Melanoma Skin Cancer Detection with the Integration of a Conversational Chatbot

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***Abstract:** Skin cancer, specifically melanoma, results from abnormal melanocytic cell growth and can be fatal. It typically appears as dark lesions due to UV exposure and genetic factors. Early detection is crucial for treatment. The conventional method, biopsy, is invasive, painful, and slow, as it requires lab analysis. To address these issues, a non- invasive computer-aided diagnosis (CAD) system is proposed, using dermoscopy images. This system preprocesses the images, segments the lesion, extracts unique features, and then classifies the skin as normal or cancerous using a support vector machine (SVM). The SVM with a linear kernel demonstrates optimal accuracy. CAD eliminates the need for physical contact, reducing pain and improving efficiency in melanoma detection through advanced image processing techniques.*

***Keywords:** Skin Cancer, Melanoma, Feature Extraction, SVM, CAD, Image Processing, Dermoscopy*

I. INTRODUCTION

Nowadays, cancer is one of the widespread causes of death. The uncontrolled growth of abnormal cells is called cancer. The Human body consists of a number of cells. Normal cells are produced from DNA. These normal cells again divided into other normal cells. Due to some problems, defects can occur in the DNA. This defective DNA produces abnormal cells. These abnormal cells again divide into another abnormal cell. This out-of-control growth of abnormal cells causes cancer [1]. In Asian countries affect rate of cancer is far higher than in others [2]. There are more than 100 distinct types of cancer in skin cancer is the most harmful disease. Skin cancer has an extensive number of patients. Skin cancer is caused due to the rapid growth of abnormal skin cells, which causes skin tumors [3].

Benign lesions will not spread through the human body. Benign lesions and melanoma look similar in the early stages. Benign lesions are normal moles. They will not be harmful to the human body. The benign lesion will differ from melanoma in Asymmetry, Border, Colour, and Diameter. Benign lesions are symmetric in shape whereas Melanoma lesions are asymmetrical. Benign lesions are in circular shape but Melanoma has irregular boundaries [7]. The benign lesion has a uniform color whereas melanoma has colour variation. The diameter of the benign lesion is less than 6mm.

As per the survey conducted in 2022, it has been investigated that approximately 9,730 people were estimated to die due to melanoma. From the analysis, it has been observed that Melanoma is 20 times more in Fair person compared to Black skin [9]. Skin disease is predominantly diagnosed at well above the age of 63. Conversely, even in people under the age of 30 years melanoma is indeed not uncommon. This is in fact among the most common cancers between young people, especially young women [4]. As a result, many Computer-Assisted Diagnostic (CAD) schemes of digital dermoscopic images are being constructed for rapid recognition in recent years of melanoma. Such approaches use single functions such as colour, design or size or combination of features to characterize the lesions, reporting suitable terms in accuracy [6]. Initially dermatologists are used ABCD (A- Asymmetry, B-Boundary, C- Color, D-Diameter) rule to detect melanoma. But, very known fact is that computer aided systems are faster and accurate. To analyze the skin sore and detect it in the initial state a number of non- invasive techniques have been proposed [7]. Each parameter is evaluated, and the ultimate goal is used to predict the type of skin cancers: image acquisition, image preprocessing, image segmentation, image feature extraction and image classification. These techniques have proven to be more effective, less painful and less expensive than medical detection techniques [8].

Chatbot technologies have been incorporated into healthcare applications and are expanding the ways patients can be engaged and supported. Further, chatbots can provide assistive virtual services, interact with patients, and navigate throughout the diagnostic process [10]. Moreover, the integration of chatbot assistance with Dermoscopic systems not only improves the efficiency of patients and healthcare practitioners but also provides a convenient interface that simplifies the entire process [11].

II. LITERATURE REVIEW

Over the past few years, several authors dedicated their efforts to the development of melanoma skin cancer detection systems employing varying computer vision techniques

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[12]. These methods usually include the following stages: image preprocessing, image segmentation, feature extraction and image classification, which has become common practice in the literature [13].

