RSET
RAJAGIRI SCHOOL OF
ENGINEERING & TECHNOLOGY
(AUTONOMOUS)

Mini Project Report On

Skin Disease Detector

Submitted in partial fulfillment of the requirements for the award of the degree of

Bachelor of Technology

in

Computer Science & Engineering

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CERTIFICATE

This is to certify that the mini project report entitled **"Skin Disease Detector"** *is a bonafide record of the work done by* **Aleena Jaison Peechanatt (U2103024)**, **Aleena Roy (U2103025)**, **Anna Maria Joseph (U2103039)**, **Chandana V S (U2103066)**, *submitted to the APJ Abdul Kalam Technological University in partial fulfillment of the requirements for the award of the degree of Bachelor of Technology (B. Tech.) in Computer Science and Engineering during the academic year 2023-2024.*

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Abstract

Skin is the largest organ in our body. It frequently suffers from many known and unknown diseases. Therefore, diagnosing and categorising skin problems from clinical images is one of the challenging tasks in medical image analysis. Rate of skin disease has been increasing due to lifestyle and changing environments. The project is to develop a system which combines Convolutional Neural Network to develop a web application that predicts the skin disease using image processing. Automated image-based method is used for diagnosing and categorizing the skin problems. Computational approaches will be used to analyze, process, and relegate picture data to consider the many different characteristics of the images that are being processed. This helps in accurate delivery of results which helps in treating and curing the disease faster.

Contents

List of Figures

Chapter 1

Introduction

1.1 Background

Skin is the largest organ of the human body. Skin diseases are conditions that affect your skin. These diseases may cause rashes, inflammation, itchiness or other skin changes. Some skin conditions may be genetic, while lifestyle factors may cause others. Some skin diseases are minor. Others cause severe symptoms. Some of the most common skin diseases include:

- Acne, blocked skin follicles that lead to oil, bacteria and dead skin buildup in your pores.

- Psoriasis, scaly skin that may swell or feel hot.

- Rosacea, flushed, thick skin and pimples, usually on the face.

- Skin cancer, uncontrolled growth of abnormal skin cells.

- Vitiligo, patches of skin that lose pigment.

The project is to classify whether an uploaded image of the skin, is affected by melanoma or eczema with the use of machine learning. Many methods for automatic detec tion and classification of melanoma have been developed, ranging from decision trees, to Support Vector Machines (SVM), to logistic regression and Bayesian classifiers. Con volutional Neural Networks (CNNs) play an essential role in the image-based detection of a pathology. Their use is widely demonstrated in the detection, segmentation and subsequent classification of melanocytic lesions

1.2 Problem Definition

The problem statement for the project is to classify and detect Skin diseases like eczema and melanoma using Image Processing and Machine Learning Algorithms and develop a web application.

1.3 Scope and Motivation

The project scope includes developing a predictive model for skin diseases, creating a user-friendly interface, managing data securely, providing informative content, ensuring privacy, conducting testing, and deploying the platform for public use and assisting healthcare professionals by providing a second opinion.

1.4 Objectives

- To develop an algorithm for efficient extraction and classification of skin diseases.

- To ease diagnosis and treatment of patient (using automation) and provide a cost-effective way of skin disease detection.

- To improve the speed of diagnosing various kinds of skin diseases.

- Develop an intuitive user interface that allows users (possibly healthcare professionals) to upload skin images and receive diagnostic predictions

1.5 Challenges

Owing to privacy and professional equipment problems, it is difficult to collect sufficient data in the process of skin disease identification. A dataset that is overly small can easily lead to overfitting owing to the lack of learning ability of the model, which makes the network model lack generalization ability. Also, after summarizing and comparing the current algorithms, it was found that there are some key limitations that make it difficult for the reported algorithms to achieve significant improvements in their diagnostic accuracy.

1.6   Societal / Industrial Relevance

This project can be beneficial for the society and the industry in the following ways:

- Early Detection and Prevention

- Reduced Healthcare Costs

- Improved Patient Outcomes

- Remote Monitoring

- allocation of limited healthcare resources in rural areas

Chapter 2

Software Requirements Specification

2.1   Introduction

The purpose of the Skin Disease Predictor Project is to enable early detection, improve accessibility to healthcare, empower users through education, optimize resource utilization and ensure privacy while using technology to enhance the diagnosis and management of skin diseases. The project scope includes developing a predictive model for skin diseases, creating a user-friendly interface, managing data securely, providing educational content, ensuring privacy, conducting testing, and deploying the platform for public use.

2.2   Overall Description

- Software Perspective:

The Skin Disease Detector is a new, self-contained product aimed at revolutionizing the diagnosis and management of skin diseases. It is not a follow-on member of a product family or a replacement for existing systems but rather a solution addressing the growing need for accessible and accurate dermatological care. Originating from the increasing prevalence of skin diseases and the limitations in accessing specialized healthcare, this product fills a crucial gap by leveraging advanced technology to provide users with a convenient and reliable tool for preliminary diagnosis.

- Disease Detection:

Users can input an image of the disease affected skin area either from their database or can click a picture and upload it. Further questions regarding the age, duration of occurrence of the disease etc. can also be specified for getting better results. After acquiring all the necessary information, the disease is detected.

- Operating Environment:

Minimum recommended specifications include a computer with a dual-core processor, 8 GB of RAM, and sufficient disk space to accommodate the application and its dependencies. Additionally, the system is web-based, and users can access it through standard web browsers such as Chrome, Firefox, or Safari. Internet connectivity is required for the users.

2.3 External Interface Requirements

- User Interfaces:

  The user interfaces for the software shall be compatible with any browser such as Internet Explorer or Mozilla by which a user can access the system. The user interfaces for the software is designed as a web-based application using Flask which is a python framework for web app development. After entering into the application, the main layout includes a user panel. In this layout, the button to Pick a photo from a gallery or camera enables one to choose a photograph from different sources. The result would be displayed in another interface. The interface is responsive, ensuring compatibility with various browsers and features error handling for invalid inputs or analysis failures. Overall, the interface aims to provide a user-friendly experience for users.

- Hardware Interfaces:

  The hardware interface for a skin disease detector leveraging machine learning technology encompasses a meticulously designed system aimed at seamlessly integrating image acquisition, preprocessing, machine learning inference, and user interaction. Minimum recommended specifications include a computer with a dual-core processor, 8 GB of RAM, and sufficient disk space to accommodate the application and its dependencies. The interface also incorporates user-friendly elements such as displays and input mechanisms, enabling users to interact with the system effectively.

- Software Interfaces:

The software interface for a skin disease detector powered by machine learning is a pivotal component that orchestrates the seamless integration of image processing, machine learning inference, and user interaction. It facilitates the preprocessing of images, optimizing them for input into machine learning models, and provides a platform for deploying and executing these models efficiently. The application is built using Python and Flask, facilitating web-based interactions. The system utilizes the Convolutional Neural Networks for image processing. Compatibility with the Python environment (version 3.6 and above) is crucial for seamless execution

- Communications Interfaces:

The communication interface for a detector employing machine learning technology serves as a vital link between the detection system and external devices or networks, facilitating seamless data exchange and collaboration. This project supports all types of web browsers. User interactions with the web-based interface are facilitated through standard HTTP and HTTPS protocols. Interaction with the training model is established internally within the application.

2.4   System Features

- Detection of disease

- Description and Priority: For a particular image, the system will pre-process, extract the features and then detect the disease. To solve problems due to difference in the size of input images, the image is either increased or decreased in size. Convolutional neural network is used to extract features from the input image.

- Stimulus/Response Sequences: Users can input an image of the disease either from their database or can click a picture and upload it. Further questions regarding the age, duration of occurrence of the disease etc. will be posed to the user. After acquiring all the necessary information, the disease is detected.

- Functional Requirements:

1. Only image files can be uploaded. No other formats will be accepted and thereby errors can be avoided.

2. While uploading images, make sure that only the affected area is there in the image.

2.5 Other Nonfunctional Requirements

- Performance Requirements:

  The web page should be able to respond to the user without much delay. It should be able to display accurate results with minimal room for error.

- Safety Requirements:

  Measures are to be implemented to protect the user privacy and ensure that personal identifiable information like the input images by the user is securely handled and stored.

- Security Requirements:

  Users must have an authorized account to register and login before performing any operations on the website. This ensures that user data is secure and handled in compliance with relevant privacy regulations and unauthorized access is prevented.

- Software Quality Attributes:

  Reliable: The application will not crash under any circumstances such as when a user enters invalid values during login. The input image files will not be tampered with or corrupted.

