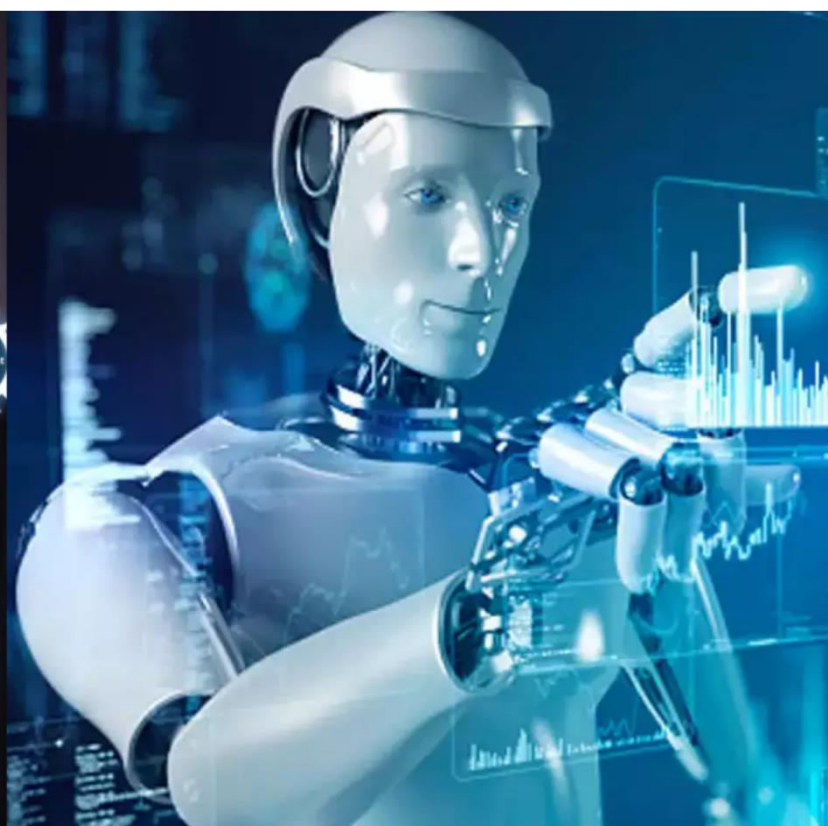




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A Survey Paper on the Comprehensive Approach to Image Disease Detection

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ABSTRACT: Skin diseases are among the most common health problems worldwide, affecting millions of people regardless of age or ethnicity. Early and accurate detection of skin abnormalities is crucial for effective diagnosis and treatment. In this study, we have presented a simple yet effective image processing approach for detecting whether the skin is affected by disease or not, using thresholding techniques implemented in MATLAB. The primary goal of this research is to develop an automated method for distinguishing between healthy and diseased skin based on visual characteristics in digital images. The methodology begins with the acquisition of high-resolution skin images, which are then preprocessed using standard techniques such as noise reduction and contrast enhancement to improve the visibility of affected regions. Following this, the images are converted to grayscale to reduce computational complexity while preserving critical textural features. The core of the detection process is based on thresholding, a segmentation technique that divides an image into foreground and background regions. Once the threshold is applied, a binary image is produced where white pixels represent potentially diseased regions and black pixels denote healthy skin. Post-thresholding, morphological operations are applied to refine the segmentation and eliminate noise. The extracted features are then analyzed to determine whether the skin is affected by disease, based on size, shape, and texture of the highlighted regions. The results demonstrate that thresholding, despite its simplicity, can be a powerful tool for preliminary skin disease detection. The use of MATLAB provides a flexible and efficient environment for rapid development and visualization of the image processing pipeline. This method can be a valuable component in telemedicine applications or as a supportive tool for dermatologists in early screening, especially in low-resource settings where access to advanced diagnostic tools is limited.

I. INTRODUCTION

Skin diseases are among the most widespread and visible forms of human illness, affecting a large segment of the population worldwide. These conditions range from minor irritations and infections to severe chronic diseases such as eczema, psoriasis, and skin cancer. The visual nature of skin diseases makes image-based diagnostic techniques particularly useful, especially when early detection can significantly improve treatment outcomes. Traditionally, dermatologists rely on physical examination and biopsy results to diagnose skin conditions. However, with the advancement of image processing and computer vision techniques, automated systems for skin disease detection have become a promising area of research and development.

