



International Journal of Innovative Research in Science Engineering and Technology (IJIRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.699

Volume 14, Issue 4, April 2025

AI-Powered Multiple Skin Cancer Detection and Virtual Dermatology Support System using Pre-Trained CNN Algorithm

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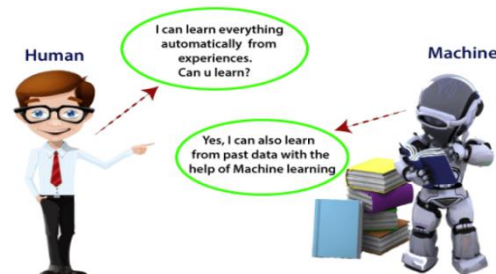
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ABSTRACT: Skin cancer is one of the most prevalent and potentially deadly forms of cancer worldwide, with early detection playing a critical role in effective treatment and improved survival rates. Traditional diagnostic methods often rely on visual inspections by dermatologists, which can be subjective and limited by access to healthcare. To address these challenges, this project proposes an AI-powered system capable of detecting multiple types of skin cancer using pre-trained Convolutional Neural Network (CNN) models. By leveraging large datasets of dermoscopic images, the system is trained to accurately classify different categories of skin lesions, including melanoma, basal cell carcinoma, and squamous cell carcinoma. The proposed solution utilizes transfer learning with advanced CNN architectures such as VGG16, ResNet50, or InceptionV3, allowing the model to achieve high accuracy even with limited data. The system is designed to analyze images uploaded by users, providing a preliminary diagnostic report based on the likelihood of malignancy. It also includes a confidence score and visual heatmaps for better interpretability. This AI-based diagnostic support significantly reduces the burden on dermatologists, enabling faster triage and prioritization of high-risk cases, especially in resource-constrained environments. In addition to detection, the platform offers a virtual dermatology support system, where users can interact with the AI for personalized skin health advice, risk factor analysis, and follow-up care suggestions. The integration of telemedicine with AI enhances accessibility and continuity of care, ensuring that patients receive timely and informed recommendations. This project ultimately aims to democratize dermatological care by combining the precision of AI with the reach of digital healthcare, contributing to the early identification and management of skin cancers.

I. INTRODUCTION

MACHINE LEARNING WITH CNN

Machine learning with CNN (ML) is a subset of AI, which uses algorithms that learn from data to make predictions. These predictions can be generated through supervised learning, where algorithms learn patterns from existing data, or unsupervised learning, where they discover general patterns in data. The term machine learning with CNN was coined in 1959 by Arthur Samuel, an IBM employee and pioneer in the field of computer gaming and artificial intelligence. The synonym self-teaching computers was also used in this time period. Machine learning with CNN holds a significant advantage in identifying trends and patterns across various industries. With the exponential growth of data, machine learning with CNN algorithms have become even more powerful in analysing vast and complex datasets.



TECHNIQUES OF ML

Machine learning with CNN

Machine learning with CNN is an Application of Artificial Intelligence (AI) it gives devices the ability to learn from their experiences and improve their self without doing any coding.

Unsupervised Learning

UL Detects hidden patterns or internal structures in unsupervised learning data. unsupervised machine learning with CNN models are given unlabeled data and allowed to discover patterns and insights without any explicit guidance or instruction.

Clustering

Clustering is a common unsupervised learning technique. It is used for exploratory data analysis to find hidden patterns and clusters in the data.

Supervised Learning

Supervised machine learning with CNN, It is defined by its use of labeled datasets to train algorithms that to classify data or predict outcomes accurately.

APPLICATIONS

One of the most notable machine learning with CNN applications is image recognition, which is a method for cataloging and detecting an object or feature in a digital image. In addition, this technique is used for further analysis, such as pattern recognition, face detection, and face recognition.

ML in Healthcare

In healthcare, machine learning with CNN (ML) is revolutionizing the industry by leveraging advanced algorithms to extract meaningful insights from vast amounts of data. From improving diagnostic accuracy through the analysis of medical imaging to enhancing personalized treatment plans based on genetic information.

ML in Retail

In retail, machine learning with CNN (ML) is like a helpful guide for stores to understand customers better and make shopping more enjoyable. Think of it as a smart friend that suggests products you might like based on what you've bought before. ML helps stores keep the right amount of products in stock so they don't run out or have too much.

