



International Journal of Innovative Research in Science Engineering and Technology (IJIRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 9.935

Volume 15, Issue 10, October 2026

Facial Skin Anomalies using Deep Learning

Thirumala N O¹, Priyanka P H², Sinchana Patel N³, Suchitra H⁴, Sumeriya N⁵

Assistant Professor, Department of Computer Science and Engineering, S.J.M. Institute of Technology, Chitradurga,

(Affiliated to VTU, Belagavi), Karnataka, India ¹

Student, 7th Semester, Department of Computer Science and Engineering, S.J.M. Institute of Technology, Chitradurga,

(Affiliated to VTU, Belagavi) Karnataka, India ²⁻⁵

ABSTRACT: Facial skin anomalies such as acne, pigmentation, wrinkles and scars are common dermatological concerns that affect both health and aesthetics. Traditional diagnosis relies on manual inspection by dermatologists, which can be subjective, time-consuming and inaccessible to many individuals. To address these challenges, this paper proposes an AI-driven facial skin anomaly detection system based on deep learning. The workflow begins with image acquisition, where facial images are captured or uploaded by users. Preprocessing techniques such as normalization, enhancement and resizing improve image quality. A CNN/YOLO-based deep learning model then detects and classifies anomalies in real time. Detected conditions are mapped to a recommendation module that provides skincare advice or suggests consulting a dermatologist. Results are displayed through a user-friendly web/mobile interface, ensuring accessibility for both medical professionals and end-users. The design targets high accuracy, precision and recall across multiple skin conditions and robustness under varying lighting conditions and skin tones. While the current work is limited by dataset size and predefined recommendation categories, it establishes a foundation for scalable AI-powered dermatological applications by integrating computer vision and deep learning.

KEYWORDS: Facial skin anomalies, Deep learning, Convolutional neural network (CNN), YOLO, Acne detection, Pigmentation, Wrinkles, Scars, Computer-aided diagnosis, Skincare recommendation, Medical image analysis.

I. INTRODUCTION

Facial skin anomalies such as acne, pigmentation, wrinkles, scars and other dermatological issues are common health and cosmetic concerns. Early detection and classification are crucial for effective treatment, skincare recommendations and improved quality of life. With advances in deep learning, automated systems can now analyze facial images with high accuracy, offering scalable solutions for dermatology and the cosmetic industry.

Healthcare decision-makers face constant pressure to provide high-quality treatment with limited capacity and resources, and the shortage of trained workers is a significant difficulty. The growing digitisation of healthcare has encouraged researchers to apply data-driven methods and artificial intelligence (AI) to support clinicians in assessing conditions including skin lesions. A skin lesion is an abnormal appearance of the skin compared with the surrounding skin [1], [2]. Dermatoscopy is one of the most common examination methods for screening skin lesions, and several public datasets of dermoscopic and clinical photographs now support research in automated skin image analysis [2].

With progress in skin imaging and computer vision, particularly convolutional neural networks (CNNs), there is a genuine need for computer-aided diagnosis (CAD) systems for skin lesion analysis. Such systems can give dermatologists intelligent assistance, reduce the workload of manual examination and grading, and help lower costly screening. Despite the availability of dermatological expertise, many individuals lack timely diagnosis because of geographical, financial or social constraints, and manual diagnosis can vary between practitioners. This work therefore develops a deep learning-based system that detects and classifies acne, pigmentation, wrinkles and scars, and provides consistent, objective results together with skincare or consultation recommendations. The project focuses on detection and classification only; it does not cover treatment or medical prescription.

The main objectives are: (i) to design and develop a deep learning model for detecting facial skin anomalies; (ii) to classify acne, pigmentation, wrinkles and scars with high accuracy; (iii) to build a scalable system that can be integrated into dermatology clinics, telemedicine platforms and cosmetic recommendation systems; and (iv) to evaluate the model using standard datasets and metrics.