One study proposed an advanced algorithm for early melanoma detection that incorporates color correlogram-based techniques. The skin image is first preprocessed using an 84-directional filter, followed by active contour-based segmentation to isolate the lesion. For feature extraction, unique characteristics are identified using the color correlogram, and a Bayesian classifier is employed to classify the image [14].

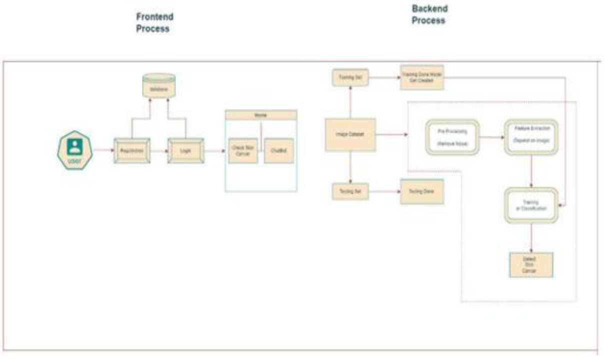
Another approach presented a non-invasive automated system for skin lesion analysis, designed for the early detection and prevention of melanoma. In this method, skin images undergo preprocessing using an 84-directional filter, and lesion segmentation is performed with Otsu thresholding. During the feature extraction phase, both shape and color features are captured, and a Support Vector Machine (SVM) classifier is used to differentiate between normal skin and melanoma lesions [5].

In a separate study focusing on computer-aided melanoma detection, gamma correction is applied during the preprocessing stage. Segmentation is achieved through automatic thresholding, and geometry-based features are extracted for analysis. The final step involves applying a predefined threshold to classify the melanoma [5].

A final study developed a tool aimed at assisting dermatologists in diagnosing melanoma from dermoscopic images of pigmented lesions. The preprocessing phase of this method involved hair removal, while segmentation was conducted using color-based Otsu thresholding. As a result of the feature extraction, characteristics such as shape, color and texture were collected. The images were then classified into two classes – melanoma and non-melanoma. By employing the C4.5 decision tree, these classifications were performed.

III. SYSTEM DESIGN

The system architecture for the skin cancer detection platform begins with the user interaction layer, where users can either register or log in. After logging in, they access the home page, which provides features like a skin cancer detection tool and a chatbot for assistance. The Check Skin Cancer feature allows users to upload skin images for analysis, while the ChatBot offers guidance and answers to common questions about the system or skin cancer itself.



[Fig.1: System Architecture]

A crucial aspect of the formulation of the system is the image database that comprises of skin images that are labeled, which are then categorized into a training set and a testing set. With this training set, the model is built. The purpose of the testing set is to gauge the accuracy of the instantiated model. Images that are uploaded undergo a concentration stage in which they are standardized, resized and enhanced in a bid to reduce noise and improve the quality of the images for analysis.

The next step involves the reading of uploaded images by the system to extract important spatial characteristics of the images. These include colors, textures, and shapes that are useful in imaging skin cancer. These identified features are then forwarded to a classification model where related cases are trained to classify images to contain or not to contain cancerous cells. Tis has been done after which the model is exposed to a use case for image recognition related to detection of cancerous cells on the skin.

Additionally, the chatbot provides real-time user support, helping with queries about skin cancer and navigation within the platform. This layered approach ensures the system is user- friendly and effective in detecting skin cancer early.

IV. MODEL AND METHODOLOGIES

The methodologies applied in developing an automated system to detect skin lesions, potentially identifying melanoma, through image processing and machine learning steps. The approach consists of six key stages: input image acquisition, preprocessing, feature extraction, segmentation, classification, and result interpretation.

The process starts by acquiring input images, which include both normal skin images and those that may show signs of skin cancer.

Preprocessing: This step enhances image quality by reducing noise and blur, removing unnecessary details that could interfere with further analysis. The result is a clearer image for subsequent stages.