ML in Media

In media, machine learning with CNN is like a wizard behind the scenes making everything more exciting. It helps recommend movies or shows you might enjoy based on what you've watched before. When you see news articles or social media posts that interest you, that's machine learning with CNN paying attention to what you like.

ML in Finance

Machine learning with CNN is like a super-smart assistant for handling money matters. It helps banks decide if you're eligible for a loan by looking at your financial history. When you use your credit card, machine learning with CNN is there to catch anything fishy and keep your transactions safe.

ML in travel

Machine learning with CNN is like a friendly travel companion, making your journey more personalized and hassle-free. It helps you find the best deals on flights and hotels by understanding your preferences. When you get suggestions for exciting destinations or activities, that's machine learning with CNN making your travel plans more tailored to your interests.



ML IN VARIOUS APPLICATIONS

ML in Marketing

Machine learning with CNN is a type of artificial intelligence that uses algorithms to make predictions and decisions based on data. It's used in many different areas of modern life, from healthcare to finance to advertising, and it can be applied directly to marketing activities like lead scoring email marketing and Social Media Advertising.

Email Marketing

Email marketing is a powerful tool for digital marketers, and machine learning with CNN can be used to create personalized email campaigns based on customer behavior. This can be done by analyzing data from various sources, such as purchase history and browsing behavior, to create targeted email campaigns more likely to resonate with customers. It also helps in marketing automation by allowing us to schedule emails beforehand.

Social Media Advertising

Social media advertising is an effective way to reach a large audience. Machine learning with CNN algorithms can be used to analyze social media data to identify patterns and insights that can be used to create more effective social media advertising campaigns. This can be done by analyzing data from various sources, such as social media engagement and website analytics.

Chatbots

Chatbots are becoming increasingly popular in digital marketing, and machine learning with CNN can be used to create intelligent chatbots that can provide customers with personalized recommendations and assistance. This can be done by analyzing customer data and using this data to develop customized chatbot interactions.

ML CHARACTERISTICS

Machine Learning

Machine learning with CNN is a subset of AI, which uses algorithms that learn from data to make predictions.

Machine learning with CNN technique that teaches computers to do what comes naturally to humans.

Chatbots

Chatbots are software to provide a window for solving customer problems through either audio or textual input

Cloud Computing

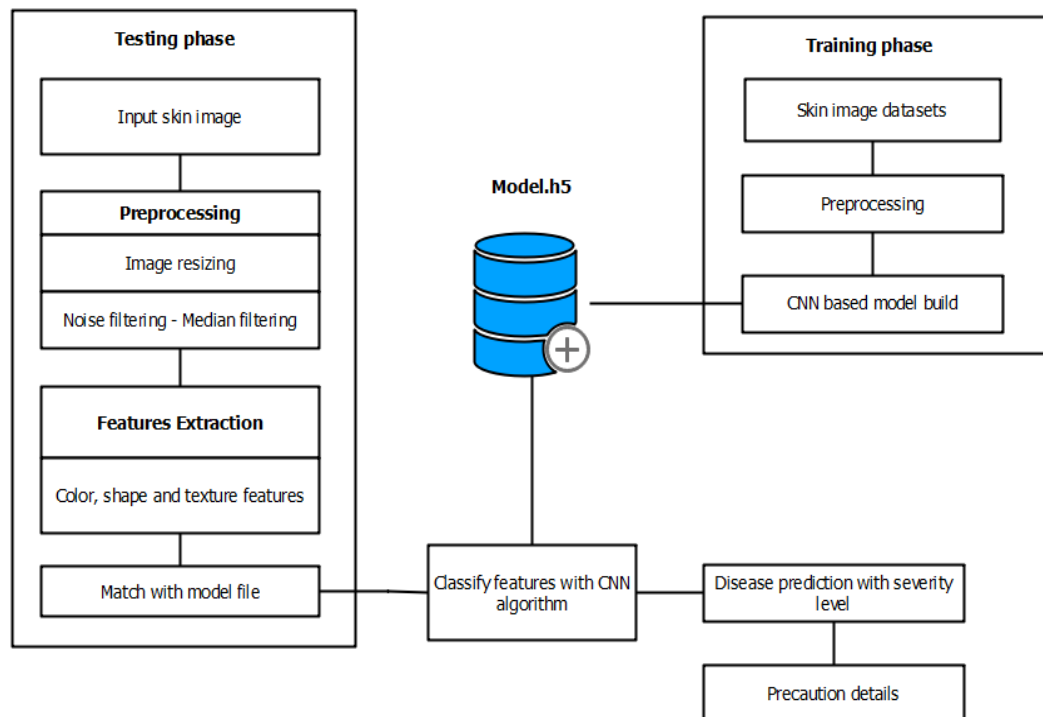
ML capabilities are working within the business cloud computing environment to make organizations more efficient, strategic, and insight-driven.

