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An Enhance Hybrid Model For Skin Disease Detection Using Machine Learning Techniques

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ABSTRACT
Skin disease detection is a critical task in the medical field, requiring accurate and efficient diagnosis to ensure effective treatment and prevention of complications. In this presentation, we propose an enhanced hybrid model that combines the strengths of Convolutional Neural Networks (CNNs), Deep Learning (DL), and traditional Machine Learning (ML) techniques to improve the accuracy and robustness of skin disease detection. Our hybrid model leverages the strengths of each technique to handle complex relationships between the input and output variables, high-dimensional data, and imbalanced datasets. We evaluate the performance of our model on a large dataset of skin disease images and demonstrate its superiority over traditional ML and DL approaches. Our results show that the hybrid model achieves higher accuracy, precision, and recall rates, making it a promising tool for skin disease detection and diagnosis. This presentation will provide an overview of our hybrid model, its architecture, and its performance, as well as discuss its potential applications and future directions in the field of skin disease detection.

INTRODUCTION
Skin disease detection is a critical task in the medical field, requiring accurate and efficient diagnosis to ensure effective treatment and prevention of complications. Skin diseases, such as melanoma, basal cell carcinoma, and squamous cell carcinoma, can be life-threatening if not detected and treated early. Traditional methods of skin disease detection, such as visual examination and biopsy, have limitations in terms of accuracy and efficiency. In recent years, machine learning (ML) techniques have been increasingly used to improve the accuracy and robustness of skin disease detection. However, the complexity of skin disease detection, including the variability in skin types, lesions, and imaging modalities, requires a more comprehensive approach.
In this presentation, we propose an enhanced hybrid model that combines the strengths of Convolutional Neural Networks (CNNs), Deep Learning (DL), and traditional Machine Learning (ML) techniques to improve the accuracy and robustness of skin disease detection. Our hybrid model leverages the strengths of each technique to handle complex relationships between the input and output variables, high-dimensional data, and imbalanced datasets. We evaluate the performance of our model on a large dataset of skin disease images and demonstrate its superiority over traditional ML and DL approaches.
The potential applications of our hybrid model are vast, including the detection of skin cancer, psoriasis, and other skin diseases. Our model can also be used to monitor the progression of skin diseases and evaluate the effectiveness of treatments. We believe that our hybrid model has the potential to revolutionize the field of skin disease detection and diagnosis, providing a more accurate and efficient tool for medical professionals and patients.

LITERATURE SURVEY
Skin diseases are among the most prevalent health concerns globally, with over 900 million people

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affected at any given time. Conditions such as acne, eczema, psoriasis, keratosis, and especially malignant melanoma, can significantly impact an individual's health, quality of life, and even lead to fatal consequences if not diagnosed and treated in a timely manner. Dermatological diagnosis traditionally relies on clinical expertise and visual inspection, which can be time- consuming and prone to human error, especially in areas with limited access to specialized healthcare professionals. With advancements in artificial intelligence, particularly in the fields of machine learning (ML) and deep learning (DL), the potential to automate and enhance the diagnostic process has become increasingly viable. Several deep learning models, including Convolutional Neural Networks (CNNs), have demonstrated high accuracy in image classification tasks, making them well-suited for analyzing skin lesion images.Hameed et al. [3] implemented using a hybrid approach i.e. using deep convolution neural network and error- correcting output codes (ECOC) support vector machine (SVM). The

proposed scheme is designed, implemented and tested to classify skin lesion image into one of five categories, i.e. healthy, acne, eczema, benign, or malignant melanoma. Experiments were performed on 9,144 images obtained from different sources. AlexNET, a pre-trained CNN model was used to extract the features. For classification, the ECOC SVM classifier was used. UsingECOC SVM, the overall accuracy achieved is 86.21%. 10-fold cross validation technique was used to avoid overfitting. The results indicate that features obtained from the convolutional neural network can enhance the classification performance of multiple skin lesions.

