ACNE DETECTION AND SEVERITY BY USING CONVOLUTIONAL NEURAL NETWORK FOR INTERNET OF HEALTHCARE THINGS (IOHT)

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This report is submitted in partial fulfillment of the requirements for the Bachelor of Computer Science (Artificial Intelligence) with Honours.

FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY
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DECLARATION

I hereby declare that this project report entitled

ACNE DETECTION AND SEVERITY BY USING CNN FOR INTERNET OF HEALTHCARE THINGS

is written by me and is my own effort and that no part has been plagiarized without citations.

STUDENT : _____ Date : 27/8/2024

(NUR FARIHAH BINTI NAZRI)

I hereby declare that I have read this project report and found this project report is sufficient in term of the scope and quality for the award of Bachelor of [Computer Science (Artificial Intelligence)] with Honours.

SUPERVISOR : _____ Date : 27/8/2024

(TS. DR. WAN MOHD YA'AKOB BIN WAN BEJURI)

DEDICATION

This report is a tribute to my family, whose steadfast support, encouragement, and affection have been the cornerstone of my journey. Their unwavering faith in my potential has been the most significant source of inspiration and fortitude. I express my profound appreciation to my supervisor for their priceless mentorship and insight. Their forbearance, expertise, and motivation have been pivotal in fulfilling this project.

Furthermore, I wish to acknowledge my friends for their relentless support, fellowship, and for always being available to help or an empathetic ear. Their support and companionship have provided immense solace and strength. Finally, I am thankful to all who have played a part in this project, both directly and indirectly. They combined endeavors and backing have enabled this achievement.

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Finally, my gratitude extends to all who have, in one way or another, lent their support and contributed to this project. Their assistance and encouragement have been pivotal in achieving this significant milestone.

ABSTRACT

Acne Detection and Severity by Using Convolutional Neural Network for Internet of Healthcare Things is a mobile application that can identify the type of acne and their severity at the face. By using the integrated camera in smartphones, user can easily capture the image of their full fac and get the result of their acne condition immediately. Acne is a skin condition that happens when hair follicles under the skin become pore clogged. Pore clogging can produce blackheads, whiteheads and other types of pimples that usually happen to the face. There are several studies about acne detections using several deep learning methods to identify the severity of acne. By implying the artificial intelligence architecture, which is CNN, this project will be developing a classification model for acne based on the acne and lesion conditions to identify the severity of acne. This project aims to research severity of acne and how to treat it. To implement the classification model on mobile application that user-friendly to use for public with treatment suggestions. Finally, Acne Detection and Severity by Using CNN for Internet of Healthcare Things will be a mobile application that can seamlessly help people to identify the severity of acne on their face and suggesting an appropriate treatment that people can use to treat their acne correctly. Furthermore, this project can be a system that benefits people to get their result about their acne fast, effective treatment and less cost.

ABSTRAK

‘Acne Detection and Severity by Using Convolutional Neural Network for Internet of Healthcare Things’ ialah aplikasi mudah alih yang boleh mengenal pasti jenis jerawat dan keterukannya di muka. Dengan menggunakan kamera bersepadu dalam telefon pintar, pengguna boleh menangkap imej fac penuh mereka dengan mudah dan mendapatkan hasil keadaan jerawat mereka dengan segera. Jerawat adalah keadaan kulit yang berlaku apabila folikel rambut di bawah kulit menjadi tersumbat liang. Penyumbatan liang boleh menghasilkan bintik hitam, bintik putih dan jenis jerawat lain yang biasanya berlaku pada muka. Terdapat beberapa kajian tentang pengesanan jerawat menggunakan beberapa kaedah pembelajaran mendalam untuk mengenal pasti keterukan jerawat. Dengan membayangkan seni bina kecerdasan buatan, iaitu CNN, projek ini akan membangunkan model klasifikasi untuk jerawat berdasarkan keadaan jerawat dan lesi untuk mengenal pasti keterukan jerawat. Projek ini bertujuan untuk menyelidik keterukan jerawat dan cara merawatnya. Melaksanakan model klasifikasi pada aplikasi mudah alih yang mesra pengguna untuk digunakan untuk orang ramai dengan cadangan rawatan. Akhir sekali, Pengesanan dan Keterukan Jerawat dengan Menggunakan CNN untuk Internet of Healthcare Things akan menjadi aplikasi mudah alih yang boleh membantu orang ramai mengenal pasti keterukan jerawat pada muka mereka dengan lancar dan mencadangkan rawatan yang sesuai yang boleh digunakan oleh orang ramai untuk merawat jerawat mereka dengan betul. Tambahan pula, projek ini boleh menjadi sistem yang memberi manfaat kepada orang ramai untuk mendapatkan hasil mereka tentang jerawat mereka dengan cepat, rawatan yang berkesan dan kos yang lebih rendah.

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LIST OF ABBREVIATIONS

CRISP-DM	-	**Cross-Industry Standard Process for Data Mining**
AI	-	**Artificial Intelligence**
CNN	-	**Convolutional Neural Network**
PSM	-	**Projek Sarjana Muda**
KNN	-	**K Nearest Neighbor**
SVM	-	**Support Vector Machine**

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CHAPTER 1: INTRODUCTION

1.1 Introduction

The healthcare industry is growing more and more advanced with the latest developments in the Internet of Things (IoT). Doctors and hospital employees will be able to carry out their tasks more conveniently and wisely thanks to the Internet of things. Most of the IoT's problems have been handled by the most recent, cutting-edge technologies. This technology has a lot of potential to revolutionize the digital world and has numerous advantages. One of the most beneficial industries for IoT application is healthcare. The ability to monitor and act quickly in life-threatening circumstances is the most significant use of IoT. This technology-based approach to treatment offers a previously unheard-of chance to improve treatment productivity and quality, as well as patient outcomes and government funding (Aghdam, Rahmani and Hosseinzadeh, 2021).

Acne is a condition where there are clogged pores with thickening of the skin at the opening of the pores caused by oil rather than cosmetic or tar ingredients. It can also depend on a person's hormones and genes that cause there to be increased oil production from the sebaceous glands. Not only that, but acne can also occur because there is an infection of bacteria. There are several types of acne including whitehead or blackhead, papules, pustular and nodules formation that may cause scarring. Although this acne is compromised among women, it is undeniable that this acne usually occurs among teenage boys. Acne usually begins in teenagers due to hormonal changes that they experience, whether they are teenage girls or boys.

Although this acne is not a life- threatening health condition, it should also be noted because without proper care of acne, it will increase a person's cost of living just to treat it.

To reduce costs and increase lifestyle productivity, an expert system can be used to identify, suggest and give advice regarding the conditions of acne. However, the success of these systems is dependent on their ability to detect and classify the acne on the human face, which can have many parameters that need to be considered. As a result, developing an expert system that can identify, classify, suggest and give advice has the potential to significantly improve the person's lifestyle.

1.2 Problem Statement

The problem statement will be described as below:

1. A handful of people do not have a high level of knowledge on how to properly treat acne and eventually causes the acne they experience to be worse due to product errors.
2. Some people have financial problems that make it difficult for them to get treatment, especially those that involve face-to-face treatment, because treatments such as facial are quite high.
3. Acne problems are skin problems that can be treated by doing self-treatment in the early stages using the right medicine, but not all types of medicine can help and eventually mistakenly buy medicine and cause the acne they experience to be worse.

1.3 Objective

This project embarks on the following objectives:

1. To propose a mobile application that has several functions such as detecting acne, giving recommendation of medicine and knowledge about treating acne.
2. To design a user-friendly mobile application that is easy to use and understands how it works.

3. To implement the image processing method where it will do an acne detection in facial area and suggest the right medicine that can be used for healing purposes.

1.4 Scope

The project involves model development and system modules that cover :

1. Data collection and preparation : Images of acne will be collected through several dataset that can be found in Kaggle and related research paper in google scholar.
2. Model development: Image processing algorithms will be developed to analyze all the images and classify into type of acne. The algorithm will be designed to decrease the factors that may affect the accuracy of the system during prediction process.
3. Face Detection module: This module will detect whether the image that has been selected is a human face or not.
4. Acne Detection module: This module will detect whether the selected image is acne or not.
5. Type of Acne Module: This module will identify the type of acne that is contained in the images and give the result which type is present the most.
6. Severity Module : This module will identify the severity of acne where has 3 stage which is mild, moderate and severe.
7. Medicine and Advice Module: This module will give suggestions of medicine that can be used to treat acne, either traditional or modern medicine and give some advice on how to prevent it.
8. Interface Module : This module is the front-end of the system where it will be the interface for user to interact with via mobile applications.

1.5 Project Significance

This project will give signification to various levels of users, especially users who are experiencing acne problems on their face. The project will also benefit users such as parents or sportsmen, which will help them by recommending appropriate medications and treatments based on their daily activities.

1.6 Expected Output

Expected output for Acne Detection and Severity by Using CNN for Internet of Healthcare Things:

1. Reduced lifestyle cost: It can help people get the right treatment for their acne without going to the dermatologist that high in treatment cost.
2. Improved efficiency; An expert system that can help in increasing the effectiveness of acne detection. This will reduce the time and cost of the treatment needed.

3. Create business opportunity: A system that can create a business opportunity for user such as the beautician where they can use the system as the value added to improve their business.

Overall, the expected output for Acne Detection and Severity by Using CNN for Internet of Healthcare Things reduces the lifestyle cost, improves efficiency and creates an opportunity in business.

1.7 Report Organization

Chapter 1: Introduction

This chapter discusses the background of the project which has detailed explanation about internet of healthcare things, acne and the system. The chapter also discusses the problem statement, objectives, scope of the project and significance of the project. Other than that, the chapter also discusses the expected outcome of the project.

Chapter 2: Literature Review and Project Methodology

This chapter discusses the review of the literature on the project as well as the methodology used to implement the project. In this chapter, it will also discuss some of the studies that have been done before and the strengths such as the software and hardware needed to make this project a success. Other than that, it will also contain the project schedule and milestones of the project.

Chapter 3: Requirement Analysis

In this chapter, it will discuss all the analyses that will be carried out throughout this project. This chapter will include an analysis of the project which will contain diagrams such as flow diagrams, architecture diagrams or activity diagrams. In addition, this chapter will also contain an analysis of the requirements needed for projects such as data, functional, non-functional, software and hardware.

Chapter 4: Design

In this chapter will contain all designs related to the project such as architectural design, user interface design, database design, AI component design and software design that help the system to achieve the objectives.

Chapter 5: Results and Discussion

This chapter will discuss the evaluation of the AI techniques used in this project as well as the testing result of functional requirements for the project.

Chapter 6: Conclusion

This chapter will discuss the weaknesses and strengths of the project, suggestions for improvement and contribution of this project towards society.

1.8 Summary

In summary, acne will occur due to clogged pores caused by oil from cosmetic materials or tar. This acne can be treated at an early stage but when it is left untreated or using improper treatment methods, it can cause the acne to get worse. Acne Detection and Severity by Using CNN for Internet of Healthcare Things will be able to assist in identifying the type of acne and give suggestions of medicine based on the severity and advising others way of treatment to prevent from getting worse. The proposed system is expected to reduce the cost of lifestyle, improve efficiency and create business opportunities for people.

To fulfill the objectives of the project, a several number of models will be created to identify types of acne. This model will be train using images from various sources such as Kaggle, research paper and Dermnet. The developed model's performance will be evaluated using metrics such as precision, recall and F1 score. The project's results are expected to contribute to the dermatologist environment where can improve the efficiency in identifying and classifying types of acne.

CHAPTER 2: LITERATURE REVIEW AND PROJECT METHODOLOGY

2.1 Introduction

Acne vulgaris is a common skin conditions diagnosed in Malaysia where it happens because of clogged pores with thickening of the skin at the opening of the pores caused by oil rather than cosmetic or tar ingredients. This skin condition usually affects young generation in range of 13 to 18 years old, but it is not only limit to that range because everyone can affect to it either woman or man.

In this chapter will discuss the literature review and methodology conducted to complete Acne Detection and Severity by Using CNN for Internet of Healthcare Things mobile application development. It will begin with the summarization of acne detection methods and their limitations. Then, this chapter will analyze recent research and projects that are related to acne. Finally, this chapter will discuss in detail the methodology that will be implemented in Acne Detection and Severity by Using CNN for Internet of Healthcare Things.

2.2 Facts and findings

This part will discuss the domains, existing systems and techniques that will help in understanding the core value of the project.

2.2.1 Domain

Dermatology is one of the medical disciplines that is concerned with the diagnosis and treatment of the disease of the skin, hair, and nails in both children and

adults (*What is dermatology? — DermNet*, 2023). In this project, will be focus on one of the dermatology diseases which is Acne Vulgaris. Acne is divided into four types, comedones (blackhead and whitehead), papules, pustules and nodules (Branch, 2016).

Related work in Acne Detection and Severity by Using CNN for Internet of Healthcare Things has focusing in developing the automatic detection of the acne and identifying the severity of the acne. For example, 'Acne Care', an innovative system that implements deep learning techniques and Resnet18 application for detection and personalized acne care (*Acne Detection Care System using Deep Learning | IEEE Conference Publication | IEEE Xplore*, 2024). The author uses Resnet 18 to classify acne images and achieved an accuracy of 90%. Other than that, Dermato, an assistive application tool that can quicky assess and classify acne lesions into respective types (*Dermato: A Deep Learning based Application for Acne Subtype and Severity Detection*, no date) . The application is applying various types of CNNs and achieve accuracy more than 90%.

