Human Skin Disease Detection using Machine Learning

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Abstract:

Due to its intricacy, dermatology is one of the most unpredictable and challenging fields to diagnose. To determine the skin condition a patient may be experiencing; numerous testings are frequently required in the field of dermatology. Depending on the practitioner, the duration could change. This is also based on their personal experience. Therefore, a system that can diagnose skin diseases without any of these limitations is needed. We suggest an automated image-based method that uses machine learning classification to identify skin disorders. Based on numerous aspects of the photographs, this system will use computational technique to analyze, process, and relabel the image data. Images of the skin are filtered to remove undesirable

Introduction:

The skin plays a pivotal role in regulating body temperature and shielding against pathogens such as viruses, bacteria, allergens, and fungi. Despite its protective function, a significant portion of the population grapples with various skin issues stemming from diverse underlying causes. Vasculitis, Lupus, Atopic Dermatitis, and Rosacea stand out as some of the most prevalent dermatological conditions, affecting individuals across all age groups. Compounded by shifting environmental factors and lifestyle habits, the incidence rates of skin ailments continue to rise.

Skin disorders encompass a spectrum ranging from chronic ailments to infectious conditions, with potential implications for skin cancer development. Notably, individuals with darker skin tones exhibit a disproportionately higher susceptibility to melanoma compared to their lighter-skinned counterparts. Moreover, the mortality risk associated with specific types of melanomas varies depending on skin tone. Accurate identification of skin lesions is imperative for tailoring effective treatment strategies. However, early-stage diagnosis poses a challenge, particularly given the intricate nature of skin conditions. Melanoma, renowned as the most severe form of skin cancer, underscores the criticality of timely detection and intervention to mitigate metastatic spread.

While fungal and allergic skin diseases are relatively manageable when detected early, viral infections necessitate prompt identification to avert potential complications. Skin ailments may manifest as alterations in skin texture, pigment production, or the presence of microbes, some of which can progress to malignant transformation. Thus, expedient management is paramount to curbing disease progression and minimizing associated morbidity and mortality.

Etiological factors contributing to skin disorders encompass a myriad of biological, physical, environmental, and genetic influences. Variations in skin pigmentation, presence of artifacts, and lesion characteristics pose challenges to accurate imaging and diagnosis. Given the diverse presentation of skin lesions in terms of color, texture, size, and location, lesion recognition remains a complex endeavor.

Recognizing the prolonged symptomatology associated with certain skin diseases, computational disease diagnosis emerges as a promising avenue, offering rapid and precise assessments compared to conventional laboratory techniques. Machine Learning (ML) techniques, widely utilized in various domains such as facial recognition and disease prediction, hold relevance in dermatology. ML algorithms demonstrate efficacy in disease classification and prognostication across a spectrum of conditions including diabetes, cancer, thyroid disorders, and skin diseases. Ensemble Data Mining Methods, leveraging multiple models to enhance prediction accuracy, epitomize the synergy achievable through amalgamating diverse ML approaches.

Literature Survey:

1. Sigurdsson et al. conducted a study in which they employed in vitro Raman spectroscopy to classify skin lesions. Utilizing a nonlinear neural network classifier, they identified unique bands in the spectrum indicative of explicit lipids and proteins, providing valuable diagnostic information.

2. Demyanov et al. adopted deep convolutional neural networks and image classification algorithms with data augmentation to explore automatic detection of dermoscopic patterns and skin lesion analysis.

3. Sumithra et al. proposed an innovative approach for auto segmentation and classification of skin lesions, leveraging support vector machines (SVM) and k-Nearest neighbor algorithm for lesion detection.

4. Lu et al. integrated two-dimensional digital image segmentation and resizing techniques with Markov random field (MRF) to classify smooth pixels, establishing a reliable segmentation methodology.

5. Salimi et al. employed pattern recognition methods to classify different skin diseases, contributing to the development of diagnostic tools in dermatology.

6. Kolkur et al. introduced a novel skin detection algorithm enhancing the identification of skin pixels, incorporating RGB, HSV, and YCbCr color models.

7. Kotian and Deepa investigated an auto-diagnosis system for skin diseases, implementing techniques such as image border identification and feature data mining using MATLAB software.

8. Kumar and Singh focused on relating skin cancer images across different types of neural networks, training and testing a collection of skin cancer images using MATLAB to aid in skin cancer classification.

9. Anurag Kumar Verma et al. utilized ensemble approaches with machine learning algorithms to segment various skin diseases, complemented by feature selection methods for comparative analysis.

10. V.R. Balaji et al. demonstrated the identification and categorization of skin diseases utilizing the dynamic graph cut technique and the Naive Bayes (NB) classifier, showcasing a comprehensive approach to lesion segmentation and disease classification.

11. While significant progress has been made in medical imaging and diagnosis, there remains a need to develop skin monitoring frameworks that are more accurate, cost-effective, and reliable for enhanced patient care and management.

Overview of Skin Disease and Machine learning algorithms:

The field of skin disease diagnosis and classification has seen significant advancements with the integration of machine learning algorithms, particularly in image recognition and classification techniques. Image recognition enables computers to identify visual components within an image, while classification techniques allow for the mapping of instances to predefined classes.

In image recognition, a vast image database is utilized to train the system to recognize emerging image characteristics and parameters. This process involves teaching the computer to perceive various visual elements within the images, such as textures, patterns, and shapes. Subsequently, classification techniques are employed to categorize instances into specific classes based on the learned features.

Two prominent machine learning algorithms currently being updated for the classification of skin diseases are kernel Support Vector Machine (SVM) and Convolutional Neural Network (CNN). SVMs are effective in separating data points into different classes by finding the optimal hyperplane, while CNNs excel in image recognition tasks by extracting hierarchical features through convolutional layers.

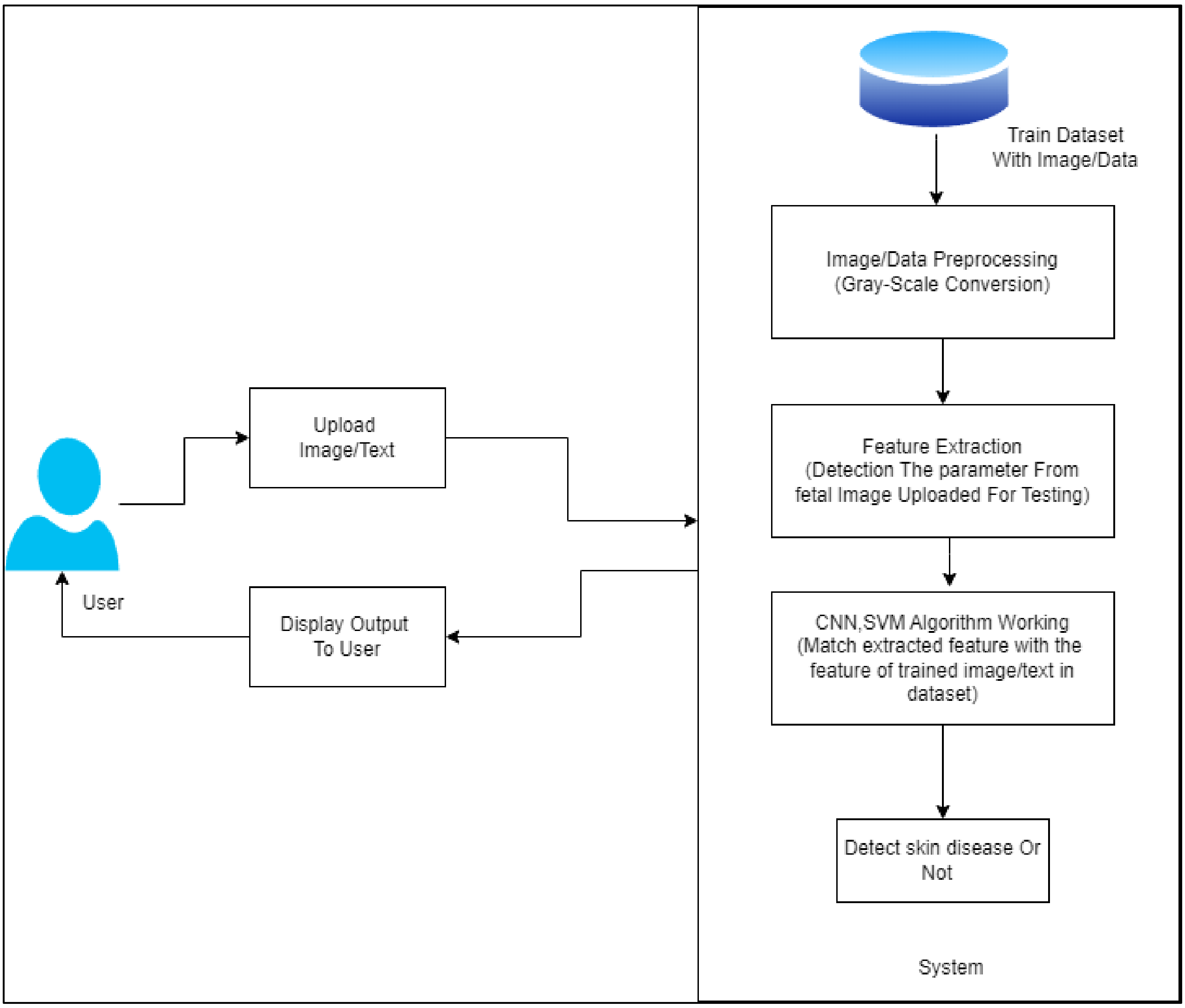
Convolutional Neural Network (CNN) is a deep learning algorithm widely used for image classification and recognition tasks. Unlike traditional neural networks, CNN follows a hierarchical model resembling the structure of a funnel. It consists of multiple layers, including convolutional layers, pooling layers, and fully connected layers. The algorithm takes an input image and assigns weights to different elements within the image, allowing it to discern patterns and features. By processing the output through fully connected layers, CNN can effectively distinguish between various objects or classes present in the image. With its hierarchical architecture and ability to learn complex features directly from raw data, CNN has demonstrated remarkable performance in image classification tasks across diverse domains.

Support Vector Machine (SVM) is a powerful machine learning algorithm used for classification tasks. It categorizes the training data as points in space by establishing a clear and wide gap between different classes. Subsequently, input data is mapped into the same space, and predictions are made to classify the data into specific classes based on which side of the gap they fall. SVM is particularly effective in high-dimensional spaces and demonstrates efficiency by utilizing a subset of training points in the decision function, thereby saving memory. The algorithm leverages support vectors, which are highlighted pixels that aid in creating the boundaries between different classes. Additionally, SVM employs kernel functions to define higher-dimensional spaces, enabling effective classification even in complex datasets.

Machine learning, as a subset of Artificial Intelligence (AI), enables systems to learn from data without explicit programming. This innovation has paved the way for the development of self-learning computer programs that continually improve from their own experiences. Machine learning finds application in various domains, including medical diagnosis, image processing, prediction, classification, association learning, regression, and more.

Within the realm of skin disease diagnosis, the implementation of machine learning techniques offers promising opportunities for enhancing accuracy and efficiency. By leveraging image recognition and classification algorithms, researchers and healthcare professionals can improve diagnostic accuracy, facilitate early detection, and optimize treatment strategies for various skin conditions.

Architecture:



Conclusion and future scope:

The detection of skin diseases stands as a significant challenge within the medical industry, yet holds the potential for successful treatment and recovery if diagnosed early. Extensive literature review highlights various techniques employed for observing different skin diseases. However, there remains a crucial need to classify these diseases at their nascent stages. Machine learning (ML) algorithms offer a promising avenue for early detection, enabling real-time adjustments and interventions. Proper implementation of these techniques can furnish invaluable support and a unified approach to preventing skin problems, thereby facilitating timely treatment for patients under the guidance of healthcare professionals.

While research and implementation of limited medical information are currently accessible, the future holds the promise of leveraging real-time data to delve deeper into skin disease detection, aided by recent advancements in artificial intelligence (AI). By harnessing the benefits of AI-assisted diagnosis, the landscape of skin disease detection can be revolutionized, offering enhanced accuracy and efficiency in diagnosis and classification.

In this study, we presented a novel approach utilizing ML algorithms for skin disease classification, leveraging the

HAM 10000 skin disease dataset. Employing grayscale conversion and feature extraction techniques, we optimized the performance of applied ML classifiers. Specifically, we explored two distinct ML algorithms: Convolutional Neural Networks (CNN) and Support Vector Machines (SVM), comparing their performance to ascertain the most effective algorithms for skin disease classification.

Our results demonstrate the efficacy of our approach in effectively classifying various types of skin infections, including melanoma, Vasculitis, nail fungus, lupus and connective tissue diseases, atopic dermatitis, acne, and rosacea. Notably, our CNN algorithm achieved an accuracy of 99.05% , surpassing that of traditional SVM algorithms. Through the integration of ensemble techniques and ML algorithms, our model exhibited heightened accuracy compared to traditional methods, underscoring its effectiveness in classifying diverse skin diseases.

Looking ahead, the continual advancement of ML techniques coupled with the availability of real-time medical data holds immense promise for the future of skin disease detection. By further refining our models and leveraging emerging technologies, we can strive towards a future where early detection and intervention for skin diseases are not only feasible but also highly accurate and accessible to all.

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