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Interpretable AI for Skin Disease Diagnosis: A Review on Enhancing Trust and Decision-Making in Dermatology

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ABSTRACT

AI-driven dermatological diagnosis improves accuracy but faces challenges in interpretability and clinical trust. This review compares deep learning models like CNNs and Transformer-based architectures with techniques such as LIME, SHAP and also Grad-CAM which overcomes black box models by giving explanations for their results. It highlights dataset biases, the need for diverse datasets for better accuracy, and gaps in model generalizability, emphasizing the importance of standardized evaluation and human-AI collaboration for equitable AI adoption in dermatology across India and worldwide.

Keywords: XAI, Interpretable AI, dermatology, LIME, SHAP, Grad-CAM

1. INTRODUCTION

Skin diseases affects both physical and mental health of a person as explained by Ahammed et al. [1] and have become common issue all over the world and also a burden in health sector mentioned by Kavita et al. [2]. These skin health issues can be as common as acne to serious issue as melanoma. [3]. The reasons for skin health issues include infections, allergies and ecological factors WHO [4, 8].

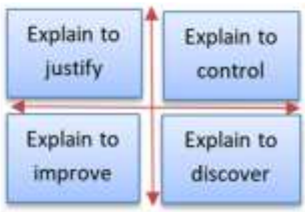
Skin diseases which are infectious are often contagious, arise from bacteria, viruses and fungi [5]. Allergic reactions like eczema mostly are triggered by environmental allergens [6]. Exposure to UV may lead to serious problems like skin cancer need to be detected at early stages to avoid health issues later on. [7]

AI is doing well in dermatological diagnosis but not able to win confidence of skin doctors due to its black box nature. XAI can overcome this gap by improving transparency and accuracy [8]. This review explores AI based interpretable solutions to help clinicians in its reliability and adoption.

Environmental factors may make the conditions worse in eczema and psoriasis especially in cold weather and low humidity [8]. Aging also plays a role in skin health, making it more susceptible to infections and skin diseases [9]. The countryside areas face limitations in dermatological care due to limited access and socio-economic barriers, slowing down treatment and making conditions more worse [10],[2].

AI has transformed dermatology by improvising diagnosis and treatment through ML models utilizing large datasets for training [11], [12]. However, its black box nature restrict clinical adoption, demanding interpretable AI models for transparency and conviction [13]. This review explores AI-driven solutions to improvise diagnostic accuracy and help clinicians in early disease detection.

Importance of XAI



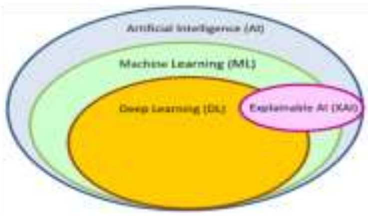


Fig.1: Application domains of XAI [13] **Fig.2: Need for Explainable AI (XAI) [13]** **Fig 3: AI vs. ML vs. DL vs. XAI. [13]**

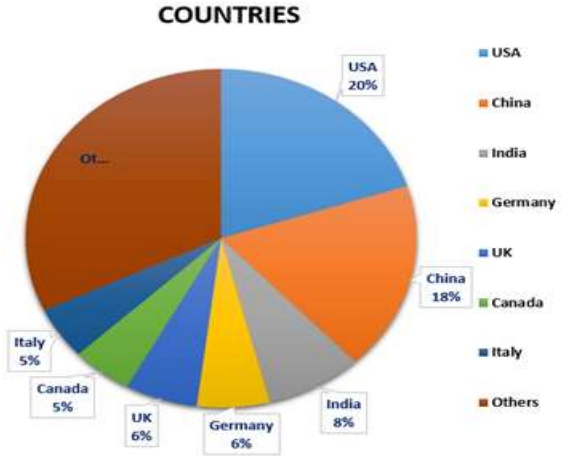


Fig. 4: Countries where research related to XAI were Produced (based on affiliation of first author). [36]

