Department of Computer Engineering

Faculty of Science and Technology

A

Preliminary Project Report on

Skin Disease Detection using Deep Learning

Submitted to Vishwakarma University, Pune

In the partial fulfilment for the award of the degree of

BACHELOR OF TECHNOLOGY

IN

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This project report has not been earlier submitted to any other Institute or University for the award of any degree or diploma.

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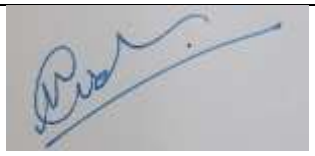
Nidhi Popli (64)	
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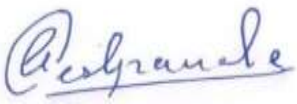
Gajanan Deshpande (66)	

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ABSTRACT

Skin is an extraordinary human structure. It frequently had a variety of illnesses, both known and unknown. As a result, the diagnosis of skin diseases in humans is the most complicated and unclear field of study. In our study, we address the challenge of diagnosing skin diseases by utilizing Decision Tree (DT), Convolutional Neural Network (CNN), and Support Vector Machine (SVM) algorithms. We have curated a dataset comprising approximately 3000 images from sources like online repositories and previously published dataset . Our approach involves pre-processing techniques such as digital hair removal, morphological filtering, and Gaussian filtering to enhance image quality. We then employ automatic segmentation to isolate affected lesions and extract features using methods like the Grey Level Co-occurrence Matrix (GLCM).

These features are utilized by our classification models (DT, CNN, SVM) to categorize skin images into different disease types. Our results demonstrate the effectiveness of our approach in accurately diagnosing skin diseases, contributing to the development of automated systems for diagnosis of diseases at Remote Location.

Keywords: Skin Disease Detection, Image Pre-processingq, Machine Learning Models, Data Cleaning ,SVM, CNN , DT.

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CHAPTER I

INTRODUCTION

1.1. Introduction

There are various organs in the human body. One of them is skin. It is the biggest organ of the human body .Any disorder that affects human skin is called skin disease .One of the most infectious diseases in the world is skin disease. The WHO reported that 9.6 million people died worldwide in 2018 and that over 14 million cases were diagnosed. Skin illnesses can be brought on by bacteria, viruses, allergies, or fungal infections. Skin conditions are also brought on by the hereditary component. There are chronic and incurable diseases, like eczema and psoriasis, and malignant diseases like malignant melanoma. Recent researchers have found the availability of cures for these diseases if they are detected in the early stages

This study highlights the significance of developing an expert application for detecting skin diseases, building on the valuable contributions of prior research in image processing for skin disease detection. Early detection of skin diseases, especially the dangerous melanoma, poses a significant challenge. The proposed solution involves employing various algorithms, including Decision Tree (DT) and Support Vector Machine (SVM), both supervised learning models, for image classification, particularly in analysing skin disease images. The study emphasizes the importance of having clean data for effective classification, addressing the challenge of categorizing skin disease images.

The literature review suggests that a combination of Convolutional Neural Network (CNN), SVM, proves to be effective for skin disease detection. The methodology outlines the development of an Android application utilizing a skin disease dataset. By incorporating DT alongside CNN and SVM, the study aims to enhance the accuracy and efficiency of skin disease detection within the proposed application.

In simpler terms, the study highlights the need for an application to detect skin diseases, recognizing the challenges in early detection. The chosen algorithms, CNN SVM and DT , are considered appropriate for this task. The study details the process of developing an Android application and presents results, including the number of detected diseases for each type of skin disease.

1.2. Need

Skin diseases are highly prevalent and can significantly affect individuals' quality of life. However, access to dermatologists is often limited, especially in rural and underserved areas, leading to delays in diagnosis and treatment. Misdiagnosis is also a common challenge due to the complexity of skin conditions.

- **Prevalence of Skin Diseases**

  Skin diseases like melanoma, psoriasis, eczema, and acne affect millions globally, impacting quality of life. Early and accurate diagnosis is vital for effective treatment.

- **Challenges in Dermatology**

  Limited Access: Many lack access to dermatologists, especially in rural areas, leading to delayed diagnosis and increased healthcare costs.

  Diagnostic Accuracy: Diagnosing skin diseases is complex and prone to misdiagnosis, even by experts.

- **Potential for Automation**

  Automating skin disease detection can provide rapid, consistent, and accurate diagnoses, aiding dermatologists and reducing routine evaluation burdens.

- **Enhanced Diagnostic Accuracy**

  The model can detect subtle patterns, improving diagnosis accuracy and reducing misdiagnosis rates.

- **Addressing Public Health Concerns**

  This project aims to develop a deep learning-based diagnostic tool to address public health needs, improving early detection and treatment of serious skin conditions like cancer.

CHAPTER II

LITERATURE SURVEY

2.1. Literature survey

A machine learning approach for skin disease detection and classification using image segmentation , Mostafiz Ahammed , Md. Al Mamun , Mohammad Shorif Uddin. ELSEVIER, Feb 2022

Skin disease is a global problem affecting many regions. An automatic Grabcut segmentation detected and segmented the skin lesion accurately. We then extracted GLCM and statistical features, applying them to SVM, KNN, and DT classifiers for disease classification.

Using the ISIC 2019 and HAM10000 datasets, which were balanced using random oversampling, we achieved average accuracies of 95%, 94%, and 93% (ISIC 2019) and 97%, 95%, and 95% (HAM10000) for SVM, KNN, and DT classifiers, respectively. Our model performed better with the HAM10000 dataset and significantly well with balanced data, outperforming some state-of-the-art methods for skin disease classification.

Intelligent System for Skin Disease Prediction using Machine Learning, Ahmed A. Elngar e. JOP:CS , Mar 2021

Identification of disease can help in reducing the problem of skin disease spread and will provide a better way to identify the skin problem. This will provide a low-cost way to do medical treatment without any delays. This will also help in early identification and early treatment of disease before they spread because most of the skin disease can get spread easily with touch. In our application we have used a modified pre-trained model of Convolutional neural network and SVM Algorithm.

