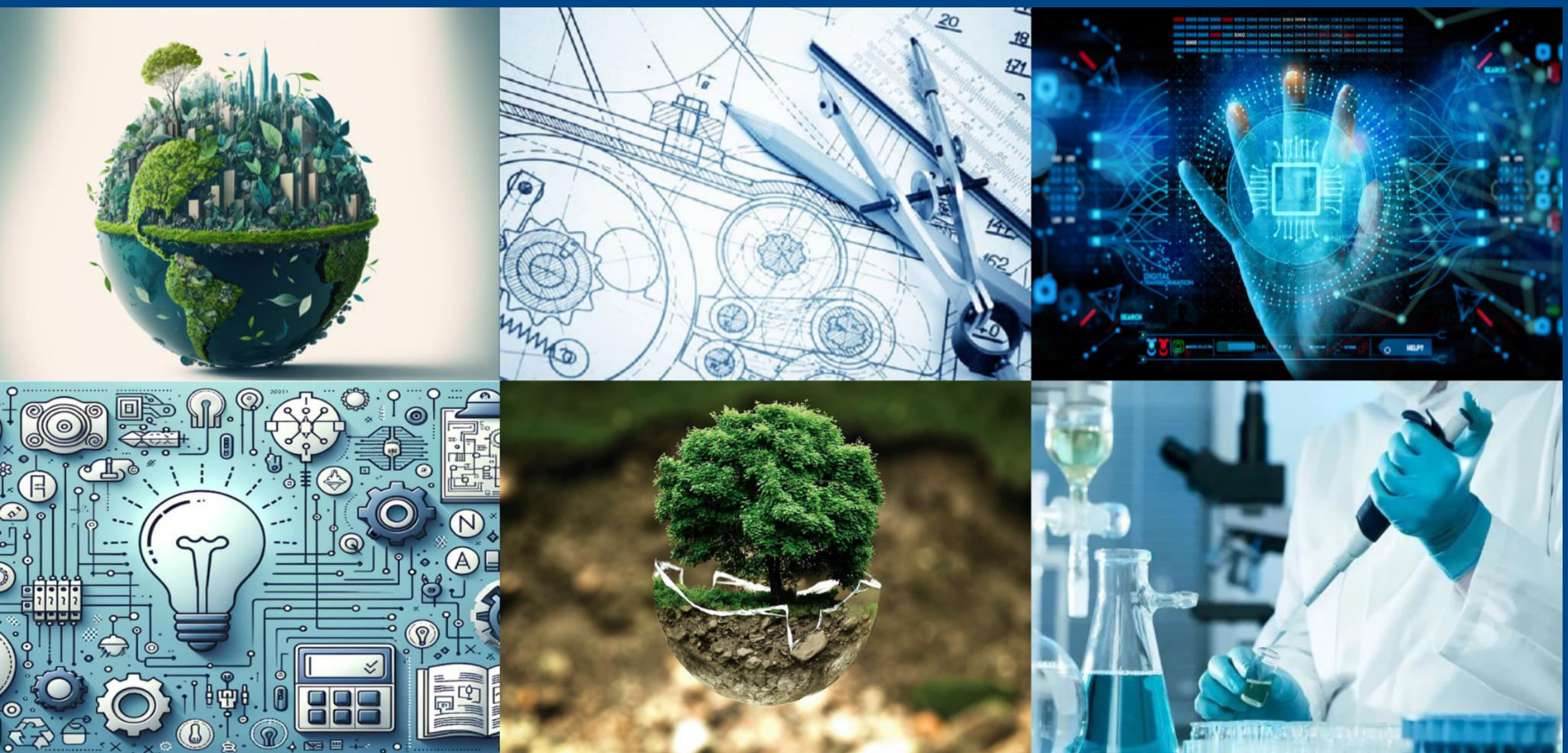
ISSN: 2582-7219

International Journal of Multidisciplinary Research in Science, Engineering and Technology

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



Impact Factor: 9.864

Volume 9, Issue 5, May 2026

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 9.864| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

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Skin Cancer Detection Using Deep Learning Techniques

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ABSTRACT: Skin cancer is one of the most common and life-threatening diseases worldwide. Early diagnosis plays a major role in improving survival rates and reducing mortality. This paper presents a Convolutional Neural Network (CNN)-based deep learning system for automatic skin cancer detection and classification. Dermoscopic images from the HAM10000 dataset are used for training and testing the model. The proposed system performs image preprocessing, feature extraction, and classification into benign and malignant categories. Data augmentation techniques are applied to improve model generalization and reduce overfitting. The CNN model automatically learns important image features such as lesion texture, shape, irregular boundaries, and color variation. Experimental results show that the system provides good accuracy with faster prediction time. The proposed approach helps reduce human error, supports dermatologists in decision making, and provides an efficient healthcare solution for early skin cancer diagnosis.

I. INTRODUCTION

Skin cancer is a dangerous disease caused by the uncontrolled growth of abnormal skin cells due to excessive exposure to ultraviolet radiation. The major types of skin cancer include melanoma, basal cell carcinoma, and squamous cell carcinoma. Among these, melanoma is considered the most harmful because it spreads quickly to other organs if not detected early.

Traditional diagnosis methods depend on visual examination, dermoscopy, and biopsy. Although effective, these methods are time-consuming and require experienced dermatologists. Manual diagnosis may also lead to incorrect prediction because benign and malignant lesions often appear visually similar. Artificial Intelligence and Deep Learning techniques have significantly improved medical image analysis by providing automated and accurate classification systems.

