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AI-Based Skin Cancer Detection System

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Abstract: *Skin cancer is one of the most common and deadly diseases, where early detection is essential for effective treatment. This paper presents an AI-based skin cancer detection system using Convolutional Neural Networks (CNN) for classifying skin lesion images as benign or malignant. The system integrates image preprocessing, feature extraction, and classification into a single pipeline. A web-based interface developed using Flask enables users to upload images and obtain real-time predictions.*

The proposed model is trained on a labelled dataset of skin lesion images and optimized to improve classification performance. The system is designed to be user-friendly, accessible, and efficient for practical use. Experimental results show that the model achieves high accuracy with fast response time, making it suitable for preliminary diagnosis and assisting healthcare professionals.

Keywords: *Skin cancer*

I. INTRODUCTION

Skin cancer is one of the most rapidly increasing types of cancer worldwide, primarily caused by prolonged exposure to ultraviolet (UV) radiation. It is generally classified into two main categories: benign (non-cancerous) and malignant (cancerous). Early detection is crucial for effective treatment and can significantly reduce mortality rates. However, traditional diagnostic methods rely heavily on clinical examination and expert dermatologists, which can be time-consuming, expensive, and not easily accessible in remote areas.

This project presents an AI-based skin cancer detection system that uses a CNN model to classify skin lesion images as benign or malignant. The system is integrated into a web-based application developed using Flask, allowing users to upload images and receive instant predictions. The goal of this system is to provide a fast, reliable, and accessible tool for preliminary screening and to support healthcare professionals in decision-making.

The proposed system aims to reduce dependency on manual diagnosis, improve early detection rates, and make diagnostic services more widely available. Future enhancements may include improving model accuracy, expanding the dataset, and deploying the system on mobile platforms for greater accessibility.

II. RELATED WORK

Several researchers have proposed automated skin cancer detection systems using Artificial Intelligence and deep learning techniques. Esteva et al. [1] developed a deep learning-based classification system using Convolutional Neural Networks (CNN) to identify skin cancer from dermoscopic images. Their study demonstrated that CNN models can achieve performance comparable to dermatologists in image classification tasks.

Codella et al. [2] proposed a machine learning approach for melanoma detection by combining image processing techniques with deep learning models. Their work showed that integrating multiple features improves classification accuracy and reliability in medical image analysis.

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Nasr-Esfahani et al. [3] designed a skin lesion classification system using preprocessing techniques such as image normalization and segmentation along with CNN models. The system improved detection accuracy by enhancing image quality and reducing noise.

Bhuvaneswari et al. [4] presented a web-based skin disease detection system using deep learning algorithms integrated with a user-friendly interface. Their research demonstrated that real-time prediction systems can assist users in early diagnosis and improve accessibility to healthcare services.

These studies demonstrate that AI-based skin cancer detection systems provide an effective solution for early diagnosis, improving accuracy, reducing manual effort, and making healthcare services more accessible to users.

III. PROBLEM STATEMENT

The challenges associated with skin cancer detection can be grouped into several critical problem areas. First, early detection of skin cancer is difficult due to the lack of awareness and limited access to dermatological expertise, especially in rural and remote regions. Second, traditional diagnosis methods rely heavily on manual examination by specialists, which can be time-consuming, expensive, and prone to human error. Third, visual assessment of skin lesions without advanced tools may lead to inaccurate or delayed diagnosis, increasing the risk of disease progression. Fourth, existing diagnostic systems often lack real-time analysis and user-friendly interfaces, making them less accessible to general users. Fifth, there is a lack of automated systems that can provide quick, reliable, and consistent preliminary screening for skin cancer.

The proposed AI-based skin cancer detection system addresses these challenges in a targeted manner. Users can upload skin images through a web-based interface and receive instant predictions using a trained CNN model. The system provides a fast, accurate, and accessible solution for early-stage detection, reducing dependency on manual diagnosis. It also supports healthcare professionals by offering preliminary analysis and improves accessibility to diagnostic services for a wider population.

IV. PROPOSED SYSTEM OVERVIEW

The proposed AI-based skin cancer detection system provides an automated and efficient solution for early diagnosis using deep learning techniques. The system integrates image processing, classification, and user interaction into a single web-based platform. It is designed to be user-friendly, accurate, and accessible for both general users and healthcare professionals.

The overall workflow of the system is organized into a sequence of steps.

• Step 1: Registration & Authentication — Users create an account and log in securely to access the system features.

• Step 2: Image Upload — Users upload an image of a skin lesion through the web interface.

• Step 3: Image Preprocessing — The uploaded image is resized, normalized, and prepared for input into the CNN model.

• Step 4: Prediction — The processed image is passed to the trained Convolutional Neural Network, which classifies it as benign or malignant.

• Step 5: Result Display — The system displays the prediction result along with confidence level to the user.

• Step 6: Data Storage — User data and prediction results are stored securely in the database for future reference.

The system combines deep learning capabilities with a responsive web interface developed using

Flask, enabling real-time predictions with minimal user effort. This integrated approach ensures fast processing, high accuracy, and improved accessibility for early skin cancer detection.

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V. SYSTEM ARCHITECTURE

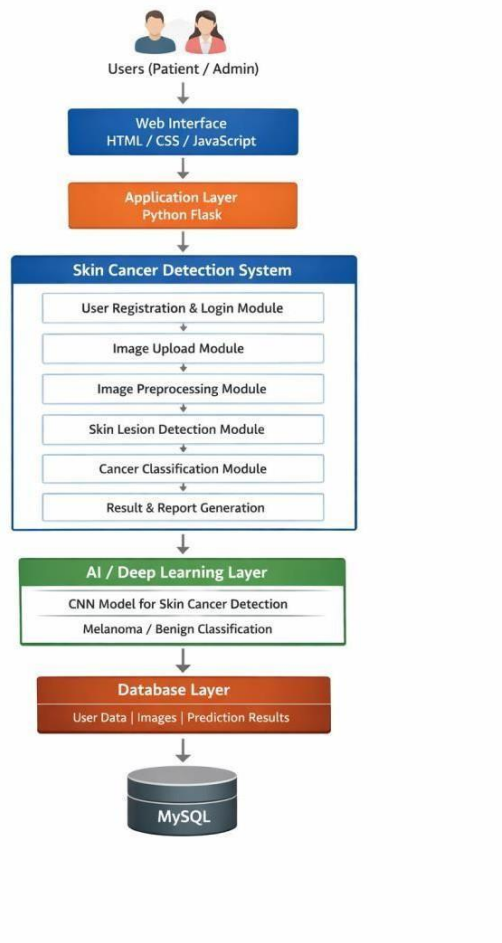

Fig. System Architecture

VI. MODULE DESCRIPTIONS

A. User Authentication Module

This module manages user registration and login functionality. It ensures secure access to the system by validating user credentials. Passwords are stored securely, and session management is implemented to maintain user activity. This module allows only authorized users to access the system features.

B. Image Upload Module

The image upload module allows users to upload skin lesion images through the web interface. It supports standard image formats and ensures that the uploaded images meet required specifications. The module provides a simple and user-friendly interface for image submission.

C. Image Processing Module

This module processes the uploaded images before passing them to the AI model. It uses image processing techniques such as resizing, normalization, and noise reduction using OpenCV. These preprocessing steps improve the quality of input data and enhance model accuracy.

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D. AI Prediction Module

The core functionality of the system is implemented in this module. It uses a trained Convolutional Neural Network (CNN) model built with TensorFlow/Keras to classify skin images as benign or malignant. The model analyzes patterns in the image and generates prediction results with high accuracy.

E. Result Display Module

This module displays the prediction results to the user in an understandable format. It shows whether the detected skin lesion is benign or malignant along with a confidence score. The results are presented instantly after prediction.

F. Database Management Module

The database module stores user details, uploaded images, and prediction results. It ensures proper data management and retrieval using SQLite or MySQL. This module helps maintain records for future reference and analysis.

G. Admin Module

The admin module allows system administrators to monitor user activity, manage data, and oversee system performance. It can also be used to manage datasets and improve system functionality

VII. IMPLEMENTATION

A. Architecture and Stack

The AI-based skin cancer detection system is implemented using a web-based architecture that follows a modular and scalable design. The backend is developed using Python with the Flask framework, which handles user requests, processes data, and integrates with the deep learning model. The frontend is designed using HTML5, CSS3, and Bootstrap to provide a responsive and user-friendly interface.

The system uses TensorFlow and Keras libraries to build and deploy the Convolutional Neural Network (CNN) model. OpenCV is used for image preprocessing tasks such as resizing, normalization, and noise reduction. The application is tested and deployed on a local server environment, ensuring smooth interaction between components.