Machine Learning Methods in Skin Disease Recognition: A Systematic Review Jie Sun , Kai Yao , Guangyao Huang , Chengrui Zhang , Mark Leach , Kaizhu Huang and Xi Yang Processes , 26 Mar 2023

This paper reviews public skin lesion datasets, the applied image preprocessing methods, and the subsequent skin lesion segmentation and classification methods. The current status, challenges, and outlook in ML-driven skin disease diagnosis are also discussed. Such studies can empower the development of advanced concepts and methodologies. In conclusion, future trends regarding image segmentation and classification of skin lesions require the development of more comprehensive datasets, investigation of more robust models, particularly for macroscopic image recognition, and methods for increasingly reliable automated diagnosis.

Method Of Skin Disease Detection Using Image Processing And Machine Learning , Nawal Soliman ALKolifi ALEnezi ELSEVIER, Feb 2022-A

In general, most of the common people do not know the type and stage of a skin disease. Some of the skin diseases show symptoms several months later, causing the disease to develop and grow further. This is due to the lack of medical knowledge in the public. Sometimes, a dermatologist (skin specialist doctor) may also find it difficult to diagnose the skin disease and may require expensive laboratory tests to correctly identify the type and stage of the skin disease. The advancement of lasers and photonics based medical technology has made it possible to diagnose the skin diseases much more quickly and accurately. But the cost of such diagnosis is still limited and very expensive. Therefore, we propose an image processing-based approach to diagnose the skin diseases. This method takes the digital image of disease effect skin area then use image analysis to identify the type of disease. Our proposed approach is simple, fast and does not require expensive equipment's other than a camera and a computer.

CHAPTER III

PROBLEM STATEMENT

3.1.Aim

The aim of this project is to develop an automated system for detecting and classifying skin diseases using deep learning techniques. This system will leverage advanced image processing methods to enhance image quality and accurately segment skin lesions. By extracting key features from these images and utilizing machine learning classifiers such as SVM , CNN, and DT, the project seeks to achieve high accuracy in diagnosing various skin conditions.

Ultimately, this tool will be designed to be user-friendly and accessible, improving the early detection and diagnosis of skin diseases, especially in regions with limited access to dermatological care.

3.2. Objective

1. Literature Survey and Analysis: Conduct a comprehensive review of existing research and technologies in automated skin disease detection and classification.

2. Data Acquisition: Collect diverse skin disease images from ISIC 2019 and HAM10000 datasets.

3. Lesion Segmentation: Use automatic Grabcut segmentation to accurately isolate skin lesions**.**

4. Model Training and Classification: Train and evaluate classifiers such as Support Vector Machine (SVM), Convolutional Neural Network (CNN), and Decision Trees (DT) to classify skin diseases.

5. System Deployment: Develop a user-friendly application or interface for practical use in healthcare settings and telemedicine platforms.

3.2. Problem statement

- To develop an automated, efficient, and reliable system for the accurate detection and classification of skin diseases, improving access to dermatological care and enabling early intervention to enhance patient outcomes.

CHAPTER IV

PROJECT REQUIREMENTS

4.1. Software Requirements

Category	Requirement
Operating System	Windows 10/11, macOS, or Linux (Ubuntu)
Programming Languages	Python 3.7 or higher
Development Environment	Jupyter Notebook, PyCharm, VS Code
Deep Learning Frameworks	TensorFlow 2.x, PyTorch 1.x
Machine Learning Libraries	Scikit-learn
Image Processing Libraries	OpenCV, PIL/Pillow
Data Manipulation Libraries	NumPy, Pandas
Visualization Libraries	Matplotlib, Seaborn
Web Framework	Flask or Django
Database	AWS, MySQL
Version Control	Git, GitHub
Others	Anaconda

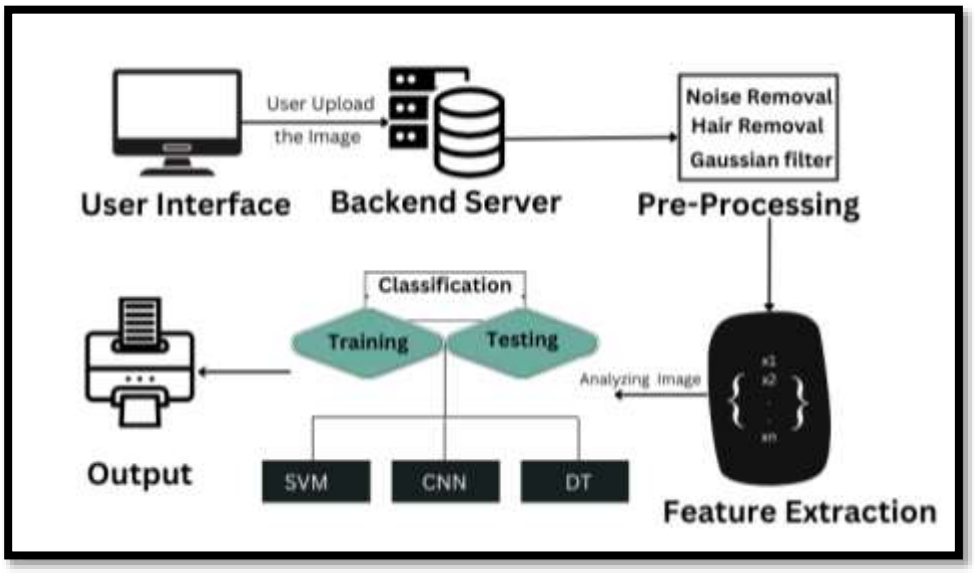
4.2. Hardware Requirements

Category	Requirement
Processor	Intel i7 or AMD Ryzen 7 (Quad-Core or higher)
Memory	Minimum 16 GB RAM (32 GB recommended)
Storage	SSD with at least 512 GB (1 TB recommended)
Graphics Processing Unit (GPU)	NVIDIA GPU with CUDA support (e.g., NVIDIA GTX 1080 Ti, RTX 2080, or newer) with at least 8 GB VRAM
Secondary Storage	Additional external hard drive or cloud storage
Monitor	Full HD (1920x1080) resolution or higher
Internet Connection	Stable and high-speed internet connection
Miscellaneous	GPU drivers (NVIDIA CUDA Toolkit, cuDNN), adequate cooling system

