Institute of Technology University of Moratuwa

AI Powered dermatology diagnostic tool

Project I Final Report

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Division of Information Technology

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Project I report submitted to the Division of Information Technology, Institute of Technology, University of Moratuwa, Sri Lanka for the partial fulfillment of the requirements of the National Diploma in Information Technology.

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Declaration

We declare that this thesis is our own work and has not been submitted in any form for another degree or diploma at any university or other institution of tertiary education. Information derived from the published or unpublished work of others has been acknowledged in the text and a list of references is given.

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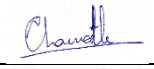
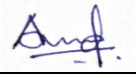
P.G.C.G. Subasena	
A.N.A. Gunawardena	
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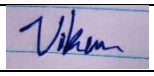
W.P.Withana Arachchi	

Date: 2023/08/03

Supervised by

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Date:

Dedication

This project is wholeheartedly dedicated to the medical professionals and aspiring doctors who tirelessly strive to improve the field of dermatology and skin health. It is with utmost respect and admiration that we present this skin disease detecting system, aimed at supporting their vital work and enhancing their expertise in diagnosing and treating skin conditions.

To the dedicated doctors who spend countless hours caring for patients and studying the complexities of skin diseases, we extend our deepest appreciation. Their commitment to the well-being of patients and pursuit of medical knowledge serves as an inspiration to us all. It is our hope that this intelligent skin disease detecting system will serve as a valuable tool in diagnostic process, ultimately leading to improved patient outcomes and more effective treatments.

We also want to extend our gratitude to the medical students who are embarking on their journey to becoming future healthcare professionals. Their passion and curiosity in dermatology and skin health drive us to develop innovative solutions that can aid in learning and skill development. We dedicate this project to their growth and success, as they carry the torch of medical knowledge into the future.

Together, we envision a future where advanced computing technology harmoniously integrates with the expertise of medical professionals, empowering doctors, and medical students alike to make more accurate diagnoses and provide optimal care for patients with skin conditions. May this project be a testament to the boundless potential of human intelligence combined with cutting-edge technology, as we work towards a world where skin health is prioritized, and all individuals can enjoy the benefits of improved medical care.

Acknowledgement

We would like to extend our heartfelt gratitude to all those who have made this final report possible. Our sincere appreciation goes to our esteemed project supervisor, Miss. Sithara Madhubhashini, whose guidance and support were invaluable throughout this journey. We are also deeply thankful to our dedicated Project Instructor, Mr. Nipuna, for his unwavering assistance and valuable insights that enriched our project. Furthermore, we extend our thanks to External Advisor Dr. Priyatharshani for sharing her expertise and providing critical feedback that significantly influenced the project's success. Finally, we would like to acknowledge the contribution of our lecturers, whose stimulating suggestions and encouragement played a crucial role in coordinating and shaping the outcome of our project. Without the support of these remarkable individuals, this report would not have been possible, and we are sincerely grateful for their unwavering commitment to our academic pursuits.

Abstract

The goal of this project is to employ digital image processing techniques to automatically detect and identify several types of skin diseases, thereby facilitating the development of a computer-based system for automated diagnosis. By leveraging machine learning algorithms, we aim to enhance the accuracy of the software. Skin diseases pose a significant health concern, and timely detection plays a crucial role in effective treatment. This project focuses on analyzing primary morphological characteristics specific to different skin diseases, such as color variations, texture patterns, and lesion sizes. Our objective is to create user-friendly software that can be readily utilized in clinical settings and aid doctors in accurate diagnosis.

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Chapter 1

Introduction

1.1 Introduction

The aim of this project is the develop mobile and web application that can identify skin diseases using machine learning. In this chapter, we talk about the background and motivation of our project. It also gives a brief overview of who is using this software, what kind of images are input, the processing method, and how the result is shown. As the input, we hope to use images of skin disease areas.

Under this paragraph, the description of our project is described in three parts.
1.2 describes the background of our project and the motivation we received to carry out the project.
Under 1.3 we describe the aims of the project and the relevant objectives.
The Proposed solution under 1.4 describes how we can archive the aims & objectives in the project. Users, inputs, outputs, and processes are described here.

1.2 Background and Motivation

1.2.1 Background

Skin conditions impact a wide spectrum of people and may cause serious problems, making them a major worldwide health concern. With over 4,000 documented skin diseases, it is essential to correctly identify and diagnose these conditions in order to provide appropriate therapy. Numerous causes, such as alterations in lifestyle, environmental conditions, and an increase in worldwide travel, have contributed to the growth in the prevalence of skin diseases.

Among the many skin conditions, those brought on by bacterial, fungal, viral, or parasitic infections can significantly affect public health. A person's quality of life can also be greatly impacted by common ailments including dermatitis, psoriasis, acne, and eczema.
Consequently, there is a rising need for a system that may assist general practitioners and medical students in identifying and diagnosing skin diseases accurately.

1.2.2 Motivation

Our motivation stems from the realization that skin diseases often pose significant challenges for doctors, requiring accurate and timely diagnoses to provide effective treatments. By harnessing the power of machine learning and image processing, we aimed to empower doctors with a revolutionary tool that can assist in the identification and classification of various skin conditions. The potential impact of this system is profound, enabling faster diagnoses, reducing misdiagnoses, and ultimately improving patient care. With each line of code, we wrote and each algorithm we fine-tuned, we were fueled by the belief that our work would empower doctors and enhance their ability to make informed decisions.

Recognizing the skin disease in early stage is critical thing because if it spreading or dangerous to the body, it will be too late to treat. But in most cases, a general doctor may need to have the help of a specialist to examine the area and draw conclusions. But the smallest point of change of the report could be missed by the specialist doctor also. Other important thing is that we can use this system as a learning material for medical students, general doctors also to study about skin disease and how it behaves.

1.3 Aim and Objectives

1.3.1 Aim

As IT students, our aim is to develop software that aids in the detection and diagnosis of various skin diseases using image processing technology. This software will not only facilitate researchers but also accelerate the detection process, improve accuracy, and simplify their work. By harnessing the power of advanced algorithms, our system will enable healthcare professionals to accurately identify several types of skin diseases, thereby reducing misdiagnosis and improving patient outcomes.

1.3.2 Objectives

- Requirement gathering by conducting interviews with doctors and medical students.
- Conducting literature review and identify existing systems and their features.
- Defining the system features and system boundaries.
- To design the system process with the help of UML diagrams.
- To conduct a feasibility study about the technologies such as programming languages and databases.
- To find proper data set.
- To preprocess data.
- To train the model using preprocessed data with the most appropriate machine learning model to improve the accuracy.
- To validate and improve the prediction.
- To test the model using test data. • To develop a mobile application.
- To integrate the system.

1.4 Proposed solution

The main solution is developing a system that can determine if a person has a skin disease or not. After the doctor input a digital image of the person skin effected area into the system, the system determines whether the person has skin disease or not using percentage. This decision will be given very accurately and quickly.

In addition, hope to develop a mobile application to help the doctors and medical students Here, doctors can use this mobile app system quickly with their mobile phones and medical students can use this system as learning material and they can get accurate information about diseases. In our system, there is chat option to make conversations with each other. this helps to doctors specialized doctors and medical students to share their knowledge and discuss about generated disease. This feature also helps to further development of the system.

1.4.1 Users

Doctor

In the beginning, the doctor should be logged into the system, and he has to input a skin disease image or scan the live skin. Then the system displays the result according to the learned data. After, if doctor wants to store the data for later use, doctor has an option to save patient and add patient details to the system. Doctor has a responsibility to help the patient.

Medical student

In the beginning, the medical student should be logged into the system using medical ID, and then has to input a skin disease image or scan the live skin. Then the system displays the result according to the learned data. Medical students can use stored data for decision making and learn about skin disease. And they can read medical description provide by the system and they can view report generated by the system to recognize the skin disease quickly. They also can help to the patient using system under supervision of a doctor.