  Scalable: The system will be capable of supporting a large number of clients and servers.

  Portable: Since the project is implemented as a web application, it is portable and supported by all major web browsers.

Chapter 3

System Architecture and Design

3.1   System Overview

The following are the stages that must be completed in order for our suggested system to be implemented.

1. As input, the system will take a dataset of picture data to increase the quality of the image and eliminate hairs from it.

2. A training file is formed as a consequence of the extraction of a number of features from the input image dataset. In this project, the CNN classification approach is applied to both the newly constructed training file collection and the freshly created test input images, which were both made from scratch.

3. Melanomas and eczemas are detected by using the CNN algorithm, which determines which particular disease is found in the image.
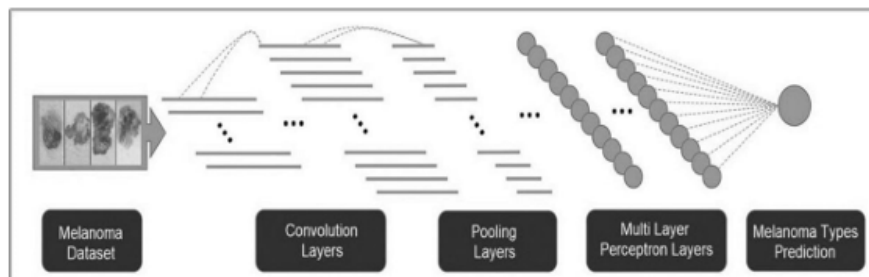

Figure 3.1: System Architecture

Figure 3.1 depicts a system that uses an image as an input. It processes the image to detect the features where the convolution layers come into play. The pooling layers enhance the image and finally disease is detected.

3.2   Dataset identified

The dataset consists of images which were collected from a lot of sources like websites such as Kaggle which are dedicated towards skin diseases and its cure to be more accurate and realistic. The data has been divided into two parts, training set and test set. The training set data is used to train our model and the test set is used to check if the model is working good or not. The dataset is then classified into various parts based upon the types of diseases to be trained for each one of them (melanoma or eczema). Only those diseases has been added that are prominent throughout the world but in the future updates will be made to add many other diseases.
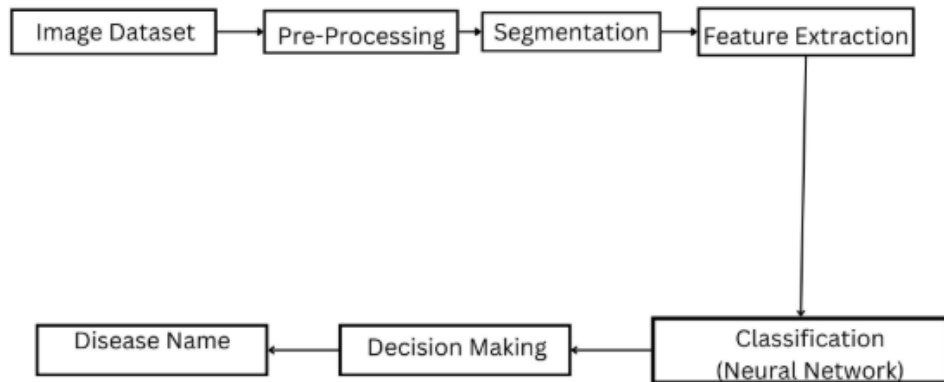
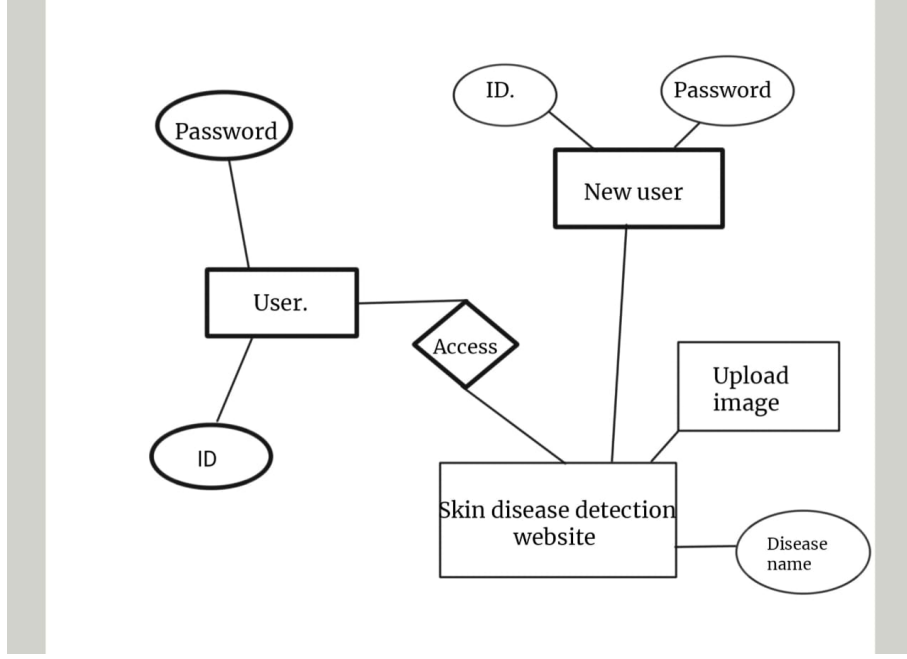## 3.3   Architectural Design

Figure 3.2: Architectural design

Figure 3.3: Architectural design, ER diagram

3.4   Proposed Methodology/Algorithms

Machine learning is an implementation of Artificial Intelligence that empowers a structure to learn without being customized accordingly. Image recognition technique teaches a computer to perceive the visual components inside an image and classification technique enables the system to learn the instance and map it to one of the numerous classes. For recognition, a big image database is used and the model learns emerging image characteristics from the image.

The machine learning algorithm used in the project for the classification of skin diseases is ResNet50. ResNet stands for Residual Network and is a specific type of convolutional neural network (CNN). ResNet-50 is a 50-layer convolutional neural network (48 convolutional layers, one MaxPool layer, and one average pool layer). Residual neural networks are a type of artificial neural network (ANN) that forms networks by stacking residual blocks.

The original ResNet architecture was ResNet-34, which comprised 34 weighted layers. It provided a novel way to add more convolutional layers to a CNN, without running into the vanishing gradient problem, using the concept of shortcut connections. A shortcut connection "skips over" some layers, converting a regular network to a residual network.

The 50-layer ResNet uses a bottleneck design for the building block. A bottleneck residual block uses 1×1 convolutions, known as a "bottleneck", which reduces the number of parameters and matrix multiplications. This enables much faster training of each layer. It uses a stack of three layers rather than two layers.

A convolutional neural network is a profound learning algorithm used to classify and recognize images. The CNN follows a hierarchical model that operates on the construction of a network like a funnel. It provides a fully linked layer that connects all the neurons and processes the output. The algorithm requires an input picture and assigns weights in the picture to different elements and is able to distinguish between them. In order to learn particular patterns within the image, the network extracts the object's characteristics. It makes a network capable of recognizing the pattern in the image. Relu layer operates to add non-linearity in pictures at the end of the convolution operation by replacing all adverse values with zero. Next is the pooling layer that decreases the input image's dimensionality and decreases the complexity of the operating computation. This helps to avoid overfitting. In addition, a traditional neural network that links all neurons from the prior layer to the next layer is being built. At the end, the number on the input image is classified using a softmax activation function.[1]

3.5   Module Division

The project is divided into four main modules:

- Image Recognition and ML Model: This module integrates image recognition technology to identify the skin disease from images uploaded by users with the help of Machine Learning. It extracts relevant information from the images to facilitate recognition.

  Assigned to: Aleena Roy and Anna

- User Interface Design and Development: This module focuses on designing and developing the user interface for the website. It ensures a seamless and intuitive user experience across different platforms with the help of HTML/CSS.

  Assigned to: Aleena Jaison and Aleena Roy

- Database Management: This module involves the development of the database infrastructure for the website, which is used to store relevant information related to the disease.

  Assigned to: Chandana and Anna

- Testing: This module is responsible for testing the functionality, performance, and accuracy of the website.