II. PROPOSED SYSTEM

The proposed system utilizes a pre-trained Convolutional Neural Network (CNN) architecture to develop a robust and accurate model for detecting multiple types of skin cancer from dermoscopic images. By employing transfer learning, models such as VGG16, ResNet50, or InceptionV3 are fine-tuned on a specialized dataset of labeled skin lesion images, such as HAM10000. These pre-trained models have already learned general image features from large-scale datasets like ImageNet, which allows the system to focus on learning skin-specific patterns with fewer training images. The CNN extracts deep features from the input images, including color, texture, shape, and lesion borders, enabling precise classification of different skin cancer types.

Once trained, the model is integrated into a user-friendly web or mobile platform where users can upload images of skin lesions for analysis. The system processes the image, performs classification, and returns the predicted class along with a confidence score and visual heatmap to highlight the regions of concern. Additionally, the system includes a

virtual dermatology support module that offers follow-up suggestions, basic health tips, and connectivity to a dermatologist if necessary. This AI-assisted platform aims to support both patients and healthcare providers by delivering quick, accurate, and accessible skin cancer screening and support. Finally, the average accuracy of this algorithm has reached 91.59%.



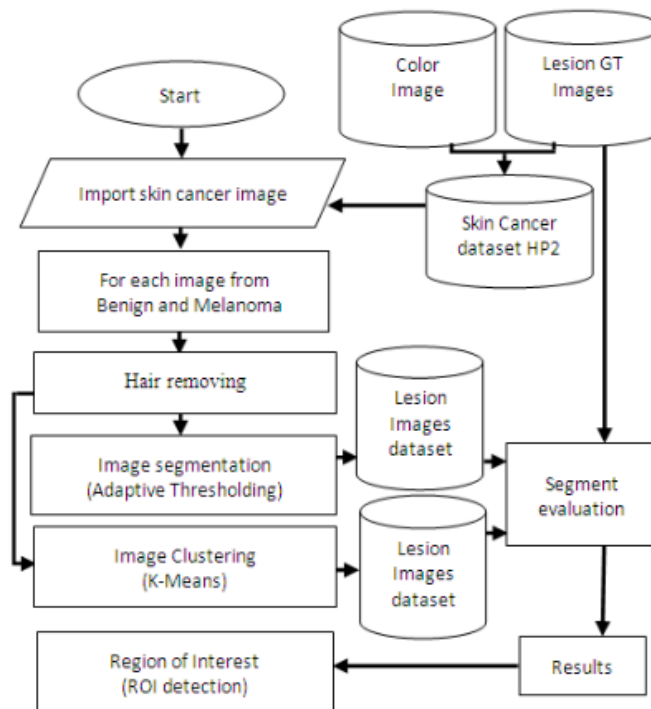
ADVANTAGES

- It perform high accuracy.
- It detected in real time.
- low risk, and cost effective.
- Scope of improvement.
- Efficient of handling a data.

IMPLEMENTATION

The implementation of the AI-powered skin cancer detection system involves several key stages, starting with data preprocessing and augmentation using a publicly available dataset such as HAM10000, which contains dermoscopic images of various skin lesions. A pre-trained CNN model like ResNet50 is selected for transfer learning, where the top layers are fine-tuned to adapt to skin lesion classification. The dataset is split into training, validation, and testing sets to ensure accurate performance evaluation. The model is trained using techniques like data augmentation, dropout, and early stopping to prevent overfitting. Once trained, the model is integrated into a web-based application using frameworks such as Flask or Django, allowing users to upload images and receive real-time predictions. The platform also features Grad-CAM-based visualizations for explainability and a virtual assistant module built with basic NLP to offer skin care advice and connect users to dermatologists when needed.

