SKIN DISEASES DIAGNOSIS SUPPORT SYSTEM USING FUZZY LOGIC

NORNADZIRAH HAFIZAH BINTI ABDULLAH

BACHELOR OF COMPUTER SCIENCE

UNIVERSITI MALAYSIA PAHANG

UNIVERSITI MALAYSIA PAHANG

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Position : SENIOR LECTURER

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ID Number : CA15115

Date : 12 December 2018

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NORNADZIRAH HAFIZAH BINTI ABDULLAH

Thesis submitted in fulfillment of the requirements
for the award of the degree of
Bachelor of Computer Science (Computer System & Networking) with Honors

Faculty of Computer System & Software Engineering

UNIVERSITI MALAYSIA PAHANG

DECEMBER 2018

ACKNOWLEDGEMENTS

Firstly, I would like to express my special thanks of gratitude to my parents Mr. Abdullah bin Chik and Mrs. Hatijah binti Abdul Majid because of the supportive advices, moral support and spending a lot of money to help me finish this final year project.

Next, I want to present a lot of gratitude to my supervisor, Dr. Noorhuzaimi @ Karimah binti Mohd Noor for being the greatest guider, give a lot of suggestions and moral support for my final year project entitled “Skin Diseases Diagnosis Support System using Fuzzy Logic. This appreciation also gives to Dr. Anis Farihan because give information about Fuzzy Logic. Not forget to Dr. Arfian for conducting the Colloqium. Here also I would like to thank to all lecturer and Staff of Faculty Computer System and Software Engineering. Thank you, I wish to all supports, encouragement and effort that faculty do for this final years students.

Lastly, I would like to extend my gratefulness to my friend Natasha binti Zainal for the helps, suggestions and moral support throughout the completion of this research.

ABSTRAK

Terdapat banyak jenis penyakit kulit dan sukar untuk mengenal pasti kategori penyakit kulit. Penyakit kulit mudah terjejas oleh semua umur yang berbeza sama ada kanak-kanak atau orang dewasa. Terdapat banyak jenis penyakit kulit termasuk lupus, jerawat, psoriasis, eksim dan impetigo. Walau bagaimanapun, kajian ini hanya memberi tumpuan kepada satu jenis penyakit kulit sahaja iaitu ekzema. Berdasarkan penyelidikan yang telah dijalankan, terdapat banyak penyelidik terdahulu menggunakan kaedah pemprosesan imej untuk menentukan penyakit kulit. Pemprosesan imej memerlukan lebih banyak masa untuk belajar dan memerlukan ruang memori yang besar untuk memasang perisian. Selain itu, pemprosesan imej juga memerlukan kamera yang berkualiti tinggi atau mana-mana peranti untuk menangkap imej untuk mendapatkan hasil yang tepat. Untuk membeli peranti itu adalah mahal dan tidak semua pengguna awam mampu membelinya. Oleh itu, kajian ini bertujuan untuk mengenalpasti jenis kulit ekzema yang berpenyakit berdasarkan faktor-faktor seperti kerengsaan kulit, keadaan kulit, lokasi kasih sayang dan sejarah keluarga. Model konseptual juga telah dicadangkan sebagai gambarajah logik untuk menunjukkan sistem kerja. Model konseptual berdasarkan peraturan diagnostik. Model dan peraturan konseptual telah diuji dengan menggunakan peningkatan pengetahuan pengguna sebelum dan selepas menggunakan penyelesaian yang dicadangkan. Ujian yang telah dijalankan tidak terlibat dengan pengesahan peraturan kerana masalah pakaian untuk bertemu dengan ahli dermatologi. Pengetahuan pengguna yang diuji menunjukkan bahawa pengetahuan pengguna meningkat ekzema berbanding sebelum mereka menggunakan penyelesaian yang dicadangkan. Oleh itu, penyelesaian yang dicadangkan memberikan manfaat kepada pengguna awam untuk memahami penyakit penyakit kulit mereka dan rawatan terdahulu yang mungkin mereka boleh memohon.

ABSTRACT

There are many types of skin diseases and difficult to identify the categories of skin diseases. Skin diseases can easily get affected by all different ages either children or adults. There are many types of skin disease include lupus, acne, psoriasis, eczema and impetigo. However, this research only focuses on one type of skin disease only which is eczema. Based on the research that has been conducted, there are many previous researchers use image processing method to determine the skin diseases. The image processing requires more time to learn and need a large space of memory to install the software. Other than that, image processing also requires a high quality of camera or any devices to capture an image to get the accurate result. To buy the devices is costing and not all public users afford to buy it. Thus, this research has purposed a system to identify the type of eczema skin diseased based on factors such as skin irritation, skin condition, location of affection and family history The conceptual model also has been proposed as a logical diagram to show the system work. The conceptual model is based on diagnostic rules. The conceptual model and rules has been tested by using user knowledge improvement before and after using the proposed solution. The test that has been conducted not involved with rules verification because of attire constraint to meet with the dermatologist. The user knowledge tested show that the knowledge of user is increase about eczema compared to before they used the proposed solution. Thus, the proposed solution gave benefit to public user to understand their skin disease diseases and earlier treatment that possible they can applied.

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LIST OF ABBREVIATIONS

SDSSS	Skin Disease Diagnosis Support System
XAMPP	Cross-platform Apache, Window, Mac, MySQL, PHP, Perl

CHAPTER 1

INTRODUCTION

1.1 Introduction

Human skin is the biggest organ of human which it masses is approximately around 4 kg to 5 kg. As it has the surface area of about 1.2 m^2, skin have high possibility expose to any skin infection (Damilola A. Okuboyejo, 2013). However, every person has different kind of sensitivity on their skin. Human skin has many functions, which is to protect human from microbes, any skin infection. It also helps to regulate body temperature and permits the sensation of touch.

Human skin has three layers known as epidermis, dermis and hypodermis. Epidermis is the most outer layer of skin that is waterproof barrier and generates our skin tone. Human skin's tone is form by cells that called melanocytes which produce the pigment known as melanin. Melanin protects the human skin from damage cause by sun exposure. The more melanin produces by the melanocytes, the ability to get darker skin is high. Meanwhile, dermis is the thick layer beneath the epidermis that consists of many important structures such as hair follicles, sweat gland, blood vessels and any other structures. Furthermore, the deeper subcutaneous tissue called hypodermis is made up of fat and connective tissue (Islam et al., 2017).

Skin is the most easily infected organ by skin diseases. Many factors are contributing to the occurrence of skin diseases. Understanding the nature of our skin problems is the most important thing in order to prevent from any skin infections occurred in future. One of the factors is diet. A physician named Yan reveals that daily diet such as seafood, coffee, tea, cold beverages and also the food that is raw, spicy or fried should be avoided if a person wants to make sure a healthy skin. Other than that,

climate also the factors of the skin become drying. It is because, the cold or dry climate causes the patients that suffer from eczema to flare while for the hot or humid climate, the skin will affect by the growth of acne.

There are many types of skin disease has been faced by the citizen in the whole world. Skin diseases can easily get affected by all different ages either children or adults. There are a few types of skin disease, lupus, acne, psoriasis, eczema and impetigo. This research only focuses one type of skin disease only which is eczema. Eczema or also called as dermatitis is a common skin condition marked by itchy and inflamed. It is caused by an overactive of immune system in human body. Commonly, eczema found in family with history of asthma and allergy. For some reason, it also caused by certain exposure to household products like detergent and soap or directly contact to animal dander may cause an infection. Respiratory infections or colds also can trigger the disease. Young children and babies are commonly affected by this disease and normally occur on the faces of toddlers. It also frequently presents on fold parts of the skin like inside the elbow and behind the knees of children, teenagers and adults.

Nevertheless, the type of skin disease has their own treatments to cure them. Every disease has different types of treatments. The treatments also depend on how serious or moderate the skin that has been exposed by the diseases. Furthermore, the medication can be any. For medium infection, normally the physician prescribes to apply cream or ointment and also moisturizer in ointment. For severe inflammation, the physicians will suggest the oral medication, light therapy and injection. Sometimes counselling session also can be done for a person that faces with depression.

Thus, this research will propose a system to identify the type of skin disease that focuses on eczema by using fuzzy logic rules based on age, symptoms and history factors. This is an initiative for users or patients identify their skin disease on their own.