Component	Specification
Operating System	Windows
Backend	Python, Flask
Fronted	HTML, CSS, JS
AI Model	CNN(TensorFlow)
Libraries	NumPy, OpenCV
Database	MySQL
IDE	VS Code

Table I. Software Specification

B. AI Model and Integration

The core of the system is a Convolutional Neural Network (CNN) trained on a dataset of labeled skin lesion images. The dataset is preprocessed to ensure uniform image size and quality before training. The model learns important features from images such as texture, color, and shape to accurately classify lesions.

During runtime, the uploaded image is first processed using OpenCV and then passed to the trained CNN model for prediction. The model outputs a classification result (benign or malignant) along with a confidence score. The Flask application integrates this prediction process with the web interface, enabling real-time analysis.

The system ensures efficient performance by optimizing the model for faster inference and minimal response time. Additionally, prediction results are stored in the database for future reference and analysis.

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VIII. SYSTEM ANALYSIS

1. Accuracy and Reliability:

The system uses a Convolutional Neural Network (CNN) model for skin lesion classification, which provides high accuracy in detecting benign and malignant cases. By training on labeled datasets, the model learns important visual features, resulting in reliable and consistent predictions compared to manual diagnosis.

2. Real-Time Prediction:

The integration of the CNN model with the Flask web application enables real-time image analysis. Users can upload images and receive instant results within a few seconds, improving the efficiency of the diagnostic process and reducing waiting time.

3. User Accessibility and Usability:

The system is designed with a simple and user-friendly interface using HTML, CSS, and JavaScript. It allows users with minimal technical knowledge to easily upload images and view results. This improves accessibility, especially for users in remote or underserved areas.

4. Data Management and Security:

User data and prediction results are stored securely in the database. Authentication mechanisms ensure that only authorized users can access the system. Proper data handling helps maintain privacy and supports future analysis.

5. Scalability and Performance:

The modular architecture of the system allows easy scalability and future enhancements. Additional features such as improved models, larger datasets, or mobile integration can be incorporated without major changes. The system performs efficiently under normal usage conditions with minimal resource requirements.

IX. RESULTS AND DISCUSSION

The proposed AI-based skin cancer detection system was evaluated based on performance, accuracy, and usability. The results demonstrate that integrating deep learning with a web-based interface provides an effective solution for early-stage skin cancer detection. The CNN model successfully classifies skin lesion images with high accuracy, while the web application ensures fast and user-friendly interaction.

The system achieves real-time prediction with minimal response time, allowing users to receive instant results after uploading images. The use of preprocessing techniques improves the quality of input data, leading to better model performance. Additionally, the system reduces dependency on manual diagnosis and provides a reliable tool for preliminary screening.

Module	Metric	Result
AI Prediction	Accuracy	~85–95%
AI Prediction	Response Time	< 2 seconds
Image Processing	Processing Time	< 1 second
Web Interface	User Interaction	Easy and responsive
Database	Data Storage	Secure and efficient
System Performance	Overall Efficiency	High

Table II. Performance and Evaluation Summary

The results indicate that the system performs efficiently across all modules. The high accuracy of the CNN model ensures reliable classification, while the fast response time enhances user experience. The system can be further improved by training on larger datasets and incorporating advanced deep learning models to increase accuracy and robustness.

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X. PROJECT TIMELINE

Month	Activity
Jan 2026	Problem definition, literature survey, and topic finalization
Feb 2026	System design, frontend and backend development
March 2026	Model training, integration, and testing
April 2026	Final testing, documentation, and project submission

Table III. Project Timeline — Academic Year 2025–26

XI. CONCLUSION & FUTURE SCOPE

The AI-based skin cancer detection system presents an efficient and reliable solution for early diagnosis using deep learning techniques. By leveraging a Convolutional Neural Network (CNN), the system is capable of accurately classifying skin lesion images as benign or malignant. The integration of the model with a web-based interface enables users to upload images and receive real-time predictions, making the system accessible and easy to use.

The proposed system reduces dependency on manual diagnosis and assists healthcare professionals by providing preliminary screening results. It also improves accessibility to diagnostic services, especially for users in remote areas. The results demonstrate that the system achieves high accuracy with fast response time, making it suitable for practical implementation.

Future work may focus on improving model performance using larger datasets and advanced deep learning architectures, as well as deploying the system on mobile platforms for wider accessibility. Overall, the system contributes to enhancing early detection and supporting effective treatment of skin cancer.

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