III. SYSTEM ARCHITECTURE



MODULES

- Acquisition Of Data.
- Image Preprocessing.
- Image Graying And Enhancement.
- Edge Extraction.
- Histogram Equalization.

MODULES DESCRIPTION

ACQUISITION OF DATA

At present, there are limited high-quality datasets available for annotated skin cancer image classification, which presents a significant challenge for the development of reliable AI diagnostic models. This study is based on the curation and annotation of a comprehensive dermoscopic image dataset sourced from reputable dermatological research and clinical archives. The dataset includes medically verified classifications and annotations of various skin lesions, including melanoma, basal cell carcinoma, and squamous cell carcinoma, among others. By leveraging expert-reviewed image data, this work ensures scientific accuracy and clinical relevance, providing a solid foundation for training and validating convolutional neural network (CNN) models for the automated detection and classification of multiple types of skin cancer.

	Layer	Feature Map	Size	Kernel Size	Stride	Activation
Input	Image	1	224 x 224 x 3	-	-	-
1	2 X Convolution	64	224 x 224 x 64	3x3	1	relu
	Max Pooling	64	112 x 112 x 64	3x3	2	relu
3	2 X Convolution	128	112 x 112 x 128	3x3	1	relu
	Max Pooling	128	56 x 56 x 128	3x3	2	relu
5	2 X Convolution	256	56 x 56 x 256	3x3	1	relu
	Max Pooling	256	28 x 28 x 256	3x3	2	relu
7	3 X Convolution	512	28 x 28 x 512	3x3	1	relu
	Max Pooling	512	14 x 14 x 512	3x3	2	relu
10	3 X Convolution	512	14 x 14 x 512	3x3	1	relu
	Max Pooling	512	7 x 7 x 512	3x3	2	relu
13	FC	-	25088	-	-	relu
14	FC	-	4096	-	-	relu
15	FC	-	4096	-	-	relu
Output	FC	-	1000	-	-	Softmax

Acquisition of Data

IMAGE PREPROCESSING

Aiming at n the context of skin cancer image analysis, dermoscopic images often suffer from several quality issues that affect the accuracy of automated diagnosis: (a) Artifacts and noise introduced by hair, air bubbles, or lighting inconsistencies that obscure important features; (b) Image blurring or poor focus due to improper camera alignment or patient movement during capture; (c) The presence of local salt-and-pepper noise and global Gaussian noise, which can distort texture and color information critical for lesion classification. To address these challenges, this study applies an image preprocessing algorithm based on OpenCV techniques to enhance the dermoscopic dataset. The preprocessing pipeline includes noise filtering, contrast enhancement, and hair artifact removal while preserving high-frequency features, thereby improving overall image quality and making critical lesion characteristics more discernible for the CNN Model.

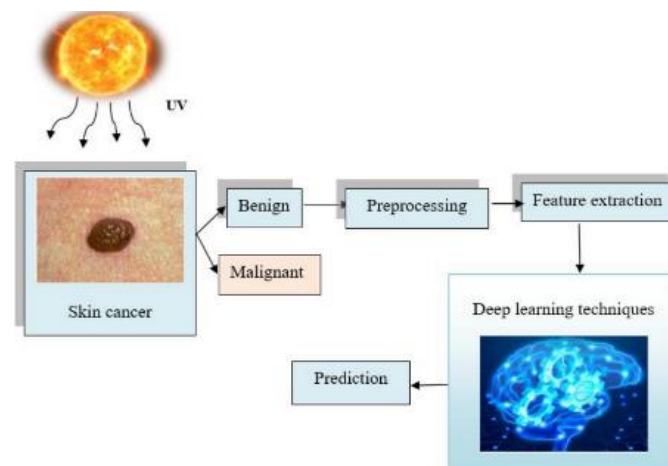


Image Processing

IMAGE GRAYING AND ENHANCEMENT

The dermoscopic images in the dataset are composed of RGB (Red, Green, Blue) color channels, which capture the optical characteristics of the skin surface and sub-surface structures. These channels are crucial for identifying the morphological patterns and pigmentation features associated with various types of skin lesions, such as asymmetry, border irregularity, and color variation. While RGB images provide rich visual information essential for accurate classification, they may also include redundant or irrelevant data that can reduce the efficiency of feature extraction and

computational performance. Therefore, careful preprocessing and feature selection are necessary to enhance the quality of the input data and ensure that the CNN model focuses on the most informative aspects of the lesion.

