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Skin Disease Detection: Web Application for the Detection of Skin Diseases

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A B S T R A C T

Early and precise detection is essential for successful treatment and better patient outcomes due to the rising incidence of skin disorders. In order to analyze dermatological images, this study investigates the combination of sophisticated image processing methods and machine learning algorithms, specifically convolutional neural networks (CNNs). We offer a comprehensive web-based application that aims to close the gap between advanced technology and human skincare. Users can upload skin photos, get real-time feedback on possible diagnoses, and access comprehensive information about a range of skin conditions thanks to our platform's user-friendly interface. We assess how well several deep learning models perform in the classification of diseases like melanoma and other dermatological conditions using a sizable, meticulously annotated dataset of skin lesion images. We consider important real-world implementation factors, such as the need for strong training protocols and strict data privacy measures, in addition to model accuracy. Using deep learning, this web application seeks to improve the accessibility, effectiveness, and dependability of skin disease detection, ultimately leading to better dermatological care.

Keywords: ***Skin disorders, convolutional neural networks (CNNs), web application, deep learning, melanoma, machine learning algorithms, data privacy, real-time feedback.***

INTRODUCTION

Skin diseases, ranging from minor irritations to malignant melanoma, represent a significant health concern for societies around the globe. Lack of access to dermatologic care, particularly in rural and low-income geographic locations, causes delays in diagnosis and extended time to treatment which increases the mental and physical burden on patients experiencing pain and suffering. Improvement in patient outcomes and reduction in healthcare disparities requires early detection and quicker interventions to reduce chronic skin conditions. Proper dermatologic care is in acute need of improvement, regardless of access to dermatologic specialists in areas afflicted with poor social determinants of health. Technology can enable early detection and intervention a means to availing patient access to healthcare. Smartphone-based diagnosis and other smart tools can democratize healthcare by empowering patients to engage in their own wellness or even their ability to work through their adverse skin condition. Reducing unnecessary medical visits and improving treatment precision are two benefits of accurate, AI-driven diagnoses that maximise healthcare resources. Dermatological care can be revolutionised and healthcare efficiency increased by addressing these issues with creative technological solutions. The goal of the Skin Guard system is to offer a user-friendly, AI-powered platform for detecting skin diseases with an intuitive interface for smooth user interaction. Users can submit photos for real-time analysis and get information about possible skin conditions by combining deep learning and image recognition. In order to equip users with the necessary dermatological knowledge, the platform also offers educational materials on symptoms, causes, and treatments.

The paper is organised as follows: Section IV addresses implementation and outcomes, Section III introduces the suggested system, and Section II covers related work.

LITERATURE ANALYSIS

To put our study in context, we include a summary of pertinent research papers and observed results from current skin disease detection systems in this section. The large number of conditions with similar visual characteristics makes diagnosing skin diseases extremely difficult and can result in misdiagnosis. In order to improve diagnostic accessibility and accuracy, a number of studies investigate deep learning and machine learning approaches.

Innovative Approaches for Skin Disease Detection here deep learning, particularly Convolutional Neural Networks (CNNs), has shown promise in automating skin disease detection. A hybrid model combining CNN with Support Vector Machines (SVM) enhances classification accuracy by leveraging CNN's feature extraction capabilities and SVM's classification strength. Additionally, K-Nearest Neighbours (KNN) is utilized to compare new skin images with labelled datasets [1]. Deep Learning for Skin Disease Diagnosis: A Review says the shortage of dermatologists, especially in rural areas, highlights the need for AI-based diagnostic tools. CNNs, trained with diverse datasets and augmented images, improve the robustness of classification models. Collaborations with dermatologists ensure clinical relevance, while mobile and web-based applications enable real-time diagnostic assistance, making healthcare more accessible [2]. Enhancing Diagnosis with CNNs and Data Augmentation uses a seven-layer CNN model, along with DenseNet-121, enhances feature extraction and pattern recognition. Data augmentation techniques such as flipping, rotation, and cropping improve model generalizability. These advancements contribute to more reliable and scalable skin disease diagnostic tools, particularly for underserved regions [3]. Deep Learning for Skin Cancer Detection has various AI models, including Artificial Neural Networks (ANNs), CNNs, Kohonen Self-Organizing Maps (KNN), and Generative Adversarial Networks (GANs), are explored for skin cancer detection. The study identifies key challenges in data availability and model accuracy, advocating for more sophisticated AI-driven solutions to improve early detection and patient outcomes [4]. Machine Learning for Skin Disease Classification uses image segmentation techniques, such as Gray Level Co-occurrence Matrix (GLCM) for texture analysis, enhance skin disease classification. The approach isolates diseased regions for more precise diagnosis, improving the efficiency of automated detection systems, particularly for conditions like melanoma [5].

