Early Screening and Detection of Skin Diseases using Deep Learning

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ABSTRACT— Skin diseases are among the most common health conditions, and early detection is crucial for effective treatment and prevention of serious complications. However, traditional diagnostic methods require expert consultation and specialized equipment, which may not be easily accessible to everyone. To address this challenge, this paper presents an AI-based system for early screening and detection of skin diseases using deep learning techniques. The proposed system utilizes a Convolutional Neural Network (CNN) model to classify skin images into three categories: melanoma, benign, and normal. The model is trained on a publicly available dataset and incorporates preprocessing techniques such as image resizing and normalization to improve performance. A user-friendly web interface is developed using Streamlit to enable real-time image input and prediction. The system provides classification results along with confidence scores, enhancing reliability and usability. Experimental results demonstrate that the proposed approach achieves satisfactory accuracy for clear and well-defined images. This system serves as an assistive tool for preliminary diagnosis and promotes early awareness, while not replacing professional medical evaluation.

INTRODUCTION

Skin diseases are among the most common health conditions worldwide, and early detection is essential to prevent severe complications, particularly in cases such as melanoma. However, traditional diagnostic methods rely on expert dermatological evaluation and specialized equipment, making them time-consuming and less accessible, especially in rural and remote areas. With the advancement of artificial intelligence, deep learning techniques have become highly effective in medical image analysis, enabling automated detection and classification of diseases. Convolutional Neural Networks (CNNs), in particular, are widely used for image classification due to their ability to extract meaningful features from images. Existing approaches using conventional machine learning methods face limitations such as lower accuracy, dependency on manual feature extraction, and poor generalization across diverse datasets. To address these challenges, this project proposes an AI-based skin disease detection system using a CNN model to classify skin images into melanoma, benign, and normal categories. The system incorporates preprocessing techniques such as image resizing and normalization and is integrated with a Streamlit-based web interface for real-time prediction. The proposed system aims to provide a fast, accessible, and efficient solution for preliminary screening and early detection of skin diseases.

I. PROBLEM DEFINITION

Industrial Internet of Things (IoT) networks enable communication between a large number of interconnected devices, making systems more efficient and automated. However, this connectivity also introduces serious security challenges, as IoT environments are highly vulnerable to cyber-attacks such as denial-of-service, probing, and unauthorized access. The large volume and dynamic nature of network traffic make it difficult to monitor and detect malicious activities effectively using traditional security approaches.

Conventional Intrusion Detection Systems (IDS), which rely on signature-based methods or basic machine learning algorithms, are often unable to detect unknown or evolving threats. These systems suffer from limitations such as low detection accuracy, high false positive rates, and poor performance when handling imbalanced datasets. Additionally, many existing methods struggle to process large-scale real-time data, reducing their effectiveness in modern IoT environments.

Therefore, there is a need for an advanced and efficient intrusion detection system that can accurately identify both known and unknown attacks while handling complex and high-dimensional data. This project addresses these challenges by proposing a hybrid deep learning-based IDS using Deep Neural Networks (DNN) and Extreme Learning Machine (ELM), which improves detection accuracy, reduces false alarms, and enhances overall security in IoT networks.

1.2 PROJECT FEATURES

Early detection of skin diseases remains a significant challenge due to limited access to dermatological expertise and lack of awareness among individuals. Many people ignore initial symptoms or delay consultation, which can lead to severe complications, especially in cases such as melanoma. Traditional diagnostic methods depend on expert evaluation and specialized equipment, making them time-consuming and less accessible, particularly in rural and remote areas.

Existing automated approaches using conventional machine learning techniques suffer from limitations such as lower accuracy, dependency on manual feature extraction, and poor generalization across diverse datasets. Variations in image quality, lighting conditions, and skin types further affect prediction reliability. Therefore, there is a need for an efficient and intelligent system that can accurately detect skin diseases using image data. This project addresses these challenges by proposing a deep learning-based approach using Convolutional Neural Networks (CNN) to classify skin images into melanoma, benign, and normal categories, enabling reliable early screening through a web-based interface.

Related Work

Several research studies have explored the use of machine learning and deep learning techniques to improve intrusion detection in network security. Traditional approaches include signature-based detection methods, statistical analysis, and classical machine learning algorithms such as Support Vector Machines and Random Forest. While these methods provide a certain level of protection, they often fail to detect unknown or evolving cyber threats and may produce high false positive rates.