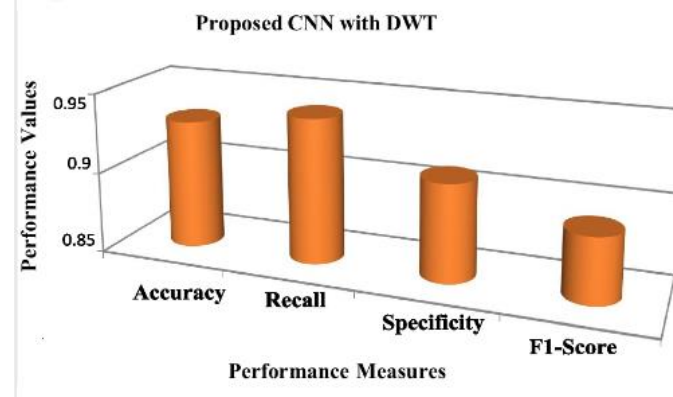
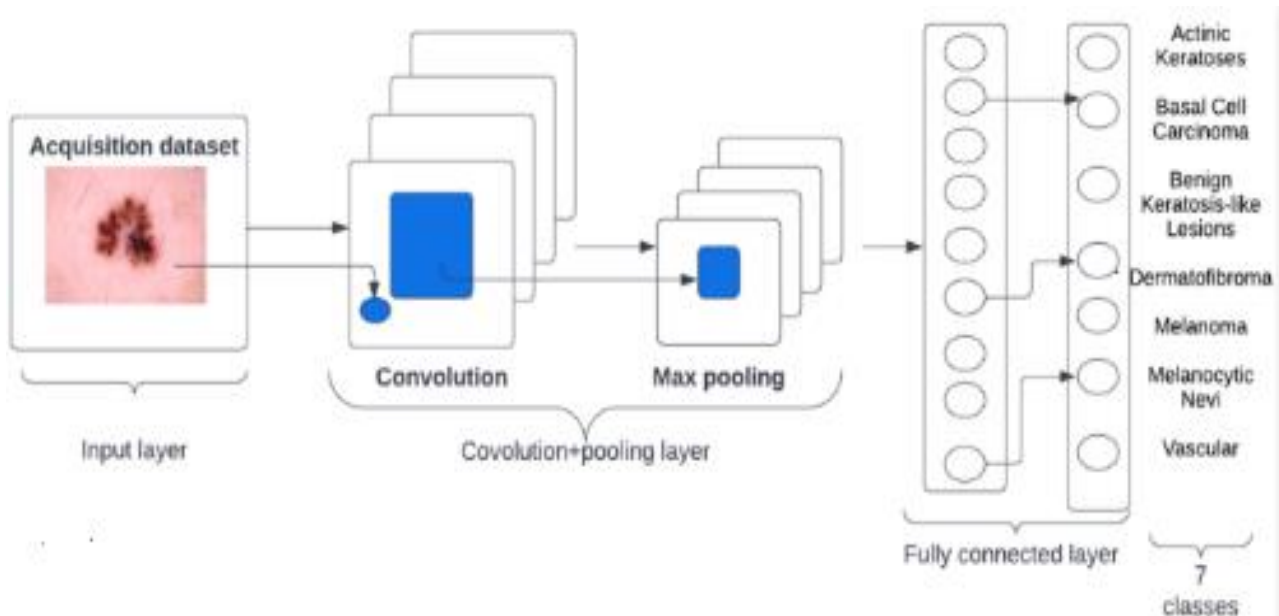


Image Graying and Enhancement

EDGE EXTRACTION

Edge extraction involves highlighting the boundaries and sharp transitions within an image, which is particularly useful for identifying the shape, structure, and borders of skin lesions. In dermoscopic images, precise edge detection can help differentiate between benign and malignant lesions based on features such as irregular borders or abrupt color changes. Machine learning algorithms, especially CNNs, can leverage these extracted edges to enhance feature recognition and improve classification accuracy. By applying edge detection techniques—such as Sobel, Canny, or Laplacian operators—to skin cancer datasets, subtle morphological details can be emphasized, leading to more reliable and precise diagnostic outcomes.