CHAPTER V

SYSTEM ANALYSIS OF PROPOSED ARCHITECTURE

5.1. System Architecture

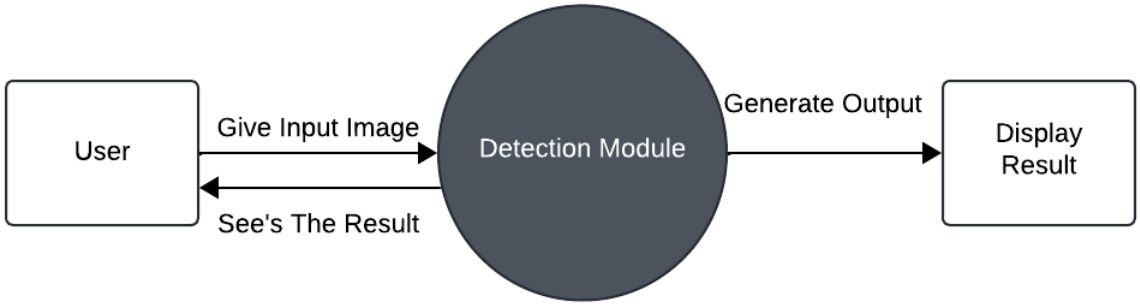


The system architecture for our skin disease detection project involves several interconnected components to facilitate efficient and accurate diagnosis. The User Interface (Web Application) serves as the primary interaction point, allowing users to upload skin images and view classification results. Upon image upload, the Backend Server receives the data and directs it to the Preprocessing Module, which enhances the images through digital hair removal and Gaussian blur. The Feature

Extraction Module then extracts relevant features using techniques like GLCM and statistical methods to generate feature vectors. These vectors are fed into the Image Classification Module, which employs CNN, SVM, and Decision Tree classifiers to predict the type of skin disease present. Finally, the Output Module presents the classification results to the user interface, displaying the disease type and associated confidence level.

This architecture ensures a streamlined process from image upload to diagnosis, leveraging deep learning techniques to enhance diagnostic accuracy and accessibility.

5.2. Data Flow Diagrams Level 0



This Level 0 Dataflow Diagram (DFD) provides a high-level overview of the skin disease detection system. It illustrates the main interactions between the user, the detection module, and the display result component.

- **User:**

  Give Input Image: The user uploads a skin image to the system.

  See the Result: After the image is processed, the user views the diagnostic results.

- **Detection Module:**

  Role: The central processing unit of the system, responsible for analysing the input image.

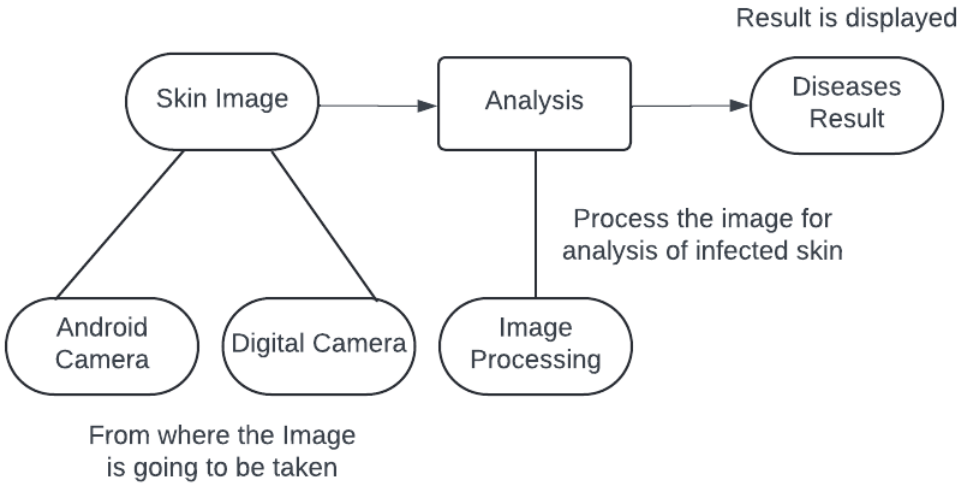
  Process: The detection module performs image pre-processing, feature extraction, and classification using deep learning models to determine the type of skin disease.

- **Display Result:**

  Generate Output: The detection module generates the classification result and sends it to the display result component.

  Function: This component presents the diagnostic result to the user, making it accessible for review.

Data Flow Diagrams Level 1



This diagram illustrates a process for diagnosing skin diseases using images. Here's a brief explanation of each step:

Image Capture:

- Android Camera and Digital Camera: These are the sources from which the skin image can be captured.
- The captured image is referred to as the Skin Image.

Image Processing:

- The Skin Image is sent to the Image Processing step.
- This step involves processing the image to prepare it for analysis, focusing on detecting and enhancing features indicative of skin infections or diseases.

Analysis:

- The processed image is then subjected to Analysis.
- This step analyzes the processed image to identify potential skin diseases.

Result Display:

The outcome of the analysis is the Diseases Result, which displays the diagnosis or findings based on the analysis of the infected skin.

