iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 12 **Issue:** III **Month of publication:** March 2024

DOI: https://doi.org/10.22214/ijraset.2024.59286

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 12 Issue III Mar 2024- Available at www.ijraset.com

Review of Machine Learning Techniques based Skin Microstructure Segmentation and Aging Classification

Farheen Sultan[1], Prof. Navneet Kaur[2]
[1]MTech, Scholar, [2]Associate Professor, Department of Electronics and Communication Engineering, Sagar Institute of Research and Technology, Bhopal, India

Abstract: Advancements in computer vision and image processing have fueled a growing interest in understanding the intricate details of skin microstructure for various applications, particularly in the context of aging. This review systematically examines recent developments in skin microstructure segmentation and aging classification methodologies, shedding light on the evolving landscape of research in this domain. Skin aging is a complex process characterized by various morphological and topological changes in the skin microstructure. Analyzing these changes can provide valuable insights into skin health and aging progression. This paper focuses on recent research advancements in skin microstructure segmentation and aging classification using convolutional neural network (CNN)-based models.
Keywords: Skin, Microstructure, Segmentation, Aging.

I. INTRODUCTION

The skin, as the largest organ of the human body, serves as a dynamic interface between the internal physiological systems and the external environment. Beyond its vital role as a protective barrier, the skin undergoes intricate microstructural changes over time, manifesting the natural process of aging. The study of skin microstructure, which involves the examination and characterization of its diverse layers, textures, and components, has garnered increasing attention in recent years. This surge in interest is driven by the intersection of advancements in computer vision, image processing, and dermatological research, offering unprecedented opportunities to unravel the subtleties of aging through the lens of skin microstructure.

Understanding the nuanced alterations in skin microstructure associated with aging holds significant implications for diverse fields, ranging from dermatology and cosmetic science to biomedicine and forensics. The ability to accurately segment and analyze the microstructural components of the skin provides a foundation for uncovering valuable insights into the aging process, contributing to the development of targeted interventions, diagnostic tools, and even age prediction models.

The pursuit of understanding skin microstructure in the context of aging is motivated by the multifaceted nature of the aging process itself. Aging imparts a range of changes to the skin, encompassing alterations in elasticity, pigmentation, wrinkles, and the overall texture of the skin. These changes are not only of aesthetic interest but also hold valuable diagnostic and prognostic information related to health and well-being.

Skin microstructure segmentation serves as the foundational step in this exploration, involving the identification and isolation of different components such as the epidermis, dermis, and subcutaneous tissue. Traditional image processing techniques, including edge detection and texture analysis, have long been employed for this purpose. However, recent strides in machine learning, particularly with the advent of deep neural networks, have revolutionized the accuracy and efficiency of skin microstructure segmentation. Convolutional Neural Networks (CNNs) and other deep learning architectures have shown promise in automatically learning hierarchical features, enabling precise delineation of complex skin structures.

Once the microstructure is segmented, the subsequent step involves leveraging this information for aging classification. The intricate details captured during segmentation become vital features for predictive models aiming to discern age-related patterns. Traditional machine learning models, such as Support Vector Machines (SVM) and Random Forests, have been applied alongside neural networks for this purpose. The fusion of domain expertise in dermatology with the computational power of these models contributes to a nuanced understanding of how specific microstructural changes correlate with age.

In the broader context of technological advancements, this review also addresses the challenges that researchers encounter in this interdisciplinary pursuit.

Variability in skin types, data acquisition methods, and the interpretability of deep learning models pose significant hurdles. Additionally, the ethical considerations surrounding the use of aging prediction models and the need for robust, diverse datasets are pivotal aspects that warrant attention.

II. LITERATURE SURVEY

M. Sanvordekar et al.,[1] Melanoma is the most fatal type of malignant skin cancer, posing a serious threat to people's physical health. If melanoma of the skin is detected early, the chances of survival are very high. Dermoscopic images can be used to make an early diagnosis. Dermoscopy magnifies the skin, allowing dermatologists to better evaluate morphological features that are not easy to see with the naked eye. Machine learning is now an important technique for detecting various types of skin cancers. Convolutional Neural Network (CNN) has the potential to greatly assist dermatologists in the diagnosis of melanoma accurately. This work uses a machine learning based approach to detect benign and malignant forms of skin cancer in dermoscopic images. The EfficientNet CNN model used here can design the appropriate network architecture to extract features with greater better accuracy and efficiency. The model is evaluated using dataset from the ISIC Archive.

