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Acne and Fungal Skin Disease Detection and Recommendation Using Convolutional Neural Networks: A VGG16-Based Approach

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Abstract:

The detection and classification of multiple skin diseases, including acne and Fungal Infections, are critical for providing timely medical intervention. This study focuses on utilizing Convolutional Neural Networks (CNN) for the detection and classification of skin diseases in various stages. Specifically, acne disease is categorized into three stages, ranging from mild to severe, while Fungal infections are taken 3 stages. The CNN model is trained on a diverse dataset of skin disease images to identify and classify the conditions accurately.

The system is designed to not only diagnose the disease but also recommend suitable treatments based on the severity of the condition. For acne, treatments may include topical creams or oral medications, while for fungal infections, antiviral medications and isolation protocols are recommended. In addition, the model provides doctor recommendations, guiding users on when to seek medical consultation based on the severity of their condition. This research highlights the potential of AI and CNN models in improving diagnostic accuracy and treatment recommendations in dermatology, offering a valuable tool for both patients and healthcare professionals.

Keywords: Skin Disease Detection, CNN, VGG16, Image Processing, Deep Learning, Acne, Fungal Infections.

1.INTRODUCTION:

Skin diseases can significantly impact a person's health and quality of life. Traditional diagnostic methods rely on clinical evaluation by dermatologists, which are often subjective and time-consuming. Automated skin disease detection using deep learning can enhance accuracy and speed. This study explores a CNN-based model, incorporating VGG16, to classify skin diseases from medical images.

2.OBJECTIVE:

- To develop a CNN-based classification system for acne and fungal infections.
- To classify skin disease images into three severity stages.
- To provide severity-based treatment recommendations.

LITERATURE SURVEY:

- Deep Learning-based Application for Acne Subtype and Severity Detection-2023
  Krithika Naidu, Omkar Kareppa, Sridhar Menon, Chitra Bhole. Achieved 83.23% accuracy in classifying acne subtypes and severity, aligning with the project's focus on acne classification

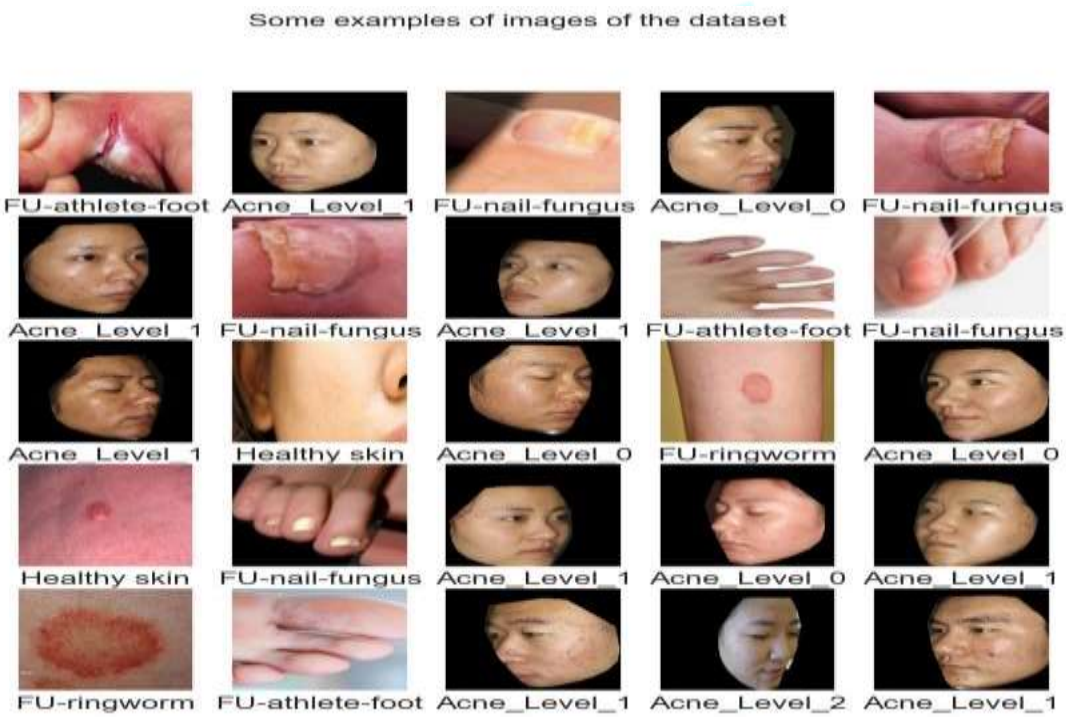
- Skin Disease Detection: Machine Learning vs Deep Learning-2021 Samir Bandyopadhyay, Amiya Bhaumik, Sandeep Poddar. Compared machine learning and deep learning; found deep learning models more effective with 80% accuracy.