Several platforms provide automated skin disease detection, each with unique features and limitations.

AI-Dermatologist [6] offers an online platform for analysing skin images to identify conditions like acne, eczema, and skin cancer. While it provides quick assessments, it lacks personalized recommendations from dermatologists, which may limit diagnostic accuracy. Medgic[7] is a mobile app that scans and analyses skin images to detect dermatological issues and suggest actions. However, its reliance on AI without human verification raises concerns about misdiagnosis and accuracy. Triage[8] functions as an AI-driven smartphone tool, offering instant skin condition analysis to help users decide whether medical consultation is necessary. Despite its convenience, it does not provide treatment guidance reducing its effectiveness for complex cases. Onlinedoctor.Boots[9] is a web-based service offering online consultations and prescription treatments for skin and general health conditions. While it increases healthcare accessibility, it primarily serves users in select regions and may not cover all dermatological concerns.

These insights highlight the need for improvements in diagnostic accuracy, human oversight, accessibility, and treatment guidance in AI-based skin disease detection systems. Addressing these challenges is essential for developing more reliable, user-friendly, and clinically effective dermatological tools

PROPOSED SYSTEM

Traditional methods of detecting skin diseases are often tedious and reliant on a specialist's availability, causing lags in diagnosis and treatment. The purpose of this project is to leverage computer vision and deep learning to develop and implement an automated, user-friendly system which automatically determines a health condition of a users' skin. Using artificial intelligence-based approaches, the system will offer a user-friendly and efficient diagnostic system that will assist individuals and medical personnel in determining skin conditions in a timely manner. The suggested system uses image processing and deep learning to identify and categorise skin conditions from photos taken with smartphones or medical imaging equipment. We classified skin diseases using a Convolutional Neural Network (CNN) in our first method, which had a 76% accuracy rate. We later switched to a more sophisticated architecture, ResNet-50, to improve performance, and this greatly increased accuracy to 85%. In order to enhance feature extraction and model robustness, we also improved the preprocessing pipeline. Through a web application, users can upload high-resolution photos of skin lesions. The affected areas will be precisely isolated using deep learning-based segmentation. The system uses a pre-trained model with transfer learning to classify different skin conditions, such as psoriasis, eczema, and melanoma, in order to improve model robustness and accuracy. It also offers information and suggestions for additional medical advice. The goal of this project is to use an intuitive web application to democratise access to dermatological diagnostics. The platform seeks to enhance healthcare outcomes and enable early detection by fusing real-time image analysis with a comprehensive database of dermatological conditions. AI-driven suggestions for expert consultations and educational materials on common skin conditions will be among the other features. A strong hardware and software foundation is necessary for the development of this system. While HTML, CSS, and Django will be used to develop the frontend, TensorFlow, Keras, and Python will be used to build the backend. The system will need a laptop with 12–16 GB of GPU memory, 12 GB of RAM, and a Wi-Fi connection to process high-resolution images smoothly.

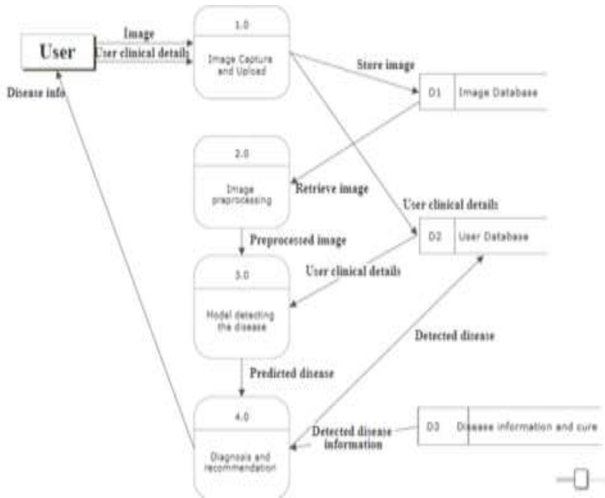

Fig. 1. Skin disease detection System Architecture

The data flow of the skin disease detection system is depicted in Fig 1. For a deep learning model to analyse and predict the disease, users upload images and clinical information, which are then stored and pre-processed. After that, the system offers the diagnosis results, pertinent disease details, and suggestions.

