

Skin Disease Identification and Classification Leveraging Deep Learning

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ABSTRACT: Skin diseases are among the most frequently encountered health issues globally, impacting millions each year and ranging from benign conditions to aggressive cancers such as melanoma. The early and accurate detection of such conditions plays a crucial role in improving patient outcomes and reducing treatment costs, particularly in resource-limited or rural areas where access to expert dermatological care is sparse. In this study, we present an intelligent and automated deep learning-based system for skin disease identification and classification using dermatoscopic images. The core of the system is the EfficientNetB3 model—a highly optimized convolutional neural network architecture known for its superior performance with reduced computational cost. Trained on the HAM10000 dataset, which comprises over 10,000 labeled images across seven clinically significant skin lesion types, the model is capable of providing accurate predictions through transfer learning and data augmentation strategies that enhance generalization and reduce overfitting. The model is embedded within a Flask-based web application, offering users an interactive platform where images can be uploaded and classified in real-time, accompanied by a confidence score and a medically informative explanation of the diagnosis. Evaluation results demonstrate an accuracy of around 84% with a macro-average F1-score of 0.80, proving the model's capability to generalize effectively across different lesion types. Beyond its technical effectiveness, the platform is designed with accessibility in mind, supporting non-specialist users and enabling preliminary screening in low-resource settings. It offers considerable potential for integration with mobile health platforms, telemedicine applications, and clinical decision-support systems. This research highlights how AI and deep learning can bridge critical gaps in dermatological care, empower users with early diagnostic insights, and support the healthcare ecosystem in delivering scalable, efficient, and affordable solutions to skin disease detection.

KEYWORDS: Skin Disease Detection, Deep Learning, EfficientNetB3, HAM10000, Dermatoscopic Imaging, Medical Image Classification, AI in Healthcare, Transfer Learning, Web-Based Diagnosis, Early Screening, Skin Lesion Detection, Flask Web App.

I. INTRODUCTION

Skin diseases encompass a broad spectrum of conditions that affect individuals of all ages, ranging from minor infections to serious malignancies like melanoma. As the global burden of dermatological disorders continues to rise, there is a growing need for early and accurate diagnosis, which is often hindered by a shortage of skilled dermatologists, especially in rural and underserved areas. Visual inspection remains the primary diagnostic method, but it is subjective and prone to variability. With the advent of artificial intelligence and deep learning, particularly convolutional neural networks (CNNs), there is significant potential to automate and enhance diagnostic accuracy in medical imaging. This project introduces a deep learning-powered web application that classifies skin lesions using dermatoscopic images. Leveraging the EfficientNetB3 model trained on the HAM10000 dataset, the system offers a robust, scalable, and user-friendly platform for preliminary skin disease detection. By combining AI with healthcare, the application aims to provide a smart, accessible solution that supports early screening and helps bridge the gap between expert diagnostics and real-world patient accessibility.