Recent research has focused on deep learning models for intrusion detection, including Deep Neural Networks (DNN), Convolutional Neural Networks (CNN), and Recurrent Neural Networks (RNN). These approaches are capable of learning complex patterns from large-scale network traffic data and improving detection accuracy. Datasets such as NSL-KDD have been widely used to evaluate these models, addressing some limitations of earlier datasets like redundancy and imbalance.

However, many existing solutions face challenges such as high computational complexity, slow training time, and difficulty in handling imbalanced data. Some models also lack the ability to generalize across different types of attacks or real-time environments. This project builds upon existing research by proposing a hybrid model that integrates Deep Neural Networks with Extreme Learning Machine (ELM), providing faster processing, improved accuracy, and a more efficient solution for intrusion detection in IoT networks.

II. METHODOLOGY

1. Data Collection
A skin image dataset (HAM10000) is used, containing labeled images of different skin conditions including melanoma, benign, and normal.

2. Data Preprocessing
The images are resized to a fixed dimension (224×224), normalized to scale pixel values, and converted into a suitable format for model training..

3. Feature Selection
The Convolutional Neural Network (CNN) automatically extracts important features such as texture, color, and shape patterns from the input images.

4. Model Training
A CNN-based deep learning model is trained on the processed dataset to learn patterns and classify skin images into different categories.

5. Classification & Evaluation
The trained model classifies input images into melanoma, benign, or normal classes and is evaluated using metrics such as accuracy and confidence scores.

III. PROPOSED SYSTEM

The proposed system presents a deep learning-based approach for early screening and detection of skin diseases using image classification techniques. The system utilizes a Convolutional Neural Network (CNN) model to analyze skin images and classify them into three categories: melanoma, benign, and normal. The model is trained on a labeled dataset of skin lesion images and is capable of learning complex patterns such as texture, color, and shape variations.

The system incorporates preprocessing techniques including image resizing and normalization to ensure consistent input quality and improve model performance. A user-friendly web interface is developed using Streamlit, allowing users to upload or capture images and receive real-time predictions along with confidence scores. Compared to traditional methods, the proposed system provides improved accuracy, faster prediction, and better usability, making it an efficient and accessible solution for preliminary skin disease screening.

IMPLEMENTATION DETAILS

The implementation of the proposed skin disease detection system is carried out using both frontend and backend technologies integrated with deep learning. The frontend is developed using Streamlit to provide a simple, interactive, and user-friendly interface for uploading or capturing skin images and displaying prediction results. The backend is implemented using Python, where the Convolutional Neural Network (CNN) model is used for image preprocessing, model inference, and real-time classification. The system is trained using a labeled skin image dataset and incorporates preprocessing techniques such as resizing and normalization to ensure consistent input quality. Users can upload or capture images, which are processed by the model to classify them into melanoma, benign, or normal categories, and the results are displayed along with confidence scores through the interface.

4.1 ALGORITHMS USED

4.1.1 CONVOLUTIONAL NEURAL NETWORK (CNN)

Convolutional Neural Network (CNN) is a deep learning algorithm widely used for image classification tasks. It consists of multiple layers such as convolutional layers, pooling layers, and fully connected layers, which help in extracting important features from images. In this project, CNN is used to analyze skin images and classify them into melanoma, benign, and normal categories. It improves prediction accuracy by automatically learning complex patterns such as texture, color, and shape from the dataset.

4.1.2 MOBILENET

MobileNet is a lightweight deep learning model designed for efficient image classification with reduced computational complexity. It uses depthwise separable convolutions to decrease the number of parameters and improve speed. In this project, MobileNet is used to enhance performance and enable faster predictions, making the system suitable for real-time applications and deployment on low-resource devices.

4.1.3 SUPPORT VECTOR MACHINE (SVM)

Support Vector Machine (SVM) is a supervised machine learning algorithm used for classification tasks. It works by finding an optimal hyperplane that separates different classes. In this project, SVM can be used as a baseline model to compare the performance of deep learning approaches in skin disease classification.

4.1.4 RANDOM FOREST (RF)

Random Forest is an ensemble learning algorithm that builds multiple decision trees and combines their outputs to improve prediction accuracy. It helps reduce overfitting and provides stable results. In this project, it can be used for comparison with deep learning models to evaluate performance in classifying skin disease images.

IV. EXPERIMENTAL RESULTS AND DISCUSSION

The following figures represent the execution and performance of the proposed skin disease detection system. These results demonstrate the working of different modules such as image input, preprocessing, model prediction, and classification output. The system uses a Convolutional Neural Network (CNN) model to classify skin images into melanoma, benign, and normal categories. The results highlight the effectiveness of the model in providing accurate predictions along with confidence scores, enabling reliable early screening of skin diseases.

System Interface – Home Page:

The below figure shows the main interface of the system where users can upload or capture a skin image for analysis. The interface is designed to be simple and user-friendly, allowing easy interaction for both technical and non-technical users.

Fig. 1. System UserInterface

Input Image:

In this figure, the user uploads a skin image to the system. The image is displayed before prediction, ensuring that the correct input is provided for analysis.

Fig. 2. Input Skin Image

Prediction Result Output:

The following figure shows the prediction result generated by the system. The model processes the input image and provides classification output along with confidence values. The system successfully identifies the skin condition and displays the result in an understandable format.

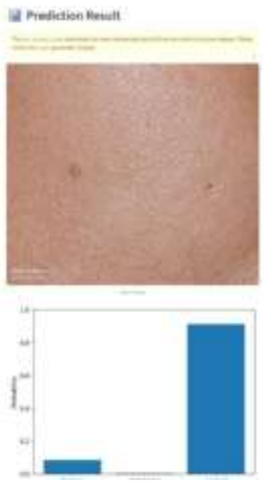

Fig. 3. Prediction Result Output

Classification Probability Graph:

The graph represents the probability distribution of the predicted classes (melanoma, benign, normal). It provides a visual representation of the model's confidence in each class. In this case, the model shows a higher probability for the "normal" class, indicating that the input image is classified as normal with high confidence.

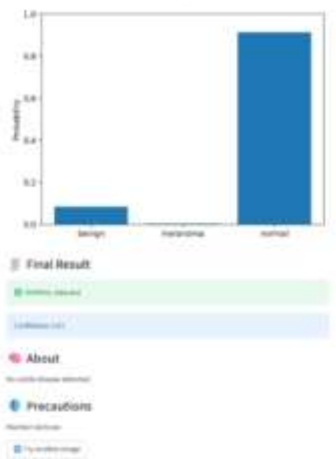

Fig. 4. Classification Probability Graph

The experimental results demonstrate that the proposed system is capable of accurately classifying skin images when clear and well-defined inputs are provided. The integration of deep learning with a user-friendly interface makes the system efficient and practical for real-time usage. The results also highlight that prediction confidence varies based on image quality, which is an important factor in medical image analysis.

VI. CONCLUSION

The proposed system for Early Screening and Detection of Skin Diseases using deep learning demonstrates an efficient and practical approach for medical image classification. The system effectively addresses challenges in traditional diagnostic methods such as dependency on expert evaluation, limited accessibility, and time-consuming procedures. By utilizing a Convolutional Neural Network (CNN) model along with image preprocessing techniques, the system is able to accurately classify skin images into melanoma, benign, and normal categories.

The integration of a user-friendly web interface enables real-time prediction and improves usability for both technical and non-technical users. The model provides reliable results along with confidence scores, enhancing the interpretability of predictions. Overall, the proposed system offers a fast, accessible, and effective solution for preliminary skin disease detection, contributing to early awareness and timely medical consultation.

VII. FUTURE SCOPE

The proposed skin disease detection system can be further enhanced by integrating advanced deep learning techniques to improve prediction accuracy and robustness. Future improvements may include the use of more powerful architectures such as advanced Convolutional Neural Networks (CNN), Transfer Learning models, and hybrid approaches to better capture complex patterns in skin images. The system can also be trained on larger and more diverse datasets to improve generalization across different skin tones, lighting conditions, and disease variations.

Additionally, the system can be extended to include more skin disease categories, making it more comprehensive and clinically useful. Integration with mobile applications and cloud platforms can enable real-time access and wider usability. Features such as user authentication, medical report generation, and telemedicine integration can further enhance functionality. These improvements will make the system more accurate, scalable, and suitable for real-world healthcare applications.

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