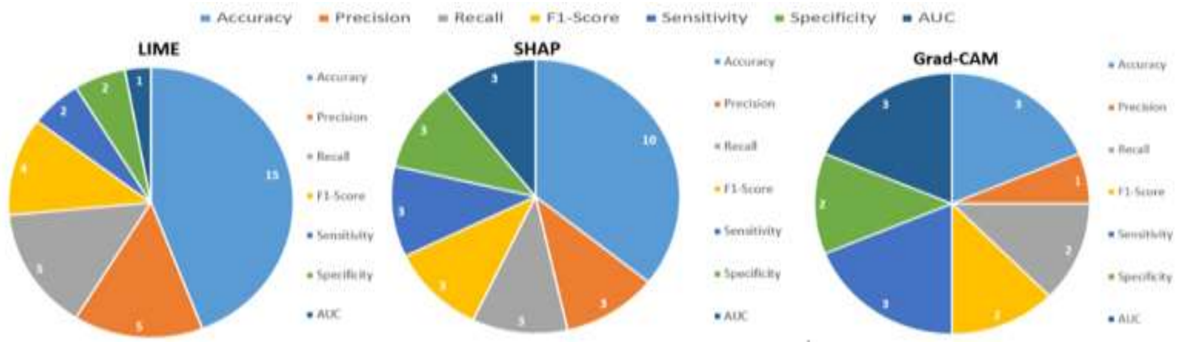


Fig.5: Performance used with XAI algorithms. [37]

Figures illustrate the significance of Explainable AI (XAI) across various domains, particularly in medical research where trust is essential. Figure 1 presents a pie chart summarizing XAI applications, while Figure 2 categorizes the need for XAI into four key aspects: justification, control, improvement, and discovery [13]. Figure 3 explains the hierarchical relationship between AI, ML, DL, and XAI emphasizing the importance of interpretability. [13]

Figure 4 highlights global research contributions to XAI, with the USA and China leading, followed by India, Germany, and the UK [36]. Figure 5 showcases performance metrics used to evaluate XAI techniques (LIME, SHAP, Grad-CAM) in healthcare, with accuracy being the most commonly assessed. [37]

SHAP and LIME both post-hoc model-agnostic methods, differ in approach—SHAP assigns feature contributions while LIME creates simpler local approximations. SHAP offers more visualization options but requires higher computational power, whereas LIME is faster but less effective with non-linear dependencies.

Table 1: Papers referred for ML techniques on datasets, key findings & gaps

Sr. No	Papers in References	Authors	Year	Dataset	Methodology	Key Findings	Identified Gaps
1	[1]	Ahammed et al.	2022	ISIC 2019, HAM10000	SVM, KNN, DT	High accuracy (95-97%)	Dataset limitations, model interpretability
2	[21]	Pacheco et al.	2020	PAD-UFES-20	Mobile platform & AI integration	Dataset contribution	Lack of skin-type diversity, ethical concerns
3	[16]	Nigar et al.	2022	ISIC 2019	Deep Learning + LIME	Improved trust in AI	Need for diverse datasets

4	[22]	Panja et al.	2021	ISIC	CNN	Enhanced diagnostic accuracy	Model generalizability issues
5	[11]	Fliorent et al.	2024	ISIC 2019, HAM10000	SVM, KNN, DT	Addressing skin tone bias	Need for dataset diversity
6	[17]	Gairola et al.	2024	ISIC 2018, Dermofit	Deep Learning + Feature Fusion	Higher classification accuracy	Model interpretability, rare conditions
7	[14]	Metta et al.	2023	ISIC Archive, HAM10000	CNN + Explainable AI	Trust enhancement through XAI	Need for more generalizable models
8	[10]	Besa et al.	2024	Primary Care Datasets	Systematic Review	AI applications in primary care	Need for standardized evaluation
9	[26]	Kundu et al.	2024	GAN-Augmented Dataset	Federated Deep Learning	Privacy-preserving AI	Need for diverse clinical validation
10	[20]	Datta et al.	2021	ISIC 2017	Soft Attention Mechanisms	Improved classification performance	Real-world clinical validation needed
11	[13]	Saranya A. & Subhashini R.	2023	HAM10000, GSE108008	Various Explainable AI approaches	Comprehensive overview of XAI principles and applications	Need for standard evaluation methodologies, user-friendly XAI for non-experts
13	[23]	Prasad et al.	2022	ISIC	PNN	Classifies skin cancer lesions as benign/malignant; cost-effective	Lower accuracy (87%), dataset bias, limited generalizability, rural accessibility issues
14	[24]	Moataz et al.	2021	ISIC 2018	CNN, Transfer Learning (VGG16, ResNet50)	Transfer learning improves classification accuracy	Limited generalization across datasets, lacks interpretability, needs clinical validation
15	[2]	Kavita et al.	2023	GBD 2017	Epidemiological Analysis, DALYs	Highlights skin disease burden in India, calls for improved healthcare strategies	Needs localized research, regional disparities, effectiveness of interventions

