Performance Comparison of Deep Learning-Based Classification of Skin Cancer

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Abstract: Skin cancer is among the most prevalent and perilous diseases globally, necessitating accurate and efficient categorisation methods for early detection. Deep learning methodologies have demonstrated significant potential in the automated identification of skin cancer by enhancing diagnostic precision and minimising human error. The main motive of this work is Deep Learning (DL)-based skin cancer classification, this work proposed NASNet DL model, compared to conventional Convolutional Neural Networks (CNNs). NASNet is a neural architecture designed through automated architecture search that optimizes feature extraction and classification accuracy while maintaining computational efficiency. Experimental results verify that NASNet surpasses most traditional CNNs in classification precision, recall, and F1-score. Consequently, the supremacy of NASNet will pave its way for usage in real applications in the domain of medicine that will eventually translate into early, improved patient diagnoses.

1 INTRODUCTION

Millions and millions of humans are diagnosed yearly with skin cancers, which occur when the ordinary cells in human skin grow or multiply in very abnormal ways usually due to intense exposure to radiation from the ultraviolet rays produced by the sun or artificial machines such as a tanning bed. It is crucial to identify skin cancer in time and classify it correctly to provide the best treatment and improve the survival chances of patients. The epidermis is the main type of tissue in the cutaneous membrane, and it acts as the outer covering of the body. It plays a significant role in the immune system's defense against infections and excessive water loss in the body. It provides a flexible, mechanical, physical, and protective barrier against all external assaults, including harmful chemicals, pathogenic bacteria, ultraviolet (UV) radiation, and mechanical forces. Moreover, it modulates immunological, thermoregulatory, and sensory coordination responses. The body's living cells grow, divide, and eventually pass away. The cell cycle replaces dead cells constantly in the human body. Contrarily, uncontrolled cell division and the growth of abnormal cells cause cancer. It originates in the skin and is brought on by cells that develop atypically and are more likely to be distributed to several bodily regions. Skin cancer can be mainly divided into three biggest categories, viz. Basal cell carcinoma (BCC), Melanoma, Squamous Cell Carcinoma (SCC).

In dermatology, skin cancer classification is a significant responsibility that involves accurate identification of malignant and benign lesions on the skin to allow their early detection and treatment. Since skin cancers are increasingly common worldwide, effective classification systems are needed to improve the chances of survival among patients as well as to reduce healthcare costs.

Traditional methods of diagnosing skin cancer include clinical examination, dermoscopy, and histological testing. However, these treatments sometimes require a lot of time, involve the expertise of trained dermatologists, and are prone to human error. Automated skin cancer classification using Deep Learning (DL) has become a feasible solution to overcome these limitations.

DL models, specifically CNNs, have been pretty efficient in the analysis of medical images and in classifying different types of skin cancer. New designs such as NASNet, a Neural Architecture Search Network, have been recently designed to improve classification performance through the

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optimization of feature extraction and efficiency of the model.

Automated skin cancer classification accelerates the diagnostic process and provides a reliable, non-invasive, and cost-effective method for early detection. Ongoing breakthroughs in AI and deep learning are anticipated to significantly assist dermatologists and enhance patient care.

2 LITERATURE REVIEW

In 2021, Chu et al. proposed two levels of fairness: expectation fairness and rigorous fairness. These measures are put in place to reduce supernet bias and enhance evaluation competence. Both methods performed better than existing unfair methods, including back-propagation and direct parameter updates for every model. Strict Fairness performs best when it is a combination of back-propagation operations (BPs) and a single parameter change as a supernet step.

Res-Unet, a combination of pre-trained CNNs ResNet and UNet, was introduced by Zafar et al. (2020) to detect lesion boundaries and significantly enhance classification performance. The proposed solution employed computer vision-based supervised learning methods. The model was validated and trained utilizing the ISIC-2017 and PH2 datasets for detecting epidermal tumours accurately, segmenting them, and classifying them. Jaccard index was employed to identify how close the datasets were to one another. Aziz et al. (2020) employed complex features that were derived from a pre-trained AlexNet network and classified them with SVM. This approach yielded correct outcomes for tumour classification.