  Assigned to: Aleena Jaison and Chandana

3.6   Work Schedule - Gantt Chart
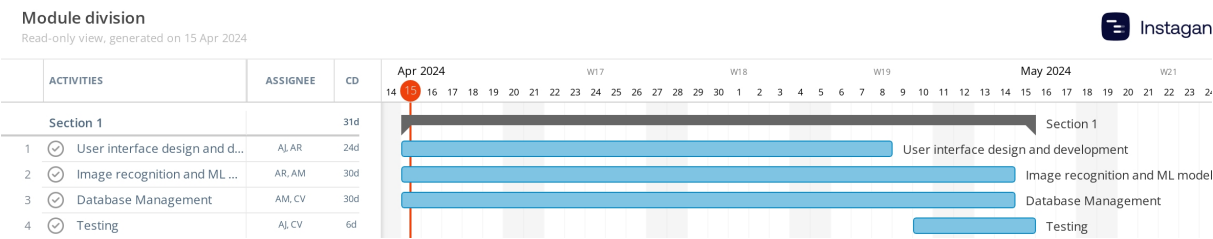
Figure 3.4: Gantt chart, Own work

Chapter 4

Results and Discussions

4.1 Overview

The model has been trained to the training data and achieves an accuracy of 97.35 and a test loss of 0.14906. It predicts well with training data provided. The website also functions well and is user-friendly.

4.2 Testing

Figure 4.1: Login page, Website
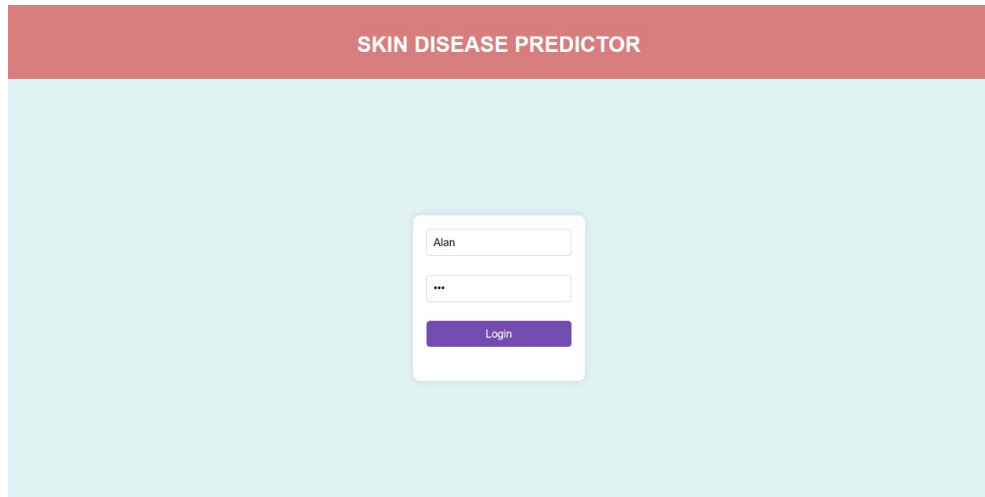
Figure 4.2: New user login, Website
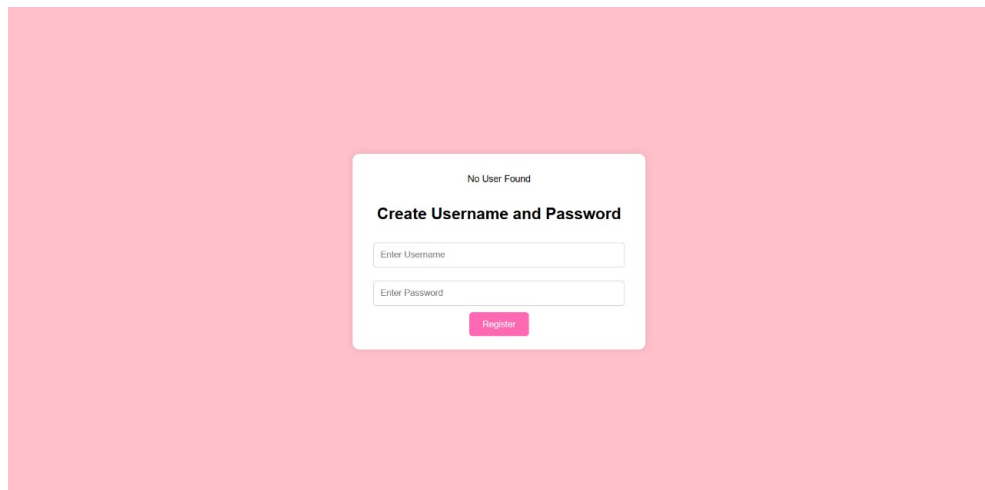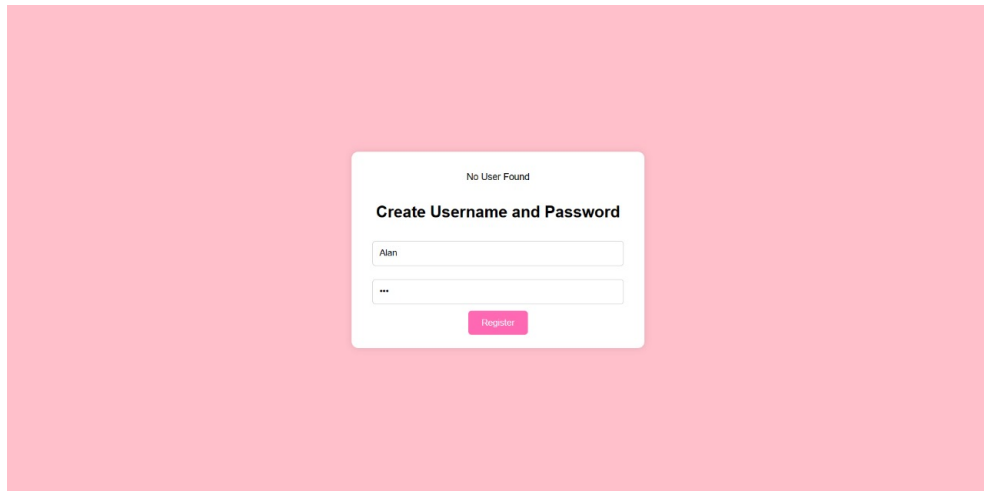
Figure 4.3: Sign Up page, Website

Figure 4.4: New user Sign up, Website

Figure 4.5: New User Login, Website
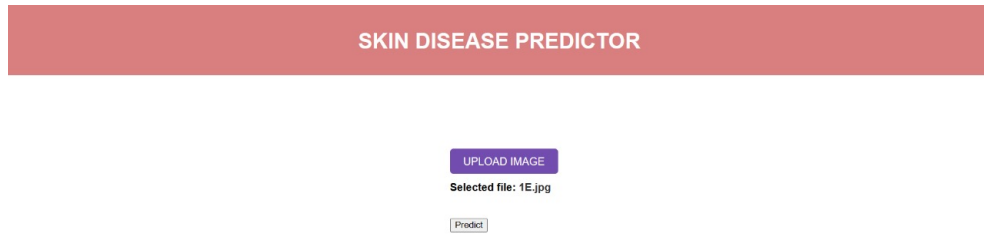
Figure 4.6: Upload image, Website
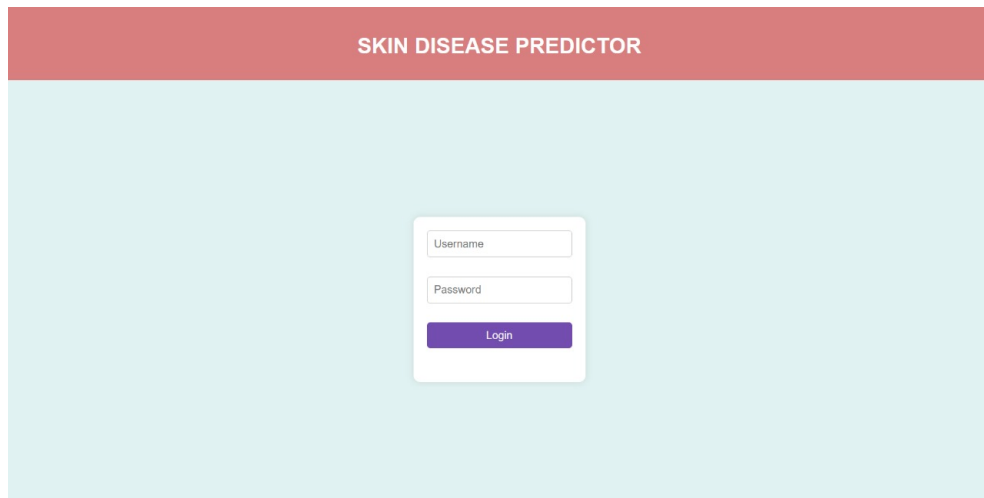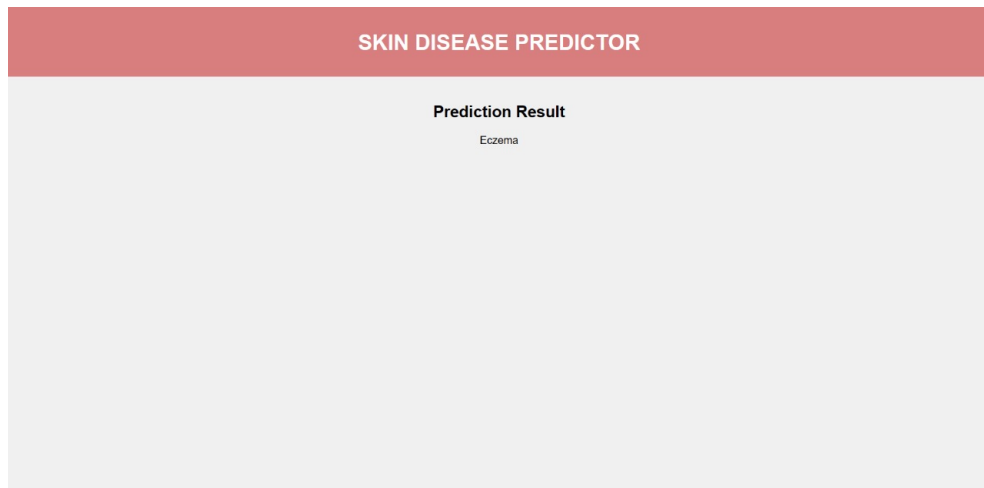

