

Machine Learning Approach for Skin Cancer Detection and Classification

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Abstract

The Skin Cancer Detection System shows the whole process and web app features are made in this study. Security is kept strong with login and registration pages that include password rules and user authentication. Once logged in, where users can see the main screen and upload a dermoscopic image or take a live photo with their camera for quick skin cancer prediction. Both uploaded and captured images are processed by a deep learning system that is built with Flask. This system identifies the skin lesion and classifies it as either melanoma or benign. It also creates visual explanations called Grad-CAMs, which highlight the parts of the image that helped the model make its decision, making the results easier to understand. The system has a real-time mode that analyzes video frames on the fly to detect any unusual changes. It also keeps user data private by storing everything locally. The results screen shows the predicted category, confidence level, and the area of the lesion, making it simple for both medical experts and regular users to understand the diagnosis. In short, this system is an accurate, easy-to-use, and ethical AI tool that helps detect skin cancer at an early stage.

Keywords: Skin Cancer, Deep Learning, EfficientNet, Multi-Task Learning, Explainable AI, Grad-CAM.

1. Introduction

Skin cancer is the most common and speedy growing cancers globally. Among the various types, melanoma is particularly dangerous because it can spread to nearby parts of the body and can be life-threatening if not detected early. According to the World Health Organization, millions of new cases are diagnosed every year, and many of these could be prevented if caught and treated in time. Detecting melanoma early makes a huge difference, as the five-year survival rate is over 99% when it's found early, but drops below 30% if it's discovered in later stages. Doctors typically use visual exams, special imaging tools, and lab tests to diagnose skin cancer. While these methods are effective, they can be time-consuming, heavily rely on the doctors experience, and sometimes lead to incorrect conclusions. These mistakes can result in extra tests, delayed treatment, or missing serious cases. This highlights the features that can help doctors make faster, more accurate decisions with less dependence on guesswork.

2. Methodology

The Skin Cancer Detection System uses a clear and

organized approach to accurately classify skin diseases by the help of machine learning. Supervised learning is used and images taken through a dermatoscope to train models that can determine if the skin is healthy or has a disease, and then identify the specific type of disease, such as melanoma, nevus, or basal cell carcinoma. The process starts with pre-processing steps such as resizing images, removing unwanted noise, normalizing data, and increasing the dataset size through augmentation.

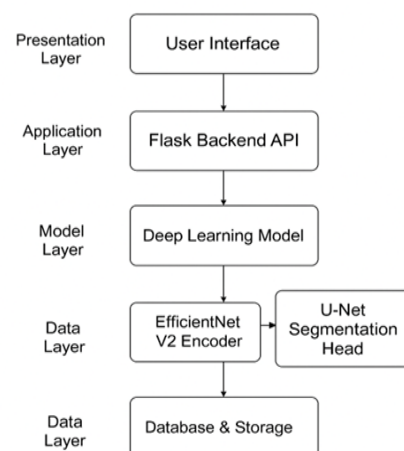


Figure 1 Methodology

These steps help maintain a consistent dataset and enhance image quality. To gather features, both simple characteristics like color, texture, and edges are used, with the more complex features extracted from the pre-trained deep learning models like VGG16, ResNet50, and EfficientNet. Feature selection is also carried out to make the process more efficient. For classification, a CNN-based architecture with transfer learning and a softmax layer is used. This allow the system to predict the kind of skin disease and display the confidence scores for each prediction. The training process involves splitting the dataset, using the Adam algorithm for optimization, and asses model performance using metrics such as accuracy, precision, recall, and F1-score. Once the model is ready, it is deployed using Flask, a web framework that lets users upload skin images and receive real-time predictions via a secure web interface. To ensure ethical use, data is anonymized, informed consent is obtained, data is stored temporarily, and efforts are made to avoid biases. The entire methodology ensures the system is robust, easy to understand, and follows ethical guidelines for early recognize of skin diseases. It also includes advanced techniques of machine learning and deep learning to build a reliable skin disease detection system. The process collecting data from high-quality, publicly available dermoscopic image datasets such as HAM10000 and ISIC 2020, which include a variety of skin lesion samples for training and testing. All collected images go through pre-processing to remove unwanted elements like hair and noise, and they are resized to a standard dimension to ensure compatibility with the model. To increase dataset diversity and prevent overfitting, augmentation methods like rotation, flipping, and scaling are applied. The pre-processed images are then passed to a Convolutional Neural Network, which automatically extracts important features related to texture and structure. Transfer learning further improves accuracy by fine-tuning pre-trained models like EfficientNet and ResNet50, especially when there is limited medical data. The Adam optimizer is used to find the best model parameters, and the training process continuously improves by

