Medical Image Analysis System for Burn Detection and Skin Condition Classification Using Deep Learning

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***Abstract*—Artificial Intelligence has become an important tool in modern healthcare, especially in analyzing medical images for early diagnosis. Detecting burn severity and skin conditions at an early stage is crucial to prevent complications and ensure proper treatment. This paper presents a Medical Image Analysis System that uses deep learning techniques to analyze images of burn injuries and skin lesions. The system classifies burn severity into different levels and predicts skin conditions along with a confidence score. It also provides first-aid guidance and diet recommendations to support user recovery. The system is implemented using Python, with deep learning models such as Convolutional Neural Networks, U-Net, and DenseNet, along with an interactive user interface. The proposed solution aims to provide accessible and efficient healthcare assistance.**

I. INTRODUCTION

Artificial Intelligence (AI) is transforming healthcare by enabling faster and more accurate diagnosis through image analysis. Skin-related conditions such as burns and lesions require timely identification to avoid serious complications. However, many individuals lack access to immediate medical support or are unable to recognize the severity of their condition. To address this issue, a Medical Image Analysis System is developed to analyze images of burns and skin conditions using deep learning. The system allows users to upload images, which are processed to determine the type and severity of the condition. It also provides guidance and recommendations, making it a useful tool for early awareness and basic healthcare support.

II. PROPOSED SYSTEM

The proposed system is an AI-based application designed to analyze medical images and generate meaningful insights. It consists of modules for image preprocessing, analysis, classification, and recommendation. Users can upload images through an interactive interface. The system processes these images and applies deep learning models to detect burn severity and classify skin conditions. Based on the results, it provides first aid suggestions and diet recommendations. The system is designed to be simple, fast, and user-friendly.

III. METHODOLOGY

A. Data Collection and Preprocessing The dataset consists of images of burn injuries and various skin conditions collected from reliable sources. Preprocessing techniques such as resizing, normalization, and noise reduction are applied to ensure consistency and improve model performance.

B. Image Analysis and Classification
The system uses Convolutional Neural Networks (CNN) to extract features from images. U-Net is used for segmentation, and DenseNet is used for classification. The model identifies patterns in images and classifies burns into first, second, or third degree, while also predicting skin conditions

C. Prediction and output.
The system generates predictions by analyzing the processed image using trained deep learning models. For burn analysis, the model classifies the injury into

first-degree, second-degree, or third-degree burns based on visual features such as color variation, texture, and depth of damage. For skin condition analysis, the system predicts the most probable class along with a secondary prediction to improve reliability. Each prediction is accompanied by a confidence score, which represents the probability of correctness. This helps users understand how reliable the output is. The system also highlights key regions of interest (in case of segmentation) to visually indicate the affected area.

D. Recommendation System

Based on the prediction results, the system provides simple and relevant recommendations to assist the user. For burn injuries, it suggests appropriate firstaid measures depending on the severity level, such as basic care for minor burns or immediate medical attention for severe cases. For skin conditions, the system indicates the risk level and advises whether professional consultation is needed, along with general precautionary guidelines.

