JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

A COMPREHENSIVE STUDY OF DISEASE DETECTION USING IMAGE PROCESSING AND MACHINE LEARNING

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Abstract: Skin diseases are prevalent and can have a significant impact on individuals' health and well-being. Timely and accurate detection of skin diseases is essential for effective treatment and preventing complications. In recent years, researchers have been exploring the integration of image processing and machine learning techniques to develop advanced systems for skin disease detection and classification. This paper presents a comprehensive review of the existing literature on skin disease detection methods, focusing on the use of image processing and machine learning technologies. Various studies involving image segmentation, feature extraction, and classification algorithms are examined. The proposed methodology aims to improve diagnostic accuracy, particularly in remote areas with limited access to healthcare facilities. The integration of image processing and machine learning techniques enables precise disease identification and timely medical interventions, providing a promising approach for non-invasive and contactless disease detection. The findings highlight the potential for further advancements in teledermatology and remote healthcare access, as well as the need for developing hybrid algorithms to address the challenges of multi-type skin disease identification.
Keywords— Teledermatology, Skin Disease, acne, eczema, psoriasis, classification.

1. Introduction:

The human skin is the body's largest organ, providing protection against external threats and maintaining the body's overall integrity. Despite its resilience, the skin is susceptible to various diseases caused by external and genetic factors. Detecting and diagnosing skin diseases accurately is crucial for timely treatment and preventing potential complications. To enhance diagnostic accuracy and broaden the application range of skin imaging, researchers have turned to non-invasive imaging technologies coupled with artificial intelligence. This paper explores a method of skin disease detection using image processing and machine learning. By combining skin imaging with AI technologies, researchers have developed a powerful tool for disease diagnosis, treatment follow-up, and surgical boundary determination. The proposed method aims to improve diagnostic accuracy, particularly in remote areas with limited access to healthcare facilities.

Diagnosing skin diseases accurately can be challenging, as many conclusions are based on doctors' experience and subjective judgments. This approach can lead to errors and delays in treatment. To address these challenges, the article proposes a methodology that uses image processing and machine learning techniques to identify various skin diseases accurately.

1.2 Related Work:

The article cites several studies on skin disease detection using different methodologies. Some of the methods mentioned include:

- Detecting chickenpox vesicles using image processing techniques.
- Classifying skin diseases using a backpropagation neural network based on GLCM features.

- Using region growing and SVM-KNN hybrid methods for classifying skin diseases.
- Developing a smartphone-based system using the Grabcut algorithm and SVM for skin disease classification.
- Utilizing rough-set based feature selection for skin disease classification.
- Employing adaptive snake method and genetic algorithm with SVM for classification.

Literature Review:

Skin diseases are prevalent worldwide and can have a significant impact on individuals' health and quality of life. The accurate and timely detection of skin diseases is crucial for effective treatment and prevention of complications. In recent years, researchers have focused on integrating image processing and machine learning techniques to develop advanced systems for skin disease detection and classification.