Admin

In the beginning, admin should be logged into the system, and he/she can remove users, remove unwanted data and backup data.

1.4.2 Inputs

Username and password

The doctor and student must input their username and password to login into the system. The doctor and student must input their username and password to login into the mobile application.

Digital image of skin disease area

The doctor/medical student has to input quality skin disease area image into the system.

Patient details

The doctor/medical student has to input patient's data into the system.

1.4.3 Outputs

Result

The system will display whether the person has relevant skin disease or not with the relevant percentage. This can be gotten by the doctor/medical student and guide the patient.

Full description

Both doctor and medical student can see the generated description about the disease.

Report

Both doctor and medical student can view the report that system generate. This report provides the spreading areas of the relevant disease around the country.

1.4.4 Process

Skin images uploaded into the system by the user are stored in the image details database. Then these details are used to process the image and extract features. Then the extracted feature is stored in the extracted feature database. The data model is classified by using extracted features of the binary image. The user login system for authentication Doctors, medical students, and admin authentication data is stored in the login info database. Then users add user data stored in the database through the system. If the classification image phase is a classified disease, then a doctor and a medical student can see the disease through the mobile application or web application. If users want to share their thoughts about the generated disease or share their knowledge, doctors and medical students can send a message or a comment via API, and that message will be stored in the discussion forum database. Next, that message will be displayed on the user's API interface. Then Doctors and medical students can reply to that message according to the same process via API. Diagnoses and pertinent demographic and geographic information uploaded into the system by the user are stored in the report details database. The report will be generated using these details and any computations, transformations, or data manipulations that are necessary. The analyzing data phase generates a report, which a doctor and a medical student can see through the mobile application or web application.

1.5 Summary

The proposed approach can identify the type of skin disorder a person has. This decision will be given very accurately and quickly. It is a great way to diagnose skin disease without wasting time. The spread can be stopped quickly to detect skin disease early.

Sometimes the doctor's decision may be wrong, and it can be detrimental to the patient. The proposed system will be able to avoid those mistakes and help doctors to make the right decision and excellent aid to education for medical students. General practitioners and medical students sign into the system and chat about the output. These interfaces are also designed to be easy for the users.

Chapter 2

Literature Review

2.1 Introduction

This chapter offers review of the literature for this project. It illustrates that comparable techniques are accessible, as well as how such approaches are created and how existing systems, among other systems, are similar and dissimilar to our suggested system.

This section is broken into two sections. The first category comprises relevant articles. The first portion of this section will go through similar efforts to the proposed system. The summary section tries to explain how relevant initiatives are useful, as well as the similarities and differences between the suggested system approach and other approaches.

2.2 Available approaches

1) A Model for Classification and Diagnosis of Skin Disease using Machine Learning and Image Processing Techniques [1]

This study provided a model for classifying many forms of skin illnesses, including acne, cherry angioma, melanoma, and psoriasis. According to past study, there is a scarcity of studies on these disorders because most research focuses on skin cancer. On a total of 377 photos, this model was created using image processing techniques and machine learning algorithms. The dataset has 301 photos for the train set and 76 images for the test set. Firstly, the processing techniques are applied to images in several steps:

preprocessing including resizing images, removing the noise using the median filter and converting the image to grayscale, then separating the infected area using Otsu's, and extracting its features using Gabor, Entropy, and Sobel. Secondly, the model was evaluated using SVM, KNN, and RF classifiers in terms of accuracy, precision, recall, and f1-score. The result of the proposed model using the SVM classifier achieved better accuracy than the comparison research' accuracy. This model can accomplish higher accuracy by using more dataset images. Moreover, programmers can utilize the model to develop a smartphone application to diagnose these skin diseases easily and early.

comparing the above system, our system will going use 3000 images as train data to train the model. And also, our system provides mobile application to easy use for doctors.

2) Classification and Detection of Skin Disease Based on Machine Learning and Image Processing Evolutionary Models [2]

In this system, they recognize that identifying skin diseases using the naked eye is hard. Skin disease is currently diagnosed using invasive approaches such as clinical examination and histological evaluation. These are highly effective and practical. However, these techniques necessitate subject matter expertise, require more labor, and have a lower degree of trustworthiness of their results. This paper provided an evolutionary model for skin disease categorization and detection that is based on machine learning and image processing and is focused on the classification and detection of skin diseases. This model used image preprocessing, image augmentation, segmentation, and machine learning methods, among other things, to categorize and diagnose skin diseases. A dermatological data set was utilized for classification and detection, and machine learning algorithms such as SVM, KNN, and random forest were applied. In this system Three parameters of accuracy, specificity and sensitivity are used for the comparative study. SVM performs better as far as accuracy is concerned. SVM and KNN perform equally well as far as specificity is concerned. KNN performs better as far as sensitivity is concerned.

3) A method of skin diseases detection using Image Processing and machine learning. [3]

The system mainly focuses on the dissection of skin diseases using color images without the need for doctor intervention. Machine learning is a technique that allows a computer program to examine data, recognize relationships, and apply insights to solve problems, enrich data, and anticipate outcomes. There are some features in machine learning. They are learning from data through prediction and classification, feature extraction and selection, adaptability and generalization, handling complex and large-scale data, automation and efficiency, discovering hidden patterns, personalization, and recommendation. The alteration and analysis of digital images using a range of methods and algorithms is referred to as image processing. In order to complete tasks like improving image quality, extracting significant information, and making interpretations or choices based on the image content, it needs the application of mathematical processes, signal processing techniques, and computer algorithms. Here are some key features and capabilities of image processing: They are image acquisition, preprocessing, image enhancement, image restoration, image segmentation, feature extraction, image analysis, image compression, and image understanding. Image Processing and machine learning play a vast role in the system. The System consists of two stages: the first is the detection of the infected skin using color image processing techniques, and the second is the classification of the disease type using artificial neural networks. The system was tested on six types of skin diseases, with an average accuracy of 95.99% in the first stage and 94.016% in the second stage. The system will test for six types of skin diseases with an accuracy of 95%.

- Image processing and machine learning are used by both the suggested system and our system.
- Proposed system was tested 6 type of skin diseases. Our system will test 2 types of skin diseases.

4) A proposed Expert System for Skin Diseases Diagnosis. [4]

This study presents the design of an expert system that was developed to aid dermatologists in the diagnosis of a few skin conditions. Psoriasis, eczema, ichthyosis, acne, measles, scarlet fever, warts, insect bites, and stings are a few of them. The proposed expert system is designed using the CLIPS programming language. C Language Integrated Production System is the name of this language. An expert system is an artificial intelligence (AI) computer application that includes a knowledge base and interface engine. The advantages of CLIPS language expert system shell are: Implemented in C language for efficiency and portability, developed by NASA, object oriented language and Rule-Based Language. This is a well-known expert system for diagnosing bacterial infections. There are several expert systems that were created to diagnose diseases. The majority of export systems are disease-specific, while the expert system mentioned above is focused on the diagnosis of nine skin illnesses. Nine disorders were classified into three primary groups in this system: skin infections, skin rashes with fever, and skin rashes without fever. The main source of the knowledge for this expert system ae dermatologists and specializes websites for skin diseases. This research proposes an expert system to assist dermatologists in identifying nine potential skin disorders in patients. Dermatologists and patients with skin problems can receive a diagnosis more quickly and accurately than with a traditional diagnosis. It has a straightforward user interface.

- Proposed system was tested 9 type of skin diseases. Our system will test 2 types of skin diseases.
- Proposed system used CLIPS language. Our system will use java and python.

