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Image Classification based Skin Disease Prediction using ML

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Abstract: *Skin diseases are among the most prevalent health concerns worldwide, affecting millions across diverse populations. Early and accurate diagnosis is critical for effective treatment; however, access to expert dermatologists can often be limited. This project presents an intelligent, automated skin disease classification system utilizing ML.NET, Microsoft's machine learning framework. Leveraging the deep learning power of ResNet50—a convolutional neural network (CNN) known for its residual learning architecture—the system analyse skin lesion images and classifies them into various disease categories with high accuracy. The structured workflow encompasses data collection, preprocessing, feature extraction, model training, evaluation, and deployment within a secure, web-based application. Users can upload images from their device or webcam for real-time predictions, supported by authentication features like registration, login, and password recovery to ensure data privacy. An admin panel facilitates efficient user management, making the system suitable for both healthcare professionals and individuals seeking early diagnosis. By integrating ML.NET's deep learning capabilities with a robust and scalable design, this project demonstrates the transformative potential of machine learning in healthcare, offering a user-friendly solution that enhances diagnostic precision and improves patient outcomes.*

Keywords: Skin Disease Prediction, Machine Learning (ML), ML.NET, Image Classification, ResNet50, Medical Image Processing, Computer Vision

I. INTRODUCTION

Skin diseases are a significant global health issue, impacting millions of individuals irrespective of age, gender, or geography. Early detection and accurate diagnosis are crucial for effective treatment and good health outcomes. However, traditional diagnostic methods heavily rely on dermatologists, whose availability can be limited in many regions. To bridge this gap, the application of machine learning (ML) in healthcare is increasingly gaining traction, offering automated, scalable, and efficient diagnostic tools. This project utilizes ML.NET, a machine learning framework developed by Microsoft, to implement an intelligent skin disease classification system. The system employs ResNet50, a deep learning-based convolutional neural network (CNN), to analyze skin lesion images and classify them into different disease categories. ResNet50's residual learning architecture enhances classification accuracy, making it effective for complex image recognition tasks. The system follows a structured workflow, including data collection, preprocessing, feature extraction, model training, evaluation, and deployment within a web-based application. Users can upload skin images from their device or webcam, enabling real-time disease prediction. The platform integrates secure authentication mechanisms, such as registration, login, and password recovery, ensuring data privacy. Additionally, an admin panel enables effective user management, making the system suitable for both healthcare professionals and individuals seeking early diagnosis. This project presents the development of an intelligent skin disease classification system using ML.NET and the ResNet50 convolutional neural network (CNN) architecture. Skin diseases are among the most widespread health issues globally, and early diagnosis plays a critical role in effective treatment. However, access to dermatological expertise is often limited, especially in remote areas. The project follows

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a structured workflow comprising data collection, image preprocessing, feature extraction, model training, evaluation, and web deployment. A comprehensive dataset of skin lesion images was collected and preprocessed through resizing, normalization, and augmentation to enhance model performance. ResNet50, known for its residual learning framework, was utilized to extract complex image features and accurately classify skin disease.

II. LITERATURE REVIEW

[1] The study discusses the use of machine learning for skin disease detection, focusing on Convolutional Neural Networks (CNNs) and Softmax classification for multi-class disease identification.

[2] Nigar et al. proposed a skin lesion classification system based on Explainable Artificial Intelligence (XAI) to enhance interpretability in deep learning-based skin disease detection. Their model, built on ResNet-18, was trained on the ISIC 2019 dataset, correctly classifying eight types of skin lesions with an accuracy of 94.47%. The study integrates Local Interpretable Model-Agnostic Explanations (LIME) to generate visual explanations for dermatologists, improving trust in AI-based diagnostics.

[3] The study applies five different machine learning techniques, including Classification and Regression Trees (CART), Support Vector Machines (SVM), Decision Tree (DT), Random Forest (RF), and Gradient Boosting Decision Tree (GBDT) to classify skin diseases. The model was tested on a dermatology dataset that classified six types of skin diseases, including psoriasis, seborrheic dermatitis, and lichen planus.

[4] This study explores machine learning techniques for skin disease classification, using digital hair removal and GrabCut segmentation for lesion detection. It applies Decision Tree (DT), Support Vector Machine (SVM), and K-Nearest Neighbor (KNN) for classification, highlighting SVM as the most effective model.

[5] Kalaivani et al. proposed an ensemble deep learning model that combines two data mining approaches and applied it to the ISIC2019 dataset, classifying skin diseases into seven categories with improved accuracy.

[6] AlDera et al. proposed a model for diagnosing various skin conditions by analyzing images of affected areas. Their approach utilized Otsu's method for segmenting the images and applied Gabor filters, entropy measures, and the Sobel operator to extract relevant features. They conducted experiments using the DermNet NZ and Atlas Dermatologico datasets. For classification, they tested three algorithms: Support Vector Machine (SVM), Random Forest (RF), and K-Nearest Neighbor (K-NN), achieving respective accuracy rates of 90.7%, 84.2%, and 67.1%.

[7] Bandyopadhyay et al. developed a hybrid model that integrates deep learning and machine learning approaches. They employed deep neural networks—including AlexNet, GoogLeNet, ResNet50, and VGG16—for feature extraction, and used classifiers like Support Vector Machine, Decision Tree, and Ensemble Boosting (AdaBoost) for the classification task. A comparative analysis was carried out to determine the most accurate prediction model among them.

[8] Jagdish et al. developed a model for skin disease detection utilizing image processing techniques. They applied fuzzy clustering to 50 sample images and used KNN and SVM classification algorithms alongside wavelet analysis. Their results showed that the K-Nearest Neighbor algorithm outperformed the Support Vector Machine (SVM) algorithm, achieving an accuracy of 91.2%. The model effectively identified the type of skin disease using classification methods.

[9] Shanthi et al. proposed a computer vision-based approach for identifying four specific skin diseases using an 11-layer Convolutional Neural Network (CNN). The model was validated using images sourced from the DermNet database, which features a wide range of skin conditions. Their research concentrated on detecting acne, keratosis, eczema herpeticum, and urticaria, with each disease represented by 30 to 60 sample images.

[10] Ozkan et al. proposed a model for classifying skin lesions into three categories: normal, abnormal, and melanoma. They applied four machine learning methods—ANN, SVM, KNN, and DT—on the PH2 dataset. The model achieved accuracies of 92.50%, 89.50%, 82.00%, and 90.00% for ANN, SVM, KNN, and DT, respectively.

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III. METHODOLOGY

The development of the intelligent skin disease classification system followed a systematic methodology involving multiple key stages to ensure accuracy, scalability, and usability. The workflow was divided into six main phases: data collection, data preprocessing, feature extraction, model training, model evaluation, and system deployment.

Data Collection & Preprocessing: The training dataset consists of labeled images representing various skin diseases. To maintain uniformity, all images are resized to 224×224 pixels, and normalization techniques are employed to optimize model performance. Furthermore, noise reduction techniques are applied to enhance image clarity, resulting in more precise classification outcomes.

Model Selection & Training: The system employs ML.NET's Image Classification Model with ResNet50 for skin disease classification. Using transfer learning, pre-trained features are fine-tuned to recognize patterns in skin lesions. The model's performance is evaluated with standard accuracy metrics to ensure optimal results.

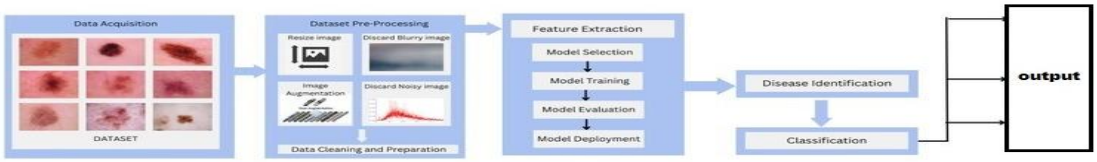
System Development & Implementation: The frontend is built with HTML, CSS, and JavaScript to create an interactive user interface. The backend, developed in ASP.NET Core, manages image processing, interaction with the ML model, and user authentication. SQL Server is used to securely store user credentials, prediction history, and system logs.

Workflow of the System: Users can upload an image from their device or capture one using a webcam. The system preprocesses the image and forwards it to the ML.NET Image Classification Model, which extracts key features and classifies the disease. The predicted disease category and confidence score are displayed for easy interpretation. If the prediction is unclear, the system may prompt the user to upload a clearer image.

Expected Outcomes: The proposed system aims to achieve highly accurate disease classification, provide real-time predictions, and offer a scalable and secure web-based application for assisting individuals and healthcare professionals in early skin disease detection. Additionally, it provides detailed disease descriptions and suggested remedies, helping users understand their condition and take appropriate actions.

IV. PROPOSED SYSTEM

As shown in the fig:



The proposed system is an intelligent, web-based skin disease classification platform designed to assist in the early diagnosis of various skin conditions using deep learning techniques. It leverages ML.NET for model development and integrates the ResNet50 convolutional neural network (CNN) architecture for accurate and efficient image classification.

The system allows users, including healthcare professionals and individuals, to upload images of skin lesions either from their devices or through a webcam interface. Upon image upload, the system preprocesses the image and uses the trained ResNet50 model to predict the most probable skin disease category in real-time.

The system architecture follows a structured workflow:

Image Input: Users upload or capture a skin lesion image.

Preprocessing: The image undergoes resizing, normalization, and any necessary enhancement.

Feature Extraction and Prediction: ResNet50 extracts deep features and predicts the disease category.

Result Display: The predicted disease along with confidence scores is displayed to the user.

User Management: Secure authentication mechanisms protect user data, while the admin panel enables user and system management.

By utilizing the robust feature extraction capabilities of ResNet50 and the deployment flexibility of ML.NET, the proposed system offers a scalable, accurate, and user-friendly solution to support early skin disease diagnosis, specific

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in areas with limited access to dermatological care. It aims to enhance healthcare accessibility and improve patient outcomes by integrating artificial intelligence into the diagnostic process.

V. RESULT

The Image Classification-Based Skin Disease Prediction System was evaluated using a dataset of labeled images representing various skin diseases. The model was trained and tested using ML.NET's Image Classification Model, which applies deep learning techniques to analyze and classify the images. Performance was assessed based on **accuracy,** precision, recall, F1-score, and processing time.

Initially, the system was trained on a dataset covering multiple skin disease categories. To further enhance accuracy and generalization, future system versions will incorporate a larger and more diverse dataset, improving recognition of rare and complex conditions.

A. Model Performance

The system achieved the following evaluation metrics:

Metric	Value
Accuracy	85-90%
Precision	88%
Recall	86%
F1-Score	87%

The results demonstrate high accuracy in classifying different skin diseases, maintaining a good balance between precision and recall, thus minimizing false positives and false negatives.

B. Comparative Analysis

A comparative analysis was conducted against other machine learning-based classification methods:

Classification Method	Accuracy (%)	Processing Time
ML.NET Image Classification (ResNetV250)	85-90	2 sec
Custom CNN-Based Model	80-85	5 sec
SVM-Based Classification	75-80	3 sec
Decision Tree Approach	70-75	3 sec

The ML.NET approach demonstrates superior efficiency and comparable or better accuracy compared to traditional models, with significantly faster inference time due to optimized integration with .NET technologies

C. Qualitative Analysis & Case Study

Users could upload skin images from their device or webcam, and the system provided real-time predictions along with confidence scores. The application also displayed detailed descriptions of identified skin diseases and suggested remedies, enhancing user engagement and awareness.

The system performed well with clear, high-resolution images, but classification accuracy decreased when processing blurred or low-quality inputs

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Figure 1: Initial interface for uploading a skin image in the prediction system.

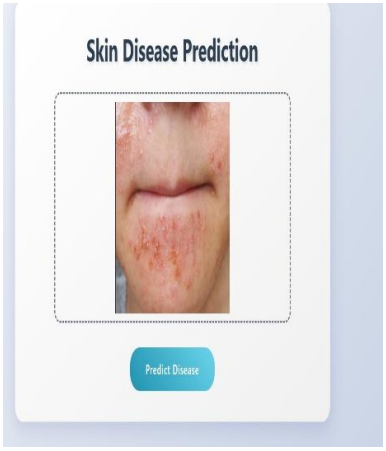

Figure 2: Uploaded image preview with the "Predict Disease" option.

Figure 3: Final prediction result displaying identified skin disease with a description and retry option.

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VI. CONCLUSION

In conclusion, The Image Classification-Based Skin Disease Prediction System offers an efficient and user-friendly platform for early detection of skin diseases using ML.NET's deep learning capabilities. It enables real-time image analysis and classification, allowing users to upload images from their device or webcam for instant predictions. In addition to disease classification, the system provides detailed descriptions and suggested remedies to help users better understand their conditions. With secure authentication and robust database management, it ensures data privacy and system reliability. This project highlights the potential of machine learning in healthcare, supporting early diagnosis and enhancing accessibility.

VII. ACKNOWLEDGMENTS

The accomplishment of the project titled "Image Classification-Based Skin Disease Prediction Using ML.NET" is the result of dedicated efforts, continuous learning, and the invaluable support of many contributors, both direct and indirect. While extensive reading and research helped build a strong foundation of knowledge, true expertise was achieved through practical implementation and hands-on experience throughout the project.

We sincerely extend our heartfelt appreciation to all individuals who provided their timely and sincere support, playing a vital role in the successful completion of this initiative. We are especially grateful to our project guide, Dr. Anup Bhange (Head of the Department, MCA), for her expert guidance, constant encouragement, and insightful suggestions that were crucial in achieving the project's objectives.

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