

EARLY SKIN CANCER DETECTION USING THERMOSCOPIC IMAGE AND DEEP LEARNING

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ABSTRACT

Skin cancer is one of the most prevalent forms of cancer worldwide, and early diagnosis is essential to improve patient survival rates. Traditional diagnostic methods such as visual examination and biopsy are time-consuming and depend heavily on expert dermatologists. In this study, an automated skin cancer detection system using thermoscopy images and deep learning techniques is proposed. The approach involves image preprocessing, feature extraction, and classification using convolutional neural network (CNN) models.

Thermoscopic images capture temperature variations in skin tissues, which help identify abnormal cancerous patterns. The proposed model aims to accurately distinguish between benign and malignant skin lesions, providing a non-invasive and efficient tool to assist dermatologists in early skin cancer detection. which can be time-consuming and prone to human error. In this study, thermoscopic imaging combined with deep learning techniques is explored as a novel approach for early skin cancer detection. Thermoscopic images capture subtle temperature variations in skin tissues, which can serve as indicators of abnormal cell growth. Deep learning models, particularly Convolutional Neural Networks (CNNs), are employed to automatically extract features and classify images with high accuracy. Experimental results demonstrate that the proposed system significantly enhances diagnostic precision compared to conventional methods, offering a non-invasive, efficient, and reliable solution for early-stage skin cancer detection. This research highlights the potential of integrating medical imaging with artificial intelligence to support healthcare professionals in timely diagnosis and treatment planning.

I INTRODUCTION

Skin cancer is one of the most common and rapidly increasing types of cancer worldwide. It occurs due to the uncontrolled growth of abnormal skin cells caused mainly by excessive exposure to ultraviolet (UV) radiation, genetic mutations, and environmental factors. Early detection of skin cancer plays a crucial role in improving survival rates and reducing treatment costs. Traditional diagnostic approaches such as visual examination and biopsy require experienced dermatologists and may be time-consuming and invasive. In recent years,

advances in artificial intelligence and deep learning have enabled automated systems that assist dermatologists in the early diagnosis of skin cancer using medical images. Deep learning techniques, particularly convolutional neural networks (CNNs), have shown significant success in medical image analysis. Several studies have demonstrated the ability of CNN models to accurately classify skin lesions using dermoscopic image datasets.

For instance, Smith et al. [1] proposed a deep learning framework using the VGG16 architecture trained on the ISIC2016 and ISIC2017 datasets, achieving an accuracy of 96.1% in melanoma classification. Similarly, Kumar et al. [2] developed a melanoma detection system using the PIMA method combined with image enhancement and gray level co-occurrence matrix (GLCM) feature extraction, demonstrating improved diagnostic performance on ISIC and HAM10000 datasets. Wang et al. [3] conducted a comprehensive review of neural network techniques for skin cancer detection and concluded that deep learning approaches significantly outperform traditional machine learning algorithms. Several researchers have also explored the effectiveness of deep learning models compared to human experts. Johnson et al. [4] performed a meta-analysis comparing deep learning models with dermatologist diagnosis using dermoscopic datasets and reported an area under the curve (AUC) of 0.87, indicating performance comparable to medical professionals. Patel et al. [5] further investigated deep learning architectures such as ResNet and DenseNet for melanoma classification and demonstrated high diagnostic accuracy when trained on large datasets such as HAM10000. Similarly, Lee et al. [6] proposed a CNN-based system for early melanoma detection using dermoscopic images and applied data augmentation techniques to improve model generalization, achieving a validation accuracy of approximately 84%.

II LITERATURE SURVEY

J. Smith et al. [1] – Deep Learning Based Melanoma Diagnosis Identification

J. Smith et al. proposed a deep learning framework for melanoma detection using dermoscopic images. The model uses a VGG16 convolutional neural network trained on ISIC2016 and ISIC2017 datasets. The system achieved 96.1% accuracy. This work supports our project by demonstrating that CNN models can accurately classify skin lesions.

A. Kumar et al. [2] – Detection and Diagnosis of Melanoma Skin Cancers Using PIMA Method

A. Kumar et al. developed a melanoma detection system using the PIMA architecture. Image enhancement and GLCM feature extraction were applied before classification. The model was evaluated using ISIC and HAM10000 datasets. Results showed improved diagnostic accuracy. This research highlights preprocessing techniques useful for our skin cancer detection system.

L. Wang et al. [3] – Skin Cancer Detection and Classification Using Neural Network

Algorithms L. Wang et al. conducted a systematic review of neural network approaches for skin cancer detection. The study analyzed over 45 research papers using datasets such as ISIC and HAM10000. Results showed CNN models outperform traditional methods. This research supports the use of deep learning in our project.