5.3. UML Diagrams

- **Use Case Diagram**

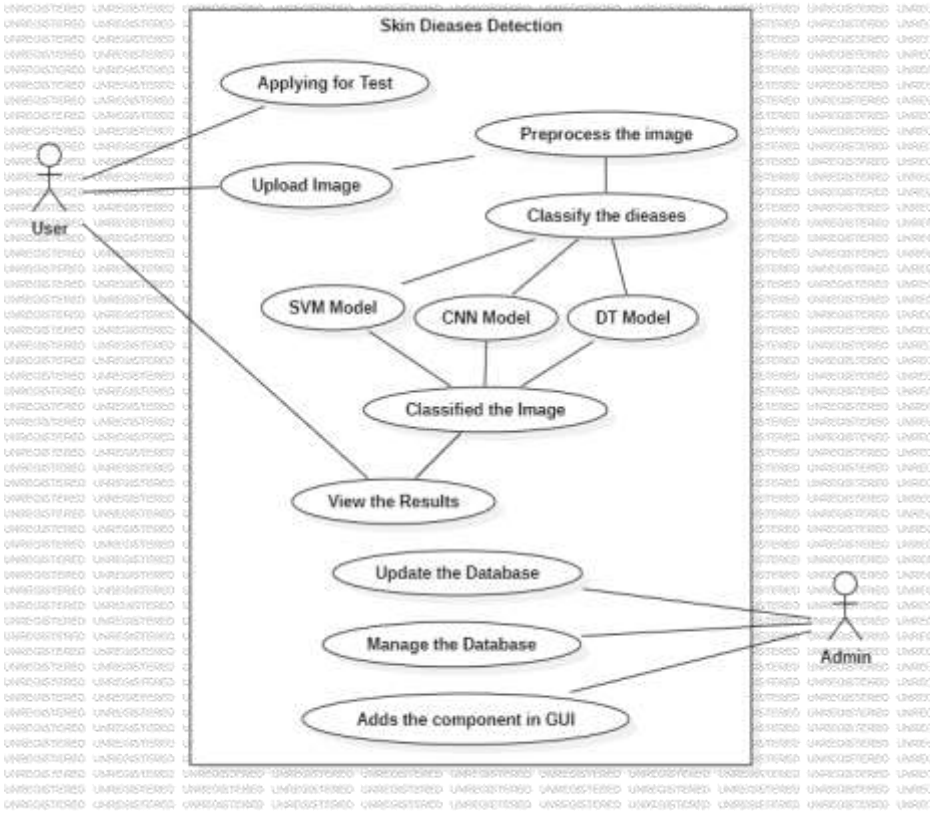
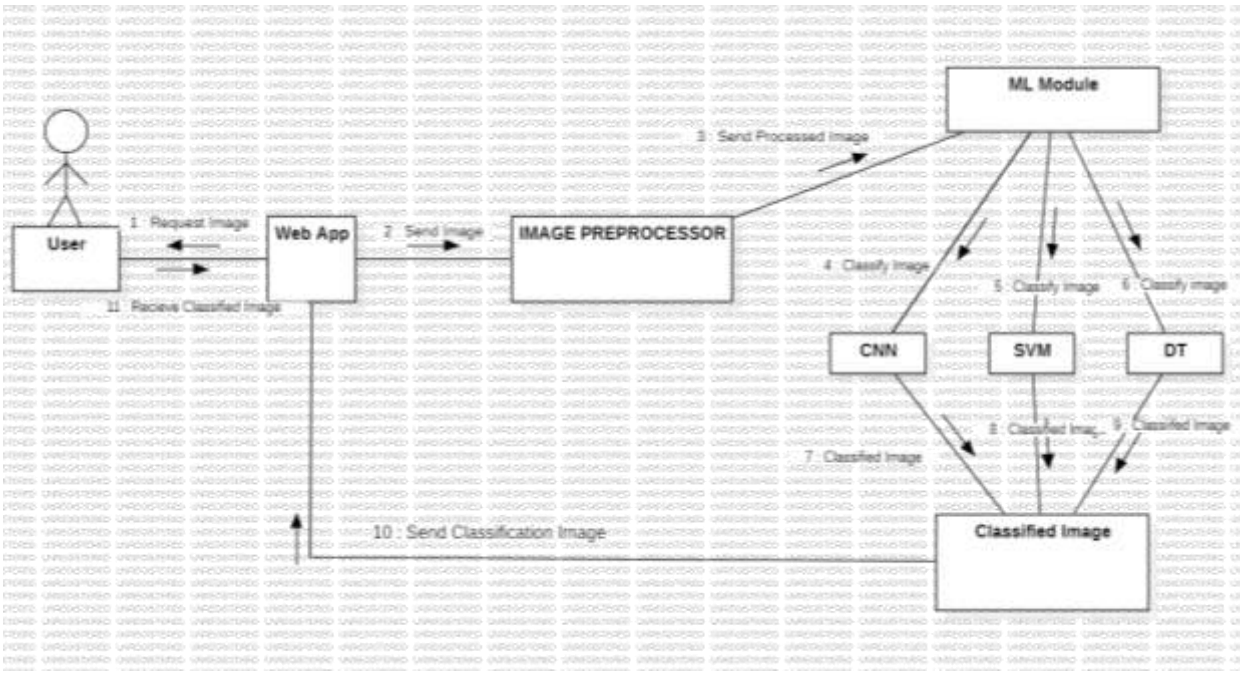