By implementing machine learning algorithm and expert system infrastructure, both will be in the project, Acne Detection and Severity by Using CNN for Internet of Healthcare Things. The system will be able to train the acne detection models using convolutional neural network (CNNs) and transfer learning with pre-trained models such as MobileNetV2. This project will be focusing on creating mobile applications where it can identify the type of acne and give medication suggestions. It also has some user details requirement where the applications will recommend additional care that can help improve the recovering process of acne and prevention.

2.2.2 Existing System

A research from Chantharaphaichi (Chantharaphaichi *et al.*, 2015) suggested a method for detecting facial acne using image processing techniques. The model was built on the HSV and grayscale color spaces. Acne spots were classified using a binary threshold applied to frontal facial pictures. However, the detection results from this method still contain noise due to color variation and lighting conditions.

Previous studies have used CNN algorithms to handle a variety of difficulties. Amandip Sangha et al. (Sangha and Rizvi, 2021) used deep learning to train an object

detection model on a publicly available image set to predict acne in images. They combined the YOLOv5 model with a dermatologist's ocular assessment.

Chiun-Li Chin et al. (Chin *et al.*, 2018) proposed a face pore identification method using CNNs. The model had three convolutional layers, three pooling layers, and four fully connected layers. They achieved approximately a 90% accuracy rate. Xiaolei Shen et al. [8] developed a CNN-based approach for treating face acne vulgaris. This model can identify six different types of acne and healthy skin. They employed the sliding window method to crop the input facial image to a limited area. The skin and non-skin of each small area were identified using a binary-classifier with CNN. A seven-classifier model using CNN was used to classify acne.

Isa and Nur et al. (2021) proposed real-time acne type detection using the YOLO technique. Their use differentiates between four types of acne: cysts, papules, pustules, and whiteheads. The application can reach up to 91.25% accuracy. However, this application solely addresses the specific acne area and does not use an expert system.

2.2.3 Technique

The following are the technique that might be used to build the mobile application

2.2.3.1 Machine Learning

Machine learning is a subfield of artificial intelligence that involves developing algorithms and statistical models that allow unprogrammed computer systems to learn from datasets. It detects patterns and relationships in datasets, which can then be utilized to make predictions or decisions about fresh data. There are several machine learning algorithm types, such as supervised learning, unsupervised learning, and reinforcement learning.

Other machine learning methods are used in this study to detect acne and determine its severity. Machine learning algorithms can be employed in acne identification and severity expert systems to analyse photos and identify acne types

such as comedones, pustules, papules, and nodules. By training the system on many photos, the algorithm may learn to classify the visual characteristics of different types of acne and accurately classify them in new images.

2.2.3.2 Convolution Neural Network

CNNs were first introduced in the 1980s by Yann LeCun and his colleagues, but they did not gain broad appeal until the early 2010s, because to their excellent performance in image recognition tasks. CNNs are made up of several layers: input, convolutional, pooling, activation, fully connected, and output layers.

The input layer receives the raw data, which is usually a picture or a series of images. The convolutional layer filters the input data, allowing for the extraction of relevant picture information. The pooling layer decreases the scale of the feature maps generated by the convolutional layer, lowering the amount of computation necessary in following layers.

The activation layer applies a non-linear activation function to the pooling layer's output, such as the Rectified Linear Unit (ReLU). This allows for the insertion of non-linearity into the model, which is required for learning complicated data patterns. The fully connected layer, like a classic neural network, connects every neuron in one layer to every neuron in the subsequent one. The output layer creates the model's final output, which for image recognition tasks is a probability score for each class. CNNs are used mostly for image processing and object detection.

Masum Shah Junayed et al. (*AcneNet - A Deep CNN Based Classification Approach for Acne Classes*, 2019) presented a new CNN model based on the Deep Residual Neural Network. The original concept of the residual neural network includes a so-called "identity shortcut connection" that goes beyond one or more tiers. They are the first to attempt to use the functionality, as it has not yet been implemented. On the contrary, CNN-based models have consistently delivered higher accuracy than other works, reaching up to 95%.

2.2.3.3 FastAPI server

According to Bansal and Abdelkader Ouda's (Bansal and Ouda, 2022) research, FastAPI is a web-based Python framework that provides a layer for ML models to deliver high performance while also exposing the functionality of the ML models as restful microservices. An innovative technique to utilizing FastAPI technology is proposed, allowing the authentication system to handle about 9000 queries simultaneously. A web-based interface was useful for monitoring overall performance and CPU utilization. This is extremely quick when compared to Flask-based solutions. This integration would provide a robust layer of enhanced security that is both transparent and frictionless. In addition, this paper illustrates how Machine Learning and FastAPI integration technologies are used to overcome integration issues that frequently arise in complicated security systems.

2.2.3.4 Facial Acne

Facial acne will be the images or dataset that will be used to train and test the model. The model that will be used is the pre-trained model named MobileNetV2 from TensorFlow. The facial acne will detect acne, differentiate type of acne and their severity.

Acne is a skin disorder characterized by clogged pores and thickening of the skin at the pore openings, which are produced by oil rather than cosmetic or chemical elements. It is also possible that a person's hormones and DNA produce an increase in oil production from the sebaceous glands.

Acne has four types which are comedones (blackhead and whitehead), pustules, papules and nodules. Each of the acne conditions has their own characteristic that can use to differentiate each of them. However, some of it might have similar characteristic with each other.

Lastly, the severity will be divided into three parts mild, moderate and severe. Where mild condition is the lowest condition and likely more to non, followed by moderate and the worst condition of acne is severe.

All the acne characteristic stated above will be used for the dataset where images of the acne will be used and distributed into two set, training and testing set. This is to make sure that the dataset is balance for model training.

2.3 Project Methodology

Agile methodology (Figure 2.3) is a customer-centric, flexible, and collaborative approach to software development and project management. It is the most recent model that is in use by well-known businesses like Facebook, Google, Amazon, and so on. It adheres to an incremental and iterative methodology that stresses the significance of providing a functional product as soon as possible. It contains six phases of lifecycle which are planning, requirement analysis, design, implementation, testing and deployment.

Agile methodology will be used to gradually and iteratively deliver the operational software system while testing and improving the model. By using this methodology, the system performs better, reacts to changes faster, and can identify and address minor problems before they become major ones. The methodology also offers project direction from requirements to evaluation, which can contribute to the success of the project.

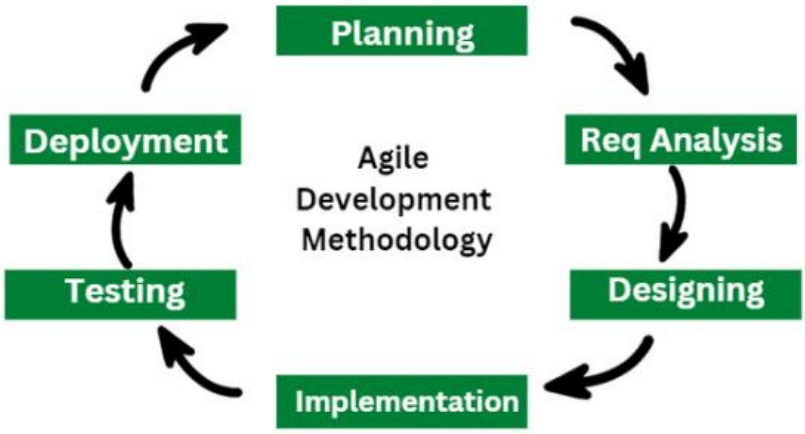

Figure 2.1 Agile Methodology (*Agile methodologies at an educational context: a systematic review*, 2023)

2.3.1 Planning Phase

Acne Detection and Severity by Using CNN For Internet of Healthcare Things is a mobile application that uses the image processing techniques to detect acne and classify acne in the image automatically. In the context of system, it refers to detecting the acne, classify the acne based on the type and give some medication and suggestions on how to treat the acne. This image processing can classify the type of acne using machine learning algorithms such as CNN. This algorithm can be trained using dataset of images of the acne and make the system to identify and classify the different types of acne.

Establishing the project's scope, objectives, and timelines the project's fundamental components during this phase is crucial to its success. to enable collaborative, flexible, and adaptive planning.

2.3.2 Requirement Analysis Phase

Collecting and evaluating the project specifications, which included outlining the system's primary components, is the aim of the requirement phase of the project. Getting relevant data for the system's training and testing is the focus of this phase of Acne Detection and Severity by Using CNN for Internet of Healthcare Things. Photographs of the acne may be included in this data. Prior to developing the model, the ACNE04 dataset will be examined to find any gaps in the data or problems with its quality that need to be fixed. The details of the dataset fraction can be referred to Chapter 4.3 AI Component Design. The objective of the phase is to make sure that the data is properly arranged for the system training.

2.3.3 Designing Phase

During the design phase, several algorithm models are being developed such as KNN, SVM and CNN to identify which algorithm will be the most suitable to use. These models will be trained using ACNE04 dataset that was collected during the data collecting process. ACNE04 dataset contain the pictures of facial acne. All the algorithms can be used in the acne detection to categorize things based on features that are collected from images. After the training process, the model can be used to predict the acne class when user give an input.

2.3.4 Implementation Phase

Several deep learning models are used for the proposed system's implementation phase. The corresponding dataset is used to train and test the models. The suggested method is expected to improve the efficacy and precision of acne detection, leading to better Acne Detection and Severity by Using CNN for Internet of Healthcare Things.

2.3.5 Testing and deployment Phase

The implementation of Acne Detection and Severity by Using CNN for Internet of Healthcare Things has the potential to lower living expenses, increase business opportunities, and enhance dermatology efficiency. This phase will include all the testing result of the functional requirements and classification report of the system.

2.4 Project Requirements

The project requirements include various aspects to get the great result. The requirements of this project consist of software requirements and hardware requirements. The list of project requirements will be listed according to the categories below.

2.4.1 Software Requirement

The following is a list of the necessary software for this project:

1. Jupyter Notebook: Integrated development environment for developing the project models and performing analysis.
2. Visual Studio Code: It is used to create the server for the mobile application system.
3. Firebase Firestore : Use to store the database of the related medicine and suggestions to prevent acne.

4. Android Studio: Software for designing the user interface of the system using flutter.
5. Draw.io: Software for creating flowcharts and data flow diagrams.
6. Microsoft 365 - Microsoft Word: For report writing during the development phase.

2.4.2 Hardware Requirement

- Laptop
  i. Intel(R) Xeon(R) CPU E3-1505M v6 @ 3.00GHz 3.00 GHz
  ii. Windows 10 Pro
  iii. 64-bit operating system
- Smartphone
  i. Android 8
  ii. 64GB storage
  iii. 4GB ram

2.5 Project Schedule and Milestones

Table 2.1 Gantt Chart for PSM

Activity	Week																					
	PSM 1														PSM 2							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Planning • Research • Project Planning																						
Analysis • Project requirement analysis • Data gathering and preprocessing																						
Design • System design																						
Implementation • Create functional code • Implement the system																						
Testing • System testing																						
Implementation • Implement incomplete module in PSM 1																						
Testing • Final testing of the mobile application																						
Documentation • Final presentation & demonstration • Final report submission																						

2.6 Summary

To sum up, chapter 2 included a thorough analysis of the literature review on Acne Detection and Severity by Using CNN for Internet of Healthcare Things. Research on everything from collecting the dataset until deep learning models were examined. The chapter also underlined how important it is to prepare and understand data before developing these systems. Overall, research indicates that acne detection systems can significantly improve acne detection's accuracy and efficiency. Nevertheless, more investigation is required to maximize these systems' effectiveness in real-world uses.

CHAPTER 3: REQUIREMENT ANALYSIS

3.1 Introduction

This chapter discusses the requirements that are needed to create Acne Detection and Severity by Using CNN for Internet of Healthcare Things. It will explain in detail several categories of requirements. This chapter will cover the problem analysis and requirements analysis. The requirement analysis will contain the data, functional, non-functional, software and hardware requirements.

The data requirements will identify the fraction of the data that is needed for training and testing the models. Functional requirements are the description of operations or functions that are in the system. Non-functional requirements relate to the system's performance metrics such as accuracy, reliability and user-friendliness.

For this project, the Convolutional Neural Network (CNN) model MobileNetV2 was selected. The choice was influenced by its proven effectiveness in giving accurate results based on previous research. This model will be used to categorize the input image.

The project's dataset contain acne and non-acne images, is sourced from the publicly accessible Kaggle dataset and Dermnet. These images are utilized to train and test the deep learning models. The model's accuracy serves as the benchmark for comparative performance, helping to identify the most effective model.

3.2 Problem Analysis

Problem analysis is the first step in creating Acne Detection and Severity by Using CNN for Internet of Healthcare Things. It will be analysing the limitations and weaknesses of the current acne detection techniques. This research can fill in the gaps and weaknesses in the field and obtain a deeper understanding of the problems that require attention by conducting research and reviewing relevant literature.

One of the challenges in detecting acne is the condition of the human facial where it might contain others facial skin disease other than acne. The presence of other facial elements such as mole, scar and others skin condition can affect the accuracy of the acne detection. Moreover, the diverse in skin colours such as natural skin tone, cool skin tone and dark skin tone can affect the detection process. These conditions need an advanced algorithms and technique that can handle the variable complexity and increase the accuracy of detecting and classify the acne.

The quality and accessibility of the data is an important component of problem analysis in this situation. Acne Detection and Severity by Using CNN for Internet of Healthcare Things testing require a high quality and representative dataset. It is needed for the system to assess the data that have various acne types.

Furthermore, a main factor in the system's success is the diversity and quality of the data. Limited detection capabilities and poor generalization can result from incomplete or biased data. As a result, solving data-related issues and obtain a solid dataset are crucial steps in the problem analysis process.