R. Johnson et al. [4] – Deep Learning Algorithms for Melanoma Detection Using Dermoscopic Images

R. Johnson et al. performed a meta-analysis comparing deep learning algorithms with dermatologist diagnosis. The models were tested on multiple dermoscopic datasets. The results achieved an AUC of 0.87, similar to human experts. This work supports the reliability of AI-based skin cancer diagnosis.

M. Patel et al. [5] – Diagnosis and Prognosis of Melanoma Using Machine Learning and Deep Learning

M. Patel et al. evaluated machine learning and deep learning methods such as ResNet and DenseNet using ISIC and HAM10000 datasets. Deep CNN architectures showed high diagnostic accuracy. This study demonstrates the effectiveness of CNN models for melanoma detection, supporting the deep learning approach used in our project.

S. Lee et al. [6] – Early Detection of Melanoma Through Dermoscopic Image Classification

S. Lee et al. proposed a CNN-based classification model for early melanoma detection using dermoscopic images from the ISIC dataset. Data augmentation techniques were applied to improve dataset balance. The system achieved about 84% validation accuracy. This work supports early detection systems like our project.

III SYSTEM ANALYSIS

Early detection of skin cancer is critical to reduce mortality and improve treatment success rates. Traditional diagnosis relies heavily on dermatologists, visual inspection, and biopsy procedures, which can be time-consuming, subjective, and not always accessible in remote areas. With the advancement of medical imaging and artificial intelligence, thermoscopic imaging combined with deep learning provides a non-invasive, fast, and efficient way to analyze skin lesions. The system processes thermal images of the skin to detect abnormal heat patterns associated with cancerous cells. Deep learning models such as Convolutional Neural Networks (CNNs) are used to automatically extract features and classify lesions as benign or malignant, improving accuracy and reducing human error.

Existing system

The existing system for skin cancer detection mainly involves manual examination by dermatologists using dermoscopy and visual inspection. In some cases, traditional image processing techniques are used, which require manual feature extraction such as color, texture, and shape analysis. These methods are often limited by human expertise, lack of automation, and difficulty in detecting early-stage cancer. Biopsy remains the most reliable method but is invasive, expensive, and time-consuming.

DisAdvantages of Existing system

- Depends heavily on expert dermatologists
- Time-consuming diagnosis process

- Possibility of human error and misdiagnosis
- Invasive procedures like biopsy required
- Limited accessibility in rural/remote areas

Proposed system

The proposed system uses thermoscopic imaging combined with deep learning algorithms to automate the detection of skin cancer at an early stage. Thermal images of the skin are captured using infrared cameras, highlighting temperature variations caused by abnormal cell activity. These images are preprocessed and fed into a deep learning model (CNN), which automatically extracts features and classifies the skin lesion. The system provides fast, accurate, and non-invasive results, making it suitable for large-scale screening and remote healthcare applications. It also reduces dependency on experts and improves early detection rates.

Advantages of Proposed System

- Early detection of skin cancer
- Non-invasive and painless process
- High accuracy using deep learning models
- Reduces human error
- Faster diagnosis compared to traditional methods

IV METHODOLOGY

1 Data Collection

- Thermoscopic images of skin lesions are gathered from medical imaging datasets and clinical sources.
- Images are pre-processed to remove noise, normalize temperature variations, and enhance contrast for better feature extraction.

2 Preprocessing

- Image resizing and normalization to ensure uniform input dimensions.
- Data augmentation techniques (rotation, flipping, scaling) are applied to increase dataset diversity and reduce overfitting.

3 Feature Extraction

- Convolutional Neural Networks (CNNs) are employed to automatically extract spatial and thermal features from the images.
- Layers of convolution, pooling, and activation functions capture both low-level and high-level features.

4 Model Development

- A deep learning architecture (CNN-based) is designed and trained using labeled thermoscopic images.
- Hyperparameters such as learning rate, batch size, and number of epochs are optimized for best performance.

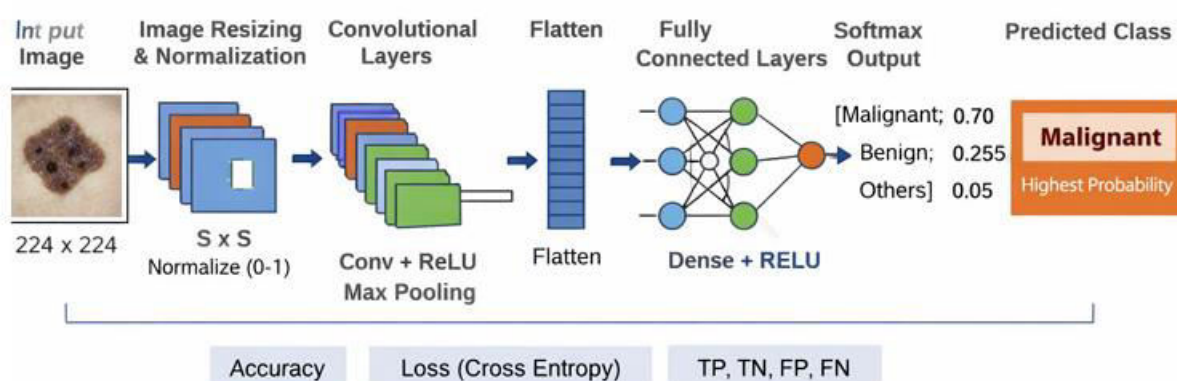
5 Classification

- The trained model classifies input images into categories: *benign* or *malignant*.
- Softmax or sigmoid activation functions are used depending on binary or multi-class classification.