A novel technique for data analysis was proposed by Arivuselvam et al. (2021). The data were then separated into training and testing sets and then classified via the SVM algorithm. Statistical measures are utilized to quantify how similar the features of two images are, which enhances the accuracy of the classifications. Lesions are eliminated and subsequently standardized into symmetrical Grey Co-occurrence Level Matrices (GLCM) for the sake of texture analysis. The Multi-Class SVM Classifier was applied in the classification. Here, Support Vector Machine classifiers are employed to compare the characteristics of the Test image and those of the data set.

Houssein et al. (2020) proposed a Levy flight distribution (LFD) metaheuristic ´ method based on Levy flight for handling practical optimization issues. The Levy flight random walk serves as the model for the LFD algorithm in traversing unfamiliar extensive search domains. A variety of optimisation test bed issues are considered to evaluate the performance of the LFD method. The statistical simulation findings indicated that the LFD technique surpasses several prominent metaheuristic algorithms in the majority of tests, producing superior outcomes.

Praveena et al. (2020) the hazardous infection which causes the prime resaon for death rate is skin malignant growth. The reason for skin disease is because of the unusual development in melanocytic cells. Because of hereditary elements and openness of bright radiation, melanoma shows up on the skin as brown or dark in variety. Early conclusion can fix this skin malignant growth totally. The conventional strategy to distinguish the skin disease is Biopsy which is obtrusive and difficult. This strategy for research facility testing consumes additional time. To determine the above issues, finding of skin disease is created in light of systematic supported. The proposed framework utilizes four stages to distinguish the skin disease. In the first place, it utilizes Dermoscopy to catch the skin picture. Subsequent stage is to pre-process the picture. After the progression of pre-handling, it is sectioned which is trailed by include extraction with novel highlights from the divided sore. A last, these highlights were given to a directed classifier named SVM to group whether the given picture is as typical picture or melanoma infected skin picture.

Arivuselvam et al. (2021) human disease is the perilous infections existing which are mainly achieved by genetic feebleness of various nuclear changes. Among the various sorts of infection, skin disease is potentially the most generally perceived kinds of threat. Skin malignant growth recognition innovation is broadly confined into four basic parts starting from social affair dermoscopic picture informational collection, dermoscopic picture data set, picture pre-handling which incorporates hair expulsion, commotion evacuation, resize, honing, contrast extending of the input data.

Priya Choudhary et al. (2022) based on the circumstance in the residing become more unpleasant constantly which appears to make a few issues to people where one of the most hazardous issue is malignant growth that should be recognize in beginning phase and afterward to fix it too. In this paper the demonstrative apparatuses for the recognition of skin disease sores as Dermoscopic pictures that will eventually help in decreasing the melanoma-actuated mortality. We have presented division procedure which helps in the mechanized skin sore determination pipe-line. Here, we have introduced quick and completely programmed calculation for the location of the skin disease in Dermoscopic pictures which are concocted by past statements. In this paper, we have likewise introduced the issues which were identified in the past work. The obtained skin pictures are preprocessed by middle channel and portioned by Edge-based division, Morphological division and K-implies strategies. The factual elements mean, and standard deviation, and the surface highlights difference, and energy are determined for all the fragmented skin injury pictures. The presentation of the three division strategies are thought about and found that the K-Means calculation creates improved outcomes.

Kavitha et al. (2020) because of the rising intricacies in human discernment challenges and subjectivity, the dermatological problems are as yet staying as one of the best clinical issues. Lately, a melanocytic malignant growth is becoming as a most dangerous disease in the mankind. Dermatologists are expecting a PC supported framework that can distinguish it in beginning phase. So, the doctors genuinely must recognize disease in its beginning phase. This paper has been introducing an overview on promptly open picture handling procedures for melanoma discovery as picture handling has a huge impact on the pictures got from the computerized center in distinguishing and characterizing the sicknesses. This paper learns about the different accessible harmless procedures that are should give a mechanized picture. Various classification techniques perform certainly for the conclusion of skin injuries is related and the comparing discoveries are described.