- Classification of Human Monkeypox Disease Using Deep Learning Models -2022. Md. Enamul Haque, Razia Sultana Nila, Md. Rayhan Ahmed. Achieved 83.89% accuracy using CNN for Monkeypox detection, relevant for multi-stage classification.

3. METHODOLOGY

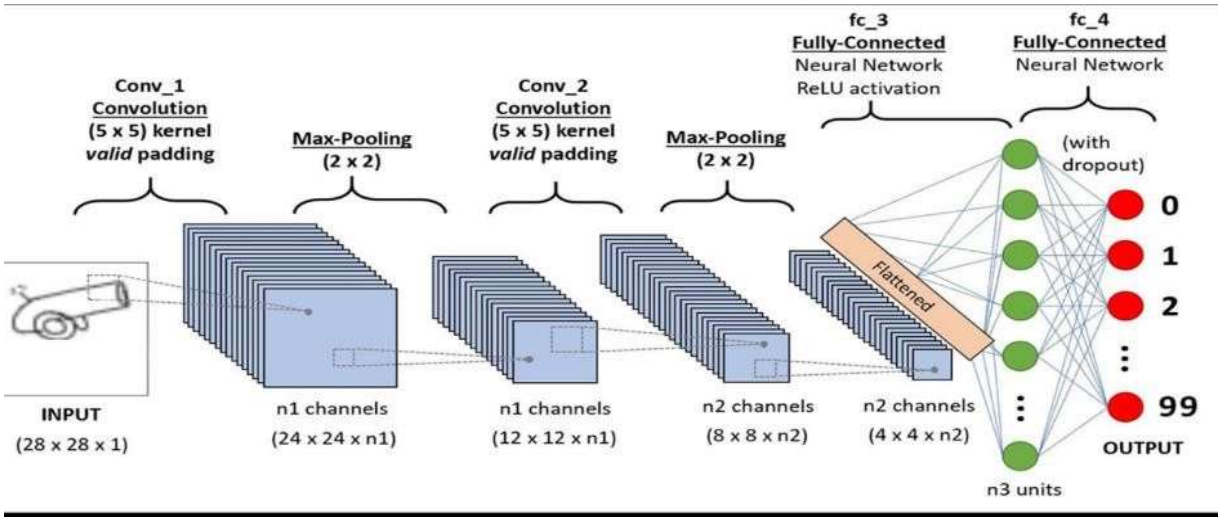
3.1 DATASET

The dataset consists of labelled images of acne and fungal infections. The dataset was split into 80% training and 20% testing. Preprocessing techniques such as resizing, colour conversion, and filtering are applied to improve image quality. Below figure shows some examples of images of the dataset.