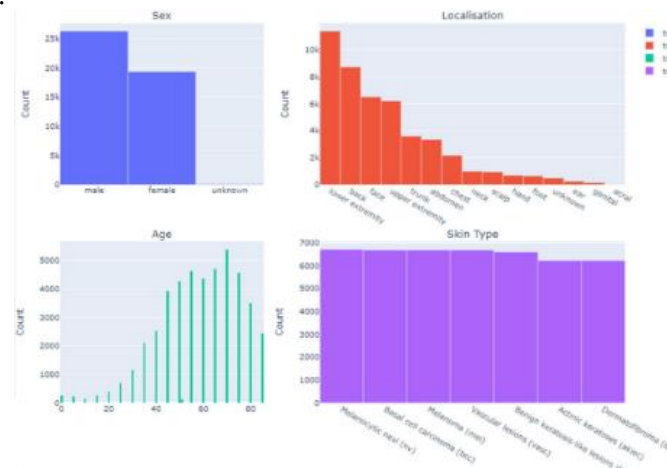
Edge Extraction

HISTOGRAM EQUALIZATION

The incorporation of histogram equalization plays a crucial role in enhancing the quality of dermoscopic images used for skin cancer detection. This image preprocessing technique improves contrast, making subtle features such as

pigmentation, texture, and lesion borders more distinguishable. In the context of medical imaging, especially for training Convolutional Neural Network (CNN) models, histogram equalization ensures that input data is optimized for feature extraction.

By enhancing contrast, the technique allows the model to better detect key diagnostic patterns, ultimately leading to improved accuracy in skin lesion classification. The integration of enhanced dermoscopic images with machine learning algorithms significantly strengthens the system's diagnostic performance and contributes to the advancement of AI-assisted dermatology.



Histogram Equalization

IV.CONCLUSION

Recently, our study has successfully demonstrated the potential of leveraging data mining and Machine learning with CNN techniques for the recognition of skin cancer lesion images. The application of Machine learning with CNN, particularly convolutional neural networks (CNNs), has shown remarkable accuracy in feature extraction and image classification. The amalgamation of data mining methodologies, including data preprocessing and feature selection, has significantly enhanced the model's performance. This research underscores the promising role of these integrated approaches in improving diagnostic capabilities in the field of skin cancer. In conclusion, the integration of Convolutional Neural Networks (CNNs) into skin cancer detection has significantly advanced diagnostic accuracy, enabling automated analysis of dermoscopic images. Studies have demonstrated that CNN-based models can achieve high performance, with some approaches reaching accuracies above 99% in melanoma detection. However, challenges such as dataset variability, model interpretability, and clinical applicability persist. Addressing these issues through dataset standardization, interdisciplinary collaboration, and continuous model refinement is essential for the continued advancement and adoption of CNNs in clinical settings. Nonetheless, it is imperative to address challenges such as dataset quality, model interpretability, and real-world clinical applicability in future research to ensure the continued advancement and adoption of these technologies in the medical field.

FUTURE ENHANCEMENT

Advancements in Convolutional Neural Networks (CNNs) have significantly enhanced the accuracy of skin cancer detection. Recent studies have demonstrated that integrating novel architectures and attention mechanisms can further improve diagnostic performance. For instance, a hybrid model combining ConvNeXtV2 blocks with focal self-attention mechanisms achieved an accuracy of 93.60% on the ISIC 2019 dataset, effectively identifying subtle skin anomalies. Additionally, incorporating patient metadata, such as age, gender, and anatomical site, alongside lesion images has been shown to enhance classification accuracy by at least 5%, highlighting the importance of comprehensive data in training robust models. Moreover, integrating AI-driven diagnostic tools into clinical practice offers potential benefits, including increased diagnostic accuracy, efficient triaging, and improved patient outcomes through early detection and treatment. Addressing challenges like dataset variability, model interpretability, and ensuring real-world applicability

remains crucial for the widespread adoption of these technologies in dermatology.. This ongoing effort is crucial for advancing the understanding and diagnosis of colorectal polyps, ultimately leading to improved patient care and medical research.

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