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A Survey on Deep Learning Techniques for Skin Lesion Classification

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Abstract

Skin problems are common in day-to-day living. Skin lesions cause patients to be emotionally and psychologically burdened, which may be worse than the physical disorders. Skin lesions must be detected early to receive effective treatment. The diagnostic method must be precise and performed within a reasonable time. Many skin lesions look similar, which increases the potential of human error when classifying them. Deep learning's use in disease diagnosis has been a key focus of dermatological research. Skin lesion classification based on deep learning aids in the automatic skin lesion classification by dermoscopy, removing errors caused by naked eye inspection. The goal of this paper is to provide a quick survey on deep learning based skin lesions categorization, and outline the features of skin lesions. The essential stages of skin lesions and elements that affect dermatological diagnosis are reviewed, and the current difficulties and prospects of classification are discussed. The findings suggest that a deep learning-based skin lesion detection technique may beat expert dermatologists in some scenarios, and that there is a lot of room for further study.

Keywords: Dermoscopy, Deep Learning, Skin lesion classification

1. Introduction

The skin weighing 3.6 kg and covering 2 m^2 in adults forms the largest organ of human body. The skin protects the body from temperature extremes, harsh sunlight, and toxic substances. The epidermis, dermis, and hypodermis make up this highly structured tissue, which provides protection, sensibility. The skin's outermost layer serves as an efficient barrier against external aggression. The connective tissue, hair follicles, and sweat glands are found under the epidermis, resulting in the variation in skin texture. Physical elements such

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as light, temperature, and friction, as well as biological factors can all contribute to skin diseases. The skin tone variation, hair, insufficient lighting, and the location of the lesion can all complicate lesion imaging. Furthermore, most lesions differ in colour, shape, size, texture, and placement within an imaging frame.

The high expense of treatment, recurrent disease, and treatment delays have created obstacles to healthy survival and social growth. Accurately diagnosing a skin illness might be difficult for a variety of reasons. To begin with, there are many different types of dermatoses, with almost 3000 documented in the literature. With a fresh dermatologist-labelled dataset of 129450 clinical photos is separated into 2032 categories. Second, clinicians have a significant hurdle due to the disease's complicated expression. Because there might be similarity between different skin illnesses, which can be confused without extensive experience, morphological distinctions in skin lesions appearance have a direct impact on diagnosis. Finally, lesions for various skin illnesses might be too similar to differentiate using simply visual information.

Skin diseases are long-term and can sometimes progress to cancerous tissues. Skin illnesses must be treated as soon as possible to prevent their spread and progression. Procedures based on imaging technology to determine the impact of various skin disorders are currently in high demand. Several skin illnesses have symptoms that may need a significant amount of work to treat since they might grow for months before being recognised. Due to concentration on standardised activities such as dermoscopy, which is the non-invasive evaluation of skin surface, previous work in computer-based categorization has reduced medical specialists' generalisation power. Through computer-aided diagnosis, it is feasible to diagnose skin disorders and prescribe medicine based on the symptoms of patients swiftly and accurately.

The skin illnesses occurs in a variety of forms, resulting in reduced and imbalanced availability of skilled dermatologists, and hence data-driven diagnostics is need for quick and accurate diagnosis of skin lesions. Skin disorders now are diagnosed more rapidly and precisely because of recent advancements in laser based medical technologies but the cost is currently restricted and high. Because of its capacity to execute rapid and accurate evaluations, deep learning affects the roles of image specialists in biomedical diagnosis. In this work, the characteristics of skin lesions are presented, as well as an overview of image approaches, a generalisation of deep learning techniques for skin disease classification, and a discussion of the limitations and future directions of automatic skin lesion diagnosis is done.

2. Literature Survey

Cascinelli et al., [1] studied clinical diagnosis of malignant melanoma using dermoscopy for the first time. On twenty colour slides, two linked computers (IBM 7350/4361) analysed cutaneous melanoma pictures. Each colour slide was scanned using a 25 X 25 micron spatial reduction. Theoretically, having an objective procedure that is simple to standardise and dependably reproducible if there is the ability to study features that are not found during naked eye examination. If that same method is applied to assess the histologic features of the lesions, it will be possible to make considerably more nuanced clinicopathologic correlations. The method must be enhanced on a technological level, with the use of a digital television camera and the creation of new computer programmes that can operate on a compact computer, to reduce the acquisition time of the digitised pictures. A sufficient clinical trial as well as an evaluation of the sensitivity and specificity of the system is required.