Figure 1.2 : Use Case Diagram

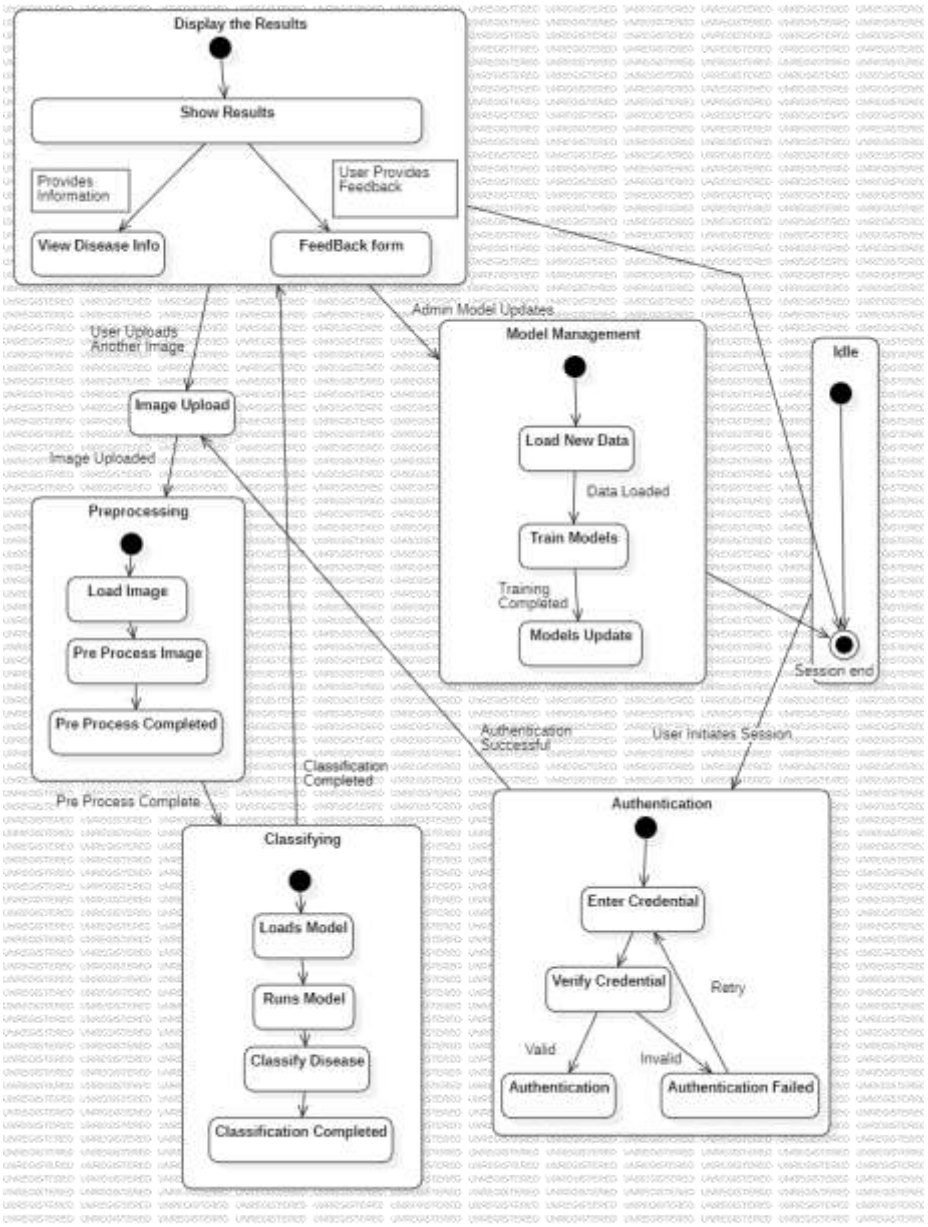
- **Applying for Test:** Users start by requesting a test.
- **Upload Image:** Users upload an image of the affected skin area.
- **Pre-process the Image:** The system preprocesses the image for better analysis.
- **Classify the Diseases:** The preprocessed image is analyzed using different models:
- **SVM Model:** Support Vector Machine model.
- **CNN Model:** Convolutional Neural Network model.
- **DT Model:** Decision Tree model.
- **Classified the Image:** The image is classified into a specific skin disease category.
- **View the Results:** Users can view the classification results.
- **Update the Database:** The system updates the database with new results.
- **Manage the Database:** Admins or system processes manage the database records.

- **Communication Diagram**



- **User Requests Image:** The user initiates a request for skin disease classification.
- **Send Image to Web App:** The user uploads an image via the web application.
- **Web App Sends Image to Preprocessor:** The web application forwards the image to the image preprocessing module.
- **Image Preprocessing:** The image preprocessor processes the image to prepare it for classification.
- **Send Processed Image to ML Module:** The preprocessed image is sent to the machine learning (ML) module.
- **Classify Image with CNN:** The Convolutional Neural Network (CNN) model classifies the processed image.
- **Classify Image with SVM:** The Support Vector Machine (SVM) model classifies the processed image.
- **Classify Image with DT:** The Decision Tree (DT) model classifies the processed image.
- **Classified Image:** The classified images from the different models are collected.
- **Send Classification Image to Web App:** The classified image is sent back to the web application.
- **Receive Classified Image:** The user receives the classification results through the web application.

- **State Chart Transition Diagram**



- **Idle:**

User Initiates Session: The system starts from an idle state when the user initiates a session.

- **Authentication:**

Enter Credential: User enters credentials.

Verify Credential: The system verifies the credentials.

Valid: If credentials are valid, authentication is successful.

Invalid: If credentials are invalid, the user can retry.

- **Image Upload:**

  Image Uploaded: The user uploads an image to the system

- **Preprocessing:**

  Load Image: The system loads the uploaded image.

  Pre Process Image: The system preprocesses the image.

  Pre Process Completed: The preprocessing is completed.

- **Classifying:**

  Loads Model: The system loads the appropriate classification model.

  Runs Model: The system runs the model to classify the disease.

  Classify Disease: The disease is classified.

  Classification Completed: The classification process is completed.

- **Display the Results:**

  Show Results: The results of the classification are displayed.

  View Disease Info: The user can view detailed disease information.

  Feedback Form: The user can provide feedback.

- **Model Management:**

  Admin Model Updates: Administrators can manage the machine learning models.

  Load New Data: New data is loaded for model training.