The proposed system uses a CNN model for automatic skin cancer detection using dermoscopic images. CNN automatically extracts important features from images and performs accurate classification. The proposed system helps reduce diagnosis time and improves healthcare efficiency.

II. LITERATURE SURVEY

Several researchers have proposed deep learning-based approaches for skin cancer detection. Christy JS and Kumari GRN developed a YOLO-UNet++ segmentation framework integrated with adaptive deep learning classification. The system improved lesion segmentation and classification accuracy but required high computational resources.

Aishwarya N et al. proposed a YOLO Deep Neural Network for real-time skin cancer diagnosis. The system provided faster detection and achieved good accuracy in lesion classification. However, it struggled with small lesions and highly irregular patterns.

Nunnari F et al. introduced Explainable Artificial Intelligence techniques using Grad-CAM saliency maps and CNN models. Their work improved interpretability and trust in AI-based diagnosis systems.

Existing systems provide improved accuracy but suffer from limitations such as computational complexity, dataset imbalance, and poor generalization capability. The proposed CNN-based model overcomes these issues through simplified architecture and effective preprocessing techniques.

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III. EXISTING SYSTEM AND LIMITATIONS

Existing skin cancer detection systems mainly rely on machine learning algorithms, segmentation models, and manual feature extraction techniques. Traditional machine learning systems depend on handcrafted features such as color, texture, and lesion shape. These methods often fail to capture complex patterns from dermoscopic images.

Another limitation is low segmentation accuracy for irregular lesions and poor performance under varying lighting conditions. Existing systems also suffer from overfitting due to limited datasets. Small lesions are often misclassified, leading to higher false positive and false negative rates.

Cloud-based diagnostic systems require internet connectivity and increase processing delay. Many deep learning systems also require high computational power and expensive GPU hardware. These limitations motivate the development of an efficient CNN-based automated skin cancer detection system.

IV. PROPOSED SYSTEM

The proposed system uses Convolutional Neural Networks for automatic skin cancer detection. The workflow consists of image acquisition, preprocessing, feature extraction, classification, and prediction.

During preprocessing, dermoscopic images are resized to 224 × 224 pixels and normalized to improve image quality and maintain consistency. Data augmentation techniques such as rotation, flipping, scaling, and zooming are applied to increase dataset diversity.

The CNN model contains convolution layers, pooling layers, fully connected layers, and sigmoid activation functions. Convolution layers automatically extract important image features such as lesion edges, texture, and abnormal patterns. Pooling layers reduce dimensionality and computational complexity. Fully connected layers perform classification into benign and malignant categories.

The trained model supports image-based prediction and real-time webcam detection. The proposed architecture improves classification accuracy and reduces diagnosis time.

V. HARDWARE AND SOFTWARE REQUIREMENTS

The proposed system requires both hardware and software resources for implementation. Hardware requirements include Intel Core i5/i7 processor, 8GB RAM, SSD storage, webcam, Raspberry Pi board, and LED monitor. These components support image processing, CNN training, and real-time prediction. The software tools used in this project include Python programming language, TensorFlow, Keras, OpenCV, NumPy, Matplotlib, and Scikit-learn. TensorFlow and Keras are used for CNN model development and training. OpenCV is used for image preprocessing and webcam integration. NumPy supports numerical computation, while Matplotlib is used for visualization of training graphs.

The HAM10000 dataset is used for model training and testing. It contains more than 10,000 dermoscopic images of different skin lesion categories.

VI. RESULTS AND DISCUSSION

The CNN model was trained and tested using dermoscopic images from the HAM10000 dataset. Experimental results show that the proposed system successfully classifies skin lesions into benign and malignant categories with good prediction accuracy.

Single image testing demonstrated the capability of the CNN model to identify lesion characteristics such as irregular borders, color variation, and abnormal texture patterns. Folder-based testing enabled automatic analysis of multiple images with faster processing speed. Real-time webcam detection was also implemented to perform live skin lesion prediction.

The results confirm that deep learning techniques can effectively support dermatologists in early skin cancer diagnosis. The proposed system reduces diagnosis time and improves prediction consistency.

VII. ADVANTAGES OF PROPOSED SYSTEM

• Early detection of skin cancer
• High classification accuracy
• Reduced human error
• Automated image analysis
• Real-time webcam detection
• Faster diagnosis process
• Cost-effective healthcare solution
• Improved healthcare accessibility
• Supports dermatologists in medical decision making
• Scalable and trainable architecture

VIII. . FUTURE SCOPE

Future improvements may include transfer learning models such as ResNet, VGG, and EfficientNet for improved classification accuracy. Multi-class classification can be implemented to classify all categories of skin lesions in the HAM10000 dataset.

Explainable AI techniques such as Grad-CAM can be integrated to highlight affected skin regions. Mobile application development and cloud integration may also improve accessibility and healthcare monitoring. IoT-enabled healthcare systems can support remote diagnosis and patient monitoring in rural areas.

IX. CONCLUSION

This paper presented a CNN-based deep learning system for automatic skin cancer detection using dermoscopic images. The proposed system successfully classifies skin lesions into benign and malignant categories using image preprocessing, feature extraction, and CNN-based classification techniques.

The system provides high accuracy, faster diagnosis, reduced human error, and real-time detection capability. Experimental results demonstrate that deep learning techniques can significantly improve healthcare diagnosis systems. The proposed system can assist dermatologists in medical decision making and improve the efficiency of skin cancer diagnosis.

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