1.2 Problem statement

Based on research that has been done, found that the method used to diagnose skin diseases usually is by using image processing. It is a safe and no side effects, risks or disruption from the user prospect. Moreover, it also gives benefit of the doctors to use it because it is fast and can be implemented in any device such as mobile phones, computers and also digital cameras (Florence Tushabe). However, this approach has its own disadvantages which is image processing is depends on camera resolution. In this case, camera with best resolution demands a high price device such as mobile phones that not all affordable to have. Additionally, capability to perform the operation of the method take time depends on a person expert. It is also requiring high capacity of processor and large amount of battery consumption.

Therefore, to make sure the public user able to use a method to detect their skin disease, this system will use age, symptom and history as a solution for this problem. A person can identify what are the types of skin disease that the user infected as he or she can see and feel the changes happen to them. Additionally, to care of eczema it needs intensive care. Therefore, the users or patient will be given suggestion of home remedies and some medication in order to taking care of their skin and. The symptom identification of skin disease may help users to detect the disease earlier before do check up to the hospital.

To make this research successful, the method or technique will be used is fuzzy logic that focused on fuzzy rules. To develop fuzzy rules, users have to enter several inputs. The fuzzy rule can be defined as a conditional statement by the form of:

IF x is A
THEN y is B

The x and y are grammatical variables, A and B are grammatical values purpose by fuzzy sets on the universe of acknowledgements X and Y commonly.

1.3 Objectives

There are three objectives that have to achieve in this research. The objectives of this research are :

i. To identify factors to detect skin diseases for Eczema skin disease.
ii. To develop conceptual model for identifying the skin disease using Fuzzy Logic.
iii. To evaluate the model of skin disease identifications.

1.4 Project scope

Based on the objectives of this research, the scopes of this research are divided into three categories, which are:

Diseases

i) The type of disease that will focus on this research is eczema. The three types of eczema that will be highlighted are Atopic dermatitis, Contact dermatitis and Seborrheic eczema.

Diagnosis input

ii) Use age, symptoms and history to detect skin disease. User will be able to detect the skin themselves.

Diagnosis support system

iii) This research provides diagnosis support system in order to prove the fuzzy rules to detect the expected skin disease.

Testing

iv) User knowledge

User will fill Google Form before and after using the system. This is for testing the functionality of the system in order to diagnose the type of skin disease.

1.5 Thesis organization

Chapter 1 is the introduction and overview of the project. Apart of that, the problem statement also had been stated in this chapter. After discussed about the problem statement, objectives and scopes are produced.

In Chapter 2, the explanation of literature review and existing system is discussed. The comparison between existing systems will be discussed. Moreover, this chapter also include includes methods, techniques or technologies that suitable to be implemented in this research.

Chapter 3 will discuss on research methodology that had been used to develop the recommended project. In addition, in this chapter also has to highlight about the planning analysis as well as the design phase.

Chapter 4 will explain about the implementation, testing and result in the project. Every process involved in this research will be recorded.

Chapter 5 will review for the conclusion of the overall chapter and also future works that can be made for this system.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter will discuss about literature review of skin disease diagnosis. In this chapter also highlight the previous method used by the researchers to detect a skin disease. A part of this chapter, the problems and limitation of previous method has been found. Comparison between the existing systems also will be discussed. There are several types of skin diagnosis by using symptom, biopsy and Tzanck Testing. The previous methods that will highlight to diagnose a skin disease are image processing and Neural network, texture analysis and data mining. This research will come out with a method as a solution based on the problem occurred and the limitation which is the use of fuzzy logic.

2.2 Skin disease

Common types of eczema that normally occur among Malaysian are Atopic dermatitis, Contact dermatitis and Seborrheic eczema (Adawiyah Jamil, 2016).

2.3 Skin Diagnosis

There are varieties of skin diseases and every disease has their own classification. Every disease has different characteristics and a bit challenging to diagnose a disease due to the complexity of the uneven edge, tone and presence of hair on the human skin. Sometimes, doctors can simply look at the skin to classify the type of this skin disorder. For example, examine the scalps, nails and mucous membrane. Frequently, the doctors use a magnifying glass or dermatoscope to get the actual view of the skin. The declaration of the characteristics includes the size, shape, colour and

also the location of the flaw as well as the presence and absence of symptom or sign (Elizabeth H. Page).

2.3.1 Symptoms of eczema

This research will focus on three types of eczema which are Atopic dermatitis, Contact dermatitis and Seborrheic eczema. The overview, factors, risk factors, symptoms and prevention for every type of eczema will discuss in this section.

2.3.1.1 Atopic dermatitis symptoms

Atopic dermatitis is often used correspondingly with eczema is the common type of eczema (Bennington-Castro). It is also chronic eczematous skin disease that commonly found in childhood but can occur to any age. Furthermore, sufferers infected with atopic dermatitis have very sensitive skin (Gary W. Cole, 2018).

Factors that caused Atopic dermatitis are the environment, irritants and allergens. People who always expose to households such as harsh soaps, detergents and disinfectants will easily affect. However, the main risk factor is a person or family history records of eczema, allergies, hay fever or asthma. The condition of this type of eczema will make patient's skin red, itchy and a long lasting disease. It may be followed by asthma and hay fever. Normally, these conditions occurred by children by age 13.

The symptoms and signs of Atopic dermatitis may different from each person. The person will experience in dry skin, thickened, cracked and scaly skin. Other than that, the serious irritation may occur especially at night that cause poor sleep quality. The common parts of body that infected are hands, feet, ankles, wrists, neck, upper chest and eyelids. The folds are such as inside the bend of the elbows and knees. For infants, the infected areas are the face and scalp. The infected skin is will turn into red to brownish-grey patches. Moreover, existing on small and raised bumps can lead fluid when the surface scratched. Figure 2.1 to Figure 2.2 show the area of infected skins of Atopic dermatitis (Clinic, 2018a).

Figure 2.1 Atopic dermatitis inside knees

Figure 2.2 Atopic dermatitis inside elbow

2.3.1.2 Home remedies of Atopic dermatitis

There are several home remedies that can be practiced by the patients to reduce the itchy skin and can soothe inflamed skin. Firstly, moisturize the skin minimum twice per day by applying creams, ointments or lotions to keep moisture the skin. For infants' skin, petroleum jelly can be used to avoid the growth of atopic dermatitis. Secondly, apply an anti-itch cream such as non-prescription hydrocortisone cream to the damaged area. The cream can temporarily cure the itch. Thirdly, patients that affected by severe itchy can take an anti-itch medication such as cetirizine (Zyrtec) or fexofenadine (Allegra). Next, use gentle soaps more preferable because it can clear away the excess natural oils and dry skin. Other than that, to cover the affected area, patients can apply bandages to help comfort the skin from serious irritated. Lastly, after bathing, dry the skin carefully with a soft towel and cover the skin with moisturizer while the skin is still wet (Clinic, 2018a).

2.3.1.3 Contact dermatitis

Contact dermatitis is a red and itchy (Clinic, 2018b). Many factors that can trigger the reaction, they are soaps, cosmetics, fragrances, jewelry and plants. There are several common types of Contact dermatitis which are Irritant contact dermatitis and Allergic contact dermatitis.

i) Irritant contact dermatitis

Be a common type of contact dermatitis that occurs when the skin contacts with the irritating chemicals like rubbing alcohol, bleach and detergents (Clinic, 2018b), heats and experiences in too much friction (Fletcher, 2017).

ii) Allergic contact dermatitis

This type of of Contact dermatitis is caused by allergic reaction or by the immune system. Overreacting to a chemical or substances also leads to this infection (Fletcher, 2017).

Individual who may suffer from Contact dermatitis will experience in a red rash and itching which may be more serious. The skin may turn into dark and rough if the exposure continually happens. Other than that, the skin becomes dry, cracked and scaly. Moreover, the bumps and blisters may presence and sometimes along with oozing and crust. The infected area is getting swelling, burning or tenderness.

To differentiate between each type of Contact dermatitis, the individual should pay attention when the symptoms begin. The examples of Contact dermatitis are shown in Figure 2.3 and Figure 2.4 (Clinic, 2018b).

