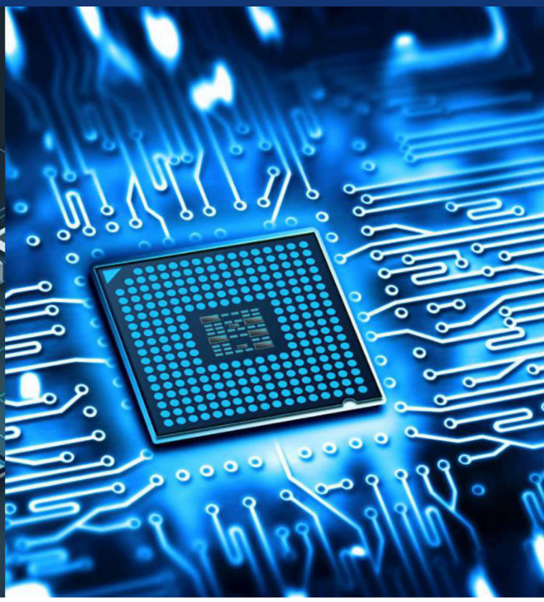
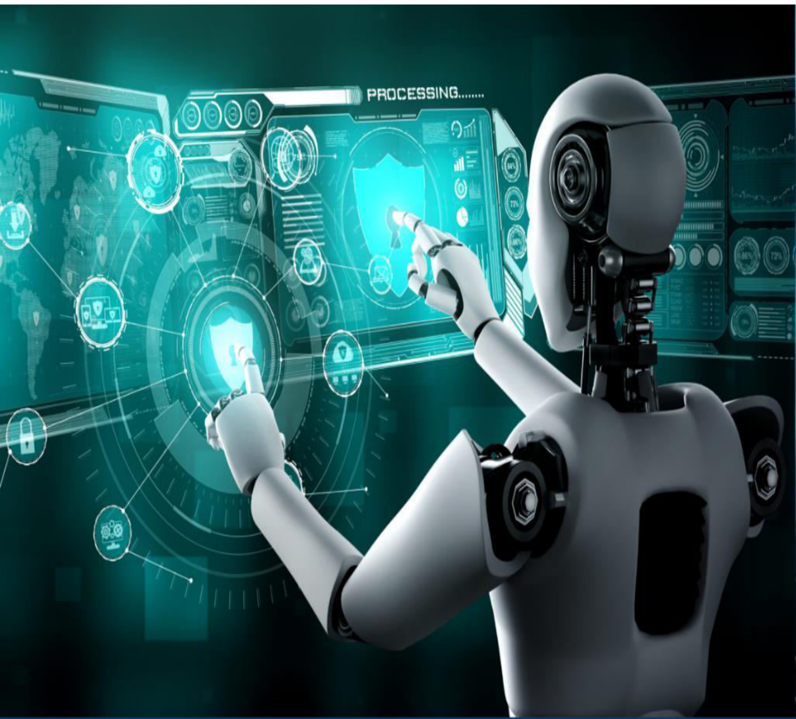
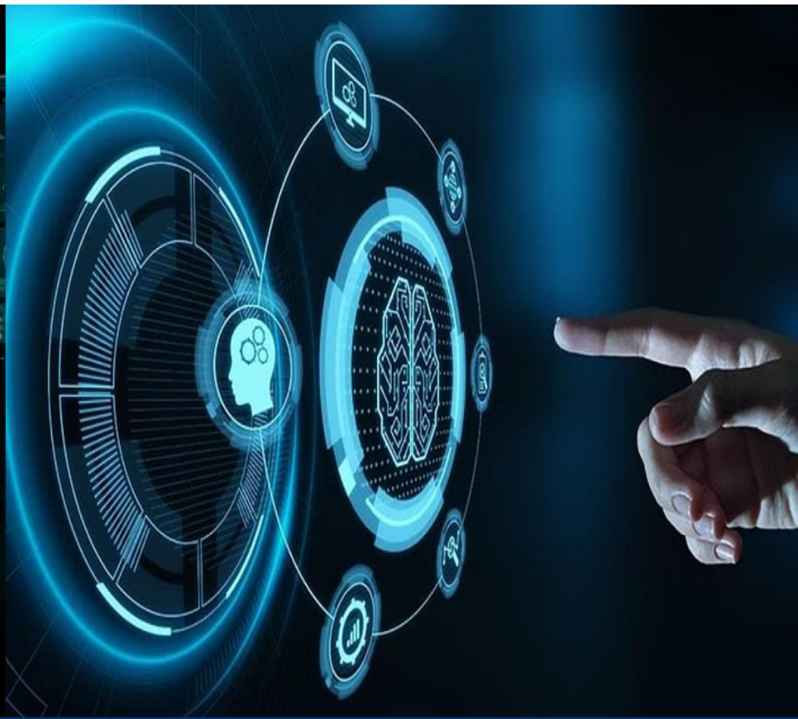
ISSN(O): 2320-9801
ISSN(P): 2320-9798