K. S. P, A. Nayak et al.,[2] The biggest organ that is present in the human body, which generally covers all the major body parts.The functions of skin in the human body are more significant, since even a little alteration in one of these functions could have an impact on other body components. Skin is more susceptible to disease and infection because it is exposed to the outside environment. Therefore, we must pay more attention to skin diseases. Lesion areas refer to the affected area of skin. The initial clinical indications of diseases like chickenpox, melanoma, etc. are skin lesions. Today, computer-aided diagnosis is more prevalent in the medical industry. For the automation of many operations in the medical profession, machine learning is crucial. It has been shown that dermoscopy, in the hands of untrained dermatologists, may actually reduce the diagnostic accuracy.

A. J. Prakash et al.,[3] Owing to shortage of awareness regarding signs and measures for prophylaxis, skin cancer (SC), among the most severe kinds of carcinoma (Ca), is actively destroying far more people than it used to. Consequently, in order to halt the progression of Ca, timely identification during an early phase is crucial. Melanoma, baseline-cell, as well as squamous cellular Ca are the deadliest subtypes of SC. Under this research, distinct SC kinds will be identified and classified utilizing machine learning and image processing techniques. Dermoscopy imaging are taken into consideration as input during the pre-processing phase. All undesirable hairs on skin lesion are removed using dull razor technique, and the picture is then smoothed using a Gaussian filtering. Median filter is employed to reduce noisiness and protect lesion's borders. Colour-based k-means grouping is carried out in the segmentation process because colour is a key element in determining the kind of malignancy.

S. R et al.,[4] Despite being one of the worst kinds of cancer, skin cancer deaths have risen rapidly in recent years. Lack of education about the disease's warning signals and the Identifying cancer early, when it's still treatable, is crucial to preventing its spread. Melanoma, basal cell carcinoma, and squamous cell carcinoma are deadly skin cancers. Atypical basal cell carcinoma and squamous cell carcinoma are other skin cancers. This study uses machine learning and image processing to classify skin cancers. Before preprocessing, dermoscopy pictures are entered. After removing unwanted hair with a dull razor, a Gaussian filter is used to smooth the image.

M. Sangeetha et al.,[5] Skin Cancer is one of the most common cancer forms in many countries, it is considered to be one of the dangerous types in the sense that it is lethal and its occurrence over time has been dramatically high. It is one of the deadliest cancers among all diseases and has a large rate of mortality. The efficiency of the earlier approaches to assess one of the most hazardous melanoma diagnosis in dermoscopic criteria are not up to the mark. Therefore, in this research, the work has been carried out in three stages in order to detect melanoma in an efficient manner. In the first stage, prior to the implementation of the image segmentation technique, noise elimination and pre-processing steps are carried out to remove the noise and to achieve better execution results.

D. V. Vasudha Rani et al.,[6] Skin is an extraordinary human structure. As a result of inherited traits and environmental variables, skin conditions are the most prevalent worldwide. People frequently neglect the effects of skin diseases in their initial stages. It commonly experienced both well-known and rare diseases. Identifying skin diseases and their kinds in the medical field is a very difficult process. It can be very challenging to identify the precise type of disease because of the intricacy of human skin complexion as well as the visual proximity effect of the conditions. As a result, it's critical to identify and categorize skin diseases as soon as they are discovered. The most ambiguous and challenging field in science is therefore the detection of human skin diseases. For segmentation and diagnosis, ML techniques are frequently employed in the biomedical industry. These techniques decide using features extracted from photos as their input.

C. -I. Moon et al.,[7] The skin surface is composed of a network-like microstructure comprising wrinkles. Observing and analyzing the microstructure of the skin that changes with the skin condition and aging are simple, stable, and accurate evaluation methods for skin diagnosis. However, the skin surface includes various morphological and topological changes, depending on the individual or the degree of aging. It is difficult to accurately extract and analyze a skin microstructure including these changes. Therefore, we perform skin microstructure segmentation and aging analysis by using convolutional neural network (CNN) models. First, we propose a fusion UNet model to extract the skin microstructure.