IV. SYSTEM DESIGN

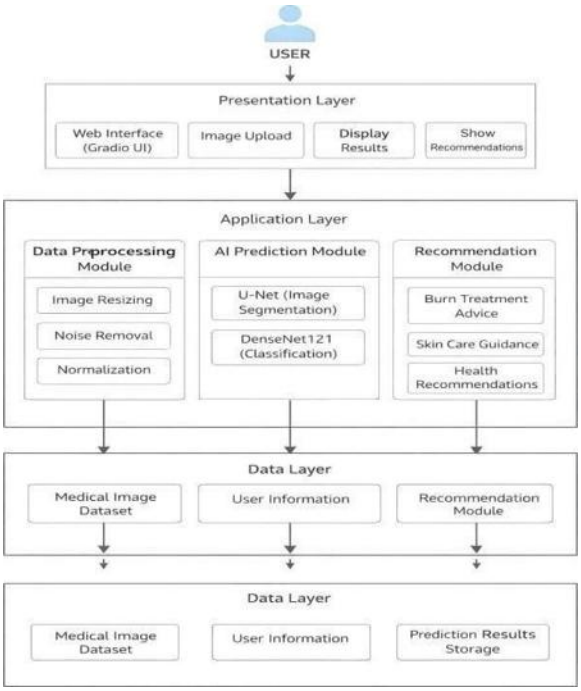

Fig. 1: System Architecture of Toxicity Analyzer

Fig. 1 shows the system architecture of the Medical Image Analysis System. The process starts with the user uploading an image through the interface. The image is then preprocessed using techniques such as resizing, noise removal, and normalization. It is analyzed using deep learning models such as U-Net for segmentation and DenseNet for classification to detect burn severity or skin conditions. Based on the prediction, the system provides recommendations like first-aid advice and health guidance. Finally, the results are stored and displayed to the user through the data layer.

V. RESULTS

The developed system successfully analyzes medical images and provides accurate and meaningful outputs for both burn detection and skin lesion classification. The system processes uploaded images efficiently using deep learning models and generates predictions along with confidence levels. The results are displayed in a clear and user-friendly interface, making it easy for users to understand their condition.

Fig. 2 shows the output of the burn analysis module. The user uploads an image of a burn injury, and the system processes it using deep learning models. The system evaluates the severity of the burn and provides appropriate care guidance. The results are generated quickly, allowing users to take immediate action based on the condition.

Fig 2: Burn analysis

Fig 3: Burn detection output

Fig. 3 shows the output of the burn assessment module. The system analyzes the uploaded burn image and predicts the severity level using deep learning models. In this case, the burn is classified as third degree with a confidence score of 59.50%. The system also provides a clear explanation of different severity levels, helping users understand the classification. This output enables users to quickly assess the seriousness of the injury and take appropriate action.

Fig. 4 shows the output of the skin lesion screening module. The system analyzes the uploaded skin image and predicts the condition using deep learning models. It provides both a primary prediction and a secondary prediction along with a malignancy risk indication. This helps users understand the possible nature of the skin condition and assess its seriousness. The output supports early awareness and guides users on whether further medical consultation is required.

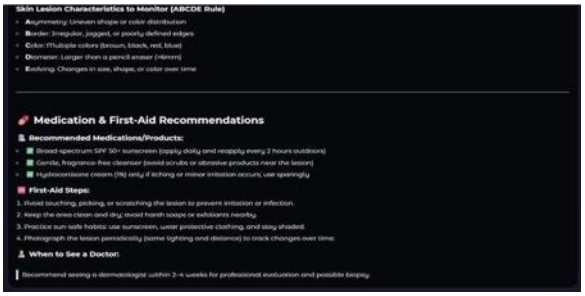

Fig 5: Medication

Fig. 5 shows the recommendation output generated by the system based on the skin lesion analysis. The system provides detailed guidance including medication suggestions, first-aid steps, and precautionary measures. It also highlights important indicators such as the ABCDE rule to help users monitor changes in the lesion. Additionally, the system advises when to consult a doctor, supporting early detection and proper medical care. This output helps users take informed decisions and manage their condition effectively.

Fig 6: Diet Recommendation

Fig. 6 shows the diet recommendation module of the system. The user provides inputs such as diet preference, health goal, meal type, and allergies through the interface. Based on these inputs, the system generates personalized diet suggestions that support recovery and overall well-being. The recommendations are designed to be simple, relevant, and easy to follow. This feature adds value to the system by not only analyzing medical conditions but also promoting healthy lifestyle choices and faster recovery.