Figure 2.3 Contact dermatitis on palms

Figure 2.4 Contact dermatitis on hand

2.3.1.4 Home remedies of Contact dermatitis

Several ways can be applied to reduce itching skin that affected by contact dermatitis. Patients can analyse and avoid substances that trigger an allergic reaction. To reduce the itchy skin, patients can apply anti-itch cream such as steroid ointments for not more than two times per day for two or four weeks. Moreover, oral anti-itch medicine also preferable if the itching is severe such as diphenhydramine (Benadryl). Furthermore, they are also suggested to wear the gloves or protecting clothing such as face masks, gloves, goggles and other protection material to protect the skin from exposed to any irritating substances including the household cleansers. The most important thing is wash the skin because it can remove the rash-causing substance. Fragrance-free soap and warm water are preferable to remove the substances. Patients are strictly forbidden to scratch the damaged area and they have to trim their nails. If they cannot avoid from scratching the area, they have to cover their hands with a cloth. Moreover, any clothes or items that contact with a plant allergen such as poison ivy have to wash them. Other than that, apply the moisturizer regularly in order to help the moisture of the skin (Clinic, 2018b).

2.3.1.5 Seborrheic eczema

Seborrheic eczema also called seborrheic dermatitis (O'Connell, 2018) and seborrheic psoriasis (Clinic, March 2018) is a common skin condition that causes of scaly patches, dandruff and redness. It normally occurs on the scalp. However, the other parts of body may be affected such as face, upper chest and back. If the infants get involved, it is known as cradle cap.

There are two main factors that contribute this disease happen. First, an overproduction an excess amount of oil on the skin that leads to irritant. It causes the skin become greasy and red. Second is the trigger for *Malassezia* fungus which generally found in the skin's oil. Other than that, the disease may occur to infants because of the hormonal changes that occur during the pregnancy O'Connell (2018). The other risk factors that contribute of this type of skin disease are the environmental factors such as pollution. The use of skin care products those containing alcohol. In addition, patients that already suffer from medical condition like stroke, HIV and Parkinson's (O'Connell, 2018).

The common symptoms of Seborrheic eczema, the existing of skin flakes (dandruff) on a person's scalp, eyebrows, hair and beard or mustache. Moreover, the patches of greasy skin covered with flaky white or yellow scales or crust on the scalp will appear. The other areas are side of the nose, eyebrows, ears, eyelid, chest, armpits, groin area or also under the breasts. The skin becomes red and itching. Figure 2.5 to Figure 2.7 shows the infected area of Seborrheic eczema (Clinic, March 2018).

Figure 2.5 Seborrheic eczema on infant's scalp

Figure 2.6 Seborrheic eczema on infant's eyebrows

Figure 2.7 Seborrheic eczema on adult's chest

2.3.1.6 Home remedies of Seborrheic eczema

There are several ways to protect and control the skin that affected by seborrheic eczema. Firstly, patients can apply mineral oil or olive oil to the scalp to remove the scales or dandruff for several hours. After that, comb and wash the hair. Secondly, they have to wash the skin frequently and rinsing the soap to whole body and scalp and use

also moisturizer. Must be remembered, do not use the hard soaps Thirdly, medicated cream such as mild corticosteroid cream can be applied to the affected areas, keeping it away from eyes. If the cream does not effective, try to apply antifungal cream ketoconazole. Patients must be remembered not to use hair sprays, gels or other styling products that contain alcohol once they get suffered by this skin disease because it can cause the disease to flare up. Furthermore, if the patients have a beard or mustache, they have to shampoo that area with one percent ketoconazole daily until that symptoms disappeared. Shaving also recommended. Moreover, if the symptoms show redness or scaling on the eyelids, wash them every night with baby shampoo and clean the scales with cotton. For some case that involved the infants that has cradle cap, intensive care should be emphasized. Parents have to wash the scalp with non-medicated baby shampoo once per day. Remove the scales with soft brush before shampooing the scalp. For other alternative medicine, tea tree oil or shampoos that contain it can be applied to the affected area. Moreover, supplements that contain omega-3 fatty acids also can be consumed. Lastly, apply the aloe vera on the damaged skin also recommended (Clinic, March 2018).

2.3.2 Biopsy test

Biopsy test is examination under a microscope which a small piece of skin is removed from body to be examined. For the simple procedure, the doctor normally applies local anaesthetic to numbs a small area of skin by using scissors, small knife (scalpel), razor blade (called a shave biopsy) or round cutter (called a punch biopsy), expel a piece of skin on the area that disease expected to occur and type of tests to be done. A shave biopsy takes a thin slice of the top skin to be examined under the microscope. Meanwhile, the punch biopsy takes a small cylindrical fragment of the tissue from the expected area. Typically, to remove a small tumor, the doctor will remove the whole tumor and also the normal skin around it (Elizabeth H. Page). Figure 2.8 shows how the skin is removed to get the sample of skin.

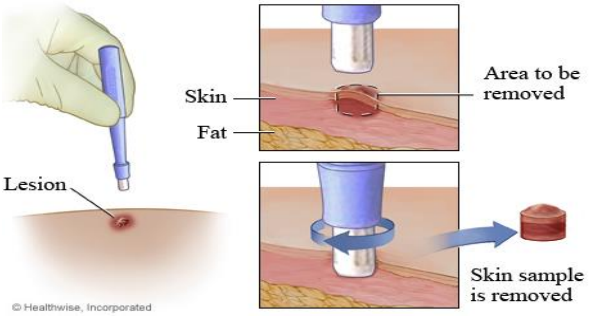

Figure 2.8 Biopsy test

2.3.3 Tzanck test

Tzanck test is conducted to guidance a doctor diagnoses certain disease that caused by viruses such as herpes simplex and herpes zoster. The blisters become visible to human skin when the diseases are active. Sharp blade will be used to remove the top of the blisters and scrapes the blister with a scalpel to get the fluid. Special stains will be applied before examining the specimen with a microscope (Elizabeth H. Page). Figure 2.9 shows how the affected skin is taken to undergo Tzanck test.

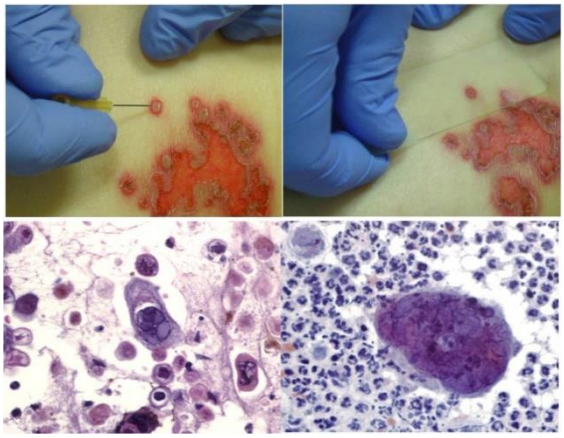

Figure 2.9 Tzanck test

2.4 Current Existing System

The following analysis of existing systems is to summarize the systems and to show the results produced by each systems. The results produced were different because of some factors.

2.4.1 Skin Disease Recognition Using Texture Analysis

(Islam et al., 2017) has conducted a research on skin disease recognition using neural network based on the texture analysis. Texture analysis is one of the most important aspects of human vision which it can distinguish objects based on visual patterns of the objects. There are some difficulties to diagnose the type of skin diseases because some diseases have very closes similarities in their symptoms such as redness, rash and pattern of infection for example, rubeola, rubella and Chickenpox. It also takes very long term process because patient's history also must be considered.

Hence, computer aided is presented to do the diagnosis and recognition. There are some computer algorithm has been implemented such as image processing, image feature extraction and classification of data with the help of classifier such as artificial neural network (ANN). The classifier can learn symptoms for specific disease and produce quick result of diagnosis and recognition.

Therefore, three types of skin diseases are considered in this system, they are eczema, impetigo and psoriasis. The results from the extracted features are divided into two which are training and testing dataset. For training system purpose, 50% of the images are used while the balance of the images works for testing set. For healthy skin, the output represent as '0' while for affected skin represent as '1'. Five out of twelve sample images are correctly classified and three of that are misclassified. The presentation of ANN is evaluated in terms of accuracy, sensitivity and specificity. The results show 80% of accuracy, 71.4% of sensitivity while 87.5% of specificity. However, the result produce are not totally correct because of some factors are not considered such as low quality of image produced due to the camera resolution, uneven skin surface and others. Other than that, neural network has its own disadvantage which the new data insert must be equal to previous data, if not it will produce the different result. However, for overall evaluation neural system determination of skin breakdown is achievable. Figure 2.10 shows the result achieves from the analysis.