Training a Sequential CNN for classification was the first method for detecting skin diseases, as illustrated in Fig. 2 (Sequential CNN). To standardise inputs and separate lesion areas, preprocessing procedures included image resizing, normalisation, and segmentation. To improve generalisation, data augmentation methods like flipping, zooming, rotation, and shifting were used. Convolution layers with ReLU activation, MaxPooling for dimensionality reduction, and dropout to avoid overfitting were all used in the CNN architecture. Final classification was handled by a Sigmoid activation function, and learning efficiency was increased by the Adam optimiser. This method's 76% accuracy rate led to additional improvements in subsequent iterations.

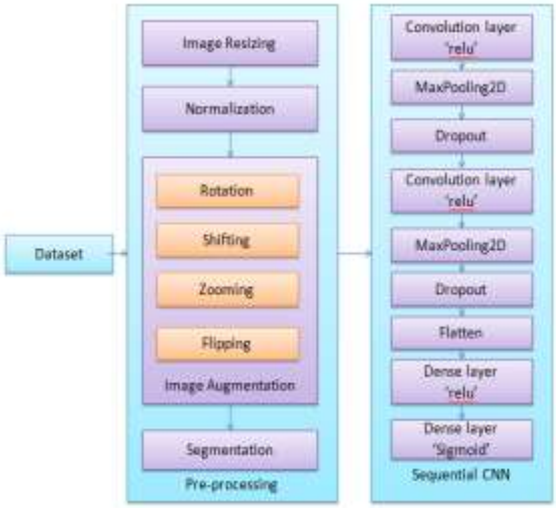

Fig. 2. Sequential CNN

The enhanced method used ResNet-50 with modifications to improve classification accuracy, as seen in Figure 3: Modified ResNet-50. The first step in image preprocessing was to use cv2.cvtColor() to convert OpenCV's default BGR format to RGB. Prior to thresholding to identify hair regions, the images were first converted to greyscale to eliminate hair artefacts. After filling in the gaps with morphological closure, the identified hair regions were eliminated using inpainting. Images were resized to 224 x 224 pixels, transformed into tensors, and normalised using the mean and standard deviation of ImageNet.

ResNet-50's original fully connected (fc) layer was eliminated for model adaptation, and a linear layer was added in its place. ReLU activation, dropout, and a final Linear(2048, 8) layer for multi-class classification came next. When compared to the original CNN-based method, these changes significantly increased classification performance by improving feature extraction and model robustness.

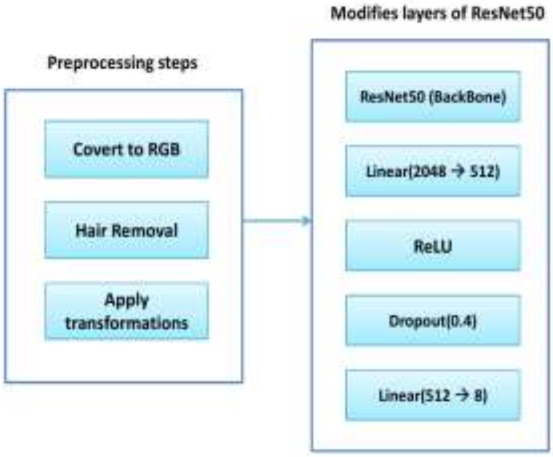

Fig 3. Modified ResNet-50

IMPLEMENTATION AND DISCUSSION

System design, development, testing, and deployment were some of the crucial stages in the Skin Disease Detection Website's implementation. The system was created to be an engaging and easy-to-use platform for people who are worried about the condition of their skin. The website makes use of AI technology for symptom-based evaluation and image analysis. Modern web technologies are used in the frontend's development to guarantee a flawless user experience, and secure cloud-based services power the backends' effective handling of data storage and image processing. The design is highly focused on scalability and modularity for future enhancements, including more sophisticated AI models and other dermatological resource. The website functionality, including image upload, analysis informed by AI, and a method of interacting with users, are available in Figures 4, 5, 6, and 7. Figure 4 gives an overview of the homepage that the user/visitor will view, which gives a summary of our project, and offers the user/visitor a chance to register or sign-in, utilize our services, or learn more about us and our project.

