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UNIVERSITY OF WESTMINSTER

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Skin Disease Analyzer
For Detecting Skin, Identifying Diseases and a Platform to Manage Medical History

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Declaration

I hereby certify that this project report and all the artifacts associated with it is our own work and it has not been submitted before nor is currently being submitted for any degree program.

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Abstract

A significant percentage of people have skin disorders at some time in their life, and in certain situations, symptoms worsen if not caught in the earliest stages. It was acknowledged that without a doctor's help, the general public occasionally had trouble detecting symptoms. Additionally, it was found that the majority of people see dermatologists relatively infrequently, with the majority never having done so in their lives. In light of this, it was decided that this project should focus on finding a solution to the issue. The approach for recognizing a skin problem from a snapshot of the symptom and proposing a doctor who treats that disease is the suggested solution.

Keywords: Image processing, Machine Learning, Neural Network, skin diseases

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Table of Contents

List of Figures

List of Tables

Abbreviations table

Abbreviation	Explanation
CNN	Convolutional neural network
ANN	Artificial neural networks
SVM	Support vector machines
VGG	Very Deep Convolutional Networks for Large-Scale Image Recognition
TBP	Total Body Photography
SSADM	Structured Systems Analysis & Design Method
OOAD	Object-Oriented Analysis & Design
WBS	Work Breakdown Structure

Chapter 1: Introduction

1.1 Chapter Overview

This chapter elaborates on the project's background to give readers a clear understanding of the problem domain, the difficulties that current solutions face, as well as the goal, objectives, scope, and resource requirements based on both hardware and software for the Skin Disease Analyzer - Second-Year Project. The Introduction chapter discusses the features of the Skin disease analyzer prototype, which is illustrated with a rich visual diagram, as well as the thesis outline, which describes all of the topics that will be discussed in this dissertation.

1.2 Problem Background

The skin is the body's biggest organ. The skin helps to keep the body's temperature steady. The organ that has the closest contact with the outside world is the skin. It regulates body fluids, prevents dehydration, and keeps harmful microorganisms out. If we didn't have it, we would catch infections. We are able to feel things like heat, cold, and pain thanks to nerve endings in our skin.

Skin disorders are conditions that damage the skin's surface. Many diseases can lead to skin anomalies such as rashes, inflammation, itching, and other skin conditions. Skin conditions might be genetically predisposed, lifestyle-related, or both. Skin illnesses can be treated with drugs, creams, and ointments as well as lifestyle modifications.

The majority of people have no idea what kind and what stage of skin ailment they have. Some skin conditions develop and spread because symptoms don't appear for months. This is a result of the general public's ignorance of medicine. In order to identify the type and stage of the condition, a dermatologist (a doctor who specializes in the skin) may need to perform pricey laboratory tests.

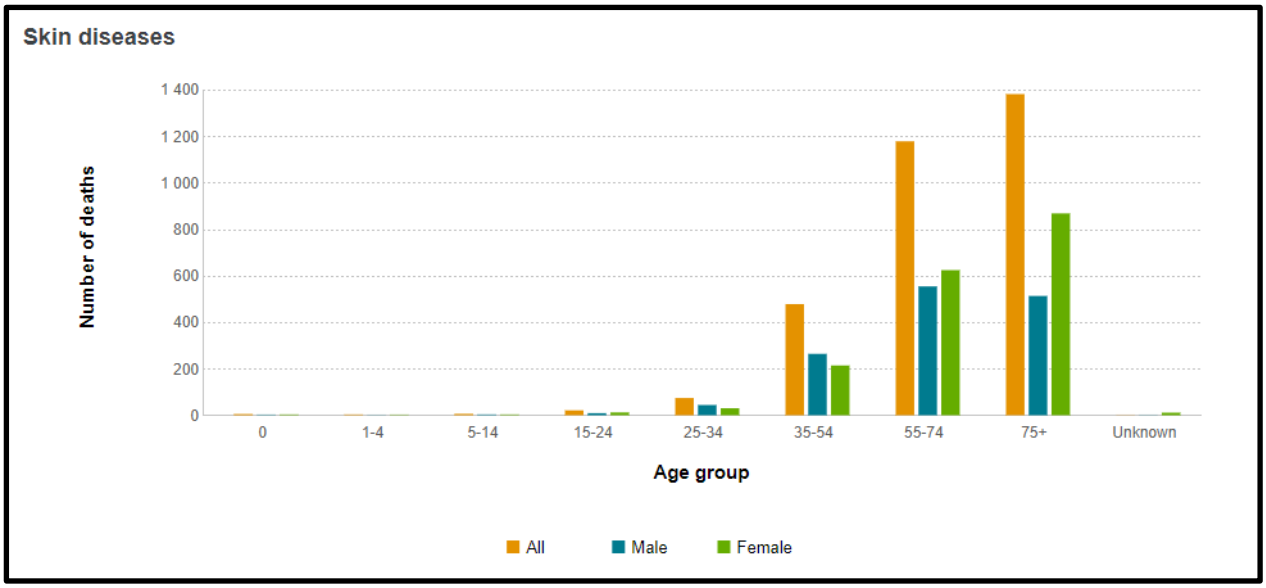


Figure 1 Skin diseases chart

The World Health Organization reports that skin diseases have caused a significant number of fatalities. According to the aforementioned chart, people between the ages of 35 and 75 are more likely to pass away from these skin disorders. The majority of these people are employed and unaware of how these diseases would affect them. Few people have taken steps to treat their skin disorders.

1.2.1 Feature Comparison Chart

Feature	**The proposed app**	**App already available in the market (Suwapetha and oDoc)**
Scanning symptoms	Scanning the images and observing what the user entered	Processes only what the user enters
Medical history	Obtain the patient's past medical records for future reference	does not possess the patients' previous medical records
Qualified Doctors/Consultants	Keep track of the doctors and consultants at all times	Doesn't have any method to verify the doctor
Channel a Doctor	Through this application, a patient	A doctor can be reached by the patient

	can contact a doctor regarding their needs.	by calling the hospital.
Take a new medical report	A digital copy of the report can be uploaded by the patient.	The patient needs to channel the doctor again.
Prescription/Feedback	It is possible for the doctor to give valid prescriptions and feedback.	The patient needs to meet the doctor.

Table 1 Feature Comparison Chart

1.3 Problem statement

being unable to quickly recognize skin problem signs at home.

1.4 Research gap

Our project's area of concentration is not only image processing and identification but also helping the user find proper medication and doctors for their illness. In order to achieve these results we will be using a type of deep learning called Convolutional Neural Networks (CNNs) to process the image that the user sends.

Artificial neural networks are used in deep learning to carry out complex calculations on vast volumes of data. It is a form of artificial intelligence that is based on how the human brain is organized and functions.

CNN's, often referred to as ConvNets, have several layers and are mostly used for object detection and image processing. When it was still known as LeNet in 1988, Yann LeCun created the first CNN. It was used to identify characters such as ZIP codes and numbers.

Data set

In order to uniquely identify each skin-related sickness and provide the user with the relevant information, we will use datasets on skin diseases to identify skin diseases from the photographs that the user input into the mobile application.

- International skin imaging collaboration (ISIC)
- dermNet

- Skin Cancer MINST: HAM10000

1.5 Research questions

- What are type of skin diseases?
- Can skin diseases identify using internet?
- People's knowledge of skin diseases?

1.6 Research Aim

The main goal of the project is to assist individuals in recognizing and diagnosing physical symptoms at home or anywhere. As a result, it is a simple way for doctors and patients to communicate with each other.

The image must be appropriately identified, along with a solution to the issue. Therefore, To further explain the described research goal, the user should upload a clear image of symptoms of their skin. When a user inputs the image, the system compares symptoms with the database and shows a possible diagnosis that matches. Therefore, the patient can suggest a doctor according to the diagnosis of the patient.

The system can manage past medical records of a patient, when the patient communicates with a doctor, So the doctor can check the past medical reports of patients' and easily examine the patient. So the user can search the reports and images about any skin disease through the database.

1.7 Project Scope

1.7.1 In-Scope

The conditions that the system will identify are of the following categories of skin diseases

- Acne
- Cold sore
- Blister
- Hives
- Actinic Keratosis
- Rosacea
- Carbuncle
- Latex allergy
- Eczema
- Psoriasis
- Cellulitis
- Measles
- Basal cell carcinoma
- Squamous cell carcinoma
- Melanoma
- Lupus
- Contact Dermatitis
- Hair loss photos alopecia and other hair diseases
- Vascular tumors
- Warts molluscum

1.7.2 Out-Scope

The proposed method will not detect conditions outside of the above-mentioned diseases. Images that are not clear or have camera filters added will also be difficult to recognize.

1.8 Rich picture diagram

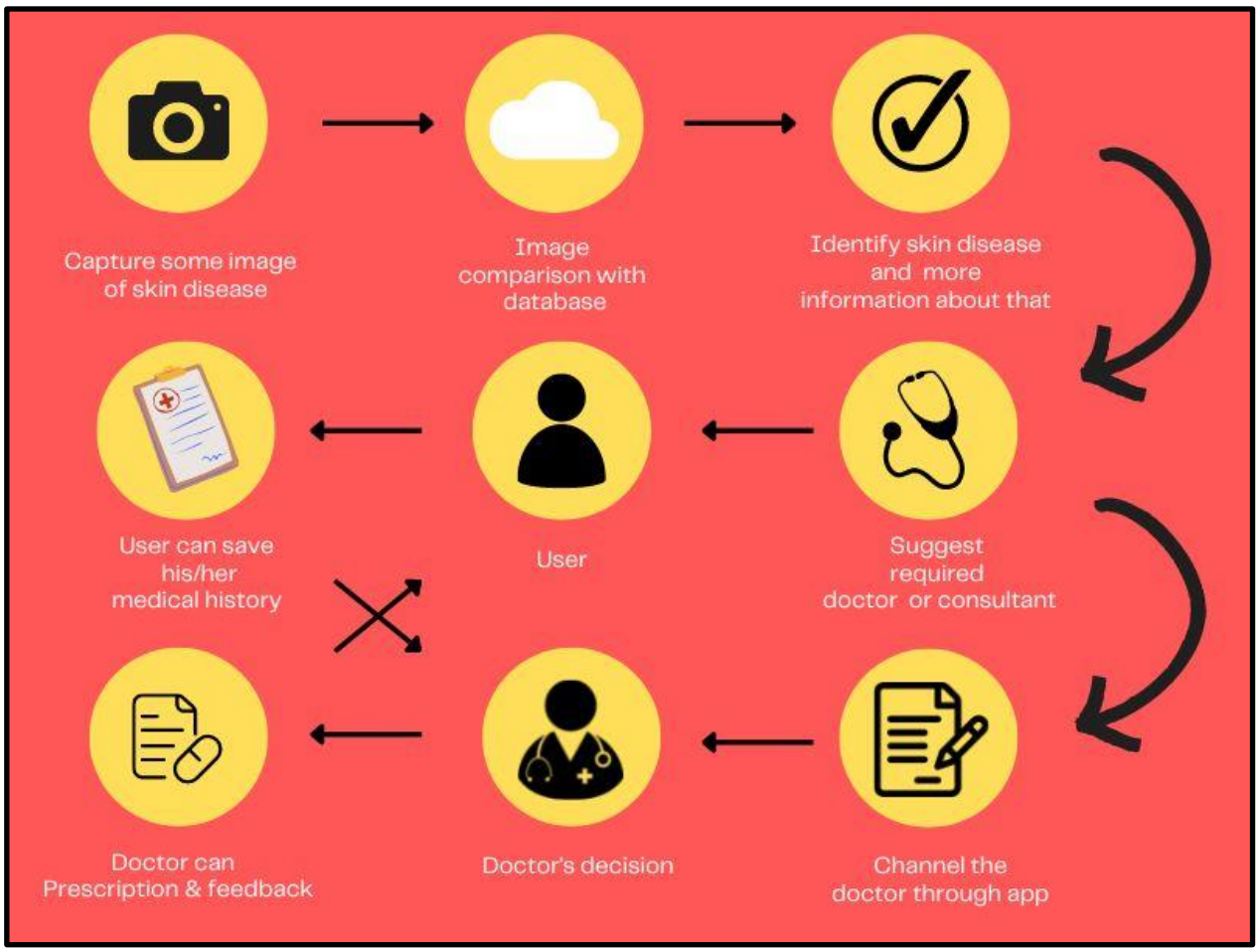


Figure 2 Rich picture diagram

1.9 Objectives

1.9.1 Research objectives

- Human skin illnesses, both standard and unique, are being studied.
- Image processing and machine learning methods are being researched.
- skin disease study and environmental skin impact analysis.
- Examine the market's present applications to discover their strengths and limitations.

1.9.2 Academic Objectives

- Completing the project's Software Requirement Specification (SRS).
- Developing critical analysis and problem-solving abilities.
- Create a design Specification document to streamline the implementation process.
- Using theoretical concepts and best practices.

1.9.3 Operational Objectives

- Conduct a background study investigating existing solutions and research in the Machine Learning, CNN, and ANN areas.
- Obtaining the necessary datasets.
- Identify and analyze the system's needs, including functional and non-functional requirements, and construct the SRS.
- Create test cases and run them through the prototype. Make any necessary bug fixes.
- Make the evaluation report.

1.10 Proposed Solution

The program will detect probable medical illnesses that may have caused the symptom when the user uploads a photo of it on their skin. The diagnosis will be shown, and the user will have the opportunity to upload an additional image to more accurately pinpoint the issue that is related to them. In that situation, the diagnosis will be based on the outcomes of both photographs.

Additionally, it will keep track of the patient's complete medical history, and linkages will allow professionals to examine the patient's medical data. The patient has the option to enter their health records, including any pre-existing problems, allergies, medical histories (blood tests, x-rays), routine medications, and so on, and then decide whether or not to share some of their medical history with their physicians.

If the doctor recommends that the patient obtain a medical report, such as one from a blood test or an x-ray, the patient can submit a picture or digital copy of the report and share a link to it with the doctor. This might be helpful to the doctor while consulting.

1.11 Resource Requirements

1.11.1Software requirements

We have to consider all the possibilities according to the software requirement. IDE coding is very important to get excellent results in the coding process and there are many options for this. The platform of users that are going to be targeted needs to be decided as well. What that means is that since we are planning to build a mobile application there are two main platforms (Oss).

1.11.2 Hardware requirements

We look forward to developing our project through image processing and machine learning. Also, the application will work very well depending on the quality of the photo sent by the user. So, the accuracy of the whole project depends largely on the photo the user sends. The higher the quality of the photo sent by the user, the more accurate the output will be.

1.11.3 Data requirements

Since we do have not much medical knowledge it was critical for us to find an appropriate dataset. A dataset representing diseases on native skins that matches the specifications of the project was not found. The dataset being used does not represent people with darker skin colors as much as it does fairer skin tones.

1.12 Chapter Summary

This chapter offered an overview of the skin disease analyzer. It offered extensive background information on the project as well as thorough descriptions of the problem domain. The prototype's key characteristics were also noted. The goal and objectives required for the project's successful completion were also detailed. Additionally, it determined the project's resource needs. The next chapter is the literature review, which will critically analyze previous work, approaches, and procedures.

Chapter 2: Literature Review

2.1 Chapter Introduction

The preceding chapter introduced the Skin Disease Analyzer. This chapter is a review of the literature, which will be used to identify the methodologies, techniques, and technologies that are currently in use and to understand their benefits and drawbacks in order to determine the best strategy for implementing the skin disease analyzer. In this chapter, existing products will also be analyzed and discussed.

2.2 Existing Work

Health care system is not a new area for machine learning. Smart records, diagnostic imaging and diagnostics, medication research and development, and the treatment of illnesses have all benefited from its use. Machine Learning is still not widely used to identify skin diseases, though. The dearth of generally regarded studies is the cause of this hesitation.

Existing Research Work	Purpose	Approach
Machine Learning Skin Disease Recognizer	Detects Acnes	Following that five learning algorithms are approaching, Machine Learning , SVM kernel, Bayers Analysis Classification, Random Forest Classification, Machine Learning and Convolutional Neural Network- CNN(Deep Learning Algorithm) , are used to identify skin illnesses.
Detection of Dermatological Disease	The system successfully detects 9 different types of	Detection of Dermatological Disease using Artificial Neural Network and Image

	dermatological skin diseases with an accuracy rate of 90%. (Yasir et al, 2014).	Processing and also can get information from the user.
Artificial Neural Network System (Kabari et al)	The system's efficiency percentage for routinely treating patients with skin disorders and predicting their diagnosis is 90% (M. SHAMSUL et al)	Ann automated system for diagnosing skin conditions. For training and testing purposes, they employed several pre-processing methods, including our own and feed- forward vessels from pre-existing artificial neural network(ANN)
Rash of Measles Recognition using CNN	To recognize measles rashes	Deep convolutional neural network (CNN)

Table 2 Existing work

2.3 Research on Approaches and Techniques used in related domains

2.3.1ANN

Artificial neural networks (ANNs) employ learning algorithms that can independently make adjustments - or learn - as fresh input is received. As a result, they are an extremely useful tool for non-linear statistical data modeling. A neural network acts similarly to the neural network in the human brain. A "neuron" in a neural network is a mathematical function that collects and processes information.

data classification based on a predetermined architecture The network closely resembles statistical approaches such as curve fitting and regression analysis.

The skin disease analyzer in the proposed system analyzes color photos uploaded by the user without the assistance of a doctor. The method is divided into two stages: the first involves the identification of sick skin using clustering and color gradient techniques in color image processing, and the second involves classifying the condition using artificial neural networks.

2.3.2 Image Resizing

To address the issue of varying picture sizes in the database, an input image is either increased or decreased in size. By reducing the picture size, all photographs will have the same amount of characteristics. Furthermore, shrinking the image decreases processing time, which improves system performance. (Wang, 2014)

2.3.3 CNN

Convolutional Neural Networks (CNNs) are among the most powerful and widely used supervised learning techniques in deep learning, mostly for image categorization. Regular neural networks (multi-layer perceptron MLPs) and convolutional neural networks (CNNs) have many similarities.

composed of neurons with learnable parameters that are changed with a loss function The primary difference is that ConvNets explicitly presume that the inputs are pictures, reducing the amount of parameters and allowing them to train much quicker. (Roska, 1993)

2.3.4 AlexNet

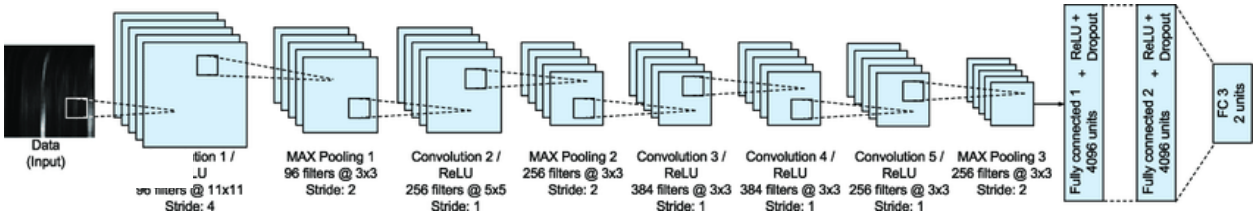


Figure 3 AlexNet

AlexNet is a deep CNN model created by Krizhevsky et al. to model the 2012 ImageNet for the Large Scale Visual Recognition Challenge (ILSVRC-2012). Five convolutional layers make up AlexNet, and each convolutional layer is followed by a nonlinear ReLU layer. Max Pooling layers are also present in the first, second, and fifth levels, as seen in Figure 5. The first and second convolutional layers are followed by two normalization layers. Additionally, the model's top two completely linked layers were preceded by the softmax layer. More than 1.2 million photos from 1000 different classes were used to train AlexNet. From a convolutional neural network that has been pretrained, we suggested feature extraction. (Alom, 2018)

2.3.5 SVM

SVM has many practical applications in a variety of domains, including bioinformatics, medical research for illness detection, diverse engineering applications for model prediction, finance for forecasting, and so on. It is commonly employed in medical science because of its excellent categorization learning capacity. It can categorize highly nonlinear data using the kernel function, analyze diagnostic models to identify the most prevalent skin diseases, and give helpful insight into the SVM technique. Skin patients in rural regions, where most individuals are treated by paramedics, are not properly diagnosed, leading in maltreatment.

The severity of the condition is immediately detected by the skin disease analysis system. The method consists of three stages: successful segmentation by skin detection comes first; the second stage extracts a collection of characteristics, including color, texture, and boundaries; and the third stage uses support vector machines to assess the severity of the condition (Van, 2021)

2.3.5 Comparison of Approaches and Techniques

Approaches and Techniques	**Strengths**	**Weakness**
CNN	1)**computational efficiency**-The convolution mechanism used in CNNs makes them far more computationally efficient than regular neural networks.To make model deployment quick and easy,Cnn uses dimensionality reduction and parameter sharing.They might be developed to work on any system,including mobile devices. 2)**Has Feature Learning**- Because CNN may learn important features during training,they don't need to be manually feature designed.By feeding it data,you can utilize the pre-	**1)Data-Intensive Training--** CNN need a lot of training data before they can show off their amazing skills.The inability to easily acquire and prepare this data might hinder the technology's wider adoption.Because of this,there are currently just a handful high quality pre trained models like GoogleNet,VGG,Inception and AlexNet.Most of them are owned by multinational corporations. 2)**Adversarial Attacks**– Adversarial assault entail supplying the network with"poor"example(i.e.,photographs

	trained CNN to change the weights even if you are working on a brand new project.CNN will Adjust to the new objective. 3)**High Accuracy-** The state of the art NNs for categorizing images are not convolutional networks,as they are employed in image transformers.But the majority of applications and activities requiring image and video identification,as well as related tasks,CNN's have long held a monopoly.in terms of accuracy,they usually beat non convolutional NNs,especially when there are enormous quantities of data involved.	that have been slightly altered)in an effort tp lead to incorrect diagnoses.Even the slightest pixel change may drive a CNN nuts.Criminals,for instance,can sneak by the camera unobserved and avoid a CNN-based facial recognition system.
ANN	**1)Has an ability to work with incomplete knowledge-** After ANN training, the data can produce results even with little information. The significance of the missing data determines how much performance is lost in this situation. **2)Storing Information on the entire network-** The network as a whole stores information. Even if a little amount of data was lost in one place, the network still works. **3)Has fault tolerance-** An ANN's output is unaffected if one or more its cells are corrupt.This property makes the networks fault tolerant. **4)Gradual Corruption-** A network loses speed and performs worse over time.it doesn't seem like the network fault is corroding property. **5)Has the ability to make machine**	**1)Determination of proper network structure-** Artificial neural networks' structure is not predetermined by any explicit rule. To design a suitable network structure, knowledge and error are combined. **2)The Difficulty of Showing the problem to the network-** ANNs have the ability to process numerical data. It is necessary to convert an issue into numerical values before applying ANN to it. The performance of the network will be directly impacted by the display method selected here. This depends on the user's degree of expertise. **3)The duration of the network is unknown** – The network has been trained when its error on the sample is below a certain level. The results for this value are not optimal. **4)Hardware dependence –** ANNs, due to their structure, require computers with parallel processing power. As a result, the

	learning- Artificial neural networks learn from comparable occurrences and make decisions based on them. **6)Has Parallel processing capability-** ANN has the computational power to perform multiple tasks at once.	equipment's manifestation is contingent.

Table 3 Comparison of Approaches and Techniques

2.4 Tools and techniques

2.4.1 Photography

Total Body Photography (TBP), also known as mapping, is a technique used during routine skin examinations to identify instances with multiple nevi and changes in the lesions. TBP records and stores images using a computerized camera. Images are captured with a high-resolution or professional medium-format camera.

are obtained from the subjects by imposing the camera at various acts and postures of the subject in order to obtain correct findings. The mapping programme digitally reuses the image once it is captured. This software analyzes the sum of all the images. Following that, the software creates an interactive, stand-alone programme containing the patient's body map.

2.4.1 **Machine Learning**

Many advanced Image Processing styles influence Machine Learning Models such as Deep Neural Networks to transform images for a variety of tasks such as applying cultural pollutants, tuning an image for optimal quality, or enhancing specific image details to maximize quality for computer vision tasks.

Convolutional Neural Networks (CNN) take in an input picture and apply filters to it, learning to perform functions such as object identification, image segmentation, and classification.
Recent machine learning methods enable engineers to compound visual data piecemeal from picture editing.
We may utilize horizontal flipping, color space accruals, zooming, random cropping) or deep learning methods like Feature Space Augmentation & Autoencoders, Generative Adversarial Networks (GANs), and Meta-Learning for excellent as a dataset.

2.6 Chapter Conclusion

This chapter covered the many approaches we are using to identify each illness on the work table as it is now set up. We divided the illnesses into Artificial Neural Networks and Convolutional Neural Networks, specifically. Additionally, there are related technologies like Cellular Neural Networks, Deep Convolutional Neural Networks, and Hybrid Neural Networks. Following that, we briefly went over what artificial neural networks and convolutional neural networks are, what they're used for, and how they operate.

Chapter 3: Methodology

3.1 Chapter Overview

Skin conditions and skin cancer seriously affect people's daily lives and health. This initiative suggests a practical method for locating certain skin conditions and skin cancers. The creation of a website is required to improve the simplicity of skin disease diagnosis for particular conditions. Initially, noise and unimportant backgrounds were taken out of skin photos using filtering and transformation. Images of various skin diseases' texture and color characteristics could be reliably determined. The experimental findings demonstrate the viability and efficacy of the suggested approach.

3.2. Research Methodology

The research approach can be broken down into two categories: deductive approach and inductive approach. The deductive approach aims to prove hypotheses based on the theories that already exist and test them to get the final conclusion. The inductive approach aims to generate new theories by collecting and analyzing data.
This project will be done using a hybrid deductive and inductive approach because there are theories and various implementations currently available in the field and also when it comes to some parts it needs to get to the conclusion by analyzing data

3.3. Development Methodology

The management or development team must select the software development methodology that will be most effective for the project at hand if they are to manage the project effectively.Every methodology differs in its strengths and weaknesses as well as the motivations for its creation. The most popular software development techniques are described below.

3.3.1Agile development methodology

The agile development methodology comes in a variety of forms, crystal, feature-driven development(FDD), extreme programming(XP) and including scrum. Agile software development's main advantage is that it enables iterative software releases and agile development methodologies focus on in the moment communication, thus new users
Frequently lack the necessary background information to get started.

3.3.2 Waterfall development methodology

The design, requirements, implementation, verification and maintenance phases of the waterfall development methodology each focus on a different objective. The waterfall development methodology process is simple to comprehend and administer due to its linear character. This method works well for projects with specific goals and consistent needs and this method's rigorous structure and stringent rules make it frequently expensive and slow.

3.3.3 Rapid application development methodology

Rapid application development methodology is a streamline development method that results in an efficient system at a high level of quality. In a market that moves swiftly and is always evolving, this development process enables our developers to quickly adapt to changing requirements. The requirements planning, user design, construction, and cutover phases make up the four stages of the rapid application development.The most successful projects for rapid application development are those that have a well defined business aim, a defined user group, and are not computationally complex.

A combination of the Waterfall and Agile methodologies was selected after researching the four development methodologies. Agile was chosen as the best methodology for the project because of its shorter time frame and Waterfall's structure

3.4 Design methodology

The creation of a system or approach for a specific circumstance is referred to as design methodology. The phrase is most commonly used in technological domains, such as web design, software design, and information system design. The design method outlines a number of phases and typically makes use of a set of notations or diagrams. There are approaches such as SSADM and OOAD, among others.

3.4.1 Object Oriented Analysis and Design Methodology (OOAD)

The Object-Oriented Analysis and Design technique will be better appropriate for this project. Object-Oriented analysis and design (OOAD) are frequently used in the creation of large-scale systems and applications, which frequently employ the Unified Modeling Language (UML).
OOAD analyzes the needs for a context using object-modeling techniques.

For instance, a system, a collection of system modules, an organization, or a business unit- and to develop a solution. Across requirements, design, implementation, testing, and deployment, most current object-oriented analysis and design approaches are use case driven.

Object Modeling,

Object modeling is the process of developing the static structure of a software system in terms of objects. It specifies the items, the classes into which they may be classified, and the relationships between them.
This will aid in the development of the doctor-patient connection through the use of the application.

Dynamic Modeling,

Following an examination of the system's static behavior, it is required to examine its behavior in respect to time and external changes. This is the purpose of dynamic modeling.
“
A method of specifying how an individual object responds to events, either internal events generated by the object or external events generated by the object.

According to Dynamic Modelling, "other objects or external events triggered by the outside environment."

Functional Modeling,

Functional modeling is the final phase in object-oriented analysis. The functional model depicts an object's internal actions as well as how data evolves as it travels between procedures.

It defines the procedures and activities of object modeling as well as dynamic modeling. This is the location of all the

Data flows to functionalities that state their purposes, and inputs and outputs are defined.

Conceptual Modeling,

Object-Oriented Analysis produces a description of what is to be produced, utilizing concepts and relationships between concepts, which is frequently described as a conceptual model.

Object-Oriented Design

Object-Oriented Design is an activity in which designers explore for logical solutions to problems by utilizing objects. Object-Oriented Design takes the conceptual model produced by Object-Oriented Analysis and adds implementation.

constraints imposed by the environment, the programming language, and the tools employed, as well as architectural assumptions chosen as the design basis The conceptual model's concepts, are translated to concrete classes and abstract interfaces, and their implementations for stable concepts are made available as reusable services. In object-oriented analysis, concepts identified as unstable will serve as the foundation for policy classes that make choices. The Object-Oriented Design process produces a detailed description of how the system can be created using objects.

Some key features need to performs when applying OOD,

- Generate an initial list of objects.
- Refine the responsibilities of each object.
- Detail the relationships between objects.
- Determine/create interaction points (the places where one object uses another).
- Build the model.

3.5 Evaluation methodology

In order to evaluate a project's effectiveness, efficiency, and impact, a methodology approach is taken. The proper procedures for gathering and evaluating data, as well as outlining the parameters of the assessment process, are covered in the topic follows.
Specific criteria must be taken into consideration while assessing the product's performance. The projected total accuracy, the longevity of the study, determining whether the project's purpose was reached, and determining if the item had an influence on the target market are some of the metrics included in this list.

3.6 Project Management Methodology

3.6.1 Waterfall Methodology

Waterfall model is a sequential model that divides software development into different phases. Each phase is designed for performing specific activity during SDLC phase.it was introduced in 1970 by Winston Royce.

Phases of waterfall Methodology

a) Requirements Gathering and analysis
b) System Design
c)Implementation
d)Integration of Testing
e) Deployment of Testing
f) Maintenance

3.6.2 Spiral Model

Spiral model is one of the most important software Development life cycle models,which provide support for risk handling.in its diagrammatic representation,its look like a spiral with many loops.The exact number of loop of the spiral is unknown and can very from project to project.each loop of the spiral is called a phase of the software development process.

The extra number of the phases needed to develop the product can be varied by the project manager depending upon the project risks.As the project manager dynamically determines the number of phases,so the project manager has an important role to develop a product using a spiral model.

The radius of the spiral at any point represents the expenses of the project so far,and the angular dimension represents the progress made so far in the current phase.

Phases of the spiral model

a) Determine objectives, alternatives, constraints
b) Evaluate alternatives, identify, resolve risks
c) Develop, verify next level product or engineering phase
d) Plan the next phases or evaluation phase.

3.6.3 Prototype Methodology

Prototype methodology is defined as a software development model in which a prototype is built, tested, and then reworked when needed until an acceptable prototype is achieved.it also creates a base to produce the final system.
Software prototype model works best in scenarios where the project's requirement is not known.it is an interactive, trial and error method which takes place between the developer and the client.

Phases of prototype methodology

a) Requirements gathering and analysis
b) Quick design
c) Built a prototype
d) Initial user evaluation
e) Refining prototype
f) Implement product and maintain

3.6.4 Agile Model

The meaning of Agile is swift or versatile. Agile model refers to a software development approach based on iterative development. Agile methods break tasks into smaller interaction or parts do not directly involve long term planning. The project scope and requirements are laid down at the beginning of the development process. Plans regarding the number of interactions, the durations and the scope of each iteration are clearly defined in advance.

Each interaction is considered as a short time "frame" in the agile process model, which typically lasts from one to four weeks. the division of the entire project into smaller parts helps to minimize the project risks and to reduce the overall project delivery time requirements analysis, design, coding, and testing before a working product is demonstrated to the client

Phases of Agile model

a) Requirements gathering
b) Design the requirements
c)Construction
d)Testing
e) Deployment
f) Feedback

3.7 Teamwork Breakdown Structure (WBS)

Work breakdown structure has been moved to Appendix Section for better clarity.

3.8 Gantt chart diagram

Work breakdown structure has been moved to Appendix Section for better clarity.

3.9 Usage of Project Management and Collaboration Software In the project

To successfully coordinate work and deadlines, a Microsoft meeting was built and used consistently throughout the project.

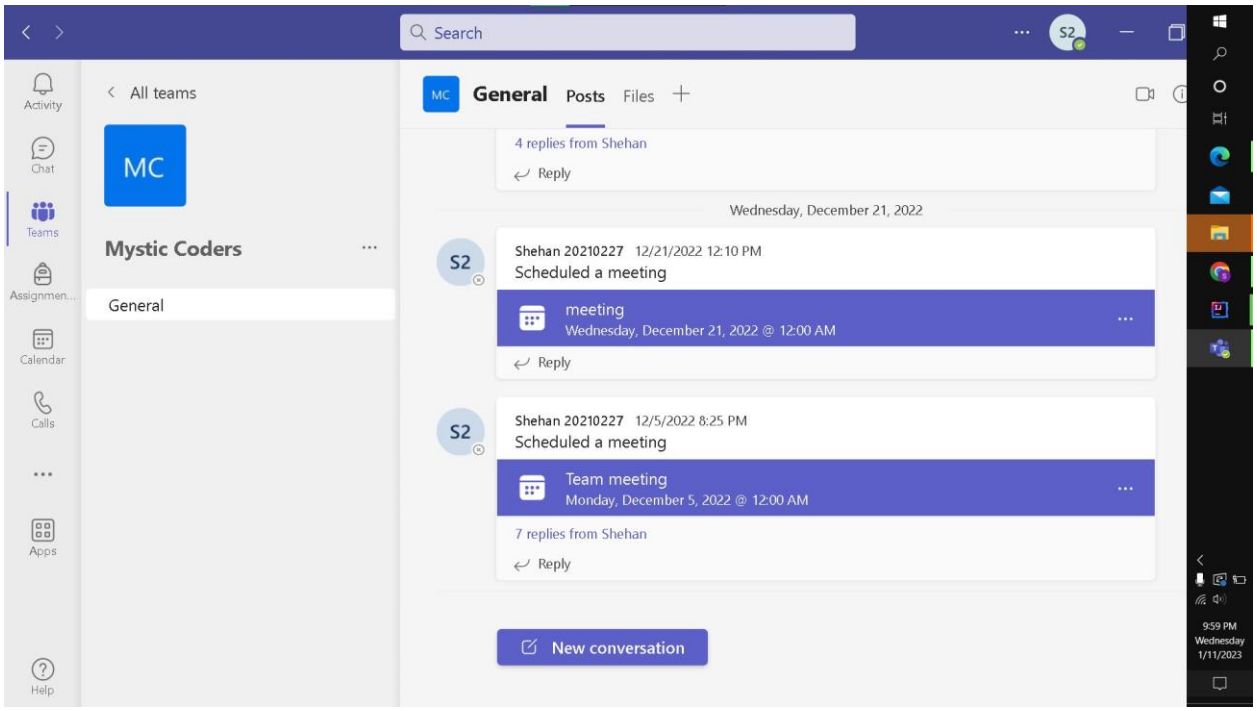


Figure 4 Project Management and Collaboration Software

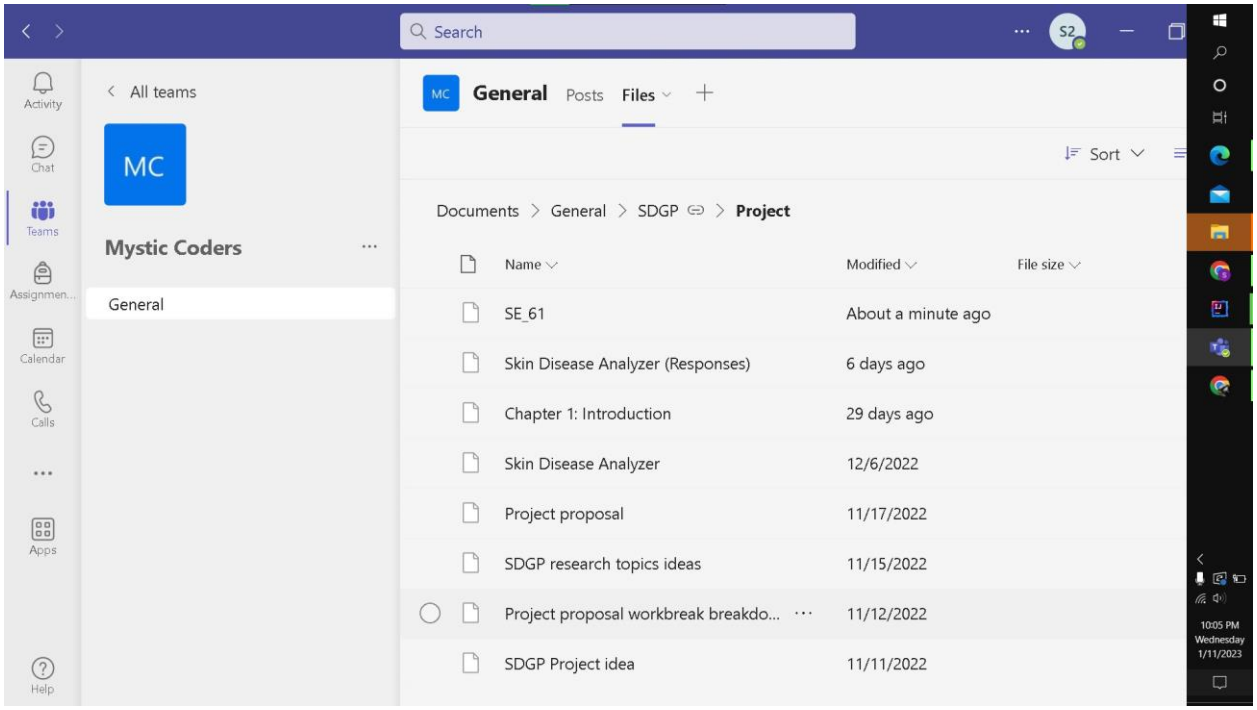


Figure 5 Project Management and Collaboration Software

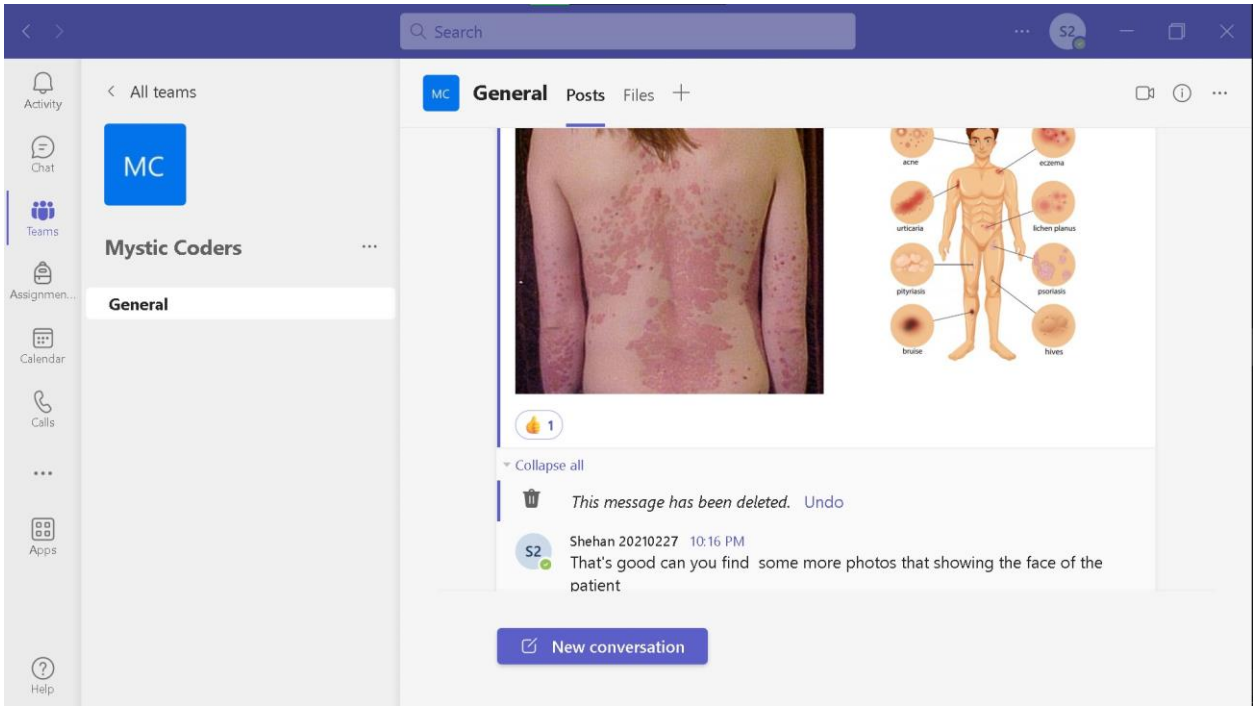


Figure 6 Project Management and Collaboration Software

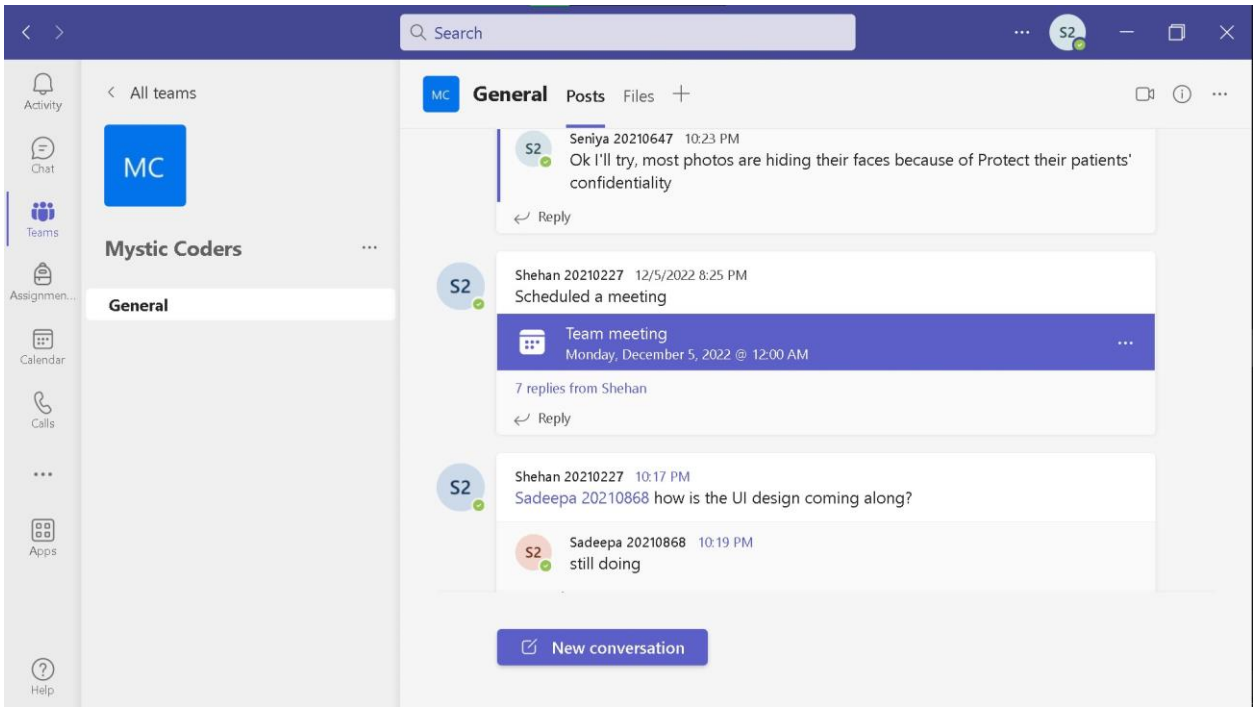


Figure 7 Project Management and Collaboration Software

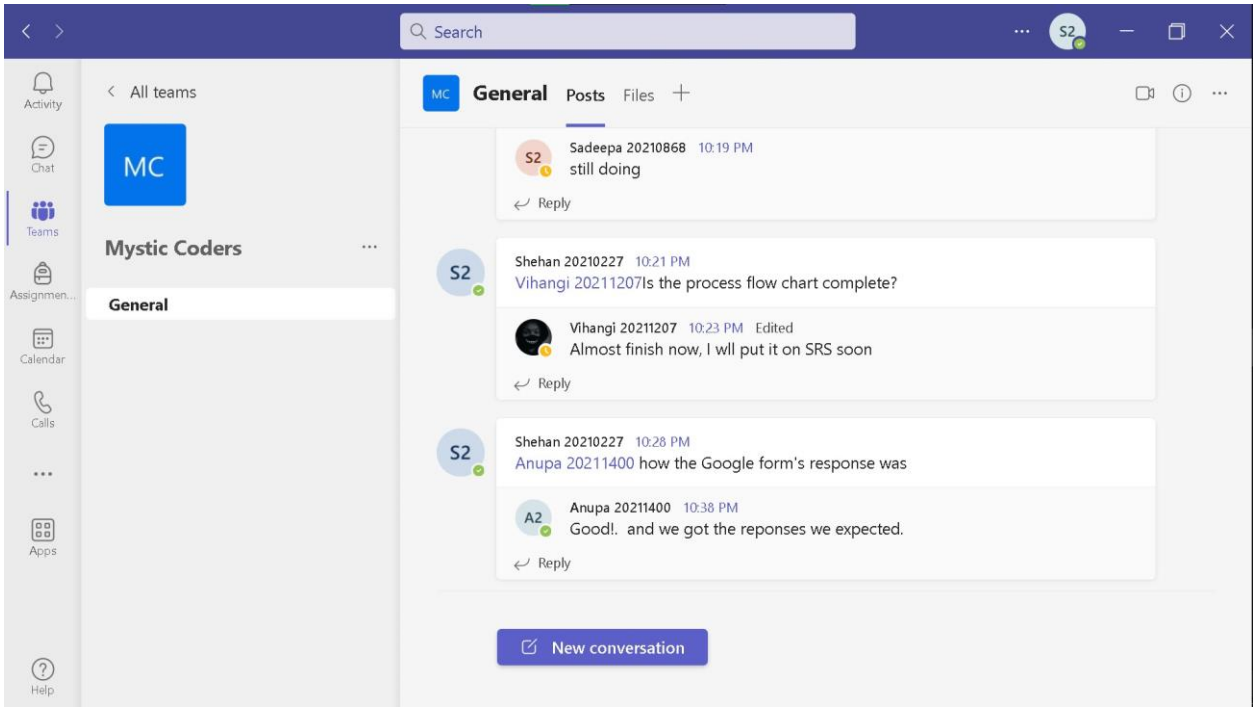


Figure 8 Project Management and Collaboration Software

Meeting Logs

21/10/2022 - 7.58 pm

1. Met each other
2. General discussion about project
3. Team name needs to be decided

10/11/2022 - 3.29pm

1. Everyone needs to think of 5 ideas each for next meeting

12/11/2022 - 4.29pm

1. Discussed everyone's ideas in detail
2. Find research papers in related topics

12/11/2022 - 7.57pm

1. Identify research components for everyone's ideas
2. Must finalize an idea soon

15/11/2022 - 12.01pm

1. Discussed research papers about the 2 ideas
2. Finalized one idea – skin diseases analyzer
3. Start writing the introduction chapter

19/11/2022 - 4.35pm
1. Start the project proposal

30/11/2022 - 7.55pm
1. Start on SDGP report

03/12/2022 - 6.525pm
1. Completed chapter 1

04/12/2022- 9.26pm
1. Start on chapter 2
2. Assign the work to the team members

05/12/2022 - 8.16pm
1. Discussion on how to do chapter 2

06/12/2022 - 11.02am
1. Discussion on how to do chapter 2
2. Assign all the chapter's work to the team

Table 4 Meeting log

3.10 Risks and Mitigation

Risk	**Mitigation**	**Frequency**
Being out of date is a risk that out comes with the introduction of new technologies	**Utilizing the internet and other resources, I try to update constantly. Remain in touch with experts in the field of dermatology.**	**Medium**
Due to unexpected events, it is possible to lose all or parts of the work that has already been completed	**Maintain a backup of your finished work and update it each time a change is made.**	**Medium**
Spending one project an excessive amount of time	**Consider alternatives as well, rather than committing**	**Medium**

	to a single method of completion	
The finished product cannot produce the desired outcome	**Before beginning the project, thoroughly research it and related tasks. Always have a fallback strategy in place for unreliable operations**	**High**

Table 5 Risks and Mitigation

3.11 Chapter Summary

The chapter concentrated on picking the best technique for the project. It describes design methodology, research methodology, and progress as well as the threats that the team had to take.

It also displays the equipment and programs that were utilized in this project, as well as how the labor was divided up.

Chapter 4: System Requirements Specification (SRS)

4.1 Chapter Overview

The preceding chapter concentrated on methodologies. This chapter is the Software Requirements Specification, which goes over the appropriate Stakeholder Analysis, Selection of Requirement Elicitation Techniques/Methods, Discussion/Analysis of Results, Use Case Diagrams, Use Case Descriptions, Functional Requirements, Non-Functional Requirements, and Use Case Diagrams, Use Case Descriptions, Functional Requirements, and Non-Functional Requirements.

4.2. Stakeholder Analysis

4.2.1. Onion Model

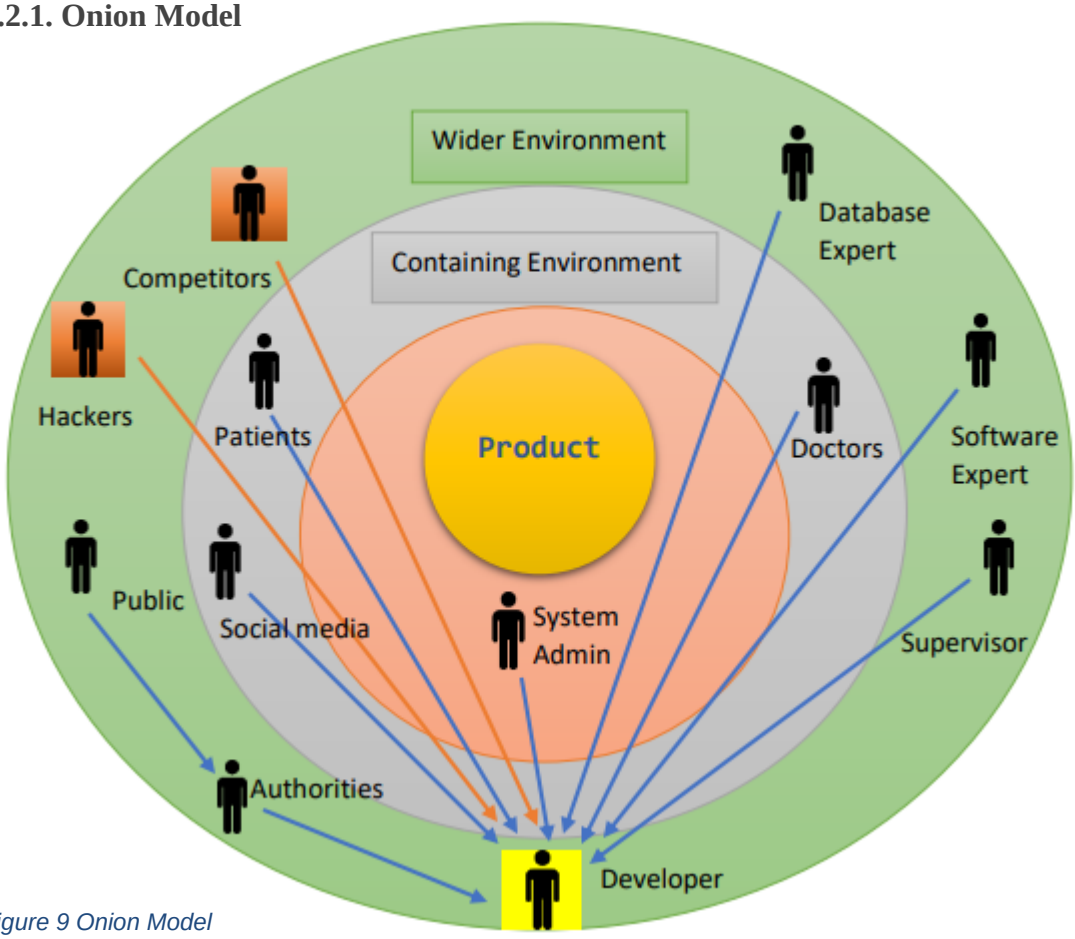


Figure 9 Onion Model

4.2.2. Stakeholder Descriptions

Stakeholder	**Viewpoint**
Functional beneficiary	
Patients	The system will be used to identify skin diseases
Social beneficiary	
Public	Aids in determining how people will feel about the system
Financial beneficiary	
Doctors	Earn benefit financially from supplying their services through the program.
Operational beneficiary	
System Admins	Will design and implement the architechture of the product , maintain and update.
Supervisor	Needs the programmer to build the product in accordance with the required specifications.
Negative Stakeholders	
Competitors	Plans to make a system that operates better than or surpasses the mentioned item/system
Hackers	Intends to stop the program from functioning as it should.
Regulatory	
Authorities	Regularly monitor this program to see if it contains certain wrong info

Experts	
Database Expert	Aims to assist programmers in manipulating large datasets.
Software Expert	Want to assist the programmers in improving and eliminating bugs from the system.
Neighboring systems	
Social Media	Aids in publishing the program and gaining publicity for it

Table 6 Stake Description

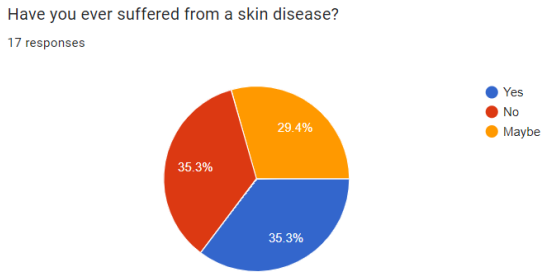
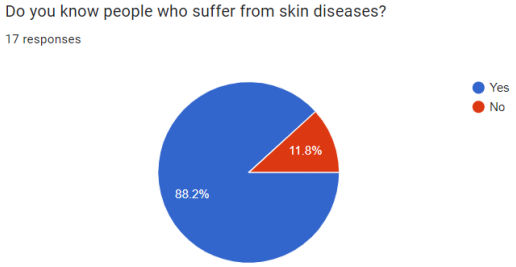
4.3. Selection of Requirement Elicitation Techniques/Methods

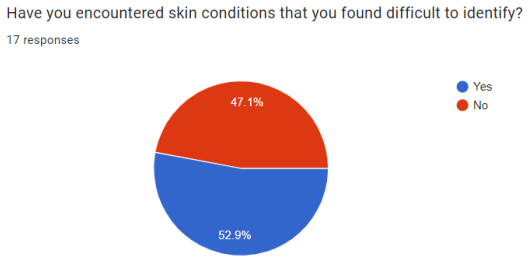
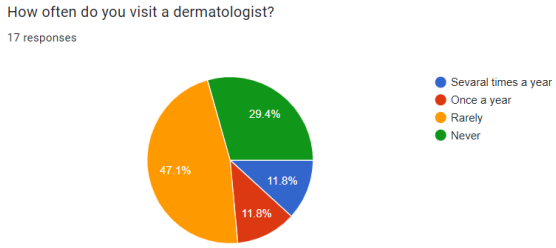
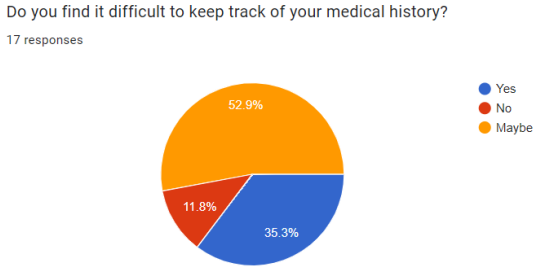
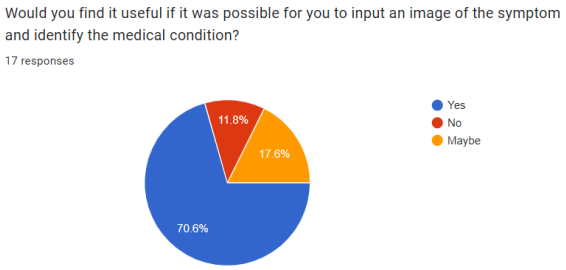
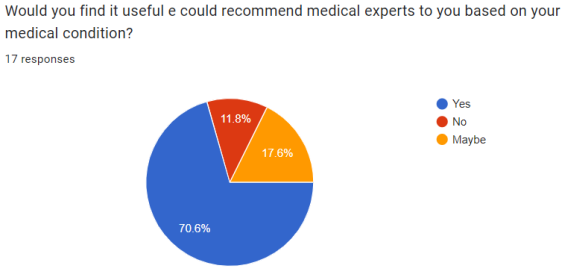
Requirement Elicitation Techniques/Method	**Description**
Questionnaire	**Description**-A Questionnaire is research instrument that consist of a set of question or other type of prompts that aims to collect information from a respondent. A research questionnaire is typically a mix of close ended questions offer the respondent the ability to elaborate on their thoughts
Literature Review	**Description-**if you must write an undergraduate dissertation, you may be required to begin by writing a literature review. A literature review is a search and evaluation of the available literature in your given subject or chosen topic area.it documents the state of the art with respect to the subject or topic you are writing about.
Brainstorming	**Description**-Brainstorming is a method of generating ideas and sharing knowledge to solve a particular commercial or technical problem, in which participants are encouraged to think without interruption. Brainstorming is a group activity where each participant shares their ideas as soon as they come to mind.

Interviewing	**Description**-An interview is a structured conversation where one participant asks questions and the other provides answers. In common parlance the word "interview" refers to a one-on-one conversation between an interviewer and an interviewee.
Observation	**Description**-Observation is a method in which a person observes behavior to note change in people or places typically as the results of an intervention. Most simply it is learning through observing and documenting.
Prototyping	**Description**-Prototyping is an experimental process where design teams implement ideas into tangible forms from paper to digital. Terms build prototypes of varying degrees of fidelity to capture design concepts and test on users. With prototypes, you can refine and validate your designs so your brand can release the right products.

Table 7 Selection of Requirement Elicitation Techniques/Methods

4.4. Discussion/ Analysis of Results

Question and Result	Analysis
	**29.4% of people think they might have had a skin disease, while 35.3% claim they have personally had one. This implies that 64.7% of people who responded to the survey as a whole may have experienced skin problems.**
	**88.2% of responders said "Yes" indicating that many people are aware of others who have experienced this.** **It is clear from the answers to the previous question and the results that many people have experienced skin conditions.**

	**The answers to this query were balanced. This led to the discovery that although 52.9% replies claimed they had not encountered circumstances that were challenging to recognize, 52.9% persons has.**
	**The majority of responses were rarely visit. Once a year and several times a year being the least frequent answers and equal.**
	**A majority of 88.2% said 'Yes' and occasionally, while 11.8% of respondents said it is not difficult for them to remember their medical history.**
	**Together the "Yes" and "Maybe" responses accounted for 88.2% of the total responses. This demonstrates the wide appeal of such a feature.**
	**88.2% of respondents said it would be helpful.**

	**The majority of respondents said "yes" indicating that they believe having the choice to stay anonymous in such a system would be beneficial**

Table 8 Discussion/ Analysis of Results

4.5. Use Case Diagram

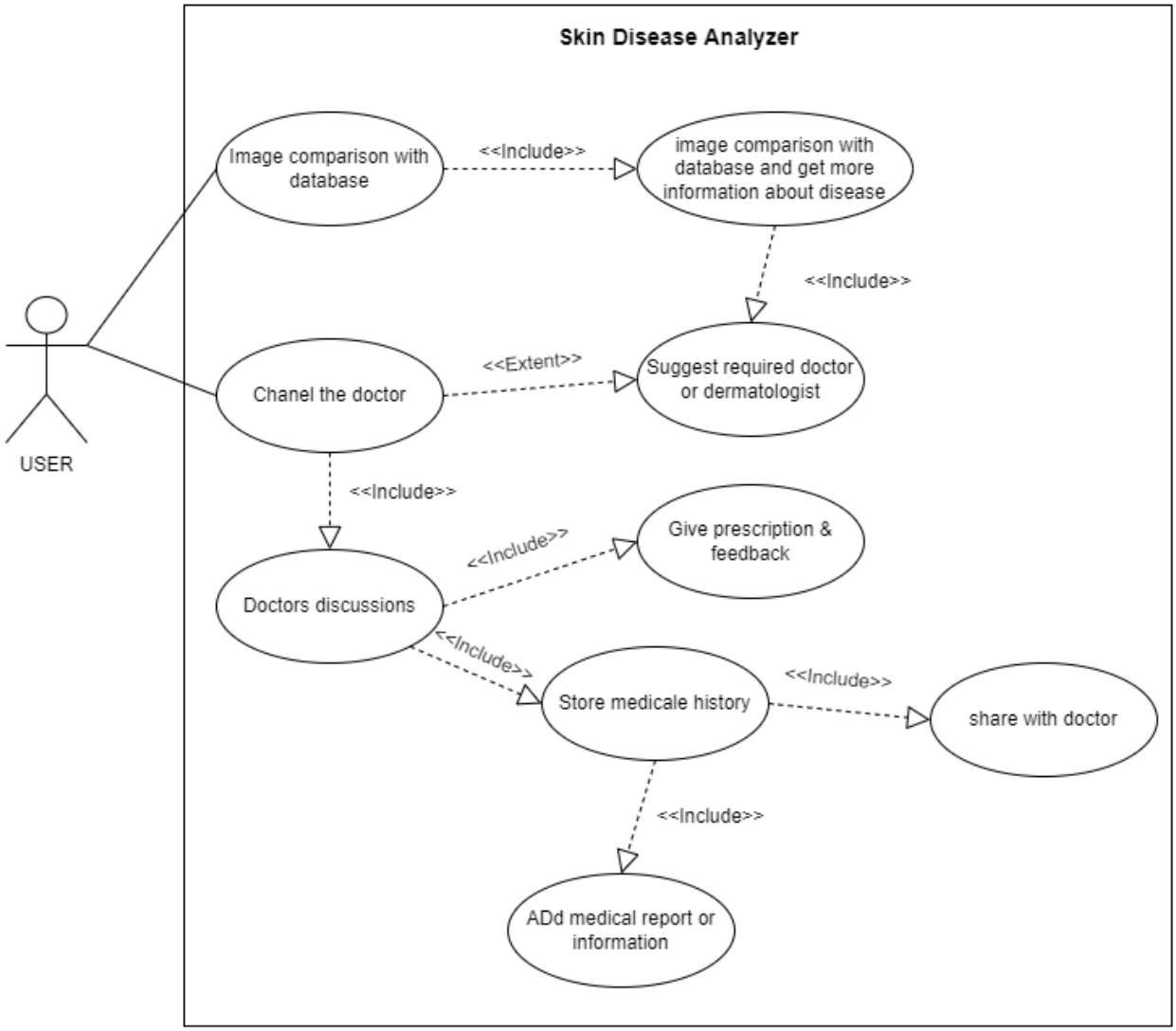


Figure 10 Use Case diagram

4.6. Use Case Descriptions

4.6.1 Capture & Upload Image – Use case description

Use Case Name	**Capture & Upload Image**	
Use Case ID	**UC-01**	
Description	**taking skin disease photographs, which is the system's fundamental input,**	
Priority	**High priority**	
Primary Actor	**User**	
Pre-Condition	● **Clear and appropriate graphic quality should be present in the photographs.** ● **Images should not include any filters and are taken in proper lighting conditions.** ● **Image capturing must be done with the proper angel.**	
Trigger	**Please upload or capture a picture.**	
Main flow	**Actor**	**System**
	1. **Log in using your log-in information to the online application.** 2. **Upload an image to the device or take a picture with the device's camera.**	**Display the dashboard** **Processing the uploaded image using the system database**
Exception flow	**Actor**	**System**
	1. **The user logged into the online application.** 2. **A user enters an image in an unsupported format.** 3. **A user enters an image in**	1. **The system will display a home page dashboard.** 2. **The system will pop up an error message.** 3. **The system will accept the**

	the correct format. **4. A picture with a beauty filter or other color filter is entered by the user.** **5. A picture without a beauty filter or other color filter is entered by the user.**	**image.** **4. The system will pop up an error message.** **5. The system will accept the image.**
Alternate flow	**Actor**	**System**
	1. The user logged into the online application. **2. The user will upload a picture with a poor internet connection** **3. The user will upload a picture with a proper internet connection**	**1. The system will display a home page dashboard.** **2. The system will not receive the uploaded picture** **3. The system will receive the picture**
Exclusion	**None**	
Post condition	**Image will store in database for processing**	

Table 9 Capture & Upload Image

4.6.2 Recognizing skin disease – Use case description

Use Case Name	**Recognizing skin disease**
Use Case ID	**UC-02**
Description	**Processing user input image with the dataset in the system database**
Priority	**High priority**
Primary Actor	**The system administrator**
Pre-Condition	**● Clear and appropriate graphic quality should be present in the photographs.** **● Images should not include any filters and are taken in proper lighting conditions.** **● Image capturing must be done with the proper angel.**
Trigger	**Comparison process**

Main flow	**Actor**	**System**
	The user may examine the doctor's advice while also seeing the probabilities of the conditions.	**The system will export the image's data-set findings.**
Exception flow	**Actor**	**System**
	A user can take another picture or post it again. **Using a reliable internet connection, the user can re-try again.**	**The system process the latest uploaded image** **The system is connected to a proper internet connection**
Alternate flow	**Actor**	**System**
	These web applications allow users to enter doctors' recommendations.	**"We can't recognize any symptoms or erroneous identification" will be shown by the system.**
Exclusion	**None**	
Post condition	**The system will suggest a qualified dermatologist or doctor and communicate with them.**	

Table 10 Recognizing skin disease

4.6.3 To keep medical records and provide prescriptions and feedback. – Use case description

Use Case Name	**To keep medical records and provide prescriptions and feedback.**
Use Case ID	**UC-03**
Description	**Save previous medical information (user provided and app use) and provide prescriptions or comments.**
Priority	**Medium priority**
Primary Actor	**User & doctor**
Pre-Condition	**User allows access to save their medical history**

Main flow	**Actor**	**System**
	A user can recommend a certain doctor. Using the medical history tool, the doctor can provide comments.	**A referral will be delivered by the system using end-to-end encryption. The system will produce and store feedback over time.**
Post condition	**If a doctor requests it, a patient can reupload any type of medical record and share it with them online.**	

Table 11 To keep medical records and provide prescriptions and feedback.

4.7. Functional Requirements (with prioritization)

Requirements		**Description**	**Priority level**
1	**Getting the image as a processing input**	**Use the app's camera to take a picture or upload an image to the app to help it process and identify the disease,**	**Critical**
2	**Image processing to detect the disease**	**Giving a reliable disease detection conclusion after processing the input image**	**Critical**
3	**Recording medical information for future reference**	**Making a note of medical information for future consultation.**	**Desirable**
4	**Recommending a doctor based on the user's requirements**	**According to the results of the skin disease detection, a consultant will be suggested.**	**Desirable**
5	**Get new medical report**	**This will make it easier to obtain a medical report online using the application without physically visiting a**	**Desirable**

		hospital	
6	**Feedback**	**This will provide a prescription via the app without the need to physically visit a hospital.**	**Desirable**
7	**Review of consultants**	**This will confirm that the consultant is a qualified physician employed by the hospital system.**	**Luxury**

Table 12 Functional Requirements

4.8. Non-Functional Requirements

Non-functional requirements are a set of specifications that describe the system's operation capabilities and constraints and attempt to improve its functionality. These are basically the requirements that outline how well it will operate including things like speed, security, reliability, data integrity, etc.

- Security
  The past records of the users should only be visible to them. And only the user can share the records with the doctor when needed.

- Accuracy
  The overall input accuracy should be high for the product satisfaction.

- Usability
  The application should be both user friendly and very easy to use

- Capacity
  There should be a storage allocated to every user (Both patient and doctor)to store the past records as well other information needed.

- Reliability
  The application is fully bug-free, does not cause downtime, and works flawlessly in all scenarios.

4.9. Chapter Summary

The chapter on System Requirements Specification first discusses how this skin disease detection system collaborates with external parties as stakeholders when implementing its features. This chapter describes in depth the user capabilities and the team's various approaches. To determine the problem domain, project scope, and solutions. The project objectives were also identified and thoroughly addressed. This chapter also includes detailed descriptions of each feature, as well as use cases divided into functional and non-functional needs. Methods for gathering information and knowledge are also discussed, along with their advantages and disadvantages.

Chapter 5: Social, Legal, Ethical, and Professional Issues

5.1. Chapter Overview

The collecting of data sets for the research, as well as the collection and analysis of personal data, presents more significant ethical legal,, and societal issues. We will be concentrating on the social, legal, Ethical and Professional concerns encountered when conducting the study for this project in this chapter. This chapter discusses each sort of problem and how to fix it.

5.2 Social Issues

The questionnaire stated in chapter 4 was administered in an anonymous manner in order to protect the privacy of individuals who responded. Thus, it was guaranteed that their security and privacy would be protected. Public and environmental safety were prioritized during project execution. Therefore, it was essential that the initiative under consideration did not contravene any existing norms of behavior.it has been shown that the dataset utilized does not fairly represent the demographics of several races and ethnicities, though. The addition of photos representing other races and ethnicities has been introduced as a potential improvement in the future.

5.3 Legal Issues

There are a variety of legal issues that surround the skin disease system. When developing this application, data protection regulations were considered.
The dataset was downloaded and used since it was released under the Creative Commons public license. The dataset was tampered with or modified in some way. It wasn't even used for illegal activities. UOW-licensed tools and open-source software are employed. The personal information of the users was not acquired through the questionnaires that were distributed. The gathered information was kept confidential, and the users' privacy was maintained. The poll participants' identities were kept anonymous. The information acquired is purely for the aim of increasing the performance and efficiency of the decision-making engine.

5.4 Ethical Issues

There are a variety of ethical issues that surround the skin disease system. Some of these issues are related to the patient's right to privacy , while others focus on the need for informed consent from the patient and their family members. The user's or the patient's consent is necessary before requesting the image to diagnose any condition. The user should be fully aware of detection and how it will work. A user may still submit and assess whether skin is healthy if they want to participate anonymously. However, consumers won't be able to utilize the other products, like calling a consultant or anything familiar.

5.5 Professional Issues

Gathering the required dataset for the project was our main professional challenge. First, we contact local experts in the field who specialize in treating skin diseases, such as doctors and dermatologists, here some issues have arisen while contacting and gathering the required information from the doctors, but we contacted the through emails and telephone calls first then we went to meet them to gather some information for the project. With the strict policies, we couldn't get much information, but they have given us valuable guidelines to follow while doing the project.
After that, we researched the internet for the required dataset for the project and found some sources that have the dataset that we needed but some of them had some copyright issues, therefore, we clarified them first and collected the necessary information we needed**.**

5.6. Chapter Summary

The project was carried out with the publics and the environment's welfare at the center, taking social issues into consideration. The questionnaire stated in chapter four was administered in an anonymous manner to protect the privacy of individuals who responded. It has been determined that the dataset utilized does not fairly represent the demographics of several races and ethnicities. The data collected in legal issues is only used to increase the effectiveness and performance of the decision-making engine. The questionnaires that were distributed did not gather any personal data about users. While using the publicly accessible Kaggle (Data science company), the terms of use and conditions were carefully considered. Regarding moral concerns, consent from the user is obtained before requesting that the image be used to identify

any disease. A user can still upload and assess whether the skin is healthy if they want to participate anonymously. However, consumers won't be able to use our other services, like calling a consultant or anything similar. Finally, when thinking about professional difficulties, it was necessary to speak with the experts in the field including doctors and dermatologists to obtain the datasets needed for the project. We initially reached out to them via phone calls and emails. Then we met with them and gathered the data we needed for our project. The biggest challenge was reaching out to them and obtaining the required information from them.

Chapter 6: System Architecture & Design

6.1. Chapter Overview

The architecture of a system describes its key elements, their connection (Structures),and their interactions. Software architecture and design should take into account a company strategy, quality attributes, human dynamics, design, and it environment. There are two stages to software architecture and design, software architecture and software design.in architecture, functional requirements cast and divide nonfunctional consideration. The design satisfies the functional specifications. We shall thus concentrate on system architecture and design in this chapter.

6.2. System Architecture Design

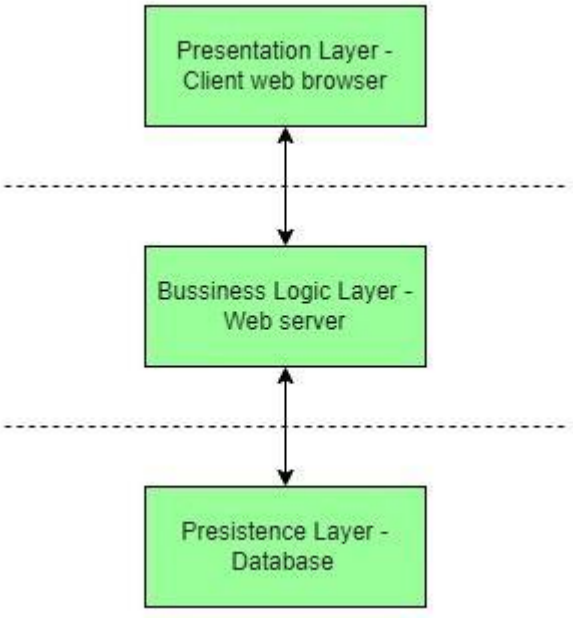


Figure 11 System Architecture Design

6.3. System Design

6.3.1. Class Diagram

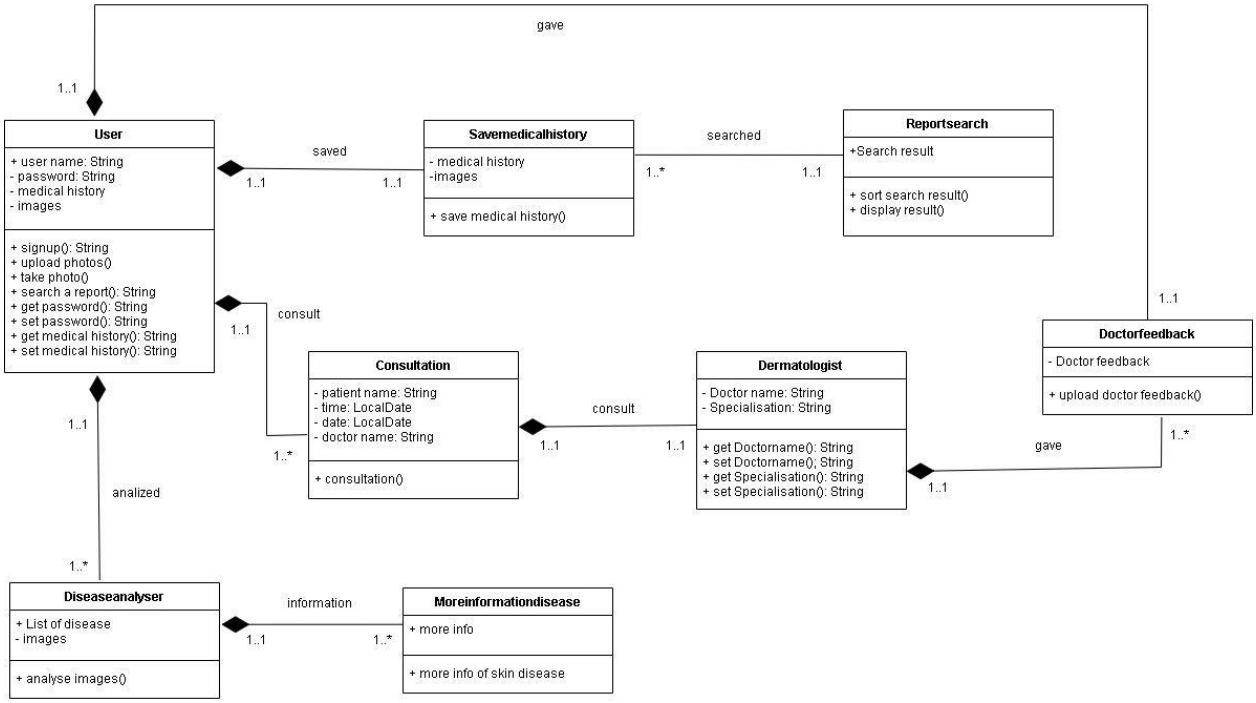


Figure 12 Class Diagram

6.3.2. Sequence Diagram

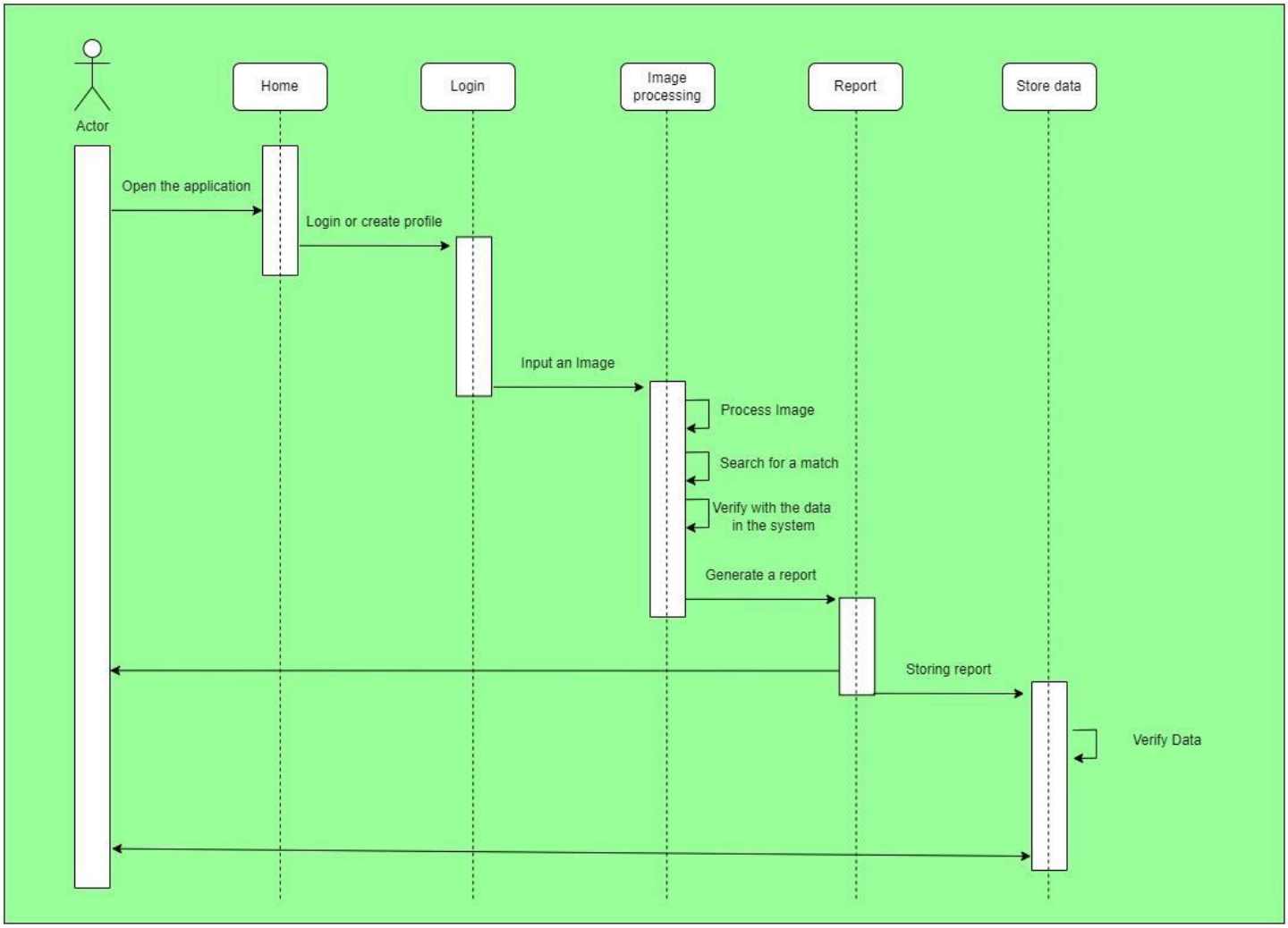


Figure 13 Sequence Diagram

6.3.3.UI Design – Use low fidelity wireframes/high fidelity prototype

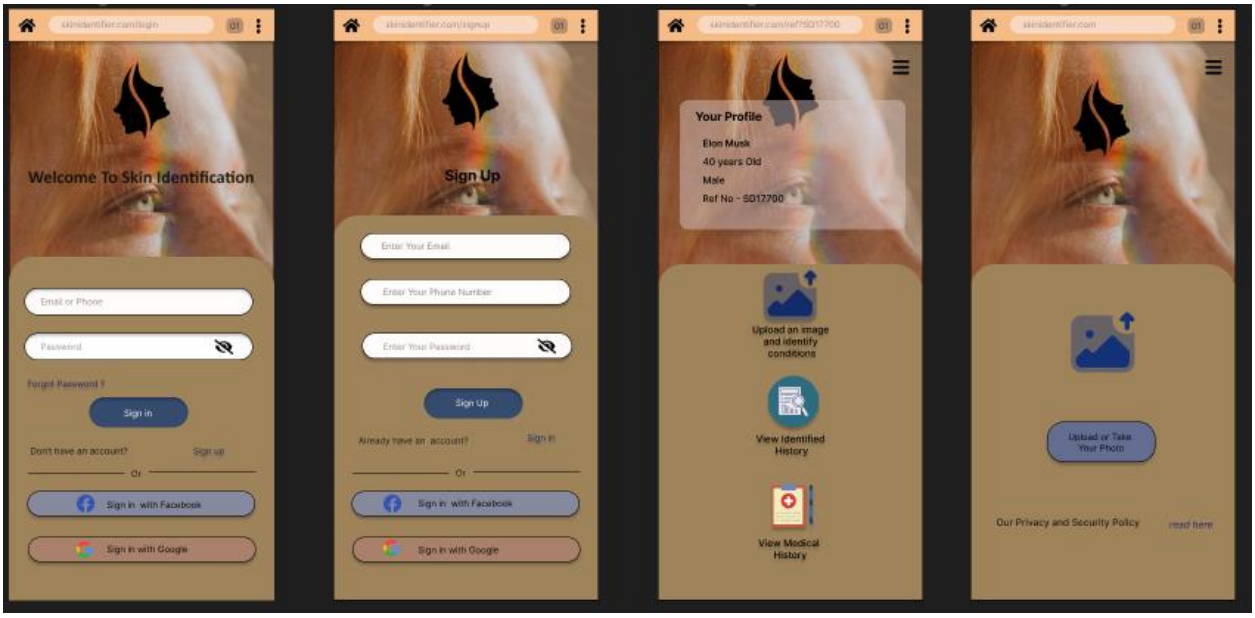


Figure 14 UI Design

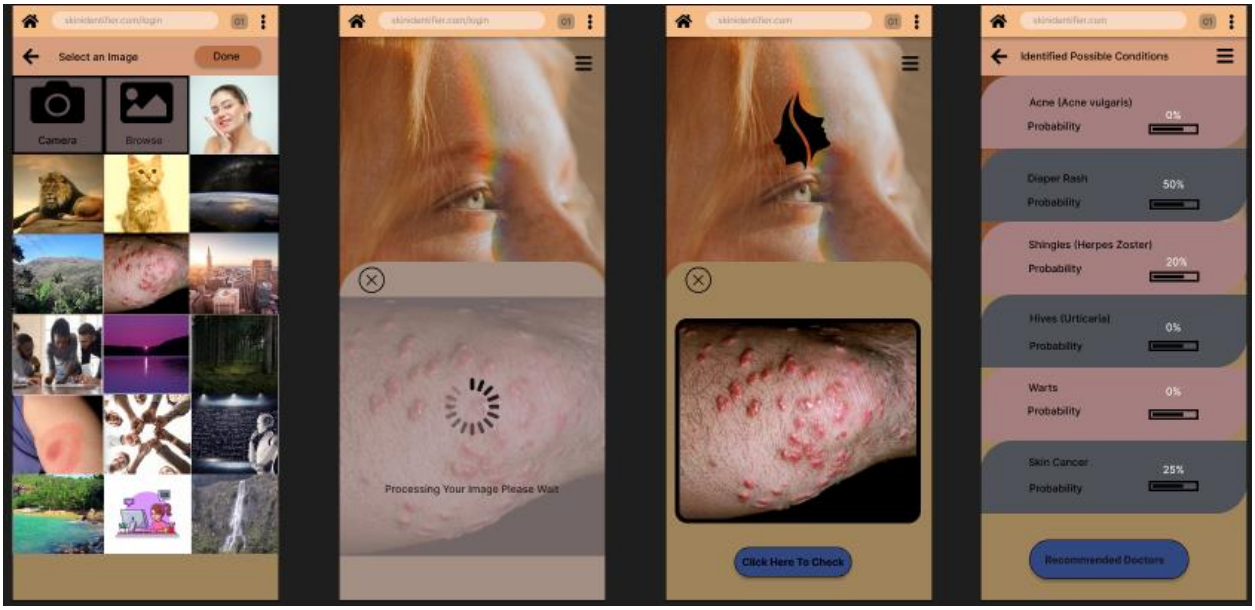


Figure 15 UI Design

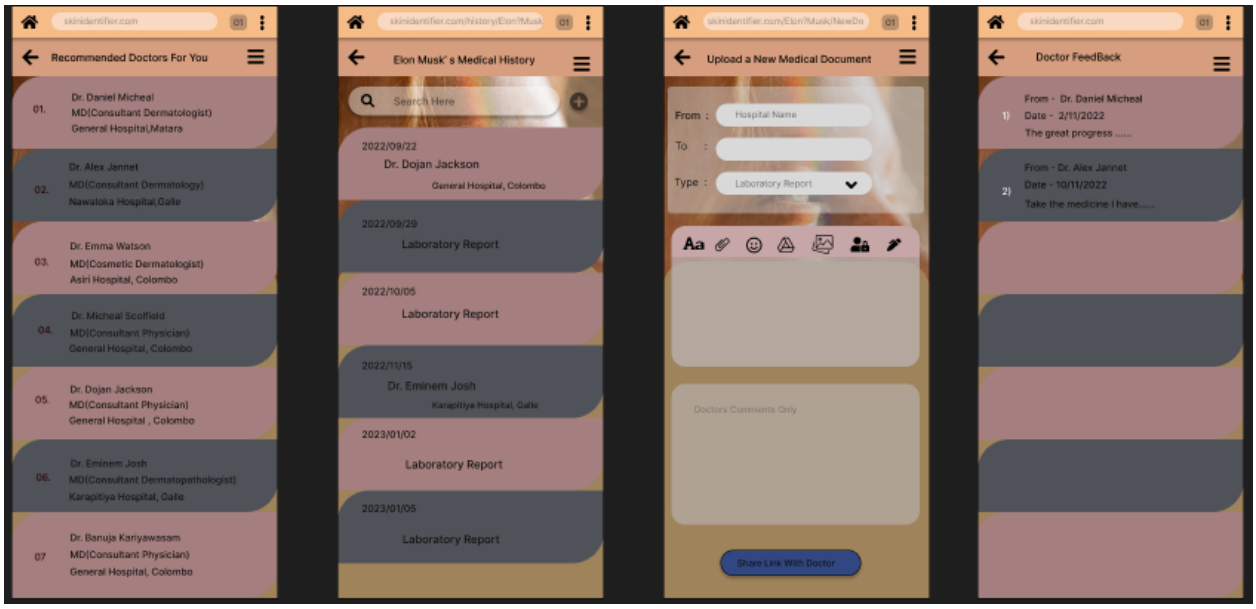


Figure 16 UI Design

6.3.4. Process flow chart – either use flowchart or activity diagram to describe system process flow.

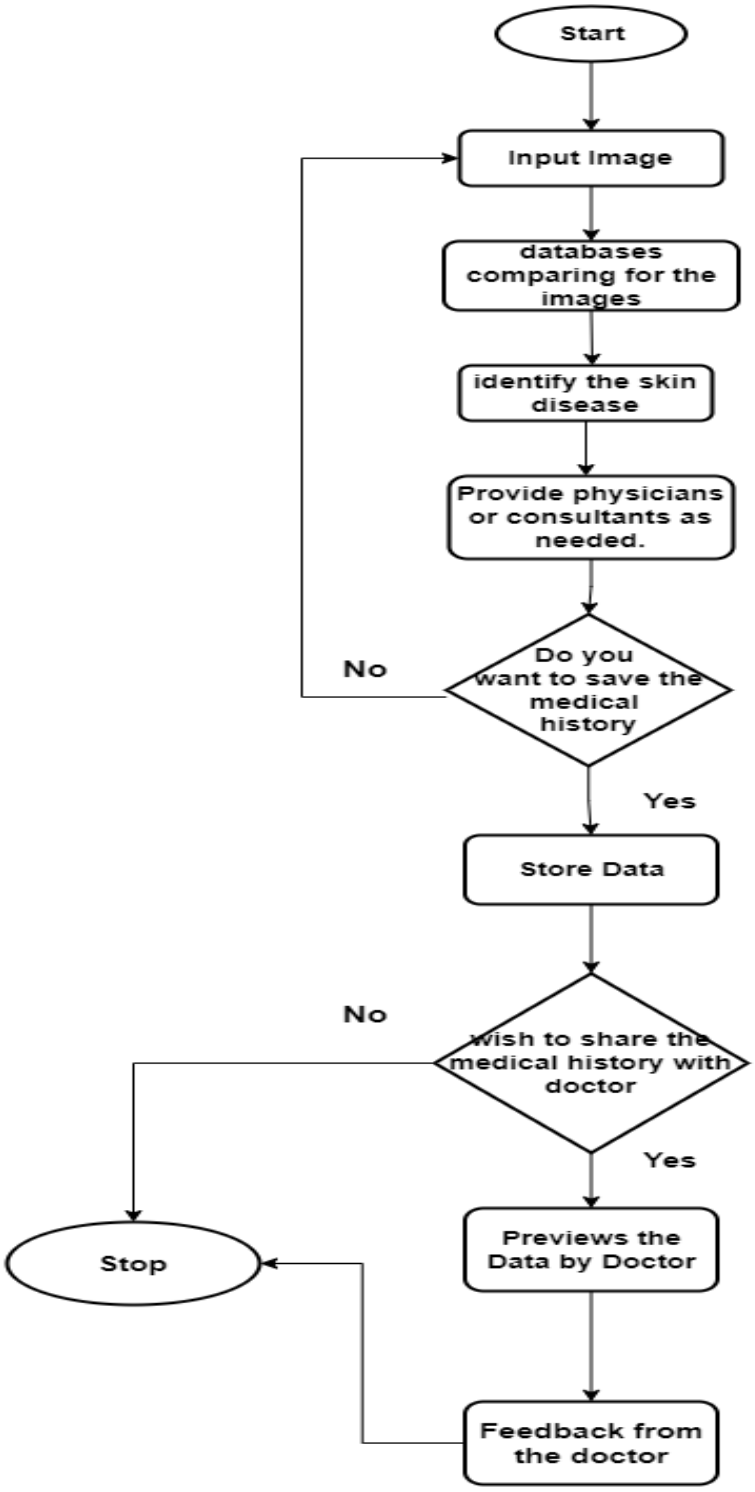


Figure 17 Process flow chart

6.4. Chapter Summary

We discussed system architecture and design in this chapter. The presentation layer, business logic layer, and persistence layer are the three fundamental levels of the architecture. The client web browser will act as the display layer, the business logic layer will be the web server, and the persistence layer will be the database. System design is the fundamental framework of the website, displaying the functionalities potential and bounds.

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Appendix

Work Breakdown Structure - Work Distribution

Topic	Member
Chapter 1: Introduction	
1.1 Chapter Overview	Shehan
1.2 Problem Background	
1.2.1 Feature Comparison Chart	
1.3 Problem Statement	
1.4 Research Gap	
1.5 Research Question/s	Shehan
1.6 Research Aim	Vihangi
1.7.1 Project In-Scope	
1.7.2 Out-Scope	Sadeepa
1.8 Rich Picture Diagram	Anupa
1.9 Objectives	Seniya
1.10 Proposed Solution	Seniya
1.11 Resource Requirements	Anupa
1.12 Chapter Summary	Shehan

Table 13 Work break down

Chapter 2: Literature Review	
2.1 Chapter Introduction	Shehan
2.2 Existing Work	Vihangi / Anupa
2.3 Existing Solutions to the Problem	
2.4 Research on Approaches and Techniques used in related domains	Sadeepa / Shehan / Seniya
2.5 Comparison of Approaches and Techniques	
2.6 The Selected Approach	Vihangi /Anupa
2.7 Tools and techniques	Seniya
2.8 Chapter Conclusion	Shehan

Table 14 Work break down

Chapter 3: Methodology	
3.1. Chapter Overview	Vihangi
3.2. Research Methodology	Shehan
3.3. Development Methodology	Anupa
3.4 Design methodology	Aeniya
3.5 Evaluation methodology	
3.6. Project Management Methodology	Sadeepa
3.7 Team Work Breakdown Structure (WBS)	
3.8 Gantt Chart description	Shehan
3.8 Gantt chart diagram	Sadeepa
3.9 Usage of Project Management and Collaboration Software In the project	Seniya
3.9 Meeting Logs	Shehan
3.10 Risks and Mitigation	Anupa
3.11 Chapter Summary	Vihangi

Table 15 Work break down

Chapter 4: System Requirements Specification	
4.1 Chapter Overview	Seniya
4.2. Stakeholder Analysis	Vihangi
4.3. Selection of Requirement Elicitation Techniques/Methods	Sadeepa
4.4. Discussion/ Analysis of Results	Anupa
4.5. Use Case Diagrams	Shehan
4.6. Use Case Descriptions	Shehan
4.7. Functional Requirements	Anupa
4.8. Non-Functional Requirements	Sadeepa
4.9. Chapter Summary	Seniya

Table 16 Work break down

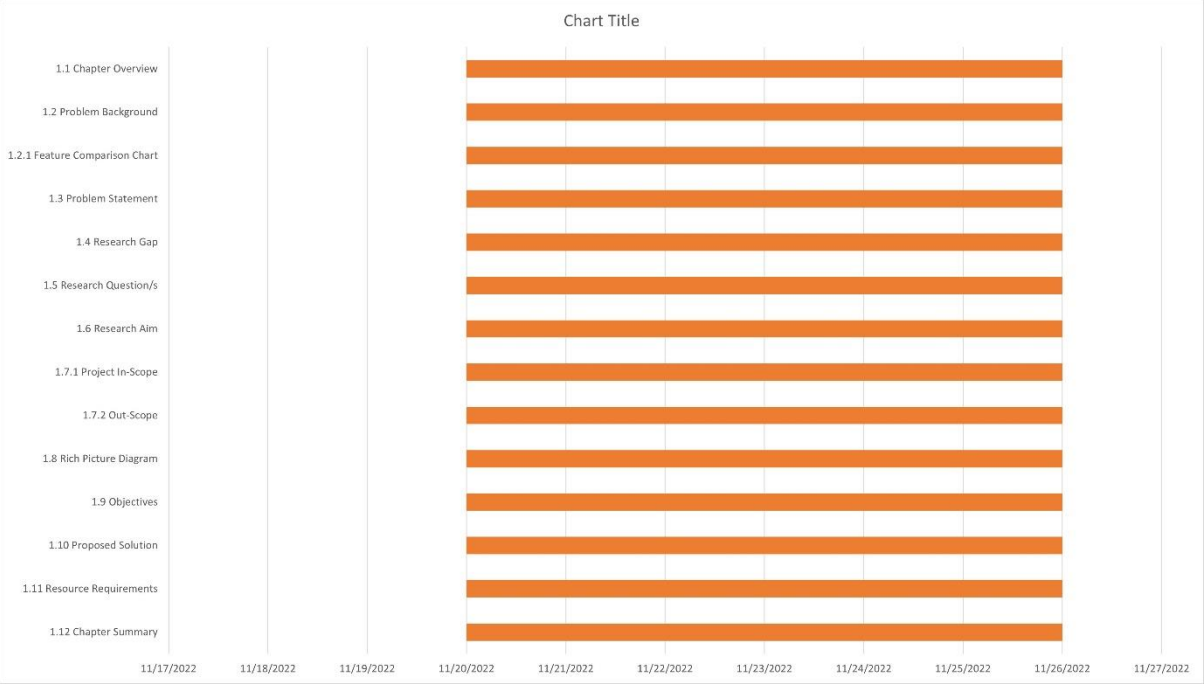
Chapter 5: Social, Legal, Ethical and Professional Issues	
5.1. Chapter Overview	Anupa
5.2 Social Issues	Sadeepa
5.3 Legal Issues	Seniya
5.4 Ethical Issues	Vihangi
5.5 Professional Issues	Shehan
5.6. Chapter Summary	Anupa

Table 17 Work break down

Chapter 6: System Architecture & Design	
6.1. Chapter Overview	Sadeepa
6.2. System Architecture Design	Shehan
6.3. System Design	
6.3.1. Class Diagram	Seniya
6.3.2. Sequence Diagram	Shehan/ Anupa
6.3.3. UI Design	team
6.3.4. Process flow chart	Vihangi
6.4. Chapter Summary	Sadeepa

Table 18 Work break down

Gantt Chart Diagram



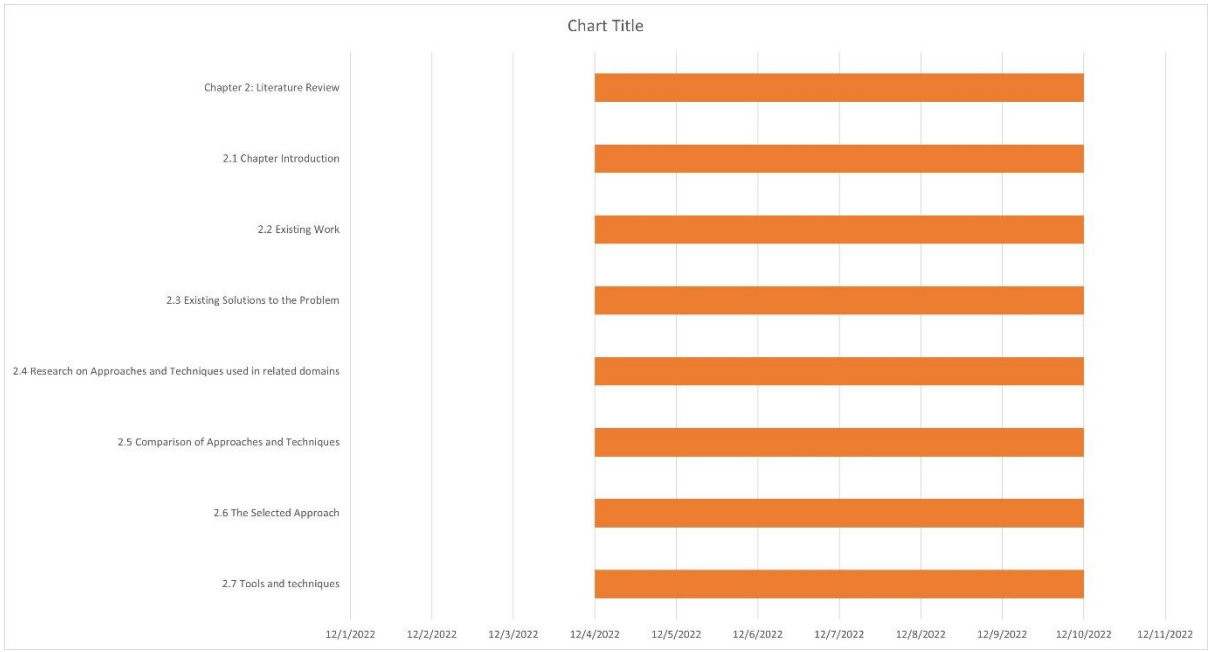


Chart Title
Chapter 2: Literature Review
2.1 Chapter Introduction
2.2 Existing Work
2.3 Existing Solutions to the Problem
2.4 Research on Approaches and Techniques used in related domains
2.5 Comparison of Approaches and Techniques
2.6 The Selected Approach
2.7 Tools and techniques
12/1/2022
12/2/2022
12/3/2022
12/4/2022
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12/11/2022