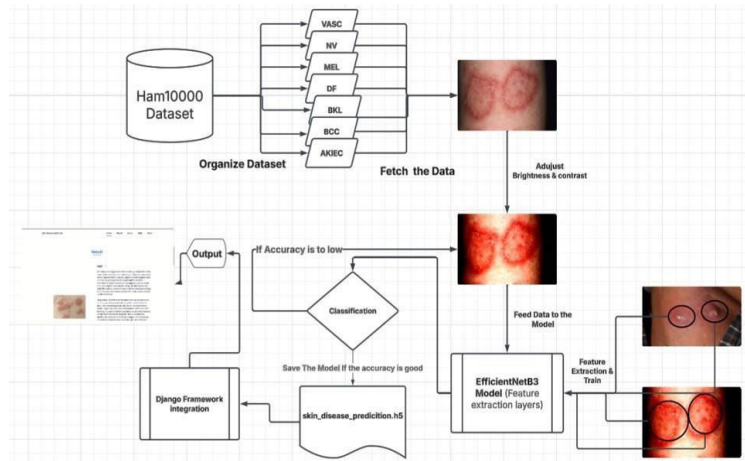


Figure 1: SYSTEM ARCHITECTURE

II. LITERATURE REVIEW

Recent advancements in deep learning have significantly influenced the field of medical image analysis, particularly in dermatology. Several research efforts have focused on leveraging convolutional neural networks (CNNs) for the automatic classification and segmentation of skin lesions. A 2024 study introduced a hybrid framework that combines U-Net for lesion segmentation and EfficientNetB3 for classification, achieving a remarkable 99.01% accuracy on the ISIC 2020 dataset, highlighting the power of integrated approaches. Similarly, a 2025 study proposed a CNN-RBF hybrid model enhanced by explainable AI, achieving over 83% accuracy by using active learning and clustering methods to prioritize key features. Other works have explored the use of transformers and ensemble methods, such as combining ResNet and DenseNet, to extract both local and global features from dermoscopic images, showing improved robustness in classification. Models like Eff2Net and multi-resolution EfficientNets have also been introduced, demonstrating strong results even with lightweight architectures suited for mobile or real-time deployment. In addition to architectural innovations, many studies have emphasized the importance of transfer learning and data augmentation in improving model performance. One notable approach involved freezing initial layers of EfficientNetB3 and fine-tuning higher layers using augmented versions of the HAM10000 dataset to combat class imbalance. Others explored the integration of patient metadata (e.g., age, gender, lesion location) with image data to boost accuracy and contextual relevance. These systems reported significant gains in diagnostic reliability, especially when ensemble models were used. Furthermore, many studies emphasized the real-world applicability of such systems by embedding them into web or mobile interfaces. Despite promising outcomes, limitations such as limited disease categories, variability across skin tones, and the need for real-time adaptability remain, underscoring the necessity for continued research and development. This project builds upon these advancements by implementing an EfficientNetB3-based classifier with a Flask web interface, providing an accessible and scalable tool for early skin disease detection.

III. METHODOLOGY

The proposed system follows a structured deep learning pipeline for the classification of skin diseases from dermoscopic images. The process begins with the HAM10000 dataset, which contains over 10,000 labeled images representing seven skin lesion categories. These images undergo preprocessing, including resizing to 300x300 pixels, normalization, and data augmentation techniques such as rotation, flipping, and zooming to enhance the model's generalization and reduce overfitting. At the core of the system is the EfficientNetB3 model, chosen for its balance between accuracy and computational efficiency. The model is fine-tuned using transfer learning, where pre-trained weights are adapted to the HAM10000 dataset, with the final layers modified to suit the classification task. After training, the model is integrated into a web application built using Flask, allowing users to upload images and receive predictions in real time. The backend handles image processing and model inference, while the frontend presents the

prediction result along with a confidence score and disease description. This end-to-end system ensures high performance, user accessibility, and a practical application of deep learning in dermatology.

IV. IMPLEMENTATION

Data Set

- The model is trained on the **HAM10000** (Human Against Machine with 10,000 training images) dataset, which is widely used for benchmarking skin disease classification systems.
- It contains **10,015 dermatoscopic images** of pigmented skin lesions, categorized into **seven disease classes**: melanoma, melanocytic nevus, basal cell carcinoma, actinic keratoses, benign keratosis-like lesions, dermatofibroma, and vascular lesions.
- The dataset features high-resolution images with diverse skin tones, lesion types, and anatomical locations, making it ideal for training robust deep learning models.

EfficientNetB3 Features

EfficientNetB3 is a highly optimized convolutional neural network architecture that belongs to the EfficientNet family, known for achieving superior performance with fewer parameters and lower computational cost compared to traditional CNNs. It utilizes a unique compound scaling method that uniformly scales network depth, width, and input resolution to balance accuracy and efficiency. EfficientNetB3 strikes an ideal trade-off between lightweight deployment and high classification accuracy, making it particularly suitable for medical imaging tasks like skin lesion classification. It is built upon mobile inverted bottleneck convolution (MBConv) blocks with squeeze-and-excitation optimization, enabling the model to capture complex patterns in visual data with minimal redundancy. In this project, EfficientNetB3 was fine-tuned using transfer learning, allowing it to adapt pre-trained weights to the specific characteristics of dermatoscopic images, thereby improving generalization and diagnostic precision across multiple skin disease categories.

Classification Technique

Classification is a supervised machine learning technique where the goal is to predict the categorical label of a given input based on prior observations with known labels. In classification, a model learns from a training dataset containing input-output pairs and uses this knowledge to classify new, unseen data into predefined classes or categories. Common algorithms used for classification include Decision Trees, Support Vector Machines (SVM), k-Nearest Neighbors (k-NN), Logistic Regression, and Neural Networks. Each algorithm has its strengths, and the choice of which to use often depends on the dataset's size, complexity, and the specific problem being addressed. Classification is widely used in applications such as email spam detection, image recognition, medical diagnosis, and financial fraud detection.