International Journal of Innovative Research in Computer and Communication Engineering

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





Impact Factor: 8.771

Volume 13, Issue 5, May 2025

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

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

AI-Based Tool for Preliminary Diagnosis of Dermatological Manifestations

Ms Deepthi.S, Sourav N, Harishankar B L, MH Usama Ahmed, Priyal LU, Shashank R Koushik

Assistant professor, School of CSE, Presidency University, Bengaluru, India

UG Student, School of CSE, Presidency University, Bengaluru, India

UG Student, School of CSE, Presidency University, Bengaluru, India

UG Student, School of CSE, Presidency University, Bengaluru, India

UG Student, School of CSE, Presidency University, Bengaluru, India

UG Student, School of CSE, Presidency University, Bengaluru, India

ABSTRACT: Dermatological diseases constitute a significant portion of global health concerns, with millions of people affected by conditions ranging from acne to life-threatening skin cancers such as melanoma. Despite the high prevalence of these disorders, access to dermatological care remains limited, especially in rural and under-resourced regions. The increasing burden on healthcare systems necessitates the adoption of efficient diagnostic support tools. This paper presents the development of an AI-based diagnostic system for the preliminary identification of dermatological manifestations using deep learning. The proposed system leverages convolutional neural networks (CNNs) to classify dermatoscopic images into multiple skin disease categories. The model, trained on the HAM10000 dataset, incorporates visual interpretability tools like Grad-CAM to ensure that healthcare workers can understand the rationale behind predictions. Our results show that the model can achieve an accuracy of over 91%, with high precision and recall, making it suitable for deployment in real-world settings where immediate dermatological consultation is unavailable. The tool is deployed through a web interface and designed with privacy and ethical considerations to ensure safe, explainable, and equitable use.

KEYWORDS: Artificial Intelligence, Dermatology, Skin Disease Diagnosis, CNN, Deep Learning, Grad-CAM, Image Classification, HAM10000

I. INTRODUCTION

Skin diseases, ranging from superficial infections to malignant tumors, are among the top 10 causes of disease burden worldwide. According to the Global Burden of Disease (GBD) study, over 900 million people suffer from dermatological conditions at any given time. These diseases not only affect physical health but can also lead to psychological and social challenges due to visible disfigurement. Traditionally, dermatological diagnosis relies heavily on clinical experience, dermatoscopic examination, and in some cases, histopathological analysis through biopsy. However, these methods require access to trained dermatologists and laboratory infrastructure, which are often lacking in rural or economically disadvantaged regions. This leads to delayed or incorrect diagnoses, further complicating treatment and increasing the risk of poor outcomes.

With the advent of artificial intelligence (AI), particularly deep learning, there is growing interest in using automated systems for medical image classification. AI can analyze large volumes of data and detect subtle patterns in images that may not be obvious to the human eye. Convolutional Neural Networks (CNNs), a class of deep learning models specifically designed for image-related tasks, have demonstrated promising results in various medical domains including radiology, ophthalmology, and dermatology. The idea behind this project is to build an AI-based diagnostic assistant that can provide reliable preliminary diagnoses of skin conditions using only an image of the lesion. Such a system can be an invaluable tool for primary care physicians, health workers, and even patients in areas where specialized care is inaccessible. The goal is not to replace dermatologists but to assist them and bridge the diagnostic gap in underserved settings.