M. Kumar et al.,[8] In the human body, one of the major diseases found in some people across the globe is cancer. Cancer can be at any portion of the body like the breast, lungs, prostate and many more. One of the major difficulties during the analysis of cancer is the prediction of the type of cancer. This work also discusses one of cancer, i.e., skin cancer, which are mainly seven types. To perform this multiclass classification, the work has done through the deep learning models based on Convolutional Neural Networks. Convolutional Neural Networks are implemented using pretrained model i.e., VGG-16. Firstly, segmentation is done with encoding and decoding using masking approach. Secondly, the model is evaluated and finally the prediction of different skin images for the cancer detection. Thereafter classification is done through Convolutional neural network and finally the model validation is done K cross fold method.

J. Alam et al.,[9] Skin diseases are mostly caused by fungal infection, bacteria, allergy, or viruses, etc. The lasers advancement and photonics based medical technology is used in diagnosis of the skin diseases quickly and accurately. But the medical equipment for such diagnosis is limited and mostly expensive. However, using an image-based diagnosis system can help in reducing both time and cost. Image processing and Deep learning techniques can be combined together which helps in detection of skin disease at an initial stage. On the other hand, feature extraction plays a key role in classification of skin diseases. We propose an efficient approach for detecting skin disease using deep learning. The proposed system enables detecting skin disease with 85.14% accuracy which is higher than that of the existing models.

Q. Zhou et al.,[10] Melanoma is the most common form of skin cancer, and skin disease image segmentation plays a vital role in automated diagnosis of skin cancer. A primary challenge of image segmentation and other automated object recognition techniques is the large amount of redundant input information which often obfuscates critical input features. In the context of dermatoscopy lesion segmentation we show that unsupervised clustering algorithms applied to input images can reduce local image redundancy and result in dramatic improvements in segmentation performance. Our work proposes a skin disease image segmentation algorithm combining an unsupervised simple linear iterative cluster algorithm (SLIC), and the supervised deep learning U-Net model. The unsupervised SLIC method can detect the fine structure of skin damage highlighting critical features that improve segmentation performance of the supervised U-Net model. Both the superpixel dermoscope image and original image are used as input information for the U-Net training deep learning model. Finally, a fully-connected conditional random field (CRF) is used for image post-processing. This algorithm achieves an Intersection Over Unit(IOU) coefficient reaching 83%, dice coefficient 90%, sensitivity 90%, improved by 10%, 7% and 4% respectively in comparison with the results of the classic U-Net, showing that this approach improves the performance of network image segmentation.

III. CHALLENGES

The exploration of skin microstructure segmentation and aging classification is not without its challenges, and researchers face a multitude of complexities in this interdisciplinary field. The following are key challenges that merit attention:

1) *Data Variability:* Skin exhibits considerable variability among individuals, encompassing diverse ethnicities, ages, and health conditions. Ensuring that segmentation and classification models generalize well across such variability is a persistent challenge.
2) *Complexity of Skin Structures:* The intricate nature of skin structures, including variations in pigmentation, texture, and composition, poses a significant challenge for accurate segmentation. Traditional methods may struggle with capturing the nuanced features, necessitating advanced techniques like deep learning for improved precision.
3) *Interpretability of Deep Learning Models:* Deep learning models, particularly convolutional neural networks, are known for their black-box nature, making it challenging to interpret how and why specific features contribute to the segmentation or classification outcomes. Understanding the decision-making process of these models is crucial, especially in applications with potential clinical implications.
4) *Lack of Standardized Datasets:* The absence of standardized and diverse datasets hampers the development and evaluation of robust segmentation and aging classification models. Datasets that encompass a broad spectrum of skin types, age groups, and environmental conditions are essential for ensuring the generalizability of the developed algorithms.