1. Oyola and Arroyo [1] proposed a method for detecting chickenpox vesicles using image processing techniques such as color transformation, equalization, and edge detection. The image of varicella was collected and classified using the Hough transform. The study demonstrated improved diagnostic accuracy for varicella detection.
2. Goel et al. [2] developed a real-time embedded system for classifying skin diseases such as melanoma, basal cell carcinoma, actinic keratosis, and squamous cell carcinoma using a backpropagation neural network (BPNN). The system achieved an accuracy rate of 95.83% by using gray-level co-occurrence matrix (GLCM) features.
3. Sumithra et al. [3] proposed a system that used a region-growing method for image segmentation and SVM-KNN hybrid method for classifying skin diseases such as melanoma, bullae, seborrheic keratosis, shingles, and squamous cells. The system achieved an impressive accuracy of 98%.
4. Taufiq et al. [4] described a smartphone-based system for real-time image segmentation using the Grabcut algorithm. The system used the histogram-based ABCD rule for feature extraction and SVM for classifying skin diseases. The sensitivity and specificity rates were 80% and 75%, respectively.
5. Lahijanian et al. [5] used a rough-set based feature selection algorithm to extract features for classifying skin diseases such as psoriasis, seborrheic dermatitis, lichen planus, pityriasis rosea, chronic dermatitis, and pityriasis rubra pilaris. The system achieved an accuracy of about 97%.
6. Tan et al. [6] proposed an intelligent decision support system that used the adaptive snake method for image segmentation and genetic algorithm with radial basis function (RBF) based support vector machine (SVM) for feature extraction and classification. The study emphasized the need for a hybrid approach to improve efficiency.
7. Alquran et al. [7] developed a feature extraction method employing the Otsu thresholding method for segmentation and PCA algorithm for classification. The SVM was used to classify skin diseases with a system accuracy of 92.10%. The study suggested the potential for employing a hybrid classification algorithm to further improve accuracy.
8. Victor et al. [8] used an active contour-based marker control watershed algorithm for image segmentation and statistical GLCM features for classification using SVM. The system achieved an accuracy rate of 94%.
9. Ajith et al. [9] proposed a mobile-based feature extraction algorithm based on DCT, DWT, and singular value decomposition (SVD). The study emphasized the need for an efficient hybrid segmentation or classification algorithm to enhance system performance.
10. Abdulbaki et al. [10] proposed a cloud computing-based skin disease detection system using the Canny edge detection (CED) algorithm for efficient boundary detection and genetic algorithm with BPNN for classification. The system aimed to detect various eczema-like skin diseases.
11. Priya et al. [11] employed the bottom-hat filter for segmentation and the Otsu thresholding method along with morphological operations for classifying skin diseases as benign, suspicious, or malignant melanoma.
12. Hameed et al. [12] developed an automated system for skin lesion segmentation using various color models, GLCM, and NGTDM. The SVM (quadratic kernel) was used for classifying skin diseases such as acne, eczema, psoriasis, benign, and malignant melanoma.
13. Arasi et al. [13] proposed a system using DWT for texture analysis and PCA to reduce the number of features. The Naive Bayes classifier was used for classifying skin diseases with an accuracy rate of 98.8%.

14. Ahmad et al. [14] employed a hybrid intelligent ACO-GA algorithm for image segmentation, and GLCM and TSVM algorithms for feature extraction and classification. The system achieved an overall accuracy rate of 95%.

The literature review reveals a growing interest in image processing and machine learning techniques for skin disease detection and classification. These studies demonstrate promising results in terms of accuracy and efficiency, laying the foundation for further advancements in teledermatology and remote healthcare access. However, there is still room for improvement, particularly in developing hybrid algorithms to address the challenges of multi-type skin disease identification.

METHODOLOGY:

The primary objective of the research is to implement a skin disease diagnosis system that assists users in detecting human skin diseases and providing timely medical treatments. The proposed system utilizes image processing and data mining technologies for disease detection, segmentation, feature extraction, and classification. By integrating these techniques, the system aims to identify various skin diseases accurately and recommend appropriate treatments to users.

The proposed methodology involves the following major steps:

1. Image Acquisition: Various skin disease lesion images are collected and used as input for further processing.
2. Image Preprocessing: The acquired images undergo preprocessing techniques for noise removal and enhancement, including intensity transformation and histogram equalization.
3. Image Segmentation: Color image segmentation is performed to separate objects falling within specific color ranges using the Mahalanobis distance measure.
4. Feature Extraction: Texture analysis and statistical approaches are used for feature extraction, including mean RGB component values.
5. Classification Model: Machine learning algorithms like SVM, TSVM, and Naive Bayes are employed for classifying skin diseases based on the extracted features.
6. Skin Disease Prediction: The system predicts the type of skin disease based on the classification results and provides recommendations for appropriate medical treatments.

Conclusion:

In conclusion, the proposed methodology of skin disease detection using image processing and machine learning shows promise for accurate and accessible diagnosis. By leveraging modern technologies, this approach can benefit individuals in remote areas with limited access to healthcare facilities. The integration of image processing and machine learning techniques enables precise disease identification and timely medical interventions. Further research and development in this field can lead to more efficient and effective skin disease diagnosis and treatment methods.

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