In recent years, digital image processing has emerged as a valuable tool in medical diagnostics, including dermatology. It offers the potential for non-invasive, rapid, and cost-effective diagnosis, especially in regions where access to specialists is limited. Among the various image processing techniques, thresholding is one of the most fundamental and widely used methods for image segmentation. Thresholding helps to separate regions of interest from the background by converting grayscale images into binary images based on intensity levels. Despite its simplicity, thresholding can be highly effective when applied properly, particularly for detecting abnormal patterns or lesions on the skin.

This Thesis focuses on developing a method to detect whether a skin image is affected by disease using the thresholding technique in MATLAB, a powerful platform for algorithm development, image processing, and visualization. The goal is to design a simple yet effective pipeline that can analyze skin images and identify abnormal regions that may indicate the presence of disease. The thresholding method is applied after preprocessing the images to enhance contrast and remove noise, ensuring better segmentation results.

The process begins by collecting a set of high-quality skin images, which include both healthy and diseased samples. These images are first converted into grayscale to reduce computational complexity while preserving the critical texture information. Next, an appropriate threshold value is chosen—either manually or automatically—based on the histogram of pixel intensities. This threshold is then applied to the grayscale image to produce a binary output, where white regions may represent affected skin and black regions represent healthy skin.

Further refinement is performed using morphological operations, such as erosion and dilation, to remove small artifacts and enhance the shape of the detected regions. The final segmented regions are then analyzed based on their size, shape, and other features to decide whether the skin in the image is likely to be diseased.

The choice of thresholding for this study is based on its computational simplicity, fast execution, and ease of implementation. Unlike more complex methods that require large amounts of training data or sophisticated feature extraction, thresholding can yield good results with relatively few resources. This makes it especially suitable for deployment in low-resource settings, such as rural clinics or mobile diagnostic units.

MATLAB is used in this work due to its comprehensive image processing toolbox, which provides built-in functions for filtering, thresholding, morphological operations, and visualizing results. The graphical and coding capabilities of MATLAB also make it easier to test different thresholding techniques (e.g., global, adaptive, or Otsu's method) and fine-tune the parameters for optimal performance.

This research lays the foundation for an automated skin disease screening tool that can assist healthcare professionals in making preliminary assessments or be integrated into mobile applications for self-checking. While the current focus is on threshold-based detection, this method can later be combined with machine learning classifiers and texture analysis techniques for improved accuracy and disease classification.

In summary, this Thesis explores how a basic yet powerful image segmentation method—thresholding—can be employed to detect diseased skin using MATLAB. By automating the detection process and providing quick visual feedback, this method has the potential to assist in early diagnosis, raise awareness, and ultimately contribute to better skin health outcomes.



Figure 1.1: Different skin diseases (Acne, Basal cell carcinoma, Actinic ker- atosis, Viral Skin infections, Bacterial skin infections, Deep dermal disorder, Tinea, Eczema)

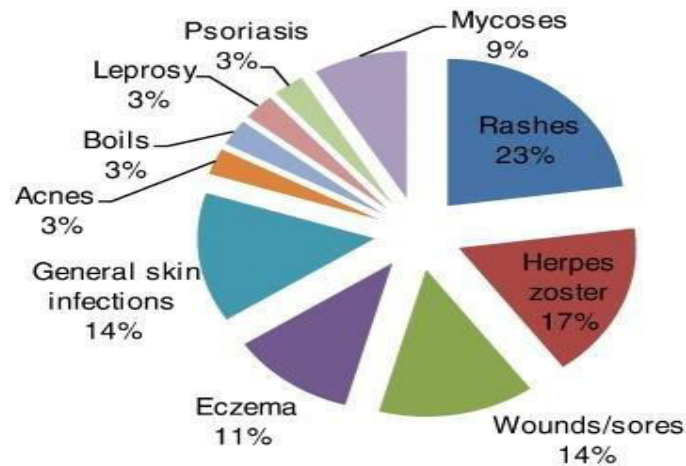


Figure1.2 Frequency of affected people of different skin diseases

II. LITERATURE SURVEY

Here are few of the literature reviews on skin disease detection, including first author's name, publication year, and the abstract or conclusion of each paper.

[1] **Esteva et al. (2017)** demonstrated the ability of deep learning models, particularly Convolutional Neural Networks (CNNs), to classify skin cancer, including melanoma, using dermoscopic images. The results indicate that the CNN model outperforms dermatologists in terms of accuracy in some cases. The study concludes that deep learning models could potentially aid in early detection, offering a promising tool for dermatological diagnostics.