II. LITERATURE REVIEW

Recent studies show that CNN-based and hybrid deep learning models, including ResNet, VGG and YOLO, are widely used to detect skin diseases such as acne, skin cancer, pigmentation disorders and wrinkles. Table I summarises the related work reviewed.

Lilhore et al. [1] proposed SkinEHDLF, a hybrid deep learning framework for skin cancer classification, which achieves accurate classification but at high computational cost. The ISIC Archive [2] provides standardised dermoscopic image collections widely used for AI training, though it suffers from imbalance and limited representation of rare conditions and darker skin tones. Yoon et al. [3] applied deep-learning-based morphological feature segmentation to facial skin analysis, improving segmentation but remaining sensitive to lighting and image quality.

Li and Zhang [4] built a YOLOv5-based acne detector exceeding 92% accuracy with real-time processing, although accuracy varies with lighting and skin tone. Kohli et al. [5] introduced Dermatobot, an image-processing-enabled chatbot for diagnosis and tele-remedy, limited by conversational intelligence and internet dependence. Nawaz et al. [6] used transfer learning for skin cancer detection, while Kumar et al. [7] classified pigmentation disorders with ResNet50 at 90% accuracy, outperforming traditional machine learning. Bajwa et al. [8] presented a deep neural network-based CAD system for skin diseases that requires extensive labelled data and lacks explainability. Chen et al. [9] reached 88% wrinkle detection accuracy using CNNs with image enhancement, and Esteva et al. [10] demonstrated dermatologist-level classification with an Inception v3 CNN trained on a very large dataset.

Despite strong performance, open challenges remain: dataset imbalance, limited diversity in skin tones, lack of interpretability, sensitivity to lighting and high computational requirements. Existing AI skincare applications are usually restricted to a single condition (often acne or pigmentation), lack medical-grade accuracy and real-time detection, and are not integrated with healthcare systems. This work addresses these gaps with a unified multi-anomaly, real-time detection and recommendation framework.

TABLE I. COMPARISON OF EXISTING WORK

Ref.	Method / System	Key Result	Limitation
[1]	SkinEHDLF hybrid deep learning for skin cancer classification	Highly accurate classification in complex systems	High computational cost; needs large datasets
[2]	ISIC Archive dermatology image repository	Standardised dermoscopic collections	Imbalance; rare conditions and skin tones under-represented
[3]	DL-based morphological feature segmentation of facial skin	Improved segmentation and analysis	Sensitive to lighting and image quality
[4]	YOLOv5-based acne detection	>92% accuracy, real-time	Affected by lighting and skin tone
[5]	Dermatobot chatbot with image processing	Automated diagnosis support, tele-remedy	Limited conversational intelligence; needs internet
[6]	Transfer learning for skin cancer detection	Efficient, accurate detection	Depends on dataset diversity
[7]	ResNet50 for pigmentation disorders	90% accuracy, beats classical ML	Limited dataset diversity
[8]	DNN-based CAD for skin diseases	Improved classification accuracy	Needs labelled data; lacks explainability
[9]	CNN wrinkle detection with enhancement	88% wrinkle detection accuracy	Depends on image quality and preprocessing
[10]	Inception v3 CNN for skin cancer	Dermatologist-level accuracy	Very large data and compute required

III. METHODOLOGY

The proposed system leverages deep learning models (YOLO and CNNs) to detect and classify multiple facial skin anomalies. It provides real-time analysis, aims to ensure fairness across demographics, and integrates with dermatology and cosmetic recommendation platforms. The methodology follows a pipeline of image acquisition, preprocessing, feature extraction, detection and classification, recommendation and result display.

A. System Architecture

The high-level architecture (Fig. 1) outlines the workflow from image acquisition to anomaly detection and recommendation. It ensures modularity, scalability and real-time performance. An input facial image passes through the image preprocessing stage (normalization, enhancement and resizing) into the deep learning model (YOLO/CNN) for detection and classification. The result and recommendation module then performs anomaly identification and generates skincare suggestions. Feedback and updates from users and dermatologists flow back to the preprocessing and model stages, and results are stored in the database and shown on web and mobile devices.