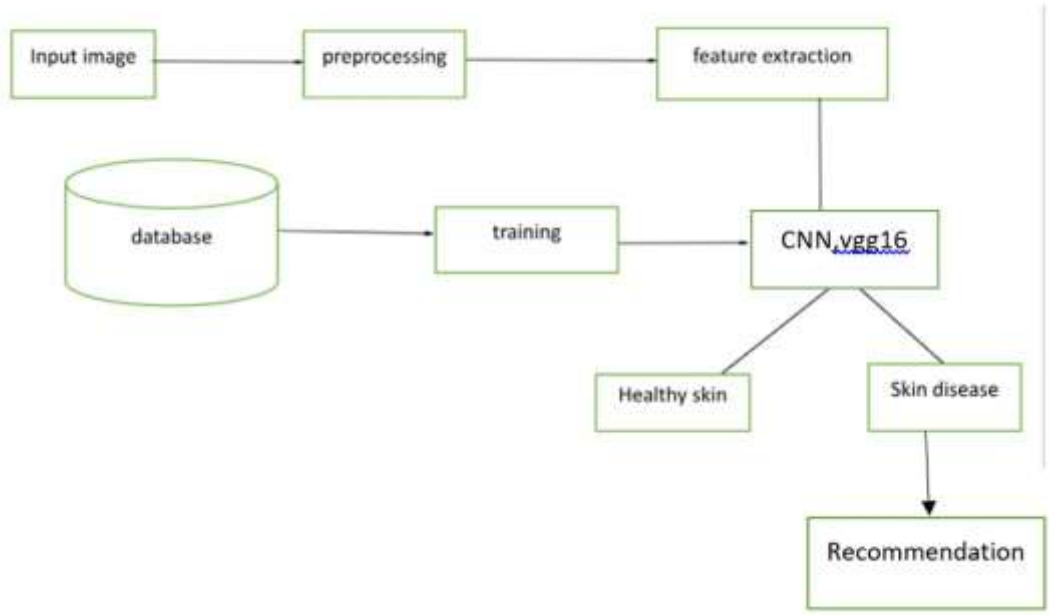


3.2 MODEL ARCHITECTURE

- **Convolutional Neural Network (CNN):** Extracts spatial features from images using convolutional layers.
- **VGG16:** A deep CNN architecture with 16 layers, known for its strong feature extraction capabilities. We fine-tuned the pre-trained VGG16 model for our dataset.



PROPOSED METHOD:

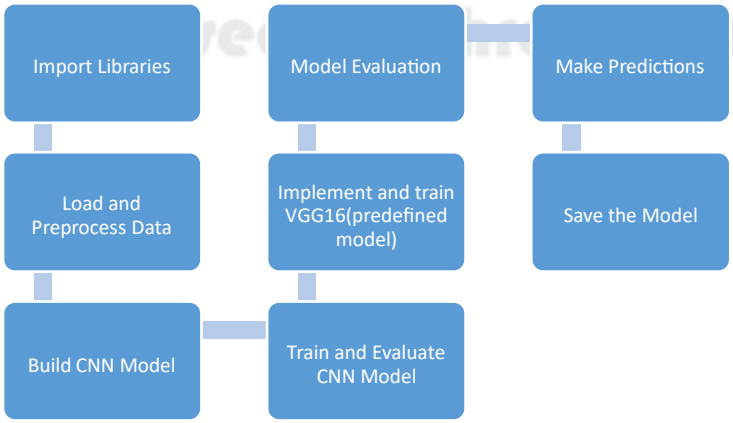


The proposed skin disease detection model illustrates the overall system architecture. The process begins with the input image, which undergoes preprocessing to enhance the quality and normalize the data. The pre-processed image is then passed through a feature extraction phase, where significant patterns are captured. These features are fed into a Convolutional Neural Network (CNN), specifically the VGG16 model, which has been trained using a database of labelled skin images. Based on the classification results, the model identifies whether the skin is healthy or diseased. In the case of a skin disease, appropriate recommendations are generated for further action.

3.3 IMPLEMENTATION

- **Libraries Used:** Python, TensorFlow, Keras, OpenCV, Flask
- **Training Process:** The CNN and VGG16 models are trained with image augmentation techniques to enhance robustness and Adam optimizer is used.