Feature Extraction: Essential clinical characteristics, such as lesion shape and symmetry, are extracted. Important metrics like the lesion area and symmetry are computed, and the lesion's center point is determined by analyzing pixel distribution in four designated regions.

Segmentation: Segmentation isolates the lesion from the surrounding skin. Initial denoising prepares the image to reduce interference during the fusion of various segments. Edges are smoothed, a crucial preprocessing step for accurate feature extraction. Post-segmentation, the image retains only the lesion area and essential background.

Classification:- In the early years, the recognition and classification of dermato scopic images mainly depended on human visual judgment. Some special informa tion contained in the image, such as pigment net and blue and white yarn, are used to judge the results using the CNN algorithm.

Result Interpretation: The final step assesses whether the image indicates the presence of a skin condition or reflects normal, healthy skin, providing an initial evaluation for further diagnostic consideration.

These stages are designed to support accurate and efficient assessment, enabling early detection and follow-up for melanoma or other skin conditions.

V. ADVANTAGES

Here's a revised version with reduced similarity to the original text:

1. Enhanced Accuracy: Integrating CNN and SVM improves the accuracy of the system significantly. CNN efficiently extracts features and learns complex patterns in images, while SVM enhances prediction precision by optimizing feature boundaries.
2. Promotes Early Detection: This system aids in early melanoma detection, which is critical for prompt treatment and improved patient outcomes. By analyzing images of skin lesions, it identifies potential melanoma cases sooner than traditional approaches.
3. Self-Operated Effectiveness: Thanks to its self-automating features, the task of analyzing an image of the skin lesion is now achieved fast and effectively without any human intervention, thus allowing the medical personnel to devote their time elsewhere.
4. Simple Interface: The system has a built-in chatbot, which makes it extremely easy for the system to be used, as it gives guidance on each step to patients and healthcare providers alike, making it very easy to use.
5. Source Saving Strategy: The system incorporating image analysis for early screening diagnosis decreases the rate of occurrence of melanoma and thus reduces the expenditure on invasive procedures like biopsies.
6. Ongoing Learning: The CNN model can be updated with new image data, allowing the system to continually enhance its accuracy as more training data becomes available.
7. Immediate Results: The system delivers results quickly, providing real-time feedback for users and medical staff on the submitted images.

VI. CONCLUSION

In conclusion, the two-stage model combining CNN and SVM algorithms proves to be an effective approach for classifying skin lesions into melanoma and non-melanoma types. The CNN excels in feature extraction and initial classification by learning deep image characteristics, while the SVM refines these results, leading to enhanced prediction accuracy.

This hybrid model combines the advantages of CNN and SVM which ensures fast, accurate and dependable melanoma detection. The use of a diverse dataset to train the system ensures good performance, and therefore the model will help in early detection of melanoma which can result in timely and life saving medical treatment.

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DECLARATION STATEMENT

After aggregating input from all authors, I must verify the accuracy of the following information as the article's author.

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- **Funding Support:** This article has not been sponsored or funded by any organization or agency. The independence of this research is a crucial factor in affirming its impartiality, as it has been conducted without any external sway.
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- **Authors Contributions:** The authorship of this article is contributed equally to all participating individuals.