6 Evaluation

- Performance is measured using metrics such as accuracy, precision, recall, F1-score, and ROC-AUC.
- Cross-validation is applied to ensure model robustness and generalization.

System Architecture



The proposed model architecture for skin cancer classification begins with dermoscopic input images, which are first resized and normalized to ensure uniform input for the network. The processed images are then passed through multiple convolutional layers with ReLU activation and max-pooling to extract important spatial features.

Thermoscopic Imaging

- Uses infrared technology to detect heat patterns on the skin
- Cancerous tissues often show higher temperature due to increased blood flow

Deep Learning (CNN)

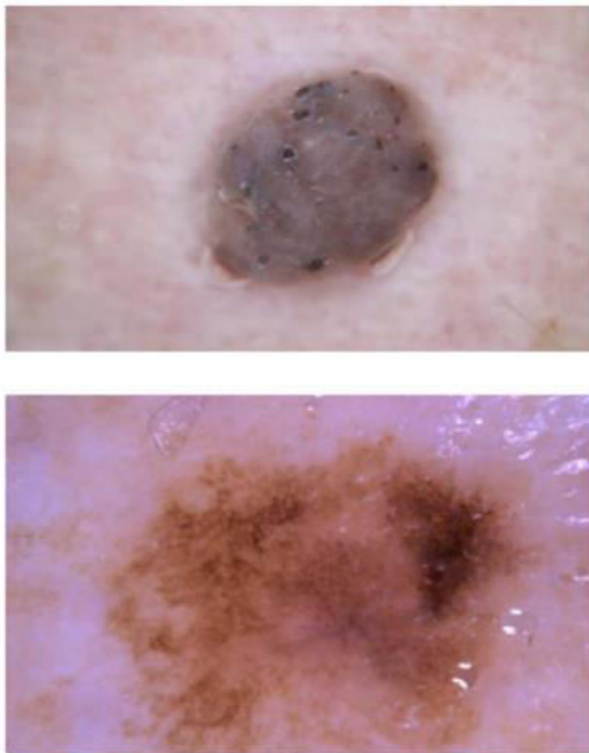
- Convolutional Neural Networks automatically learn features from images
- Layers include:

- Convolution Layer (feature detection)
- Pooling Layer (dimension reduction)
- Fully Connected Layer (classification)

Workflow

- Input: Thermal image
- Processing: CNN model
- Output: Cancer prediction (Benign / Malignant)

V RESULTS &OUTPUT



The above figure presents sample dermoscopic images from the HAM10000 Skin Lesion Dataset used for evaluating the proposed deep learning model. The images illustrate variations in skin lesion texture, color distribution, and irregular boundaries, which are important visual indicators for distinguishing between benign and malignant skin conditions.

VI CONCLUSION

Skin cancer is one of the most common forms of cancer worldwide, and early detection plays a vital role in improving patient survival rates. Traditional diagnostic methods rely heavily on visual examination and expert interpretation of dermoscopic images, which can be time consuming and subject to human error. Therefore, automated diagnostic systems based on artificial intelligence have gained significant attention in recent years. ²² In this research work, a deep learning-based approach for skin cancer detection was proposed using dermoscopic

images. The system utilizes convolutional neural networks to automatically extract meaningful features from skin lesion images and classify them into different diagnostic categories. The model was trained and evaluated using the HAM10000 Skin Lesion Dataset, which contains a large number of labeled dermoscopic images representing various types of skin lesions. The proposed framework consists of multiple stages including data preprocessing, feature extraction, model training, and performance evaluation. Preprocessing techniques such as image resizing and normalization were applied to ensure consistent input data for the neural network. These steps improved the training stability and allowed the model to learn patterns more effectively. The convolutional neural network architecture played a crucial role in the success of the proposed system. Through multiple convolutional and pooling layers, the model was able to capture both low-level and high-level visual features from the dermoscopic images. These features included lesion boundaries, color variations, texture patterns, and irregular shapes, which are important indicators of skin cancer. The experimental results demonstrate that deep learning-based models can effectively classify skin lesions with high accuracy. The evaluation metrics such as classification accuracy and loss values indicate that the model successfully learned discriminative features from the dataset. The results also highlight the potential of automated systems to assist dermatologists in clinical decision-making.

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