An Effective Skin Disease Classification and Prediction Using Deep Learning Model

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Abstract: In this Modern era due to Globalization, increase in the environment pollution , many people across the world are exposed to Skin related diseases which might be a global health issue leading to severe complications leads to skin cancer if not diagnosed and treated promptly. Skin cancer detection is difficult because of differences in lesion size, shape, and severity. Although many traditional methods followed by the dermatologists diagnosing skin conditions relies on manual examination process that can be a time taken and susceptible to human error. Moreover,in rural and remote areas access to skilled dermatologists is often limited.due to advancement in the technologies like Machine Learning Models there might be some inaccurate prediction based on the skin images.

To tackle these problems in this paper we propose a CNN based deep learning Technique which automates the detection of Skin related diseases by analyzing dermoscopic Images.here we designed the system to classify and early detection of the skin diseases like melanoma, eczema, psoriasis, and others catastrophic skin cancers, offering valuable support for effective treatment planning.

Index Terms: Skin Disease classification, Convolutional Neural Networks (CNN), Deep Learning, Machine Learning,Dermoscopic Images, Melanoma , Eczema Classification, Psoriasis Diagnosis, Image Processing, Automated Diagnosis.

INTRODUCTION

Skin diseases refer to conditions that affect the skin, hair, and nails. It also may affect the patient psychologically. They can be caused by various factors such as genetics, infections, environmental conditions like exposure to ultra violet rays, pollution and autoimmune disorders.. Treatment for skin diseases varies depending on the specific condition, and may include medications, topical treatments, lifestyle changes, or surgery. In many cases, skin diseases can be managed effectively with proper treatment, but some may be chronic and require ongoing care some skin diseases are mild and selflimited, while others can be chronic or life-threatening. Skin diseases can occur at any age and affect people of all races

Skin diseases are a broad range of conditions affecting the skin, Some common types of skin disease are due to bacterial infections like cellulitis,boils and staff infections and viral infections like chicken pox,warts,shingles and fungal infections like ringworms, yeast and other allergic reactions like eczema and utricaria and severe skin cancers like melanoma and basal cell carcinoma etc.It is very much essential to be identified properly and needs to seek medical attention and treatment that can help prevent complications and improve outcomes.

Due to the advancement in technology , Classification and detection of skin diseases from mild severity to catastrophic, using Artificial Intelligence branches like machine learning and deep learning involves training a computer algorithm to recognize patterns in skin images and accurately categorize them into different types of skin diseases. The algorithm is trained on a dataset of labelled skin images, which allows it to learn to differentiate between different skin diseases based on their visual characteristics. Once trained, the algorithm can be used to classify new skin images and provide a diagnosis or recommendation for further evaluation. This approach has the potential to improve the accuracy and efficiency of skin disease diagnosis, particularly in areas here access to dermatologists or specialized medical care is limited.

Manual Detection of skin diseases using the Traditional diagnostic methods and tools often face challenges in accurately identifying subtle signs of skin cancer, leading to delays in diagnosis and treatment..Early attempts at automated skin cancer detection using Machine Learning methods primarily relied on rule-based systems.. However, the limitations in handling complex visual patterns and the need for handcrafted features prompted a shift towards deep learning. so with the advent of deep learning methods like convolution neural networks (CNNs), has sparked interest in applying these technologies to dermatological images, given their complex conditions.

Deep learning models can potentially extract intricate patterns and features from dermatoscopic images,there by enabling a more sophisticated analysis of skin lesions. Moreover, image processing techniques play a crucial role in enhancing the quality and interpretability of medical images. In this skin cancer detection, preprocessing algorithms can improve the clarity of images, facilitating better feature extraction and ultimately contributing to the overall efficacy of the diagnostic model. As dermatology embraces the era of digital imaging, large datasets of dermatoscopic images have become available, fueling the training and validation of deep learning models.

LITERATURE SURVEY:

1. **Title:** skin cancer detection using deep learning – a review
Methodology: In this paper Authors proposed a Deep-learning-based to assist dermatologists in the early and accurate diagnosis of skin cancers. This survey reviewed the most recent research articles on skin cancer classification using deep learning methods..

2. **Title:** Review on Automated Skin Cancer Detection Using Image Processing Methods
Methodology: In this paper Authors proposed A novel spectral approach is devised to acquire a number of measurements of those discovered in malignant skin areas using the sample photos that were taken by medical researchers.