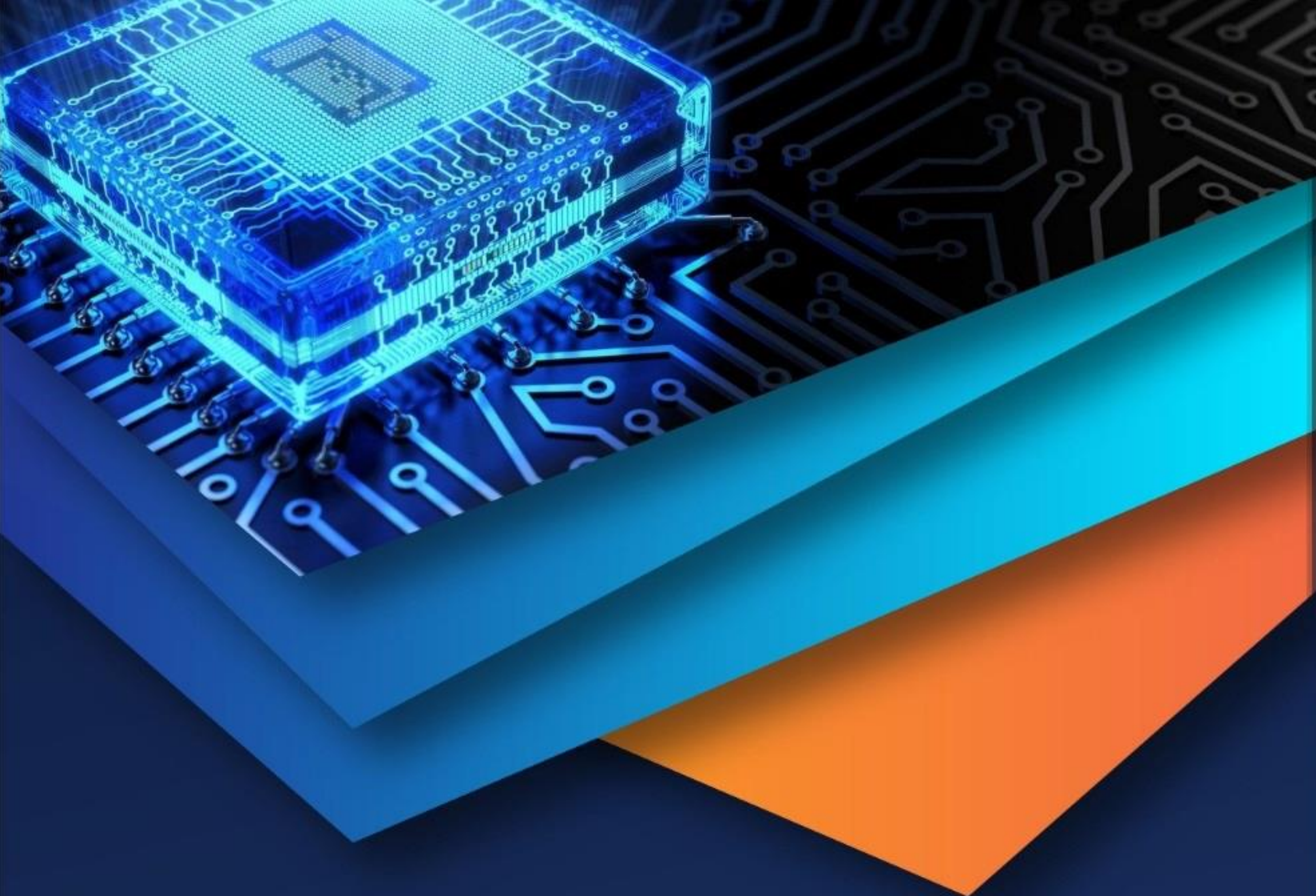
5) *Ethical Considerations:* The use of aging prediction models raises ethical concerns, especially in the context of privacy and consent. Striking a balance between technological advancements and ethical considerations is crucial to ensure responsible and transparent deployment of these models in real-world scenarios.
6) *Integration of Multi-Modal Information:* Skin health and aging involve multi-modal information, including genetic factors, lifestyle, and environmental influences. Integrating these diverse data sources into a cohesive model presents a challenge, but doing so could enhance the accuracy and reliability of predictions.
7) *Clinical Translation and Validation:* Bridging the gap between research findings and clinical applications is a critical challenge. Validating the efficacy of segmentation and classification models in real-world clinical settings requires collaboration between computer scientists, dermatologists, and healthcare professionals.
8) *Longitudinal Studies:* Understanding the dynamic changes in skin microstructure over time requires longitudinal studies. Designing and conducting such studies pose logistical challenges, but they are essential for capturing the temporal aspects of aging-related changes in the skin.