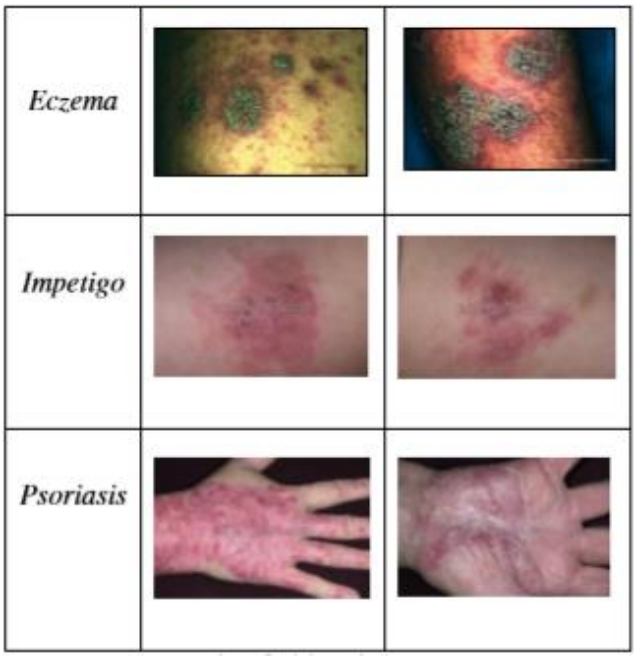

Figure 2.10 Result of three different types of skin diseases

2.4.2 Expert System for Diagnosis of Skin Diseases

According to this research paper by A.A.L.C Amarathunga (2015), a skin disease diagnosis system has been developed which enable users to identify a human skin diseases and come up with solution that gives them advises or medical treatments in a very short time period. The system will ask users to upload an image of skin disease and they also have to answer some questions that related to their skin condition or symptoms. The image will be used to detect what type of diseases that affected and also recommend a treatment. The technology is used by this system are image processing and data mining to diagnose a skin disease. The image taken must be subjected to vary preprocessing and free from noise. Threshold values are used for segmentation of the image.

Furthermore, data mining techniques are used to classify skin disease affected by a patient and suggest the medical treatment. Some questions will be asked from users such as age, gender, affected areas, how long it was infected. This is called questionnaires input that very applicable to classify the diseases. Moreover, five different data mining classification algorithm are used which are AdaBoost, Bayesnet, J48, MLP, and NaiveBayes. The best classifier will be determined from the result

produced. Based on the data mining classification model, the diagnosis of skin disease, forecast of skin disease and suggestion of medical treatment will be advertised to users.

Therefore, the result from this system expected the best five of classification algorithms that achieved from data mining classifier conclude the type of skin diseases they are, Melanoma, Impetigo and Eczema. The diseases classification accuracy for Eczema is 85%, 95% for Impetigo and 85% for Melanoma produce by this expert system. However, the results show less accuracy due to the distance when capturing the affected skin and camera lens about 5cm and the light effect when capturing the affected area is not considered. Figure 2.11 shows the accuracy result for the expert system.

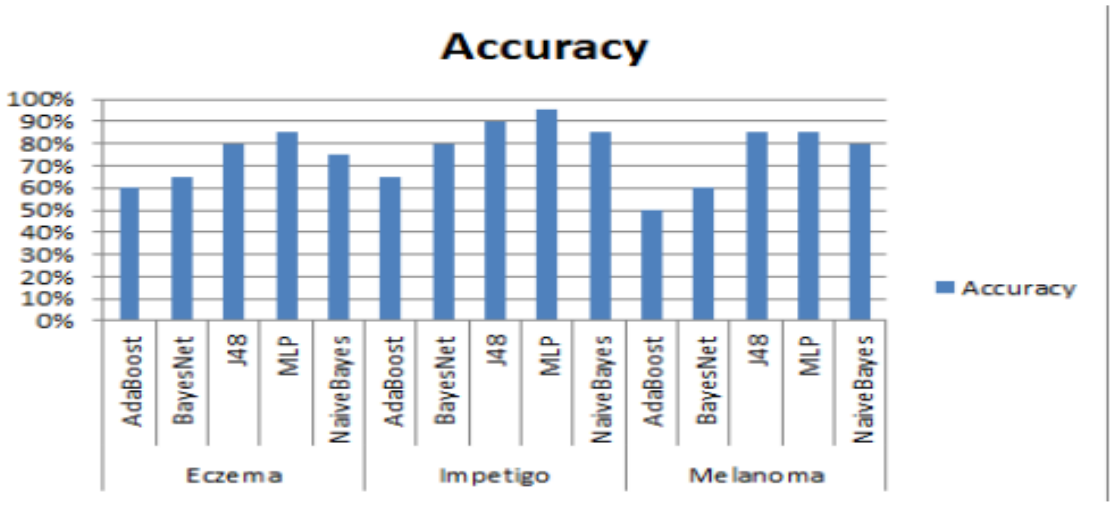

Figure 2.11 Accuracy result

2.4.3 A Web Based Decision Support System Driven by Fuzzy Logic for the Diagnosis of Typhoid Fever

(O.W. Samuel*, 2013) has proposed a Web-Based Decision Support System (WBDSS) for the determination of Typhoid Fever (TF). The diagnosis of typhoid fever comprises several variables that make it hard to get definite and timely diagnosis result. To solve the problem, this research proposes the WBDSS and the technique used is Fuzzy Logic (FL). This proposed system can help to support the inadequate of medical experts in developing countries and yet can cut down the extensive amount related with patient diagnosis.

The system uses signs, symptoms and laboratory experiment for the fuzzy logic inputs. The inputs are used to do the inspection of diagnosis process of specific patient. The proposed architecture of WBDSS by this system shows that the inputs values are retrieving from medical expert. The uses of www component in this system make it available to be accessed remotely around the world. Furthermore, the Knowledge Base (KB) and the Database (DB) also uses in the system. The data collected such as hereditary data, bio-data, strength of signs, symptoms, laboratory experimental result, medical diagnosis output and also medical expert's details that achieve from patients can be stored in the database. Other than the database, Rule Based (RB) also consists in the knowledge base that is the collection of IF-THEN statement to build the rules for the diagnosis of typhoid fever patient that working for the medical experts. Meanwhile, the signs, symptoms and laboratory experiment results represent as fuzzy logic component that supply by the medical expert and put in an application for pre-defined procedure to them. Finally, Fuzzy Inference Engine obtains its input from the rule base and fuzzification interface and the results of the diagnosis are developed by the pre-defined procedure. The other remaining parts are fully working in this research. Figure 2.12 shows the architecture of WBDSS for diagnosis of typhoid fever.

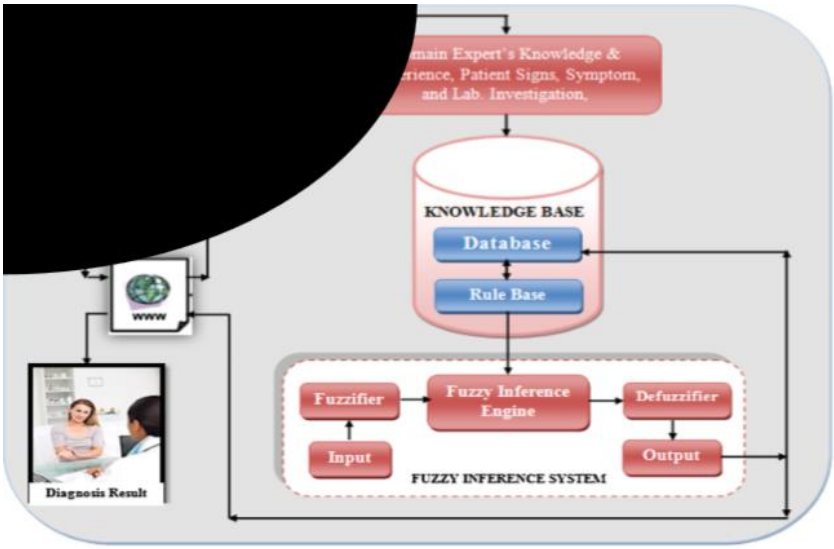

Figure 2.12 Architecture of WBDSS of typhoid fever

For the experiment purpose by the Federal Medical Center, Owo, Ondo State-Nigeria, 30 typhoid fever patients aged between 15 to 70 were collected, evaluated and

preprocessed to the required format. After that, the input and output parameters of the proposed system were described based on the linguistic variables and their allied fuzzy value range. Table 2.1 shows the linguistic variables and their fuzzy value range.

