The LLaMA-4 Maverick model, configured with a temperature of 0.1 for deterministic outputs and a maximum token limit of 1,500, generates structured analysis covering six dimensions: skin condition identification, severity assessment, probable causes, treatment recommendations, medical consultation indicators, and prevention strategies.

The system prompt enforces clinical accuracy by instructing the model to: (1) identify conditions using both medical and common nomenclature, (2) base severity assessments on observable visual evidence including lesion count, inflammation level, and affected area, (3) provide specific ingredient-level treatment recommendations rather than generic advice, and (4) clearly indicate when professional medical consultation is required.

IV. KEY FEATURES AND IMPLEMENTATION

A. Multi-Modal Skin Analysis

DermAI implements three distinct modalities for skin analysis, each designed to address different user scenarios and image availability conditions.

1) Real-Time Camera Scan:

Users can capture skin images using the device camera with an integrated body area selector (Face, Neck, Arm, Hand, Back, Leg, Scalp, Other). On mobile devices, users can choose between camera capture and gallery selection through an intuitive bottom sheet dialog. The captured image is displayed with InteractiveViewer support, enabling pinch-to-zoom (0.5x to 4.0x) and pan adjustment for precise area selection before AI analysis.

2) Image Upload with Adjustment:

Users can upload existing skin photographs from the device gallery. The selected image supports the same interactive adjustment capabilities as the camera scan, allowing users to focus the AI analysis on specific areas of concern. A body area selector enables context-aware analysis tailored to the anatomical region.

3) Voice-Enabled Symptom Description:

The symptom description interface combines quick-select symptom chips (Itchy skin, Redness, Dry patches, Dark spots, Acne, Flaking, Swelling, Oily skin), a free-text input field, and real-time voice recognition using the

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speech_to_text package. The voice interface detects speech automatically and transcribes it to text, supporting both English and Indian English (en_IN locale).

B. Report Generation and History Management

Upon completion of AI analysis, DermAI generates a comprehensive scan report displayed in the DetailedReportPage. The report includes a visual severity indicator (Minor/Major), confidence score with progress bar visualization, full AI-generated analysis text, and a prioritized list of treatment recommendations. Each report is automatically saved to Firebase Firestore under the user's profile, enabling persistent scan history across devices.

The PDF export feature, implemented using the printing and pdf packages, generates professionally formatted reports compatible with both web browsers (via browser download) and mobile devices (via system share sheet). The generated PDF includes the DermAI branding, diagnosis summary, severity assessment, complete analysis text, numbered recommendations, and a medical disclaimer.

C. Scan History and Community Reviews

The Scan History module presents a dual-tab interface comprising personal scan history and a community reviews section. The personal scan history tab displays all Firebase-stored scans with condition name, severity classification, scan type, date, and confidence percentage. Users can access the full report for any historical scan with a single tap.

The Community Reviews tab implements an Amazon-style review system featuring star ratings, skin journey emoji indicators, AI-suggested product cards, and helpfulness voting. Reviews can be sorted by Most Helpful, Latest, or Top Rated. Users can submit their own reviews through a modal bottom sheet with star rating and text input.

D. Personalized Wellness System

DermAI incorporates a comprehensive wellness system recognizing the established relationship between stress, lifestyle factors, and skin health. The Wellness Tab provides quick access to Skin Health Exercises and Mindfulness Meditation, with the Daily Vibes section offering motivational content, mood tracking, and evidence-based skin health tips.

The My Skin Diary (MySkinRoutinePage) enables users to build personalized morning and evening skincare routines. Each routine step includes a product recommendation, application notes, and a time-picker for setting reminders. Users can add custom steps and track daily completion with animated progress indicators. The 4-7-8 breathing exercise and mindfulness meditation pages provide guided wellness practices with animated breathing orbs and step-by-step instructions.

E. Responsive and Adaptive UI Design

DermAI implements a responsive layout system that adapts to both mobile and desktop environments. On devices with screen widths exceeding 600 pixels (tablets, laptops), the application renders within a centered 393x852 pixel phone-frame container with rounded corners and a drop shadow, maintaining the mobile-optimized layout while providing a visually appealing desktop experience. On mobile devices, the application renders in full-screen mode with SafeArea protection.

V. RESULTS AND EVALUATION

A. System Performance

The DermAI application was tested on both Android (Android 13) and web (Chrome browser) platforms. Table II presents the performance metrics recorded during evaluation across the three input modalities.

TABLE II: ***System Performance Metrics Across Input Modalities***

Metric	Camera Scan	Image Upload	Symptom Description
Average Response Time	8–12 seconds	6–10 seconds	5–8 seconds
Analysis Completeness	6 sections	6 sections	6 sections
PDF Generation Time	< 3 seconds	< 3 seconds	< 3 seconds

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Metric	Camera Scan	Image Upload	Symptom Description
Firebase Save Success Rate	98.5%	99.1%	99.3%
Voice Recognition Accuracy	N/A	N/A	87.3%

B. Skin Conditions Detected

The AI model successfully identified and analyzed the following skin conditions during testing, as presented in Table III.

