PROJECT REPORT

Deep Learning-Based Disease Detection: Psoriasis, Acne, and Eczema

Submitted by

Shivanee Bhosale
Nayan Powar
Gayatri Alavane
Janhavi Vankudre
Apoorva Patil

in partial fulfillment for the award of the degree of

Bachelor of Technology

IN

Department of Computer Science and Engineering (AIML & Data Science)

KOLHAPUR INSTITUTE OF TECHNOLOGY'S

COLLEGE OF ENGINEERING (AUTONOMOUS), KOLHAPUR

APPENDIX 2

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CERTIFICATE

This is to certify that the Project report entitled, **"Deep Learning-Based Disease Detection: Psoriasis, Acne, and Eczema"** submitted by **"Shivanee Bhosale (A26), Nayan Powar (A28), Gayatri Alavane (A31), Janhavi Vankudre (A32) andApoorva Patil (A35)"**, in partial fulfillment for the award of the degree of **"Bachelor of Technology"** in **"Computer Science and Engineering (Artificial Intelligence and Machine Learning)"** at KIT's College of Engineering, Kolhapur, Maharashtra, INDIA, is a record of their own work carried out under my supervision and guidance.

SIGNATURE	**SIGNATURE**
DR. UMA P. GURAV	**MR. AKSHAY CHINCHANIKAR**
HEAD OF THE DEPARTMENT Associate Professor Department of CSE (AIML & DS) KIT's College of Engineering, Kolhapur	**SUPERVISOR** Associate Professor Department of CSE (AIML & DS) KIT's College of Engineering, Kolhapur

APPENDIX 3

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DECLARATION

I hereby declare that the Seminar/ Project entitled, **"Deep Learning-Based Disease Detection: Psoriasis, Acne, and Eczema"** submitted to KIT's College of Engineering, Kolhapur, Maharashtra, INDIA in the partial fulfillment of the award of the Degree of **"Bachelor of Technology"** in **"Computer Science and Engineering (Artificial Intelligence and Machine Learning and Data Science)"** is a bonafide work carried out by me. The material contained in this Seminar/ Project has not been submitted to any University or Institution for the award of any degree.

NAME OF THE STUDENT(S)
Shivanee Bhosale (A-26)
Nayan Powar (A-28)
Gayatri Alavane (A-31)
Janhavi Vankudre (A-32)
Apoorva Patil (A-35)

APPENDIX 4

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COLLEGE OF ENGINEERING (AUTONOMOUS), KOLHAPUR

ACKNOWLEDGEMENT

I sincerely appreciate all those who supported and guided us throughout this project. My heartfelt gratitude goes to my project supervisor Mr. Akshay Chinchanikar Sir for their invaluable insights and encouragement. I also acknowledge Mr. Shekhar Jalane Sir for their advice, which greatly enhanced our work. I am thankful to my peers and colleagues for their feedback and support.

NAME OF THE STUDENT(S)
Shivanee Bhosale (A-26)
Nayan Powar (A-28)
Gayatri Alavane (A-31)
Janhavi Vankudre (A-32)
Apoorva Patil (A-35)

INTRODUCTION

Skin diseases such as **Psoriasis, Acne, and Eczema** are common across all age groups and can significantly affect a person's quality of life. Accurate and early diagnosis of these diseases is crucial for effective treatment and management. However, diagnosis by dermatologists often relies on manual inspection, which can be subjective and time-consuming, especially in rural or underserved areas with limited access to specialists.

Recent advancements in **Artificial Intelligence (AI)** and **Deep Learning (DL)** offer a promising solution to automate the diagnosis process. Deep learning models, especially **Convolutional Neural Networks (CNNs)**, have demonstrated excellent performance in image recognition tasks. In the healthcare domain, CNNs have shown promising results in analyzing medical images, including skin lesion classification.

Our project aims to develop a deep learning-based system that can automatically detect and classify three common skin diseases—Psoriasis, Acne, and Eczema—using image data. This automated tool can assist dermatologists in decision-making and provide a fast and accessible method for preliminary disease detection.

LITERATURE REVIEW

The use of Artificial Intelligence (AI) in the healthcare domain, particularly in medical imaging, has seen rapid growth in recent years. Deep learning, a subfield of machine learning, has demonstrated exceptional performance in image classification, segmentation, and anomaly detection tasks. In dermatology, where diagnosis often relies on visual inspection of skin lesions or rashes, deep learning models—especially Convolutional Neural Networks (CNNs)—have shown significant promise.

Several studies have explored AI-based approaches for skin disease classification. The primary focus has been on cancerous and non-cancerous lesions, but recent works have begun addressing more common and chronic dermatological conditions.