Figure 4.7: Prediction result, Website

Figure 4.1 shows the login page of the website. When a new user attempts a login it fails and is redirected to the sign up page as shown in Figure 4.2 and Figure 4.3. Once the new user is entered, after successful login the user is now able to upload an image for detection as shown in Figures 4.4, 4.5, 4.6. The predicted disease name is then displayed in the next page (Figure 4.7).

4.3 Quantitative Results

The skin disease detection system has demonstrated strong performance in identifying melanoma and eczema with quantitative metrics indicating high accuracy and reliability. For melanoma detection, the system achieved an accuracy of 97 percent, with a precision of 97 percent and a recall of 97 percent. The F1 score for melanoma stands at 0.97, reflecting excellent model discrimination ability. In the case of eczema, the system shows an accuracy of 98 percent, precision of 98 percent, recall of 98 percent, and an F1 score of 0.98. The system is highly capable of distinguishing eczema and melanoma from other skin conditions. These results underscore the system's effectiveness in the automated detection of these skin diseases. The F1 score is calculated using the below given formula: F1=2× [(Precision x Recall)/(Precision + Recall)]. [2]

4.4 Graphical Analysis
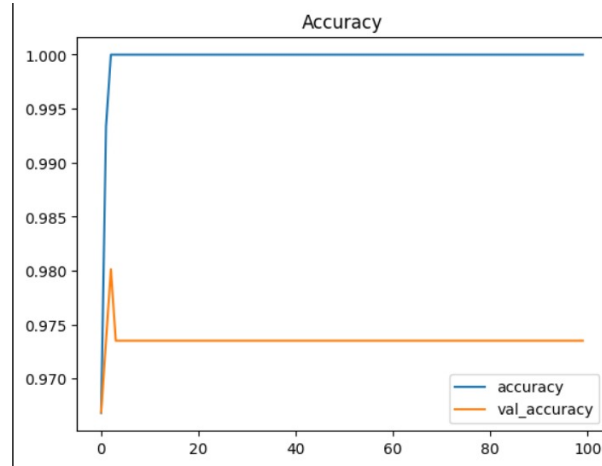
Figure 4.8: Accuracy graph, Result

Figure 4.8 depicts that the model achieves perfect accuracy on the training data very quickly and maintains it, suggesting that the model is fitting the training data very well. The validation accuracy reaches a high value (0.975) but does not improve beyond that. This indicates that the model has learned to generalize to the validation data up to a certain point. The significant gap between training accuracy and validation accuracy

suggests potential overfitting. The model performs perfectly on training data but slightly less well on validation data. [2]
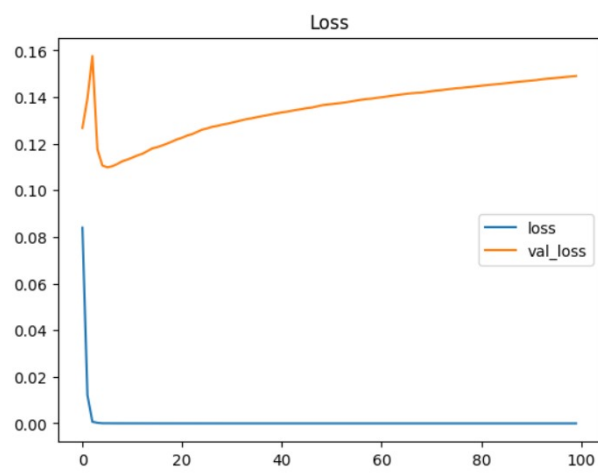
Figure 4.9: Loss graph, Result

Figure 4.9 depicts that the low training loss shows that the model is performing very well on the training data, suggesting it has learned to predict the training samples accurately. The validation loss starts low but increases over time, indicating that the model is overfitting to the training data. [2]

4.5   Discussion

Explaining the reasons behind the results of a skin disease detection project, particularly one focused on conditions such as melanoma and eczema, involves analyzing several factors that contribute to the model's performance include:

- High-Quality Images: The accuracy and reliability of the results often correlate with the quality of the images used for training. High-resolution images that are well-lit and taken from consistent angles can significantly improve model accuracy.

- Diverse Dataset: Including a wide range of images representing different stages of each disease, variations across different skin tones, and images from varied equipment can help the model learn to generalize better across real-world conditions.

- Algorithm: Using state-of-the-art neural network architectures like Convolutional

Neural Networks (CNNs) tailored for image recognition tasks can lead to higher performance metrics.

- Data Augmentation: Employing methods such as rotation, scaling, and horizontal flipping can artificially expand the diversity of the training dataset, which helps in improving the robustness of the model against overfitting and enhances its ability to generalize.

- Multiple Evaluations: Using cross-validation techniques to evaluate the model on different subsets of the data ensures that the reported accuracy and reliability are not artifacts of a particular sample but are representative of the model's overall performance.

Each element plays a critical role in ensuring that the model not only learns effectively from the training data but also performs well in practical, real-world scenarios where variability is much higher than in controlled test conditions.

Chapter 5

Conclusion

5.1   Conclusion

With careful consideration the skin disease detection project aimed at diagnosing melanoma and eczema using advanced machine learning techniques has been successfully demonstrated using the potential of Artificial Intelligence in enhancing dermatological diagnostics. Leveraging a robust dataset that included high-quality images annotated by medical professionals, the project developed a model which achieved high accuracy, precision and recall. These metrics underscore the model's capability to effectively identify and differentiate between melanoma and eczema, which are critical for timely and accurate treatment. An architecture aimed at efficient and accurate diagnosis has been successfully crafted.[1]

5.2   Future Scope

Building on the successful outcomes of the skin disease detection project, there are several avenues for future enhancements that can further improve its accuracy, usability.

- Broader Diversity: Include more diverse data covering a wider range of skin tones, ages, and underlying health conditions to improve the model's performance across different demographics.

- Additional Diseases: Expand the dataset to include other skin diseases, allowing the system to become more comprehensive and useful.

- Textual Data: Include descriptions from patients or annotations from dermatologists to combine visual learning with natural language processing for enhanced diagnostic accuracy.

- Clinical Data: Incorporate patient history and demographic information to create a more holistic model that can leverage known risk factors along with visual symptoms.

- Mobile Integration: Develop mobile applications that can perform real-time analysis of skin images captured by smartphones, making the tool accessible directly to consumers and primary care providers.

- Data Privacy: Ensure all enhancements comply with data privacy laws, particularly when handling sensitive health data.

Bibliography

[1] Ahmed A. Elngar et al 2021 J. Phys.: Conf. Ser. 1998 012037.

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Appendix A: Presentation

SKIN DISEASE DETECTOR

Guided by:
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Aleena Jaison Peechanatt
Aleena Roy
Anna Maria Joseph
Chandana V S

CONTENTS

- Introduction
- Problem Definition
- Objectives
- Scope and Relevance
- System Overview
- Architectural design
- Module division
- ResNet50
- Dataset
- Work Division – Gantt Chart
- Software/Hardware Requirements
- Result
- Conclusion
- Future Enhancements
- References

INTRODUCTION

- Machine Learning is a highly relevant domain. It is a branch of Artificial Intelligence (AI) and computer science that focuses on the using data and algorithms to enable AI to imitate the way that humans learn, gradually improving its accuracy.
- A number of machine learning algorithms are commonly used. These include Neural networks, Logistic regression, Clustering, etc. In the project neural networks are used.
- Neural networks simulate the way the human brain works, with a huge number of linked processing nodes. Neural networks are good at recognizing patterns and play an important role in applications including natural language translation, image recognition, speech recognition, and image creation.