Table 2.1 Linguistic variables and their fuzzy value range

S/N	Linguistic variables	Fuzzy value
1	Very mild	0.0 <= x < 0.2
2	Mild	0.2 <= x < 0.4
3	Moderate	0.4 <= x < 0.6
4	Severe	0.6 <= x < 0.8
5	Very severe	0.8 <= x <= 1.0

The membership functions graph of the values shows in Figure 2.13. Meanwhile, Figure 2.14 depicts the patient diagnosis module interface. The interface is used for the medical expert on key in the values appear for signs, symptoms and laboratory experiment of the typhoid fever patient.

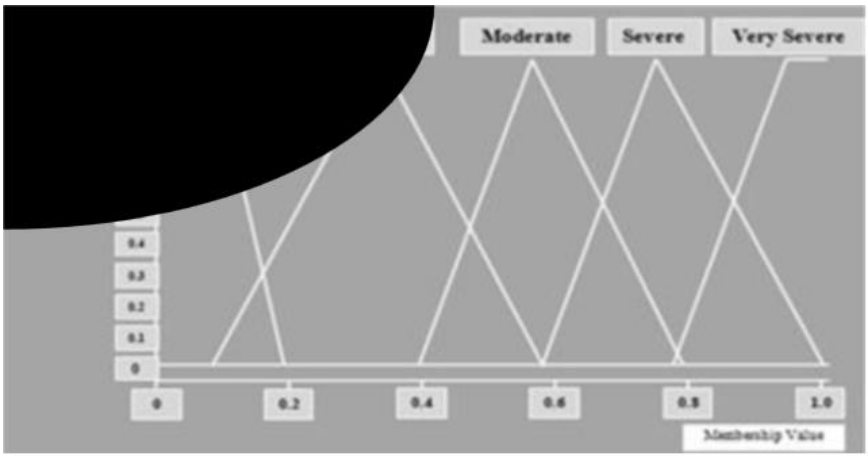

Figure 2.13 Membership function

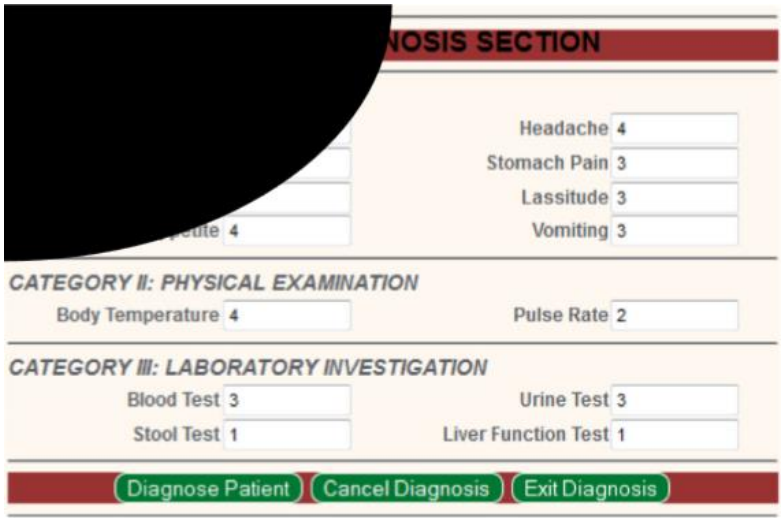

Figure 2.14 Patient diagnosis module

For the experimental result and system evaluation, for the strength of the signs, symptoms and lab experiment for typhoid fever patients were assessed as very mild (1), mild (2), moderate (3), severe (4) and very severe (5). In effort to get the accuracy results of proposed system, the comparative analysis of diagnosis results of five patients that acquired from conventional method was transferred to the system. Since the knowledge base of the proposed system is consolidated, it has the ability of placing a huge amount of information from which functional knowledge and patterns that could support the decision making. As the result, noticed that the proposed system is 94% efficient in giving accurate diagnosis. Figure 2.15 shows the diagnosis output for a sample patient. Based on the figure, the patient has Moderate Typhoid Fever with 56% severity. The result was achieved from the crisp value of defuzzification technique.

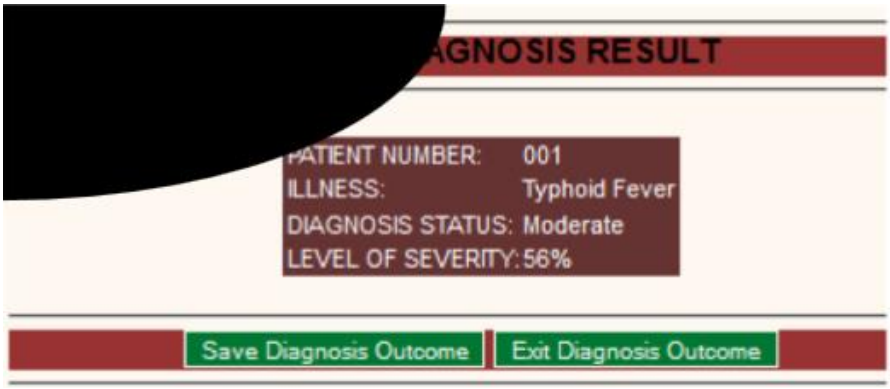

Figure 2.15 Diagnosis output for a sample patient

2.5 Techniques of current existing systems

There are three techniques that applied by previous researchers. The techniques are image processing, neural network and fuzzy logic.

2.5.1 Image processing technique

In this research paper by A.A.L.C Amarathunga (2015), image processing is required to identify the location of the skin affected by the disease. The captured image of the skin disease must be saved and eliminate all the noises such as hairs, bubbles etc. To help this average filtering process, Gaussian smoothing process is applied. To eliminate the background of the image, algorithms are used in this segmentation process. Separation of the region of the disease occurs. The image also undergoes features extraction then the extracted features will be sent to data mining unit to enable the diagnosis of skin diseases process. Figure 2.16 shows the flow of the image processing unit.

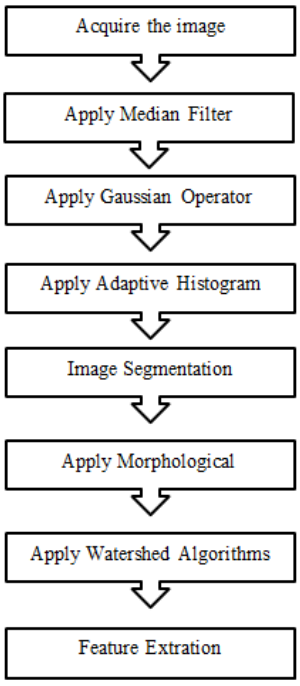

Figure 2.16 Flow of image processing unit

2.5.1.1 Implementation of image processing

Implementation of method will differ for every different technologies used. The digital image that takes from normal camera normally contains noises such as hair, air bubbles etc. If the noise does not eliminate from this digital images, it will lead to inaccuracy of the classification and the system will produce a wrong prediction of skin disease.

Two techniques apply to this image processing which is preprocessing and post processing. Preprocessing is done to remove the background noises from the image. Gaussian and median filtering are used to eliminate the particular skin image and to obtain smoothing image. Median filtering is a common step in image processing uses for smoothing image. Meanwhile, post processing is used to improve the shape and edges of skin image. Then, this system will apply image segmentation in order to separate the skin disease from the healthy skin by using threshold segmentation concept. Then, to eliminate the same type of objects, Morphological segmentation is used that commonly perform on binary images. This process needs two inputs that called original image and structuring elements or kernel which decide the nature of operation. To identify skin disease area, watershed is used and finally extracted feature is done. The C++ using open sources library called OPEVCV is implemented to all components image processing unit. Figure 2.17 shows the identification of disease region.