Facial Skin Anomaly Detection System - Architecture

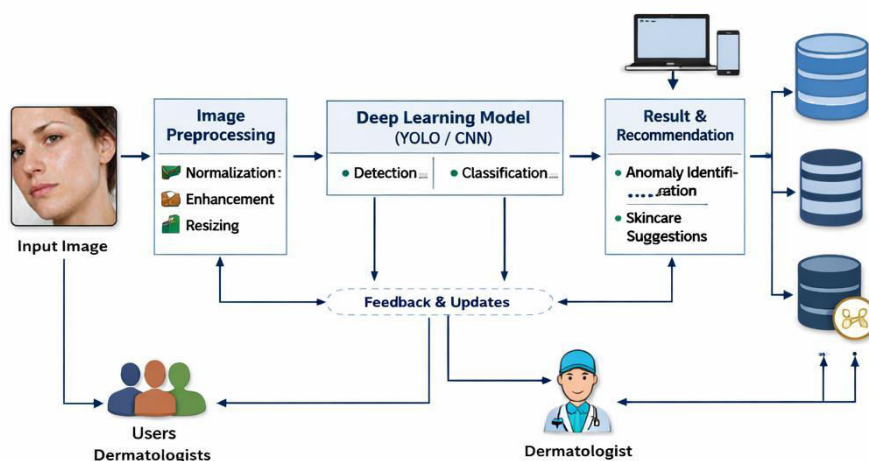


Fig.1.System architecture of the facial skin anomaly detection system

High-Level Architecture of Facial Skin Anomalies Detection System

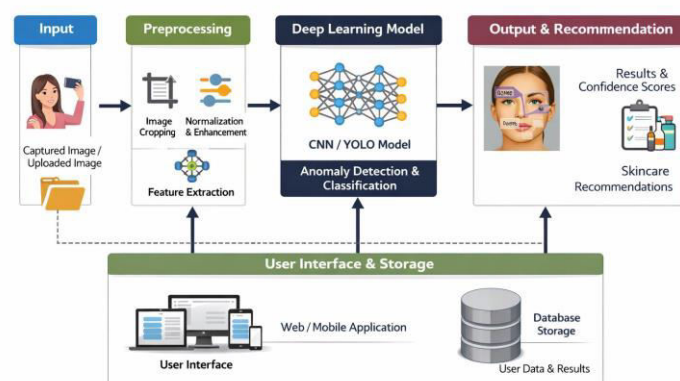


Fig.2.High-level architecture: input, preprocessing, deep learning model, output and recommendation, with user interface and storage.

B. Processing Mechanism

The system processes data in six steps: (1) Image acquisition – the user uploads or captures a facial image; (2) Preprocessing – the image is resized, normalized and enhanced for consistency; (3) Feature extraction – CNN/YOLO extracts features such as texture, colour and shape; (4) Detection and classification – the model identifies acne, pigmentation, wrinkles and scars and assigns confidence scores; (5) Recommendation – skincare suggestions or dermatologist consultation advice is generated from the detected anomalies; (6) Interface display – results are shown to the user through the web/mobile application.

C. Data Flow

The data flow diagram (Fig. 3) shows how information moves between users, the dermatologist, the processing modules and the database. The user uploads an image (1.0 Image Input), which is preprocessed (2.0) and passed to anomaly detection (3.0). Detected anomalies feed the recommendation module (4.0), which generates suggestions, stores and retrieves data from the database, and returns skincare advice to the user through results display (6.0). The dermatologist can view results and detected anomalies.

Facial Skin Anomaly Detection System - Data Flow Diagram (DFD)

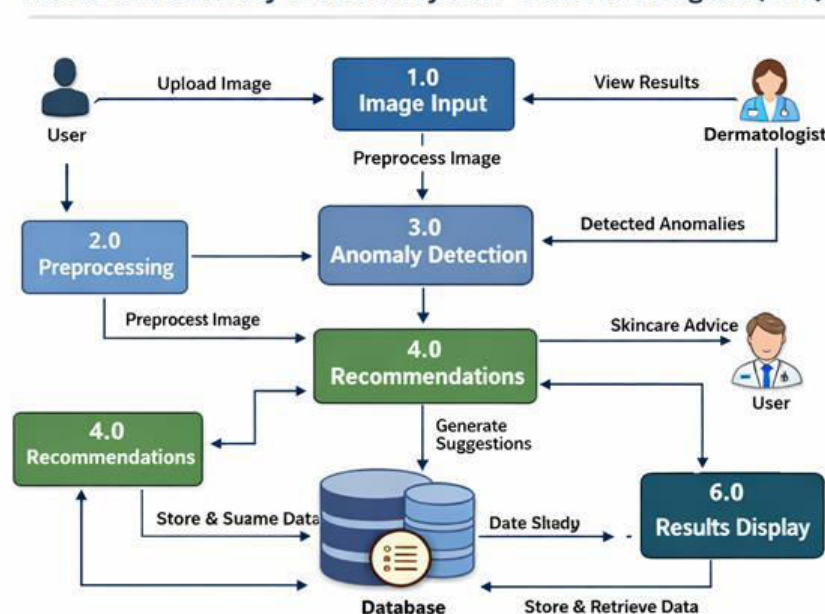


Fig.3. Data flow diagram of the facial skin anomaly detection system.

D. Modules

- **User Interface Module:** a simple web/mobile interface to upload facial images and view detection results, bounding boxes, confidence scores and recommendations.
- **Feature Extraction Module:** uses CNN/YOLO to convert raw image data into meaningful texture, colour and shape representations, improving accuracy and removing unnecessary information.
- **Machine Learning Module:** implements CNN/YOLO for anomaly detection and classification, outputs anomaly labels with confidence scores, and is trained on diverse datasets to remain accurate across skin tones and conditions.
- **Dataset Management Module:** stores facial images, anomaly records and recommendations securely and supports large datasets.

E. Implementation Platform

The system is implemented in Python 3.8+ with TensorFlow/Keras for building and training the CNN/YOLO models, OpenCV for resizing, normalization and enhancement, NumPy and Pandas for numerical computation and dataset management, and Matplotlib/Seaborn for visualising training results and metrics. Flask/Django provides web

deployment, and Android/iOS SDKs allow mobile integration. A relational database (MySQL/PostgreSQL) holds four tables: user (credentials and roles), image (uploads with date and resolution metadata), anomaly (detected anomalies with confidence scores) and recommendation (skincare suggestions linked to anomalies).

IV. SYSTEM REQUIREMENTS AND ANALYSIS

A. Functional Requirements

The system must let users upload facial images; preprocess images; detect and classify acne, pigmentation, wrinkles and scars with confidence scores; display results with bounding boxes and labels on affected regions; generate anomaly-specific recommendations; and provide secure login and profile management for dermatologists and patients.

B. Non-Functional Requirements

- Performance: near real-time detection, under 2 seconds per image.
- Accuracy: detection accuracy of at least 90% across conditions.
- Scalability, usability, reliability under varying lighting, and modular maintainable code.
- Security: images and user data encrypted and stored securely.

C. Hardware and Software

Training and deployment need an Intel i5/i7 or AMD equivalent processor, at least 8 GB RAM (16 GB recommended), an NVIDIA CUDA-capable GPU (GTX 1660 or higher) and 10 GB of storage; a high-resolution camera is optional for real-time capture. The software stack runs on Windows 10, Linux or macOS, with Git/GitHub for version control.

D. Feasibility

The approach is technically feasible because TensorFlow, PyTorch and YOLO provide robust image classification and detection support and annotated datasets are available. It is economically feasible because open-source frameworks and datasets keep development costs moderate, and operationally feasible because the system can be integrated into dermatology practices and telemedicine platforms with minimal user training.