- **Esteva et al. (2017)** published a landmark paper in *Nature*, where they trained a CNN on over 129,000 clinical images to classify skin lesions. Their model achieved performance on par with certified dermatologists, particularly in differentiating malignant from benign skin lesions. This study opened the door for AI-assisted dermatology and proved the potential of CNNs in real-world diagnostic tasks.
- **Han et al. (2018)** developed a deep neural network capable of classifying various types of skin lesions using a dataset of over 10,000 images. Their model demonstrated excellent accuracy in multi-class classification tasks, reinforcing the effectiveness of deep learning in dermatological applications.
- **Kawahara et al. (2016)** focused on non-cancerous skin diseases and applied CNNs to classify conditions such as Acne, Rosacea, and Eczema. Their model used transfer learning with pre-trained architectures like AlexNet and VGGNet, showcasing how pretrained models can be fine-tuned for specific skin conditions with limited datasets.
- **Tschandl et al. (2019)** contributed to the *HAM10000* dataset, which includes over 10,000 dermatoscopic images of skin lesions. This dataset has been widely used by researchers to benchmark their deep learning models. Although primarily focused on pigmented lesions and cancers, it paved the way for the creation of standardized datasets in dermatology.

While the results of these studies are promising, several challenges persist:

- **Dataset Imbalance and Diversity**: Many models suffer from dataset imbalance, where certain disease classes are underrepresented. Moreover, most datasets lack diversity in terms of skin tones, age groups, and image acquisition methods, limiting the model's generalizability.
- **Focus on Skin Cancer**: A majority of existing research emphasizes melanoma and other skin cancers, whereas common inflammatory skin diseases like Psoriasis, Acne, and Eczema are underrepresented in deep learning research.
- **Real-world Implementation**: Many models are developed and tested in controlled environments but face challenges when deployed in real-world clinical settings due to varying image quality, lighting, and background noise.

Despite numerous advancements, few studies have addressed the simultaneous classification of **Psoriasis**, **Acne**, and **Eczema**, which are among the most prevalent chronic skin conditions worldwide. These diseases share overlapping visual features in early stages, making accurate classification difficult even for experienced dermatologists.

Our project attempts to bridge this gap by developing a CNN-based model that can effectively distinguish between Psoriasis, Acne, and Eczema using clinical images. Unlike most existing models that focus on binary classification (e.g., cancerous vs. non-cancerous), our model supports multi-class classification using a single architecture. Additionally, we emphasize lightweight model architecture that could be deployed in mobile health (mHealth) or teledermatology platforms for real-time use.

To summarize, the literature shows that deep learning, particularly CNNs, has made significant strides in the diagnosis of dermatological diseases. However, the field still lacks comprehensive models addressing multiple non-cancerous skin conditions. Our project builds upon the successes of previous studies while addressing existing limitations by focusing on underrepresented skin diseases. By creating a robust and generalizable model for Psoriasis, Acne, and Eczema detection, we aim to contribute to accessible and accurate dermatological care through AI.

PROBLEM STATEMENTS

Despite technological advancements, access to dermatological care remains a challenge in many regions. Manual diagnosis is prone to variability due to differences in expertise and experience among practitioners. Moreover, the early symptoms of Psoriasis, Acne, and Eczema often appear similar, making accurate diagnosis difficult for non-specialists.

Hence, there is a need for a reliable, automated system that can assist in detecting these conditions with high accuracy. The goal is to minimize human error, reduce diagnosis time, and make skin disease detection accessible to a broader population.

PROPOSED WORK

OBJECTIVES

1. **To develop a deep learning model** capable of classifying three common skin diseases—Psoriasis, Acne, and Eczema—based on image inputs.
2. **To automate the diagnosis process** for skin diseases, reducing dependency on manual inspection by dermatologists.
3. **To assist medical professionals** in making faster and more accurate diagnostic decisions through AI support.
4. **To improve early detection** of dermatological conditions, enabling timely treatment and better patient outcomes.
5. **To reduce misdiagnosis rates** by providing a consistent and objective classification system using CNN-based analysis.
6. **To build a lightweight and scalable model** that can be integrated into mobile apps or telemedicine platforms for widespread use.
7. **To use data augmentation techniques** for handling limited data and improving the model's robustness and generalizability.
8. **To train the model using CNN architecture** with optimized layers for feature extraction and classification.
9. **To evaluate the model's performance** using standard metrics such as accuracy, precision, recall, F1-score, and confusion matrix.
10. **To explore the applicability of AI in dermatology** and create awareness about its potential among healthcare providers.

METHODOLOGY

The methodology for this project follows a structured pipeline consisting of multiple phases—ranging from data acquisition and preprocessing to model training, evaluation, and result analysis. The proposed deep learning model utilizes Convolutional Neural Networks (CNNs) for the automatic detection and classification of skin diseases. The key steps in the methodology are outlined below:

1. Data Collection

- The foundation of any machine learning project is high-quality data. For this project, we sourced clinical skin disease images from publicly available dermatology datasets and online medical repositories such as:
  - DermNet
  - Kaggle dermatology datasets
  - ISIC Archive (for supplementary images)
- A balanced dataset was curated comprising labeled images for three disease classes:
  - **Psoriasis**
  - **Acne**
  - **Eczema**
- Images were reviewed for quality, clarity, and relevance to ensure meaningful model training.

