Literature Survey

AI-based localization and classification of skin disease with erythema

1. **S. Ayyappan, "Performance Analysis on Dermoscopic Images for Enhancing the Diagnostic Support System in Healthcare," 2021 5th International Conference on Trends in Electronics and Informatics (ICOEI), 2021, pp. 1157-1161, doi: 10.1109/ICOEI51242.2021.9452860.**

Diagnostic support system plays a significant role in detecting skin cancer. Skin cancers cases are often misdiagnosed due to lack of experience and knowledge of different skin lesion types. Exploring the role of image processing in computer aided diagnosis system. To detect quantification of vascular structures towards skin lesions diagnosis. By taking a dermoscopic image split out the formation of the lesion by initially using independent component analysis into melanin and haemoglobin regions. Haemoglobin component is then clustered into three regions. Shaping filters are also used to erythema region for finding various measures. Hence, a vessel mask is created from global thresholding.12 vascular features are extracted towards lesion diagnosis fed into a classifier and achieves 94.1% accuracy. The proposed technique provides better accuracy and well suited for decision making in diagnostic support system.

2. **Z. Wu et al., "Studies on Different CNN Algorithms for Face Skin Disease Classification Based on Clinical Images," in IEEE Access, vol. 7, pp. 66505-66511, 2019, doi: 10.1109/ACCESS.2019.2918221.**

Skin problems not only injure physical health but also induce psychological problems, especially for patients whose faces have been damaged or even disfigured. Using smart devices, most of the people are able to obtain convenient clinical images of their face skin condition. On the other hand, the convolutional neural networks (CNNs) have achieved near or even better performance than human beings in the imaging field. Therefore, this paper studied different CNN algorithms for face skin disease classification based on the clinical images. First, from Xiangya–Derm, which is, to the best of our knowledge, China’s largest clinical image dataset of skin diseases, we established a dataset that contains 2656 face images belonging to six common skin diseases [seborrheic keratosis (SK), actinic keratosis (AK), rosacea (ROS), lupus erythematosus (LE), basal cell

carcinoma (BCC), and squamous cell carcinoma (SCC)]. We performed studies using five mainstream network algorithms to classify these diseases in the dataset and compared the results. Then, we performed studies using an independent dataset of the same disease types, but from other body parts, to perform transfer learning on our models. Comparing the performances, the models that used transfer learning achieved a higher average precision and recall for almost all structures. In the test dataset, which included 388 facial images, the best model achieved 92.9%, 89.2%, and 84.3% recalls for the LE, BCC, and SK, respectively, and the mean recall and precision reached 77.0% and 70.8%.

3. **L. -F. Li, X. Wang, W. -J. Hu, N. N. Xiong, Y. -X. Du and B. -S. Li, "Deep Learning in Skin Disease Image Recognition: A Review," in IEEE Access, vol. 8, pp. 208264-208280, 2020, doi: 10.1109/ACCESS.2020.3037258.**

The application of deep learning methods to diagnose diseases has become a new research topic in the medical field. In the field of medicine, skin disease is one of the most common diseases, and its visual representation is more prominent compared with the other types of diseases. Accordingly, the use of deep learning methods for skin disease image recognition is of great significance and has attracted the attention of researchers. In this study, we review 45 research efforts on the identification of skin disease by using deep learning technology since 2016. We analyze these studies from the aspects of disease type, data set, data processing technology, data augmentation technology, model for skin disease image recognition, deep learning framework, evaluation indicators, and model performance. Moreover, we summarize the traditional and machine learning-based skin disease diagnosis and treatment methods. We also analyze the current progress in this field and predict four directions that may become the research topic in the future. Our results show that the skin disease image recognition method based on deep learning is better than those of dermatologists and other computer-aided treatment methods in skin disease diagnosis, especially the multi deep learning model fusion method has the best recognition effect.