Table 2: Papers referred for XAI techniques, key findings & gaps

Sr. No.	Paper	Authors	Year	Methodology	Key Findings	Identified Gaps

1	[13]	S. A. Saranya, R. Subhashini	2023	Systematic review	Overview of models of XAI and applications	Need for standardized evaluation metrics
2	[29]	J. Mayanja et al.	2023	Deep Transfer Learning & XAI	XAI enhances interpretability in skin disease detection	Generalizability issues across different populations
3	[30]	A. Nazir et al.	2024	Deep Learning & Holography Imaging	AI advancements in medical diagnostics	Lack of explainability in DL models
4	[31]	T. Chanda et al.	2023	XAI-driven AI models	Increased trust and accuracy in melanoma diagnosis	Need for real-world clinical validation
5	[32]	S. Roy et al.	2024	XAI & Healthcare AI Systems	Enhanced transparency and trust in AI	Lack of interpretability frameworks
6	[33]	S. Abbas et al.	2025	Transfer Learning & XAI	High accuracy in skin disease classification	Limited dataset generalizability
7	[34]	E. Rezk et al.	2023	Incremental Domain Knowledge Learning	Improved interpretability in skin cancer classification	Need for real-world testing
8	[35]	P. Moral et al.	2024	Grey Wolf-based Feature Selection & XAI	Improved feature selection for PCOS detection	Need for clinical validation
9	[36]	E. Şahin et al.	2025	Systematic review	Comprehensive analysis of interpretability in DL	Need for real-world applications of XAI
10	[37]	Mélanie Champendal et al.	2023	Scoping review	Overview of AI interpretability in medical imaging	Need for standardized XAI methodologies
11	[38]	Subhan Ali et al.	2023	Systematic Literature review	Highlights the significance of XAI in healthcare	Need for clinical validation of XAI frameworks

Methodology: A systematic review of 26 journal papers (2020–2024) focused on AI applications in dermatology, analysing model interpretability, dataset diversity, and clinical utility. Key aspects included datasets, ML techniques, interpretability methods, and research gaps. Challenges such as dataset biases and generalizability issues were identified, with proposed strategies to enhance human-AI collaboration.

AI-Based Dermatological Diagnosis:

- **Machine Learning:** Traditional classifiers like SVM, KNN, and DT showed high accuracy but lacked interpretability (Ahammed et al., 2022; Fliorent et al., 2024).
- **Deep Learning & Transfer Learning:** CNNs improved accuracy, while VGG16 and ResNet50 enhanced efficiency but raised concerns over dataset biases (Panja et al. 2021; Moataz et al. 2021 et al.; Kalbande et al. 2020).
- **Explainable AI:** XAI techniques like LIME, SHAP, and Grad-CAM provided visual insights but lacked standardization (Nigar et al., 2022; Hauser et al., 2022).

2. CONCLUSION

Interpretable AI enhances trust in dermatological diagnosis by making AI decisions transparent. Overcoming challenges like dataset biases and standardizing explainability metrics is crucial for clinical adoption. Future research should refine XAI models and strengthen human-AI collaboration to improve diagnostic reliability and usability in dermatology.

REFERENCES

[1] Ahammed, M., M. A. Mamun, and M. S. Uddin. 2022. "A Machine Learning Approach for Skin Disease Detection and Classification Using Image Segmentation." Healthcare Analytics 12:100122-10037. Elsevier. doi:10.1016/j.health.2022.100122.