INTRODUCTION

- The project improves efficiency in healthcare delivery, and contributes to research in dermatology.
- Empowers users with early detection for better skincare.
- Bridge healthcare accessibility gaps, promote timely detection, and contribute to skin health research.

PROBLEM DEFINITION

To classify and detect Skin diseases(Eczema and Melanoma) using Image Processing and Machine Learning Algorithms and develop a web application.

OBJECTIVES

- Efficient classification of Skin Diseases.
- To ease diagnosis and treatment of patients.
- To improve the speed of diagnosis.
- Cost-effective detection.
- Assist healthcare professionals by providing a second opinion.

SCOPE AND RELEVANCE

- The project scope includes:
  - developing a predictive model for skin diseases
  - creating a user-friendly interface
  - managing data securely
  - providing accurate content
  - ensure privacy
- The project's relevance lies in the fact that it facilitates early detection of skin diseases.

SYSTEM OVERVIEW

- As input, the system will take a dataset of image data.
- A training file is formed as a consequence of the extraction of a number of features from the input image dataset.
- CNN classification approach is applied to the newly constructed training file collection.
- Melanomas and eczemas are detected by using the CNN algorithm which detects the disease.

ARCHITECTURAL DESIGN
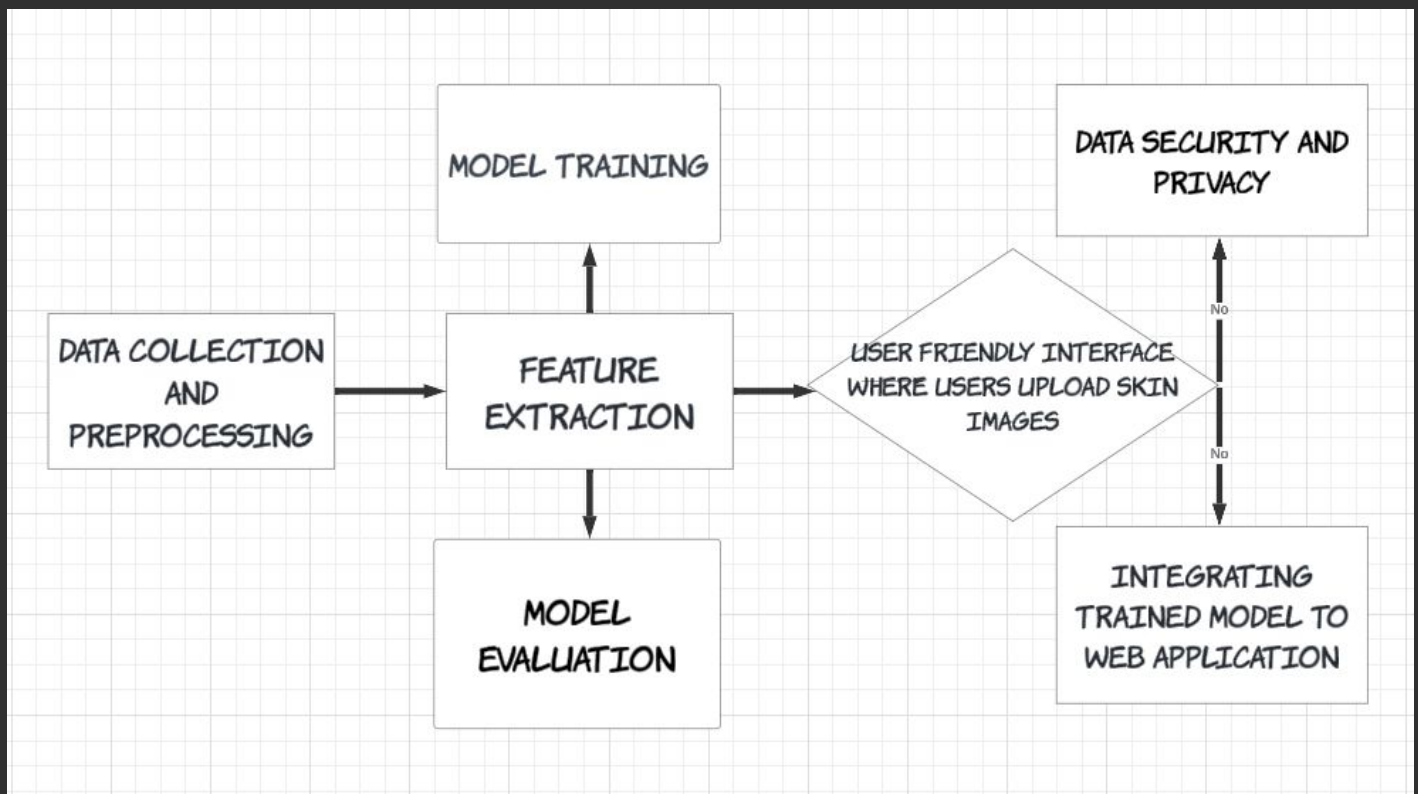
MODULE DIVISION

- Image Recognition and ML Model: This module integrates image recognition technology to identify the skin disease from images uploaded by users with the help of Machine Learning. It extracts relevant information from the images to facilitate recognition.

- User Interface Design and Development: This module focuses on designing and developing the user interface for the website. It ensures a seamless and intuitive user experience across different platforms with the help of HTML/CSS.

MODULE DIVISION

- Database Management: This module involves the development of the database infrastructure for the website, which is used to store relevant information related to the disease.

- Testing: This module is responsible for testing the functionality, performance, and accuracy of the website using testing datasets.

RESNET50

- ResNet stands for Residual Network.
- Type of convolutional neural network.
- The "50" in ResNet-50 refers to the number of layers that contain trainable weights or parameters.
- Highly effective for tasks like object detection and classification across a wide range of images.
- The layers in a ResNet learn only the residual changes from one layer to the next, building incrementally on what has already been learned.

SYSTEM DESIGN
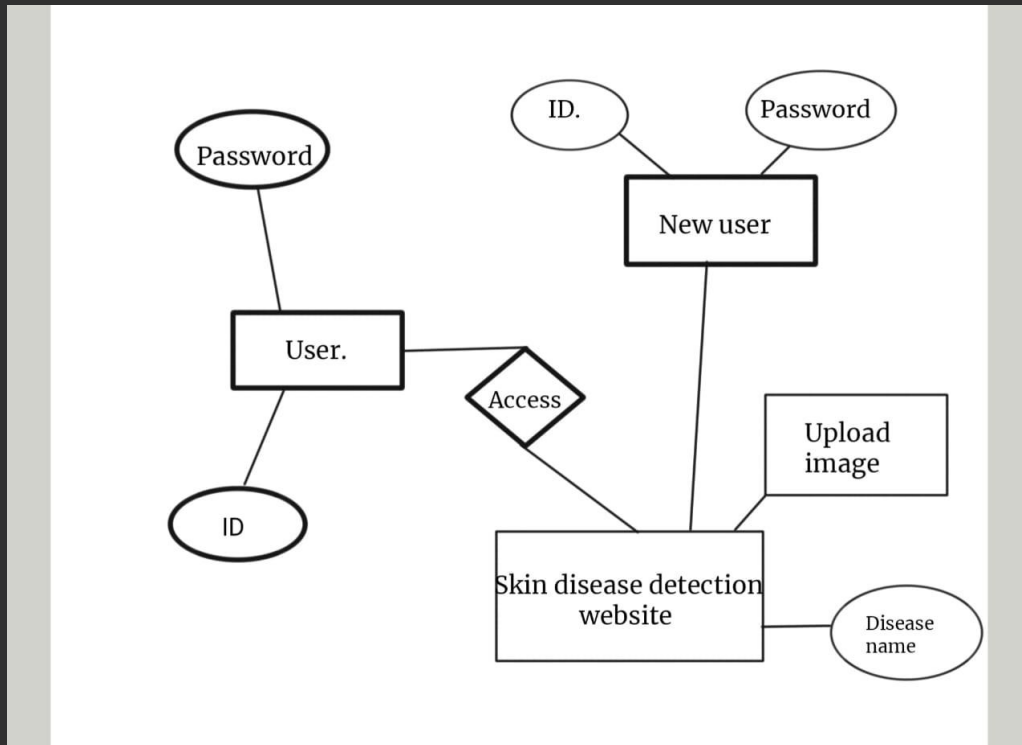
E-R diagram of Skin disease detector

DATASET

- The dataset consists of images which were collected from Kaggle.

