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Original Article

AI-Based Skin Disease Prediction System Using Deep Learning

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ABSTRACT
Among the most widespread health issues all over the world, skin diseases need to be diagnosed properly and on time. Nevertheless, dermatological expertise is not readily available in rural and underserved areas. The paper is about an AI-based skin disease prediction system that uses deep learning techniques. The system proposed is based on Convolutional Neural Network (CNN), the ConvNeXt-tiny architecture, to recognize the skin disease in the image. The model is trained on labeled datasets and implemented using a Streamlit-based web interface. Also, it is integrated with the Gemini API to give treatment recommendations and proactive solutions. This has been experimentally proven to have an accuracy of about 85-90%, which proves effectiveness of the system in real-time diagnosis.

Keywords: Transformers, Artificial Intelligence (AI), skin, effectiveness

INTRODUCTION

The field of healthcare has been transformed by Artificial Intelligence (AI) that allows the automatic and correct diagnosis of diseases. The visual examination is essential in identifying skin diseases like acne, eczema, psoriasis as well as infections. The latest developments in deep learning, most notably Convolutional Neural Networks (CNNs), have greatly enhanced the capabilities of medical image classification systems. In this paper, an AI-based system is introduced that uses deep learning to identify skin diseases based on images. The system is developed with Python, PyTorch, and Streamlit, which enables users to upload images and get immediate predictions with confidence scores and medical advice.

PROBLEM STATEMENT

Diagnosis of skin diseases used to be based on clinical examination by skilled dermatologists. This expertise is, however, not easily accessible in rural and remote areas resulting in delays in diagnosis and treatment. Skin conditions can also be manually examined and this is time consuming and can be exposed to human error leading to misdiagnosis or poor consistency. Moreover, the current diagnostic systems are usually not automated, lack real-time processing and cannot be used by ordinary people. These restrictions present a huge disparity in delivering prompt and cost-effective healthcare services. Thus, the necessity to create an intelligent and automated system capable of analyzing skin images, precisely detecting skin diseases, and offering credible medical support is high. This type of system can facilitate the early identification, lessen reliance on specialists, and enhance access to healthcare in general.

LITERATURE REVIEW

Many studies have been conducted on the topic of skin disease detection with the help of machine learning and deep learning models. The ensemble learning techniques are a set of models that are used together to enhance accuracy and minimize overfitting but they present high computational complexity and cannot be implemented easily in real-time systems. Transformers based architectures (Vision Transformers (ViT)) exhibit high accuracy (up to 96%), although they need large datasets and are computationally expensive. ResNet, MobileNet, and

Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

EfficientNet are CNN-based methods that are popular because of their accuracy/efficiency balance. Transfer learning methods have also enhanced performance by utilizing.

Hybrid solutions to combine conventional machine learning with deep learning have also been considered to improve feature extraction. Even with these developments, issues like imbalance of data, overfitting, high computing demands and lack of real world implementation remain. This brings to the fore the necessity of an accurate and practical system to be utilized in real-time.

PROPOSED METHODOLOGY

A. Data Collection

A large set of annotated images of skin diseases was also garnered via publicly available websites and edited to contain various disease types, including acne, psoriasis, eczema, ringworm, urticaria, cellulitis, and impetigo. The dataset was aimed at capturing the differences in skin tone, lighting, and image quality to enhance the model robustness. Adequate labeling was also done to enhance reliability of datasets and enhance classification accuracy...

B. Data Preprocessing

A vital step towards the effectiveness of the deep learning model is data preprocessing. To make the images consistent across the dataset, all images were downsampled to a standard size. When training, pixel values were subjected to normalization in order to enhance convergence. To artificially raise the amount of data and minimize overfitting, data augmentation methods, i.e. rotation, flipping, zoom, etc., were used to enlarge the data. Moreover, images that contained too much noise, blur or bad quality were eliminated so as to improve the consistency and reliability of the datasets.

C. Model Development

The system is based on the ConvNeXt-tiny framework, which is implemented on PyTorch.

D. Model Training

To examine the effectiveness of the models, the dataset was split into two groups: training and testing in the 80:20 proportion. Adam optimizer was the preferred model type because it has the ability to adjust to changes. Measures of prediction error were the categorical cross-entropy loss function. The training was done in various epochs where the performance was monitored at each epoch to maintain the desired convergence and prevent overfitting. Learning rate and batch size are among the hyperparameters that were optimized to ensure the best performance.

E. Model Evaluation

Widely accepted measures, including accuracy, precision, and recall, were used to assess the performance of the model. Measures of accuracy are used to determine the overall accuracy of the predictions, whereas precision and recall give more insight into the performance of the classifications. A confusion matrix was also created, to examine misclassifications between various categories of disease. These assessment methods can be used to comprehend the reliability of the models and zone of development.