4. **A.Mohanty, A. Sutherland, M. Bezbradica and H. Javidnia, "Skin Disease Analysis With Limited Data in Particular Rosacea: A Review and Recommended Framework," in *IEEE Access*, vol. 10, pp. 39045-39068, 2022, doi: 10.1109/ACCESS.2022.3165574.**

Recently, the rapid advancements in Deep Learning and Computer Vision technologies have introduced a new and exciting era in the field of skin disease analysis. However, there are certain challenges in the roadmap towards developing such technologies for real-life applications that must be investigated. This study considers one of the key challenges in data acquisition and computation, viz. data scarcity. Data scarcity is a central problem in acquiring medical images and applying machine learning techniques to train Convolutional Neural Networks for disease diagnosis. The main objective of this study is to explore the possible methods to deal with the data scarcity problem and to improve diagnosis with small datasets. The challenges in data acquisition for a few lamentably neglected skin conditions such as rosacea are an excellent instance to explore the possibilities of improving computer-aided skin disease diagnosis. With data scarcity in mind, the possible techniques explored and discussed include Generative Adversarial Networks, Meta-Learning, Few-Shot classification, and 3D face modelling. Furthermore, the existing studies are discussed based on skin conditions considered, data volume and implementation choices. Some future research directions are recommended.

5. **B. Ahmad, M. Usama, C. -M. Huang, K. Hwang, M. S. Hossain and G. Muhammad, "Discriminative Feature Learning for Skin Disease Classification Using Deep Convolutional Neural Network," in *IEEE Access*, vol. 8, pp. 39025-39033, 2020, doi: 10.1109/ACCESS.2020.2975198.**

Nowadays, skin disease among humans has been a common disease, especially in America millions of people are suffering from various kinds of skin disease. Usually, these diseases have hidden dangers which lead to human not only lack of self-confidence and psychological depression but also a risk of skin cancer. Diagnosis of these kinds of diseases usually required medical experts with high-level instruments due to a lack of visual resolution in skin disease images. Moreover, manual diagnosis of skin disease is often subjective, time-consuming, and required more human effort. Thus, there is a need to develop a computer-aided system that automatically diagnoses the skin disease

problem. Moreover, most of the existing works in skin disease used convolutional neural networks (CNN) with classical loss functions, which limit the model to learn discriminative features from skin images. Thus to address the above mention problem we proposed a new framework by fine-tuning layers of ResNet152 and InceptionResNet-V2 models with a triplet loss function. In the proposed framework, first, we learning the embedding from input images into Euclidean space by using deep CNN ResNet152 and InceptionResNet-V2 model. Second, we compute L-2 distance among corresponding images from euclidean space to learn discriminative features of skin disease images by using triplet loss function. Finally, classify the input images using these L-2 distances. Human face skin disease images used in the proposed framework are acquired from the Hospital in Wuhan China. Experiment results and their analysis shows the effectiveness of the proposed framework which achieve better accuracy than many existing works in skin disease tasks.

6 M. Sadeghi, T. K. Lee, D. McLean, H. Lui and M. S. Atkins, "Detection and Analysis of Irregular Streaks in Dermoscopic Images of Skin Lesions," in IEEE Transactions on Medical Imaging, vol. 32, no. 5, pp. 849-861, May 2013, doi: 10.1109/TMI.2013.2239307.

Irregular streaks are important clues for Melanoma (a potentially fatal form of skin cancer) diagnosis using dermoscopy images. This paper extends our previous algorithm to identify the absence or presence of streaks in a skin lesions, by further analyzing the appearance of detected streak lines, and performing a three-way classification for streaks, Absent, Regular, and Irregular, in a pigmented skin lesion. In addition, the directional pattern of detected lines is analyzed to extract their orientation features in order to detect the underlying pattern. The method uses a graphical representation to model the geometric pattern of valid streaks and the distribution and coverage of the structure. Using these proposed features of the valid streaks along with the color and texture features of the entire lesion, an accuracy of 76.1% and weighted average area under ROC curve (AUC) of 85% is achieved for classifying dermoscopy images into streaks Absent, Regular, or Irregular on 945 images compiled from atlases and the internet without any exclusion criteria. This challenging dataset is the largest validation dataset for streaks detection and classification published to date. The data set has also been applied to the two-class sub-problems of Absent/Present classification (accuracy of 78.3% with AUC of 83.2%) and to Regular/Irregular classification (accuracy 83.6% with AUC of 88.9%).