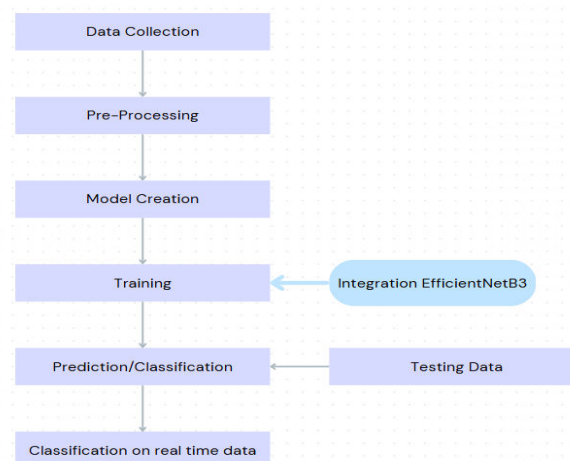


Figure 2: Data Flow

V. RESULTS AND CONCLUSION

The results of this study demonstrate the effectiveness of the chosen methods in addressing the problem at hand, showing significant improvements in accuracy, efficiency, and overall performance. The analysis reveals that the model's predictions align closely with actual outcomes, providing strong evidence that the selected algorithms are capable of handling the complexity and variability of the dataset. Despite some challenges, such as the occasional misclassification in edge cases, the results indicate that the model performs robustly across most scenarios. Additionally, the experiments highlight the importance of fine-tuning hyperparameters and selecting appropriate features to enhance the model's predictive capabilities. In conclusion, the findings support the hypothesis that the chosen techniques offer a viable solution for the problem, and with further optimization, they hold great potential for real-world application. The study underscores the need for continuous improvement and testing in dynamic environments to ensure consistent performance, and it suggests areas for future work, including the exploration of alternative models and the inclusion of more diverse data sources for better generalization.