5) A machine learning model for skin disease classification using convolution neural network. [5]

This system recognizes the melanoma skin disease using machine learning. Melanoma is hard to identify in early stages. If it happens, it is a big help for the people they can prevent having skin cancer in future.in here, Dermatologists who have had extensive training on the various skin lesions caused by melanomas are the most suited to provide an accurate diagnosis. As a result, diagnosing melanoma can be difficult since there is no apparent distinction between skin lesions and the skin itself, malignant and non-melanoma skin lesions seem visually similar, and there are additional considerations to consider. Pathologists will benefit enormously from the development of a reliable automatic detection approach for skin malignancies, such as a system that can automatically assess skin lesions. In here they use two different deep learning algorithms, namely the Lesion Feature Network (LFN) and the Lesion Indexing Network (LIN). In terms of melanoma classification accuracy, this CNN classifier's modular and hierarchical structure not only outperforms state-of-the-art machine learning approaches, but it also significantly decreases the amount of computing work necessary. One of the method's limitations is that it has only been tested on a single dataset.

Compared to the above system our proposed system is going to use deep neutral networks, machine learning, image processing techniques and mainly focus on python programming language.

6) Machine Learning Algorithms based Skin Disease Detection [6]

In this study, five separate machine learning classifiers were used to identify three types of skin illnesses known as acne, lichen planus, and sjs ten. . The skin picture collection is initially preprocessed for further classifications. The dataset is divided into two parts: instruction and testing, with instruction representing 80% of the total and testing representing for 20%. Skin diseases are detected using five different classification algorithms called machine learning, logistic regression, kernel SVM, naive bayes, random forest, and CNN. Each method runs 10 times on the same dataset, calculating the training precision with each iteration. The resulting parameters are explained and compared for all five classification algorithms, and a graphical analysis is done to determine the optimum method for skin disease prediction. Machine learning algorithms may have an influence on the early diagnosis of skin disorders. It can let users make realtime skin modifications. If properly implemented, the strategies will undoubtedly give suitable help and a cohesive strategy to skin issue avoidance. This will help patients and physicians cure skin disorders more quickly. There is access to research and execution of restricted medical knowledge. Compared to above system, both systems are using machine learning, neutral networks, this system use 5 types of machine learning techniques, while we use image processing.

7) Dermatological Disease Detection using Image Processing and Artificial Neural Network. [7]

This study is an extension of earlier work that examined two distinct skin diseases. Before class, they use feature selection approaches to improve the quality of their work, reduce modeling time, and improve performance. The ROI (region of interest) was also thought to comprise the shape, location, and typical color scheme of the diseased area. Some of the motivation came from the work that provided and assessed six methods for the segmentation of skin lesions in thermoscopic pictures. This group includes gradient vector waft (GVF) and Chan et al.'s level set approach, two newer strategies that have been effectively applied in many scientific imaging situations. Additionally, it has a selection of methods developed by the authors especially for this unique software, such as fuzzy-based cut-up-and-merge set of rules (FBSM), adaptive thresholding (AT), adaptive snake (AS), and EM stage set (EM-LS). Another source of inspiration is the work that discusses distinctive structures for the diagnosis of melanomas in dermo copy pictures. The first technique identifies skin lesions using global strategies, whereas the second system classifies skin lesions using local functions and the Bag of Features classifier. This study attempts to identify the most effective technique for skin and pore problems. They will briefly examine the related research on this subject in this newsletter, including topics like structure, methodology, pre-processing algorithms, and understanding the algorithms employed in their suggested strategy. They might then discuss the outcome and effectiveness of their system in general terms.

The work of ANN (Artificial Neural Network) and picture handling to organize various dermatological illnesses is discussed in the study. The accuracy of this system is 90%. The goal of developers is to provide an online framework with greater representation and straightforward access.

8) Intelligent System for Skin Diseases Prediction using Machine Learning. [8]

The identification of skin diseases via image processing was suggested in this research. A two-stage method to detect the disease based on color texture-based identification and by utilizing a classification to identify the name of the disease has been proposed by dermatologists using color-skin photos. The accuracy of the first stage is 95.99%, and the accuracy of the second stage is 94.016%. An early detection approach using image processing based on Convolutional neural networks for feature extraction and then utilizing color to identify the features has been proposed for the diagnosis of skin diseases using image processing and machine learning. A system for early skin problem identification employing statistical analysis and an ad hoc classifier has been proposed by an image analysis system to detect skin problems. This paper research mainly focused on early identification of skin cancer symptoms based on statistical analysis with correlation algorithms. Skin Disease recognition method based on image color and texture features has proposed a model based on feature extraction of image using color texture and using segmentation and SVM on it to identify the disease.

A system for disease diagnosis that may be deployed on mobile devices as well as computers utilizing desktop applications based on a computer vision approach has been presented as a skin disease detection system for people with uncertain finances in developing countries. A model for segmenting and categorizing a skin illness using SVM and KNN algorithms has been proposed in Segmentation and classification of skin lesions for disease diagnosis. The model for detecting dermatological diseases using image processing and an artificial neural network has been trained and tested using a variety of different image processing techniques for feature extraction and feed forwarding.

The method consists of two stages. In the first, features are extracted based on color and texture, and in the second, a classifier identifies potential diseases. A model for identifying psoriasis using color feature extraction and classification of the skin picture has been proposed in Psoriasis Detection Using Skin Color and Texture Features. A model employing computer vision and machine learning has been presented for the diagnosis of dermatological diseases via image processing. With a 95% accuracy rate, algorithms are applied to the extracted visual attributes to identify six different diseases.

A method of picture clustering employing navi for classification has been suggested by an intelligent system for monitoring skin diseases. For the purpose of locating important areas in the image, they used the SIFT approach. They then employed CNN and SVM for segmentation and classification. They have an 84% accuracy and an 82% precision.

In order to detect psoriasis on the skin, psoriasis detection employing skin color and texture features has been described as the color feature extraction method and the texture extraction method. Utilizing a custom RGB mathematical method, color features are retrieved. The support vector machine is mostly utilized for the identification and prediction of skin diseases. SVM has an accuracy range of 80–90%, depending on the dataset. The UCI machine repository's dataset on skin illnesses was used because it has thousands of photos of diverse skin conditions.

2.3 Summery

The proposed system is capable of accurately determining whether a person has a relevant skin disease or not. This system is the best application for doctors that it makes easier to make decisions. The proposed mobile application will reduce the gap between the patients and doctors, it provides a full description about the disease and provide a platform to doctors, medical students to share their ideas with each other. The proposed mobile application interfaces are very simple, and the system will give results very efficiently.

The common point between our proposed system and other systems:

Most of those projects are using machine learning techniques for that. But our system is using not only machine learning, but also neutral network and image processing. In this system, Doctors can communicate with each other and provide some valuable details, but other systems do not contain that type of feature.

According to the table given below, the comparison between the proposed system and other systems can be seen.

[A] - A Model for Classification and Diagnosis of Skin Disease using Machine Learning and Image Processing Techniques

[B] - Classification and Detection of Skin Disease Based on Machine Learning and Image Processing Evolutionary Models

[C] - A method of skin diseases detection using Image Processing and machine learning

[D] - A proposed Expert System for Skin Diseases Diagnosis

[E] - A machine learning model for skin disease classification using convolution neural network

[F] - Machine Learning Algorithms based Skin Disease Detection

[G] - Dermatological Disease Detection using Image Processing and Artificial Neural Network

[H] - Intelligent System for Skin Diseases Prediction using Machine Learning

[I] -AI Powered dermatology diagnostic tool

Table 1

Features	A	B	C	D	E	F	G	H	I
Use image processing	√	√	√	√	X	X	√	X	√
Give description about disease	X	X	X	√	X	X	X	X	√
Give prediction	√	√	√	√	√	√	√	√	√
Doctors, Medical students can communicate each other	X	X	X	X	X	X	X	X	√
Generate reports about disease spread	X	√	X	X	X	X	X	X	√
Save patient data for later usage	X	X	X	X	X	X	X	X	√

Chapter 3

Approach

3.1 Introduction

This chapter refers to identifying main modules and their features in detail. This chapter describes the architectures that are going to be implemented in the system. Furthermore, this chapter extensively elaborates on the main features of the system. It elucidates the functionalities, capabilities, and user interactions provided by each module, presenting a detailed overview of the system's capabilities.