F. Deployment

This is implemented on the Streamlit system, and can receive real-time predictions, when users upload pictures.

SYSTEM ARCHITECTURE

The system consists of:

1. Image Input Module

2. Preprocessing Module

3. CNN Model (ConvNeXt-tiny)

4. Prediction Output Module

5. Gemini API to integrate treatment suggestions.

RESULTS AND DISCUSSION

A. Performance

The test data show that the model has an accuracy of around 85- 90%.

B. Output Features

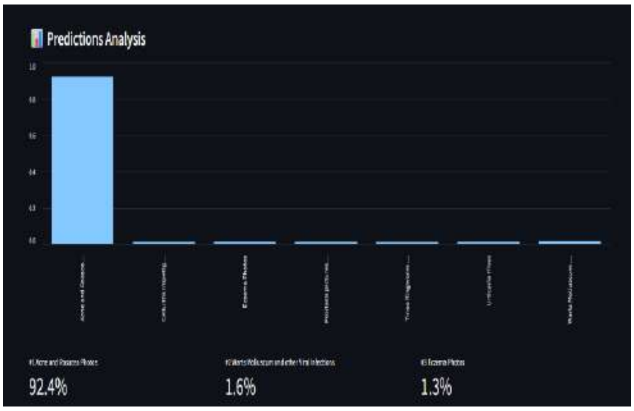
The system displays the user with detail output, the name of the predicted disease and a confidence score that shows the assurance of the prediction. Moreover, it integrates with the Gemini API to provide treatment recommendations and prophylaxis. This renders the system more informative and practical to apply in real life.

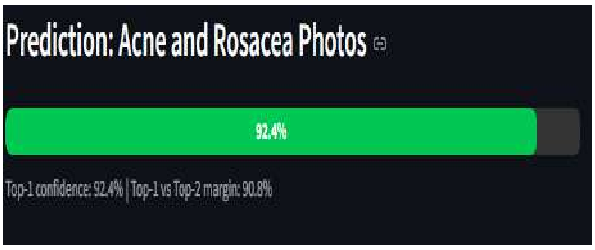
C. Visualization

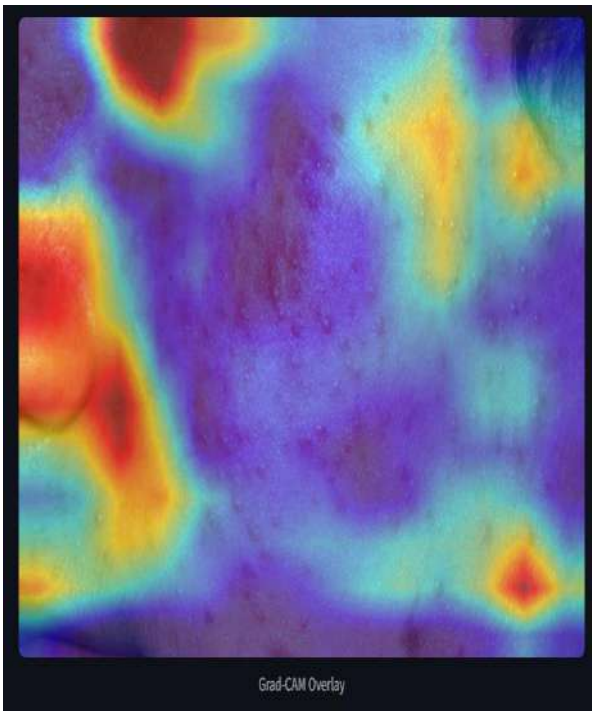
The visualization is performed with Grad-CAM to highlight the affected areas, enhancing model interpretability.

D. Analysis

The model performs effectively across multiple disease classes. However, performance is influenced by image quality and dataset diversity.







CONCLUSION

In this paper, an AI-based system of skin disease predication using deep learning techniques to diagnose skin disease accurately and in real time is presented. The system is capable of classifying several skin diseases with a high level of accuracy and also offers an accessible platform where users can get instant medical information. The proposed solution, based on AI and a web-based interface, alleviates the reliance on manual diagnosis and enhances the accessibility of healthcare. The system could be improved in the future by adding bigger and varied datasets that would enhance the process of generalization. It is possible to experiment with more sophisticated models, including hybrid CNN-transformer, to achieve accuracy improvements. Also, implementation of the system as a mobile app and combining the system with IoT-based healthcare devices can further enhance its application. The multilingual assistance and the feature of doctor consultation at any time or place may also be added to the system to make it more realistic in the real-life applications.

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