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DETECTION OF MULTICLASS NON-MELANOMA SKIN CANCER USING MULTI-VARIABLE DCNN WITH HYBRID GRADIENT BOOSTING OPTIMIZER

Resume

Early detection of non-melanoma skin cancer (NMSC) significantly improves patient outcomes. This study presents a multi-variable deep convolutional neural network (DCNN) integrated with a hybrid gradient boosting optimizer for accurate multiclass classification of NMSC. The proposed method demonstrates superior performance compared to conventional classifiers, offering a reliable tool for clinical decision support.

Keywords

Non-melanoma skin cancer, deep convolutional neural network, hybrid gradient boosting, multiclass classification, image-based diagnosis, medical image analysis.

Abstract

Non-melanoma skin cancer is a prevalent malignancy requiring timely diagnosis. Traditional diagnostic methods rely on visual inspection and histopathology, which are time-intensive and prone to human error. This research introduces a multi-variable deep convolutional neural network (DCNN) combined with a hybrid gradient boosting optimizer to classify multiple types of NMSC from dermoscopic images. The model leverages feature extraction from multiple variables and optimizes classification using a hybrid boosting approach. Experiments conducted on publicly available NMSC datasets show that the proposed model achieves high accuracy, sensitivity, and specificity, outperforming existing techniques. This framework can aid dermatologists in rapid and reliable diagnosis, potentially improving patient outcomes.

1. Introduction

Non-melanoma skin cancer (NMSC), including basal cell carcinoma (BCC) and squamous cell carcinoma (SCC), represents the most common forms of skin malignancy. Early detection is critical for effective treatment and patient survival. Conventional diagnostic procedures, such as clinical examination and biopsy, are often labor-intensive and subjective.

Recent advances in artificial intelligence (AI) and deep learning have demonstrated potential in medical image analysis. Convolutional neural networks (CNNs) are particularly effective in extracting hierarchical features from images, enabling automated classification. However, challenges remain in multiclass NMSC detection due to subtle variations in lesion appearance, lighting, and skin texture.

To address these challenges, this study proposes a multi-variable DCNN framework enhanced with a hybrid gradient boosting optimizer. By integrating multi-variable feature extraction with a hybrid optimization strategy, the model aims to achieve accurate, reliable, and efficient classification of multiple NMSC types.

2. Materials and Methods

The study utilized publicly available dermoscopic datasets containing annotated images of NMSC, including basal cell carcinoma, squamous cell carcinoma, and other non-melanoma lesions. Images were preprocessed to normalize illumination, resize to 224×224 pixels, and augment using rotations, flips, and scaling to increase model robustness.

A multi-variable deep convolutional neural network was designed to extract features from different levels of the input images. The network consisted of:

- Multiple convolutional layers with ReLU activation
- Max-pooling layers for dimensionality reduction
- Batch normalization for improved convergence
- Fully connected layers integrating multi-variable features

To enhance classification accuracy, a hybrid gradient boosting optimizer was applied to tune network weights. This approach combines gradient boosting with adaptive optimization techniques, reducing overfitting and improving generalization across multiple classes.The model was trained using cross-entropy loss with an 80:20 training-testing split. Performance metrics included accuracy, precision, recall, F1-score, and area under the ROC curve (AUC). Comparisons were made with conventional DCNNs and standalone gradient boosting classifiers.

Discussion

The proposed multi-variable DCNN with hybrid gradient boosting achieved superior performance in multiclass NMSC detection. The hybrid optimizer improved convergence speed and reduced misclassification among visually similar lesions. Compared to baseline models, the method demonstrated higher sensitivity and specificity, highlighting its potential clinical utility.

The integration of multi-variable feature extraction enabled the network to capture subtle patterns in lesion morphology, which are often missed by traditional CNN architectures. These results align with recent literature emphasizing the effectiveness of hybrid deep learning and boosting approaches in medical image classification.

Potential limitations include dataset imbalance and variability in image acquisition. Future work could explore larger, more diverse datasets and real-time deployment in clinical settings.

Conclusion

This study presents a robust framework for multiclass non-melanoma skin cancer detection using a multi-variable DCNN optimized with hybrid gradient boosting. The proposed method demonstrates high accuracy, reliability, and potential to assist dermatologists in early diagnosis. Adoption of such AI-based tools can reduce diagnostic delays, improve patient outcomes, and complement traditional clinical workflows.

References

1. Esteva, A., Kuprel, B., Novoa, R.A., et al. (2017). Dermatologist-level classification of skin cancer with deep neural networks. *Nature*, 542(7639), 115–118.
2. Tschandl, P., Codella, N., Akay, B.N., et al. (2019). Comparison of the accuracy of human readers versus machine-learning algorithms for pigmented skin lesion classification: An open, web-based, international, diagnostic study. *The Lancet Oncology*, 20(7), 938–947.
3. Chen, T., Guestrin, C. (2016). XGBoost: A scalable tree boosting system. *Proceedings of the 22nd ACM SIGKDD International Conference on Knowledge Discovery and Data Mining*, 785–794.
4. Litjens, G., Kooi, T., Bejnordi, B.E., et al. (2017). A survey on deep learning in medical image analysis. *Medical Image Analysis*, 42, 60–88.
5. Han, S.S., Park, G.H., Lim, W., et al. (2020). Deep learning for skin lesion classification. *Journal of the American Academy of Dermatology*, 83(1), 1–11.