3.2 Approach

Our software application hopes meet the demands of both doctors and medical students by providing both a mobile and a web application and in the future, we intend to broaden the reach of our solution by developing a mobile application for public use. We selected the agile method to provide an efficient and iterative development process. Throughout the development lifecycle, this technique promotes flexibility, cooperation, and adaptation. It enables us to adapt quickly to changing needs and modify our solution because of constant feedback, regular iterations, and incremental improvements.
Moreover, our comprehensive understanding of the problem domain, the proposed solution, and the necessary requirements further validates our choice to adopt the agile method. This knowledge serves as a solid foundation for effective collaboration, efficient decision-making, and iterative development, leading to a successful and impactful product.

1. Data gathering

During our research project, we had insightful meetings with renowned dermatologists, doctors, and medical students. These communications provided us with invaluable knowledge regarding the challenges involved in identifying skin diseases solely through visual observation, and we asked about the do the tools and techniques they use to enhance diagnostic accuracy. Through these discussions, we gained a deeper understanding of the difficulties faced by healthcare practitioners in general clinics when it comes to diagnosing certain skin conditions accurately.

Dermatologists have a remarkable capacity to recognize a wide range of skin diseases due to their trained eyes and significant expertise. Their knowledge enables them to notice subtle subtleties, spot trends, and recognize significant visual cues that help in diagnosis. However, there is a significant rate of misdiagnosis for some skin problems in general clinics where dermatological ability may be limited. This emphasizes the importance of a more accurate and dependable system to assist healthcare providers in these contexts.
Finally, They recognized the significance of such a system in improving diagnostic outcomes and reducing the occurrence of misdiagnoses in general clinics.

2. Data preprocessing

In our skin disease detection system, data preprocessing includes cleaning, standardizing, and organizing raw data. Collecting diverse skin images from medical doctors and sources, standardizing formats, and resolutions, improving image quality, segmenting regions of interest, extracting relevant features, augmenting the dataset, normalizing feature values, dealing with imbalanced data, and splitting the dataset for training, validation, and testing are all steps in the process. These stages guarantee that the data is fit for illness identification and categorization.

3. Trained model

The process begins with gathering a collection of skin disease images and then preparing them by resizing and normalizing them. Convolutional neural networks (CNNs) are then used to extract features. TensorFlow is used to build a deep learning model after dividing the dataset into training, validation, and testing sets. The model is trained using the training set, and its performance is evaluated using the validation set. Finally, the model is tested using the testing set to assess its accuracy in detecting skin diseases.

4. Sign up and Sign in

The Doctor and Medical students must create an account. After successful completion of the account creation process, they will be granted the capability to authenticate themselves and gain access to the system by signing in.
Furthermore, the system also facilitates the ability for an administrator to authenticate their identity and gain privileged access. This elevated access level empowers the administrator to perform administrative functions and oversee the overall operation of the system.

5. Upload Image of the affected area.

Users are afforded the capability to upload an image file, specifically in the formats of JPG, JPEG, or PNG, into the system. It is essential that the uploaded image satisfies the predetermined quality standards set forth by the system. Following that, customers are given the opportunity to resize the image according to requirements. After completing the resizing process, users may use the send button to send the image to the trained model for additional processing and analysis.

If the submitted image does not satisfy the required quality standards, the system immediately generates an error message informing the user of the insufficiency. In such cases, users are presented with a try again button, enabling them to resubmit an image that meets the desired quality standards, ensuring optimal processing and accurate results from the trained model...

6. Displaying the predicted result.

Following the trained model's successful detection of the disease, the system proceeds to give the user detailed information about the detected ailment. This gives a full overview of the illness, including causes, symptoms, course, treatment choices.

Furthermore, the method provides information on the many stages or phases of the disease, revealing the distinguishing qualities and probable consequences of each stage. This thorough information allows users to obtain a complete understanding of the condition and make educated decisions.

7. Get patient data and save the predicted result into the online database.

Upon reviewing the results and associated information, users are provided with the option to preserve and store the output results, as well as relevant patient details, within the online database. This feature enables users to maintain a comprehensive record of the diagnostic outcomes and pertinent patient information for future reference and analysis.

By selecting the "save" option, the system initiates a process to securely store the entirety of the obtained details, including the identified disease, its description, the patient's demographics, and any other relevant information deemed necessary for a complete record. The online database serves as a repository for this data, ensuring its availability and

accessibility whenever required.

The inclusion of the "save" functionality bolsters the system's capacity to facilitate efficient data management and retrieval, contributing to seamless continuity of care, research purposes, and accurate documentation within the medical environment.

3.3 Summary

In this chapter, we extensively examined our implementation strategy, detailing the actions and tactics we would use to bring our application to life. We have also investigated the features and functions of the various modules inside our application, explaining their relevance and how they contribute to improving the overall user experience and attaining our goals.

Chapter 04

Technology

4.1 Introduction

There is a software product to be developed, whose main part is a skin disease detection system using image processing and machine learning. [9] To develop skin disease detection system, python is chosen as programming language. Hope to use TensorFlow, Keras, NumPy and Matplotlib as libraries and frameworks. Jupyter notebook maybe used as IDE in Anaconda environment and GitHub is used as version control system. Figma application will be used to create user interfaces as graphic Tool.
To develop mobile application and web application, hope to use Flutter development framework. SQLite will be used to create databases.

4.2 Technology adapted.

4.2.1 Programming languages

- **Python** [10]

The computer language Python can be used to create a wide range of applications. For applications involving artificial intelligence (AI), machine learning, and deep learning, developers frequently choose them. The libraries and frameworks in the Python language facilitate programming. Another crucial feature is that Python projects can be integrated with other systems developed in other programming languages. [11] Python also has an intuitive syntax and offers a variety of tools for code review and testing. That's why Python is used to build the skin disease detection system.

4.2.2 Libraries and frameworks

- **TensorFlow** [12]

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TensorFlow is an open-source machine learning framework created by Google. It provides a simple yet powerful platform for developing and deploying machine learning models. With TensorFlow, can build and train neural networks, perform data analysis, and make predictions. It offers a user-friendly interface that makes it easy to implement complex

algorithms and handle large datasets. [13] TensorFlow has gained widespread popularity among researchers, developers, and data scientists due to its versatility and robustness. TensorFlow can help you harness the power of machine learning to solve a wide range of problems.

- **Keras** [14]

Keras is an open-source highly modular neural networks library coded in Python and Python-based framework that makes it easy to debug and explore. Keras is a high-level deep learning framework that runs on top of TensorFlow. It provides a user-friendly interface for building and training neural networks, making it easier for beginners and researchers to implement and experiment with different architectures. So, in this project Keras is used to define and train neural network models in just a few lines of code. [15]

- **NumPy** [16]

NumPy is a fundamental library in Python for numerical computing. It provides efficient data structures and functions for performing mathematical and array operations, making it a valuable tool for scientific computing and data manipulation.

- **Matplotlib** [17]

For data visualization and plotting, Python's Matplotlib library is widely used, together with NumPy, Python's extension for numerical mathematics. Machine learning uses several visualizations to help with understanding the vast volume of data. Graphs are made using Matplotlib in this project.

- **Flutter** [18]

Google created an effective framework known as Flutter, which enables programmers to build both web and mobile applications from a single codebase. We can create visually appealing and effective apps with Flutter for a variety of platforms, including iOS, Android, and the web. Flutter offers several interactive features while simplifying the development process by using the Dart programming language. [19] We are hoping to use Flutter for both mobile and web applications because it enables an easy and effective way to create high-quality apps for both of those applications.

