SKIN CANCER CLASSIFICATION USING MACHINE LEARNING AND DEEP LEARNING

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***Abstract*— Skin is the primary protective layer of the internal organs of the body. Nowadays, due to increasing pollution and multiple other factors, various types of skin diseases are growing globally. With variable shapes and multiple types, the classification of skin lesions is a challenging task. Further, both ReLU and leakyReLU activation functions are purposefully used in the proposed model. The model accurately classified all of the classes of the HAM10000 dataset.**

Further, our work is compared with some popular state-of-the-art and recent existing model. To date, various techniques exploiting skin images have been applied directly to skin cancer classification, showing promising results in improving diagnostic accuracy. This study aims to develop a machine learning based model capable of accurately classifying skin cancer by utilizing extracted features from preprocessed images available in HAM10000 dataset. Preprocessed features are known to provide more significant information than raw image data, as they capture specific characteristics of the images that are relevant to the classification task. The proposed model of this study can identify the most pertinent information in the images more accurately, thereby improving the performance and interpretability of the machine learning classification. The proposed technique effectively distinguishes between non-melanoma and melanoma skin cancer.

Keywords—Skin cancer, segmentation, machine learning, Convolutional Neural Network.

I. INTRODUCTION

The Skin Cancer pose a significant threat to human lives around the world. Therefore, the early detection and preventive measures are utmost important for mitigation . In recent years, the integration of Machine learning technology and deep learning techniques have revolutionized the way we approach skin cancer detection and mitigation. This combination has enabled more efficient and proactive strategies to mitigate the impact of skin lesions.

A. Deep Learning in Skin Cancer Classification:

Deep learning, a subset of machine learning, has proven to be highly effective in processing and analyzing the vast amount of data related to skin cancer detection. Convolutional Neural Networks are commonly used deep learning models for this purpose. Here's how deep learning contributes: Image Analysis: Deep learning models can analyze images from cameras to detect the presence of skin cancer, as well as classify the type of skin cancer. A Convolutional Neural Network is a deep learning technique and a class of the artificial neural networks that are applied for analyzing the visual image-based data. Deep learning's role in medical applications has been explored in depth in some studies.

B. Machine Learning in Skin Cancer Classification:

Machine Learning is used for training and validation of the datasets to classify the type of skin cancer and detect it. Some key components of machine learning based skin cancer detection include:
The total number of images obtained from the HAM1000 dataset for Machine Learning model training is 700 images.After augmenting the dataset, 1400 images are used for ML model training, with 1120 images accounting for 80% of the training.The OpenCV application was used to validate the machine learning models.The proposed work used machine learning models and a Convolutional Neural Network model to train and test the image dataset.Alongside classification, the system should incorporate the preventive measures, such as automated skin cancer detector, to avoid the spreading of the diseases or cancer around the body.
More recently, the emergence of a machine learning paradigm known as deep learning has enabled the development of medical image analysis systems that can display remarkable accuracy.

II. LITERATURE SURVEY

The survey conducted for this study is summarized in a tabular format, providing a comprehensive overview of relevant research works. The table encompasses crucial details such as the name of the study, author(s), publication year, research objectives, and key advantages and disadvantages identified in each work.