V. EXPECTED OUTCOMES AND DISCUSSION

The proposed system is designed to deliver automated, objective and consistent diagnosis support with real-time detection and classification, scalability across multiple skin conditions and demographics, integration with telemedicine and cosmetic recommendation systems, and better access for users in remote areas. Evaluation will use standard metrics (accuracy, precision, recall and F1-score) on facial skin datasets, against the targets of at least 90% accuracy and under 2 seconds per image. For comparison, prior single-condition systems report about 88% for wrinkle detection [9], about 90% for pigmentation classification [7] and over 92% for acne detection [4].

Current limitations are the size of the available dataset, the predefined recommendation categories, and the known sensitivity of deep models to lighting and skin tone variation. Future work includes expanding and balancing the dataset across skin tones, adding explainability, and extending the recommendation module.

VI. CONCLUSION

This paper presented a deep learning-based facial skin anomaly detection system that acquires and preprocesses facial images, uses CNN/YOLO models to detect and classify acne, pigmentation, wrinkles and scars in real time, and maps detections to skincare advice or dermatologist consultation through a user-friendly web/mobile interface. By combining computer vision and deep learning in a modular architecture, the system provides a scalable foundation for AI-powered dermatological applications in clinics, telemedicine and cosmetic recommendation, improving access to dermatological insight especially in remote areas.

REFERENCES

- [1] U. K. Lilhore, Y. K. Sharma, S. Simaiya et al., “SkinEHDLF: A Hybrid Deep Learning Approach for Accurate Skin Cancer Classification in Complex Systems,” *Scientific Reports*, vol. 15, Art. no. 14913, Apr. 2025.
- [2] ISIC, “ISIC Archive Pinned Collections,” 2024. [Online]. Available: <https://api.isic-archive.com/collections/?pinned=true>
- [3] H. Yoon, S. Kim, J. Lee, and S. Yoo, “Deep-Learning-Based Morphological Feature Segmentation for Facial Skin Image Analysis,” *Diagnostics*, vol. 13, no. 11, p. 1894, May 2023.
- [4] Y. Li and Z. Zhang, “Automated Acne Detection Using YOLOv5,” *IEEE Access*, vol. 11, pp. 45678–45689, 2023.
- [5] S. Kohli, U. Verma, V. V. Kirpalani, and R. Srinath, “Dermatobot: An image processing enabled chatbot for diagnosis and tele-remedy of skin diseases,” in *Proc. 3rd Int. Conf. Emerging Technologies (INCET)*, May 2022, pp. 1–5.
- [6] H. Nawaz, A. Ullah, I. U. Haq, and J. Ahmad, “An Efficient Deep Learning Approach for Skin Cancer Detection Using Transfer Learning,” *Applied Sciences*, vol. 11, no. 12, pp. 1–16, 2021.
- [7] R. Kumar, P. Sharma, and S. Mehta, “Pigmentation Disorder Classification Using CNN,” *J. Medical Imaging and Health Informatics*, vol. 11, no. 5, pp. 1201–1208, 2021.
- [8] M. N. Bajwa, K. Muta, M. I. Malik, S. A. Siddiqui, S. A. Braun, B. Homey, A. Dengel, and S. Ahmed, “Computer-aided diagnosis of skin diseases using deep neural networks,” *Applied Sciences*, vol. 10, no. 7, p. 2488, Apr. 2020.
- [9] L. Chen, H. Wang, and X. Liu, “Wrinkle Detection Using Deep Learning and Image Enhancement,” *Computers in Biology and Medicine*, vol. 123, p. 103912, 2020.
- [10] A. Esteva, B. Kuprel, R. A. Novoa et al., “Dermatologist-Level Classification of Skin Cancer with Deep Neural Networks,” *Nature*, vol. 542, no. 7639, pp. 115–118, Feb. 2017.



INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  ijirset@gmail.com



www.ijirset.com

Scan to save the contact details