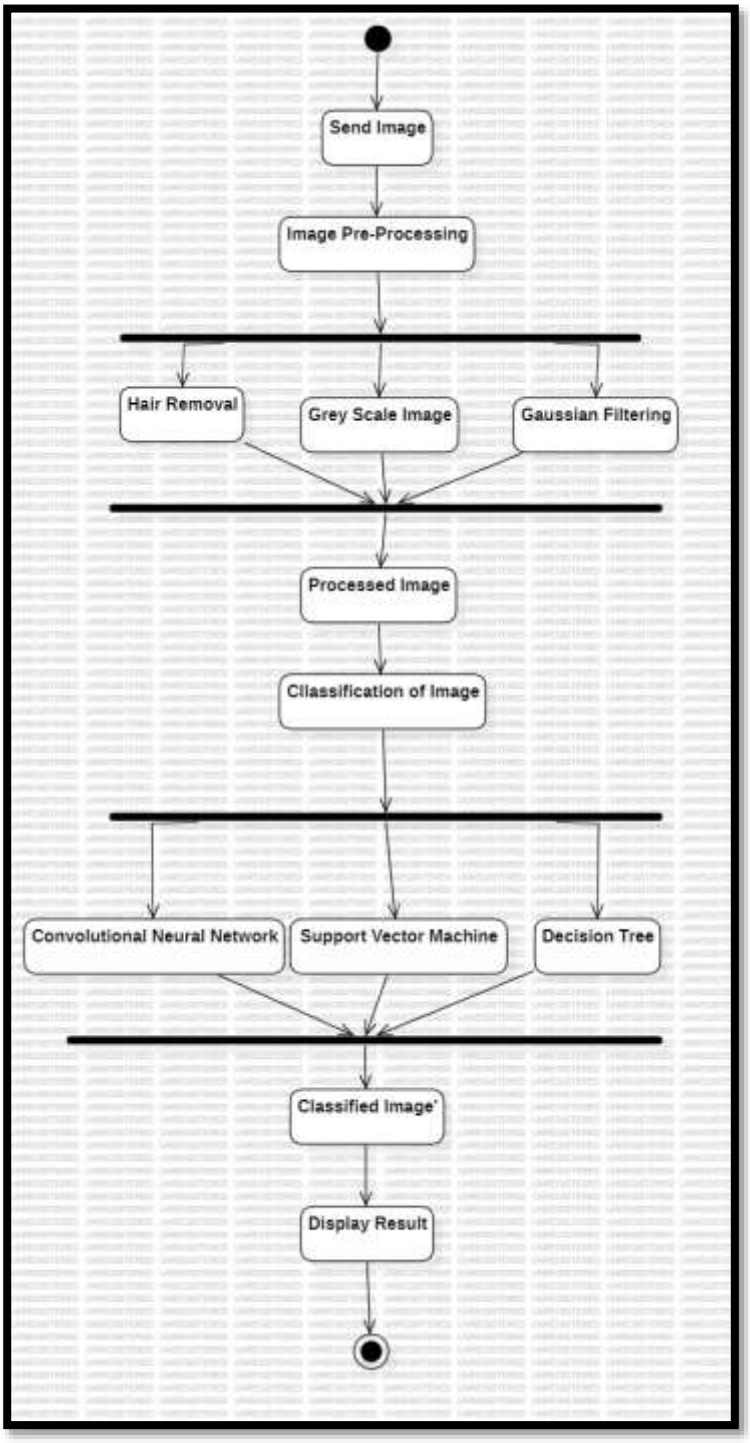
  Train Models: The system trains the models with the new data.

  Models Update: The models are updated after training.

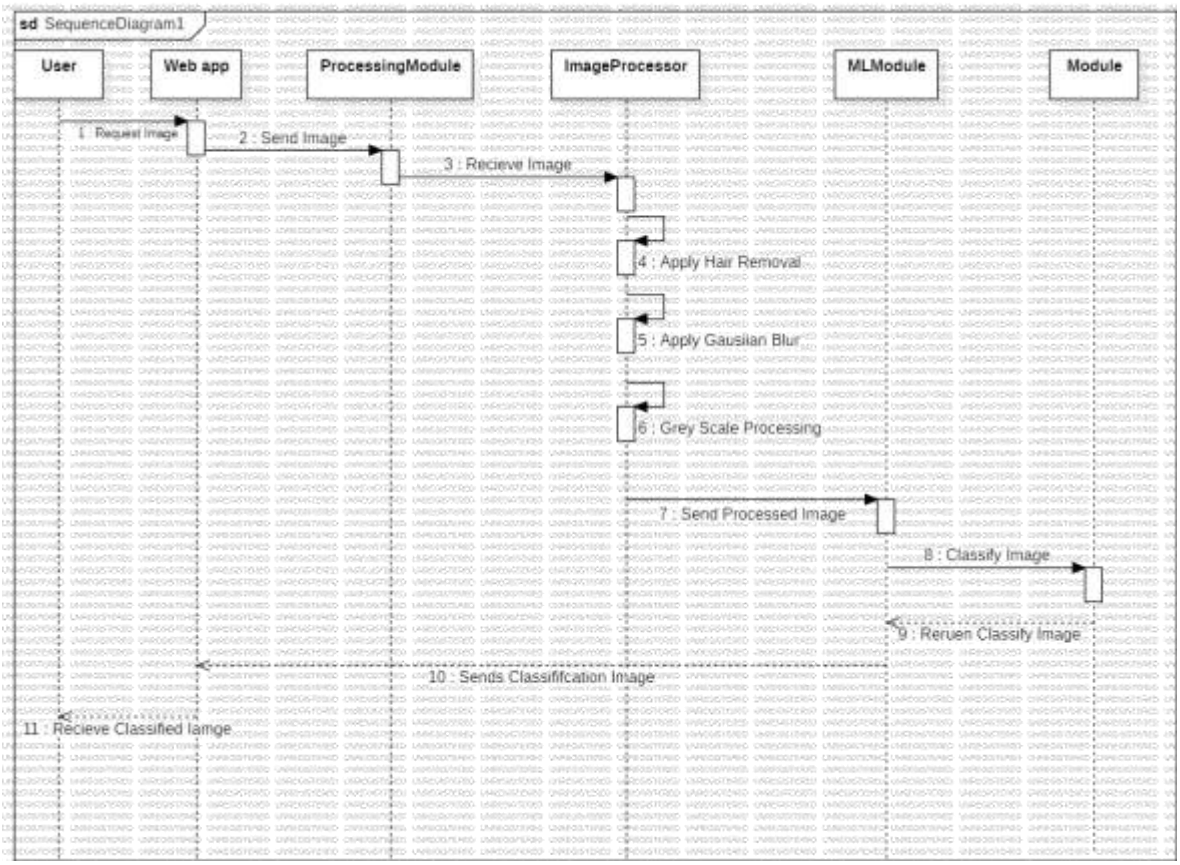
- **Session End:**

  After completing the tasks, the session can be ended, returning the system to the idle state.