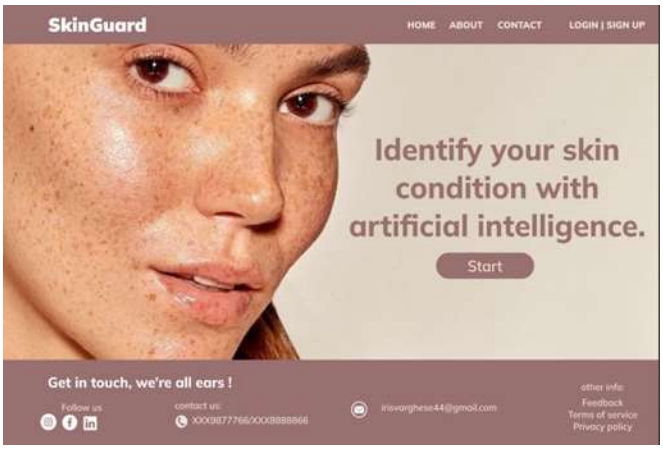

Fig. 4. Landing page of Skin disease detection website

Figure 5. shows the capture or upload page, you're now ready to easily manage your account. Here, you can quickly update your profile, check for notifications, and find all the tools and resources designed just for you.

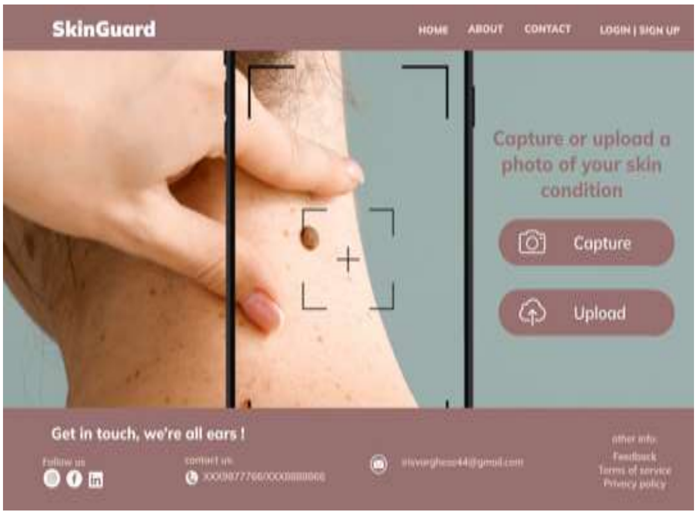

Fig. 5. Capture or Upload page of Skin disease detection website

Fig 6 shows how the uploaded or captured image to classify it into a specific skin disease category. The predicted result is then displayed to the user with confidence scores.

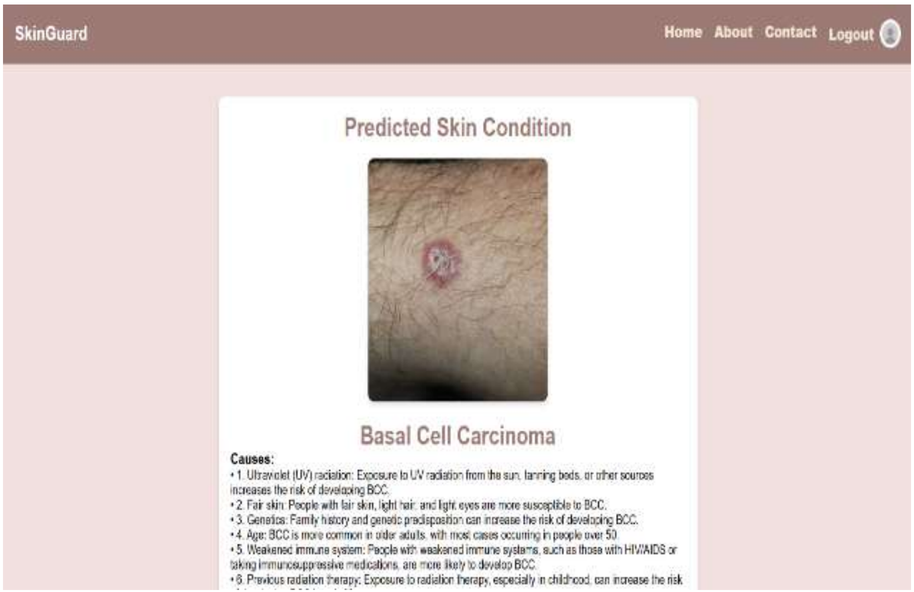

Fig 6: Skin Disease Classification and Prediction Result

Fig 7 depicts how the web app provides detailed information on the causes and treatment options for the detected skin disease. It also suggests home remedies and advises when to consult a doctor for medical attention.