[2] **Liu et al. (2017)** developed a machine learning-based system for identifying and classifying skin diseases from images. Using a combination of SVM (Support Vector Machine) and Random Forest algorithms, they focused on the feature extraction phase to distinguish between benign and malignant lesions. The authors conclude that such systems can complement dermatologists in clinical decision-making, improving diagnostic outcomes.

[3] **Rajpurkar et al. (2017)** developed a deep learning model using CNNs to classify skin lesions. Their model was trained on a large and diverse dataset of skin lesions, and the study concluded that the model performed on par with experienced dermatologists in diagnosing melanoma. This work highlights the potential of deep learning to serve as a diagnostic aid in dermatology.

[4] **Codella et al. (2018)** explored the application of deep learning models, specifically CNNs, in detecting skin cancer from dermoscopic images. The authors trained their models using a large dataset of skin lesions. The conclusion suggests that these models can match or exceed the performance of dermatologists in certain diagnostic tasks, offering a potential tool for telemedicine and skin cancer screening.

[5] **Zhou et al. (2018)**: In this study, the authors apply deep learning techniques, particularly CNNs, to the problem of skin disease detection. By processing and classifying skin lesion images, they aim to create a robust system for automatic detection. The study concludes that combining image preprocessing techniques with CNNs results in a system with improved classification accuracy and generalization across diverse skin diseases.

[6] **Mendonça et al. (2018)** reviewed different feature extraction methods for skin lesion classification. The study focuses on color, texture, and shape features in dermoscopic images. The conclusion suggests that these handcrafted features, when combined with machine learning techniques, can improve the classification accuracy of skin diseases, but more research is needed to address dataset variability and image quality.

[7] **Afonso et al. (2018)**: Afonso and colleagues reviewed the application of deep learning models for skin cancer detection, focusing on CNNs. They discuss how CNNs have outperformed traditional machine learning models in terms of accuracy and efficiency. The review concludes that deep learning techniques offer significant potential in automating the diagnosis of skin diseases.

[8] **He et al. (2018)** proposed a deep learning-based approach for multi-class skin disease classification. They used a large-scale dataset and fine-tuned pre-trained models to detect and classify various types of skin lesions. The conclusion highlights the importance of leveraging transfer learning to improve model performance, especially in settings with limited annotated data.

[9] **Saha et al. (2018)** proposed a multi-stage machine learning framework for the classification of skin diseases. The framework includes feature extraction, dimensionality reduction, and classification using algorithms like Random Forests and SVMs. The authors conclude that such multi-stage models enhance the performance of automated skin disease detection, especially in challenging cases.

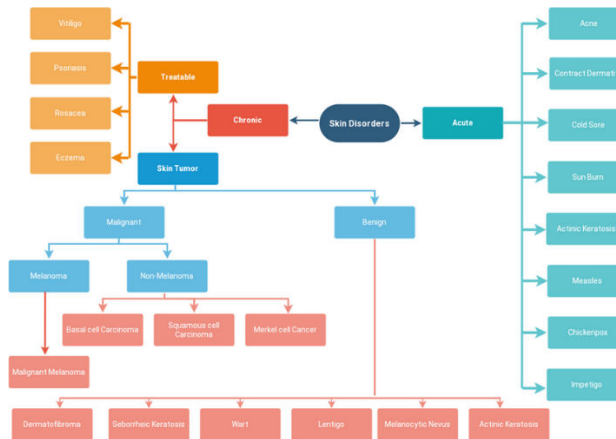
[10] **Xu et al. (2018)** reviewed various deep learning techniques for skin disease diagnosis, focusing on CNN architectures and their ability to classify skin lesions. The authors concluded that CNN-based methods have demonstrated superior performance compared to traditional techniques, but further research is needed to handle the variability in image quality and types of skin diseases.

[11] **Hamarneh et al. (2019)** presented a review of computer-assisted systems for dermatological disease diagnosis. It provides an overview of various machine learning and image processing techniques applied to skin disease detection, highlighting challenges such as the lack of annotated data and variations in skin types. The conclusion stresses the need for more robust and generalizable models to improve the real-world application of automated skin disease detection systems.

