Transfer Learning-Based Skin Disease Detection System

K. Madhusudhan[1], K. Pavankumar[2], K. Parameswar Naidu[3]
[1'2'3] *Department of AI & DS, School of Engineering and Technology, Dhanalakshmi Srinivasan University, Samayapuram Campus, Tiruchirappalli, Tamil Nadu – 621112, India*
Guided by: Mrs. J. Sivasangari, Assistant Professor, Department of AI & DS

***Abstract*—**Skin diseases worldwide affect a large population but early detection can reduce their impact. Advances in artificial intelligence and deep learning have enabled automated medical image analysis. This paper proposes a transfer learning-based skin disease detection framework that integrates deep convolutional networks. The early detection system uses the Xception model for feature extraction and classification, along with a voting classifier for prediction. YOLOv5x6, YOLOv8, and YOLOv9 models are used for accurate lesion detection in skin care applications.

***Index Terms*—**Transfer Learning, Skin Disease Detection, Xception, Voting Classifier, YOLO, Deep Learning, Dermoscopy, Medical Image Analysis.

I. INTRODUCTION

Skin diseases represent one of the most common health problems across the globe. Millions of people suffer from dermatological conditions such as eczema, acne, psoriasis, melanoma, and fungal infections. Many of these diseases require early diagnosis to prevent severe complications and long-term damage. Traditional skin disease diagnosis relies on visual examination by experienced dermatologists. However, this process can be time-consuming and subjective. In many rural or developing areas, access to expert dermatologists is limited. Artificial intelligence techniques have emerged as a powerful tool to assist in medical diagnosis. Deep learning models, particularly convolutional neural networks, can automatically learn features from images and classify them with high accuracy.

II. LITERATURE REVIEW

Several researchers have explored automated skin disease detection systems using machine learning and deep learning techniques. Early studies used traditional image processing techniques to extract color and texture features from skin lesion images, using classifiers such as Support Vector Machines and Decision Trees. Recent research focuses on deep convolutional neural networks including VGGNet, ResNet, Inception, and MobileNet architectures, which have demonstrated superior performance in medical image classification tasks.

III. SYSTEM ARCHITECTURE

The proposed skin disease detection system consists of multiple modules including image acquisition, preprocessing, feature extraction, classification, and lesion detection. The architecture begins with input dermoscopic images which are preprocessed to remove noise and improve contrast. After preprocessing, transfer learning using the Xception model extracts deep features from the images. A voting classifier combines predictions from multiple models to improve reliability.

IV. DATASET DESCRIPTION

The dataset used for this study contains dermoscopic images collected from publicly available dermatology datasets. The images represent multiple categories of skin diseases such as melanoma, benign keratosis, psoriasis, eczema, and acne. Each image is labelled with the correct disease category, allowing supervised learning methods to train classification models.

V. DATA PREPROCESSING AND AUGMENTATION

Preprocessing is an important step in medical image analysis. Common preprocessing techniques include resizing images to a fixed resolution, normalization of pixel values, and noise reduction. Data augmentation techniques such as rotation, flipping, scaling, and brightness adjustment are used to increase the diversity of training data.

VI. TRANSFER LEARNING USING XCEPTION

Transfer learning allows the use of pre-trained neural networks for new tasks. The Xception model is chosen because of its efficient architecture and high classification accuracy. The model is initially trained on a large dataset such as ImageNet, and the learned features are then fine-tuned for the skin disease dataset. Only the final layers of the network are retrained while earlier layers remain frozen to preserve previously learned image features.

VII. ENSEMBLE LEARNING WITH VOTING CLASSIFIER

Ensemble learning combines predictions from multiple models to improve performance. A voting classifier aggregates outputs from several classifiers and selects the final prediction based on majority voting. Soft voting is used in this study, where prediction probabilities from each classifier are averaged before selecting the final class.

VIII. SKIN LESION DETECTION USING YOLO MODELS

Object detection models are used to identify the location of skin lesions within an image. YOLO (You Only Look Once) is a real-time object detection algorithm capable of detecting multiple objects simultaneously. In this work, YOLOv5x6, YOLOv8, and YOLOv9 models are implemented to detect lesion regions accurately.

IX. EXPERIMENTAL RESULTS AND EVALUATION

The performance of the proposed system is evaluated using several metrics including accuracy, precision, recall, and F1-score. Experimental results indicate that the Xception model combined with a voting classifier achieves high classification accuracy. YOLO-based detection models provide reliable lesion localization with minimal processing time.

X. DISCUSSION

The integration of classification and detection modules provides a comprehensive solution for automated dermatological diagnosis. The system can significantly reduce diagnostic time and assist healthcare professionals in screening large numbers of patients. However, the system still depends on the quality and diversity of the dataset used for training.

XI. ADVANTAGES, LIMITATIONS & FUTURE WORK

Advantages

- Improved classification accuracy and reliable lesion detection.
- Transfer learning reduces the need for large labelled datasets.
- Integration with telemedicine platforms can enable remote diagnosis in rural areas.

Limitations

- The dataset may not include all possible skin disease categories.
- Variations in lighting conditions and skin tones can sometimes affect classification accuracy.

Future Work

- Integrating segmentation models to identify precise lesion boundaries.
- Developing a mobile application for real-time skin disease diagnosis.
- Expanding the dataset with more diverse images.

XII. CONCLUSION

This paper presented a transfer learning-based skin disease detection system using deep learning and YOLO object detection models. The Xception architecture combined with ensemble learning provides high classification accuracy. The integration of YOLO models enables accurate localization of skin lesions, making the system suitable for practical dermatology applications.

REFERENCES

[1] J. Esteva et al., “Dermatologist-level classification of skin cancer with deep neural networks,” Nature, 2017.

[2] K. He et al., “Deep residual learning for image recognition,” IEEE CVPR, 2016.

[3] G. Jocher et al., YOLOv5 Object Detection Framework, 2020.

[4] Research articles on medical image analysis and dermatology AI systems.