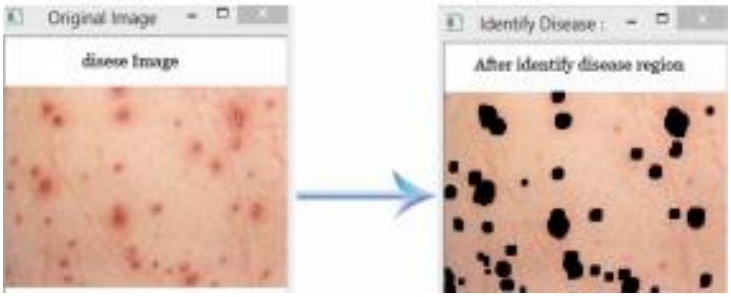

Figure 2.17 Identification of disease region

2.5.2 Neural network technique

Neural networks are parallel computing devices. Basically, it is an effort of making computer model of the brain. The objective of developing the neural network is

to make a system with faster computational task performance rather than traditional systems. Artificial Neural Network (ANN) is a dynamic computing system whose fundamental topic from analogy of biological neural networks. The nerve cell called as neuron is a representation of biological neural networks. Moreover, there are the similarities based on the terminology between Biological Neural Network (BNN) and Artificial Neural Network (ANN), firstly the soma in neuron represent as node. Secondly, the dendrites represent as input. Then, the synapse represent as weight or interconnections. Meanwhile, axon represent as the output. Figure 2.18 show the example of neuron while Figure 2.19 shows the general model of artificial neural network.

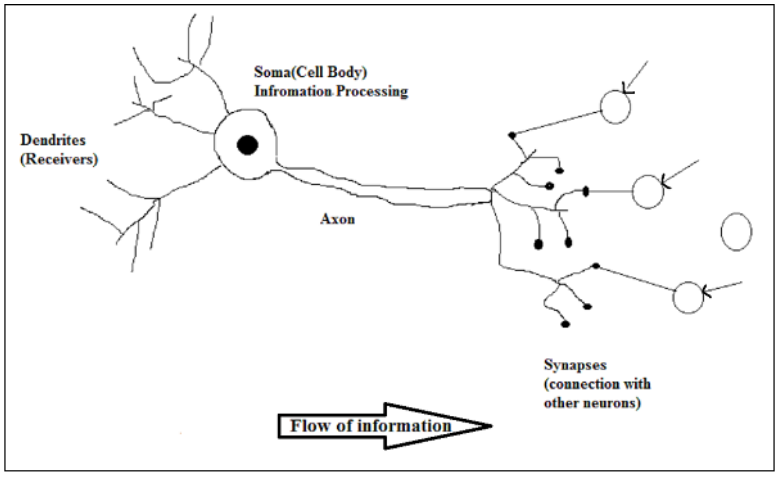

Figure 2.18 Example of neuron

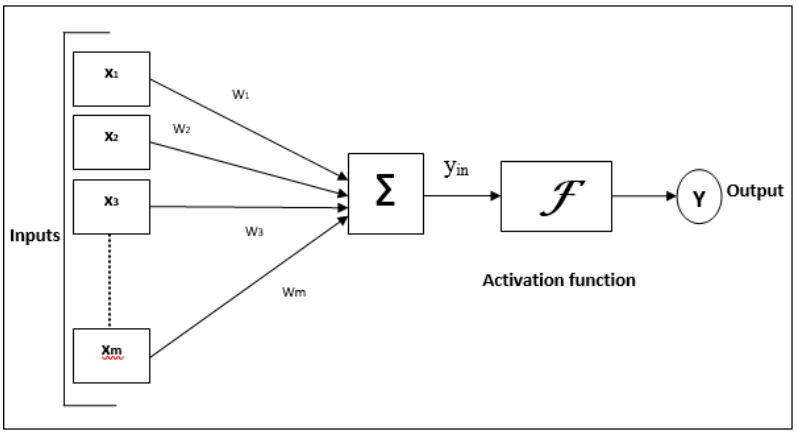

Figure 2.19 General model of neural network

For the input calculation of the general model of artificial neural network, it can be calculated as below:-

Furthermore, there are two network architecture in neural network which are single layer architecture and multilayer architecture. The concept of the single layer architecture of feed forward ANN only has one weighted layer which is the input layer if totally linked to the output layer. Meanwhile, the multilayer architecture, the feed forward of ANN has one or more weighted layer. The layers are called as input layer, hidden layer also known as middle layer and output layer. The feed forward means the signal able to flow in both directions by using loops that also makes it a non-linear dynamic system. Figure 2.20 shows the single layer network while Figure 2.21 shows the multilayer network (A. N. N. Tutorial, 2018).

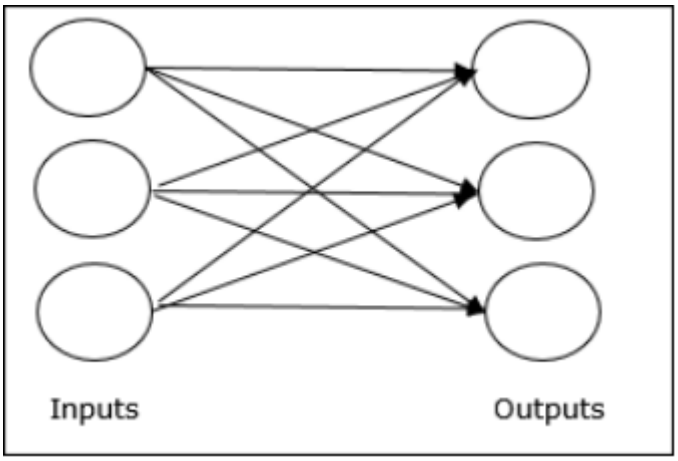

Figure 2.20 Single layer network

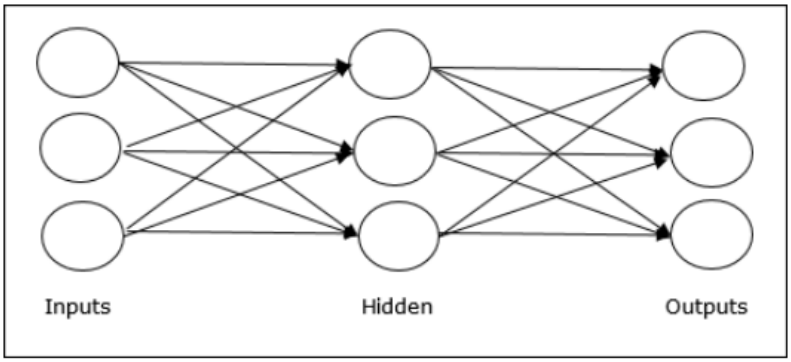

Figure 2.21 Multilayer network

Based on the system conducted by Islam et al. (2017), the neural network is used in classification of segmented image in image processing process. In this system, the multilayer architecture is used. For the training purpose, Back propagation (BPN) algorithm is applied. For the modifying weight value, hidden layer and output layer is used based on the error output in classification of dissimilar features. Meanwhile, in the

BPN algorithm, signal motion will be in forward direction. Furthermore, if both outputs do not match every time the output of the network being contrast with the required output, it will be caused of error signal. The solution to lower the error signal, alter the weights at the middle layer and propagate backwards of the error signal. Moreover, in BPN algorithm, initialized randomly the hidden layer and output layer weights during the initial of training. The inputs used for the neural network are Contrast, Correlation, Energy and Homogeneity.

2.5.3 Fuzzy logic technique

Fuzzy logic is a method to compute based on "degree of truth" rather than using "true or false" (0 or 1) of Boolean logic expression where the modern computer is refer to it. The fuzzy logic was introduced by Dr. Lotfi Zadeh of the University of California at Berkeley, USA in year of 1965 due to the difficulty of computer to understand the natural language (Rouse, 2014). Moreover, fuzzy logic is a way to make use of natural language in logic.

In the fuzzy logic, there are membership functions that used in fuzzification and defuzzification steps of a Fuzzy Logic System (FLS). Furthermore, the membership functions map the non-fuzzy input values to fuzzy linguistic terms and vice versa. Not only that, membership function is used to specify a linguistic term. Membership functions can be divided into four which are triangular, trapezoid, Gaussian (A. S. F. L. Tutorial, 2010).