- **Activity Diagram**



- **Sequence Diagram**

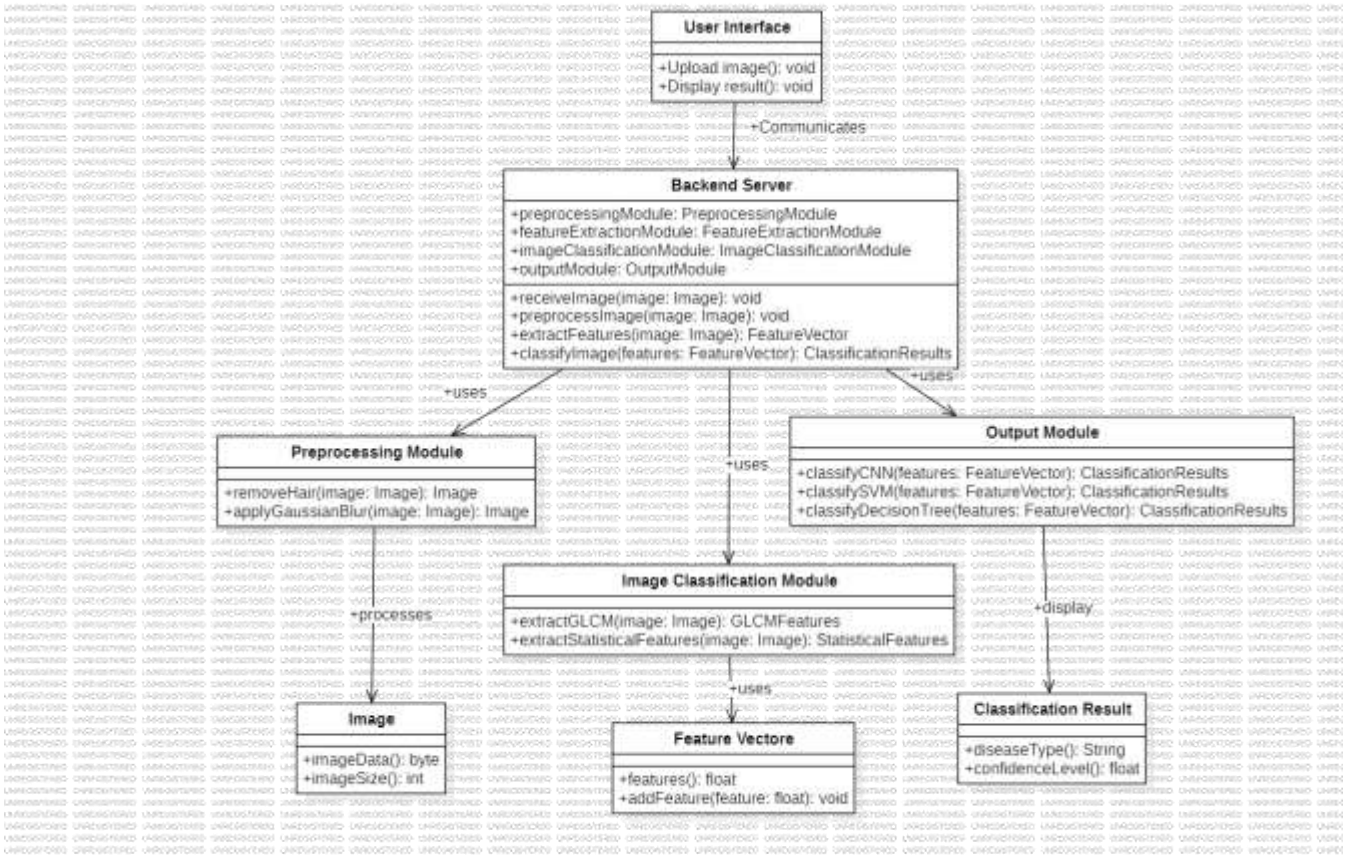


The sequence diagram outlines the workflow and interactions within the skin disease detection system. It begins with the user uploading a skin image via the web application. The web application receives this image and sends it to the processing module. The processing module first receives the image and then forwards it to the image processor for preprocessing tasks.

The image processor performs several key preprocessing steps: it removes hair from the image using morphological black-hat transformation, applies a Gaussian blur for enhancement, and conducts grayscale processing to standardize the image for subsequent feature extraction. After these steps, the processed image is sent back to the processing module.

Next, the processing module forwards the processed image to the machine learning (ML) module. The ML module uses Convolutional Neural Networks (CNN), Support Vector Machine (SVM), and Decision Tree (DT) models to classify the image, determining the type of skin disease. Once the classification is complete, the ML module returns the classified image back to the processing module, which then sends the classification results to the web application. Finally, the user can view the diagnostic results through the web application interface.

- ## Class Diagram



- The class diagram provides a structural overview of the skin disease detection system, detailing its main components and their interactions. The User Interface allows users to upload images and display diagnostic results. It communicates directly with the Backend Server, which coordinates the workflow of the entire system.

- The Backend Server consists of several key modules: the Preprocessing Module, Feature Extraction Module, Image Classification Module, and Output Module. It manages the image processing pipeline by receiving images from the User Interface, preprocessing them to enhance quality and remove noise, extracting relevant features, and classifying the images to detect skin diseases.
- The Preprocessing Module is responsible for preparing the images for analysis by removing hair and applying a Gaussian blur. Once preprocessing is complete, the images are passed to the Feature Extraction Module, which extracts important features using techniques such as Grey Level Co-occurrence Matrix (GLCM) and other statistical methods.

- These features are then forwarded to the Image Classification Module, which uses machine learning algorithms, including Convolutional Neural Networks (CNN), Support Vector Machines (SVM), and Decision Trees (DT), to classify the images. The results of the classification are sent to the Output Module, which compiles the classification results and sends them back to the Backend Server.

- Finally, the Backend Server relays the classification results to the User Interface, where they are displayed to the user. The Feature Vector and Classification Result classes encapsulate the features extracted from the images and the results of the classification, respectively, ensuring a clear and organized flow of information throughout the system. This structure enables efficient and accurate detection and classification of skin diseases from input images.

CHAPTER VI

IMPLEMENTATION

6.1 Methodology

The proposed methodology for classifying skin diseases aims to enhance the accuracy and efficiency of disease detection through a multi-step process. It begins with image pre-processing, where techniques such as resizing, hair removal, and noise removal are applied to improve image quality and reduce complexity. Image resizing ensures uniformity in feature extraction and processing time, while hair removal techniques, such as digital hair removal (DHR) algorithms based on morphological filtering, enhance disease detection by eliminating unwanted elements. Additionally, noise removal techniques, like Gaussian filtering, further enhance image clarity and quality. Following pre-processing, the process involves image segmentation, feature extraction, and classification. The segmentation step partitions the image into meaningful regions, while feature extraction captures relevant information for disease classification.