For summary, problem analysis has the details of information on the difficulties and specifications involved in creating an Acne Detection and Severity by Using CNN for Internet of Healthcare Things. It led to the project's next phases, which include algorithm selection, data gathering, and system design, to guarantee that the suggested solution successfully solved the problems found and satisfies the requirements of the dermatology sector.

3.3 Requirement Analysis

Requirement analysis discuss about the analysis of the requirements and expectations of all relevant parties, including users, researchers, and business specialists. The research can guarantee that the established system satisfies the intended aims and performs well in the context of acne detection.

Data requirements are one aspect of requirement analysis. The types and amounts of data required for the acne detection system's testing and training must be determined through research. Collecting a various and high-quality of dataset is needed. It includes getting data on comedones, papules, pustules, and nodules. To guarantee correct data for system training, attention should also be paid to the labelling and annotation process.

It is possible to develop a complete range of the data, functional, and non-functional requirements for the Acne Detection and Severity by Using CNN for Internet of Healthcare Things by carrying out the requirement analysis. It will help in the next phase of the system which resulting the efficiency of detection and classification of the acne.

3.3.1 Data Requirement

The ACNE04 dataset from Kaggle and dataset from DermNet is being used for this project. This dataset has been used in the past to train deep learning models for acne detection. The dataset comprises 1657 images of the acne, categorized into two categories with eight class names which is mild, moderate, severe, comedones, papules, pustules and nodules. The dataset will be divided into a ratio of 80% training and 20% testing as shown in Figure 3.1, Figure 3.2 and Figure 3.3.

The training dataset is used to educate the model, while the testing and datasets is used to test the model's effectiveness. After the deep learning models are trained and evaluated, their classification accuracy and loss will be documented and analysed the effectiveness of the model for acne detection. In summary, the dataset serves as a valuable resource for training and evaluating deep learning models for an Acne Detection and Severity by Using CNN for Internet of Healthcare Things.

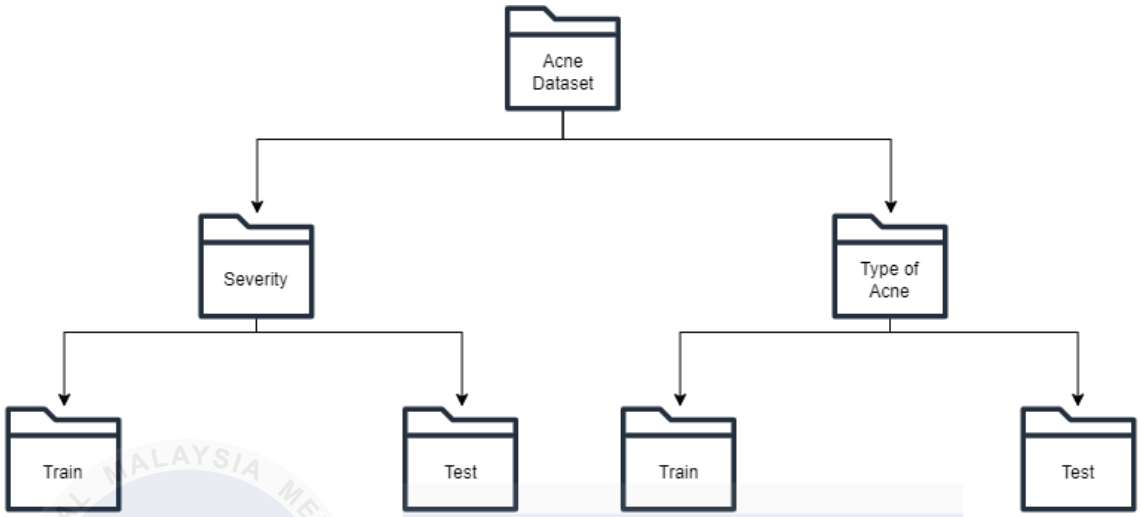

Figure 3.1 Acne dataset split into two categories

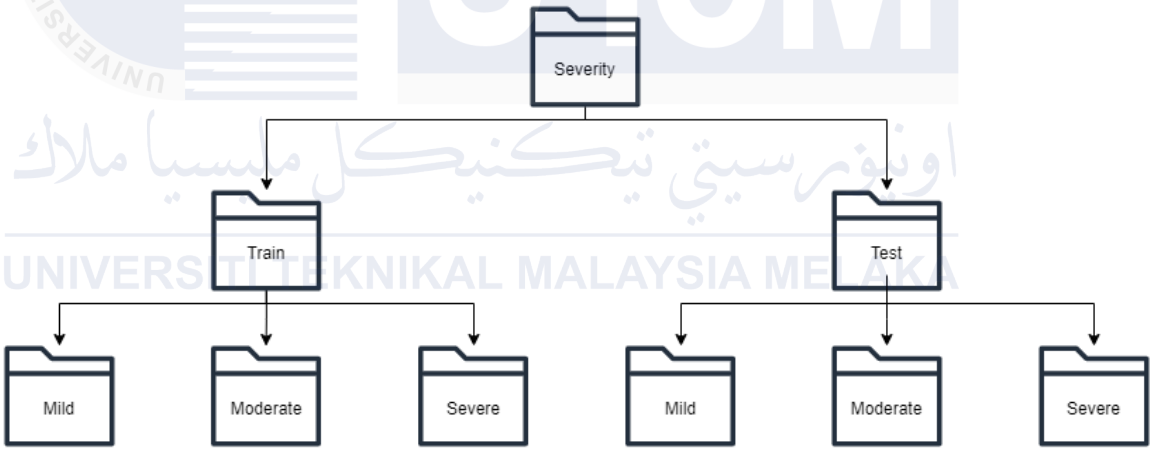

Figure 3.2 Severity categories split into two group train and test with associated class

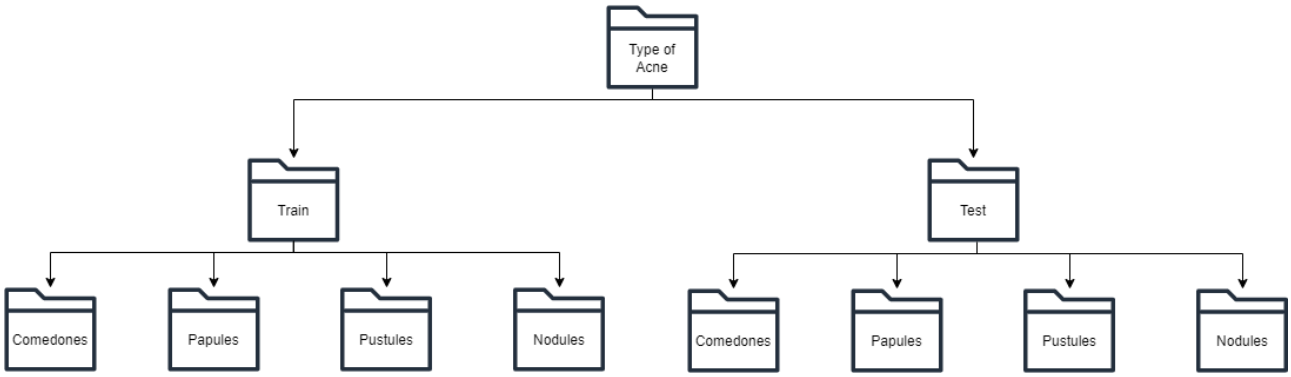

Figure 3.3 Type of acne category split into two groups, train and test with associated class

3.3.2 Functional Requirement

Functional requirements are important when designing Acne Detection and Severity by Using CNN for Internet of Healthcare Things. These requirements define the exact qualities and skills that the system must possess to successfully carry out its intended function. There are several critical functional requirements that can be found in the context of acne identification and severity.

Firstly, the image processing system must be capable of detecting and classifying face acne. This includes finding the acne on the face and distinguishing between it and other skin problems and providing accurate detection results. Second, the system can classify the severity of acne based on the lesions present on the face. Each severity has distinct conditions depending on the number of lesions that emerge. Finally, the algorithm may classify the data according to the type of acne that shows more frequently in the photos.

Aside from that, an Acne Detection and Severity by Using CNN for Internet of Healthcare Things should be able to provide appropriate medication to treat the acne as well as additional recommendations on how to avoid the acne from recurring or worsening. This prescription and advice are based on the image that the user has placed, as well as certain user characteristics such as name, age, gender, activity preferences, and any medication allergies.

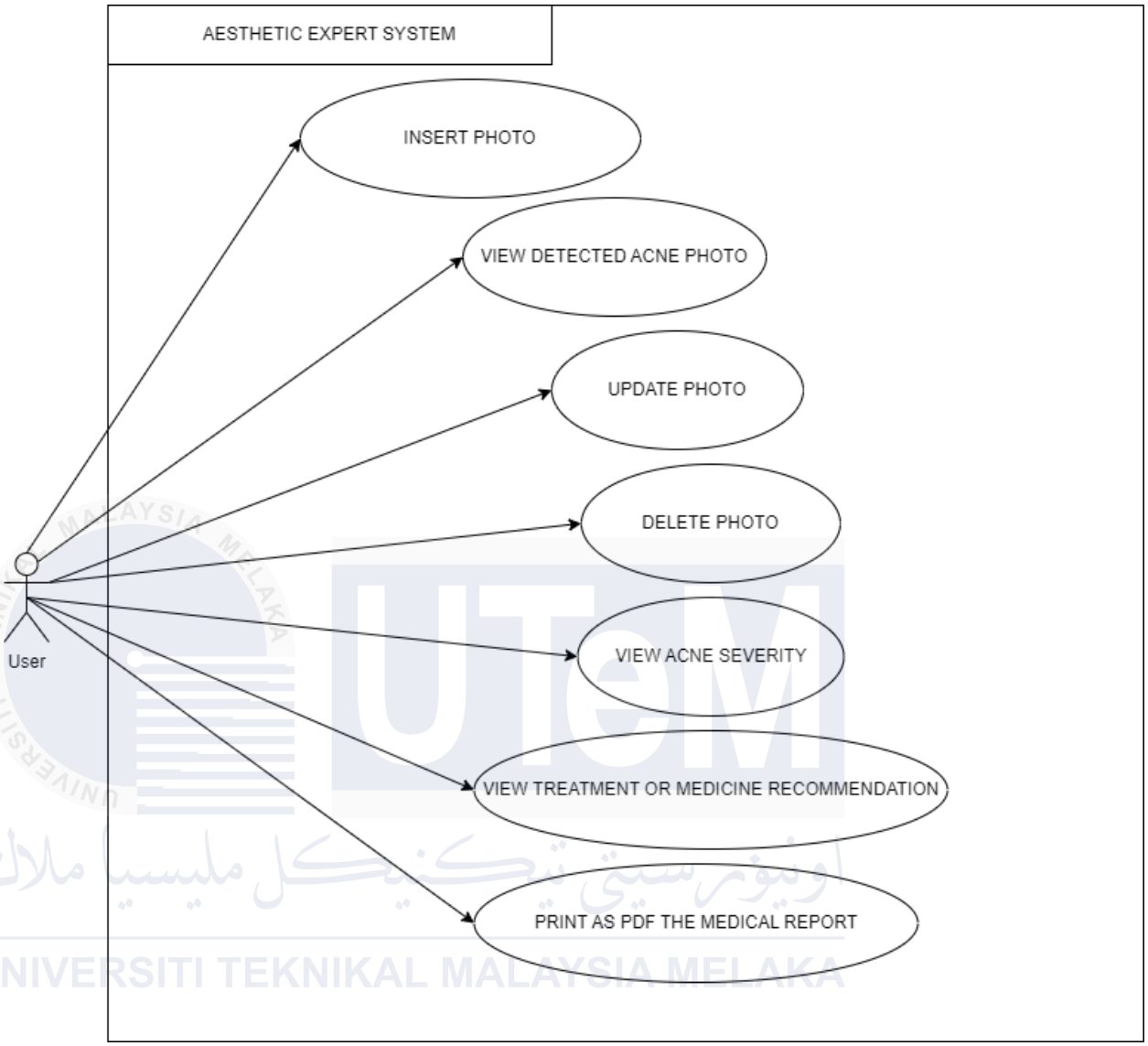

Figure 3.4 shows use case diagram for whole system interaction with user

3.3.3 Non-functional Requirement

The creation of an Acne Detection and Severity by Using CNN for Internet of Healthcare Things is dependent on non-functional needs. Non-functional requirements discuss the aspects of the system that are essential to both the system's overall effectiveness and user pleasure.

Firstly, the non-functional requirements that are necessary for Acne Detection and Severity by Using CNN for Internet of Healthcare Things is the performance of the system. The system must have low response time when analyzing an input image

from the user. The system must have great scalability when handling an increasing number of users and images without downgrading in performance.

Another non-functional requirement is the performance of Acne Detection and Severity by Using CNN for Internet of Healthcare Things is the compatibility of the system. The system should be compatible to operate with others mobile platforms such as IOS and Android. The integration of the system should be seamless with existing healthcare management systems.

3.3.4 Others Requirement

This section will analyze the software and hardware requirements for Acne Detection and Severity by Using CNN for Internet of Healthcare Things in detail. Identifying the specific software and hardware components required to support the system functionality and ensure its seamless operation is essential.

3.3.4.1 Software Requirements

Table 3.1 Software requirements for Acne Detection system and severity expert system

Software	Usage
Microsoft Word	Drafting and documentation report of the project
Draw IO	Designing diagram such as flowchart and use case
Visual Studio Code	Code for mobile application server
Android Studio	Interface for Acne Detection and Severity by Using CNN for Internet of Healthcare Things
Jupyter Notebook	preprocessing data, test and train model, implement code

3.3.4.2 Hardware Requirements

Table 3.2 Hardware requirements for Acne Detection and Severity by Using CNN for Internet of Healthcare Things

Hardware	Specifications

Processor	Intel(R) Xeon(R) CPU E3-1505M v6 @ 3.00GHz 3.00 GHz
Installed RAM	32 GB
System Type	64-bit operating system, x64-based processor

3.4 Summary

In conclusion, the successful completion of a project requires analysis and planning of all its aspects. This includes identifying the required software and hardware for system development. The system is designed to cater to its intended users, but it's also important to consider both functional and non-functional requirements.

Through the analysis of these variables and scope of the project's requirements, the system will achieve all the goals and fulfill all needs. This chapter shows the system's design and execution is needed in the project development process. After the requirements analysis is completed, it will go to the next chapter that involves the design process of the project.

CHAPTER 4: DESIGN

4.1 Introduction

This chapter sets an environment for Acne Detection and Severity by Using CNN for Internet of Healthcare Things's design phase. This is a phase when the requirements analysis from previous chapters are turned into an operational design framework. The chapter highlights how important this phase is to bridge the gap between the project's objectives and the system's execution. This introduction outlines the primary goals and objectives of the design process.

Developing a dependable and efficient system architecture that integrates deep learning models, image processing, and data storage is the major objective. A well-designed mobile application system interface can enable straightforward user-system interaction. The challenges of developing a mobile application for detecting and grading acne has also been discussed to show how crucial it is to carefully consider several factors, such as user usability, computing efficiency, accuracy, and scalability.

This chapter also discuss about the user interface design, dataset design, and high-level design. The introduction to Chapter 4 emphasizes the importance of the design phase in developing the Acne Detection and Severity by Using CNN for Internet of Healthcare Things.

4.2 High-Level Design

Chapter 4's high-level design concentrates on the Acne Detection and Severity by Using CNN for Internet of Healthcare Things's general architecture and

organization. A thorough description of the system's modules, parts, and interactions is given in this section. The system architecture that lists the main parts and its connections explains how image processing methods, data storage, and deep learning models are integrated. The architecture guarantees effective acne detection that allowing the system to precisely detect and categorize the acne.

The high-level design also discusses the dataset design, which is required for organizing and storing the amount of image data. It covers topics including retrieval procedures, storage structure, and data arrangement. For training, and validation purposes, the dataset architecture guarantees quick and easy access to the stored photos and allows for a smooth interaction with the deep learning models. Additionally, the system architecture's scalability and adaptability are highlighted in the high-level design part. It considers the possibility of alterations and improvements in the future to meet changing needs and advances in technology. Because of the design's consideration of modularity and extensibility, future additions of additional models, algorithms, and features will be simple to integrate.

In conclusion, the section on high-level design offers a comprehensive overview of the Acne Detection and Severity by Using CNN for Internet of Healthcare Things to identify and classify acne on the face. It provides an overview of the dataset design, system architecture, and user interface design. The high-level design guarantees the effectiveness, precision, and flexibility of the system, which helps the Acne Detection and Severity by Using CNN for Internet of Healthcare Things be successfully used in the dermatology field.

4.2.1 System Architecture

The main parts of the Acne Detection and Severity by Using CNN for Internet of Healthcare Things and how they work together to achieve the system's goals are arranged in system architecture in Figure 4.1.

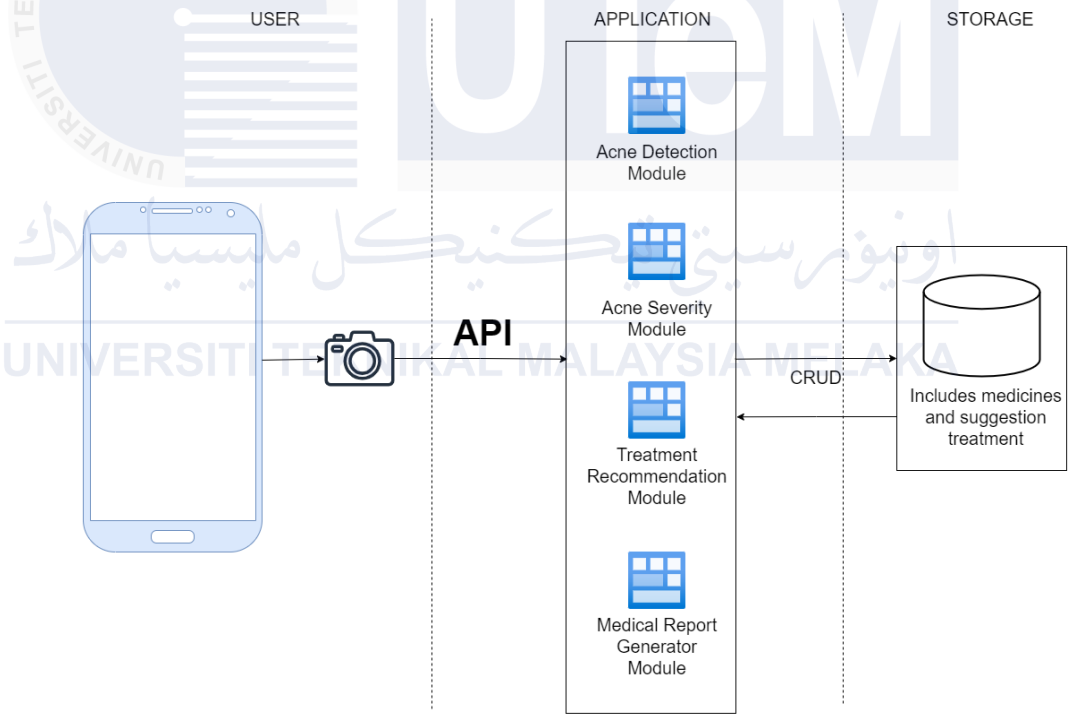

Figure 4.1 System Architecture

4.2.2 User Interface Design

Figure 4.2 shows the user-friendly interface for the Acne Detection and Severity by Using CNN for Internet of Healthcare Things. The requirements for the user interface, including the graphical components, navigation, and functionality, are examined in this section.

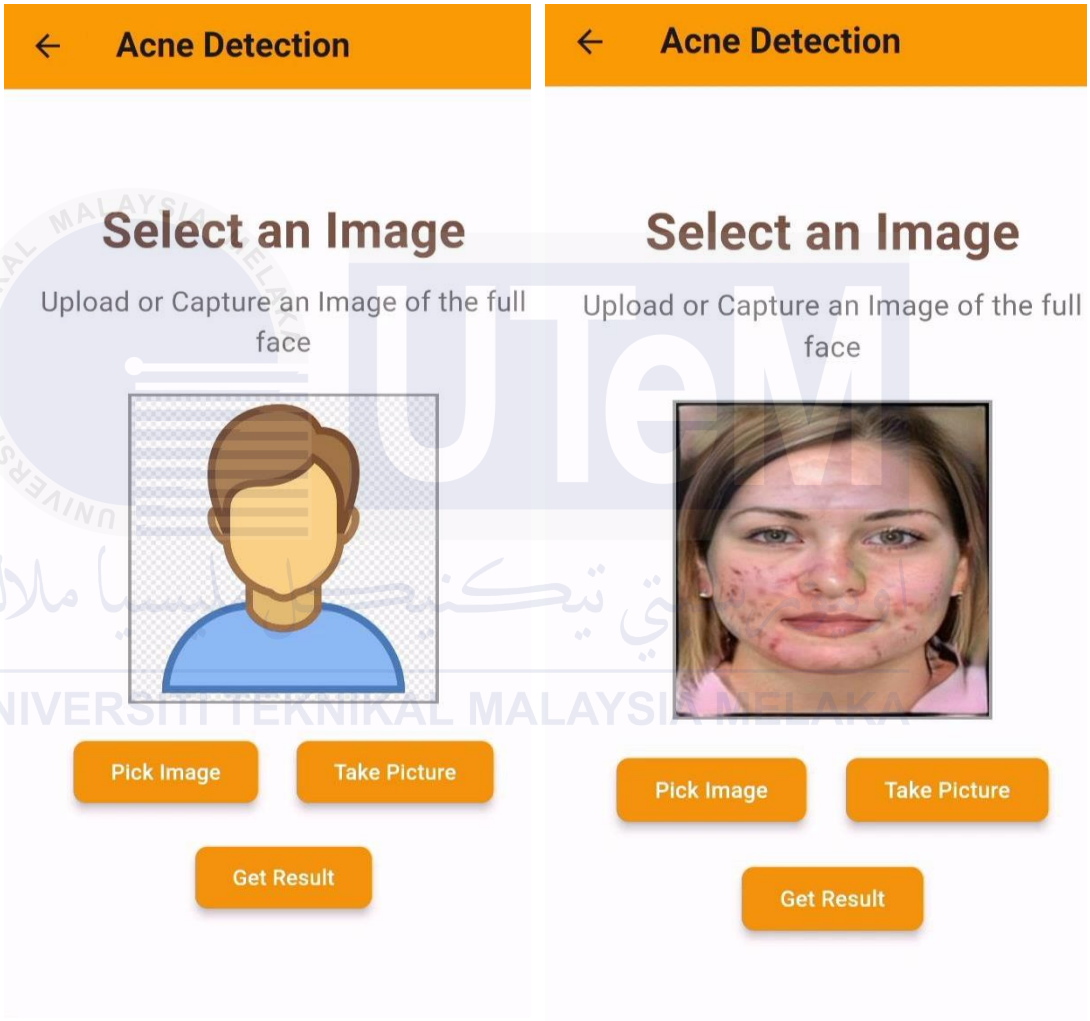

Figure 4.2 User interface design for detection

4.2.2.1 Navigation Design

The Acne Detection and Severity by Using CNN for Internet of Healthcare Things mobile application is designed to be user-friendly, as seen in Figure 4.3's navigation design. To begin the detecting procedure, the user will launch the mobile applications. After being presented with an interface to provide some personal information, the user can choose or insert a picture of their face that shows acne. Following their click to "get result," the system will then show the result, including information about the type of acne, its severity, recommended medications, and some advice on how to avoid it in the future. The user then has the option to store the results in PDF format on their device for future use in relation to medication.

Figure 4.3 Software navigation design

4.2.2.2 Input Design

The input design, Figure 4.4, is where the user will insert their basic details into the Acne Detection and Severity by Using CNN for Internet of Healthcare Things mobile application to get a better recommendation of treatment after the detecting their acne and severity.

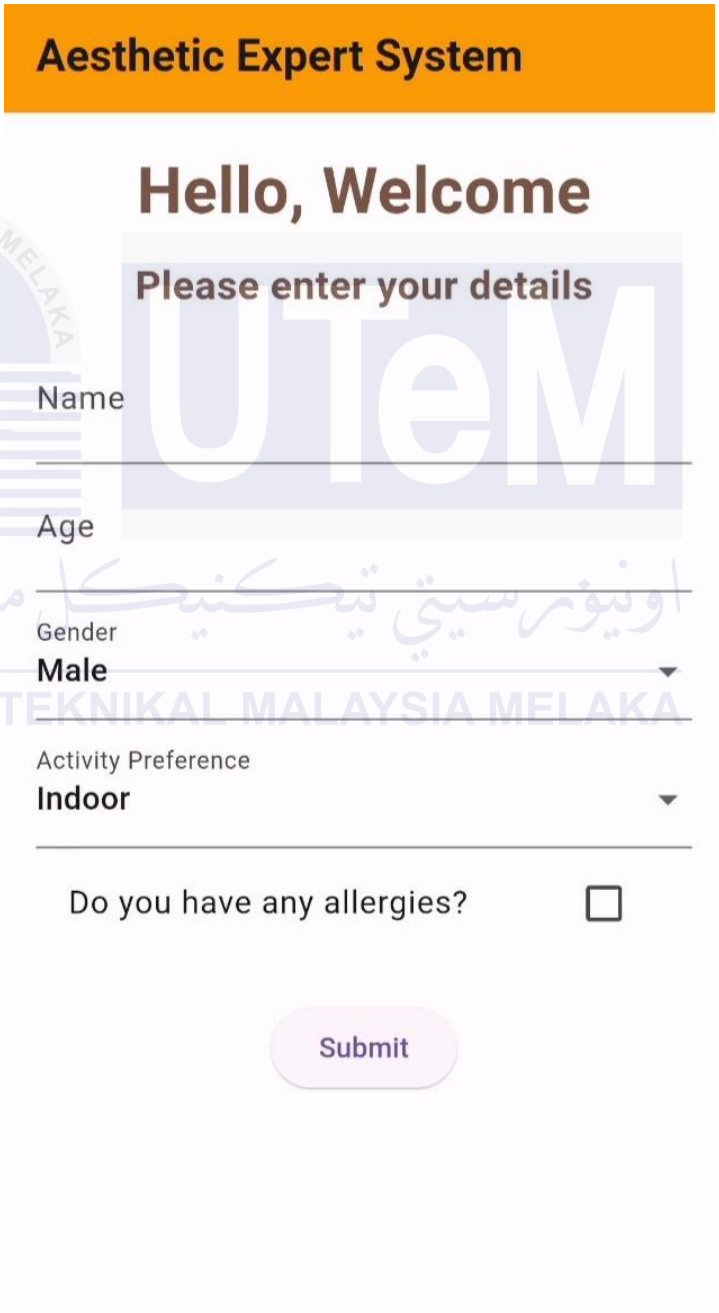

Figure 4.4 Input design interface

4.2.2.3 Output Design

The user will receive their whole result regarding the acne image they inserted, medication recommendations, and advice on how to keep the acne from coming back in the output design, Figure 4.5. Additionally, users can choose to store the outcome on their device as a PDF.

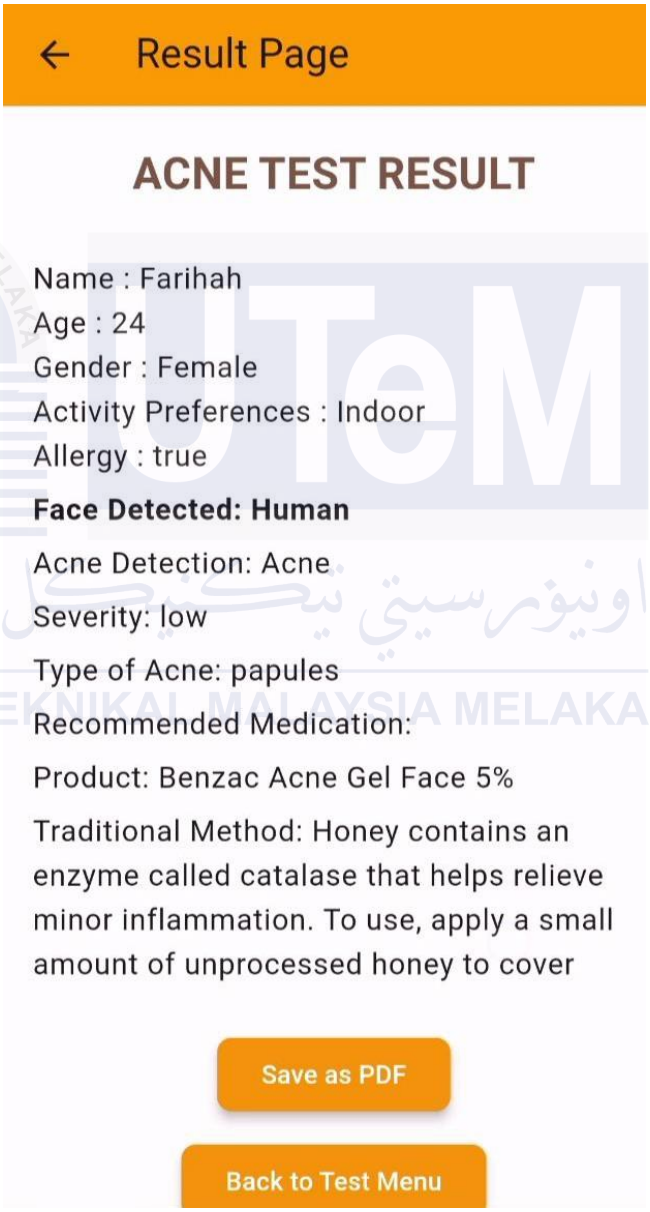

Figure 4.5 Output design of the acne test result

4.2.3 Database Design

For this project, the dataset contains a total of 5129 images. Out of which, 2369 images are acne while 2760 images are non-acne. The dataset is then divided into 70-20-10 for train, validation and test respectively. The directory is organized as Figure 4.6.

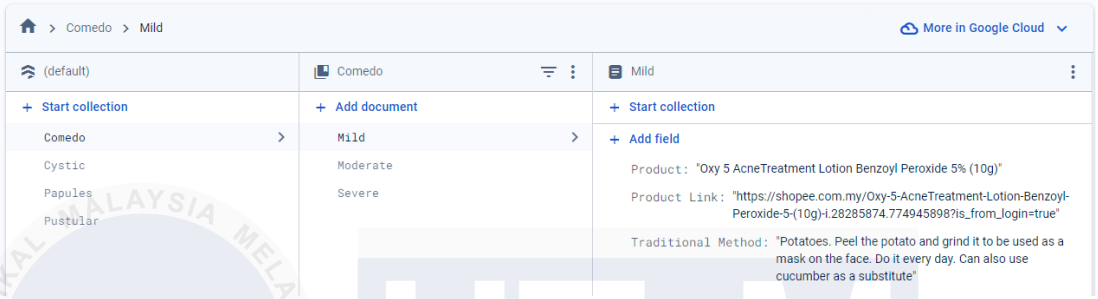

Figure 4.6 Part of database in Firestore in Firebase

The entity relationship diagram of Acne Detection and Severity by Using CNN for Internet of Healthcare Things is shown as Figure 4.7 to show how the relation between the mobile application and database in Firestore Firebase works. All the entity relates to one-to-one relation where the user can insert the information once at a time. The detector can have one input image at a time and will detect four types of detection and get the medication preferences from the database before displaying the result of the detection.

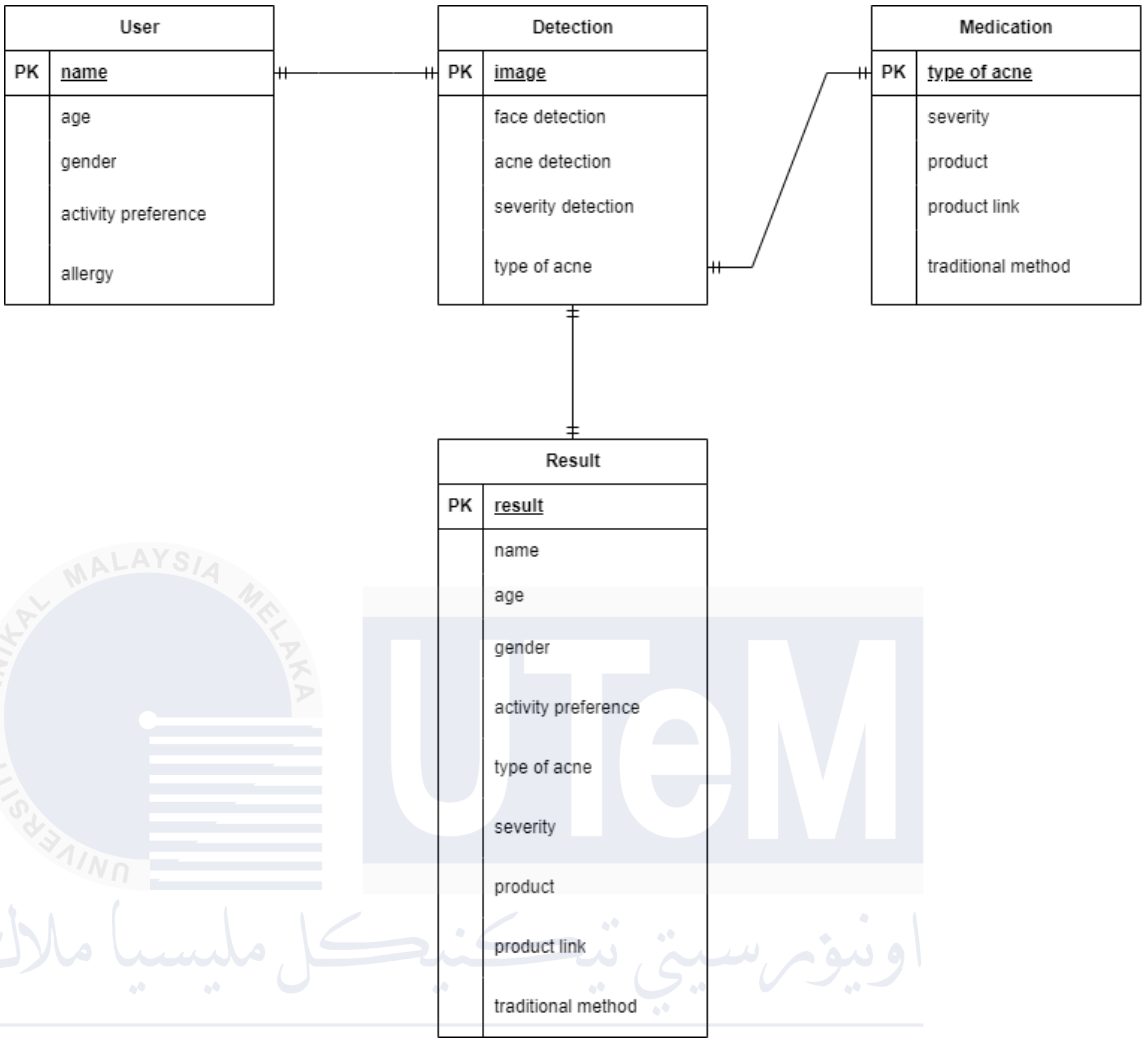

Figure 4.7 Entity Relationship Diagram

4.3 AI Component Design

For this project, there are four types of datasets for each model. The dataset is for face detection model, acne detection model, acne severity model and type of acne model. Each of the dataset is set into 80% training and 20% testing where the details of the ratio are as Table 4.1 .

Table 4.1 Dataset Directory

Dataset	Categories	Training	Validation
Face Detection	Human	2372	593

	Other	2366	592
Acne Detection	Acne	128	46
	Other	133	34
Acne Severity (ACNE04)	Mild	397	100
	Moderate	509	128
	Severity	257	66
Type of acne	comedones	40	10
	papules	40	10
	pustular	40	10
	nodules	40	10

Acne Detection and Severity by Using CNN for Internet of Healthcare Things mobile application will using an input image from user either take the image using camera or insert existing image in their device. The image that had been insert will go through all four models untill they get the desire result. All four models are connected to each other. First, they system will identify either the image is human face or not. Then it will identify are they any acne visible. Then, the image will go through next model which is the severity and lastly the type of acne model. Then, the system will give the result based on the four model and also the medicine recommendation to treat the acne.All the models are using the CNN method with MobileNetV2 algorithm to classify the input image based on their classification that had been set up for each model.

4.4 Summary

The Acne Detection and Severity by Using CNN for Internet of Healthcare Things's design features are thoroughly described in the design chapter. It includes database design, user interface design, and high-level system architecture. The design stage establishes the framework for the project's development and implementation phases to make sure that the system satisfies the objectives and offers a practical acne detection solution. The project may go on to the following stage that includes system development and testing, now that the design is in place.

CHAPTER 5: RESULT AND DISCUSSION

5.1 Introduction

This chapter will conclude the system testing procedure for the application created and focus on the findings and discussion of Acne Detection and Severity by Using CNN for Internet of Healthcare Things. Aspects of the functional requirement testing procedure, and the evaluation of AI techniques will be covered in this part.

5.2 Evaluation of AI Techniques used in the project

Evaluation of AI Techniques will be covered in two categories of comparison which is comparison with others algorithm and past research. For the algorithm comparison, this project will be compared with K Nearest Neighbor (KNN) and Support Vector Machine (SVM). For the past research comparison, this project will be compared with other two identical projects to compare the accuracy of acne detection.

5.2.1 Algorithm Comparison

Based on Figure 5.1, there are three types of algorithms that are being compared for acne detection in this project. The comparison is between CNN, KNN and SVM algorithm. Ass the result, the highest accuracy is with the SVM algorithm with 0.7125 compared to CNN with 0.7 and KNN with 0.5750. For the accuracy rate, the result would say that SVM is the best algorithm. However, SVM has disadvantages

where the training process will take longer times for large dataset and it also not suitable for image data. As for conclusion, I decided to use the CNN algorithm where it the second highest accuracy and it also suitable to train large dataset and image data because for this project is using an input image from user for the detection. Figure 5.1 shows the model performance comparison where the blue bars represent log loss while red line the accuracy.

Figure 5.1 Model performance comparison

5.2.2 Past Research Comparison

As for the comparison with past research, this project will be compared based on the acne severity using ACNE04 dataset. The first research is Acne Severity Classification Framework Based on Adaptive Feature Enhancement (Chen, Liu and Lu, 2023) where it first detect the face in the input image then applies adaptive feature enhancement. Then, by applying deep learning model to determine the severity level of acne using public acne dataset ACNE04. Another research is Acne Vulgaris Severity Analysis Application (Nethravathi *et al.*, 2023) where the development process is using YOLOv5 using several dataset from Dermnet, ACNE04 and private dataset from dermatology. This research also goes through detecting the severity of acne. The summary of the comparison with previous research and this project is as Figure 5.2.

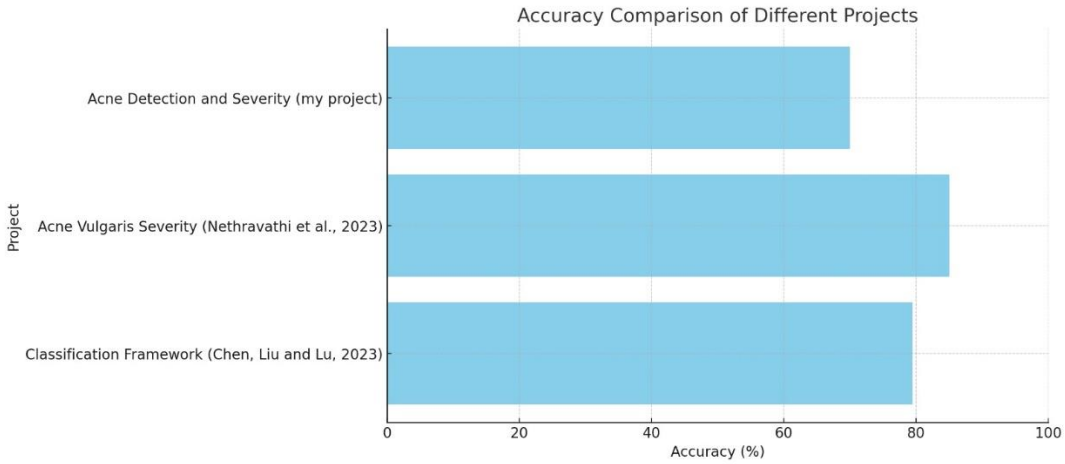

Figure 5.2 Previous Research Comparison

In summary, Acne Detection and Severity by Using CNN for Internet of Healthcare Things has accuracy that comparable with another project because the accuracy not that far. This project will be seamless project with others with an extra feature because has the mobile application implementation for public use. Acne Detection and Severity by Using CNN for Internet of Healthcare Things can increase the accuracy of detection with more development on preparing the dataset with high quality images of the acne.

5.2.3 Result of Each Model

For every model had its own confusion report with confusion matrix respectively as below.

5.2.3.1 Face Detection Model

Classification Report

	precision	recall	f1-score	support
Human	1.00	0.89	0.94	593
Non Human	0.90	1.00	0.95	592
accuracy			0.95	1185
macro avg	0.95	0.95	0.95	1185
weighted avg	0.95	0.95	0.95	1185

Confusion Matrix

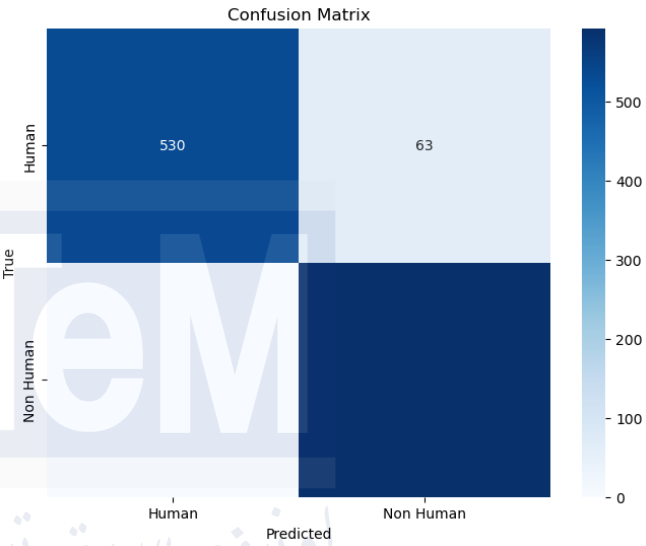

Figure 5.3 Face Detection Report

5.2.3.2 Acne Detection Model

Classification Report

	precision	recall	f1-score	support
Acne	1.00	0.48	0.65	46
Non Acne	0.59	1.00	0.74	34
accuracy			0.70	80
macro avg	0.79	0.74	0.69	80
weighted avg	0.82	0.70	0.69	80

Confusion Matrix

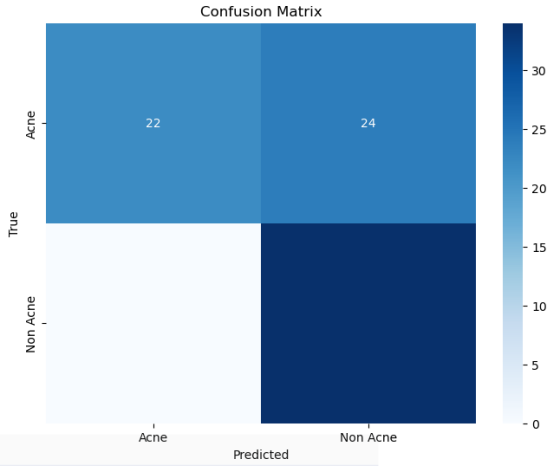

Figure 5.4 Acne Detection Report

5.2.3.3 Severity Detection Model

Classification Report

	precision	recall	f1-score	support
mild	0.40	0.96	0.57	100
moderate	0.34	0.09	0.14	128
severe	0.83	0.29	0.43	66
accuracy			0.43	294
macro avg	0.52	0.44	0.38	294
weighted avg	0.47	0.43	0.35	294

Confusion Matrix

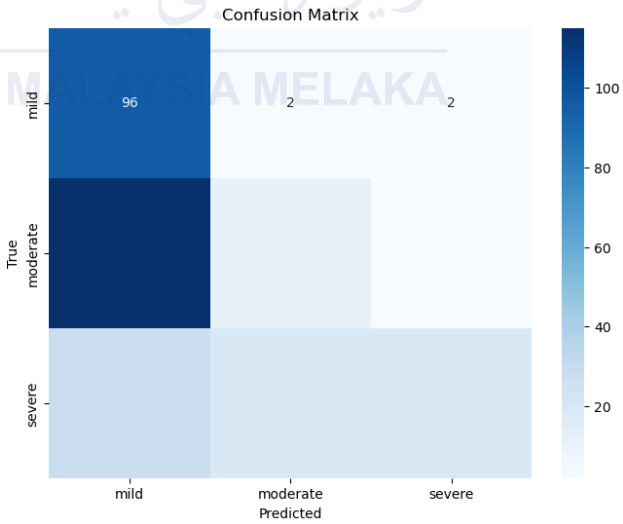

Figure 5.5 Severity Detection Report

5.2.3.4 Type of Acne Detection Model

Classification Report

	precision	recall	f1-score	support
comedo	0.40	1.00	0.57	10
cystic	0.75	0.30	0.43	10
papules	0.67	0.60	0.63	10
pustuler	1.00	0.20	0.33	10
accuracy			0.53	40
macro avg	0.70	0.53	0.49	40
weighted avg	0.70	0.53	0.49	40

Confusion Matrix

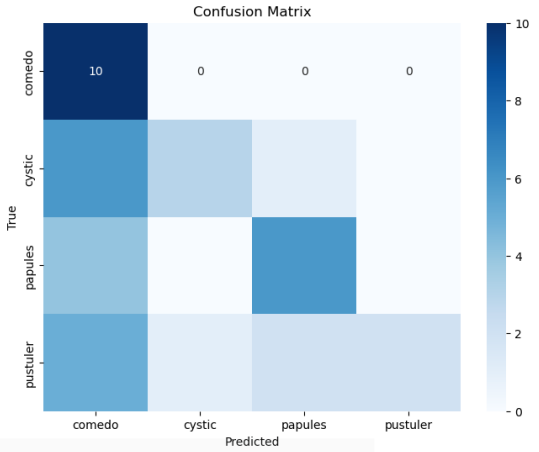

Figure 5.6 Type of Acne Detection Report

5.3 Testing of Functional Requirement

Every module or function in the Acne Detection and Severity by Using CNN for Internet of Healthcare Things is undergoing testing to ensure it meets the functional criteria by the system tester as table 5.1. The type of test and its description for each application are displayed in Table 5.2.

Table 5.1 Tester Identification

Role	Name	Smartphone system version	Responsibilities
Developer	Nur Farihah binti Nazri	Android 8	Project development and testing
Tester	Aliyah Najma binti Nadzri	Android 14	Project testing based on several test description
	Marshitah binti Azhar	Android 12	
	Muhammad Arif Zaqwan bin Mohd Zaki	Android 14	
	Muhammad Zawawi bin Ismail	Android 14	

Table 5.2 Test Case Description

Type of Test	Test Description	Test Case ID	Test Case	Expected Result
Acne Detection Module	Able to detect the acne from the user input images	TC-01	Detect human face or other	Able to differentiate human and non-human images
		TC-02	Detect the acne or other	Able to identify can and others
Acne Severity Module	Able to classify the acne based on the severity and type of acne	TC-03	Identify the type of acne	Able to identify the type of acne
		TC-04	Classify the acne based on severity	Able to classify the severity of the acne
Treatment Recommendation Module	Able to prescribe the right medication and make treatment recommendations based on the acne outcome	TC-05	Give the prescribe medication to treat the acne	Able to give prescription of the medication
		TC-06	Suggest appropriate treatment recommendation based on the result and user detail	Able to give the suggestion treatment for the acne
Medical Report Generator Module	Able to generate a medical report based on the acne outcome	TC-07	Generate the medical report based on acne result	Able to generate the medical report based on acne result
User Interface Module	Able to deliver all the functions to user	TC-08	Insert or select images from user device	Able to select or insert images

		TC-09	Use the detection and treatment module	User able to understand how the detection and treatment module works
		TC-10	Use the medical report module	user able to get the medical report in PDF format
		TC-11	The design and interface of the system	User able to understand the flow of the interface system

5.3.1 Test Result and Analysis

The test result is divided into five types of tests which are acne detection module, acne severity module, treatment recommendation module, medical report generator module and user interface module.

5.3.1.1 Acne Detection Module

Table 5.3 Acne Detection Module Test

Test Case	Test Description	Result from tester	Success / Fail
TC-01	Detect human face or other	Able to differentiate human and non-human images	Success (5)
TC-02	Detect the acne or other	Able to identify can and others	Success (5)

5.3.1.2 Acne Severity Module

Table 5.4 Acne Severity Module Test

Test Case	Test Description	Result from tester	Success / Fail
TC-03	Identify the type of acne	Able to identify the type of acne	Success (5)
TC-04	Classify the acne based on severity	Able to classify the severity of the acne	Success (5)

5.3.1.3 Treatment Recommendation Module

Table 5.5 Treatment Recommendation Module Test

Test Case	Test Description	Result from tester	Success / Fail
TC-05	Give the prescribe medication to treat the acne	Able to give prescription of the medication	Success (5)
TC-06	Suggest appropriate treatment recommendation based on the result and user detail	Able to give the suggestion treatment for the acne	Success (5)

5.3.1.4 Medical Report Generator Module

Table 5.6 Medical Report Generator Module Test

Test Case	Test Description	Result from tester	Success / Fail
TC-07	Generate the medical report based on acne result	Able to generate the medical report based on acne result	Success (5)

5.3.1.5 User Interface Module.

Table 5.7 User Interface Module Test

Test Case	Test Description	Result from tester	Success / Fail
TC-08	Insert or select images from user device	Able to select or insert images	Success (5)
TC-09	Use the detection and treatment module	User able to understand how the detection and treatment module works	Success (5)
TC-10	Use the medical report module	user able to get the medical report in PDF format	Success (5)
TC-11	The design and interface of the system	User able to understand the flow of the interface system	Success (5)

5.4 Summary

This chapter discuss further into the application's testing processes. The test findings showed that the application met the project's essential requirements. The benefits, challenges, and possible areas for improvement are discussed in the next chapter.

CHAPTER 6: CONCLUSION

6.1 Observation on Weaknesses and Strengths

In the following section, we will look at the strengths and weaknesses of the Acne Detection and Severity by Using CNN for Internet of Healthcare Things. This review is critical for providing an assessment of the system's performance and potential areas for improvement. By examining the system's flaws, it is possible to identify crucial parts that require attention and improvement. Recognizing the system's strengths provides useful insights into its successful aspects, which improve the user experience. This complete examination of strengths and weaknesses serves as the foundation for informed recommendations aimed at correcting the system's shortcomings while strengthening its advantages. The purpose of this systematic procedure is to fine-tune the acne identification and severity expert system so that it better meets user expectations and requirements.

6.1.1 Strengths

In dermatology, there are few mobile applications that use to determine the acne and its severity. This rarity creates a great opportunity because the system is made to the specific needs and challenges of an acne detection system. Beyond its uniqueness, the Acne Detection and Severity by Using CNN for Internet of Healthcare Things are significant for its simplicity and user-friendliness. It was designed to be not just functional but also accessible to various types of users due to the user interface's simplicity and user-friendly.

6.1.2 Weaknesses

The Acne Detection and Severity by Using CNN for Internet of Healthcare Things have some weaknesses that should be highlighted. One of the most significant issues is the lack of sufficient dataset for algorithm training and fine-tuning. Some datasets have low image quality and cannot effectively detect acne. As a result, reaching the appropriate level of accuracy in classification remains a difficulty. Furthermore, while the system benefits users, its accuracy for both the detection and classification phases is currently below the desired threshold, causing the system to be inaccurate at times when detecting and classifying acne due to certain variables that may appear on the human face. Finally, it is crucial to highlight that developing and deploying a system incurs significant costs and effort. The money and time investment may present some problems in developing a smoothly integrated Acne Detection and Severity by Using CNN for Internet of Healthcare Things.

6.2 Propositions for Improvement

There are several propositions for improvement that can be made based on Table 6.2 below.

Improvement	Description
Collect more high-quality images for dataset	With more high-quality images of the acne, type of acne and their severity, the algorithm can learn more and has the benefit to increase the efficiency on detecting the acne and grading it.
Improve the efficiency and accuracy of the model	Using different algorithm or fine tuning more the model to increase the accuracy and efficiency of detection and classification
Add more variable to differentiate acne and others skin disease	Consider all the variable that might appear in the human face so it can increase the accuracy of the detection

Extra components in the mobile application	The mobile applications can be improved by adding extra feature such as the tips on skincare and chatbot about skincare and acne.

6.3 Project Contribution

Acne Detection and Severity by Using CNN for Internet of Healthcare Things can benefit several sectors in Malaysia such as social and economic sectors. This social sector includes self-treatment of acne that can be applied by various levels of user if they have access to the internet and ability to download the applications. This self-treatment can help in reducing the cost of treatment as it helps from the early stages and prevents it from getting worse in the future.

Next, Acne Detection and Severity by Using CNN for Internet of Healthcare Things can help improve the quality of the economic sector because this application can help in increasing business opportunities among the community, especially small businesses such as beauty salon or facial spa who are just starting to grow. For example, it can be used as the first step of beauty treatment. To help in get the right ingredient to treat the acne, beautician can use the application to identify the customer type of acne before they begin for further treatment. This will help in improving the quality of their business and treatment.

6.4 Summary

In conclusion, the Acne Detection and Severity by Using CNN for Internet of Healthcare Things achieved the project's objectives. Even if they have not yet been fully optimized to provide correct output, all the application's functions perform properly when a user uses them. This system's concept has real-world applications, particularly in dermatology. Its functionality can be enhanced for real-world use.

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APPENDICES

Appendix A : Main Interface (homepage.dart)

File - D:\UTEM\PSM\2. FrontEnd\Aesthetic Expert System\lib\homepage.dart

```dart
import 'package:aesthetic_expert_system/splash.dart';
import 'package:flutter/material.dart';
import 'detectionpage.dart'; // Make sure to import
  the DetectionPage file

void main() => runApp(const MyApp());

class MyApp extends StatelessWidget {
  const MyApp({super.key});

  static const appTitle = 'Aesthetic';

  @override
  Widget build(BuildContext context) {
    return const MaterialApp(
        debugShowCheckedModeBanner: false,
        title: appTitle,
        home: Splash()
    );
  }
}

class Homepage extends StatefulWidget {
  const Homepage({super.key});

  @override
  _HomepageState createState() => _HomepageState();
}

class _HomepageState extends State<Homepage> {
  final _formKey = GlobalKey<FormState>();

  // Variables to store user input
  String _name = '';
  int _age = 0;
  String _gender = 'Male';
  String _activity = 'Indoor';
  bool _hasAllergy = false;

  // Gender options
  final List<String> _genders = ['Male', 'Female', '
```

File - D:\UTEM\PSM\2. FrontEnd\Aesthetic Expert System\lib\homepage.dart

```
40 Other'];
41
42   // Activity options
43   final List<String> _activities = ['Indoor', '
   Outdoor'];
44
45   @override
46   Widget build(BuildContext context) {
47     return Scaffold(
48       appBar: AppBar(
49         title: const Text(
50           'Aesthetic Expert System',
51           style: TextStyle(
52             fontWeight: FontWeight.bold,
53           ),
54         ),
55         backgroundColor: Colors.orange,
56       ),
57       body: SingleChildScrollView(
58         padding: const EdgeInsets.only(left:16.0,
   right: 16.0,top: 16.0),
59         child: Center(
60           child: Column(
61             mainAxisAlignment: MainAxisAlignment.
   center,
62             crossAxisAlignment: CrossAxisAlignment.
   center,
63             children: [
64               const Text(
65                 'Hello, Welcome',
66                 style: TextStyle(
67                   fontSize: 32,
68                   fontWeight: FontWeight.bold,
69                   color: Colors.brown,
70                 ),
71               ),
72               const SizedBox(height: 10),
73               const Text(
74                 'Please enter your details',
75                 style: TextStyle(
76                   fontSize: 20,
```

File - D:\UTEM\PSM\2. FrontEnd\Aesthetic Expert System\lib\homepage.dart

```
77                    fontWeight: FontWeight.bold,
78                    color: Colors.brown,
79                  ),
80                ),
81                const SizedBox(height: 10),
82                Form(
83                  key: _formKey,
84                  child: Column(
85                    crossAxisAlignment:
   CrossAxisAlignment.start,
86                    children: [
87                      TextFormField(
88                        decoration: const
   InputDecoration(labelText: 'Name'),
89                        validator: (value) {
90                          if (value == null || value.
   isEmpty) {
91                            return 'Please enter your
   name';
92                          }
93                          return null;
94                        },
95                        onSaved: (value) {
96                          _name = value ?? '';
97                        },
98                      ),
99                      TextFormField(
100                       decoration: const
   InputDecoration(labelText: 'Age'),
101                       keyboardType: TextInputType.
   number,
102                       validator: (value) {
103                         if (value == null || value.
   isEmpty || int.tryParse(value) == null) {
104                           return 'Please enter a
   valid age';
105                         }
106                         return null;
107                       },
108                       onSaved: (value) {
109                         _age = int.tryParse(value
```

File - D:\UTEM\PSM\2. FrontEnd\Aesthetic Expert System\lib\homepage.dart

```
109  ?? '0') ?? 0;
110                         },
111                       ),
112                       DropdownButtonFormField<String>(
113                         decoration: const
    InputDecoration(labelText: 'Gender'),
114                         value: _gender,
115                         onChanged: (newValue) {
116                           setState(() {
117                             _gender = newValue ?? '
    Male';
118                           });
119                         },
120                         items: _genders.map((String
    gender) {
121                           return DropdownMenuItem<
    String>(
122                             value: gender,
123                             child: Text(gender),
124                           );
125                         }).toList(),
126                       ),
127                       DropdownButtonFormField<String>(
128                         decoration: const
    InputDecoration(labelText: 'Activity Preference'),
129                         value: _activity,
130                         onChanged: (newValue) {
131                           setState(() {
132                             _activity = newValue ?? '
    Indoor';
133                           });
134                         },
135                         items: _activities.map((String
     activity) {
136                           return DropdownMenuItem<
    String>(
137                             value: activity,
138                             child: Text(activity),
139                           );
140                         }).toList(),
141                       ),
```

File - D:\UTEM\PSM\2. FrontEnd\Aesthetic Expert System\lib\homepage.dart

```
142                     CheckboxListTile(
143                       title: const Text('Do you have
    any allergies?'),
144                       value: _hasAllergy,
145                       onChanged: (newValue) {
146                         setState(() {
147                           _hasAllergy = newValue ??
    false;
148                         });
149                       },
150                     ),
151                     const SizedBox(height: 20),
152                     Center(
153                       child: ElevatedButton(
154                         onPressed: () {
155                           if (_formKey.currentState
    ?.validate() ?? false) {
156                             _formKey.currentState?.
    save();
157                             Navigator.push(
158                               context,
159                               MaterialPageRoute(
160                                 builder: (context
    ) => DetectionPage(
161                                   name: _name,
162                                   age: _age,
163                                   gender: _gender,
164                                   activity:
    _activity,
165                                   hasAllergy:
    _hasAllergy,
166                                 ),
167                               ),
168                             );
169                           }
170                         },
171                         child: const Text('Submit'),
172                       ),
173                     ),
174                   ],
175                 ),
```

File - D:\UTEM\PSM\2. FrontEnd\Aesthetic Expert System\lib\homepage.dart

```
176                 ),
177               ],
178             ),
179           ),
180         ),
181       );
182   }
183 }
184
```

Appendix B : Detection Interface (detection.dart)

File - D:\UTEM\PSM\2. FrontEnd\Aesthetic Expert System\lib\detectionpage.dart

```dart
import 'package:flutter/material.dart';
import 'dart:io';
import 'package:image_picker/image_picker.dart';
import 'dart:convert';
import 'package:http/http.dart' as http;
import 'resultpage.dart'; // Import the ResultPage file

class DetectionPage extends StatefulWidget {
  final String name;
  final int age;
  final String gender;
  final String activity;
  final bool hasAllergy;

  const DetectionPage({
    super.key,
    required this.name,
    required this.age,
    required this.gender,
    required this.activity,
    required this.hasAllergy,
  });

  @override
  State<DetectionPage> createState() => _DetectionPageState();
}

class _DetectionPageState extends State<DetectionPage> {
  String buttonText = 'Get Result';
  String IP = '192.168.43.154:8000';
  File? _pickedImage;

  @override
  Widget build(BuildContext context) {
    return Scaffold(
      appBar: AppBar(
        title: const Text(
          'Acne Detection',
```

File - D:\UTEM\PSM\2. FrontEnd\Aesthetic Expert System\lib\detectionpage.dart

```
39            style: TextStyle(
40              fontWeight: FontWeight.bold,
41            ),
42          ),
43          backgroundColor: Colors.orange,
44        ),
45        body: Padding(
46          padding: const EdgeInsets.all(20.0),
47          child: Center(
48            child: Column(
49              mainAxisAlignment: MainAxisAlignment.
   center,
50              crossAxisAlignment: CrossAxisAlignment.
   center,
51              children: [
52                const Text(
53                  'Select an Image',
54                  style: TextStyle(
55                    fontSize: 32,
56                    fontWeight: FontWeight.bold,
57                    color: Colors.brown,
58                  ),
59                ),
60                const SizedBox(height: 10),
61                Text(
62                  'Upload or Capture an Image of the
   full face',
63                  textAlign: TextAlign.center,
64                  style: TextStyle(
65                    fontSize: 18,
66                    color: Colors.grey[600],
67                  ),
68                ),
69                const SizedBox(height: 20),
70                Container(
71                  height: 200,
72                  width: 200,
73                  decoration: BoxDecoration(
74                    border: Border.all(width: 2, color
   : Colors.grey),
75                    borderRadius: BorderRadius.circular
```

File - D:\UTEM\PSM\2. FrontEnd\Aesthetic Expert System\lib\detectionpage.dart

```
(0.0),
                ),
                child: _pickedImage != null
                    ? Image.file(_pickedImage!, height: 200, width: 200, fit: BoxFit.cover)
                    : Image.asset('images/face.jpg', height: 200, width: 200, fit: BoxFit.cover),
              ),
              const SizedBox(height: 20),
              Row(
                mainAxisAlignment: MainAxisAlignment.spaceEvenly,
                children: [
                  ElevatedButton(
                    style: ElevatedButton.styleFrom(
                      backgroundColor: Colors.orange,
                      elevation: 5,
                      shape: RoundedRectangleBorder(
                        borderRadius: BorderRadius.circular(8),
                      ),
                    ),
                    onPressed: () async {
                      File? pickedImage = await _pickedImageFromGallery();
                      if (pickedImage != null) {
                        setState(() {
                          _pickedImage = pickedImage;
                        });
                      }
                    },
                    child: const Text(
                      'Pick Image',
                      style: TextStyle(color: Colors.white),
                    ),
                  ),
                  ElevatedButton(
                    style: ElevatedButton.styleFrom(
```

File - D:\UTEM\PSM\2. FrontEnd\Aesthetic Expert System\lib\detectionpage.dart

```
108                       backgroundColor: Colors.orange
    ,
109                       elevation: 5,
110                       shape: RoundedRectangleBorder(
111                         borderRadius: BorderRadius.
    circular(8),
112                       ),
113                     ),
114                     onPressed: () async {
115                       File? pickedImage = await
    _pickedImageFromCamera();
116                       if (pickedImage != null) {
117                         setState(() {
118                           _pickedImage = pickedImage
    ;
119                         });
120                       }
121                     },
122                     child: const Text(
123                       'Take Picture',
124                       style: TextStyle(color: Colors
    .white),
125                     ),
126                   ),
127                 ],
128               ),
129               const SizedBox(height: 20),
130               ElevatedButton(
131                 style: ElevatedButton.styleFrom(
132                   backgroundColor: Colors.orange,
133                   elevation: 5,
134                   shape: RoundedRectangleBorder(
135                     borderRadius: BorderRadius.
    circular(8),
136                   ),
137                 ),
138                 onPressed: () async {
139                   if (_pickedImage != null) {
140                     await _showConfirmationDialog
    (() async {
141                       String apiUrl = 'http://$IP/
```

File - D:\UTEM\PSM\2. FrontEnd\Aesthetic Expert System\lib\detectionpage.dart

```
141 predict/';
142                         Map<String, dynamic> result =
    await fetchResult(apiUrl, _pickedImage!);
143
144                         Navigator.pushReplacement(
145                           context,
146                           MaterialPageRoute(
147                             builder: (context) =>
    ResultPage(
148                               result: result,
149                               name: widget.name,
150                               age: widget.age,
151                               gender: widget.gender,
152                               activity: widget.
    activity,
153                               hasAllergy: widget.
    hasAllergy,
154                             ),
155                           ),
156                         );
157                       });
158                   }
159                 },
160                 child: const Text(
161                   'Get Result',
162                   style: TextStyle(color: Colors.
    white),
163                 ),
164               ),
165             ],
166           ),
167         ),
168       ),
169     );
170   }
171
172   Future<File?> _pickedImageFromGallery() async {
173     final picker = ImagePicker();
174     final pickedFile = await picker.pickImage(source
    : ImageSource.gallery);
175
```

File - D:\UTEM\PSM\2. FrontEnd\Aesthetic Expert System\lib\detectionpage.dart

```
176     if (pickedFile != null) {
177       return File(pickedFile.path);
178     }
179
180     return null;
181   }
182
183   Future<File?> _pickedImageFromCamera() async {
184     final picker = ImagePicker();
185     final pickedFile = await picker.pickImage(source
    : ImageSource.camera);
186
187     if (pickedFile != null) {
188       return File(pickedFile.path);
189     }
190
191     return null;
192   }
193
194   Future<Map<String, dynamic>> fetchResult(String
    apiUrl, File imageFile) async {
195     var request = http.MultipartRequest('POST', Uri.
    parse(apiUrl))
196       ..files.add(await http.MultipartFile.fromPath(
'file', imageFile.path));
197
198     var response = await http.Response.fromStream(
    await request.send());
199
200     if (response.statusCode == 200) {
201       return jsonDecode(response.body);
202     } else {
203       throw Exception('Failed to fetch result');
204     }
205   }
206
207   Future<void> _showConfirmationDialog(Function
    onConfirm) async {
208     return showDialog<void>(
209       context: context,
210       barrierDismissible: false,
```

File - D:\UTEM\PSM\2. FrontEnd\Aesthetic Expert System\lib\detectionpage.dart

```
211        builder: (BuildContext context) {
212          return AlertDialog(
213            backgroundColor: Colors.white,
214            shape: RoundedRectangleBorder(
215              borderRadius: BorderRadius.circular(15.0
    ),
216            ),
217            title: const Row(
218              children: <Widget>[
219                Icon(
220                  Icons.warning_rounded,
221                  color: Colors.red,
222                ),
223                SizedBox(width: 8),
224                Text(
225                  'Warning',
226                  style: TextStyle(
227                    color: Colors.red,
228                    fontSize: 18,
229                    fontWeight: FontWeight.bold,
230                  ),
231                ),
232              ],
233            ),
234            content: const Column(
235              crossAxisAlignment: CrossAxisAlignment.
    start,
236              mainAxisSize: MainAxisSize.min,
237              children: <Widget>[
238                Text(
239                  'Using the wrong image may impact
    the accuracy of the Acne Prediction.',
240                  style: TextStyle(
241                    color: Colors.black,
242                    fontSize: 16,
243                  ),
244                ),
245                SizedBox(height: 12),
246                Text(
247                  'Are you sure you want to proceed
    with this image?',
```

File - D:\UTEM\PSM\2. FrontEnd\Aesthetic Expert System\lib\detectionpage.dart

```
248                   style: TextStyle(
249                     color: Colors.black,
250                     fontSize: 16,
251                   ),
252                 ),
253               ],
254             ),
255             actions: <Widget>[
256               TextButton(
257                 child: const Text(
258                   'Cancel',
259                   style: TextStyle(
260                     color: Colors.red,
261                     fontSize: 16,
262                   ),
263                 ),
264                 onPressed: () {
265                   Navigator.of(context).pop();
266                 },
267               ),
268               TextButton(
269                 child: const Text(
270                   'Confirm',
271                   style: TextStyle(
272                     color: Colors.red,
273                     fontSize: 16,
274                   ),
275                 ),
276                 onPressed: () {
277                   Navigator.of(context).pop();
278                   onConfirm();
279                 },
280               ),
281             ],
282           );
283         },
284       );
285     }
286 }
287
```

Appendix C : Result Interface (resultpage.dart)

File - D:\UTEM\PSM\2. FrontEnd\Aesthetic Expert System\lib\resultpage.dart

```dart
import 'package:flutter/material.dart';
import 'package:pdf/pdf.dart';
import 'package:pdf/widgets.dart' as pw;
import 'package:printing/printing.dart';
import 'package:flutter/services.dart';
import 'detectionpage.dart';

class ResultPage extends StatelessWidget {
  final Map<String, dynamic> result;
  final String name;
  final int age;
  final String gender;
  final String activity;
  final bool hasAllergy;

  const ResultPage({
    super.key,
    required this.result,
    required this.name,
    required this.age,
    required this.gender,
    required this.activity,
    required this.hasAllergy
  });

  Future<Uint8List> buildPdf(PdfPageFormat format) async {
    DateTime now = DateTime.now();
    String formattedMinute = '${now.minute}'.padLeft(2, '0');
    String dateTime = '${now.year}-${now.month}-${now.day} ${now.hour}:$formattedMinute';

    final pw.Document doc = pw.Document();

    doc.addPage(
      pw.Page(
        build: (pw.Context context) {
          return pw.Center(
            child: pw.Column(
              mainAxisAlignment: pw.MainAxisAlignment
```

File - D:\UTEM\PSM\2. FrontEnd\Aesthetic Expert System\lib\resultpage.dart

```
38 .center,
39                 crossAxisAlignment: pw.
   CrossAxisAlignment.center,
40                 children: [
41                   pw.Text(
42                     'Acne Test Report',
43                     style: pw.TextStyle(
44                       fontSize: 28,
45                       fontWeight: pw.FontWeight.bold,
46                       color: PdfColors.orange,
47                     ),
48                   ),
49                   pw.SizedBox(height: 20),
50                   pw.Text(
51                     'Generated on: $dateTime',
52                     style: pw.TextStyle(
53                       fontSize: 14,
54                       fontStyle: pw.FontStyle.italic,
55                       color: PdfColors.grey,
56                     ),
57                   ),
58                   pw.SizedBox(height: 10),
59                   pw.Text(
60                     'by Aesthetic',
61                     style: pw.TextStyle(
62                       fontSize: 14,
63                       fontStyle: pw.FontStyle.italic,
64                       color: PdfColors.grey,
65                     ),
66                   ),
67                 ],
68               ),
69             );
70           },
71         ),
72       );
73
74       doc.addPage(
75         pw.MultiPage(
76           pageFormat: PdfPageFormat.a4,
77           footer: (pw.Context context) {
```

File - D:\UTEM\PSM\2. FrontEnd\Aesthetic Expert System\lib\resultpage.dart

```
78            return pw.Container(
79              alignment: pw.Alignment.centerRight,
80              margin: const pw.EdgeInsets.only(top: 10
    .0),
81              child: pw.Text(
82                'Aesthetic - $dateTime',
83                style: pw.TextStyle(
84                  fontSize: 12,
85                  fontWeight: pw.FontWeight.bold,
86                  fontStyle: pw.FontStyle.italic,
87                  color: PdfColors.grey,
88                ),
89              ),
90            );
91          },
92          build: (pw.Context context) {
93            final currentResult = result;
94            final List<pw.Widget> content = [];
95
96            final isFace = currentResult['face_class'
    ] == 'Human';
97            final isAcne = currentResult['acne_class'
    ] == 'Acne';
98
99            content.addAll([
100             pw.Text(
101               'Name : ${name}',
102             ),
103             pw.Text(
104               'Age : ${age}',
105             ),
106             pw.Text(
107               'Gender : ${gender}',
108             ),
109             pw.Text(
110               'Activity Preferences : ${activity}',
111             ),
112             pw.Text(
113               'Allergy : ${hasAllergy}',
114             ),
115             pw.SizedBox(height: 15),
```

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```
116             pw.Text(
117               'Face Detected: ${currentResult['
    face_class']}',
118               style: pw.TextStyle(fontSize: 16,
    fontWeight: pw.FontWeight.bold),
119             ),
120             pw.SizedBox(height: 10)
121
122           ]);
123
124           if (isFace){
125             if (isAcne) {
126               content.addAll([
127
128                 pw.Text(
129                   'Acne Detection: ${currentResult['
    acne_class']}',
130                   style: const pw.TextStyle(fontSize
    : 16),
131                   textAlign: pw.TextAlign.left,
132                 ),
133                 pw.Text(
134                   'Severity: ${currentResult['
    severity_class']}',
135                   style: const pw.TextStyle(fontSize
    : 16),
136                 ),
137                 pw.Text(
138                   'Type of Acne: ${currentResult['
    type_of_acne_class']}',
139                   style: const pw.TextStyle(fontSize
    : 16),
140                 ),
141                 pw.Text(
142                   'Recommended Medication:',
143                   style: pw.TextStyle(fontSize: 16,
    fontWeight: pw.FontWeight.bold),
144                 ),
145                 pw.SizedBox(height: 5),
146                 pw.Text(
147                   'Product: ${currentResult['
```

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```
147 treatment_info'][Product']}',
148                     style: const pw.TextStyle(fontSize
    : 16),
149                   ),
150                   pw.Text(
151                     'Traditional Method: ${
    currentResult['treatment_info']['Traditional Method'
    ]}',
152                     style: const pw.TextStyle(fontSize
    : 16),
153                   ),
154                 ]);
155               } else {
156                 content.add(
157                   pw.Text(
158                     'Results indicate no signs of acne
     in your examination.',
159                     style: const pw.TextStyle(fontSize
    : 16),
160                   ),
161                 );
162               }
163             }
164             else {
165               // Handle case when there are no results
166               content.add(
167                 pw.Center(
168                   child: pw.Text(
169                     'Please insert full face image',
170                     style: const pw.TextStyle(fontSize
    : 16),
171                   ),
172                 ),
173               );
174             }
175
176
177             return content;
178           },
179         ),
180       );
```

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```
181
182     return await doc.save();
183   }
184
185   @override
186   Widget build(BuildContext context) {
187     return Scaffold(
188       appBar: AppBar(
189         leading: IconButton(
190           icon: const Icon(Icons.arrow_back),
191           onPressed: () {
192             Navigator.pushReplacement(
193               context,
194               MaterialPageRoute(
195                 builder: (context) => DetectionPage(
196                   name: name,
197                   age: age,
198                   gender: gender,
199                   activity: activity,
200                   hasAllergy: hasAllergy,),
201               ),
202             );
203           },
204         ),
205         title: const Text('Result Page'),
206         backgroundColor: Colors.orange,
207       ),
208       body: SingleChildScrollView(
209         child: Center(
210           child: Column(
211             mainAxisAlignment: MainAxisAlignment.
    center,
212             crossAxisAlignment: CrossAxisAlignment.
    center,
213             children: [
214               const SizedBox(height: 20),
215               const Text(
216                 'ACNE TEST RESULT',
217                 style: TextStyle(fontSize: 24,
    fontWeight: FontWeight.bold, color: Colors.brown),
218               ),
```

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```
219                const SizedBox(height: 20),
220                SizedBox(
221                  height: MediaQuery.of(context).size.
    height * 0.6,
222                  child: ListView(
223                    shrinkWrap: true,
224                    children: _buildResultDetails(
    result['face_class'], context),
225                  ),
226                ),
227                const SizedBox(height: 20),
228                ElevatedButton(
229                  style: ElevatedButton.styleFrom(
230                    backgroundColor: Colors.orange,
231                    elevation: 5,
232                    shape: RoundedRectangleBorder(
233                      borderRadius: BorderRadius.
    circular(8),
234                    ),
235                  ),
236                  onPressed: () {
237                    Printing.layoutPdf(
238                      onLayout: (PdfPageFormat format
    ) => buildPdf(format),
239                    );
240                  },
241                  child: const Text(
242                    'Save as PDF',
243                    style: TextStyle(color: Colors.
    white),
244                  ),
245                ),
246                const SizedBox(height: 10),
247                ElevatedButton(
248                  style: ElevatedButton.styleFrom(
249                    backgroundColor: Colors.orange,
250                    elevation: 5,
251                    shape: RoundedRectangleBorder(
252                      borderRadius: BorderRadius.
    circular(8),
253                    ),
```

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```
254                 ),
255                 onPressed: () {
256                   Navigator.of(context).
    pushReplacement(MaterialPageRoute(
257                     builder: (context) =>
    DetectionPage(
258                       name: name,
259                       age: age,
260                       gender: gender,
261                       activity: activity,
262                       hasAllergy: hasAllergy,),
263                   ));
264                 },
265                 child: const Text(
266                   'Back to Test Menu',
267                   style: TextStyle(color: Colors.
    white),
268                 ),
269               ),
270             ],
271           ),
272         ),
273       ),
274     );
275   }
276
277   List<Widget> _buildResultDetails(String faceLabel
    , context) {
278     final List<Widget> details = [];
279
280     if (faceLabel == 'Human') {
281       if(result['acne_class'] == 'Acne')
282         {
283           details.addAll([
284             ListTile(
285               title: Column(
286                 crossAxisAlignment:
    CrossAxisAlignment.start,
287                 children: [
288                   Text(
289                     'Name : ${name}',
```

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```
290                     ),
291                     Text(
292                       'Age : ${age}',
293                     ),
294                     Text(
295                       'Gender : ${gender}',
296                     ),
297                     Text(
298                       'Activity Preferences : ${
    activity}',
299                     ),
300                     Text(
301                       'Allergy : ${hasAllergy}',
302                     ),
303                     const SizedBox(height: 5),
304                     Text(
305                       'Face Detected: ${result['
    face_class']}',
306                       style: const TextStyle(
    fontWeight: FontWeight.bold),
307                     ),
308                     const SizedBox(height: 5),
309                     Text('Acne Detection: ${result['
    acne_class']}'),
310                     const SizedBox(height: 5),
311                     Text('Severity: ${result['
    severity_class']}'),
312                     const SizedBox(height: 5),
313                     Text('Type of Acne: ${result['
    type_of_acne_class']}'),
314                     const SizedBox(height: 5),
315                     Text('Recommended Medication:'),
316                     const SizedBox(height: 5),
317                     Text('Product: ${result['
    treatment_info']['Product']}'),
318                     const SizedBox(height: 5),
319                     Text('Traditional Method: ${result
    ['treatment_info']['Traditional Method']}'),
320                   ],
321                 ),
322               ),
```

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```
323             ]);
324           } else {
325           // If the predicted label is not 'Acne',
    display only the predicted label
326           details.addAll([
327             ListTile(
328               title: Column(
329                 crossAxisAlignment: CrossAxisAlignment
    .start,
330                 children: [
331                   Text(
332                     'Name : ${name}',
333                   ),
334                   Text(
335                     'Age : ${age}',
336                   ),
337                   Text(
338                     'Gender : ${gender}',
339                   ),
340                   Text(
341                     'Activity Preferences : ${activity
    }',
342                   ),
343                   Text(
344                     'Allergy : ${hasAllergy}',
345                   ),
346                   const SizedBox(height: 5),
347                   Text(
348                     'Face Detected: ${result['
    face_class']}',
349                     style: const TextStyle(fontWeight
    : FontWeight.bold),
350                   ),
351                   const SizedBox(height: 10),
352                   Text(
353                     'Acne Detection: ${result['
    acne_class']}',
354                   ),
355                   const SizedBox(height: 10),
356                   const Text(
357                       'Results indicate no signs of
```

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```
357 acne in your examination.'
358                   ),
359                 ],
360               ),
361             ),
362           ]);
363
364           }
365
366       }
367       else {
368         details.addAll([
369           ListTile(
370             title: Column(
371               crossAxisAlignment: CrossAxisAlignment.
    start,
372               children: [
373                 Text(
374                   'Face Detected: ${result['face_class
    ']}',
375                   style: const TextStyle(fontWeight:
    FontWeight.bold),
376                 ),
377                 const SizedBox(height: 10),
378                 const Text(
379                     'Please insert human full face
    image'
380                 ),
381               ],
382             ),
383           ),
384         ]);
385       }
386
387       return details;
388     }
389 }
390
```