Firstly, triangular membership functions are the simplest membership that constructs using straight line. The first membership function is triangular membership where it is the uncomplicated function. The function name called trimf. Meanwhile, the trapezoid membership function also called trapmf is flat top and curtail triangle curve. These straight line memberships give the advantage of simplicity. Figure 2.22 shows the example of the curves of trimf and trapmf.

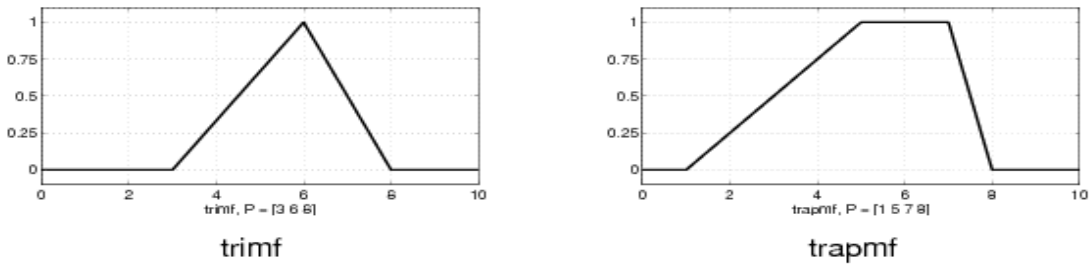

Figure 2.22 Trimf and trapmf curves

Below is the triangular membership function. The value a, b and c represent the coordinate of the three vertices of $\mu_A(x)$ in a fuzzy set A (value a is a lower boundary and value c is a upper boundary where the membership degree is zero, value b is the centre where membership is 1).

$$\mu_A(x) = \begin{cases} 0 & if\ x \le a \\ \dfrac{x-a}{b-a} & if\ a \le x \le b \\ \dfrac{c-x}{c-b} & if\ b \le x \le c \\ 0 & if\ x \ge c \end{cases}$$

Meanwhile, for the trapezoid membership function as below. The value a, b, c and d represent the x coordinate of the four vertices of $\mu_A(x)$ in a fuzzy set A (value a is a lower boundary and value d is a upper boundary where the membership degree is zero, value b and value c is the centre line where membership degree is 1).

$$\mu_A(x) = \begin{cases} 0 & if\ x \le a \\ \dfrac{x-a}{b-a} & if\ a \le x \le b \\ 1 & if\ b \le x \le c \\ \dfrac{d-x}{d-c} & if\ c \le x \le d \\ 0 & if\ x \ge d \end{cases}$$

The, third membership function is Gaussian distribution. This membership functions produce simple Gaussian curve and two-sided composite of two distinct Gaussian curve. The Gaussian membership functions are *gaussmf* and *gauss2mf.* Other than that is the bell-shaped membership called gbellmf. In addition, Gaussian and bell membership are the common approach to determine the fuzzy sets as they are smooth and pithy notation. The advantages of curves are smooth and non-zero at overall points. However, the drawbacks of this membership functions are incapable to determine asymmetric membership function. Figure 2.23 shows the example of Gaussian membership curves (Falah, 2014).

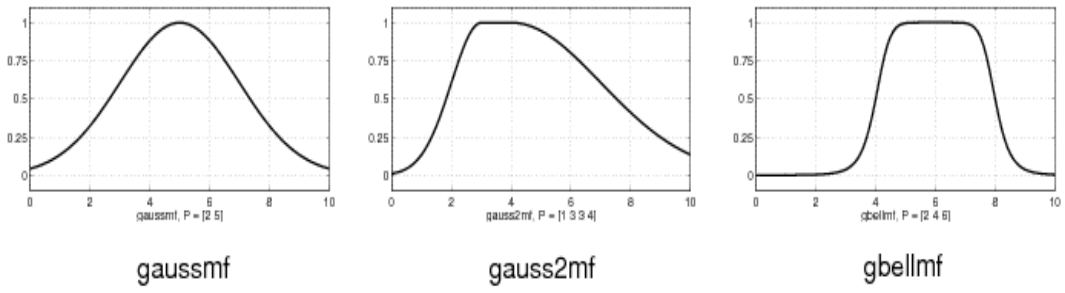

Figure 2.23 Gaussian membership curves

Fuzzy, logic also have fuzzy logic system (FLS) which can be interpret as a non-linear mapping of an input set to a scalar output data. To complete the FLS, it came out with four main parts called as fuzzifier, rules, inference engine and defuzzifier. Based on system proposed by (O.W. Samuel*, 2013), the FLS is shown in Figure 2.24 below.

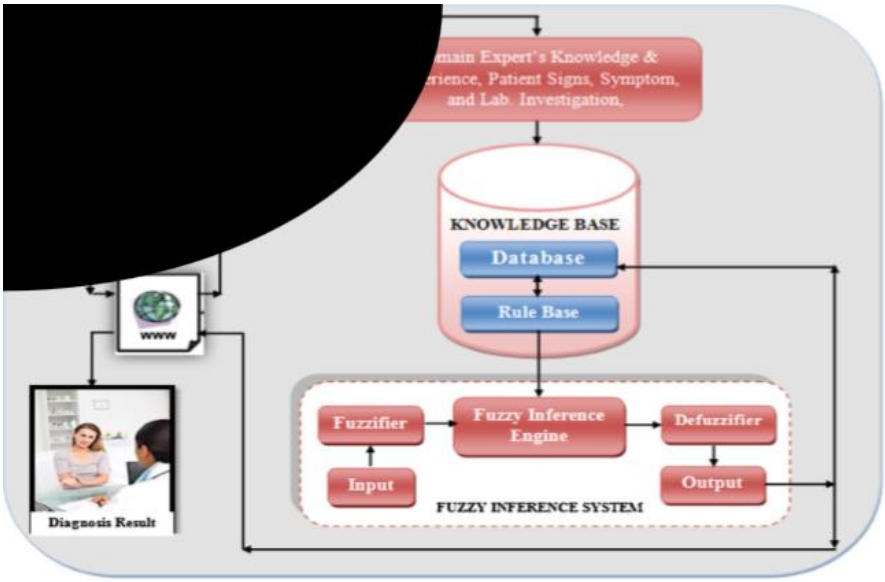

Figure 2.24 Fuzzy Logic System

Based on the propose system, the type membership function used is triangular membership function. Figure 2.25 shows the evaluation of the outcome of the linguistic variables using triangular membership function.

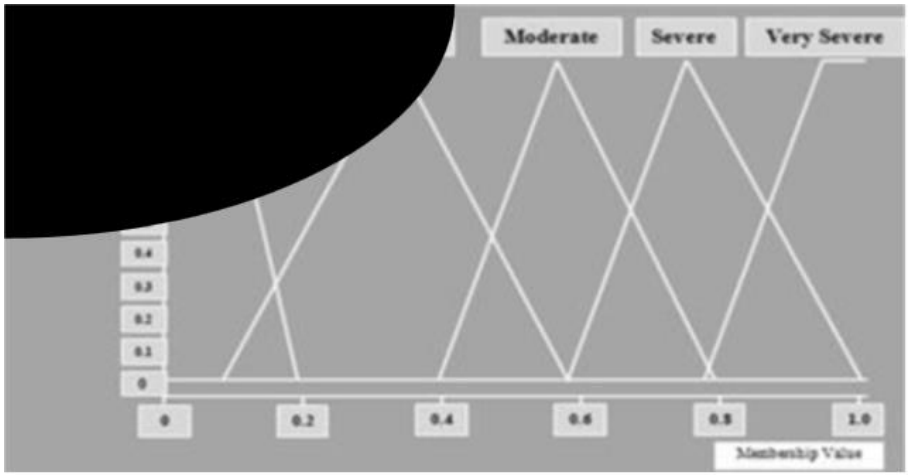

Figure 2.25 Membership function

The characterization of rule base for typhoid fever is a set of IF-THEN rules where the earlier (IF parts) and the resulting (THEN parts) associate linguistic variable. The rule base was created faithfully formulated with the aid of medical expert in the

field of tropical medicine. The rule burn if any of its priority parameter such as very mild, mild, moderate, severe, and very severe rate to true or 1 or else the rule does not burn. The example of the form of the rules in the rule base is shown as below:

IF FEV (fever) is Mild, AND HAD (headache) is Moderate AND AP

(abdominal pain) is Severe… THEN TF is Moderate

The fuzzy inference engine serve as the decision making engine. It collects its input from the rule base and the fuzzification interface. After that, it uses a pre-defined procedure in order to produce the required output to the set of inputs.

