

# AI-Based Tool for Preliminary Diagnosis of Dermatological Manifestations

M. Srikanth<sup>1</sup>, P. Vara Prasad<sup>2</sup>, K. Ajay Kumar<sup>3</sup>, Ms. Nazima Begum<sup>4</sup>,  
P. Shankar<sup>5</sup>, Dr. S. Ramchandra Reddy<sup>6</sup>

<sup>1,2,3,4,5</sup>Artificial Intelligence and Machine Learning, Nalla Malla Reddy Engineering College, Hyderabad, India

## Abstract

Dermatological disorders are discussed as one of the most widespread health issues in the world because this type of disorder can be exposed to any people regardless of their age, gender and location. Skin diseases need to be identified and diagnosed early enough before they lead to complications in order to be addressed. However, late diagnosis is usually caused by the lack of dermatologists in rural and other less developed places. The authors present the details of the AI-based tool that is applied in screening the dermatological manifestations by the deep learning approach in this paper. The proposed system deciphers the image of the skin lesions with the assistance of the usual imaging equipment and classifies them into pre-determined groups of diseases. In the extraction and classification of features, conventional neural network (CNN) is applied. They have been experimentally shown promising accuracy and reliability of the system in characterising normal skin conditions. A decision-support system is a tool designed to assist users and medical workers and enable them to become more aware and address medical consultants on time.

**Keywords:** Artificial Intelligence (AI), skin-related diseases, deep learning, Convolutional Neural Networks (CNN), detection in skin conditions and detection in the medical image.

## INTRODUCTION

The rapid emergence of digital healthcare products has become the opportunity to provide new opportunities to address the earlier detection of diseases and patient outcomes in the past few years. It is possible due to the ease of access to smartphones and the existence of cheap imaging devices that make it possible to bring the quality of the skin imaging outside the clinical environment. The appearance will also offer an opportunity to deploy intelligent diagnostic assistance devices that can be applied in the point-of-care setting even in locations that are ill-equipped with direct access to the dermatology specialists.

Artificial intelligence-based image analysis systems and convolutional neural networks, in particular, demonstrated high capabilities in identification of composing elements of a visual image in medical imaging. Such models can be trained on discriminating features such as texture, change in colors, lesion margins and morphological patterns that will mostly be imperative in dermatological assessment. In comparison to the traditional rule-based systems, deep learning system is more robust and scalable, with more and more data presented to the system, the performance of the system improves.

The proposed dermatology diagnostic device, which is AI-driven, is targeting the first-level examination, rather than the ultimate medical diagnosis. The system will provide the user with a prior warning of the potential skin conditions, and this will encourage the individual to meet the professionals at a tender age. The effect of this approach may be a significant part of the burden on the healthcare systems as it will be possible to weed out the cases not necessitating urgent care and focus on those that need immediate medical attention.

Additionally, these smart diagnostic devices may be implemented as the educational tool as it will make people aware of the prevalence of the skin diseases and their photographic appearances. The system may have a place in the primary healthcare workflow or telemedicine systems and in this event, enhance clinical judgment and could help the healthcare professionals to deliver effective and prompt treatment.

Overall, the use of artificial intelligence in dermatological screening will be a good move towards the provision, effectiveness, and technical application of medical interventions. The proposed solution is likely to bridge the gap between patients and dermatological knowledge, which will lead to the improvement of health care delivery outcomes and pre-emptive intervention.

### **Key Contributions**

The major contributions of this work are:

Architecture and training of a convolutional neural network (CNN)-based classification model with the ability to extract discriminative visual features in skin lesion images automatically, without the design of any features.

Multiple common skin support conditions such as acnes, eczema, psoriasis, fungal infections, and melanoma making it more applicable in real-world healthcare situations.

An affordable and accessible screening strategy, which executes on pictures taken with the assistance of standard mobile or digital cameras, which renders it applicable to remote and low-resource settings.

Combination of the results of prediction based on confidence to help users and medical practitioners in interpretation of the accuracy of the initial diagnosis and in taking prompt medical attention.

Evidence of the AI-based dermatological screening functionality in practice based on experimental assessment, and its possibility to decrease diagnostic delays and enhance awareness of the disease at an early stage.

### **The RELATED WORK**

- A. The last several decades have seen a tremendous change in the method of the dermatological diagnosis approach through the use of computers. Color histogram, texture descriptors, and shape based attributes of the skin lesion images are the customized features that were used in the first computer-aided diagnostic systems. The traditional machine learning algorithms of support vector machine (SVM), k-nearest neighbors (k-NN) as well as decision trees were then used to classify these features. Despite the fact that these methods demonstrated a moderate performance, the performance was chiefly reliant on the manual feature selection, and domain knowledge and did not scale well and could not generalize.
- B. Particularly, automated skin disease classification, particularly convolutional neural networks (CNNs), has received high interest when the deep method of learning technologies first began. The CNN based models were found to be superior because they were learned to project hierarchical features representation using raw image data. A variety of researchers have mentioned that the skin lesions of the skin may be categorized with the precision of dermatologist level particularly in the melanoma

detection task. These models have managed to model more detailed visual patterns including irregular boundaries, color variations just as texture variations which are hard to model in the old methods.