[2] Kavita, Thakur, J. S., and T. Narang. 2023. "The Burden of Skin Diseases in India: Global Burden of Disease Study 2017." Indian Journal of Dermatology, Venereology and Leprology 89:421-5. doi:10.25259/IJDVL_978_20.

[3] Thamizhvani, T. R., A. K. Ajayan, V. Sannidhya, R. J. Hemalatha, and R. Chandrasekaran. 2022. "Psoriasis Skin Disease Identification Using Support Vector Machine (SVM) Image Classification and Determining the Growth Rate." Journal of Physics: Conference Series 2318:012034. doi:10.1088/1742-6596/2318/1/012034.

[4] World Health Organization. "World Health Organization (WHO)." Available: https://www.who.int/. [Accessed: Sep. 3, 2024].

[5] Aljanabi, M. H., F. A. Jumaa, A. O. Aftan, M. S. S. Alkafaji, N. Alanı, Z. H. Al-Tameemi, and D. H. Al-Mamoori. 2019. "Various Types of Skin Tumors Lesion Medical Imaging (STLMI) of Healthy and Unhealthy Moles: A Review and Computational of Segmentation, Classification, Methods, and Algorithms." IOP Conference Series: Materials Science and Engineering 518:052014. doi:10.1088/1757-899X/518/5/052014.

[6] Kalbande, D., R. Naik, J. Jatakia, and U. Khopkar. 2020. "An Artificial Intelligence Approach for the Recognition of Early Stages of Eczema." International Journal of Medical Engineering and Informatics 12(1):52-61.

[7] Hauser, K., A. Kurz, S. Haggenmüller, R. C. Maron, C. von Kalle, J. S. Utikal, F. Meier, S. Hobelsberger, F. F. Gellrich, M. Sergon, A. Hauschild, L. E. French, L. Heinzerling, J. G. Schlager, K. Ghoreschi, M. Schlaak, F. J. Hilke, G. Poch, H. Kutzner, C. Berking, M. V. Heppt, M. Erdmann, S. Haferkamp, D. Schadendorf, W. Sondermann, M. Goebeler, B. Schilling, J. N. Kather, S. Frohling, D. B. Lipka, A. Hekler, and E. Krieghoff-Henning. 2022. "Explainable Artificial Intelligence in Skin Cancer Recognition: A Systematic Review." European Journal of Cancer 167:54–69. doi:10.1016/j.ejca.2022.02.025.

[8] Dalgard, F. J., U. Gieler, L. Tomas-Aragones, L. Lien, F. Poot, G. B. E. Jemec, L. Misery, C. Szabo, D. Linder, F. Sampogna, A. W. M. Evers, J. A. Halvorsen, F. Balieva, J. Szepietowski, D. Romanov, S. E. Marron, I. K. Altunay, A. Y. Finlay, S. S. Salek, and J. Kupfer. 2015. "The Psychological Burden of Skin Diseases: A Cross-Sectional Multicenter Study among Dermatological Out-Patients in 13 European Countries." Journal of Investigative Dermatology 135(4):984–991. doi:10.1038/jid.2014.530.

[9] Mittal, R., F. Jeribi, R. J. Martin, V. Malik, S. J. Menachery, and J. Singh. 2024. "DermCDSM: Clinical Decision Support Model for Dermatosis Using Systematic Approaches of Machine Learning and Deep Learning." IEEE Access 12:45678-45689. doi:10.1109/ACCESS.2024.3373539.

[10] Escale-Besa, A., J. Vidal-Alaball, Q. Miro Catalina, V. H. Garcia Gracia, F. X. Marin-Gomez, and A. Fuster-Casanovas. 2024. "The Use of Artificial Intelligence for Skin Disease Diagnosis in Primary Care Settings: A Systematic Review." Healthcare 12(12):1192-1202. doi:10.3390/healthcare12121192.

[11] Fliorent, R., B. Fardman, A. Podwojniak, K. Javaid, I. J. Tan, H. Ghani, T. M. Truong, B. Rao, and C. Heath. 2024. "Artificial Intelligence in Dermatology: Advancements and Challenges in Skin of Color." Journal of Dermatology Research 63:455–461. doi:10.1111/ijd.17076.