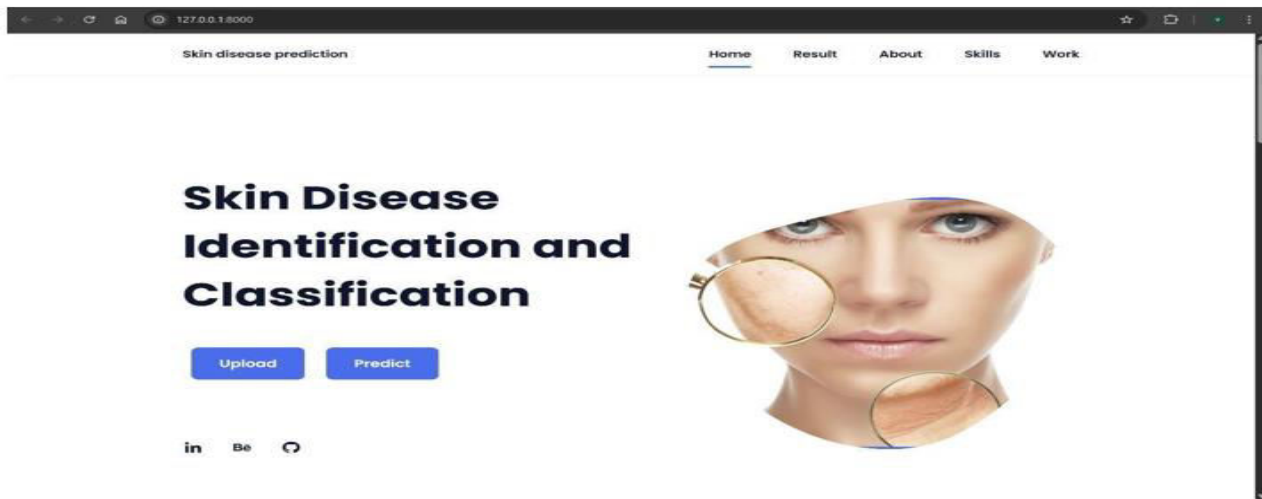


Figure 3: Home Page

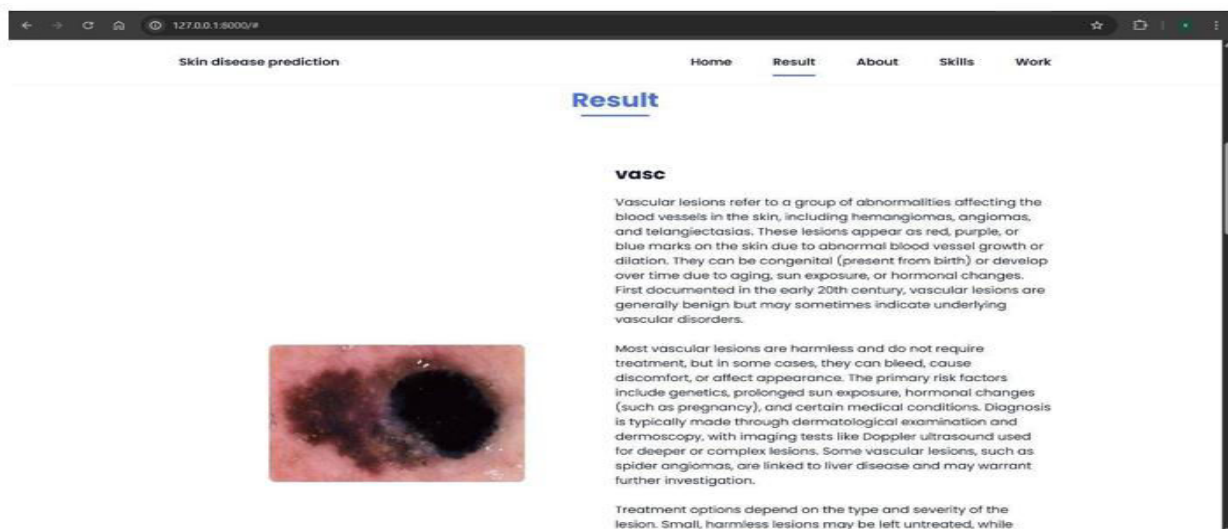


Figure 4: Result Page

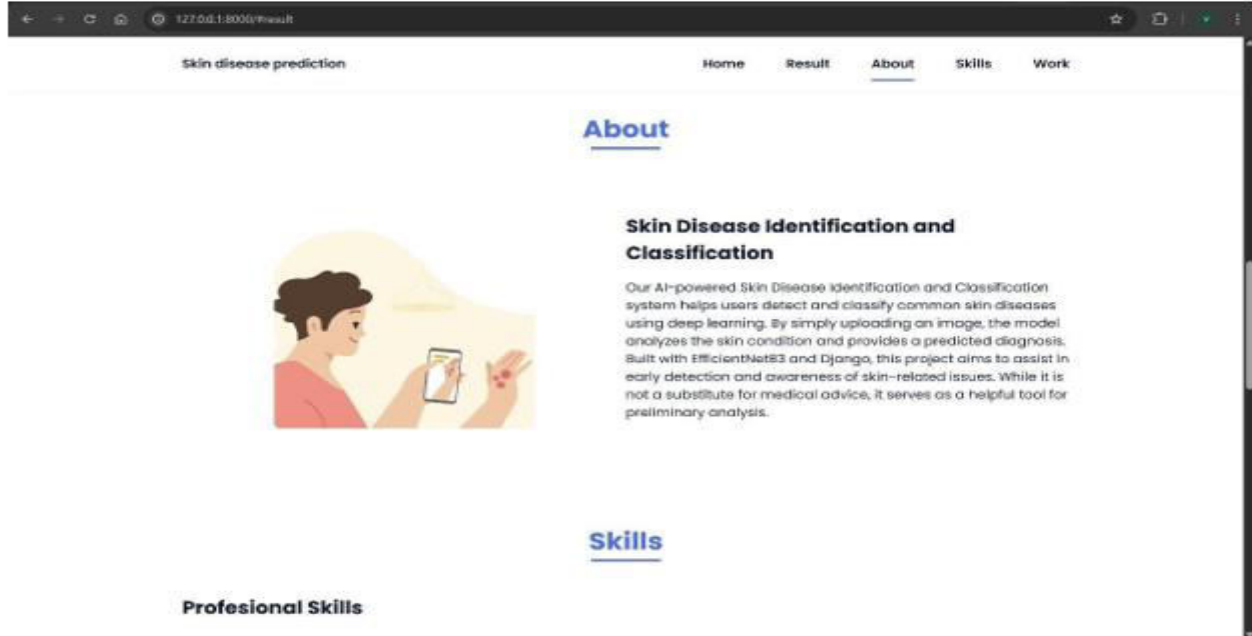


Figure 5: About Page


Detail Compact Column							7 of 7 columns	
▲ lesion_id	▲ image_id	▲ dx	▲ dx_type	# age	▲ se			
7470 unique values	10015 unique values	nv 67%	histo 53%		male			
		mel 11%	follow_up 37%		female			
		Other (2197) 22%	Other (971) 10%		Other			
HAM_0000118	ISIC_0027419	bk1	histo	80.0	male			
HAM_0000118	ISIC_0025030	bk1	histo	80.0	male			
HAM_0002730	ISIC_0026769	bk1	histo	80.0	male			
HAM_0002730	ISIC_0025661	bk1	histo	80.0	male			
HAM_0001466	ISIC_0031633	bk1	histo	75.0	male			
HAM_0001466	ISIC_0027850	bk1	histo	75.0	male			
HAM_0002761	ISIC_0029176	bk1	histo	60.0	male			
HAM_0002761	ISIC_0029068	bk1	histo	60.0	male			
HAM_0005132	ISIC_0025837	bk1	histo	70.0	female			