IV. CONCLUSION

The dynamic interplay between advancements in computer vision, image processing, and dermatological research has paved the way for a nuanced exploration of skin microstructure segmentation and aging classification. This review has traversed the landscape of methodologies, challenges, and emerging trends in this interdisciplinary field, shedding light on the complexities inherent in unraveling the secrets embedded in the skin's intricate microstructure. The accurate segmentation of skin microstructures, facilitated by traditional image processing techniques and propelled by the transformative power of deep learning, has opened new frontiers in our ability to discern and delineate the various layers and components of the skin. This foundational step lays the groundwork for further investigations into the relationship between microstructural changes and the aging process.

REFERENCES

[1] M. Sanvordekar, V. Kuppili and C. Modi, "Machine Learning Approach for Skin Melanoma Classification," 2022 International Conference on Smart Generation Computing, Communication and Networking (SMART GENCON), Bangalore, India, 2022, pp. 1-5, doi: 10.1109/SMARTGENCON56628.2022.10083665.
[2] K. S. P, A. Nayak, S. Shiromani, N. Hemanth, A. Dekhane and N. Patel, "Improved Deep Learning Framework for Segmenting and Classifying Skin Lesions using K-nearest neighbor algorithm and Multi-Instance Learning," 2022 4th International Conference on Advances in Computing, Communication Control and Networking (ICAC3N), Greater Noida, India, 2022, pp. 554-558, doi: 10.1109/ICAC3N56670.2022.10074344.
[3] A. J. Prakash, G. Satpathy, R. Raman, E. Manikandan, D. Buddhi and D. Kapila, "Applications of Machine Learning to Skin Cancer Detection," 2022 5th International Conference on Contemporary Computing and Informatics (IC3I), Uttar Pradesh, India, 2022, pp. 1591-1595, doi: 10.1109/IC3I56241.2022.10072651.
[4] S. R and V. K, "Skin Cancer prediction using Machine Learning," 2022 International Interdisciplinary Humanitarian Conference for Sustainability (IIHC), Bengaluru, India, 2022, pp. 1112-1115, doi: 10.1109/IIHC55949.2022.10060544.
[5] M. Sangeetha, C. Karthikeyini, S. Vasundhara, D. Saravanan and G. Arunkumar, "Detection and Classification of Skin Cancer by Using a Parallel Deconvolutional Network Model," 2022 International Interdisciplinary Humanitarian Conference for Sustainability (IIHC), Bengaluru, India, 2022, pp. 661-670, doi: 10.1109/IIHC55949.2022.10059956.
[6] D. V. Vasudha Rani, G. Vasavi and B. Maram, "Skin Disease Classification Using Machine Learning and Data Mining Algorithms," 2022 IEEE 2nd International Symposium on Sustainable Energy, Signal Processing and Cyber Security (iSSSC), Gunupur, Odisha, India, 2022, pp. 1-6, doi: 10.1109/iSSSC56467.2022.10051620.
[7] C. I. Moon and O. Lee, "Skin Microstructure Segmentation and Aging Classification Using CNN-Based Models," in IEEE Access, vol. 10, pp. 4948-4956, 2022, doi: 10.1109/ACCESS.2021.3140031.
[8] M. Kumar and S. M. P. Gangadharan, "Skin cancer multiclass classification through different types of Convolutional Neural Networks," 2021 2nd International Conference on Computational Methods in Science & Technology (ICCMST), Mohali, India, 2021, pp. 84-87, doi: 10.1109/ICCMST54943.2021.00028.
[9] J. Alam, "An Efficient Approach for Skin Disease Detection using Deep Learning," 2021 IEEE Asia-Pacific Conference on Computer Science and Data Engineering (CSDE), Brisbane, Australia, 2021, pp. 1-8, doi: 10.1109/CSDE53843.2021.9718427.
[10] Q. Zhou, P. Akbari and Y. Zou, "Unsupervised Learning Reduces Local Image Redundancy and Improves Supervised Segmentation of Dermoscopy Lesions," 2021 8th International Conference on Soft Computing & Machine Intelligence (ISCMI), Cario, Egypt, 2021, pp. 247-252, doi: 10.1109/ISCMI53840.2021.9654807.



10.22214/IJRASET

INDEX COPERNICUS
45.98

ISRA JIF
IMPACT FACTOR:
7.129

TOGETHER WE REACH THE GOAL
IMPACT FACTOR:
7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY