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Literature Survey of Skin Disease Detection & Treatment Recommendation System using Deep Learning

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Abstract - Millions of people worldwide suffer from skin conditions, which, if not identified and treated promptly, can result in serious health issues. The lack of dermatologists and the difficulty of visual diagnosis make timely detection difficult even with advancements in medical technology. In this project, we use Convolutional Neural Networks (CNN) and sophisticated architectures such as ResNet-50 to propose a deep learning-based system for automatic skin disease detection and treatment recommendation. The system categorizes illnesses, suggests treatments, and determines the severity to help users decide whether to see a doctor. In remote or underserved areas, this automated method can help medical professionals and be implemented as a scalable solution for early skin disease diagnosis.

Key Words: Neural Network (CNN); ResNet-50; Treatment Recommendation System; HAM10000; DermNet.

1. INTRODUCTION

Computer vision has greatly improved medical applications in recent years, especially in dermatology. Due to limited access to dermatologists, particularly in remote areas, skin diseases are common and frequently go undetected. From minor ailments to more serious ones like melanoma, skin diseases are among the most prevalent medical conditions in the world. Although early detection is essential, delayed diagnosis and treatment are frequently the result of limited access to dermatologists, particularly in rural areas. By using deep learning to create an intelligent system for automated skin disease detection and treatment recommendation, this project seeks to close that gap. In medical image analysis, Convolutional Neural Networks (CNNs) have demonstrated impressive success. Using large datasets like ISIC, studies like Esteva et al. (2017) and Brinker et al. (2019) achieved dermatologist-level accuracy.

However, many existing models lack treatment guidance and suffer from generalization issues. To address these challenge, we propose a CNN-based model using ResNet-50, trained on datasets like HAM10000 and DermNet. The system classifies various skin diseases and suggests basic treatment plans. Additionally, we explore Capsule Networks (CapsNet) to better capture spatial relationships often missed by CNNs. Models incorporate preprocessing techniques like resizing, normalization, and augmentation to improve performance and robustness, aiming to deliver an accessible and scalable solution for early skin disease detection and telemedicine support. This template is intended to be a tool to improve manuscript clarity for the reviewers. The final layout of the typeset paper will not match this template layout.

2. LITERATURE SURVEY

[1] By combining a dataset augmentation technique using Grad-CAM++ and Smooth Grad-CAM++, the authors suggest a creative way to improve the detection of malignant skin diseases across various skin tones. The Stanford Diverse Dermatology Image (DDI) dataset, which notably comprises a broad range of skin tones, is used to train the two convolutional neural network architectures, ResNet-34 and VGG-11, that they test. One notable aspect of their approach is the use of heatmaps produced by Grad-CAM to pinpoint important lesion locations. These heatmaps are then cropped and re-added to the training dataset to enhance the model's focus.

[2] This paper presents a clever system that helps people find the best doctor to treat their skin conditions. It uses a deep learning model (ResNet-50) to correctly identify a number of skin conditions, such as acne, rosacea, and eczema. Following the identification of the disease, the system goes one step further and recommends doctors based on the doctor's location, patient feedback, and history of successfully treating cases similar to the one in question. This approach is special because it does not only pinpoints the problem but also gives guidance on how to solve it. The goals is to decrease treatment delays and give people a reliable, easy-to-use tool for managing and monitoring skin health.

[3] This paper proposed a smart skin disease detection system that uses deep learning and cloud computing to help people identify skin issues early and get treatment suggestions. It mixes multiple CNN models with GAN-generated images to improve accuracy, going up to 97%, which is much higher than traditional models. The system does not just stop at detection it also recommends medications and care tips using AWS Personalize and provides helpful blogs for prevention. By using advanced AI techniques and making the system really easy to access online, the authors aim to make skin care more accurate, faster, and accessible for everyone, even in remote areas.

[4] A user-friendly system has been developed to help individuals detect skin diseases through image analysis and receive basic treatment suggestions. Employing the VGG19 deep learning model, trained on a custom dataset, the system accurately identifies over nine types of skin conditions with 94% accuracy. It is available as both a web and mobile application. It allows users to either upload an image or capture one in real time. The platform then processes the image and offers the most likely diagnosis along with recommended remedies, dos and don'ts, and self care tips. To ensure consistent performance across different environments, the system is deployed using Docker, making it widely accessible. This solution stands out for its ease of use, accessibility, and effectiveness particularly for users without immediate access to dermatologists.

[5] An advanced system has been developed to help people identify their skin tone, skin type, and common skin diseases using images and short questionnaires. It uses powerful machine learning models like ResNet-50 and decision trees to predict skin tone with 92% accuracy, skin type with 88% accuracy, and diagnose conditions like acne, eczema, and psoriasis with 90% accuracy. In this system its use of web scraping and NLP to gather the latest treatment advice from trusted dermatology sources online really stand outs, ensuring users get real time and reliable skincare suggestions. To keep the information accurate, the system filter data using techniques like Named Entity Recognition and sentiment analysis. It addresses everyday skincare needs, offering a more complete and personalized experience for users of all skin tones and types.

[6] Skin conditions are all over the world and can be particularly difficult to precisely diagnose in areas with inadequate medical resources. This study presents medilab-plus, a web-based system for diagnosing skin diseases that was developed on the TensorFlow platform using convolutional neural networks (CNNs). It focuses on identifying common skin conditions like scabies, acne vulgaris, and atopic dermatitis in Ghana. The system demonstrated encouraging potential to expedite diagnosis while easing the burden on limited dermatologists by achieving classification accuracies of roughly 85-88% for these conditions. Using this system, a dermatologist could potentially treat over a thousand patients every day because the model can analyze images in a fraction of a second. In addition to its useful advantages the platform can also serve as a valuable learning tool for medical students studying dermatology in Ghana. This research shows how AI-driven tools can improve healthcare accessibility, efficiency especially in regions with limited medical availability.

[7] In this work, skin disease detection and classification are performed using a deep learning approach based on the ResNet-50 Convolutional Neural Network (CNN) architecture. The system processes dermoscopic images from well-known datasets such as HAM10000 and DermNet to identify various skin conditions and suggest a treatments. To improve accuracy, images are first preprocessed through resizing, normalization, and augmentation techniques. ResNet-50, with its deep structure and residual connections, allows the model to extract complex features and make accurate classifications. Compared to traditional machine learning methods like K-Nearest Neighbors and Support Vector Machines, the CNN model achieves higher performance in terms of precision, recall, and F1-score. Other classification, the system also offers insight into the severity of the condition, recommends treatments, and suggests whether a doctor should be consulted. These features are integrated into a user friendly web interface, making the system practical for early diagnosis and clinical support.

[8] Hashmani et al. proposed a smart system that uses federated machine learning to detect skin diseases while keeping user data private. Their model works on both local devices and a central server, improving its accuracy over time without needing raw image uploads. They used deep learning (ensemble CNNs) to diagnose conditions like melanoma and eczema using the ISIC 2019 dataset. What makes this approach stand out is its ability to adapt and learn new disease patterns continuously, making it ideal for use in smart dermoscopy devices. This helps dermatologists get more accurate results while protecting patient privacy.

[9] Using a varied 31-class dataset, transformer based deep learning architectures are investigated for thorough skin disease classification. With the help of DinoV2, Vision Transformer (ViT), and Swin Transformers, the framework surpasses current CNN benchmarks by about 10%, achieving a state-of-the-art test accuracy of 96.48% and an F1-score of 0.9727. Notably, the method uses explainable AI (XAI) techniques, GradCAM and SHAP, to clarify model predictions and expands robustness evaluation to two more datasets, HAM10000 and DermNet. More precise clinical diagnosis and treatment planning are made possible by the visual explanations that are produced, which helps locate diseased areas within pictures.

[10] Using four sophisticated pre-trained CNNs that were trained on the HAM10000 dataset, a novel method for classifying skin cancer is presented. Extensive image augmentation is used in the methodology to improve generalization and reduce class imbalance. One of the study's main strengths is the incorporation of explainable artificial intelligence (XAI) methods, such as SmoothGrad and Faster Score-Cam, which produce interpretive heatmaps that highlight important lesion regions that affect model choices. When deep learning and XAI are combined, automated skin cancer diagnosis systems can become much more reliable and clinically useful. The XceptionNet architecture performs better than other models, with an accuracy of 88.72%.

Table-1: *Consolidated Performance Metrics of Deep Learning Models for Skin Disease Detection*

Model	**Accuracy**	**Precision**	**Recall**	**F1-score**
CNN	85-89%	83-88%	83-88%	84-87%

VGG-based Models	90-93%	89-92%	88-91%	89-92%
ResNet-based Models	88-91%	87-90%	87-90%	87-90%
Transformer Models	92-97%	91-94%	91-94%	91-94%
Siamese/ Grad-CAM CNN	95-99%	95-98%	95-98%	95-98%

3. RELATED WORKS

Dermatology and healthcare are becoming better thanks to artificial intelligence. The Dermatec study by Sudharson et al. [15] presented an AI-based platform that monitors skin disease with remarkable accuracy (99.8%) by combining CNN and a Siamese Neural Network. Its unique capability of tracking a patient's skin condition over time motivated us to investigate comparable progress-monitoring features in our own system.

In another, Chinnasamy et al. [15] developed a Health Recommendation System using deep learning techniques like RBM and CNN, Their model looked beyond just medical data, using behavioral and social inputs to offer personalized health advice. Their focus on privacy and data-driven suggestions influenced our own system's design, especially the way we link diagnosis with treatment tips while keeping user information secure.

Dolatabadian et al. (2025)[16] reviewed image-based crop disease detection using deep learning, highlighting CNNs like VGG16, ResNet, and MobileNet for their accuracy in classification. They also noted CNN limitations in capturing spatial relationships and suggested Capsule Networks as a more robust alternative.
These studies shaped our approach – Dermatec for its accuracy and monitoring, and the HRS for its smart, personalized recommendations. We've combined these ideas to build a system that's practical, accurate, and helpful to users.

4. FUTURE WORK

Many advances have been made in building lightweight and useful systems for detecting skin diseases, especially with hybrid approaches that combine geolocation data, expert knowledge, and image analysis to enhance practicality. However, there are a few areas that needs more research. In order to facilitate adaptive learning and system improvement, future studies should think about implementing user feedback mechanisms.

The usefulness of these systems would be increased by broadening their scope to encompass a wider variety of skin conditions. Additionally, adding multilingual support would make it more accessible to a wider range of users. Finally, using explainable AI methods like SHAP or LIME is necessary to increase openness and encourage more user confidence in model forecasts.

5. CONCLUSION

Skin disease detection is crucial to bringing about equitable healthcare for everyone — especially in rural or marginalized communities where quick access to medical treatment can mean the difference between a swift recovery and a grave outcome This study presents a practical and accessible technological approach aimed at facilitating the diagnosis of common skin conditions, offering clear treatment guidance, and helping users connect with appropriate healthcare providers for further care.

Importantly, the system achieves this without relying on complex and resource-intensive deep learning models. Instead, it leverages the strengths of classical machine learning techniques, rule-based logic, and geolocation services to deliver an efficient, interpretable, and cost-effective solution for skin disease detection. In a landscape increasingly dominated by intricate CNN architectures, this approach highlights the value of hybrid systems that prioritize usability and accessibility while maintaining strong performance.

Such tools have the potential to empower individuals, support earlier interventions, and help close healthcare gaps—particularly in regions where advanced infrastructure may not be available. Looking ahead, further development will focus on expanding disease coverage, enhancing model accuracy, and exploring integrations with wearable devices and mobile health platforms. By advancing in these directions, we aim to contribute to making digital dermatology solutions more inclusive, reliable, and widely accessible across diverse populations.

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