In [2], Ganster et al., extracted shape and radiometric features which improved the early detection of malignant melanoma from ELM, a technique for computerised analysis of pictures has been created. The skin lesion data taken consists of handheld 5393 skin lesion images. Several fundamental segmentation algorithms are used to obtain the mask of the skin lesion as a first stage. To define the malignancy of a lesion, a collection of characteristics is computed that includes shape and radiometric features. Statistical feature subset selection techniques are then used to choose significant features from this collection. The final kNN classification had an 87 percent sensitivity and a 92 percent specificity and used K-Nearest Neighbour classification which gave an improved sensitivity and specificity. The use of new good parameters describing lesion boundary and texture descriptors has to be included in the feature set for more accuracy.

K. He et al., [3] presented a ResNet based framework that demonstrates that residual structures are easy to tune and can give improved accuracy with increased depths of layers. With the number of layers being 152 which is 8 times the number of layers in VGG -16, the framework won ILSVRC 2015 classification task. Its entries to the ILSVRC& COCO 2015 competitions were built on deep residual nets, and placed first in the tasks of detection, localization, and segmentation. But for very deep networks more than 1000 layers, the training error still increased which needs to be addressed.

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Zhou et al., [4] proposed a nested residual based on CNN with transfer learning. The dataset consists of 28,653 dermoscopic images. It includes various kinds of skin diseases taken from 4748 patients. Among which 11,566 images consisting of skin diseases- nevus, seborrheic keratois, psoriasis, seborrheic dermatitis, eczema, basal cell carcinoma was considered. The experiments were conducted on lesion. The method also outperformed the four state of art architectures. But the classification accuracy was still average.

Dorj et al., [5] addressed the need for an intelligent classification system based on deep convolutional neural network for skin lesions. The RGB images were collected from the internet, cropped in order to reduce the noise. AlexNet was used to extract features and a ECOC based SVM classifier for the classification of 3753 images of skin cancer giving maximum values average accuracy, sensitivity, specificity to squamous cell carcinoma, actinic keratosis, squamous cell carcinoma, respectively. Minimum values of the average in these measures are basal cell carcinoma, Squamous cell carcinoma, and melanoma respectively. The drawback was that squamous cell carcinoma was not clearly classified.

Celebi et al., [8] used the Euclidean distance transform for the colour and texture related features extraction. Two digital dermoscopy atlases yielded a total of 567 digital dermoscopy pictures. The first batch and second batch of pictures was obtained from different hospitals across the world. True-colour photos with a resolution of 768 x 512 pixels were used. The feature data ranking was done by feeding it into an optimization framework using multiple algorithms for feature selection. The experiments yielded improved specificity and sensitivity. But here for achieving better training and testing for the developed algorithms, the image set should be expanded as much as possible.

F.Y. Xie et al., [9] used self-generating neural network and neural network ensemble model together to classify the melanocytic tumours as benign or malignant. It began by identifying lesion descriptive features and new lesion boundary traits. Also, new border features are presented that may accurately define border abnormalities on both full and partial lesions. To boost the performance, a network ensemble model was proposed. Experiments were carried out on images of xanthous and Caucasian races resulted in enhanced classification accuracy. The feature extraction and reduction were verified and classification performance was tested by comparing the model with various deep learning models. This model particularly worked for differentiating deadly skin lesion from benign skin lesion which shall be extended in the future.

Kittipat Sriwong et al., [10] presented three kinds of the learning models namely, transfer learning with the existing AlexNet architecture (called AlexNet-TL), SVM modelling from feature extraction data of image (FESVM), and SVM modelling from feature extraction data of image and patient data (FESVM+PD: Type I, II, III) for the classification of skin diseases. The experiment was performed on HAM10000 dataset which showed that the method takes into account the patient's background knowledge in the modelling phase and improved the accuracy.

Nazia Hameed et al.,[16] implemented a hybrid approach that uses CNN and error correcting output codes based support vector machine. The approach was intended to categorise dermoscopy images into five categories: healthy, acne, eczema, benign, or malignant melanoma. The features were extracted using AlexNet, and the hybrid model was utilised for classification. The total accuracy attained with ECOC SVM is 86.21 percent. To minimise overfitting, a 10-fold cross validation procedure was applied. The findings show that characteristics extracted from CNN can improve the performance of skin lesion classification.