- The dataset is then classified into various parts based upon the types of diseases ,i.e, melanoma or eczema.

- skin detection acc=98% (kaggle.com)

DATASET

Sample dataset of image dataset

WORK DIVISION

<Skin disease detector>
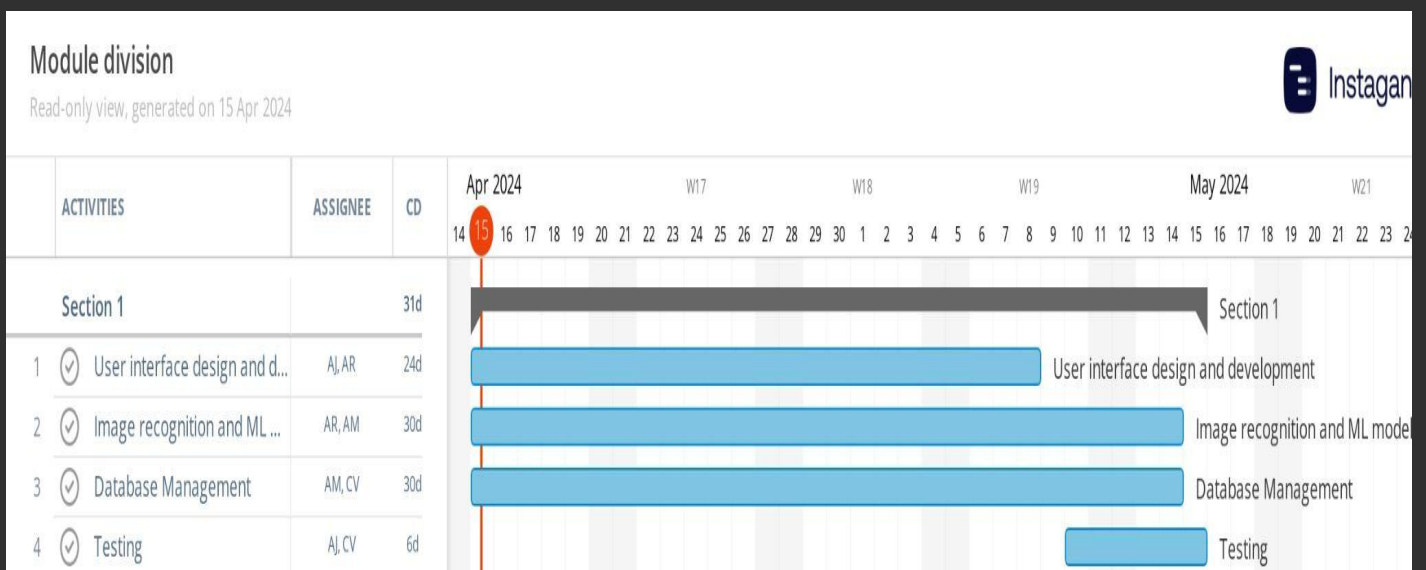
SOFTWARE/HARDWARE REQUIREMENTS
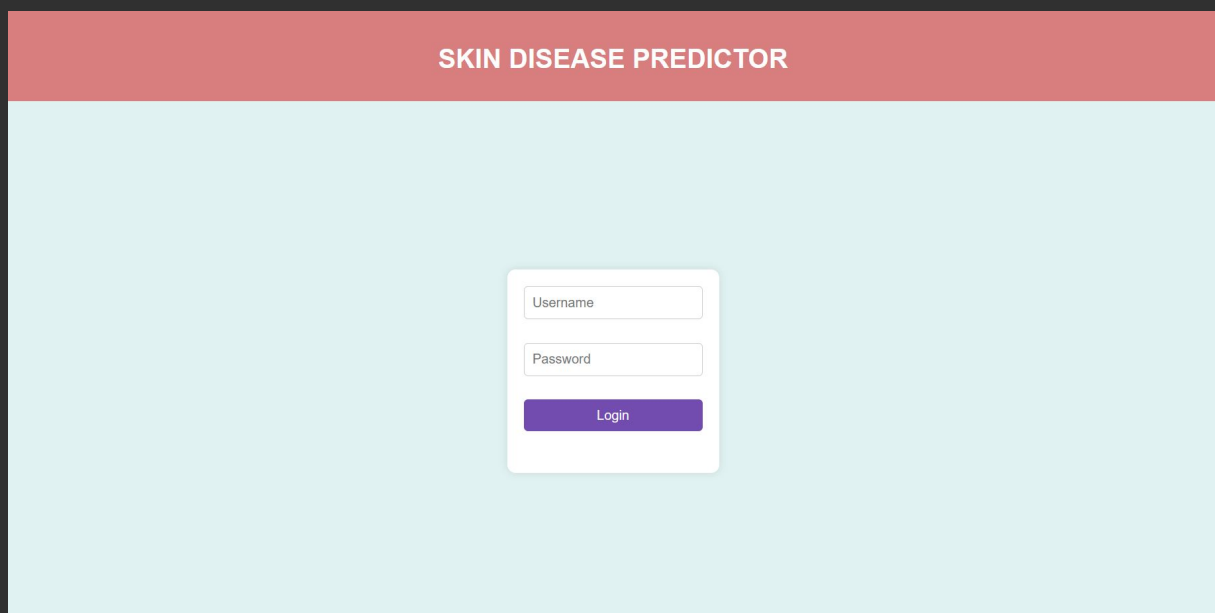
- The system utilizes the CNN algorithm for image processing.
- Python and Flask is used to facilitate web-based interactions.
- For database implementation, MongoDB has been used.
- Computer with a dual-core processor, 8GB of RAM.
- Sufficient disk space, Internet connectivity.

RESULT

RESULT

No User Found

Create Username and Password

Alan

...

Register

RESULT

SKIN DISEASE PREDICTOR

Alan

...

Login

RESULT

SKIN DISEASE PREDICTOR

UPLOAD IMAGE

Selected file: 1E.jpg

Predict

RESULT

SKIN DISEASE PREDICTOR

Prediction Result

Eczema

RESULT

Test Loss: 0.14906
Test Accuracy: 97.35%

	precision	recall	f1-score	support
Eczema	0.98	0.98	0.98	93
Melanoma	0.97	0.97	0.97	58
accuracy			0.97	151
macro avg	0.97	0.97	0.97	151
weighted avg	0.97	0.97	0.97	151
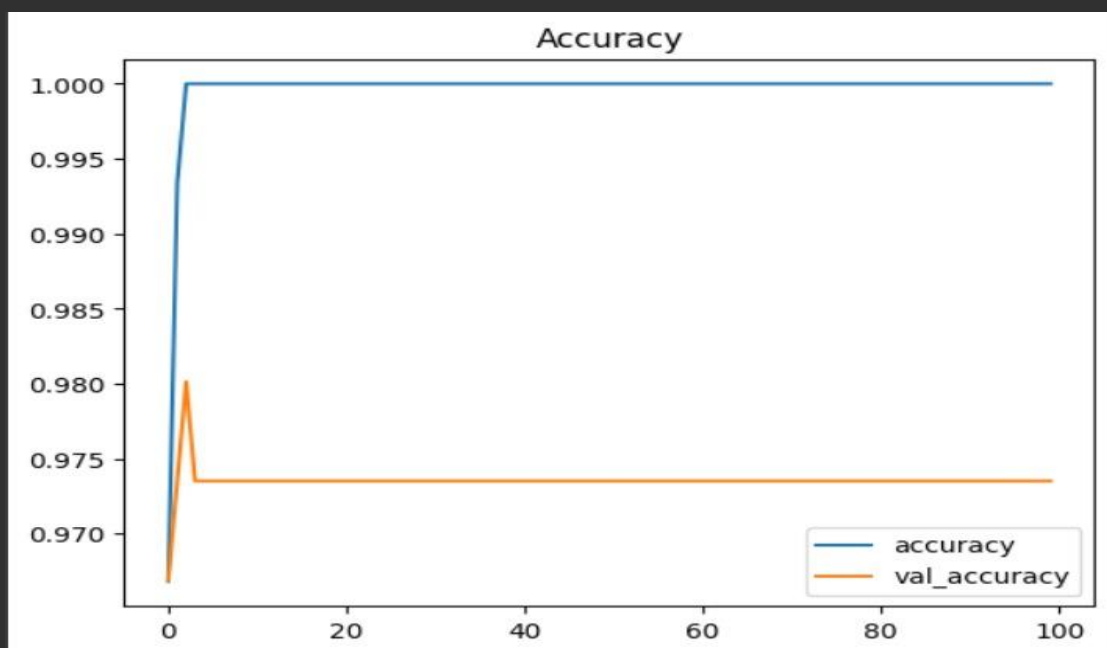
RESULT