[12] Sorour, S. E., A. Abo Hany, M. S. Elredeny, A. Sedik, and R. M. Hussien. 2023. "An Automatic Dermatology Detection System Based on Deep Learning and Computer Vision." IEEE Access 11:12345-12356. doi:10.1109/ACCESS.2023.3340735.

[13] Saranya, S. A., and R. Subhashini. 2023. "A Systematic Review of Explainable Artificial Intelligence Models and Applications: Recent Developments and Future Trends." Decision Analytics Journal 7. Elsevier. doi:10.1016/j.dajour.2023.

[14] Metta, C., A. Beretta, R. Guidotti, Y. Yin, P. Gallinari, S. Rinzivillo, and F. Giannotti. 2023. "Improving Trust and Confidence in Medical Skin Lesion Diagnosis Through Explainable Deep Learning." International Journal of Data Science and Analytics. Springer. doi:10.1007/s41060-023-00401-z.

[15] Vachmanus, S., T. Noraset, W. Piyanonpong, T. Rattananurom, and S. Tuarob. 2023. "DeepMetaForge: A Deep Vision-Transformer Metadata-Fusion Network for Automatic Skin Lesion Classification." IEEE Transactions on Medical Imaging 11(1):145467-145484. doi:10.1109/ACCESS.2023.3345225.

[16] Nigar, N., M. S. Rahman, T. Ahmed, and A. M. Noor. 2022. "A Deep Learning Approach Based on Explainable Artificial Intelligence for Skin Lesion Classification." IEEE Access 10:220342–220355. doi:10.1109/ACCESS.2022.3224521.

[17] Gairola, A. K., V. Kumar, A. K. Sahoo, M. Diwakar, P. Singh, and D. Garg. 2024. "Multi-feature Fusion Deep Network for Skin Disease Diagnosis." Multimedia Tools and Applications. doi:10.1007/s11042-024-18958-7.

[18] Kolkur, S., and D. R. Kalbande. 2016. "Survey of Texture-Based Feature Extraction for Skin Disease Detection." 2016 International Conference on ICT in Business Industry & Government (ICTBIG), Indore, India. IEEE Xplore, April 2017. doi:10.1109/ICTBIG.2016.7892649.

[19] Debelee, T. G. 2023. "Skin Lesion Classification and Detection Using Machine Learning Techniques: A Systematic Review." Diagnostics 13:3147. MDPI. doi:10.3390/diagnostics13193147.

[20] Datta, S. K., M. A. Shaikh, S. N. Srihari, and M. Gao. 2021. "Soft Attention Improves Skin Cancer Classification Performance." In Interpretability of Machine Intelligence in Medical Image Computing, and Topological Data Analysis and Its Applications for Medical Data. Springer. 12929:13-25. doi:10.1007/978-3-030-87444-5_2.

[21] Pacheco, P. A., L. D. T. Pimenta, J. C. Ferreira, M. G. Silva, J. C. B. P. Lima, and M. A. S. Pereira. 2020. "PAD-UFES-20: A Skin Lesion Dataset Composed of Patient Data and Clinical Images Collected from Smartphones." Data in Brief 14(1):100013-100023. Elsevier. doi:10.1016/j.health.2020.100013.

[22] Panja, A., A. Saha, and M. T. Sharma. 2021. "An Approach to Skin Cancer Detection Using Keras and TensorFlow." Journal of Physics: Conference Series 1911:012032-012041. doi:10.1088/1742-6596/1911/1/012032.

[23] Prasad, S., A. Kumar, and R. Singh. 2022. "Skin Cancer Lesions Classification Using Probabilistic Neural Network." Journal of Physics: Conference Series 2335:012028-012036. doi:10.1088/1742-6596/2335/1/012028.

[24] Moataz, L., G. I. Salama, and M. H. Abd Elazeem. 2021. "Skin Cancer Diseases Classification Using Deep Convolutional Neural Network with Transfer Learning Model." Journal of Physics: Conference Series 2128:012013-012024. IOP Publishing. doi:10.1088/1742-6596/2128/1/012013.