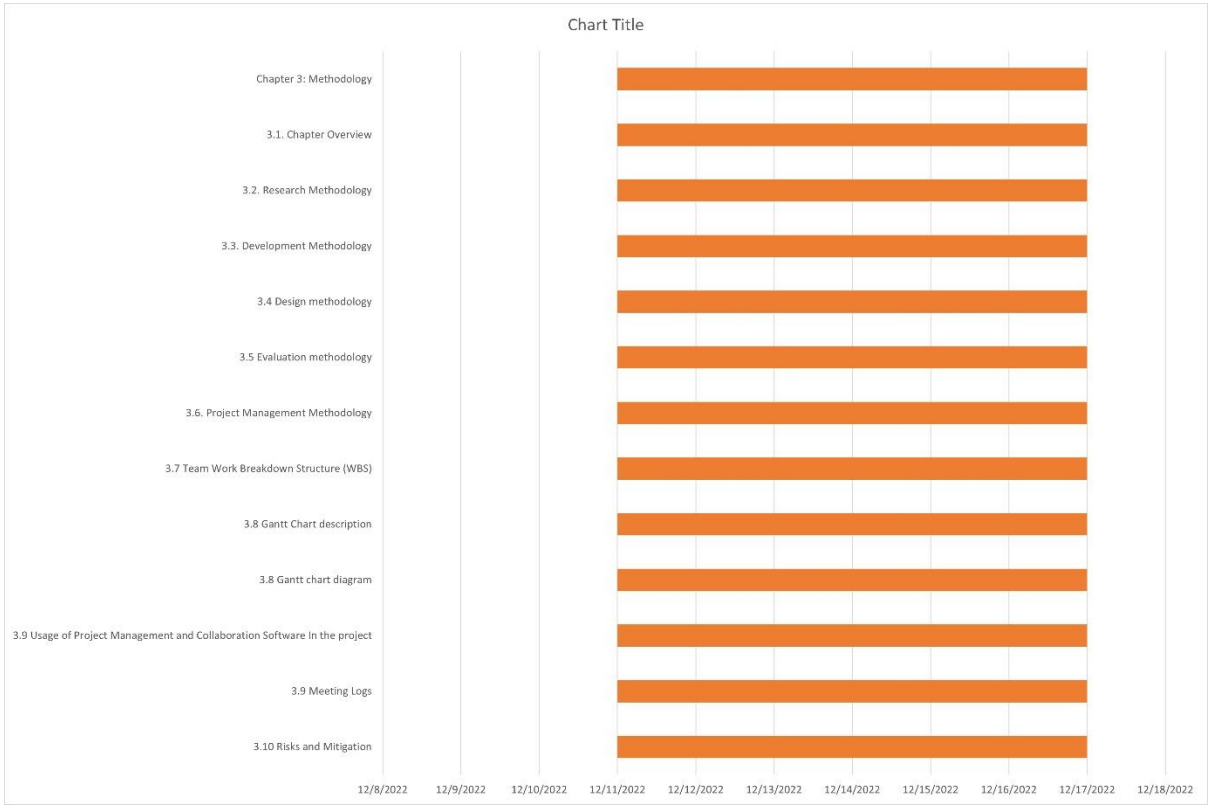
Chart Title
Chapter 3: Methodology
3.1. Chapter Overview
3.2. Research Methodology
3.3. Development Methodology
3.4 Design methodology
3.5 Evaluation methodology
3.6. Project Management Methodology
3.7 Team Work Breakdown Structure (WBS)
3.8 Gantt Chart description
3.8 Gantt chart diagram
3.9 Usage of Project Management and Collaboration Software In the project
3.9 Meeting Logs
3.10 Risks and Mitigation
12/8/2022
12/9/2022
12/10/2022
12/11/2022
12/12/2022
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12/16/2022
12/17/2022
12/18/2022

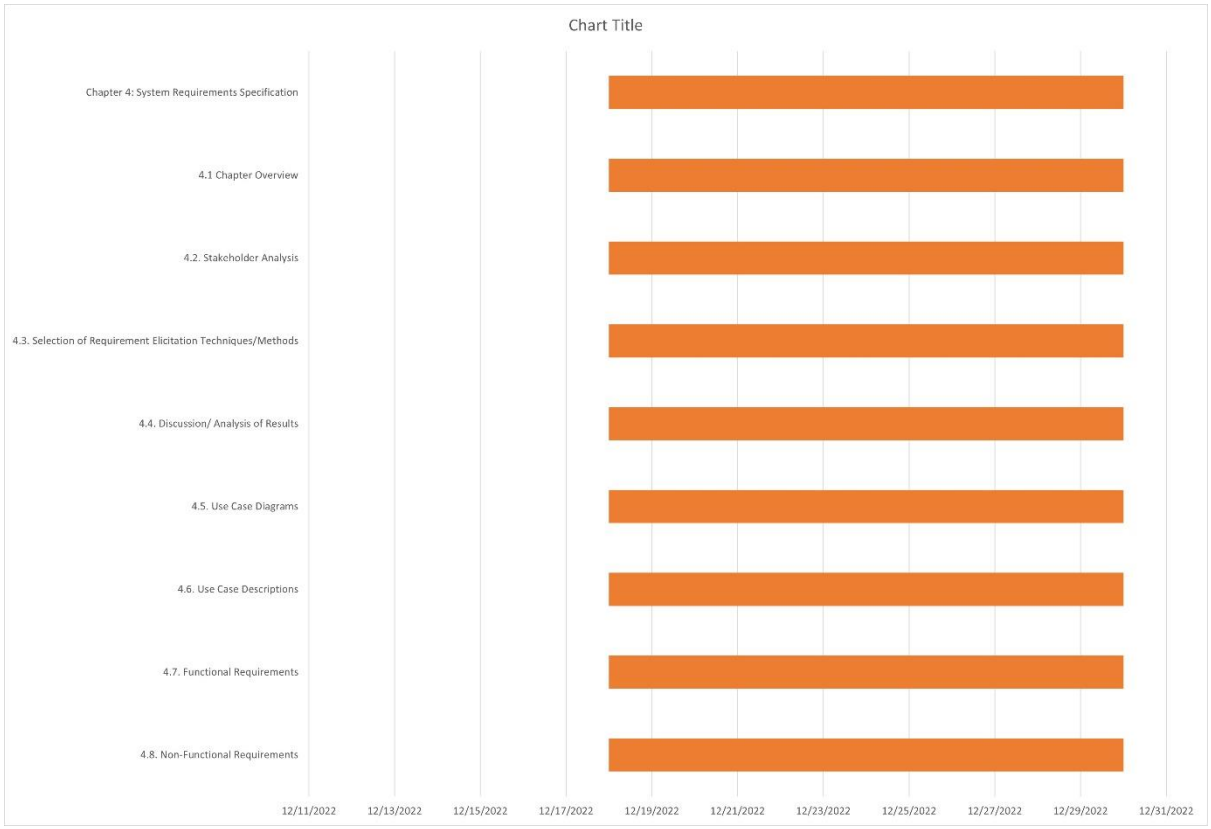
Chart Title
Chapter 4: System Requirements Specification
4.1 Chapter Overview
4.2. Stakeholder Analysis
4.3. Selection of Requirement Elicitation Techniques/Methods
4.4. Discussion/ Analysis of Results
4.5. Use Case Diagrams
4.6. Use Case Descriptions
4.7. Functional Requirements
4.8. Non-Functional Requirements
12/11/2022
12/13/2022
12/15/2022
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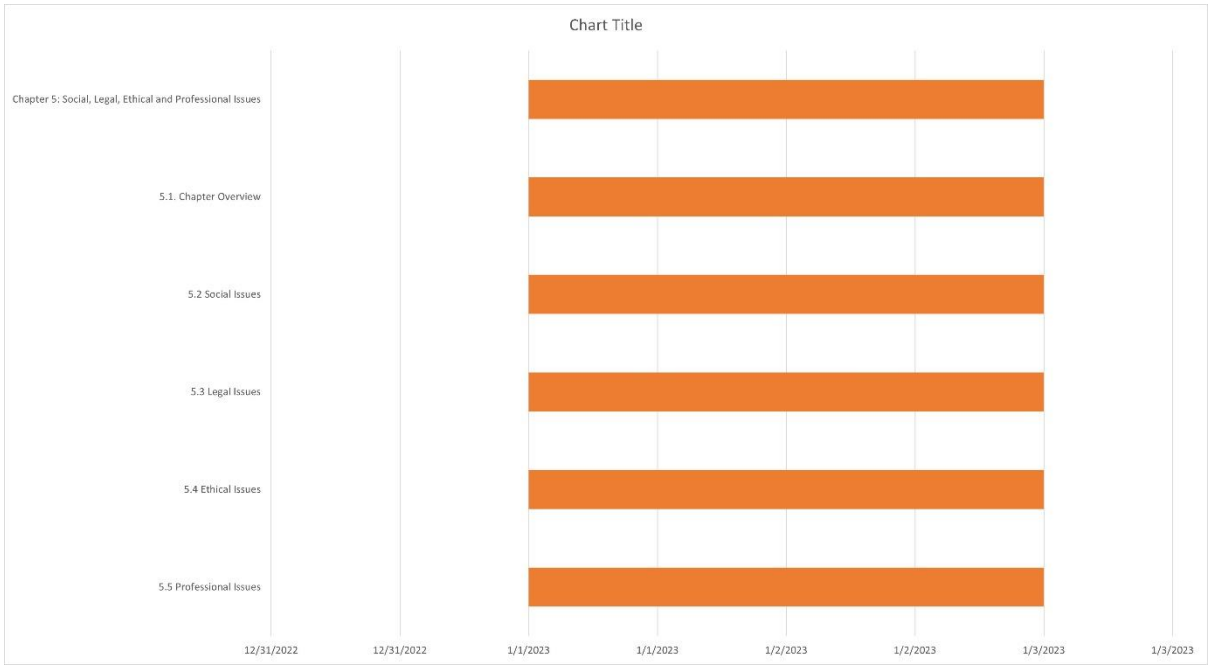
Chart Title
Chapter 5: Social, Legal, Ethical and Professional Issues
5.1. Chapter Overview
5.2 Social Issues
5.3 Legal Issues
5.4 Ethical Issues
5.5 Professional Issues
12/31/2022
12/31/2022
1/1/2023
1/1/2023
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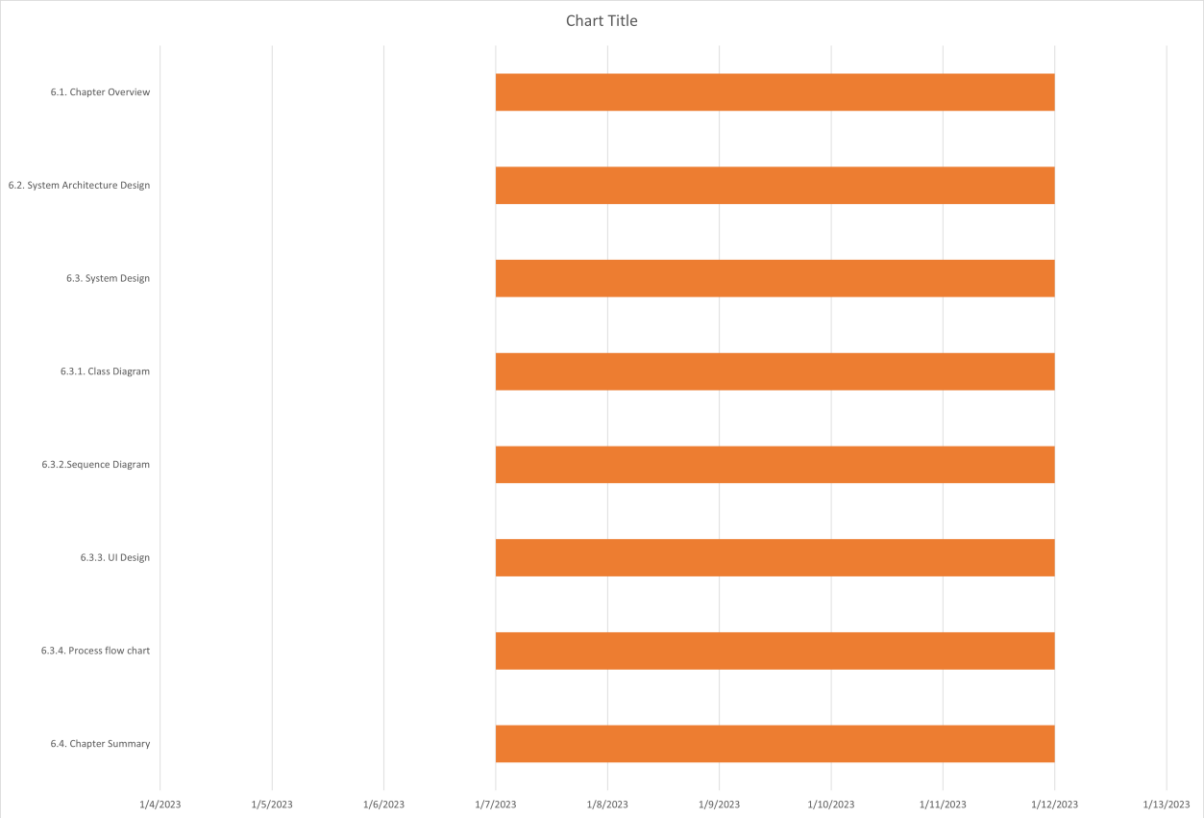
Chart Title
6.1. Chapter Overview
6.2. System Architecture Design
6.3. System Design
6.3.1. Class Diagram
6.3.2.Sequence Diagram
6.3.3. UI Design
6.3.4. Process flow chart
6.4. Chapter Summary
1/4/2023
1/5/2023
1/6/2023
1/7/2023
1/8/2023
1/9/2023
1/10/2023
1/11/2023
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