Accuracy graph
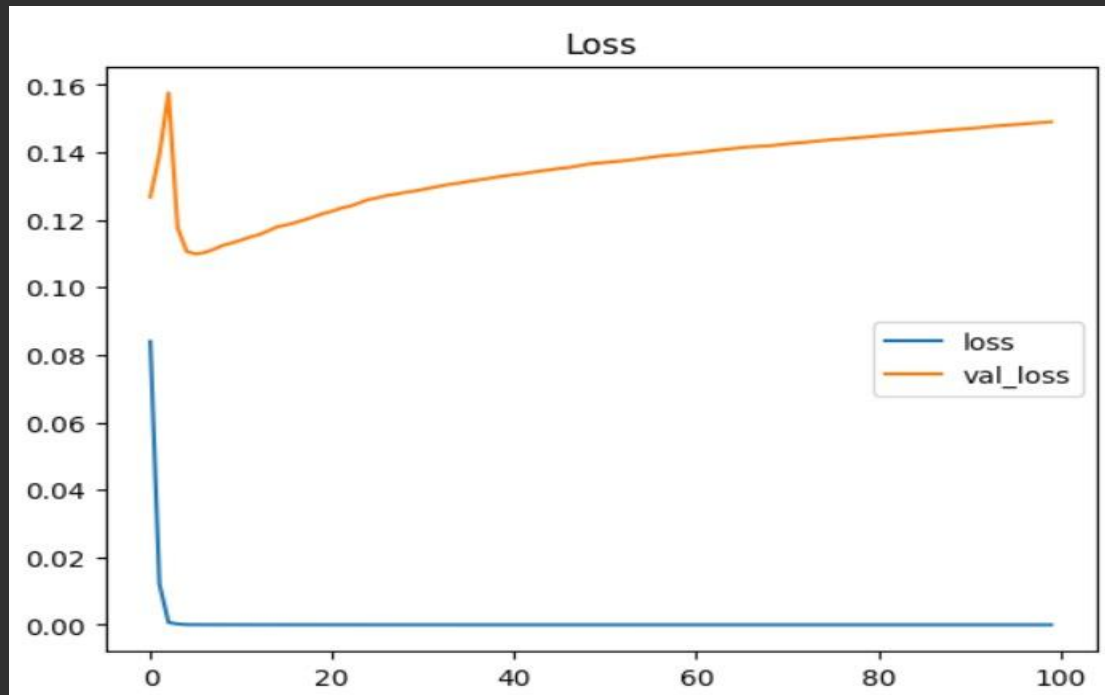
RESULT

Loss graph

RESULT

Sample test images

CONCLUSION

- An architecture aimed at efficient and accurate diagnosis has been crafted.
- With careful consideration given to entity modelling, and relationship establishment, an impact in the field of dermatology can be made.

FUTURE ENHANCEMENTS

Future enhancements to the project could be to focus on several areas to improve the usability and performance.

- **Dataset expansion**: Increasing the diversity of the dataset can enhance the model's ability to recognize rare or under-represented skin conditions.
- **Real time analysis**: Optimizing the model for real-time analysis and deploying it on portable devices.
- **Privacy and security**: Implementing robust privacy and security measures to protect patient data.

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Thank You

Appendix B: Vision, Mission, Programme Outcomes and Course Outcomes

Vision, Mission, Programme Outcomes and Course Outcomes

Institute Vision

To evolve into a premier technological institution, moulding eminent professionals with creative minds, innovative ideas and sound practical skill, and to shape a future where technology works for the enrichment of mankind.

Institute Mission

To impart state-of-the-art knowledge to individuals in various technological disciplines and to inculcate in them a high degree of social consciousness and human values, thereby enabling them to face the challenges of life with courage and conviction.

Department Vision

To become a centre of excellence in Computer Science and Engineering, moulding professionals catering to the research and professional needs of national and international organizations.

Department Mission

To inspire and nurture students, with up-to-date knowledge in Computer Science and Engineering, ethics, team spirit, leadership abilities, innovation and creativity to come out with solutions meeting societal needs.

Programme Outcomes (PO)

Engineering Graduates will be able to:

1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. Conduct investigations of complex problems: Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsi-

bilities and norms of the engineering practice.

9. Individual and Team work: Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.

10. Communication: Communicate effectively with the engineering community and with society at large. Be able to comprehend and write effective reports documentation. Make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team. Manage projects in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Programme Specific Outcomes (PSO)
A graduate of the Computer Science and Engineering Program will demonstrate:

PSO1: Computer Science Specific Skills
The ability to identify, analyze and design solutions for complex engineering problems in multidisciplinary areas by understanding the core principles and concepts of computer science and thereby engage in national grand challenges.

PSO2: Programming and Software Development Skills
The ability to acquire programming efficiency by designing algorithms and applying standard practices in software project development to deliver quality software products meeting the demands of the industry.

PSO3: Professional Skills
The ability to apply the fundamentals of computer science in competitive research and to develop innovative products to meet the societal needs thereby evolving as an eminent researcher and entrepreneur.

Course Outcomes
After the completion of the course the student will be able to:

CO1:
Identify technically and economically feasible problems (Cognitive Knowledge Level: Apply)

CO2:
Identify and survey the relevant literature for getting exposed to related solutions and get familiarized with software development processes (Cognitive Knowledge Level: Apply)

CO3:
Perform requirement analysis, identify design methodologies and develop adaptable & reusable solutions of minimal complexity by using modern tools & advanced programming techniques (Cognitive Knowledge Level: Apply)

CO4:
Prepare technical report and deliver presentation (Cognitive Knowledge Level: Apply)

CO5:
Apply engineering and management principles to achieve the goal of the project (Cognitive Knowledge Level: Apply)

Appendix C: CO-PO-PSO Mapping

COURSE OUTCOMES:

After completion of the course the student will be able to

SL. NO	DESCRIPTION	Blooms' Taxonomy Level
CO1	Identify technically and economically feasible problems (Cognitive Knowledge Level: Apply)	Level 3: Apply
CO2	Identify and survey the relevant literature for getting exposed to related solutions and get familiarized with software development processes (Cognitive Knowledge Level: Apply)	Level 3: Apply
CO3	Perform requirement analysis, identify design methodologies and develop adaptable & reusable solutions of minimal complexity by using modern tools & advanced programming techniques (Cognitive Knowledge Level: Apply)	Level 3: Apply
CO4	Prepare technical report and deliver presentation (Cognitive Knowledge Level: Apply)	Level 3: Apply
CO5	Apply engineering and management principles to achieve the goal of the project (Cognitive Knowledge Level: Apply)	Level 3: Apply

CO-PO AND CO-PSO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PS O3
CO1	3	3	3	3		2	2	3	2	2	2	3	2	2	2
CO2	3	3	3	3	3	2		3	2	3	2	3	2	2	2
CO3	3	3	3	3	3	2	2	3	2	2	2	3			2
CO4	2	3	2	2	2			3	3	3	2	3	2	2	2
CO5	3	3	3	2	2	2	2	3	2		2	3	2	2	2

3/2/1: high/medium/low

JUSTIFICATIONS FOR CO-PO MAPPING

MAPPING	LOW/ MEDIUM/ HIGH	JUSTIFICATION
100003/CS622T.1-PO1	**HIGH**	Identify technically and economically feasible problems by applying the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
100003/CS622T.1-PO2	**HIGH**	Identify technically and economically feasible problems by analysing complex engineering problems reaching substantiated conclusions using first principles of mathematics.
100003/CS622T.1-PO3	**HIGH**	Design solutions for complex engineering problems by identifying technically and economically feasible problems.
100003/CS622T.1-PO4	**HIGH**	Identify technically and economically feasible problems by analysis and interpretation of data.
100003/CS622T.1-PO6	**MEDIUM**	Responsibilities relevant to the professional engineering practice by identifying the problem.
100003/CS622T.1-PO7	**MEDIUM**	Identify technically and economically feasible problems by understanding the impact of the professional engineering solutions.
100003/CS622T.1-PO8	**HIGH**	Apply ethical principles and commit to professional ethics to identify technically and economically feasible problems.
100003/CS622T.1-PO9	**MEDIUM**	Identify technically and economically feasible problems by working as a team.
100003/CS622T.1-PO10	**MEDIUM**	Communicate effectively with the engineering community by identifying technically and economically feasible problems.
100003/CS622T.1-P011	**MEDIUM**	Demonstrate knowledge and understanding of engineering and management principles by selecting the technically and economically feasible problems.
100003/CS622T.1-PO12	**HIGH**	Identify technically and economically feasible problems for long term learning.
100003/CS622T.1-PSO1	**MEDIUM**	Ability to identify, analyze and design solutions to identify technically and economically feasible problems.
100003/CS622T.1-PSO2	**MEDIUM**	By designing algorithms and applying standard practices in software project development and Identifying technically and economically feasible problems.
100003/CS622T.1-PSO3	**MEDIUM**	Fundamentals of computer science in competitive research can be applied to Identify technically and economically feasible problems.
100003/CS622T.2-PO1	**HIGH**	Identify and survey the relevant by applying the knowledge of mathematics, science, engineering fundamentals.