Title	Authors	Year	Objectives	Advantages	Disadvantages
A Deep Convolutional Neural Network for Skin Cancer Classification. [1]	Nour Aburaed, Alavikunhu Panthakkan, Mina Al-Saad, Saad Ali Amin, Wathiq Mansoor.	2020	1. To provide better comparable performance to the existing state-of-art methods in terms of accuracy. 2. To achieve the best accuracy, higher than pre-trained models.	This proposed model made a significant advancement in detecting the skin cancer types from the dermoscopic images in-spite of its fine grained variability in its appearance.	1.Due to memory limitations, it requires large amounts of training data and computational power to train and they are notoriously difficult to optimize. 2.It can be costly and time-consuming to obtain and annotate.
Detection and classification of skin cancer by using a parallel CNN model. [2]	Noortaz Rezaoana, Mohammad Shahdat Hossain, Karl Andersson.	2020	1. To have outstanding classification performance relative to the two well-known CNN architecture. 2. To ideally overcome intellectual difficulties in identifying further cases of skin cancer and using them to test for skin cases in AI-based system.	1.Due to the requisition of vast data for the effective training and implementation of CNN-based architecture, it has used data augmentation techniques for the existing dataset. 2.In this process we achieved the desired outcome. Better outcomes have been achieved for the proposed method.	This proposed system was able to classify based on the identification of only two types of cancers namely, benign and malignant.
Skin Lesion Classification by Multi-View Filtered Transfer Learning. [3]	Jianxiao Bian, Song Zhang, Shaoqiang Wang, Jianrui Zhang, Jinchang Guo.	2021	1. To propose multi-view filtered transfer learning network, that exploits information from different image views. 2. To solve the problems that existing skin lesion classification works.	1.The experimental results of skin lesion classification perform our excellent classification capability on ISIC 2017 dataset with average AUC 91.8% on Melanoma and Seborrheic Kerato-sis classification tasks. 2.Besides, the evaluation of those two major modules also prove their necessary contributions for our method.	1.Existing skin lesion classification methods are either supervised models with poor expansibility to new scenario, or simply conduct transfer learning by distilling knowledge from all source samples. 2.Therefore, they involve many wrong samples, which have extreme large domain gap to target data.
Single Model Deep Learning on Imbalanced Small Datasets for Skin Lesion Classification. [4]	Peng Yao, Shuwei Shen, Mengjuan Xu, Peng Liu, Fan Zhang, Jinyu Xing, Pengfei Shao, Benjamin Kaffenberger, Ronald X. Xu.	2022	1. To achieve significant performance with less computing resources and shorter time. 2. To explore mobile devices for automated screening of skin lesions and can be implemented in developing automatic diagnosis tools in other clinical disciplines.	1.The Modified RandAugment helps to achieve the significant performance with less computing resources in a short time. 2.This study shows that this method is able to achieve a high classification performance at a low cost of computational resources on a small and imbalanced dataset.	1.The Multi-weighted New Loss can not only deal with the class imbalance issue, cannot improve the accuracy of key classes, but also reduce the interference of outliers in the network training. 2.However, implementing ensemble models is less practical due to the limitation in computing resources and computing time.

Title	Authors	Year	Objectives	Advantages	Disadvantages
Dermatologist-level classification of skin cancer using cascaded ensembling of convolutional neural network and handcrafted features based deep neural network. [5]	Akhilesh Kumar Sharma, Gaurav Aggarwal, Nitika Goenka, Anil Kumar, Prasun Chakrabarti, Tulika Chakrabarti, Radomir Gono, Zbigniew Leonowicz, Michal Jasinski.	2022	1. To gain high accuracy of the skin disease image classifications. 2. To create more robust model by combining clinical features like itching, burning, medical history and location with handmade features.	1.The experimental results of skin lesion classification perform our excellent classification capability on ISIC 2017 dataset with average AUC 91.8% on Melanoma and Seborrheic Kerato-sis classification tasks. 2.Besides, the evaluation of those two major modules also prove their necessary contributions for our method.	1.Existing skin lesion classification methods are either supervised models with poor expansibility to new scenario, or simply conduct transfer learning by distilling knowledge from all source samples. 2.Therefore, they involve many wrong samples, which have extreme large domain gap to target data.
An improved transformer network for skin cancer classification. [6]	Chao Xin, Zhifang Liu, Keyu Zhao, Linlin Miao, Yizhao Ma, Xiaoxia Zhu, Qiongyan Zhou, Songting Wang, Lingzhi Li, Feng Yang, Suling Xu, Haijiang Chen.	2022	1. To study and overcome the current problems like slow processing speed for large images. 2. To build a unified multi-model skin cancer classification model and to validate the performance of the model.	1.The transformer network has not only achieved good results in natural language but also achieved ideal results in the field of vision, which also lays a good foundation for skin cancer classification based on multimodal data. 2.This paper is convinced that it will be of interest to dermatologists, clinical researchers, computer scientists and researchers in other related fields, and provide greater convenience for patients.	1.The authors of the paper realize that, the model in this paper is slow to process high-resolution images. 2.This model has not been verified in a large number of clinical trials.
An Interpretable Skin Cancer Classification Using Optimized Convolutional Neural Network for a Smart Healthcare System. [7]	Krishna Mridha, Mezbah Uddin, Jungpil Shin, Susan Khadka, M. F. Mridha.	2023	1. To train this model, by using attention or transformer so that the interpretability score gets increased. 2. To approach skin image analysis in domain-specific manner.	This perturbation-based explanation technique for diagnosis employing medically relevant and irrelevant characteristics may have implications in other medical domains.	Although a large research community has helped, these AI-based systems can only make predictions and cannot explain their rationale.