When the method was tested on a cleaned subset of 300 images randomly selected from the 945 images, the AUC increased to 91.8%, 93.2% and 90.9% for the Absent/Regular/Irregular, Absent/Present, and Regular/Irregular problems, respectively.

7 **Mirbeik-Sabzevari, E. Oppelaar, R. Ashinoff and N. Tavassolian, "High-Contrast, Low-Cost, 3-D Visualization of Skin Cancer Using Ultra-High-Resolution Millimeter-Wave Imaging," in IEEE Transactions on Medical Imaging, vol. 38, no. 9, pp. 2188-2197, Sept. 2019, doi: 10.1109/TMI.2019.2902600.**

The goal of this paper is to develop a new skin imaging modality which addresses the current clinical need for a non-invasive imaging tool that images the skin over its depth with high resolutions while offering large histopathological-like contrasts between malignant and normal tissues. We demonstrate that by taking advantage of the intrinsic millimeter-wave dielectric contrasts between normal and malignant skin tissues, ultra-high-resolution millimeter-wave imaging (MMWI) can achieve 3-D, high-contrast images of the skin. In this paper, an imaging system with a record-wide bandwidth of 98 GHz is developed using the synthetic ultra-wideband millimeter-wave imaging approach, a new ultra-high-resolution imaging technique recently developed by the authors. The 21 non-melanoma skin cancer (NMSC) specimens are imaged and compared with histopathology for evaluation. A programmable measurement platform is designed to automatically scan the tissues across a rectangular aperture plane. Furthermore, a novel frequency-domain imaging algorithm is developed to process the recorded signals and generate an image of the cancerous tissue. The high correlations achieved between MMWI images and histological images allow for rapid and accurate delineation of NMSC tissues. The millimeter-wave reflectivity values are also found to be statistically significant higher for cancerous areas with respect to normal areas. Since MMWI does not require tissue processing or staining, it can be performed promptly, enabling diagnosis of tumors at an early stage as well as simplify the tumor removal surgery to a single-layer excision procedure.

8 **Z. Wu et al., "Studies on Different CNN Algorithms for Face Skin Disease Classification Based on Clinical Images," in IEEE Access, vol. 7, pp. 66505-66511, 2019, doi: 10.1109/ACCESS.2019.2918221.**

Skin problems not only injure physical health but also induce psychological problems, especially for patients whose faces have been damaged or even disfigured. Using smart devices, most of the people are able to obtain convenient clinical images of their face skin condition. On the other hand, the convolutional neural networks (CNNs) have achieved near or even better performance than human beings in the imaging field. Therefore, this paper studied different CNN algorithms for face skin disease classification based on the clinical images. First, from Xiangya–Derm, which is, to the best of our knowledge, China's largest clinical image dataset of skin diseases, we established a dataset that contains 2656 face images belonging to six common skin diseases [seborrheic keratosis (SK), actinic keratosis (AK), rosacea (ROS), lupus erythematosus (LE), basal cell carcinoma (BCC), and squamous cell carcinoma (SCC)]. We performed studies using five mainstream network algorithms to classify these diseases in the dataset and compared the results. Then, we performed studies using an independent dataset of the same disease types, but from other body parts, to perform transfer learning on our models. Comparing the performances, the models that used transfer learning achieved a higher average precision and recall for almost all structures. In the test dataset, which included 388 facial images, the best model achieved 92.9%, 89.2%, and 84.3% recalls for the LE, BCC, and SK, respectively, and the mean recall and precision reached 77.0% and 70.8%.