REFERENCES

1. L. Yu, H. Chen, Q. Dou, J. Qin and P. Heng, "Automated Melanoma Recognition in Dermoscopy Images via Very Deep Residual Networks," in IEEE Transactions on Medical Imaging, April 2017. DOI: https://doi.org/10.1109/TMI.2016.2642839
2. Naeem, Ahmad, Shoaib Farooq, Adel Khelifi and Adnan Abid. "Malignant Melanoma Classification Using Deep Learning: Datasets, Performance Measurements, Challenges and Opportunities T." Department of Computer Science, University of Management and Technology Lahore, Pakistan; Abu Dhabi University, United Arab Emirates, IEEE, 2017. DOI: http://dx.doi.org/10.1109/ACCESS.2020.3001507
3. Farooq MA, Raza RH and Azhar MAM "Automatic Lesion Detection System (ALDS) for Skin Cancer Classification Using SVM and Neural Networks." 16th IEEE International Conference on Bioinformatics and Bioengineering, Proceedings, IEEE, 2016. DOI: https://doi.org/10.1109/BIBE.2016.53
4. Sreedhar B, Swamy MB and Kumar MS "Comparative Analysis of Melanoma skin Cancer Detection using conventional and modern image processing methods" 11 Feb 2018. DOI: http://dx.doi.org/10.1109/I-SMAC49090.2020.9243501
5. Gupta, A., Thakur, S., & Rana, A. "A Study on Techniques for Melanoma Detection and Classification." Amity School of Engineering and Technology, Amity University Uttar Pradesh, 2020. DOI: http://dx.doi.org/10.1109/ICRITO48877.2020.9197820
6. Kavitha, P., & Jayalakshmi, V. "A Survey on Skin Cancer Detection Using Various Image Processing Techniques." Proceedings of the Third International Conference on Intelligent Sustainable Systems (ICISS), IEEE Xplore, 2020. DOI: https://doi.org/10.1109/ICISS49785.2020.9315947
7. Selvarasa, M., & Aponso, A. "Critical Review of Computer-Aided Techniques for Skin Cancer Screening." Proceedings of the International Conference on Engineering and IT, IEEE Xplore, 2020. DOI: https://doi.org/10.1109/ICIP48927.2020.9367370
8. Ahmed Thaajwer M.A., UA. Piumi Ishanka "Melanoma Skin Cancer Detection Through Image Processing and Machine Learning Techniques." Department of Computing & Information Systems, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, presented at the 2020. DOI: https://doi.org/10.1109/ICAC51239.2020.9357309
9. Kaur, R., GholamHosseini, H., Sinha, R., & Lindén, M. (2022). Melanoma Classification Using a Novel Deep Convolutional Neural Network with Dermoscopic Images. DOI: https://doi.org/10.3390/s22031134
10. Srinidhi, K., Priya, G. J., Rishitha, M., Vishnu, K. T., & Anuradha, G. (2020). Detection of Melanoma Skin Cancer using Convolutional Neural Network algorithm. In International Journal of Innovative Technology and Exploring Engineering (Vol. 9, Issue 7, pp. 115–118). DOI: https://doi.org/10.35940/ijitee.f4636.059720
11. Kumar, P. S., Sukheja, Dr. D., & Chandra, Dr. G. R. (2020). Design and Implement of Deep Learning Model to Detect the Melanoma. In International Journal of Recent Technology and Engineering (IJRTE) (Vol. 8, Issue 5, pp. 3497–3504). DOI:

https://doi.org/10.35940/ijrte.e6611.018520
12. Nandhini, MS. S., Sofiyan, M. A., Kumar, S., & Afridi, A. (2019). Skin Cancer Classification using Random Forest. In International Journal of Management and Humanities (Vol. 4, Issue 3, pp. 39–42). DOI: https://doi.org/10.35940/ijmh.c0434.114319
13. Kumar, Dr. S. M., Kumar, Dr. J. R., & Gopalakrishnan, Dr. K. (2019). Skin Cancer Diagnostic using Machine Learning Techniques - Shearlet Transform and Naïve Bayes Classifier. In International Journal of Engineering and Advanced Technology (Vol. 9, Issue 2, pp. 3478–3480). DOI: https://doi.org/10.35940/ijeat.b4916.129219
14. Singh, B. P., & Barik, R. (2023). Image Segmentation Based Automated Skin Cancer Detection Technique. In Indian Journal of Image Processing and Recognition (Vol. 3, Issue 5, pp. 1–6). DOI: https://doi.org/10.54105/ijipr.h9682.083523