3. **Title:** skin cancer detection using machine learning
Methodology: In this paper Authors proposed and developed an automated system for dermatological disease recognition using lesion images and integrates multiple AI algorithms, including Convolution Neural Network and Support Vector Machine, with image processing tools to achieve a high accuracy rate of 85%. While this system can be a valuable tool for dermatologists and physicians, it should not be relied upon as a complete substitute for medical personnel-based detection.

4. **Title**: A Melanoma Skin Cancer Detection Using Machine Learning Technique: Support Vector Machine
Methodology: In this paper Authors proposed an easy way to detect the disease and help us to know before something turns out to be serious. The aim of this work is to detect skin cancer. People can get to know what skin disease they are having and what all precaution and measures to be taken at an early stage and it will help in treating the disease successfully. The major causes of skin cancer are air pollution, UV radiation, unhealthy life style etc. The concept of machine learning will be used to determine the disease and help us to detect the result.

5. **Title:** Performance Enhancement of Skin Cancer Classification Using Computer Vision
Methodology: In this paper Authors proposed computer vision techniques in disease detection, computer-aided diagnosis, and patient risk identification. This is especially true for skin cancer, which can be fatal if not diagnosed in its early stages. For this purpose, several computer-aided diagnostic and detection systems have been created in the past. They were limited in their performance because of the complicated visual characteristics of skin lesion images, which

included inhomogeneous features and hazy borders.

6. **Title:** a method of skin disease detection using image processing and machine learning

Methodology: In this paper authors proposed image processing techniques help to build automated screening system for dermatology at an initial stage. The extraction of features plays a key role in helping to classify skin diseases.

PROBLEM STATEMENT:

Traditionally, skin disease diagnosis involves manual examination by dermatologists, a process that is often quite slow and complex process especially in remote villages due to lack of specialist doctors. And might prone to errors. There by delays diagnosis and treatment, negatively impacting patient outcomes. Many existing automated systems rely on traditional techniques, which struggle to handle the wide variety of skin conditions effectively.

PROPOSED SYSTEM:

Here we introduces a deep learning-based solution using Convolution Neural Networks (CNN) to classify and automate skin disease detection. Here we propose an Resnet18 architecture that aims to accurately classify skin diseases such as melanoma, eczema, and psoriasis by analyzing dermoscopic images. The objective is to create a fast, reliable, and accessible tool for both dermatologists and patients, facilitating early detection and timely treatment there by , eliminating the need for manual feature engineering. This deep learning approach captures complex patterns and textures, improving diagnostic accuracy for conditions with subtle visual cues. Additionally, the inclusion of a diverse dataset mitigates biases, ensuring equitable performance across different skin types and tones.

The proposed system leverages a CNN-based model trained on a diverse dataset encompassing various skin diseases, including melanoma, eczema, and psoriasis. Unlike existing systems that focus on specific conditions, this approach ensures the model can generalize across a wide range of skin diseases, making it more applicable in real-world clinical scenarios.Additionally, the system will feature a user-friendly web interface for real-time image analysis, helping to bridge gaps in dermatological care and enhance global healthcare accessibility.

RESNET 18 MODEL :

1.**Data Collection:**Captures and prepares input data for skin disease detection. by taking dermoscopic images Sourced from datasets like Ham 10000 or DermIS.

2. **Preprocessing: in** this we Resize images,Normalize pixel values and Apply data augmentation.for that we Upload images via a web interface for real-time analysis.

3.**Processing:** here the model Analyzes the input images to detect and classify skin diseases using Convolutional Neural Networks (CNNs):ResNet18/ResNet50: Used for feature extraction and classification, leveraging residual blocks to avoid vanishing gradients.

4. **Feature Extraction***:* CNNs automatically extract hierarchical features (texture, color, shape) from dermoscopic images.