[12] **Yin et al. (2019)**: investigated a deep learning framework for skin lesion segmentation, which is crucial for detecting skin cancers like melanoma and basal cell carcinoma. The authors use a fully convolutional network (FCN) to improve segmentation accuracy. The study concludes that accurate lesion segmentation significantly enhances the detection and classification of skin diseases in medical imaging systems.

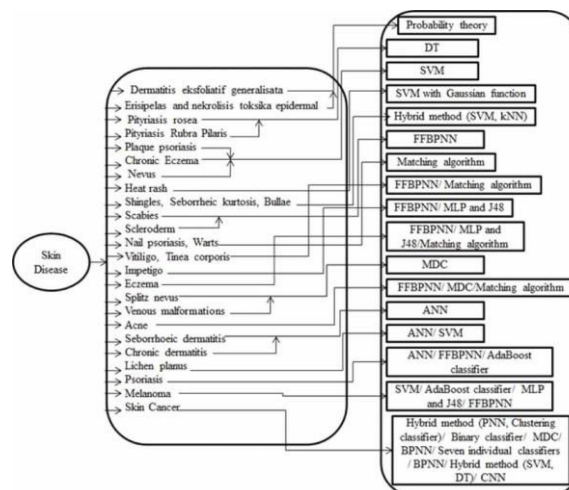
III. SKIN DISEASE DETECTION AND CLASSIFICATION USING MACHINE LEARNING AND DEEP LEARNING

The world population is growing very fast and the lifestyle of human beings is changing with time and place. So, there is a need for disease management which includes disease diagnosis, its detection and classification, cure and lastly for future disease prevention. The outermost protective layer of a human body is the skin. Skin not only impacts a person's health but also psychologically impacts one's life. Computer-aided systems are very helpful in skin disease detection and classification and their application is growing rapidly in healthcare. This literature review paper aims to help the researchers to get a synthesized and appropriate information for the same. We have included papers from 2021 to 2023 for the review from the Scopus database. 45 studies are selected for the review of which 32 studies use deep learning techniques, 11 use machine learning techniques and 2 studies use a hybrid approach. The studies are compared on various parameters like models, datasets, and performance metrics. The work also identified some of the challenges like dealing with noise and also explained disease symptoms.



IV. A SURVEY ON A SKIN DISEASE DETECTION SYSTEM

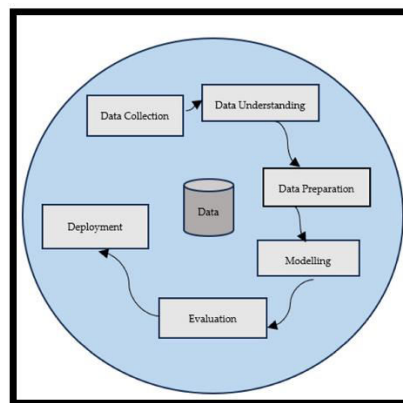
Skin diseases are frequent and quite perennial in the world, and in some cases, these lead to cancer. These are curable if detected earlier and treated appropriately. An automated image-based detection system consisting of four main modules: image enhancement, region of interest segmentation, feature extraction, and detection can facilitate early identification of these diseases. Diverse image-based methods incorporating machine learning techniques are developed to diagnose different types of skin diseases. This article focuses on the review of the tools and techniques used in the diagnosis of 28 common skin diseases. Furthermore, it has discussed the available image databases and the evaluation metrics for the performance analysis of various diagnosis systems. This is vital for figuring out the implementation framework as well as the efficacy of the diagnosis methods for the neophyte. Based on the performance accuracy, the state-of-the-art method for the diagnosis of a particular disease is figured out. It also highlights challenges and shows future research directions.