3 SYSTEM METHODOLOGY

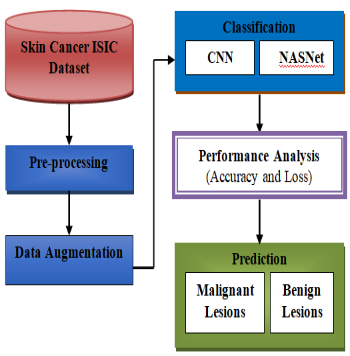

Figure 1: System methodology.

Figure 1 illustrates the proposed System Methodology for skin cancer classification.

3.1 Pre-Processing

ISIC image pre-processing for skin cancer classification involves essential steps to enhance image quality and improve classification accuracy. First, images are resized and normalized to a standard resolution (e.g., 224×224) to ensure uniform input for deep learning models like NASNet. Noise reduction techniques, such as median filtering, are applied to remove unwanted artifacts like hair, reflections, and uneven lighting. Additionally, color normalization is performed to maintain consistency in color distribution across images, improving lesion feature extraction. These preprocessing procedures enhance dermoscopic pictures, facilitating improved feature representation and more precise skin cancer classification.

3.2 Data Augmentation

After preprocessing, data augmentation techniques are applied on ISIC images to enhance generalization in a model and hence increase the precision of skin cancer classification. A few of these common augmentation techniques include rotation, flipping, scaling, and cropping, used in improving the diversity of lesion orientation and size. It has the ability to adjust to several lighting conditions with contrast and brightness adjustments, although Gaussian noise and blurring are used to emulate the fluctuations found in images during real-world scenes. Additionally, elastic transformations as well as affine distortions indirectly change the geometry of lesions while not changing the diagnostic features of the lesions. This type of augmentation has the impacts of minimizing class imbalance, minimizing overfitting, and maximizing the robustness of deep learning models like NASNet when it comes to diagnosing skin cancer.

3.3 Classification

Deep learning models, especially Convolutional Neural Networks (CNN), are commonly used to classify skin cancers since they can learn automatically hierarchical features from dermoscopic images with or without human involvement. Existing methods primarily use CNN models such as as VGG16, ResNet, or Inception for skin lesion identification and classification. The performance of these models is impressive; however, accuracy and efficiency have shortcomings, particularly with complicated lesion types. To address this issue, the improved version is NASNet, or the Neural Architecture Search Network. NASNet uses automated search to improve network design, enabling better feature extraction and achieving high classification accuracy while maintaining computing efficiency. This study reveals that the NASNet model far outperforms conventional CNN models in skin cancer diagnosis, making it a better and more effective method.

3.4 NASNet

The Neural Architecture Search Network (NASNet) is a state-of-the-art deep learning architecture created through automated neural architecture search. It improves accuracy as well as computational efficiency. NASNet has proven to be quite effective in image classification, making it a good candidate for skin cancer classification.

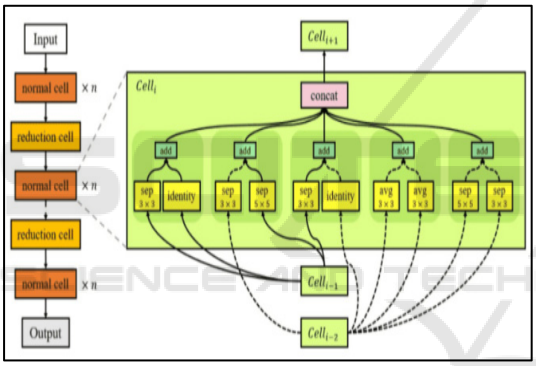

Figure 2: NASNet architecture diagram.

Figure 2 shows the architecture of NASNet, which is automatically built to optimize the layers and parameters of the network and determine the most efficient architecture. The process entails the search for the best convolutional layer arrangement, activation functions, pooling, and skip connections to create a better and more robust architecture with the capability to extract the important information from images and improve classification accuracy.