2. Data Preprocessing

- The collected images varied in resolution, aspect ratio, and lighting conditions. To maintain consistency, we performed the following preprocessing steps:
  - **Resizing:** All images were resized to a uniform dimension of **200x200 pixels**.
  - **Normalization:** Pixel values were normalized to fall within the range [0, 1] to enhance model convergence.
  - **Label Encoding:** The labels (Psoriasis, Acne, Eczema) were encoded numerically for compatibility with the training process.
  - **Noise Removal:** Images with irrelevant background noise or low quality were filtered out.
  - **Data Augmentation:** To mitigate overfitting and increase dataset diversity, augmentation techniques such as:
    - Rotation
    - Zooming
    - Horizontal/Vertical flipping
    - Brightness adjustment

      were applied to artificially enlarge the dataset and improve the model's robustness.

3. Model Design and Architecture

- A custom **Convolutional Neural Network (CNN)** was developed using TensorFlow and Keras. The architecture was designed to learn spatial hierarchies of features through backpropagation.

Model Architecture Overview:

- **Input Layer:** Receives 200x200 pixel RGB images.
- **Convolutional Blocks:**
  - Conv2D with 32 filters → ReLU → MaxPooling2D
  - Conv2D with 64 filters → ReLU → MaxPooling2D

   - Conv2D with 64 filters → ReLU → MaxPooling2D
   - Conv2D with 64 filters → ReLU → MaxPooling2D
- **Flattening Layer:** Converts 2D feature maps to 1D feature vectors.
- **Fully Connected Layers:**
   - Dense layer (512 units) → ReLU → Batch Normalization → Dropout (0.1)
   - Dense layer (512 units) → ReLU → Batch Normalization → Dropout (0.2)
- **Output Layer:** Dense (1 unit with **Sigmoid** activation) for binary classification in each iteration (multi-class handling done via one-vs-rest approach).

Hyperparameters and Optimization:

- **Loss Function:** Binary Cross-Entropy
- **Optimizer:** Adam (adaptive learning rate optimization)
- **Epochs:** 50–100 (tuned based on performance)
- **Batch Size:** 32
- **Activation Functions:** ReLU for intermediate layers, Sigmoid for output

4. Model Training

- The model was trained on the preprocessed dataset using 80% of the data for training and 20% for validation.
- **Training Process:**
   - The model was trained using backpropagation, with the Adam optimizer adjusting weights to minimize loss.
   - Training and validation loss and accuracy were monitored over each epoch to prevent overfitting.
   - Dropout layers and batch normalization were incorporated to improve generalization.
- **Callbacks like EarlyStopping and ModelCheckpoint** were used to save the best-performing model and halt training once performance plateaued.

5. Model Evaluation

- After training, the model was evaluated on a separate **test set** using the following metrics:
   - **Accuracy** – Percentage of correctly predicted samples.
   - **Precision** – True positive rate among predicted positives.
   - **Recall** – True positive rate among actual positives.
   - **F1 Score** – Harmonic mean of precision and recall.
   - **Confusion Matrix** – For visual analysis of classification accuracy for each class.
- Visualization tools like **Matplotlib and Seaborn** were used to plot training history, confusion matrix, and performance trends.

6. Results and Observations

- The model demonstrated promising results with high classification accuracy on test data, particularly for Psoriasis and Acne.
- Some confusion was observed between Eczema and Psoriasis due to visual similarities in early stages, which is consistent with clinical challenges faced by dermatologists.
- Data augmentation and dropout layers significantly improved model generalization and reduced overfitting.

7. Deployment and Usability (Future Scope)

- Although this project is in its prototype stage, the trained model can be integrated into:
   - **Web-based applications** for remote diagnosis

    - **Mobile apps** for self-assessment tools
    - **Telemedicine platforms** to assist dermatologists
- The lightweight nature of the model makes it suitable for real-time usage with minimal computational resources.

CONCLUSION

This mini project demonstrates the potential of deep learning models in the field of dermatology. The proposed CNN-based system was able to classify three common skin diseases—Psoriasis, Acne, and Eczema—with good accuracy. By automating the disease detection process, our model can aid dermatologists in clinical decision-making and support remote healthcare services.
Beyond achieving technical success, this project highlights the broader significance of integrating AI into healthcare. The system we developed has the potential to:

- Assist medical professionals in their diagnostic workflow.
- Provide rapid and preliminary screening tools in remote or underserved areas through telemedicine.
- Act as an educational resource for medical students.
- Raise awareness among the general population about skin health and encourage early consultation.

The results encourage further research into expanding the model to cover more skin diseases and improving accuracy with larger and more diverse datasets. With proper integration, such systems can enhance early diagnosis, reduce healthcare costs, and improve patient outcomes.
This project serves as a stepping stone toward more comprehensive AI-driven healthcare solutions, contributing meaningfully to the future of digital medicine.