V. EARLY DETECTION OF SKIN DISEASES ACROSS DIVERSE SKIN TONES USING HYBRID MACHINE LEARNING AND DEEP LEARNING MODELS

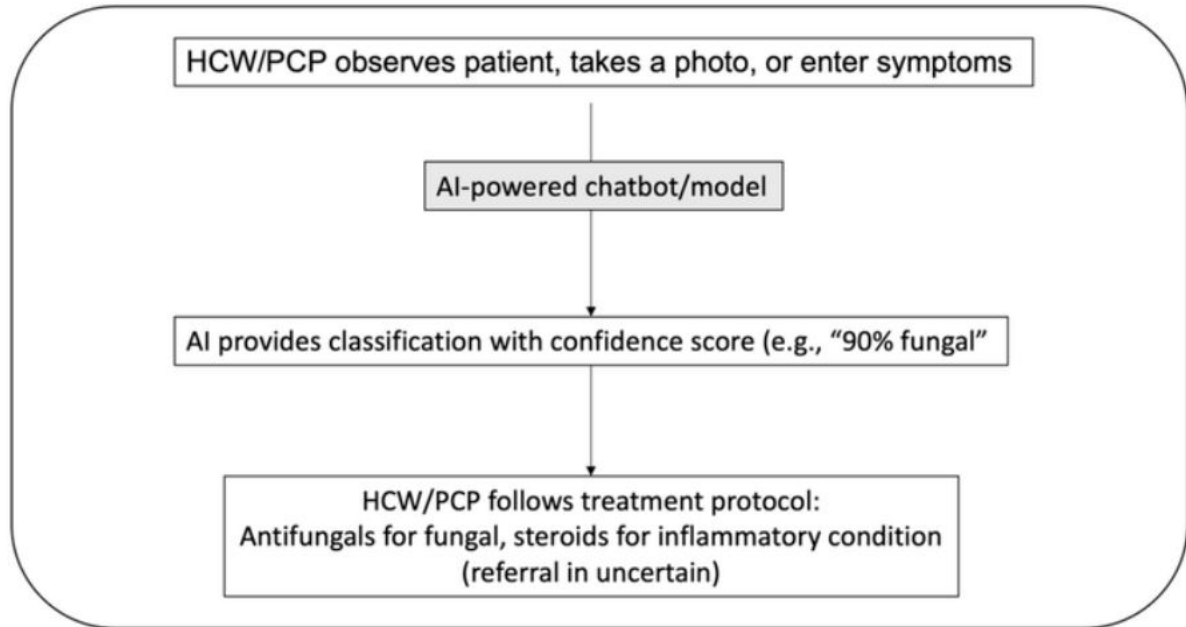
Skin diseases in melanin-rich skin often present diagnostic challenges due to the unique characteristics of darker skin tones, which can lead to misdiagnosis or delayed treatment. This disparity impacts millions within diverse communities, highlighting the need for accurate, AI-based diagnostic tools. In this paper, we investigated the performance of three machine learning methods -Support Vector Machines (SVMs), Random Forest (RF), and Decision Trees (DTs)-combined with state-of-the-art (SOTA) deep learning models, Efficient Net, MobileNetV2, and DenseNet121, for predicting skin conditions using dermoscopic images from the HAM10000 dataset. The features

were extracted using the deep learning models, with the labels encoded numerically. To address the data imbalance, SMOTE and resampling techniques were applied. Additionally, Principal Component Analysis (PCA) was used for feature reduction, and fine-tuning was performed to optimize the models. The results demonstrated that RF with DenseNet121 achieved a superior accuracy of 98.32%, followed by SVM with MobileNetV2 at 98.08%, and Decision Tree with MobileNetV2 at 85.39%. The proposed methods overcome the SVM with the SOTA Efficient Net model, validating the robustness of the proposed approaches. Evaluation metrics such as accuracy, precision, recall, and F1-score were used to benchmark performance, showcasing the potential of these methods in advancing skin disease diagnostics for diverse populations.



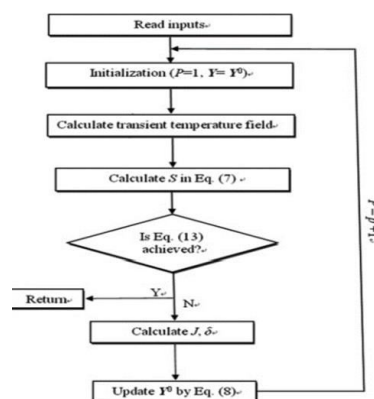
VI. SKIN HEALTH MATE APP: AN AI-POWERED DIGITAL PLATFORM FOR SKIN DISEASE DIAGNOSIS