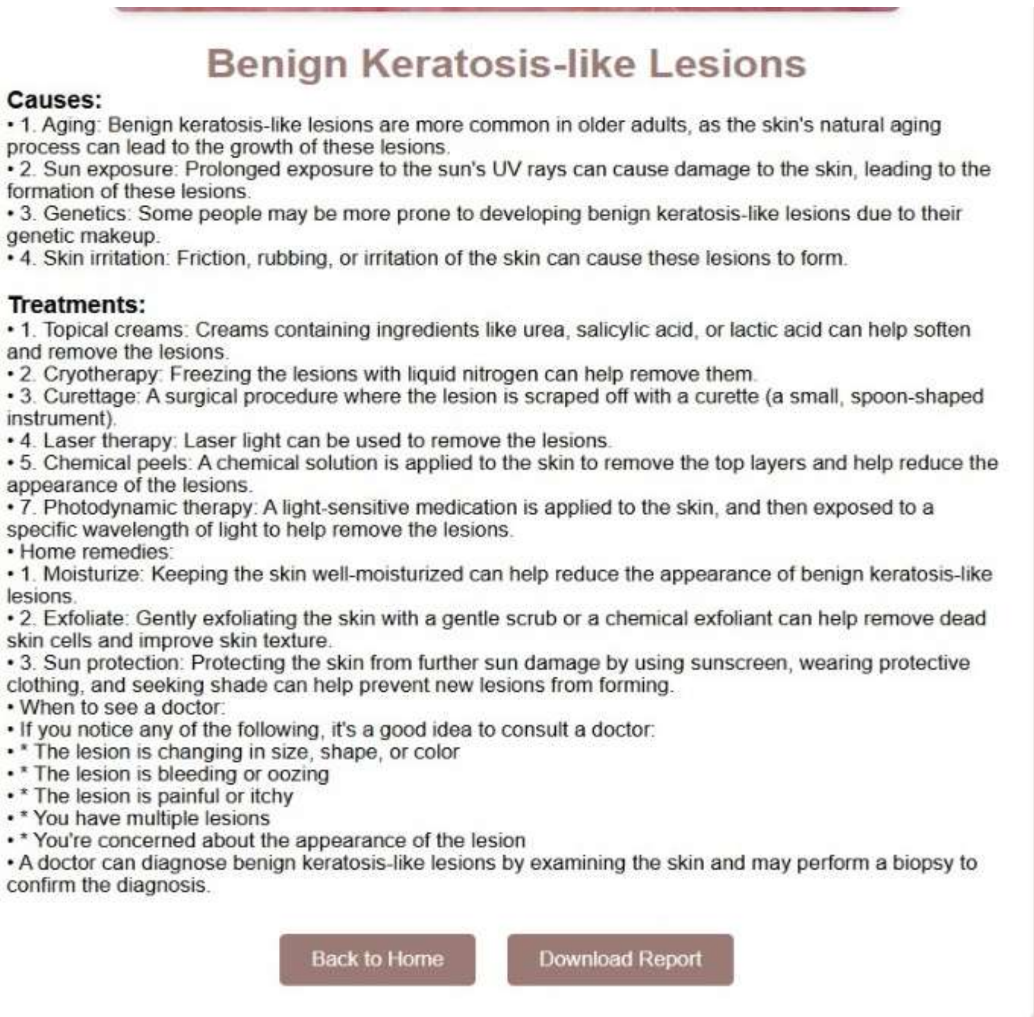

Fig 7: Causes and Treatment Information Display

Figure 8 show that the model demonstrates consistent improvement, achieving over 90% training accuracy and 85.64% validation accuracy at peak. The best validation accuracy was observed at Epoch 27 (85.64%).