Finally, classification algorithms such as Decision Trees (DT), Support Vector Machine (SVM), and Convolutional Neural Networks (CNN) are employed to accurately classify skin diseases based on the extracted features. This comprehensive approach ensures efficient and accurate disease detection, making it superior to traditional methods.

6.2 System Overview

- **Project: Skin Disease Detection Using Deep Learning**

  This project aims to develop an automated system for detecting and classifying skin diseases using deep learning techniques. The system is designed to assist dermatologists and provide quick and accurate diagnoses for patients, particularly in areas with limited access to specialized healthcare.

- **Components and Workflow:**

  User Interface (Web Application):

  Purpose: Provides an accessible platform for users (patients or healthcare providers) to upload skin images and view diagnostic results.

- **Functionality:**

  Image Upload: Users can upload skin images directly through the web application.

  Results Display: The interface displays the classification results, including the type of skin disease and the confidence level of the prediction.

- **Backend Server:**

  Purpose: Manages the overall workflow by coordinating between the user interface, preprocessing, feature extraction, classification, and output modules.

- **Functionality:**
  1. Receives images from the user interface.
  2. Routes images to the preprocessing module.
  3. Collects preprocessed images and sends them to the feature extraction module.
  4. Receives extracted features and forwards them to the classification module.
  5. Sends classification results to the output module.
  6. Returns results to the user interface for display.

- **Preprocessing Module:**

Purpose: Enhances the quality of images to ensure accurate feature extraction and classification.

Functionality:

Hair Removal: Uses Morphological Black-Hat Transformation to remove hairs from skin images.

Image Enhancement: Applies Gaussian Filter to smooth and enhance image quality.

- **Feature Extraction Module:**

Purpose: Extracts meaningful features from preprocessed images to be used for classification.

Functionality:

1. **GLCM Features:** Extracts texture features using the Gray-Level Co-occurrence Matrix (GLCM).
2. **Statistical Features:** Extracts statistical features such as mean, variance, skewness, and kurtosis.
3. **Feature Vector:** Compiles extracted features into a feature vector.

- **Image Classification Module:**

Purpose: Classifies images into specific skin disease categories using trained machine learning models.

Functionality:

1. **CNN:** Convolutional Neural Network model for high-accuracy image classification.
2. **SVM:** Support Vector Machine model for classification.
3. **Decision Tree:** Decision Tree classifier for classification.
4. **Model Training:** Models are trained using benchmark datasets (HAM10000 and ISIC 2019) to recognize patterns and make accurate predictions.

- **Output Module:**

Purpose: Presents the classification results to the user.

Functionality:

1. **Results Display:** Shows the predicted disease type and confidence level.
2. **Recommendations:** Provides additional information or recommendations based on the classification results.

- **Interaction Flow:**
  1. **Image Upload:** The user uploads a skin image through the web application.
  2. **Preprocessing:** The backend server receives the image and sends it to the preprocessing module, where hair removal and image enhancement are performed.

3. **Feature Extraction:** The preprocessed image is forwarded to the feature extraction module, where GLCM and statistical features are extracted to form a feature vector.
4. **Classification:** The feature vector is sent to the image classification module. The CNN, SVM, and Decision Tree models classify the image and determine the skin disease.
5. **Results Display:** The classification results are sent to the output module, which then presents the results on the web application for the user to view.

- **Data Flow:**
    1. **Input:** Skin images uploaded by users.
    2. **Processing:** Image preprocessing, feature extraction, and classification.
    3. **Output:** Classification results with disease type and confidence level.
- **Datasets:**

HAM10000: A large collection of multi-source dermatoscopic images of common pigmented skin lesions.

Hyperlink:
https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/DBW86T

ISIC 2019: A dataset provided by the International Skin Imaging Collaboration for the ISIC Challenge, containing labeled dermatoscopic images.

Hyperlink:

https://challenge.isic-archive.com/data/

CHAPTER VII

PROJECT PLAN

Phase	Tasks	Start Date	End Date	Duration
Initiation	Define project scope and objectives, identify stakeholders, develop initial project plan	15/01/2024	30/01/2024	2 weeks
Planning	Requirement analysis, define technical specifications, develop detailed schedule, resource planning, risk management planning	01/02/2024	20/02/2024	3 Weeks
Data Collection and Preparation	Collect data from ISIC 2019 and HAM10000 datasets, data cleaning and preprocessing (hair removal, Gaussian blur, grayscale conversion), data balancing	21/02/2024	15/03/2024	4 weeks
Model Development	Feature extraction (GLCM and statistical features), train and evaluate CNN, SVM, and Decision Tree models, model optimization	02/04/2024	24/05/2024	3 weeks
System Development	Develop backend server (integrate preprocessing, feature extraction, classification modules), develop user interface (image upload, display results)	01/06/2024	12/07/2024	6 weeks
Integration and Testing	Integrate backend and frontend components, system testing (unit, integration, user acceptance), debugging, optimization	15/07/2024	30/07/2024	2 weeks
Deployment	Deploy web application on a server, setup database and API integrations, user training and documentation	02/08/2024	12/09/2024	4 weeks
Submission	Submission of Developed System at University Level	01/10/2024	15/10/2024	2 weeks

CHAPTER VIII

CONCLUSION

The skin disease detection project using deep learning has gathered comprehensive datasets from ISIC 2019 and HAM10000. We are now developing a robust model using techniques like CNN, SVM, and DT to achieve high classification accuracy for various skin conditions. Advanced image preprocessing methods will enhance image quality, and feature extraction techniques like GLCM will ensure reliability.

We are also creating an intuitive web application for easy image uploads and diagnostic result viewing, making the system accessible to remote and underserved areas. This project aims to aid dermatologists by providing an advanced tool for early and accurate skin disease detection, ultimately improving patient outcomes..

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