NASNet is able to learn hierarchical features of incoming images independently without any human intervention. Skin cancer classification identifies essential features like texture, colour patterns, and morphology that distinguish malignant lesions from benign lesions.

NASNet uses a modular architecture with several convolutional layers and cell blocks. The cells in NASNet are engineered to collect both detailed and overarching information, which are crucial for differentiating various types of skin diseases. The architectural components comprise

- **Convolutional Layers** for detecting edges, textures, and patterns.
- **Max Pooling Layers** for down sampling the image, preserving important features while reducing computational complexity.
- **Batch Normalization** for stabilizing and accelerating training.
- **Dense Layers** at the final stage to perform classification based on the learned features.

This transfer learning method allows the model to use previously acquired attributes (such as edges and textures) and adapt them for the specific aim of detecting skin cancer. By training on the ISIC dataset, NASNet improves its ability to extract features and classify skin lesions. While being trained, NASNet decreases loss (for example, category cross-entropy) and improves its performance by employing back-propagation and gradient descent.

4 EXPERIMENTAL RESULTS

The effectiveness of the proposed model is assessed using measures such as validation accuracy and loss.

4.1 Dataset Details

The ISIC dataset is a well-known standard for classifying skin cancer and segmenting lesions. It consists of 25,000 annotated dermoscopic photographs, as well as high-resolution dermoscopic JPEG and PNG photos. Dermatologists have annotated it, and it includes a wide range of skin problems, such as benign lesions and malignant types.

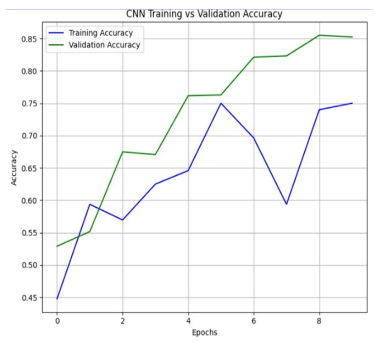

Figure 3: Accuracy of CNN training versus validation

Figure 3 presents Accuracy of CNN Training versus Validation and Figure 4 shows the Loss of CNN Training versus Validation.

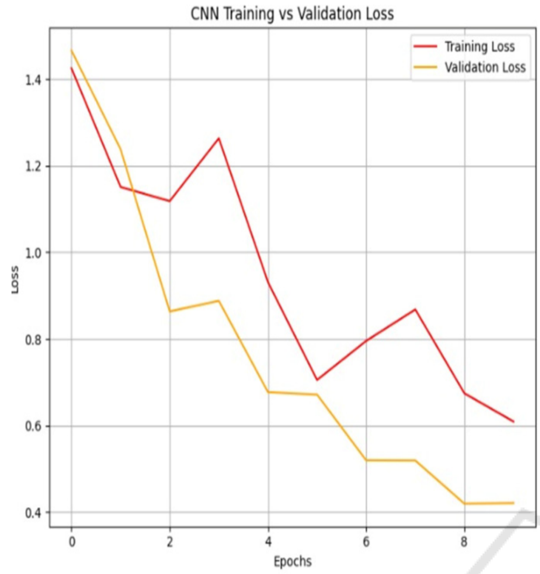

Figure 4: Loss of CNN training versus validation.

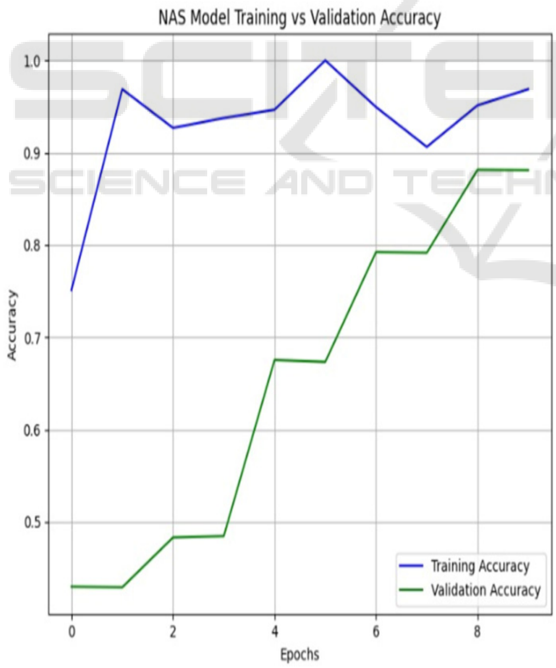

Figure 5: Accuracy of NASNet training versus validation.