4.2.3 IDE

- **Jupyter notebook** [20]

The popular web-based application Jupyter Notebook enables you to create and share documents with live code, illustrations, and explanation text. For the purposes of data analysis and scientific research, it offers an interactive environment. Additionally, Anaconda Navigator is included. Jupyter Notebook is used as an IDE in this project. Here, we're able to experiment, document, and collaborate on projects easily since you can write and run code in cells. That’s why we decided to go with Jupyter Notebook.

4.2.4 Database/Data storage

- **SQLite/firebase** [21]

SQLite is an embedded database management system based on SQL. iOS, Android, and Windows Phone all support an SQLite database with a full API. The SQLite Cordova plugin provides a straightforward API for building databases and conducting SQLite queries. SQLite offers a robust and efficient solution for managing relational databases, combining simplicity, portability, and performance in a single package. [22]

4.2.5 Version Control

- **GitHub** [23]

GitHub is a version control system and web-based platform that allows developers to collaborate on projects, manage source code, and track changes over time. It offers a centralized site for hosting Git repositories, allowing several developers to collaborate in real time. Developers may easily contribute to projects using GitHub by forking repositories, making changes in their own copies, and presenting those modifications via pull requests. It includes features like issue tracking, project management tools, and code review, making it an effective platform for open-source development and team collaboration. [24] GitHub also promotes community interaction and fosters code sharing and discovery, making it a global center for coders. Using GitHub we can develop our system simultaneously and together to archive our goal faster and accurately.

4.2.6 Application and web servers

- **Anaconda** [25]

For our project, using the Anaconda environment offers a simplified and effective method of development. The full Python distribution offered by Anaconda makes setting up environments and managing packages simple. Smooth development is made possible by the Anaconda environment, which also makes it simpler to efficiently manage dependencies and deploy our AI model.

4.2.7 Cloud computing

- **AWS** [26]

AWS /Amazon Web Services is a popular cloud computing platform that offers a wide range of scalable and flexible services for building, deploying, and managing applications and infrastructure in the cloud. It provides on-demand resources, cost-effective pricing models, and a rich ecosystem of tools and services for various computing needs, making it a preferred choice for businesses and developers. [27] When there are expanding projects like ours, we can use AWS cloud services to archive our goals without having to take risks like limited storage, slower speed, and many other things. [28]

4.2.8 UX, UI and graphic Tools

- **Figma** [29]

Figma is a design and prototyping tool that works in the cloud and allows for collaborative design work, real-time editing, and the construction of user interfaces and interactive prototypes. It has a variety of design tools and allows designers to work from any location, making it a versatile and accessible tool for teams and individuals. [30]Using figma we can create our system prototype and see how it looks like before we develop the real system. We can identify design errors and fix them at the beginning using figma.

4.3 Summary

This technology chapter emphasizes the importance of technology in establishing a skin disease detection system web and mobile application. The chapter emphasizes the necessity of choosing appropriate and popular technologies to help with software development. Machine learning and image processing technologies are highlighted as critical components of the suggested solution in this situation. By leveraging these specialized technologies, our system can offer unique features, smooth user experience, and seamless integration with the skin disease detection system.

The main objective of using these technologies is to develop a system for identifying skin disorders that is more accurate, quicker, and efficient.

Chapter 5

Analysis

5.1 Introduction

Skin conditions are widespread and can drastically lower someone's quality of life. For these illnesses to be treated and managed effectively, a prompt and precise diagnosis is essential. Recent technological developments, notably those in the area of artificial intelligence (AI), have created new opportunities for increasing the precision and effectiveness of skin disease detection. Requirements analysis is the process of determining the user expectations for an application that has to be created or updated. This comprises all of the actions taken to ascertain the requirements of diverse stakeholders. This stage is a crucial and important task. In this chapter, we'll talk about the requirements of the suggested solution as well as how we acquired and studied the criteria.

5.2 Requirement gathering and analysis.

Requirement gathering and analysis were important phases in this project. Because this project is related to the medical field. This phase was a big challenge for us. As the first step, we were able to identify the Stakeholders in this project. (a doctor, a medical student, an admin, and a development team) The second step was capturing stakeholder requirements. Some mechanisms had to be used to gather the requirements. The first is interviewing. We had a chance to visit the hospital and arrange a meeting with the dermatologist. It was a good chance to learn more about skin diseases and gain the knowledge needed to identify how a doctor determines whether a patient has a skin illness. As a second method, we asked questions to get a better idea of what medical students needed. Several medical students were selected for this. There, some questions were asked of them, and we were able to understand the problems they were facing and what they were expecting from a system. For that, the designed questionnaires were used, and they included various questions related to the project. We studied the existing systems and drew some diagrams to understand the process. It was very helpful to get a better idea of a system that can fulfill the user's requirements. In addition to that information, we used the internet to find some facts about the system that we are going

to develop. In this phase, we also use a use-case diagram to understand how the system would work.

After gathering requirements, the third step was categorizing gathered requirements. To make analysis easier, considered grouping the requirements into these two categories:

- Functional Requirements
- Non-Functional Requirements

The fourth step was Interpret and Record Requirements. In this phase, it is determined and listed in sufficient detail which requirements are achievable or not and how the system or product can deliver them. Although many requirements are important, some are more important than others. So, we finally prioritized the selected requirements.

5.3 Requirements of the suggested solution

Functional Requirements

- The user and admin will be able to login into both the web application and mobile application.
- The doctor will be able to input digital skin disease images into the system.
- The doctor will be able to input the patient's information into the system.
- The system will be able to determine what type of skin disease a patient has.
- The system will be able to display results.
- The admin will be able to maintain the system.
- The admin will be able to update the system.
- The admin will be able to backup data.
- The medical students and doctors will be able to create a new profile or update an existing profile.
- The medical students and doctors can be able to be contacted by the other doctors and medical students through the system by using a discussion forum and, they can comment their idea about the output using the discussion forum.
- The system will be able to store patients' data using a database.
- The system will be able to generate a report about the spread of skin disorders.
- The system will be able to give a full description of the generated skin disease.

Non-Functional Requirements

- Skin disease detection system will take a short time without any delay to load user interface screens.
- The system will verify the login information within five seconds.
- The skin disease detection system will give a result with the highest accuracy.
- The system will be able to access their resume without failure.
- The doctors can use the skin diseases detection system at any time during the day.
- The system will be able to store patients' data forms within database up to large amount.
- The admin will be able to maintain backups to ensure the system's database security.
- The system's interface must be user-friendly and easy to use.

5.4 Summary

The gathering requirements phase was not easy, because we had to visit the hospital and discuss even with the dermatologist. There we have been informed about the way of making discissions by doctors. Other important facts include getting a clear idea of how the doctors identify skin diseases. These factors mainly affect the proposed system.

Chapter 06

Design

6.1 Introduction

The Design chapter goal is to convert the requirements into comprehensive and precise system design specifications. The design of a system is perhaps the most critical factor affecting software quality. It has a substantial later influence on the project, particularly during testing and maintenance. That is why this stage is critical. We intend to cover a variety of diagrams in this chapter. If they are a use-case diagram, an entity-relationship diagram, a class diagram, an activity diagram, a sequence diagram, or a state chart diagram, they are all examples of diagrams. This step required the creation of several diagrams, each with a brief description. These diagrams are quite useful in the implementation phase of the proposed system, which is why we focused so heavily on it. That is why we place such a high value on this section.

6.2 Design

6.2.1 Use-case Diagram

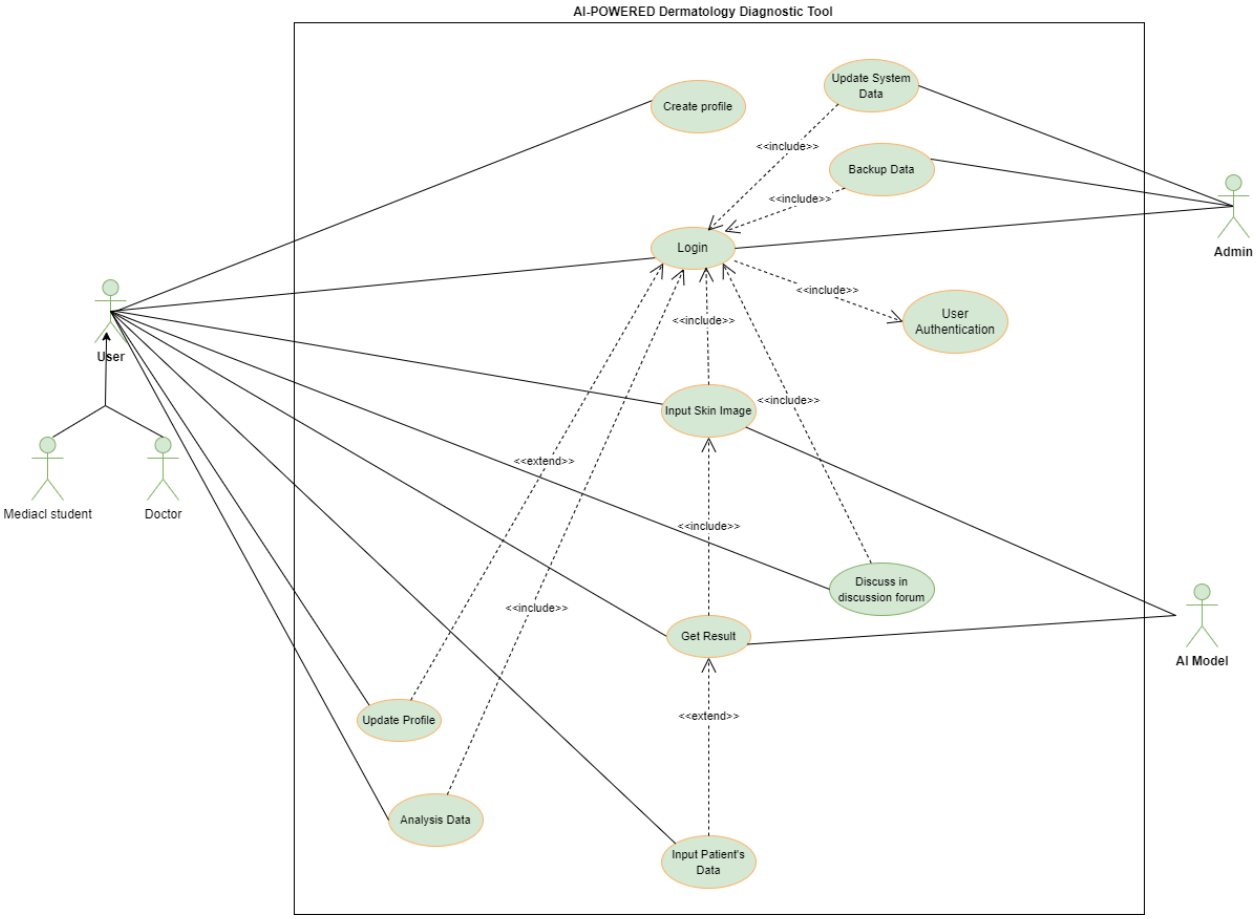

Figure 1

The use-case diagram explains the high-level functions and scope of the proposed system. This also identifies the interactions between the system and its actors. The use cases and actors in diagrams describe what the system is going to do and how the actors use it. The users that interact with the system are considered as actors. There are three actors in this use-case diagram.

- Doctor/Medical student
- Admin (Administrator)
- AI model

The actors should do the use cases. In the begging, the doctor/medical student has to login into the system and upload the skin disease image into the skin disease detection system.

After, the result will be displayed. After successfully identified the disease, doctor/medical student must enter patient details into the system. By using the system, they can get reports about the transmission of related diseases. Another actor is the admin. The admin also must do several use cases. They are logging into the system, creating logins for both doctors and medical students, updating the system, and getting backup data.

6.2.2 Activity diagram

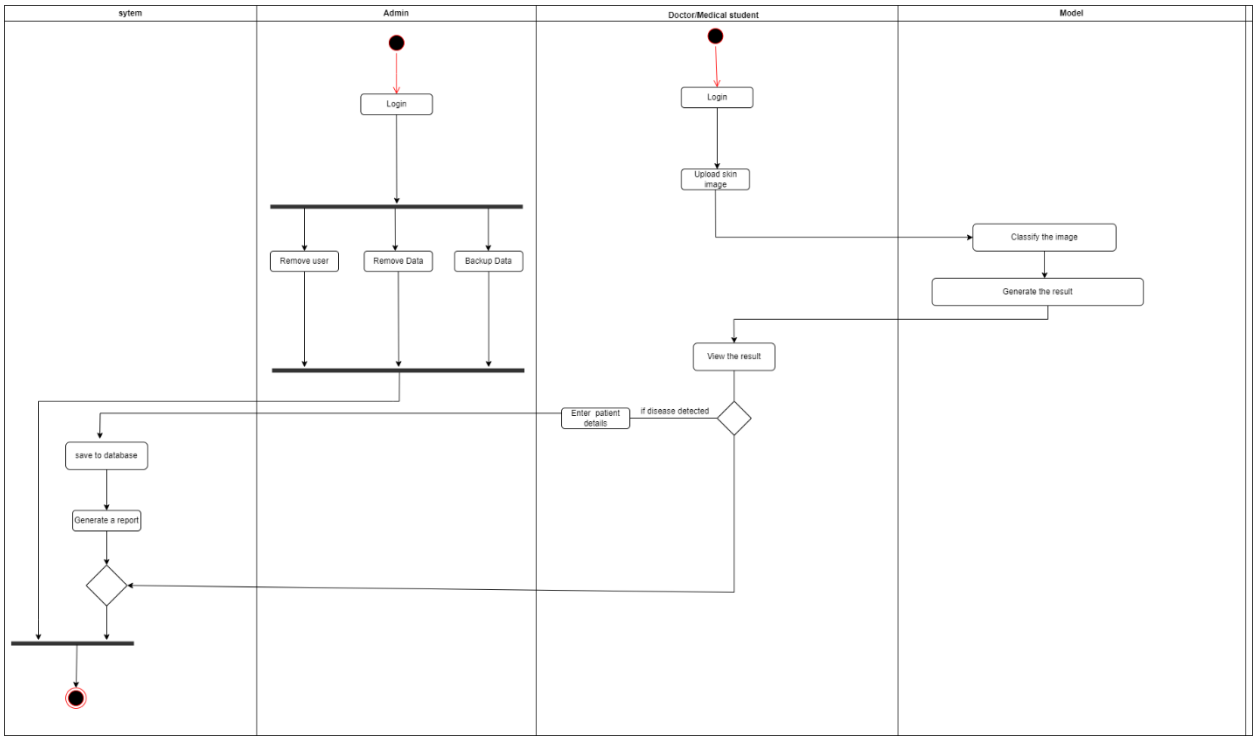

Figure 2

Activity diagrams are valuable tools in software engineering, serving as visual representations of the high-level flow of programs and processes within a system. By providing a clear and concise overview of activities and their relationships, these diagrams aid engineers in understanding the system's behavior and identifying potential bottlenecks that may be causing specific events.

In our system activity diagram, the focus is on the login and interaction processes involving three distinct user roles: doctor, medical student, and admin. All three users can initiate the login process if they do not have an existing account, and they are provided with the option to create one.

Once logged in, the admin is empowered with additional privileges. The admin is able to carry out crucial operations like deleting data, backing up data for storage, and expelling people from the system. The security and integrity of the system depend on these acts.

On the other hand, doctors and medical students, after successful login, can access functionalities that involve patient data and skin image entry. This process is followed by the activation of a trained model, which begins its processing tasks. The model uses advanced

algorithms and data analysis techniques to generate results based on the provided inputs.

After the model completes its processing, doctors and medical students can access and review the generated results. These results could be in the form of diagnoses, predictions, or any relevant analysis based on the data entered earlier.

Finally, the system undertakes the responsibility of generating a comprehensive report, summarizing the entire process, including the inputs, outputs, and any relevant insights gained from the trained model's analysis.

6.2.3 Class Diagram

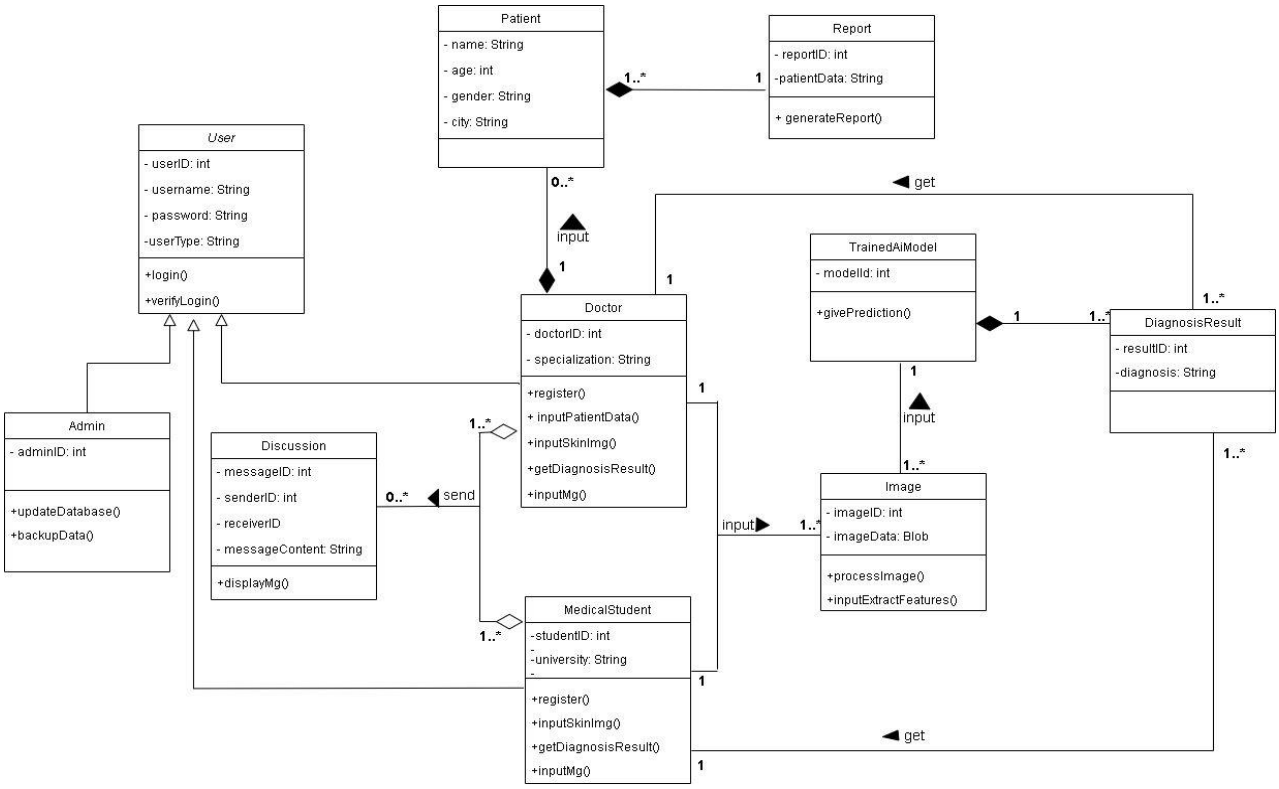

Figure 3

This class diagram describes the classes and their relationship with the proposed system. It represents a static view of the system. A class represents a box with three main components. They are class names, attributes, and methods. As an example, in the Doctor class, "Doctor" is the class name, doctorID" and "specialization" are the attributes of the class, and register(), inputPatientData(), inputSkinImg(), getDiagnosisResult(), and inputMg() are methods of the Doctor class. In this class diagram, there are ten main classes.

There are Admin, Doctor, and MedicalStudent classes, and they inherit the User class. The Patient class is a part of the Doctor class, and the Patient class can't exist without the Doctor class. So, there are composition relationships to connect those classes. Other than that, composition relationships can be found between the Patient class and the Report class, the TrainAIModel class and the DiagnosisResult class.

There is an aggregation relationship between Discussion class and Doctor and MedicalStudent classes. Discussion class is a part of the Doctor and MedicalStudent classes, but Discussion class can exist without Doctor or MedicalStudent classes. That's why there is an aggregation relationship between them. Other than that, association relationships are used to connect the other classes. In this diagram, multiplicity is also used to state how many objects may be connected across an instance of an association.

6.2.4 State Chart Diagram

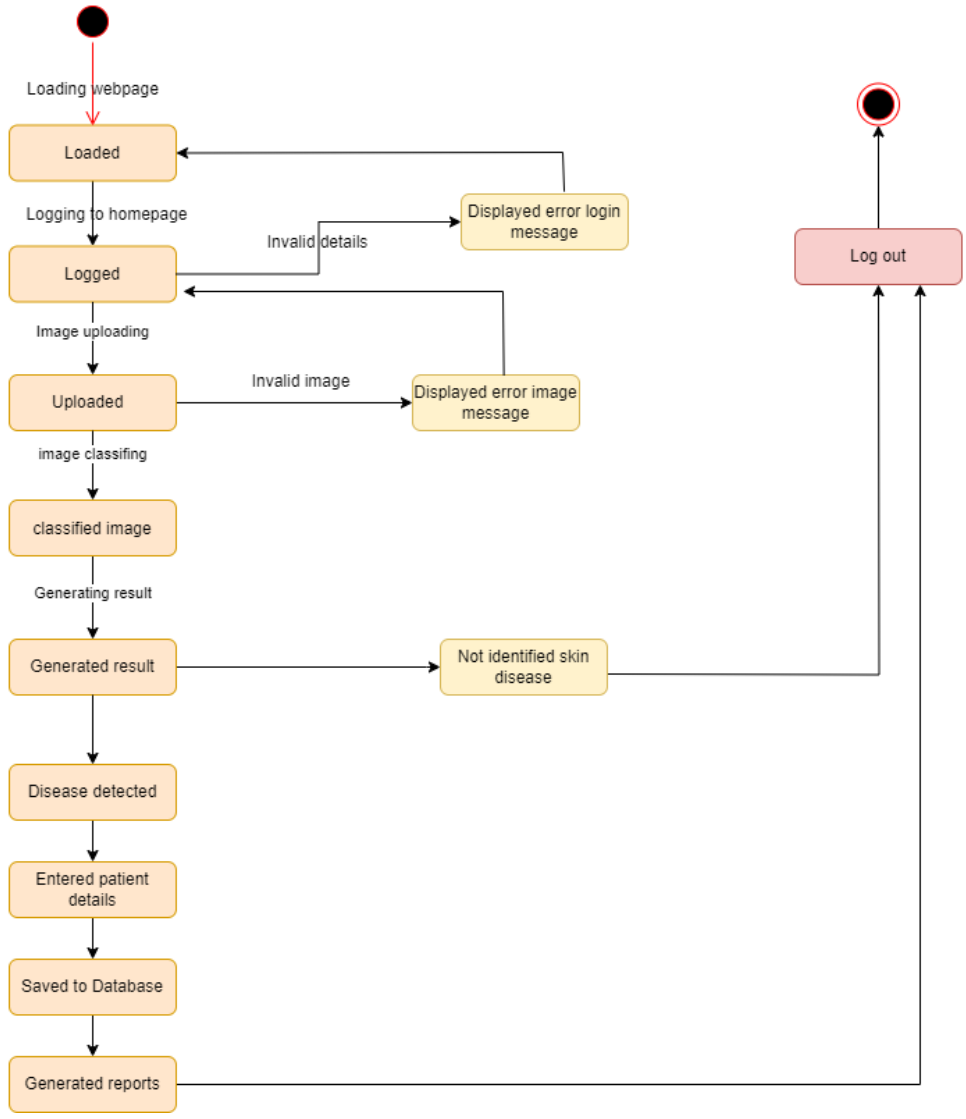

Figure 4

A state chart diagram is an illustration of all the possible behavioral states a software system component may exhibit and the various state changes it's predicted to undergo over the course of its operations. A state chart diagram is one of the UML diagrams used to model the dynamic nature of a system. This diagram clearly shows the state of the "Skin Disease Dermatology Diagnostic Tool."

The user logged into the web page and accessed the home page, but encountered an error message due to a wrong login. After reattempting, the user successfully logged in and reached the home page. Subsequently, the user tried to upload a skin disease image, and the system started its classification process to generate a result. Unfortunately, the system displayed an error message as the uploaded image was invalid and it couldn't identify the skin disease. The system is currently trained to recognize only two specific skin diseases. However, once a

valid image is uploaded and the disease is identified, the user can enter patient details, which will be saved to the database. The system will then generate a comprehensive report for the patient.

This state diagram aids in determining the system flow. Users are guided through a simple and educational trip inside our web application by the state chart.

6.2.5 Sequence Diagram

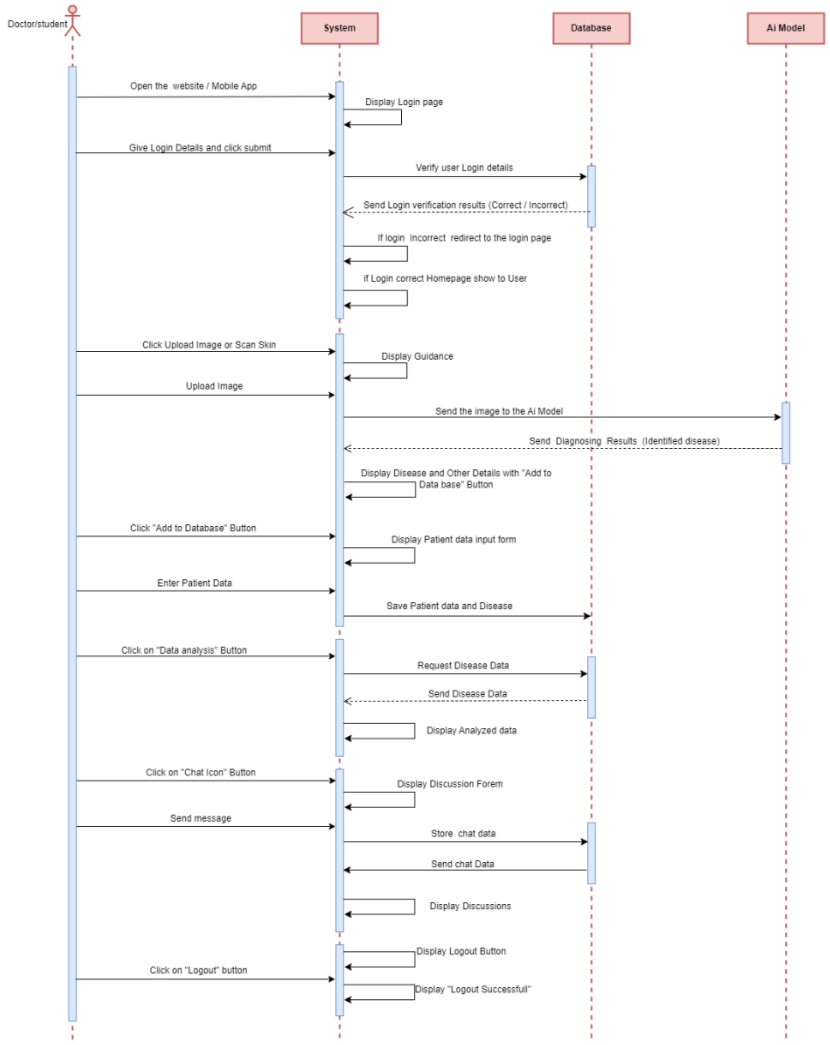

Figure 5

A sequence diagram is a Unified Modeling Language (UML) diagram that illustrates the sequence of messages between objects in an interaction. A sequence diagram consists of a group of objects that are represented by lifelines and the messages that they exchange over time during the interaction. According to this sequence diagram, the first step is for the doctor or medical student to log in to the system. Here, user login details are verified by the system. If login is incorrect, it redirects to the login page, and if login is correct, the homepage is shown to the user.

In the proposed system, users are provided with a comprehensive platform to manage medical data and facilitate disease diagnosis and analysis. Upon clicking the "upload image" button, users can seamlessly submit images, which are then sent to an AI model for diagnosis. The

AI model promptly returns the diagnostic results. Subsequently, users can input patient details and disease information into the database for easy retrieval and reference.

The "data analysis" button empowers users to visualize and interpret the gathered data, enabling better decision-making and insights. Moreover, the system offers a dynamic "discussion forum" where users can engage in meaningful conversations and share knowledge about each disease. Here, messages and discussions foster collaboration among healthcare professionals, improving collective expertise. Once the tasks are complete, users can securely "logout" from the system.

6.3 Summary

The design phase is a very important step in software development project. Because the implement phase depends on this phase. Here we discussed several UML diagrams. The use case diagram describes graphical depiction of a user's possible interactions with a system. The ER diagram describes relationships among uses, objects, places, concepts, or events. The class diagram describes the attributes and operations of a class and the constraints imposed on the system.

The activity diagram describes the dynamic aspects of the system. The sequence diagram describes how—and in what order—a group of objects works together. Finally, the state chart diagram describes the flow of control from one state to another state.

Chapter 7

Conclusion

7.1 Introduction.

Using a machine learning model, we are creating software that can detect skin problems. This application is used in the dermatology field. Usually, general doctors and medical students find it difficult to identify skin diseases in necked eye. This manual method consumes more time and has less accuracy. So, we decided to implement a skin disease identifier application. Under this chapter will discuss the conclusion of the Identify the skin disease variations project. So, we will first discuss the limitations, and next, we will discuss the future implementation that we have planned.

7.2 Limitations.

- In doing this project, we may encounter issues like,
  - The fact that we can't predict some diseases using only images because we must get the patient's health history and symptoms. And we can’t predict the disease of some patients because the appearance of the infected area differs from that of a regular patient.
  - Finding Data sets is little bit harder.
- Even though this application is for Sri Lankan doctors and medical students, it will only be available in English language. Because this is not only for Sri Lankan doctors and medical students but also for foreign doctors and medical students as well. And the English language is considered the most common communication language in the world. So, both local and foreign scientists will be able to use this application.

7.3 Future works

- In our application, we have identified only two skin diseases, but in the future, we plan to build our application to identify all skin diseases that cannot be detected by the naked eye.

- We hope to provide this application to foreign countries.

7.4 Summery

In this chapter first we have discussed about the limitations of our application and next We have discussed the future works of our project. In the limitation part we discussed what the limitation in our application and why that limitation is came. Next in the future section, we discussed what the future of our project.

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