100003/CS6 22T.2-PO2	**HIGH**	Identify, formulate, review research literature, and analyze complex engineering problems get familiarized with software development processes.
100003/CS6 22T.2-PO3	**HIGH**	Design solutions for complex engineering problems and design based on the relevant literature.
100003/CS6 22T.2-PO4	**HIGH**	Use research-based knowledge including design of experiments based on relevant literature.
100003/CS6 22T.2-PO5	**HIGH**	Identify and survey the relevant literature for getting exposed to related solutions and get familiarized with software development processes by using modern tools.
100003/CS6 22T.2-PO6	**MEDIUM**	Create, select, and apply appropriate techniques, resources, by identifying and surveying the relevant literature.
100003/CS6 22T.2-PO8	**HIGH**	Apply ethical principles and commit to professional ethics based on the relevant literature.
100003/CS6 22T.2-PO9	**MEDIUM**	Identify and survey the relevant literature as a team.
100003/CS6 22T.2-PO10	**HIGH**	Identify and survey the relevant literature for a good communication to the engineering fraternity.
100003/CS6 22T.2-PO11	**MEDIUM**	Identify and survey the relevant literature to demonstrate knowledge and understanding of engineering and management principles.
100003/CS6 22T.2-PO12	**HIGH**	Identify and survey the relevant literature for independent and lifelong learning.
100003/CS6 22T.2-PSO1	**MEDIUM**	Design solutions for complex engineering problems by Identifying and survey the relevant literature.
100003/CS6 22T.2-PSO2	**MEDIUM**	Identify and survey the relevant literature for acquiring programming efficiency by designing algorithms and applying standard practices.
100003/CS6 22T.2-PSO3	**MEDIUM**	Identify and survey the relevant literature to apply the fundamentals of computer science in competitive research.
100003/CS6 22T.3-PO1	**HIGH**	Perform requirement analysis, identify design methodologies by using modern tools & advanced programming techniques and by applying the knowledge of mathematics, science, engineering fundamentals.
100003/CS6 22T.3-PO2	**HIGH**	Identify, formulate, review research literature for requirement analysis, identify design methodologies and develop adaptable & reusable solutions.

100003/CS622T.3-PO3	**HIGH**	Design solutions for complex engineering problems and perform requirement analysis, identify design methodologies.
100003/CS622T.3-PO4	**HIGH**	Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
100003/CS622T.3-PO5	**HIGH**	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools.
100003/CS622T.3-PO6	**MEDIUM**	Perform requirement analysis, identify design methodologies and assess societal, health, safety, legal, and cultural issues.
100003/CS622T.3-PO7	**MEDIUM**	Understand the impact of the professional engineering solutions in societal and environmental contexts and Perform requirement analysis, identify design methodologies and develop adaptable & reusable solutions.
100003/CS622T.3-PO8	**HIGH**	Perform requirement analysis, identify design methodologies and develop adaptable & reusable solutions by applying ethical principles and commit to professional ethics.
100003/CS622T.3-PO9	**MEDIUM**	Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.
100003/CS622T.3-PO10	**MEDIUM**	Communicate effectively with the engineering community and with society at large to perform requirement analysis, identify design methodologies.
100003/CS622T.3-PO11	**MEDIUM**	Demonstrate knowledge and understanding of engineering requirement analysis by identifying design methodologies.
100003/CS622T.3-PO12	**HIGH**	Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change by analysis, identify design methodologies and develop adaptable & reusable solutions.
100003/CS622T.3-PSO3	**MEDIUM**	The ability to apply the fundamentals of computer science in competitive research and prior to that perform requirement analysis, identify design methodologies.
100003/CS622T.4-PO1	**MEDIUM**	Prepare technical report and deliver presentation by applying the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
100003/CS622T.4-PO2	**HIGH**	Identify, formulate, review research literature, and analyze complex engineering problems by preparing technical report and deliver presentation.

100003/CS6 22T.4-PO3	**MEDIUM**	Prepare Design solutions for complex engineering problems and create technical report and deliver presentation.
100003/CS6 22T.4-PO4	**MEDIUM**	Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions and prepare technical report and deliver presentation.
100003/CS6 22T.4-PO5	**MEDIUM**	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools and Prepare technical report and deliver presentation.
100003/CS6 22T.4-PO8	**HIGH**	Prepare technical report and deliver presentation by applying ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
100003/CS6 22T.4-PO9	**HIGH**	Prepare technical report and deliver presentation effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.
100003/CS6 22T.4-PO10	**HIGH**	Communicate effectively with the engineering community and with society at large by prepare technical report and deliver presentation.
100003/CS6 22T.4-PO11	**MEDIUM**	Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work by prepare technical report and deliver presentation.
100003/CS6 22T.4-PO12	**HIGH**	Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change by prepare technical report and deliver presentation.
100003/CS6 22T.4-PSO1	**MEDIUM**	Prepare a technical report and deliver presentation to identify, analyze and design solutions for complex engineering problems in multidisciplinary areas.
100003/CS6 22T.4-PSO2	**MEDIUM**	To acquire programming efficiency by designing algorithms and applying standard practices in software project development and to prepare technical report and deliver presentation.
100003/CS6 22T.4-PSO3	**MEDIUM**	To apply the fundamentals of computer science in competitive research and to develop innovative products to meet the societal needs by preparing technical report and deliver presentation.
100003/CS6 22T.5-PO1	**HIGH**	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
100003/CS6 22T.5-PO2	**HIGH**	Identify, formulate, review research literature, and analyze complex engineering problems by applying engineering and management principles to achieve the goal of the project.

100003/CS6 22T.5-PO3	**HIGH**	Apply engineering and management principles to achieve the goal of the project and to design solutions for complex engineering problems and design system components or processes that meet the specified needs.
100003/CS6 22T.5-PO4	**MEDIUM**	Apply engineering and management principles to achieve the goal of the project and use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
100003/CS6 22T.5-PO5	**MEDIUM**	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools and to apply engineering and management principles to achieve the goal of the project.
100003/CS6 22T.5-PO6	**MEDIUM**	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities by applying engineering and management principles to achieve the goal of the project.
100003/CS6 22T.5-PO7	**MEDIUM**	Understand the impact of the professional engineering solutions in societal and environmental contexts, and apply engineering and management principles to achieve the goal of the project.
100003/CS6 22T.5-PO8	**HIGH**	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice and to use the engineering and management principles to achieve the goal of the project.
100003/CS6 22T.5-PO9	**MEDIUM**	Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings and to apply engineering and management principles to achieve the goal of the project.
100003/CS6 22T.5-PO11	**MEDIUM**	Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team. Manage projects in multidisciplinary environments and to apply engineering and management principles to achieve the goal of the project.
100003/CS6 22T.5-PO12	**HIGH**	Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change and to apply engineering and management principles to achieve the goal of the project.
100003/CS6 22T.5-PSO1	**MEDIUM**	The ability to identify, analyze and design solutions for complex engineering problems in multidisciplinary areas. Apply engineering and management principles to achieve the goal of the project.

100003/CS622T.5-PSO2	**MEDIUM**	The ability to acquire programming efficiency by designing algorithms and applying standard practices in software project development to deliver quality software products meeting the demands of the industry and to apply engineering and management principles to achieve the goal of the project.
100003/CS622T.5-PSO3	**MEDIUM**	The ability to apply the fundamentals of computer science in competitive research and to develop innovative products to meet the societal needs thereby evolving as an eminent researcher and entrepreneur and apply engineering and management principles to achieve the goal of the project.