minimizing losses through backpropagation. After training, the model predicts the class of the skin lesion and provides a confidence score to assist doctors in interpreting the results. The system is built into a Flask-based web application, allowing users to get predictions by uploading images or using live camera input. Ethical guidelines are firmly maintained to protect user privacy, avoid bias, and securely handle medical data.

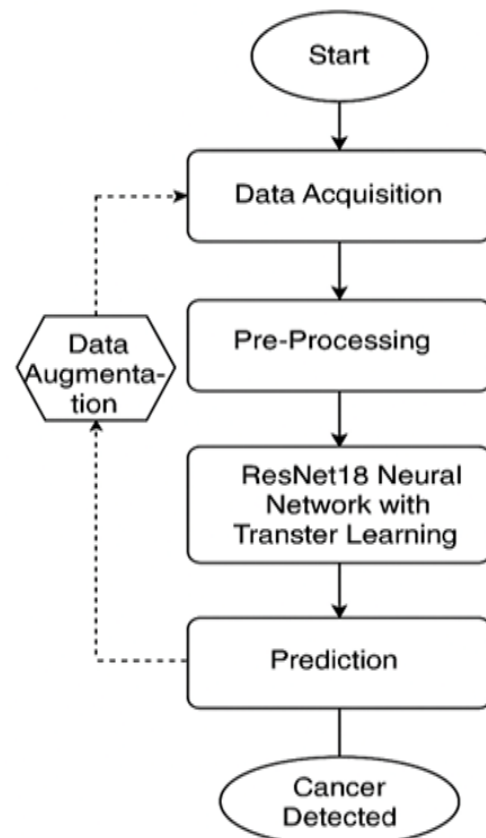


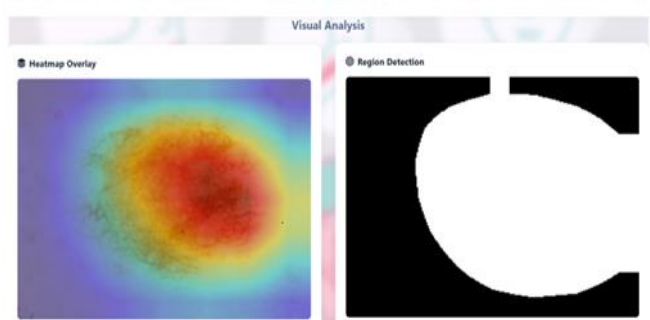
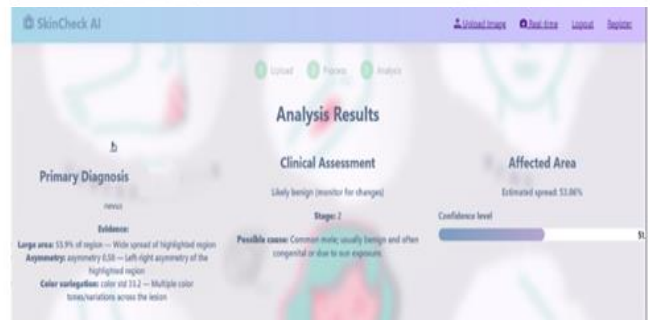
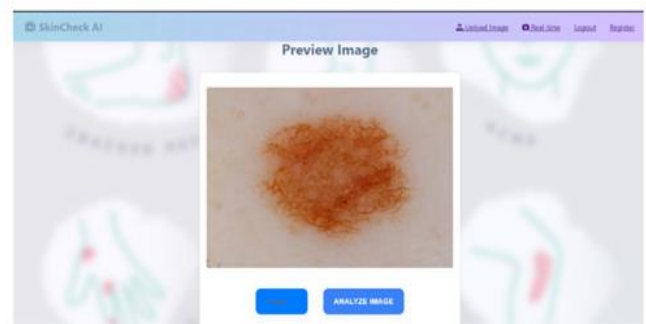
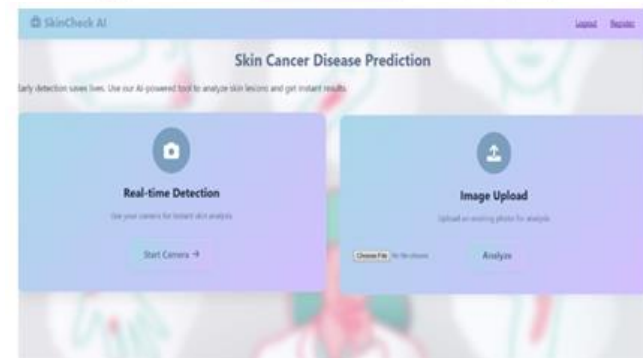
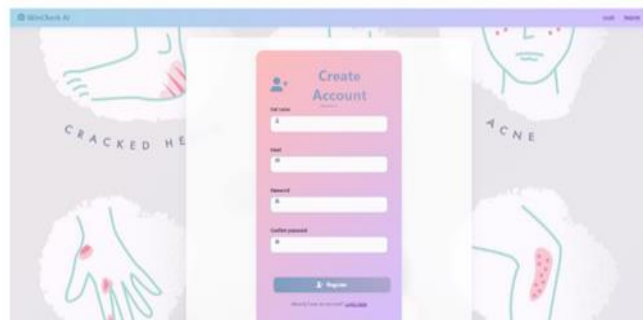
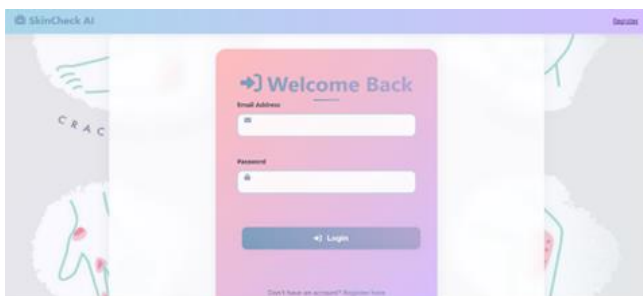
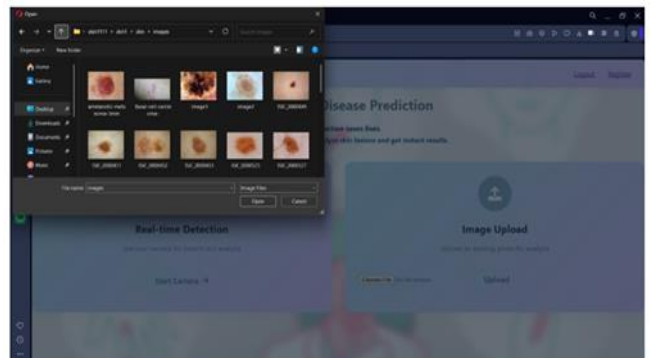
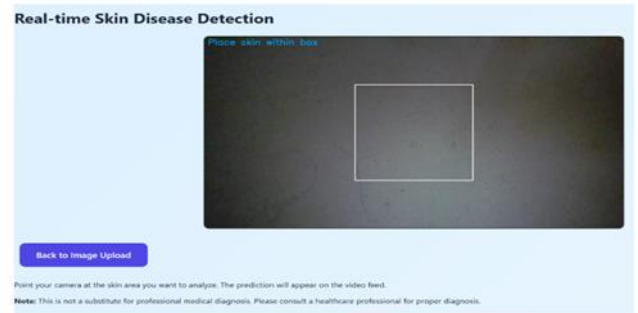
Figure 2 System Architecture Diagram

3. Results and Discussion

3.1. Results

The Skin Cancer Detection System shows the complete process and key features of the web application developed during this study. Security is maintained through login and registration pages that include user authentication and rules for creating strong passwords. Once users are logged they directed to the main screen, where they can either upload a dermoscopic image or use their camera to take a live photo for immediate skin cancer

prediction. Both types of images are processed by a system built on Flask, which identifies the skin lesion and classifies it into categories such as melanoma or benign. During this process, the system also generates visual explanations called Grad-CAMs, which highlight the parts of the image that had the most impact on the model's decision, helping users better understand the results. The system also has a real-time detection mode that continuously analyzes video frames to detect any unusual changes. All user data is stored locally to protect privacy. The results screen clearly shows the predicted category, the level of confidence in the prediction, and the region of the lesion that was identified, making it easy for both medical professionals and regular users to understand the diagnosis. In short, this system provides an accurate, easy-to-use, and ethical AI tool that helps with the early identification of skin cancer.



3.2. Discussion

The Skin Cancer Detection System uses a convolutional neural network to recognize skin conditions. The process starts when a user uploads a photo or takes a picture of their skin. The image is then sent through a preprocessing stage where it is resized, normalized, and adjusted to prepare it for analysis. After that, a CNN classification module analyzes the image to extract key features and find out the type of skin Cancer. The system then provides the user with the predicted cancer type, the confidence level of the prediction, and the specific area of the skin impacted. This result is displayed to the user, finishing the entire detection process.

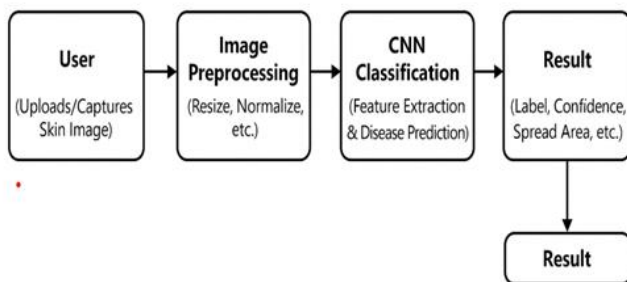


Figure 3. Process of Dataflow

Conclusion

A skin Cancer detection and Classification system using CNN and transfer learning has been productively created to help identify different skin diseases early and accurately.

This project shows how deep learning and computer vision can be effectively used in medical image examination for diagnosing skin conditions.

The system uses CNNs with transfer learning, which ensures high accuracy without needing complex manual feature extraction. By fine-tuning pre-trained models like VGG16, ResNet, and MobileNet on collected dermatology datasets, the model effectively learned the unique visual features of skin lesions. This approach gives significantly improved classification results compared to traditional methods. The system was tested by taking publicly accessible datasets such as ISIC and DermNet, which include a large variety of skin conditions. The experimental results allowing the model to effectively classify images as normal or abnormal

and, when abnormal, accurately identify the specific disease with high reliability. A user-friendly web interface allows both medical professionals and patients to upload images, view predictions, and see results in real time. In addition, it emphasizes that during model development, preprocessing, data augmentation, and validation techniques should work together. The system design also includes the ability to handle unknown or uncertain cases to ensure safe and dependable predictions. Overall, the developed system provides a reliable, quick, and cost-effective way for preliminary screening of skin diseases. While it cannot replace professional diagnosis, it serves as a helpful decision-support tool for dermatologists and a self-assessment aid for patients. Future improvements may involve expanding the dataset, adding explainable AI for better model transparency, and integrating the system with mobile health platforms for real-time detection.

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