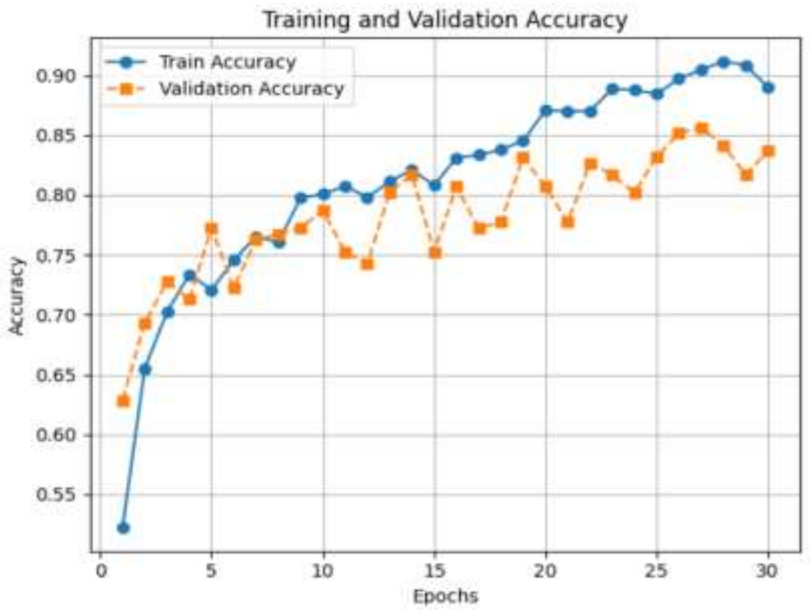

Fig.8. Graph of Epochs v/s Accuracy

The model performs well in the majority of classes, as illustrated in Figure 9, with high precision, recall, and F1-scores, especially for the nv, healthy, and vasc classes. Effective classification is indicated by the overall balanced scores, even though some classes, like bkl and mel, show comparatively lower recall. The model is dependable for detecting skin diseases because of its high F1-scores, which indicate that it strikes a good balance between precision and recall.

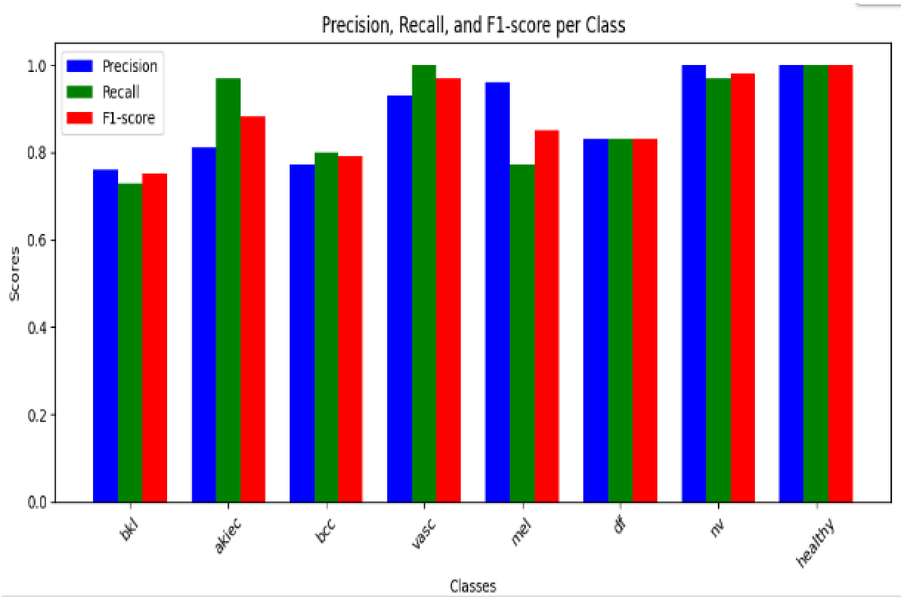

Fig 9: Precision, Recall, and F1-score per Class

CONCLUSION

This study describes the creation and deployment of a Skin Disease Detection Website that uses cutting-edge machine learning techniques to improve accessibility to dermatological insights. The platform tackles important issues in early skin disease detection by utilising AI-based image analysis. Our study shows that AI-powered diagnostics offer quick and initial evaluations of skin diseases like skin cancer, eczema, and acne. While privacy-focused data handling ensures secure processing of user information, the incorporation of an intuitive web interface guarantees smooth navigation. When combined, these technologies enhance dermatological assessments' precision, usability, and accessibility. The platform provides users with useful insights into their skin health by emphasising early detection and tailored recommendations, encouraging proactive self-care and lowering reliance on conventional dermatology visits.

Future work could explore further enhancements such as improved AI accuracy through continuous learning, integration with telemedicine services for expert consultations, and expanded coverage of diverse skin conditions to improve diagnostic reliability across different demographics.

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