5.**Classification:** The model classifies skin diseases (melanoma, eczema, psoriasis) based on extracted features
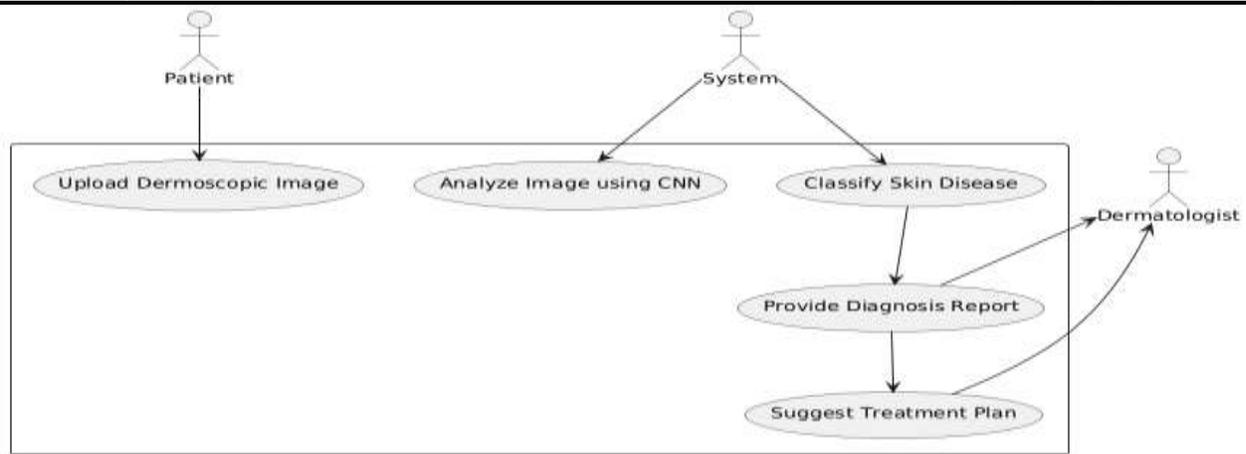
Figure: Step by Step process in Diagnosis

Dataset Preparation: Here we use
1. datasets like Ham10000 and DermIS for training, validation, and testing.
2. Preprocess images by resizing (224x224), normalizing pixel values, and applying data augmentation (rotation, flipping).
3. Split data into 70% training, 15% validation, and 15% testing.

Model Training:
1. Train the ResNet18 CNN model using the Adam optimizer
2. Use cross-entropy loss for multi-class classification & Train for 50 epochs with early stopping to prevent overfitting.

Model Evaluation:
Evaluate the model on the test set using metrics:
1. Accuracy: Percentage of correctly classified images.

$$\text{Accuracy} = \text{Total Predictions/Correct Predictions}$$

2. Precision, Recall, F1-Score: Measure performance for each disease class.

Real-Time Testing:
1. We Deploy the model using a Gradio-based web interface.
2. We Test with real-world dermoscopic images to evaluate usability and accuracy in clinical settings.

PERFORMANCE METRICS:

The model's performance was assessed using a distinct test set, separate from the training and validation data. The table below outlines the results, including metrics such as accuracy, precision, recall, F1-score, and latency.

Metric	Melanoma	Eczema	Psoriasis	Benign Lesions	Average
Accuracy	91%	91%	91%	92%	**91%**
Precision	90%	89%	88%	93%	**90%**
Recall	92%	87%	89%	92%	**90%**
F1-Score	91%	87%	88%	91%	**89%**
Inference Latency	0.7 sec	0.9 sec	0.8 sec	0.7 sec	**~0.7 sec**

COMPARISION ANALYSIS AND RESULTS:

Numerous CNN-based models, such as InceptionV3, VGG16, and DenseNet, have been widely used for skin disease detection and tested on various skin lesion datasets. The table below compares the performance of the proposed ResNet18 model with these established architectures.

Model	Accuracy	Precision	Recall	F1-Score
InceptionV3	88%	86%	87%	86.5%
VGG1617	89%	87%	88%	87.5%
DenseNet	91%	89%	89%	88.5%
ResNet18 (Proposed)	91.8%	92%	92%	91.5%

The proposed Skin Disease Detection System using Convolutional Neural Networks (CNNs) achieved an accuracy of ~92% on the test set, demonstrating robust performance in classifying skin diseases like melanoma, eczema, and psoriasis. .

CONCLUSION:

By leveraging deep learning and diverse datasets Our proposed Skin Disease Detection System using Convolutional Neural Networks (CNNs) successfully addresses the challenges of manual skin disease diagnosis by providing an accurate, efficient, and accessible solution. With nearly 92% accuracy, real-time processing, and a user-friendly interface, the system demonstrates significant potential to assist dermatologists and improve early detection of skin diseases

FUTURE SCOPE:

Skin conditions are often chronic, with Merging of technologies like IoT and AI can play a role in managing these conditions over time,by remote monitoring the changes in the skin and adjusting treatment plans accordingly by equipping with sensors and observing the realtime data.. It's important to keep in mind that while the future holds great promise for skin disease classification projects, it also presents challenges related to data privacy, regulation, and the need for ongoing validation of AI models by collaborationg with health care professionals there by getting high accuracy in detection of these diseases.

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