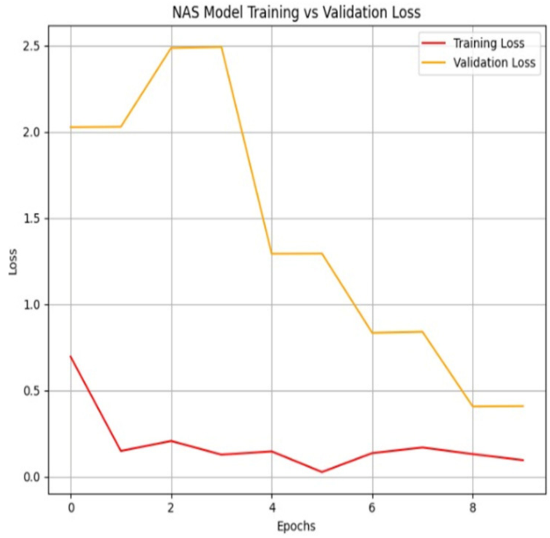

Figure 6: Loss of NASNet training versus validation.

Figure 5 represents Accuracy of CNN Training versus Validation and Figure 6 illustrates the Loss of CNN Training versus Validation.

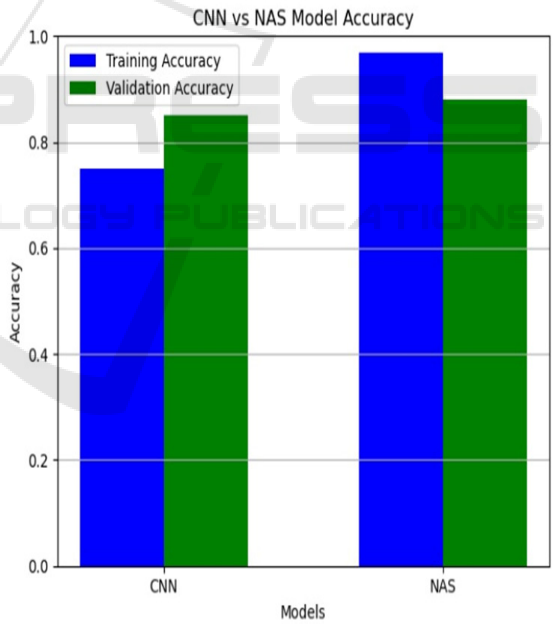

Figure 7: Performance analysis – accuracy.

Figure 7 depicts the Performance Analysis that uses Accuracy. NASNet is better than typical CNN models since it automatically finds the ideal architecture for classifying skin cancer. Figure 8 gives Output skin cancer classification image.

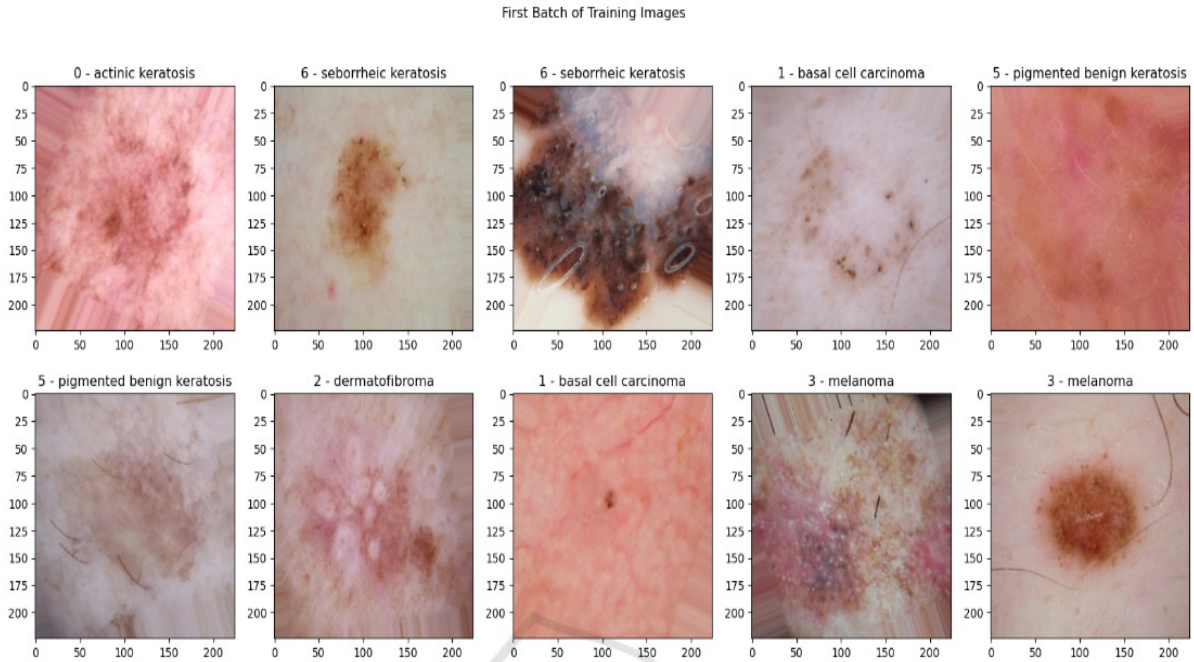

Figure 8: Sample output image.

5 CONCLUSIONS

This work highlights the efficacy of deep learning models in skin cancer classification, with NASNet's design delivering major enhancements over standard CNNs. It is extremely effective for automated skin cancer detection, especially when trained on ISIC datasets, because to its advanced search for the best design. The study, which is based on validation accuracy and loss, shows that NASNet is significantly better than traditional CNN models when it comes to classification accuracy and efficiency. The automated architectural optimisation of NASNet improves its ability to gather complex features of skin lesions, leading to more accurate predictions and lower loss values during training. The findings show that NASNet is a suitable model for detecting skin cancer. It performs better and is more reliable than current CNN-based approaches, which leads to better early diagnosis and patient outcomes.

REFERENCES

Ajmal, M., Khan, M. A., Akram, T., Alqahtani, A., Alhaisoni, M., Armghan, A., Althubiti, S. A. and Alenezi, F. (2023), 'Bf2sknet: Best deep learning features fusion-assisted framework for multiclass skin lesion classification', Neural Computing and Applications 35(30), 22115– 22131.

Arivuselvam, B. et al. (2021), 'Skin cancer detection and classification using svm classifier', Turkish Journal of Computer and Mathematics Education (TURCOMAT) 12(13), 1863–1871.

Bassel, A., Abdulkareem, A. B., Alyasseri, Z. A. A., Sani, N. S. and Mohammed, H. J. (2022), 'Automatic malignant and benign skin cancer classification using a hybrid deep learning approach', Diagnostics 12(10), 2472.

Cassidy, B., Kendrick, C., Brodzicki, A., Jaworek-Korjakowska, J. and Yap, M. H. (2022), 'Analysis of the isic image datasets: Usage, benchmarks and recommendations', Medical image analysis 75, 102305.

Chu, X., Zhang, B. and Xu, R. (2021), Fairnas: Rethinking evaluation fairness of weight sharing neural architecture search, in 'Proceedings of the IEEE/CVF International Conference on Computer Vision', pp. 12239–12248.

Houssein, E. H., Saad, M. R., Hashim, F. A., Shaban, H. and Hassaballah, M. (2020), 'Levy flight distribution: A new metaheuristic algorithm for solving engineering opti- ´ mization problems', Engineering Applications of Artificial Intelligence 94, 103731.