[25] Vasconcelos, C. N., and B. N. Vasconcelos. 2024. "Experiments Using Deep Learning for Dermoscopy Image Analysis." Pattern Recognition Letters 155:153-160. Elsevier. doi:10.1016/j.patrec.2024.08.009.

[26] Kundu, D., M. M. Rahman, A. Rahman, D. Das, U. R. Siddiqi, M. G. R. Alam, S. K. Dey, G. Muhammad, and Z. Ali. 2024. "Federated Deep Learning for Monkeypox Disease Detection on GAN-Augmented Dataset." IEEE Access 12:15432-15445. doi:10.1109/ACCESS.2024.3370838.

[27] Reshma, M., and B. P. Shan. 2020. "A Clinical Decision Support System for Micro Panoramic Melanoma Detection and Grading Using Soft Computing Technique." Measurement 163:108024. Elsevier. doi:10.1016/j.measurement.2020.108024.

[28] Mayanja, J., E. H. Asanda, P. Tumwebaze, J. Mwesigwa, and G. Marvin. 2023. "Explainable Artificial Intelligence and Deep Transfer Learning for Skin Disease Diagnosis." Fourth International Conference on Image Processing and Capsule Networks, Lecture Notes in Networks and Systems 798. Springer. doi:10.1007/978-981-99-7093-3_47.

[29] Nazir, A., A. Hussain, M. Singh, and A. Assad. 2024. "Deep Learning in Medicine: Advancing Healthcare with Intelligent Solutions and the Future of Holography Imaging in Early Diagnosis." Multimedia Tools and Applications. doi:10.1007/s11042-024-19694-8.

[30] Chanda, T., T.-C. Bucher, K. Hauser, S. Hobelsberger, C. N. Garcia, H. Kittler, S. Podlipnik, P. Tschandl, C. Wies, C. Navarrete-Dechent, et al. 2023. "Dermatologist-Like Explainable AI Enhances Trust and Confidence in Diagnosing Melanoma." Nature Communications 14 (6574). doi:10.1038/s41467-023-43095-4.

[31] Roy, S., D. Pal, and T. Meena. 2024. "Explainable Artificial Intelligence to Increase Transparency for Revolutionizing Healthcare Ecosystem and the Road Ahead." Network Modeling Analysis in Health Informatics and Bioinformatics 13 (4). doi:10.1007/s13721-023-00437-y.

[32] Abbas, S., F. Ahmed, W. A. Khan, M. Ahmad, M. A. Khan, and T. M. Ghazal. 2025. "Intelligent Skin Disease Prediction System Using Transfer Learning and Explainable Artificial Intelligence." Scientific Reports 15: 1746. doi:10.1038/s41598-024-83966-4.

[33] Rezk, E., M. Eltorki, and W. El-Dakhakhni. 2023. "Interpretable Skin Cancer Classification Based on Incremental Domain Knowledge Learning." Journal of Healthcare Informatics Research 7: 59–83. doi:10.1007/s41666-023-00127-4.

[34] Moral, P., D. Mustafi, and S. K. Sahana. 2024. "PODBoost: An Explainable AI Model for Polycystic Ovarian Syndrome Detection Using Grey Wolf-Based Feature Selection Approach." Neural Computing and Applications 36: 18627–18644. doi:10.1007/s00521-024-10171-9.

[35] Şahin, E., N. N. Arslan, and D. Özdemir. 2025. "Unlocking the Black Box: An In-Depth Review on Interpretability, Explainability, and Reliability in Deep Learning." Neural Computing and Applications 37: 859–965. doi:10.1007/s00521-024-10437-2.

[36] Champendal, M., H. Müller, J. O. Prior, and C. S. dos Reis. 2023. "A Scoping Review of Interpretability and Explainability Concerning Artificial Intelligence Methods in Medical Imaging." European Journal of Radiology, Oct. doi:10.1016/j.ejrad.2023.111159.

[37] Ali, S., F. Akhlaq, A. S. Imran, Z. Kastrati, S. M. Daudpota, and M. Moosa. 2023. "The Enlightening Role of Explainable Artificial Intelligence in Medical & Healthcare Domains: A Systematic Literature Review." European Journal of Radiology. doi:10.1016/j.ejrad.2023.111159.