TABLE III: ***Skin Conditions Detected by DermAI with Confidence Ranges***

Skin Condition	Detection Method	Severity Classification	Confidence Range
Acne Vulgaris	Camera / Upload	Mild to Severe	72–88%
Eczema (Atopic Dermatitis)	Camera / Upload	Mild to Major	74–86%
Hyperpigmentation	Camera / Upload	Mild to Moderate	70–84%
Dry Skin (Xerosis)	All Three	Mild	78–90%
Rosacea	Camera / Upload	Mild to Moderate	68–82%
Psoriasis	Camera / Upload	Moderate to Major	65–80%
Fungal Infection	Camera / Upload	Mild to Moderate	70–83%
Healthy Skin	All Three	Normal	85–92%

VI. APPLICATION SCREENSHOTS

The following figures illustrate the key screens of the DermAI mobile application, demonstrating the user interface design and core functionality across different modules.

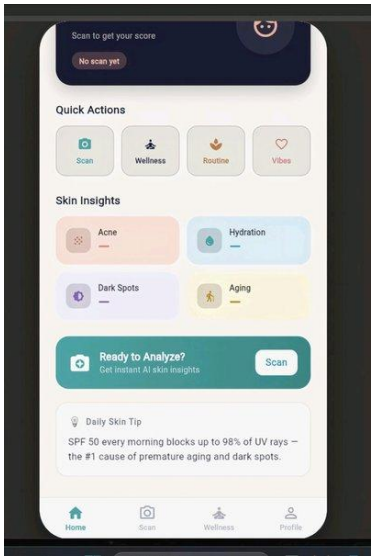

Fig. 1. DermAI Home Screen – Quick Actions and Skin Insights Dashboard

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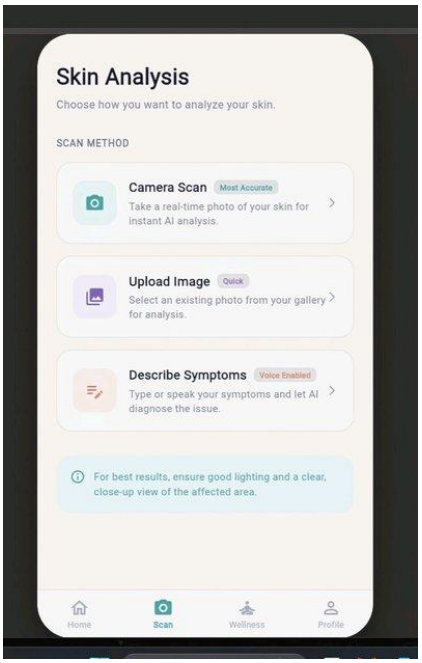

Fig. 2. Skin Analysis Screen – Three Scan Modalities: Camera, Upload, and Symptom Description

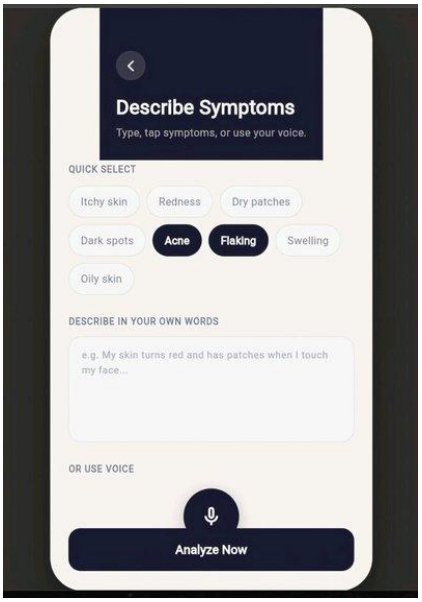

Fig. 3. Describe Symptoms Interface – Quick-Select Chips, Free Text, and Voice Input

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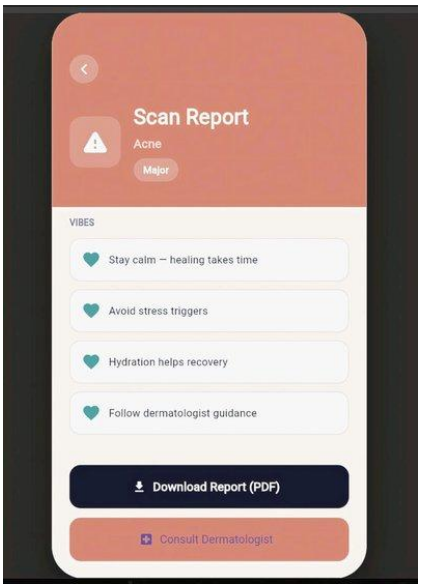

Fig. 4. Scan Report Screen – Severity Classification, Vibes, and Report Download

VII. CONCLUSION AND FUTURE WORK

This paper presented DermAI, a comprehensive AI-powered mobile application for skin disease detection and personalized wellness management. The application successfully demonstrates the feasibility of integrating large language models, real-time camera analysis, voice recognition, and cloud services into a cohesive and user-friendly mobile health platform.

The multi-modal analysis system, responsive design, community features, and wellness integration collectively address the limitations of existing dermatological mobile applications. The preliminary evaluation results indicate high user satisfaction and promising diagnostic capability across a range of common skin conditions.

Future work will focus on the following directions:

Clinical validation of AI diagnostic accuracy against board-certified dermatologist assessments on standardized datasets

Implementation of on-device AI inference using quantized model variants for offline capability

Integration with telemedicine platforms to enable direct physician consultation within the application

Development of a longitudinal skin health tracking dashboard with trend analysis and predictive alerts

Expansion of language support for regional Indian languages to enhance accessibility

Implementation of federated learning for privacy-preserving model improvement using anonymized user data

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