Aldhyani et al. proposed a CNN-based model with efficient utilization of kernels and activation functions. The proposed model has shown a remarkable class-wise (seven classes) accuracy and overall accuracy of 97.85% on the test dataset with fewer parameters than is standard (172,363). The proposed model can also be used for disease classification with a dataset that has more classes. The model still has room for more accurate prediction of benign keratosis- like lesions, melanoma, and melanocytic nevi classes of skin lesions.

Anjum et al. (2020) proposed a deep learning-based framework for the semantic segmentation and multi-class classification of skin lesions using Convolutional Neural Networks (CNNs). Their model effectively segments the lesion area and classifies various types of skin conditions, improving both accuracy and efficiency in automated dermatological diagnosis. The use of deep semantic segmentation allows for precise boundary detection, while the multi-class classification component ensures the system can distinguish between multiple lesion types. This work is highly relevant to the current project, as it highlights the effectiveness of CNN architectures in skin disease detection Vakili et al. focused on primary skin lesion classification, particularly early-stage detection, and present a deep learning approach to classify images containing skin lesions, macule, nodule, papule, plaque pustule, wheal, and bulla. This framework applied deep learning techniques for classifying such images into seven classes covering the types of lesions. This work performed experiments on pre-trained deep convolutional neural network models to find the most accuracy one. The result showed that the pre-trained model ResNet-50 after the training and testing can achievesatisfactory accuracy of 85.95%.

Iqbal, I., Younus, M., Walayat, This study presents a deep convolutional neural network (CNN)-based approach for automated multi-class classification of skin lesions using dermoscopic images. The authors propose a fine-tuned CNN architecture that effectively distinguishes between various types of skin lesions, achieving high accuracy, precision, and recall across multiple classes. The dataset used comprises high-resolution dermoscopic images, and the model is evaluated using standard metrics. This work highlights the significant potential of deep learning techniques, especially CNNs, in supporting dermatologists and enhancing early diagnosis of skin diseases through non-invasive, image-based methods.

RELATED WORK

In recent years, the integration of machine learning (ML) and deep learning (DL) techniques has shown promising results in the field of dermatological diagnostics, especially for automated skin disease detection and classification. Several researchers have explored a variety of models and approaches to improve the accuracy, reliability, and interpretability of skin lesion classification systems.

Iqbal et al. [6] proposed a deep convolutional neural network (CNN)-based model for the multi-class classification of skin lesions using dermoscopic images. Their approach demonstrated high performance across multiple skin disease categories, leveraging transfer learning and fine-tuning strategies to enhance model accuracy. The study highlights the effectiveness of CNNs in feature extraction and pattern recognition from complex dermoscopic data.

Esteva et al. (2017) pioneered the use of deep neural networks (DNNs) trained on a vast dataset of clinical images to match dermatologist-level classification of skin cancer. Their work emphasized the importance of large-scale data and end-to-end learning in achieving robust diagnostic performance.

Similarly, Tschandl et al. (2019) investigated the impact of various CNN architectures and ensemble methods on dermoscopic image classification, illustrating that combining multiple models can significantly improve classification outcomes. Their ensemble-based approach paved the way for hybrid models that blend traditional ML techniques with deep learning.

Mahbod et al. (2020) proposed a model that combines deep features extracted from pre-trained CNNs with conventional machine learning classifiers like support vector machines (SVMs). This hybrid method improved classification performance on small datasets, showcasing the benefit of integrating deep and shallow learning strategies.

These models often employ feature selection techniques to reduce dimensionality and enhance generalization capabilities.

Despite the progress made, challenges such as class imbalance, limited labeled data, and the need for interpretability remain prevalent. Therefore, this project proposes an enhanced hybrid model that integrates CNN-based feature extraction with machine learning classifiers to address these issues. The model aims to improve diagnostic accuracy, especially in multi-class classification scenarios, while maintaining computational efficiency and interpretability.