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Performance Enhancement of Skin Cancer Classification Using Computer Vision. [8]	Ahmed Magdy, Hadeer Hussein, Rehab F. Abdel-Kader, Khaled Abd El Salam.	2023	1. To improve the performance of the model by employing deep learning techniques. 2. To construct a model for categorizing benign and malignant skin cancers. 3. To reduce the errors while improving the accuracy.	In this paper, various classifiers were tested to classify skin cancer in the images and distinguish between malignant and benign tumors.	1.In this model, it was observed that the basic ML algorithms were less accurate on the tested 4000 dermoscopic images from the ISIC dataset. 2.When images were examined using CNN and pretrained deep networks, there were apparent and discernible differences in accuracy compared to previous methodologies.
Skin cancer diagnosis: Leveraging deep hidden features and ensemble classifiers for early detection and classification. [9]	Akilandasowmya, G. Nirmaladevi, S. U. Suganthi, A. Aishwarya.	2023	1. To reduce the dimensionality issues in data, feature optimization by establishing Enhanced Harmony Search(EHS) method. 2. To separate the deeply hidden features from the known features in order to guarantee improved accuracy.	The prediction of the skin cancer is done based on the real-time data for classifying and detecting the skin cancers.	Due to prediction of skin cancer is based on the real-time data, the obtained accuracy is relatively less when compared to the other models.
A Portable Non-Invasive Electromagnetic Lesion-Optimized Sensing Device for the Diagnosis of Skin Cancer (SkanMD). [10]	Nader Shafi, Joseph Costantine, Rouwaida Kanj, Youssef Tawk, Ali H. Ramadan, Mazen Kurban, Jihane Abou Rahal, Assaad A. Eid.	2023	1. To exhibit several advantageous features when compared to other efforts within the literature such as portability, non-constraining and low cost. 2. For improving the accuracies for detection of the skin caners.	1.As for clinical utility, the sensing tip is particularly useful for surgeons removing cancerous skin lesions. 2.There is a clear need for a quick point-of-care device capable of diagnosing skin cancer, especially because delays in skin cancer screening cause the disease to evolve.	1.It can classify only two types of skin cancer. 2.The accuracy is very less when compared to the other proposed models used for detecting the skin cancers.

III. CONCLUSION

In conclusion, our survey of existing research papers on skin cancer detection, classification, mitigation, and related technologies has provided valuable insights into the strengths and limitations of current approaches. The identified drawbacks in various methodologies highlight the need for a comprehensive and integrated solution. We acknowledge the challenges highlighted in the surveyed papers, such as the accuracy of trained models, detection, mitigation and classification. These challenges emphasize the importance of a reliable system that considers the complex dynamics of skin lesions, and the various limitations posed by the skin cancers. We seek to overcome these challenges by integrating Deep Learning based Convolutional Neural Network(CNN) approach involved aggregating results from multiple iterations, enabling the enhancement of overall classification accuracy, while Machine Learning technology ensures the training and validation of the datasets to classify the type of skin cancer and detect it, we will be attentive to cost-effectiveness, efficiency, flexibility and scalability, addressing concerns related to implementation and maintenance costs, precautionary measures to be taken, and the scalability of the system.. This study contributes valuable insights to the field of automated skin cancer detection and classification, paving the way for improved diagnosis and treatment strategies. This study aimed to address these challenges by leveraging convolutional neural networks to diagnose and classify various types of skin lesions, using the HAM10000 datasets.

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