Iqbal, I., Younus, M., Walayat, K., Kakar, M. U. and Ma, J. (2021), 'Automated multi-class classification of skin lesions through deep convolutional neural network with dermoscopic images', Computerized medical imaging and graphics 88, 101843.

Kaur, R. and Ranade, S. K. (2023), 'Improving accuracy of convolutional neural networkbased skin lesion segmentation using group normalization and combined loss function', International Journal of Information Technology pp. 1–9.

Kavitha, P & Jayalakshmi, V 2020, Survey of Skin Cancer Detection using Various Image Processing Techniques, Proceedings of the Third International Conference on Intelligent Sustainable Systems, IEEE Xplore Part Number: CFP20M19-ART; ISBN: 978-1-7281-7089-3, pp. 1062-1069.

Khan, M. A., Akram, T., Zhang, Y.-D. and Sharif, M. (2021), 'Attributes based skin lesion detection and recognition: A mask rcnn and transfer learning-based deep learning framework', Pattern Recognition Letters 143, 58–66.

Khouloud, S., Ahlem, M., Fadel, T. and Amel, S. (2022), 'W-net and inception residual network for skin lesion segmentation and classification', Applied Intelligence pp. 1–19.

Li, X., Zheng, J., Li, M., Ma, W. and Hu, Y. (2022), 'One-shot neural architecture search for fault diagnosis using vibration signals', Expert Systems with Applications 190, 116027.

Mehwish Dildar, Shumaila Akram, Muhammad Irfan, Hikmat Ullah Khan, Muhammad Ramzan, Abdur Rehman Mahmood, Soliman Ayed Alsaiari, Abdul Hakeem M Saeed & Mohammed Olaythah Alraddadi 2021, 'Skin cancer detection: A review using deep learning techniques', International Journal of Environmental Research and Public Health, vol. 18, no. 01, pp. 1-22.

Mohakud, R. and Dash, R. (2022), 'Designing a grey wolf optimization based hyperparameter optimized convolutional neural network classifier for skin cancer detection', Journal of King Saud University-Computer and Information Sciences 34(8), 6280–6291.

Nawaz, M., Mehmood, Z., Nazir, T., Naqvi, R. A., Rehman, A., Iqbal, M. and Saba, T. (2022), 'Skin cancer detection from dermoscopic images using deep learning and fuzzy k-means clustering', Microscopy research and technique 85(1), 339–351.

Ragab, M., Choudhry, H., Al-Rabia, M. W., Binyamin, S. S., Aldarmahi, A. A. and Mansour, R. F. (2022), 'Early and accurate detection of melanoma skin cancer using hybrid level set approach', Frontiers in Physiology 13, 2536.

Ragumadhavan, R, Aravind Britto, KR & Vimala, R 2022, 'Melanoma skin cancer detection using wavelet transform and local ternary pattern', Journal of Medical Imaging and Health Informatics, vol. 12, no. 1, pp. 15-19, ISSN: 2156-7018,

Sangers, T, Reeder, S, Vander Vet, S, Jhingoer, S, Mooyaart, A, Siegel, DM & Wakkee, M 2022, 'Validation of a market-approved artificial intelligence mobile health app for skin cancer screening: A prospective multicenter diagnostic accuracy study', Dermatology: Skin CancerResearch Article, vol. 11, no. 8, pp. 1-8.

Wu, Y. P., Parsons, B., Jo, Y., Chipman, J., Haaland, B., Nagelhout, E. S., Carrington, J., Wankier, A. P., Brady, H. and Grossman, D. (2022), 'Outdoor activities and sunburn among urban and rural families in a western region of the us: Implications for skin cancer prevention', Preventive Medicine Reports 29, 101914.

Zafar, K., Gilani, S. O., Waris, A., Ahmed, A., Jamil, M., Khan, M. N. and Sohail Kashif, A. (2020), 'Skin lesion segmentation from dermoscopic images using convolutional neural network', Sensors 20(6), 1601.