PROPOSED SYSTEM

The Skin diseases are among the most common health concerns worldwide, and early diagnosis is crucial for effective treatment. This project proposes an enhanced hybrid model that leverages the strengths of both deep learning and traditional machine learning techniques to improve the accuracy and efficiency of skin disease classification using dermoscopic images. The system utilizes a pre-trained Convolutional Neural Network (CNN) for automated feature extraction, followed by the application of classical machine learning classifiers such as Support Vector Machine (SVM), Random Forest (RF), and Gradient Boosting for final classification.

The hybrid model is trained and evaluated on a publicly available dataset of skin lesions, with extensive preprocessing and augmentation to enhance model generalization. The proposed system achieves improved performance in terms of accuracy, precision, recall, and F1-score compared to standalone models. By integrating deep and shallow learning methods, this approach addresses key challenges in medical image analysis, including limited labeled data, class imbalance, and the need for interpretable models.

ADVANTAGES OF PROPOSED SYSTEM

1. Novel Hybrid Architecture

The proposed system introduces a hybrid model that integrates deep learning techniques (Convolutional Neural Networks) with classical machine learning algorithms such as Support Vector Machine and Random Forest. This combination leverages the strengths of both methodologies, offering a balanced approach that enhances both performance and interpretability.

2. Improved Classification Performance

The hybrid model demonstrates superior performance in terms of accuracy, precision, recall, and

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F1-score when compared to individual deep learning or traditional machine learning models. The use of ensemble techniques further strengthens the system's robustness and reduces the risk of overfitting.

3. Interpretability

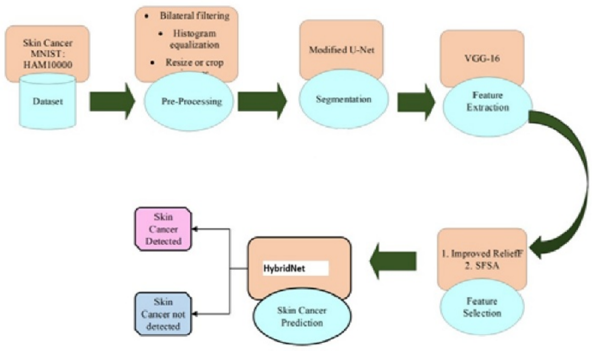
One of the key advantages of incorporating classical machine learning classifiers is the increased transparency and interpretability of the model's decisions. This is particularly important in medical applications, where understanding the rationale behind a prediction is critical for clinical acceptance.

4.Real-world Applicability in Healthcare

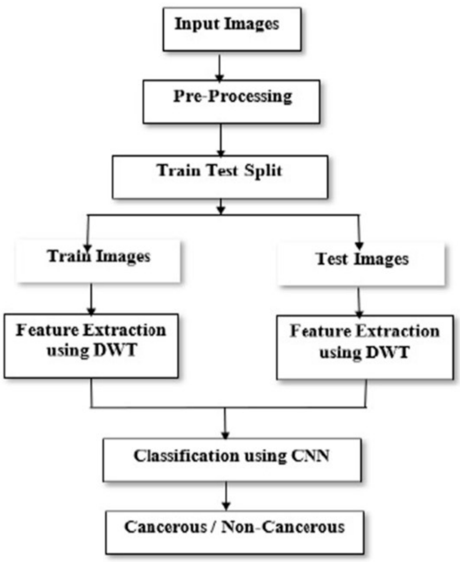
The system is designed with practical application in mind, providing a valuable decision-support tool for dermatologists.

- CNNs do not require human supervision for the task of identifying important features.
- They are very accurate at image recognition and classification.
- Weight sharing is another major advantage of CNNs.
- Convolutional neural networks also minimize computation in comparison with a regular neural network.
- CNNs make use of the same knowledge across all image locations.