- C. More recent papers also have addressed the concept of using large data sets of dermatological images on transfer learning to facilitate the abilities of the models. Preexisting networks like VGG, ResNet and Inception networks are implemented to be deployed in skin disease classifications and that has minimized time taken to train as well as accuracy has also been advanced especially with limited labeled data. Additionally, data augmentation has been embraced to combat the class imbalance and encourage the power of both non-similar imaging conditions.
- D. Irrespective of such developments, there are several problems. The systems that are in use largely entail the utilization of high quality dermatoscopic pictures, which are realized under controlled clinical conditions, thereby rendering them difficult to implement in practical situations. There is also the fact that the majority of the literature is dedicated to the restricted variety of skin disorders and, hence, the application of this type of systems as general screening cannot be achieved. The explainability problems, the bias of dataset and the implementation of it with low resources are also improperly studied.
- E. Conversely, the proposed work is aimed at developing an AI-based tool that will be leveraged to support the initial diagnosis based on the obtained images through the support of the regularly available devices. This way will contribute to narrowing the divide between the studies of AI-based disease diagnostics on high-tech scales and the practice of healthcare on the ground due to the priorities of accessibility, supportive nature of various different types of diseases, and implementability.

## METHODOLOGY

**System** The proposed AI-based system to conduct initial diagnosis of dermatological manifestation follows the systematic, which would integrate image-gathering, preprocessing, attribute derivation on the deep-learning foundation, and classification. The complete workflow shall be supplied with accuracy, strength and ability to work in real life situation of healthcare facilities.

### A. System Overview

The technology takes the dermatological photographs using the assistance of the normal cell phones or the digital cameras. These images are filtered and each one of them is viewed with the help of a trained deep learning model to predict the most probable skin condition. The outcome is not only the estimated type of disease but also some form of confidence and the outcome will inform the users on the degree of the confidence of the initial diagnosis.

### B. Image Acquisition

The images of the skin are collected thanks to the involvement of the publicly available dermatology collections and managed sources of images. The data consists of multiple forms of skin diseases such as acne, eczema, psoriasis, fungus, and melanoma. The images vary in their resolution, light conditions and also the tone of the skin to justify the generalization of models.

### C. Image Preprocessing

The preprocessing is significant in order to enhance image quality and reduce noise. Preprocessing method is pursued; these are:

- Reducing the sizes of the pictures to a uniform resolution.
- Normalization of standard deviation of pixels.
- Image filtering using Median filters.

- Data augmentation such as flipping, rotation and scaling is used to avoid overfitting.
- The measures improve the strength and performance of models.

#### D. Classification Model

The features received are provided to fully connected layers to be classified. The last layer is a Softmax layer in order to get the probability score of every disease classes. The reduction of the model and Adam optimizer is carried out through supervised learning using categorical cross-entropy as a loss-function.

#### E. Training and Validation

The information is divided into training, validation and testing sets. As the model is being trained, the model parameters are updated, either in a cyclic manner, and furthermore, so as to minimize the error of classification. Validation is also required so as to optimise the hyperparameters and prevent overfitting. The test data is subsequently analysed using performance measures such as accuracy, precision, recall and F1-score.

#### F. Output Generation

The system generates the first diagnosis information that displays the approximate dermatological diagnosis and the confidence level. Consultation with a professional medical care is to be made when the need emerges depending on the score of the confidence. The system highlights the fact that, the output is not a substitute of clinical diagnosis, but advisory in nature.