STEP-BY-STEP IMPLEMENTATION WORKFLOW:



4.SOFTWARE REQUIREMENTS

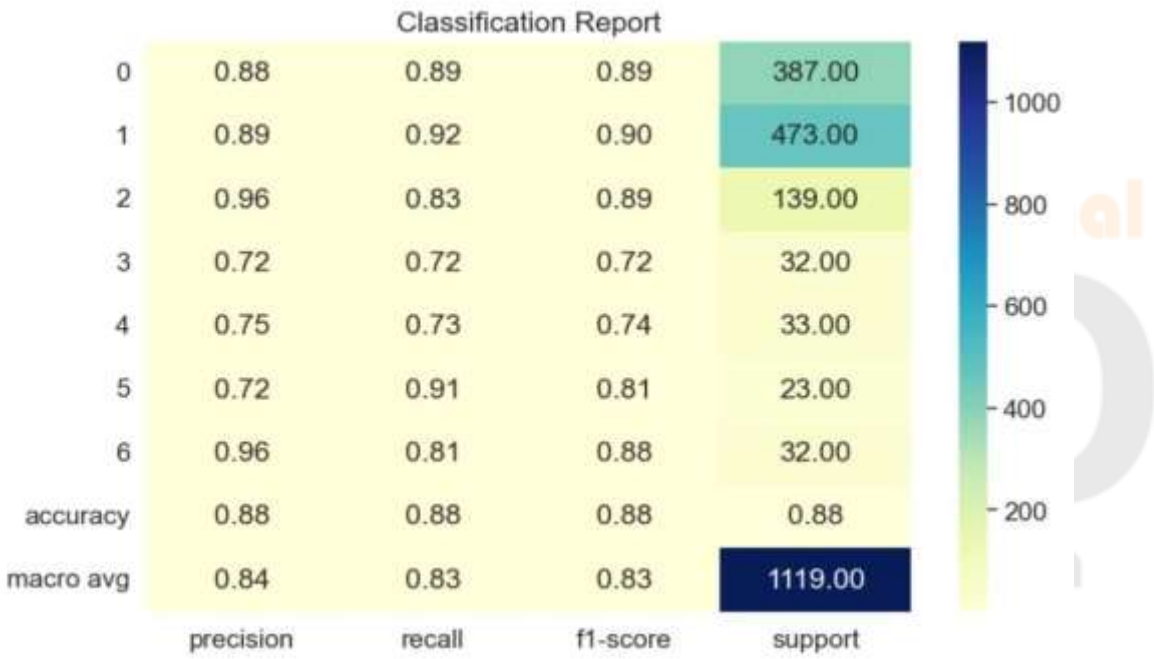
1. Programming Language: Python
2. Jupyter Notebook
3. Anaconda navigator
4. OpenCV

HARDWARE REQUIREMENTS:

1. Operating System: Windows Only
2. Processor: i5 and above
3. RAM: 4GB and above
4. Hard Disk: 50 GB

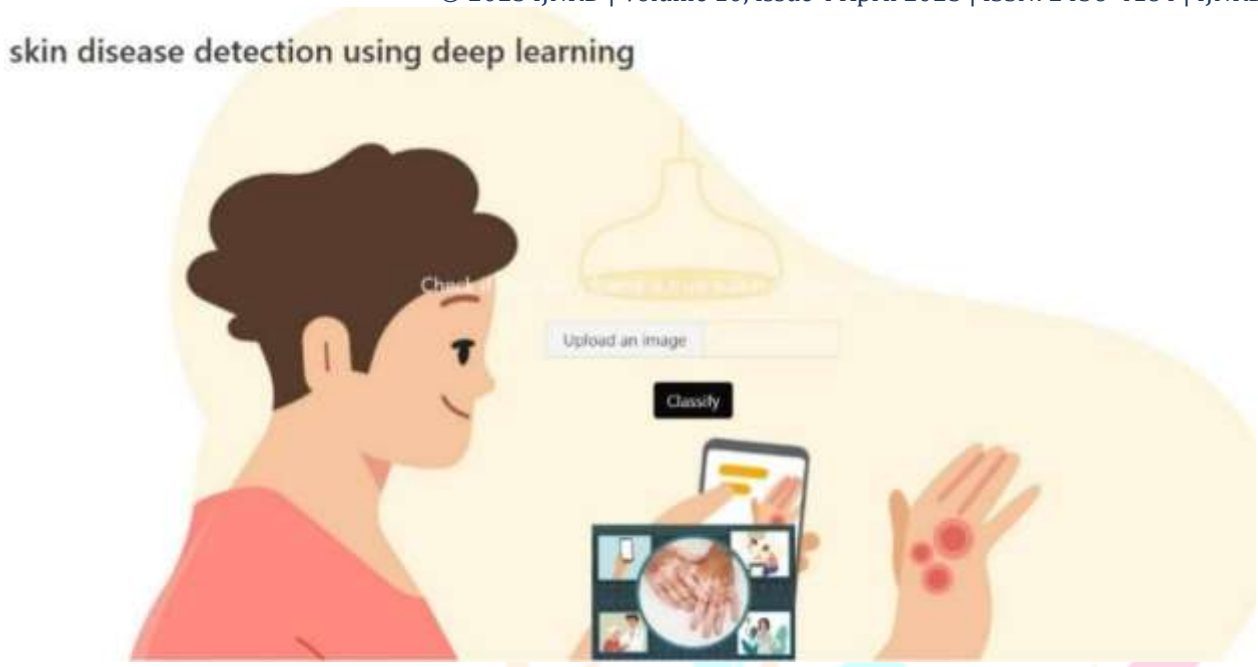
5.1RESULTS AND DISCUSSION

The models were evaluated using accuracy, precision, recall, and F1-score. The VGG16 model outperformed the basic CNN model, achieving higher classification accuracy. Visualization techniques such as confusion matrices and loss curves were used to analyse performance. The final model was deployed using Flask, enabling real-time image classification.



5.2 FRONTEND OUTPUT VISUALIZATION:

The system features a web-based user interface developed using Flask, where users can upload skin images and receive predictions along with suggested treatments. Below is a screenshot of the frontend displaying to upload the image.



5.3 VISUAL OUTPUT AND PREDICTION RESULTS:

INPUT IMAGE:

IMAGE_1: **IMAGE_2:** **IMAGE_3:**

IMAGE_4: **IMAGE_5:** **IMAGE_6:**

IMAGE_7:

PREDICTED OUTPUT:

IMAGE_1: Acne_Level_0:

IMAGE_2: Acne_Level_1:

IMAGE_3: Acne Level 2:

IMAGE_4: FU-athlete-foot:

IMAGE_5: FU-nail-fungus:

IMAGE_6: FU-ringworm:

IMAGE_7: Healthy Skin:

CONCLUSION

This paper presented a skin disease detection and classification system using a convolutional neural network based on the VGG16 architecture. The system focused on identifying acne and fungal infections and classifying them into three severity stages. Image processing techniques such as resizing and filtering were applied to improve model input quality. The model was implemented using Python and TensorFlow, with a Flask-based web interface for interaction. The system demonstrated accurate predictions, helping users understand their skin condition and providing recommendations accordingly. This approach highlights the potential of deep learning in dermatology and can serve as a foundation for further research and application in real-world healthcare settings.

FUTURE SCOPE

This work can be further extended by incorporating more diverse skin disease datasets to enhance model accuracy and generalization across various demographics. The existing Flask-based web interface can be transformed into a mobile-friendly application, ensuring accessibility in rural and remote areas. Moreover, the system can be integrated with telehealth platforms for remote diagnosis and can include multilingual support to serve a broader population. These advancements would contribute significantly to real-time, AI-based dermatological support systems.

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