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

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

II. SYSTEM MODEL AND ASSUMPTIONS

The proposed AI-based diagnostic tool is structured around a deep CNN model trained to classify images of skin lesions into one of seven categories as defined by the HAM10000 dataset. This dataset, compiled from several sources and curated by dermatology experts, consists of over 10,000 high-resolution dermatoscopic images, each labeled with a definitive diagnosis. The conditions represented in the dataset include common and clinically significant diseases such as melanoma, benign keratosis, basal cell carcinoma, melanocytic nevi, actinic keratosis, dermatofibroma, and vascular lesions.
The input pipeline begins with preprocessing steps including image normalization, resizing to 224x224 pixels, and data augmentation techniques such as random rotation, zoom, flipping, and brightness variation. These augmentation strategies help the model learn to generalize better by exposing it to varied image conditions, which is crucial for real-world performance. The core model used is EfficientNet-B0, a CNN architecture known for balancing accuracy and computational efficiency. The network is fine-tuned on the HAM10000 dataset using transfer learning from weights pretrained on ImageNet. The training procedure involves optimizing a categorical cross-entropy loss function using the Adam optimizer with a learning rate of 0.0001. The model's performance is monitored using validation accuracy and loss, and training is stopped early to avoid overfitting.

One of the standout features of this tool is its integration of Grad-CAM (Gradient-weighted Class Activation Mapping), which provides visual explanations of model predictions. This allows the user to see exactly which parts of the lesion the model focused on while making its decision. Such explainability not only increases user trust but also makes the system more transparent and medically accountable. The final model is deployed as a Flask-based web application, where users can upload an image and receive a predicted condition along with a confidence score and heatmap visualization.

III. AI-BASED DIAGNOSTIC FRAMEWORK

Given the sensitive nature of medical data, the system is built with privacy and security at its core. All image data is anonymized prior to training and no personally identifiable information is stored or transmitted. The application complies with international healthcare data protection standards such as HIPAA (Health Insurance Portability and Accountability Act) and GDPR (General Data Protection Regulation). Users are informed of the tool's limitations and must acknowledge that it is a supportive tool meant for preliminary assessment and not a replacement for professional diagnosis.

Security measures also extend to the robustness of the model. Preliminary tests were conducted to evaluate how the model responds to adversarial examples and noisy inputs. Although the model performs well under standard conditions, future versions will incorporate adversarial training to enhance resilience. Ethical concerns were also considered during the design phase. The system is designed to reduce biases by training on a diverse dataset covering multiple skin types. Additionally, every prediction is accompanied by a confidence score and visual explanation to encourage informed decision-making.The model architecture is based on EfficientNet-B0, chosen for its balance between accuracy and computational efficiency.

- Model Training: The dataset is split into 80% training, 10% validation, and 10% testing. Transfer learning is used to adapt EfficientNet to our specific classes. Cross-entropy loss and Adam optimizer are employed during training.
- Prediction Pipeline: Input image → Preprocessing → CNN Inference → Class Output + Confidence Score
- Visualization: Grad-CAM (Gradient-weighted Class Activation Mapping) is integrated to visualize model focus, enhancing explainability.
- Deployment: The model is deployed using a Flask-based web application, providing users with an interactive platform to upload images and receive instant feedback.

