# Project Title: Explainable AI for Skin Disease Classification Using Grad-CAM and Transfer Learning.

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**Topic**: [Medical Science]

**Research Paper**: [Badhon, SM Saiful Islam, Sharun Akter Khushbu, Noyon Chandra Saha, Asif Hossain Anik, Md Aiyub Ali, and KSM Tozammel Hossain. "Explainable AI for Skin Disease Classification Using Grad-CAM and Transfer Learning to Identify Contours." (2024).DOI:10.20944/preprints202407.2556.v1]

### Initial Prompt

**Description: The preprint explores AI-driven methods for classifying skin diseases using transfer learning and Grad-CAM. Five deep learning models (e.g., VGG-16, VGG-19) were trained on an imbalanced dataset of 5,184 skin images.Augmentation and Grad-CAM were used to enhance accuracy and explain model predictions.**

**Generated Summary: This study presents a novel AI approach to skin disease classification using transfer learning and explainable AI (Grad-CAM). Five models, including VGG-16 and VGG-19, were evaluated using a dataset of skin disease images. Augmentation improved model performance, with VGG-16 achieving the highest accuracy of 97.07% on balanced data. The explainability feature provided insights into how the models identified disease patterns, specifically targeting rare conditions like acne, vitiligo, and SJS-TEN. The study highlights the importance of balancing datasets and using AI explainability in medical diagnostics.**

### Iteration 1

**Description: The first iteration refines the summary by focusing on key methods and outcomes. The study's significance in medical diagnostics and transfer learning is emphasized.**

**Generated Summary:** The research focuses on enhancing skin disease classification using transfer learning models like VGG-16 and VGG-19. By employing data augmentation on a dataset of 5,184 images, the study improves accuracy, with VGG-16 achieving 97.07%.Grad-CAM explains model decisions, identifying skin diseases like acne and vitiligo. The use of transfer learning and augmentation demonstrates the ability to classify rare conditions effectively, supporting low-resource healthcare settings. Key outcomes suggest AI-based diagnostics can improve early-stage identification of skin disorders, particularly when model predictions are made interpretable through explainable AI techniques.

### Iteration 2

**Description: This iteration focuses on enhancing the clarity and importance of the Grad-CAM explainability, and the broader implications for using AI in low-resource healthcare environments. It highlights the key findings and their impact on diagnosing rare skin diseases.**

**Generated Summary: This study explores AI techniques for skin disease diagnosis using transfer learning models like VGG-16 and VGG-19. By balancing an imbalanced dataset through augmentation, the VGG-16 model achieved 97.07% accuracy. Grad-CAM was used to visualize and explain the decision-making process, improving transparency in disease identification, particularly for rare conditions like SJS-TEN and vitiligo. The research demonstrates how AI models can overcome data scarcity challenges, providing significant value for medical diagnostics in low-resource environments. The study underscores the role of explainable AI in enhancing trust in machine learning-based medical diagnoses.**

### Final Prompt

**Description: Final prompt emphasizing the study’s methodology (transfer learning, data augmentation, explainability) and the application of results for medical diagnostics. Highlights the potential for AI to be used in early-stage disease detection in low-resource settings.**

**Generated Summary:** **This research demonstrates the application of AI in skin disease classification using transfer learning models and explainable AI (Grad-CAM). The study utilized five models, with VGG-16 achieving the highest accuracy of 97.07% after applying data augmentation to balance the dataset. Grad-CAM enhanced transparency by visualizing the model’s decision-making process, enabling the identification of rare skin conditions like SJS-TEN and vitiligo. The findings highlight the potential of AI for early-stage disease detection, especially in low-resource medical environments, where data scarcity is a challenge. The integration of explainable AI improves diagnostic trust and decision-making.**

### Insights and Applications

**Key Insights:** **The study provides critical insights into the role of transfer learning and data augmentation in improving the accuracy of skin disease classification models. Using VGG-16 and VGG-19, the researchers demonstrated that augmenting an imbalanced dataset can significantly boost accuracy, with VGG-16 reaching 97.07%. Grad-CAM, an explainable AI tool, provided visual insights into how models made predictions, improving transparency. This method successfully identified rare skin diseases such as vitiligo and SJS-TEN, highlighting its potential in medical diagnostics. The research underscores the importance of data preprocessing and model interpretability, especially in medical fields where decisions must be explained clearly.**

**Potential Applications:** **This study’s findings have far-reaching applications in healthcare, particularly in dermatology and medical diagnostics. The integration of explainable AI (Grad-CAM) can help medical practitioners understand and trust AI-generated diagnoses, particularly in complex cases involving rare skin diseases. The use of transfer learning models, like VGG-16, provides a cost-effective solution for developing diagnostic tools in resource-constrained environments. Augmentation techniques can also be applied to other areas where imbalanced datasets are a challenge, extending the model’s utility beyond skin disease classification to other medical fields, such as radiology and pathology.**

### Evaluation

**Clarity: The final summary clearly conveys the methodology and findings of the research, highlighting the use of transfer learning, data augmentation, and explainable AI (Grad-CAM). It presents the key outcomes in a straightforward manner, ensuring that both technical and non-technical readers can understand the importance of the study.**

**Accuracy:** **The final summary accurately reflects the core elements of the study, including the performance of the VGG-16 model (97.07% accuracy) and the role of Grad-CAM in improving transparency. It maintains fidelity to the original findings, ensuring that the research outcomes are presented truthfully and without overgeneralization.**

**Relevance:** **The insights and applications derived from the study are highly relevant to medical AI and dermatology. The summary emphasizes the importance of explainable AI and its application in low-resource healthcare environments, demonstrating a clear link between the research findings and potential real-world use cases.**

**Reflection**

### This project has provided valuable insights into the intersection of artificial intelligence and medical diagnostics. One of the most significant challenges I encountered was understanding the technical nuances of transfer learning and explainable AI, especially in the context of medical imaging. However, through careful study and iterative refinement of the summary, I gained a deeper appreciation of how these technologies can be applied to real-world problems, such as skin disease detection.

### The use of Grad-CAM to make AI models interpretable was a particularly interesting aspect. It highlighted the need for transparency in machine learning, especially in critical fields like healthcare, where the trust of medical professionals and patients is essential. Moreover, learning about data augmentation techniques provided me with practical knowledge on how to handle imbalanced datasets, which is a common issue in many AI applications.

### This experience has underscored the importance of accuracy, clarity, and relevance in summarizing complex research. I learned how to extract key findings without losing the essence of the study, balancing technical depth with accessibility. In future projects, I will apply these learnings to improve my approach to analyzing and communicating scientific research, particularly in interdisciplinary fields like AI and medicine.