VI. CONCLUSION

The Medical Image Analysis System demonstrates the effective use of deep learning techniques for analyzing burn injuries and skin conditions. The system successfully processes medical images, predicts the severity of burns and identifies skin lesions, and provides meaningful outputs with confidence scores. In addition to detection, the system offers first-aid guidance, medical recommendations, and personalized diet suggestions, making it a complete and user-friendly healthcare support tool. The Medical Image Analysis System demonstrates the effective use of deep learning techniques for analyzing burn injuries and skin conditions. The system successfully processes medical images, predicts the severity of burns and identifies skin lesions, and provides meaningful outputs with

confidence scores. In addition to detection, the system offers first-aid guidance, medical recommendations, and personalized diet suggestions, making it a complete and user-friendly healthcare support tool.

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REFERENCES

[1] Goodfellow, Y. Bengio, and A. Courville, *Deep Learning*. Cambridge, MA, USA: MIT Press, 2016.

[2] Géron, *Hands-On Machine Learning with*

Scikit-Learn, Keras, and TensorFlow. Sebastopol, CA, USA: O'Reilly Media, 2022.

[3] Chollet, *Deep Learning with Python*. Shelter Island, NY, USA: Manning Publications, 2018.

[4] O. Ronneberger, P. Fischer, and T. Brox, "U-Net: Convolutional Networks for Biomedical Image Segmentation," in *Proceedings of the International Conference on Medical Image Computing and Computer-Assisted Intervention (MICCAI)*. Cham, Switzerland: Springer, 2015, pp. 234–241.

[5] Huang, Z. Liu, L. Van Der Maaten, and K. Q. Weinberger, "Densely Connected Convolutional Networks," in *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, 2017, pp. 4700–4708.

[6] Litjens *et al*., "A Survey on Deep Learning in Medical Image Analysis," *Medical Image Analysis*, vol. 42, pp. 60–88, 2017.

[7] Esteva *et al*., "Dermatologist-Level Classification of Skin Cancer with Deep Neural Networks," *Nature*, vol. 542, no. 7639, pp. 115–118, 2017.

[8] J. Han, M. Kamber, and J. Pei, *Data Mining: Concepts and Techniques*. 3rd ed. Burlington, MA, USA: Morgan Kaufmann, 2011.

[9] F. Pedregosa *et al*., "Scikit-Learn: Machine Learning in Python," *Journal of Machine Learning Research*, vol. 12, pp. 2825–2830, 2011.

[10] W. McKinney and Pandas Development Team, *Pandas: Data Analysis and Manipulation Library Documentation*, 2023.

[11] J. D. Hunter, "Matplotlib: A 2D Graphics Environment," *Computing in Science & Engineering*, vol. 9, no. 3, pp. 90–95, 2007.

[12] M. Abadi *et al*., "TensorFlow: Large-Scale Machine Learning on Heterogeneous Systems," 2016.

[13] European Commission, *CosIng Database: Cosmetic Ingredient Database*, 2019.

[14] U.S. Food and Drug Administration (FDA), *Guidelines for Medical and Cosmetic Safety*, 2022.

[15] Organisation for Economic Co-operation and Development (OECD), *Guidelines for the Testing of Chemicals and Safety Evaluation*, 2018.

[16] Y. LeCun, Y. Bengio, and G. Hinton, "Deep Learning," *Nature*, vol. 521, no. 7553, pp. 436–444, 2015.

[17] K. Simonyan and A. Zisserman, "Very Deep Convolutional Networks for Large-Scale Image Recognition," in *Proceedings of the International Conference on Learning Representations (ICLR)*, 2015.

[18] K. He, X. Zhang, S. Ren, and J. Sun, "Deep Residual Learning for Image Recognition," in *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, 2016, pp. 770–778.

[19] Esteva *et al*., "Dermatologist-Level Classification of Skin Cancer with Deep Neural Networks," *Nature*, vol. 542, no. 7639, pp. 115–118, 2017.

[20] Dosovitskiy *et al*., "An Image Is Worth 16×16 Words: Transformers for Image Recognition at Scale," in *Proceedings of the International Conference on Learning Representations (ICLR)*, 2021.