Artificial intelligence (AI) is transforming the diagnosis and management of cutaneous infections by improving accuracy, efficiency, and accessibility of care. Leveraging advanced machine learning (ML) algorithms, particularly convolutional neural networks (CNNs), AI can analyse clinical images to identify and classify skin infections caused by bacterial, viral, fungal, or parasitic pathogens with high sensitivity and specificity. For instance, AI models like MPXV-CNN have demonstrated remarkable accuracy in detecting viral infections such as Mpox. Similarly, DL architectures such as Inception-v3 and ResNet-50 are widely employed to diagnose leprosy, and fungal infections while assessing disease severity. AI also plays a critical role in epidemiological surveillance, utilizing platforms like EPIWATCH to monitor outbreaks of cutaneous infections in real time. These tools predict infection trends and identify high-risk populations, enabling timely public health interventions. AI aids in personalized treatment planning by predicting therapeutic responses and minimizing adverse drug reactions. This ensures optimized patient care while improving adherence to treatment regimens. In addition to diagnostics and management, AI accelerates drug discovery for cutaneous infections by streamlining compound screening and vaccine development. Collaborative approaches integrating AI with clinician expertise significantly enhance diagnostic accuracy, even among non-specialists. By addressing challenges such as overlapping clinical presentations and limited access to dermatological expertise, AI offers scalable solutions for global healthcare systems. While promising, the integration of AI into dermatology requires addressing ethical concerns, data privacy issues, and the need for robust validation studies to ensure equitable and reliable outcomes.



VII. SKIN DISEASE IDENTIFICATION USING MATLAB

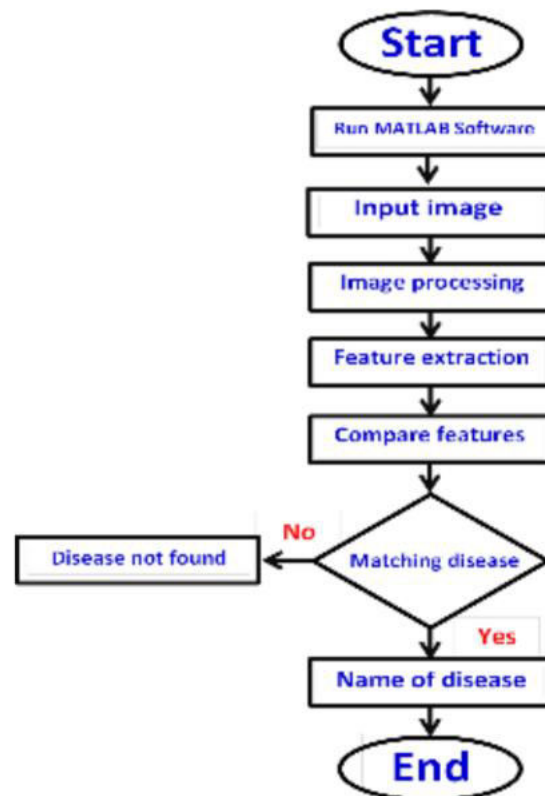
Skin is the largest organ of the body and it is the protective layer of the human body which protects from microbes and germs guarding the body against extremes of temperature, damaging sunlight, and harmful chemicals. It also releases antibacterial substances that prevent infection. Suppose that skin is affected with harmful diseases, especially in remote areas where a dermatologist is not available. We have to detect the disease is dangerous or not before it become worse and causes death. So to use in especially in remote areas we implemented an idea about skin disease identification using matlab and completely noninvasive to patient skin. In this based on image of the infected skin provided by the user, image processing is done and tells the user whether the infected portion of skin is harmful or not. Here we are using matlab software which compares original diseased image with user image and decides disease is harmful or not.



VIII. DETECTION OF SKIN DISEASES USING MATLAB

It is a great challenge for doctors even with the existence of emerging technology, to diagnose the symptoms of a skin disease. Many people are exposed to serious skin diseases that require them to go to hospitals and go through a number of different expensive medical examinations which takes up to days. The proposed work can solve the above problem to an extent, through the design of a program by MATLAB, a method based on vertical image segmentation, and is proposed to identify three various types of skin diseases, namely, Acne, Cancer and Psoriasis dermatitis. The work is a

key to detect a range of symptoms in just a few seconds, making the diagnosis more intuitive and realistic. The aim of this project is the classification of different diseases based on images given as input. The project is based on MATLAB software platform. The images are collected from various publicly available databases Dermnet, DermWeb, etc. Firstly, the sample images of four skin diseases need to be preprocessed. Secondly, the vertical image is segmented and made corresponding geometric transformation. Based on this, three types of skin diseases' features are extracted, and their correlated parameters of feature texture and pixels of lesion areas are collected through image segmentation. Finally, the symptoms of Acne, Cancer and Psoriasis dermatitis are identified by utilizing the support vector machine (SVM) method in order to improve identification accuracy and provide an interface to doctors.



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