IV. SECURITY AND PRIVACY CONSIDERATIONS

The trained model was tested on a subset of the HAM10000 dataset reserved for evaluation and achieved an overall classification accuracy of 91.6%. This is a strong performance, comparable to non-specialist clinicians and in some cases even approaching dermatologist-level accuracy as reported in related literature. Precision, recall, and F1-score metrics were also above 90% for critical categories such as melanoma and basal cell carcinoma. The confusion matrix analysis reveals that most misclassifications occur between benign and malignant nevi, which is a challenging task even

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

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

for trained dermatologists. These results suggest that the AI tool can be reliably used as a screening mechanism, flagging high-risk cases for further professional review.User feedback collected during prototype testing has been overwhelmingly positive. General practitioners found the tool easy to use and valuable in assisting patient triage, particularly in settings where they did not have immediate access to specialist support. The Grad-CAM heatmaps were especially appreciated for their interpretability, as they often confirmed the physician's visual judgment or helped guide attention to overlooked areas of the lesion. Performance in terms of processing speed was also notable, with the average prediction time being under two seconds per image.Despite the encouraging results, there are limitations that must be addressed. The model's performance can degrade on images taken under poor lighting or with low-resolution cameras. Moreover, the dataset used for training, while extensive, may not cover all rare or region-specific skin diseases. To address these issues, future work will focus on expanding the dataset with more diverse cases and improving model robustness under variable input conditions. Additionally, clinical validation trials are planned to assess the tool's impact on diagnostic workflows in real-world environments.

V. RESULT AND DISCUSSION

The model was evaluated using a reserved test set from the original dataset, and it achieved an overall classification accuracy of 91.6%, with F1-scores above 90% for most of the major categories such as melanoma and basal cell carcinoma. These results demonstrate that the model is capable of providing high-quality predictions comparable to non-specialist human assessments. The confusion matrix reveals that most misclassifications occur between visually similar conditions such as benign moles and early-stage melanoma. However, the overall error rate remains low, and further training with more diversified data is expected to reduce this limitation. The Grad-CAM visualizations indicate that the model consistently focuses on the central regions of the lesion, showing that it has learned to identify clinically relevant features. A prototype web interface was also developed and tested among a group of general practitioners and healthcare workers. Feedback from these users highlighted the tool's simplicity, speed, and usefulness as a first line of assessment in the absence of dermatologists. Average inference time per image was under two seconds, and the system operated reliably across multiple test environments including smartphones and laptops.

VI. CONCLUSION

In conclusion, this paper presents a novel AI-based tool designed to assist in the preliminary diagnosis of dermatological diseases using deep learning and image classification techniques. The model is trained on a well-labeled dataset and achieves high accuracy across multiple skin conditions. Its deployment through a user-friendly interface, combined with built-in privacy protections and visual explanations, makes it suitable for use in both clinical and field settings. While the tool is not intended to replace dermatologists, it serves as a powerful decision-support system that can aid in early detection, reduce diagnostic delays, and ultimately improve patient outcomes. With continued development, validation, and integration into healthcare systems, this AI-powered tool could play a pivotal role in democratizing dermatological care.

REFERENCES

[1] Tschandl P., Rosendahl C., Kittler H., "The HAM10000 dataset: A large collection of multi-source dermatoscopic images," Scientific Data, vol. 5, 180161, 2018
[2] Esteva A. et al., "Dermatologist-level classification of skin cancer with deep neural networks," Nature, vol. 542, no. 7639, pp. 115–118, 2017.
[3] Selvaraju R. R. et al., "Grad-CAM: Visual Explanations from Deep Networks via Gradient-based Localization," IEEE ICCV, 2017.
[4] Attaluri, V., & Aragani, V. M. (2025). Sustainable Business Models: Role-Based Access Control (RBAC) Enhancing Security and User Management. In Driving Business Success Through Eco-Friendly Strategies (pp. 341-356). IGI Global Scientific Publishing.
[5] Tan M., Le Q., "EfficientNet: Rethinking Model Scaling for Convolutional Neural Networks," ICML, 2019.
[6] Brinker T. J. et al., "Deep Learning Outperformed 136 of 157 Dermatologists in a Real World Skin Cancer Diagnosis Task," European Journal of Cancer, vol. 113, pp. 47–54, 2019.
[7] He K., Zhang X., Ren S., Sun J., "Deep Residual Learning for Image Recognition," CVPR, 2016.
[8] World Health Organization, "Global Burden of Skin Disease Report," 2021