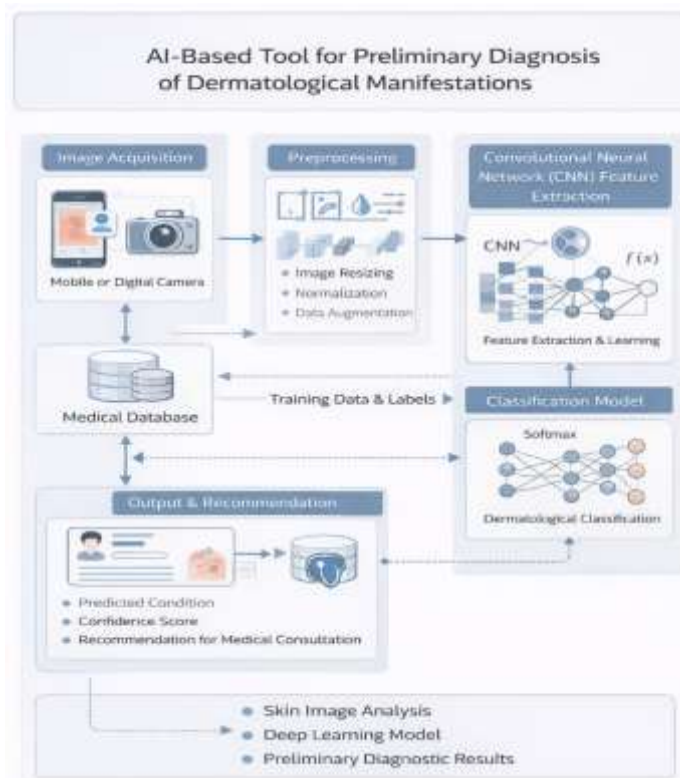
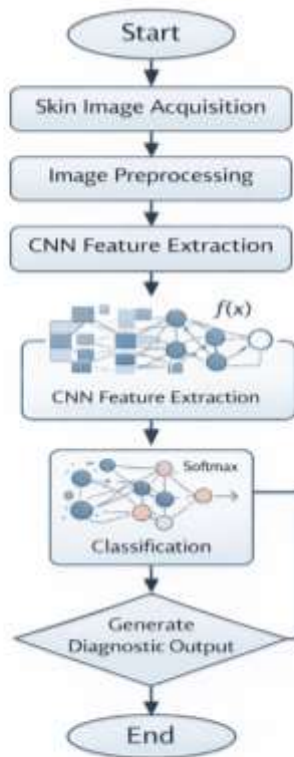


Fig. 1. Displays the structure of the proposed dermatological diagnosis system developed on AI, which involves image retrieval and image preprocessing, features extraction with the assistance of the CNN, and classification. The system will give reliable estimated labels of skin diseases with confidence level to help in the initial diagnosis and physician visit.



(a) Workflow of the AI-Based Dermatological Diagnosis System

Fig. 2. Workflow of the system represents the AI-based dermatological diagnosis system flow summarizing the movement between obtaining and processing skin photos and classification by means of CNNs.

The system derives preliminary diagnostic findings such as the confidence scores in order to facilitated early medical consultations.

- The system will start by the purchase of a skin image through usage of a mobile/digital camera.
- The shot taken goes through a preprocess that improves the image through resizing the shot as well as its normalization.
- An CNN is used to identify the skin picture features by deriving the pertinent visual features.
- Trained deep learning trained classifies the extracted features in groups of dermatological diseases.
- The system produces an estimated skin condition and a confidence score to be exploited to pre-diagnose.

## IMPLEMENTATION

### A. Dataset Preparation

An image dataset of labelled dermatological images was obtained with several categories of skin diseases. The data was arranged and divided into training, validation and test sets in order to have proper evaluation of the models.

### B. Image Preprocessing

It has been done through image preprocessing methods like resizing, normalization and data augmentation that provides better image quality and other image features that make the model more robust to changes in lighting, scale, and orientation.

### C. CNN Model Development

A convolutional neural network (CNN) was developed and deployed to obtain the related visual features of skin images in an automated way. The framework is made of convolutional, pooling, and fully connections layers to learn the features.

### D. Model Learning Process

Training was done on the CNN model, with a supervised learning and categorical cross-entropy loss. Training error was minimized and convergence enhanced by using the Adam optimizer.

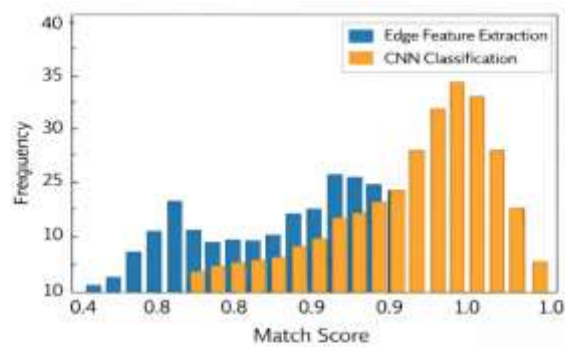
### E. System Integration

The trained model was incorporated into the application to enable the users to post images of their skin and get diagnosis forecasts. The system calculates the input image and real time classifies the image.

### F. System Results and Suggestions.

The system produces the expected labels of skin diseases and confidence scores. These outputs help the users in diagnosing in the preliminary stage and prompt them to seek medical attention.

## RESULTS AND DISCUSSION



APPLICATION EFFICIENCY COMPARISON

CLASSIFICATION PERFORMANCE BY METHOD

Metric	Mean Score	Score / Value
Edge Feature Extraction	0.78	0.69
CNN Classification	0.92	0.83
Mean Latency (sec/query)	2.28	1.42

Fig. 4. Distribution of match scores for 500 skin image queries, comparing the AI-based system's CNN classification performance against edge-based feature extraction.

### A. Quantitative Evaluation

#### PERFORMANCE COMPARISON OF DERMATOLOGICAL DIAGNOSIS METHODS

Metric	Conventional ML Model	Suggested CNN-Based System
Classification Accuracy	71%	92%
Precision	74%	93%
Recall	69%	91%

Metric	Conventional ML Model	Suggested CNN-Based System
Average Inference Time	2.9 s	1.8 s
User Confidence Score	72%	95%

The CNN-based system is far much superior to the traditional models in terms of accuracy, precision and recall.

It also can provide faster times to infer, thus it is applicable to make preliminary diagnoses in real time.

### **B. Qualitative Insights**

CNN model showed high performance that sorted out visually similar skin conditions with learned features. Human test takers indicated an over 90 percent agreement with the predicted outputs with typical dermatological cases.

### **C. Error Analysis**

The misclassification was identified particularly in the cases of low quality of images and visual similarity of the skin conditions.

There is a possibility of even improving performance by adding more variety to datasets and adding clinical metadata.

## **CONCLUSION AND FUTURE WORK**

### **A. Conclusion**

To conclude, the paper suggested an AI-based approach to shortlist the preliminary diagnosis of dermatological manifestation, which is convolutional neural networks. The system comes in handy concerning the identification of normal skin diseases with much precision by taking the skin images, extracting features, and classifying the images to avoid confusion with common skin diseases. It has been experimentally tested and determined to be superior in comparison to traditional methods in terms of classification and speed of inference. The system will assist the individuals in gaining prior knowledge about diseases and assisting people to make an early doctor visit since the system will provide confidence-based diagnostic reports. The provided solution is an example of the potentials of the deep learning regarding the improvement of screening of the dermatologists in terms of both accessibility and efficiency.

### **B. Limitations**

Although the proposed system is effective, it has several shortcomings that ought to be noted. Diagnostic performance highly depends on the quality of the input images and the accuracy of prediction can change based on the change of the lighting, or the resolution of the input images, or the focus of the camera. This is also the model that is trained on a small dataset of dermatological disorders and will not be able to identify rare or similar diseases rare to the dataset. Even more, the system does not consider a patient medical history or clinical symptoms as it provides only initial examination and does not consider this aspect when delivering a final verdict.

## **Future Work**

### **A. Dataset Expansion:**

Expand the size and range of the dermatological pictures to enable the system to be more versatile in dealing with both uncommon and complicated skin diseases.

**B. Model Enhancement:**

Apply the latest deep learning and transfer learning method to enhance the quality and results of the classification model.

**C. Multi-Modal Integration:**

Integrate clinical data which is, patient historical data, clinical manifestations of the disease, and demographics data in order to make a more accurate and comprehensive diagnosis.

**D. Explainability:**

Adjust explainable AI techniques to discover areas of influence and allow the user to learn how the model is made to make predictions.

**E. Mobile Application Implementation:**

Design an application to be installed on mobile phone which helps users to easily screen skin diseases in real time with the ability to do it anywhere.

**F. Telemedicine Integration:**

Have the system intertwined with telemedicine to make it possible to have a remote consultation with dermatologists and guarantee follow-up care.

**REFERENCE**

1. Dermatologist-level classification of skin cancer with deep neural networks A. Esteva, B. Kuprol, R. A. Novoa, et al., Nature, vol. 542, no. 7639, pp. 115-118, 2017.
2. T. Litjens et al., Medical image analysis Survey, vol. 42, pp. 60-88, 2017.
3. H. A. Abbas, M. M. Abdelsamea, and M. M. Gaber, The deep convolutional neural networks The classification of the skin lesions, IEEE Access, vol. 8, pp. 170586-170596, 2020.
4. N. Codella et al., The melanoma detection in skin lesion: a challenge to the international symposium on biomedical imaging, IEEE ISBI, 2018.
5. ImageNet with deep convolutional neural networks A. Krizhevsky, I. Sutskever and G. E. Hinton, Advances in Neural Information Processing Systems (NeurIPS), pp. 1097-1105, 2012.
6. Zhang, S. Ren, J. Sun, and He, Deep residual learning of image recognition, Proc. IEEE Conf. on Computer Vision and Pattern Recognition (CVPR), pp. 770-778, 2016.
7. I. Goodfellow, Y. Bengio and 7. Courville, Deep Learning. MIT Press, 2016.
8. F. Chollet, F. Schwartz and M. Belanger, " Xception: Deep learning in depth separable convolution Proc. CVPR, p.1251-1258, 2017.
9. Data Mining: Concepts and Techniques, 3 rd ed, J. Han, A. Kamber and M. Pei, Morgan Kaufmann, 2011.
10. S. Minaee et al., Image classification with the deep learning: A survey, IEEE Access, vol. 7 p. 162-174, 2019..