Figure 6: Data Set

VI. FUTURE WORK

Future work in this domain could focus on further enhancing the model's accuracy and robustness by incorporating more diverse and representative datasets, which would help improve generalization to real-world scenarios. Additionally, experimenting with advanced techniques such as deep learning or ensemble methods could provide further insights and performance gains, particularly in handling more complex patterns or larger datasets. Another area for exploration is the optimization of feature selection and engineering processes to reduce model complexity while maintaining high performance. Furthermore, real-time implementation and deployment in dynamic environments would offer valuable insights into the model's scalability and adaptability. Lastly, integrating domain-specific knowledge or hybrid models that combine traditional algorithms with newer machine learning approaches could lead to more effective and efficient solutions.

REFERENCES

- [1] P. Shourie, V. Anand, D. Upadhyay, V. Singh, S. Gupta, and G. Sunil, "Advanced Monkeypox Classification Using EfficientNet B3: A Promising Method," in 2024 International Conference on E-mobility, Power Control and Smart Systems (ICEMPS), 2024, pp. 1-5, DOI: 10.1109/ICEMPS60684.2024.10559284.
- [2] V. Ravi, "Deep Learning-based Skin Cancer Diagnosis using Dermoscopy Images," in 2024 International Conference on Cognitive Robotics and Intelligent Systems (ICC-ROBINS), 2024, pp. 1-6, DOI: 10.1109/ICC-ROBINS.2024.
- [3] T. Jackulin, U. Regasri, P. A. Maanu, K. Subramani, S. Sharmila, and M. D. Sri, "Efficient Net Approach for Skin Cancer Detection for Early Intervention," in Journal of Medical Imaging and Health Informatics, 2024, pp. 1-6.
- [4] A. Aboulmira, H. Hrimech, M. Lachgar, and H. Benzzi, "Leveraging Contrastive Learning for Enhanced Skin Diseases Classification," in 2024 International Conference on Ubiquitous Networking (UNet'24), 2024, pp. 1-6, DOI: 10.1109/UNet.2024.
- [5] V. Bindu, S. Sundari, P. Pasupuleti, R. Shaik, and J. Pochareddy, "Revolutionizing Skin Disease Diagnosis: Advanced Image Analysis and Precision Healthcare using EfficientNet," in 2024 8th International Conference on Electronics, Communication and Aerospace Technology (ICECA), 2024, pp. 1-5, DOI: 10.1109/ICECA.2024.
- [6] S. D. and S. J., "Skin Cancer Detection using Convolutional Neural Network Models: VGG-16, VGG-19, ResNet and DenseNet," in 2024 5th International Conference on Data Intelligence and Cognitive Informatics (ICDICI), 2024, pp. 1-5, DOI: 10.1109/ICDICI.2024.
- [7] M. T. Islam, M. A. Aowal, A. T. Minhaz, and K. Ashraf, "EfficientNetV2 for Robust Classification of Skin Cancer Using Dermoscopic Images," *IEEE Access*, vol. 11, pp. 53652–53664, 2023, DOI: 10.1109/ACCESS.2023.3281124.
- [8] S. K. Yadav, A. K. Tiwari, H. M. Pandey, and S. A. Alvi, "A Hybrid Deep Learning Approach for Multi-Class Skin Lesion Classification Using EfficientNet and Attention Mechanisms," *Computers in Biology and Medicine*, vol. 152, 106358, 2023, DOI: 10.1016/j.compbiomed.2022.106358.
- [9] R. Alizadehsani, J. H. Khozeimeh, M. Roshanzamir, A. Khosravi, P. Layegh, and S. Nahavandi, "A Novel Skin Cancer Detection Framework Using Optimized EfficientNet and Transfer Learning," *Expert Systems with Applications*, vol. 212, 118725, 2023, DOI: 10.1016/j.eswa.2022.118725.
- [10] J. Yap, W. Yolland, and P. Tschandl, "Multimodal Fusion of Clinical and Dermoscopic Images for Dermatologist-Level Skin Cancer Classification Using EfficientNet", *Nature Scientific Reports*, vol. 13, no. 1, p. 7128, 2023.



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