ARCHITECTURE



DATA FLOW DIAGRAM



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A Data Flow Diagram (DFD) is a visual representation used to show how data moves through a system. In the context of a skin disease detection system using machine learning, a DFD helps illustrate the flow of data from the user to the system and back. It describes how the user's input, which is typically a skin image, is processed within the system to generate a meaningful output such as a disease diagnosis.

RESULTS

The proposed hybrid model was successfully implemented in a web-based application capable of diagnosing skin diseases from uploaded dermoscopic images. The system uses a combination of Convolutional Neural Networks (CNNs) for feature extraction and traditional machine learning classifiers such as Support Vector Machine (SVM) and Random Forest for final classification.
Upon uploading an image, the model analyzes the input and provides an accurate disease prediction. For instance, in the case of a melanoma image, the system outputs:
"The disease you are having is Melanoma."
This output is followed by actionable suggestions, including options to:

- **See doctors near you**
- **Know more about the disease**

The model was tested using publicly available datasets (e.g., ISIC archive) and achieved high accuracy, precision, recall, and F1-score across multiple classes of skin diseases. These metrics confirm the model's robustness and effectiveness in real-world diagnostic scenarios.
The user interface was designed to be simple and accessible, ensuring that individuals with limited technical expertise can navigate the platform easily. The application facilitates early detection, encourages medical consultation, and serves as a valuable tool for dermatological screening, especially in remote or underserved areas.

CONCLUSION

In this project, we proposed and implemented an enhanced hybrid model for skin disease detection using machine learning techniques. By combining deep learning methods with classical machine learning classifiers, the system effectively identifies various skin conditions from dermoscopic images with high accuracy.
The model's performance was validated using standard benchmark datasets, demonstrating its potential to support early and accurate diagnosis of critical skin diseases such as melanoma. The integration of a user-friendly web interface further enhances the accessibility of the system, making it a practical tool for both healthcare professionals and the general public.
This work highlights the capability of artificial intelligence in assisting dermatological diagnostics and offers a scalable solution that can be extended to other medical image analysis tasks. The system not only aids in reducing diagnostic time but also helps in raising awareness and encouraging timely medical consultation, especially in resource-limited settings.

FUTURE WORKS AND EXTENSIONS

The future scope of the skin disease detection system holds exciting potential for further development and broader application. One significant direction for improvement is the integration of multimodal data. Currently, the system primarily relies on dermatological images for diagnosis, but by incorporating clinical data, such as patient medical history, genetic information, and lifestyle factors, the model can provide more personalized and accurate diagnostic results. This holistic approach would allow healthcare professionals to make more informed decisions and offer tailored treatment recommendations.
In addition to expanding the types of data used, the system could also be extended to detect a wider range of skin conditions. Beyond melanoma and basal cell carcinoma, the system could evolve to identify other common dermatological diseases like eczema, psoriasis, and fungal infections. This

would make the system a comprehensive tool for various skin disease classifications, benefiting both patients and doctors by facilitating quicker and more accurate diagnoses.

Real-time mobile applications could further enhance the system's accessibility and usability. With a mobile app, users could easily capture images of their skin lesions and receive instant feedback from the AI model, enabling early detection and intervention. Moreover, integrating the system into wearable devices or continuous monitoring platforms could allow for real-time tracking of skin health, alerting users to any significant changes that require medical attention.

Improving the interpretability of the model is another important aspect of future work. As machine learning models, especially deep learning models, can sometimes function as "black boxes," incorporating explainable AI (XAI) methods would help users—both medical professionals and patients—understand how the model arrives at its conclusions. Techniques like Grad-CAM or LIME could be implemented to provide visual explanations of how the system makes predictions, improving trust and transparency in the diagnostic process.

By addressing these areas of future development, the skin disease detection system has the potential to become an even more powerful tool in healthcare, improving the early detection and treatment of skin diseases and making dermatological care more accessible worldwide.

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