3. Conclusion

The potential advantages of deep learning methods for skin disease classification are enormous, and there is an unrivalled use in terms of minimising dermatologists' repetitious work. There is a growing need for more reliable and automatic system for the detection and classification of skin lesions. This also can help in the process of diagnosis for both professional and entry level medical experts. Deep learning is a broad topic that needs a broad understanding of engineering, information, computer science, and medicine. Deep learning is undergoing rapid growth because of the disciplines' continuous development, and it has drawn the interest of several nations. Deep learning methods in the detection of skin illness are clearly a feasible approach in the foreseeable future, due to the increasing inexpensive ways, software that may swiftly collect and effectively process huge data, and hardware that can provide automation.

References

[1] N. Cascinelli, M. Ferrario, T. Tonelli, et al., "A possible new tool for clinical diagnosis of melanoma: the computer," Journal of the American Academy of Dermatology, vol. 16, no. 2, pp. 361-367, 1987

[2] H. Ganster, A. Pinz, R. Rohrer, et al., “Automated melanoma recognition,” IEEE Transactions on Medical Imaging, vol. 20, no. 3, pp. 233- 239, 2001

[3] K. He, X. Zhang, S. Ren, et al., “Deep Residual Learning for Image Recognition,” Computer Vision and Pattern Recognition, pp. 770-778, 2016

[4] Zhou, Hangning, and FengyingXie, et al., “Multi-Classification of Skin Diseases for Dermoscopy Images Using Deep Learning,” 2017 IEEE international conference on imaging systems and techniques, Beijing,China,18-20 Oct. 2017

[5] Dorj, UO., Lee, KK., Choi, JY. et al. ”The skin cancer classification using deep convolutional neural network”,Multimed Tools Appl 77, 9909–9924 ,2018

[6] Brinker T, Hekler A, et al., “Skin Cancer Classification Using Convolutional Neural Networks: Systematic Review” , J Med Internet Res ,2018

[7] A.J. Sober , J.M. Burstein. “Computerized digital image analysis: an aid for melanoma diagnosis–preliminary investigations and brief review,” Journal of Dermatology, vol. 21, no. 11, pp. 885-890, 1994

[8] M.E. Celebi, H.A. Kingravi, B. Uddin, et al., “A methodological approach to the classification of dermoscopy images,” Computerized Medical Imaging and Graphics, vol. 31, no. 6, pp. 362-373, 2007

[9] F.Y. Xie, H. Fan, L. Yang, et al., “Melanoma Classification on Dermoscopy Images using a Neural Network Ensemble Model,” IEEE Transactions on Medical Imaging, no. 99, pp.1-1, 2016

[10] Sriwong, Kittipat, et al. "Dermatological classification using deep learning of skin image and patient background knowledge." International Journal of Machine Learning and Computing, vol. 11, no. 6,pp. 862-867,2019

[11] Goceri, Evgin. "Skin disease diagnosis from photographs using deep learning."In ECCOMAS thematic conference on computational vision and medical image processing, pp. 239-246.Springer, Cham, 2019.

[12] Tanaka, Masaya, et al. "Classification of large-scale image database of various skin diseases using deep learning." International Journal of Computer Assisted Radiology and Surgery ,16.11 (2021): 1875-1887.

[13] Srinivasu, Parvathaneni Naga, JalluriGnanaSivaSai, Muhammad FazalIjaz, Akash Kumar Bhoi, Wonjoon Kim, and James Jin Kang. "Classification of skin disease using deep learning neural networks with MobileNet V2 and LSTM." Sensors 21, no. 8 (2021): 2852.

[14] Simonyan, Karen, and Andrew Zisserman. "Very deep convolutional networks for

large-scale image recognition." arXiv preprint arXiv:1409.1556 (2014).

[15] Krizhevsky, Alex, IlyaSutskever, and Geoffrey E. Hinton. "ImageNet classification with deep convolutional neural networks." Communications of the ACM 60.6 (2017): 84-90.

[16] N. Hameed, A. M. Shabut and M. A. Hossain, "Multi-Class Skin Diseases Classification Using Deep Convolutional Neural Network and Support Vector Machine," 2018 12th International Conference on Software, Knowledge, Information Management & Applications (SKIMA), 2018, pp. 1-7, doi: 10.1109/SKIMA.2018.8631525.

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