The final process is defuzzification that converts the output of the inference engine into crisp values which is particularly need by the medical experts for the appropriate analysis and explanation. In this system, it uses Centroid of Area (CoA) technique to undergo the defuzzification.

2.6 Comparison between existing system

Each existing system has its own strengths and weakness. Below are the table of comparison between three currents existing systems which are Skin Disease Recognition Using Texture Analysis, Expert System for Diagnosis of Skin Diseases and A Web Based Decision Support System Driven by Fuzzy Logic for The Diagnosis of Typhoid Fever based on particular specification. Table 2.2 shows the summarization of all systems comparison that discussed in the above paragraph.

Table 2.2 Comparison of three current exsting system

	Skin Disease Recognition Using Texture Analysis	Expert System for Diagnosis of Skin Disease	A Web Based Decision Support System Driven by Fuzzy Logic for The Diagnosis of Typhoid Fever

Method	Image processing, Artificial Neural Network (ANN)	Image processing, Data mining	Fuzzy logic
Input value	Image	Image, user questionnaires	User questionnaires
Validation method	Sensitivity, accuracy, specificity	Accuracy	Accuracy
Result & systems accuracy	Sensitivity-71.4%, Acuraccy-80%, Specificity-87.5%	Accuracy- Eczema:85% Impetigo:95% Melanoma:85%	Accuracy-94%
Limitation of systems	The use of image processing in this system will take a long period of time to produce an image without noise such as hair and air bubbles due to the image has to undergo many processes. The high resolution of camera is needed to take a perfect image.	Questionnaire is the data mining that collected from the user that may lead to inaccuracy of result because the possibility that the user input the wrong estimating of duration that the skin affected by a disease.	The membership function of fuzzy logic systems which explaining the linguistics labels working by systems that have similarity as the system normally takes longer time to design.

2.7 Conclusion

Due to the problem occur based on the previous systems, this research will propose a diagnosis support system to determine the type of skin diseases using fuzzy logic rule base. This research will develop a support system and the fuzzy rules will be implemented into the system to do the diagnosis of the type of skin disease. Users will select the symptom that occurs to their skin. This system will also provide some home remedies guidance for the patient to be more concern of their affected skin disease. The factors which contribute of constructing the fuzzy rules are age, symptoms and history.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter discussed on an applicable methodology that was used for this research. Methodology was defined as systematic, theoretical analysis of the methods applied to a field of study. It encompasses the theoretical analysis of methods and principle that related with a branch of knowledge (Irny, 27 March 2018). It is also the investigations of a research problem and the suitable actions and techniques that will be used to identify, select, process and analyse information applied to understanding a problem in a project Kallet (6 April 2018).

The applicable methodology used as guidance to finish this research from beginning until fully finished. In this chapter discussed about the suitable methodology, hardware such as laptop or smartphone and software such as Microsoft Project that were used. Other than that, the importance and function of hardware and software were highlighted. Next, develop Gantt chart to show research phase from the beginning till this research is finished. In implementation phase, explained how process or hardware has been implemented into selected algorithm or model and record all processes involved in this research. Lastly, testing phase should be testing on the conceptual model after it has been implemented and get the user acceptance.

3.2 Methodology

The method consists of four phases which are project requirement, investigate symptom of skin disease, develop conceptual and evaluate the model. For each phase have specific activities and outcome. Table 3.1 shows the table of methodology.

Table 3.1 Table of methodology

	Activity	Outcome
START		
Research requirement	The analyse investigation were taken from journal article and authorize medical websites.	Objective, scope, problem statements were found after this literature review.
Identify skin disease factors	Investigation of symptom obtain from literature review, they are journal and survey on authorize medical website.	List of factors parameter to determine skin disease.
Develop conceptual model	A comparison about previous models was made after the investigation, interview and website survey.	A conceptual model for skin disease.
Evaluate the model	Develop system using web based system. Collect several respondents to test the functionality of the system	Expected skin disease produced.
END	Write a complete report for this research project.	A complete report was proposed.

3.3 Project requirement

Based on this research of Skin Disease Diagnosis Support System using Fuzzy Logic (SDDSS), there a few requirements needed to be completed. The technique that was used is fuzzy logic rule based which is implemented to generate the fuzzy rules to detect the types of skin disease affected by the users. The system created is to prove the fuzzy rules to diagnose the skin disease affected. The fuzzy rules were created based on the research on authorized medical website. The factors that used to create the fuzzy rules were users' age, symptom and history. Ten websites has been selected to be used as a main reference to this research. The authorised websites are the website that has been published by the dermatologist The ten selected websites are MedicalNewsToday (Mclntosh, 2017), MayoClinic (Clinic, 2018a), Healthline (Cobb, 2017), WebMD (Symptoms, 2018), EverydayHealth (Bennington-Castro, 2018), DermNetNZ (Stanway, 2004), emedicinehealth (Meffert, 2018), Drugs.com (Eczema, 2018), FamilyDoctor.org (staff, 2017), Medlineplus (dermatitis, 2018).

The system also as an alternative way for the public users to check the affected skin occurred by them. By using this system, they can diagnose the skin on their own rather than spending money on specialist which can be costly. With the existing of this system, they can cure their skin by themselves because the system provided suggestion of home remedies such as how to take care the affected skin, oral medication that they can take and others.

3.3.1 Software requirements

In developing this Skin Disease Diagnosis Support System (SDDSS), the software that will be used are Windows 10 Pro, XAMPP, Notepad++ and Microsoft Project. The software clarified in Table 3.2.

Table 3.2 Software requirements

Software	Version	Purpose
Windows 10 Pro	Pro x64 bit	To run the operating system of software development

		process.
XAMPP	Version 5.6.3 (PHP 5.6.3)	To simplify the installation and to control of the specific web services.
Notepad++	Version 5.7.6	Is a source code and text editor used by the Microsoft Windows. To support the tabbed editing that allows engage in multiple open files in a single window.
Microsoft Project	Professional 2015	To create the Gantt chart

3.3.2 Hardware requirements

The hardware used in this research is Acer laptop, smartphone and printer. Table 3.3 shows the hardware requirements

Table 3.3 Hardware requirements

Hardware	Version	Purpose
Acer laptop	1803	To develop, generate the system and documentations.
Smartphone	Vivo V3	To connect to the Internet via Hotspot.
Printer	Canon E510	To print out the documents.

3.3.3 Context diagram

Context diagram is a Context-Level Data-Flow Diagram or also called as Level-0 Data Flow Diagram. It is used to initiate the condition and partition of the system to be modelled. The objects inside and outside of the system are being modelled and what is the relation of the system with those outside entities. Moreover, context diagram also recognize the flows of the information between system and outer entities (Material, 2011). Figure 3.1 shows the context diagram for SDDSS.

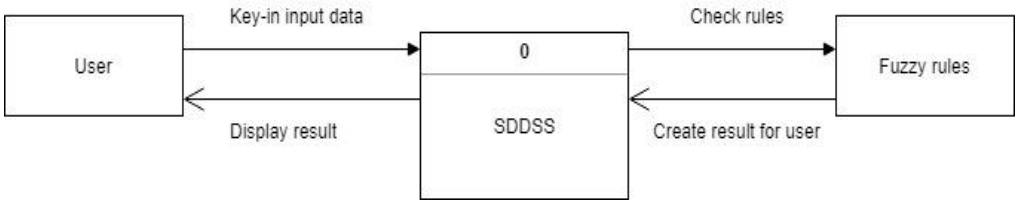

Figure 3.1 Context diagram of SDDSS

3.3.4 Flowchart of the SDDSS

This flowchart is created to show how the system is running. The input such as age, symptoms and history is to create the fuzzy rules. If the user inserts any input that related to any type of skin disease, the result of skin disease affected will be displayed along with the information that had been entered and the operation will stop. If the input inserted not related to any type of skin disease, the output of skin type affected will not be display, it only displays the information entered. Figure 3.2 shows the flowchart of the SDDSS.

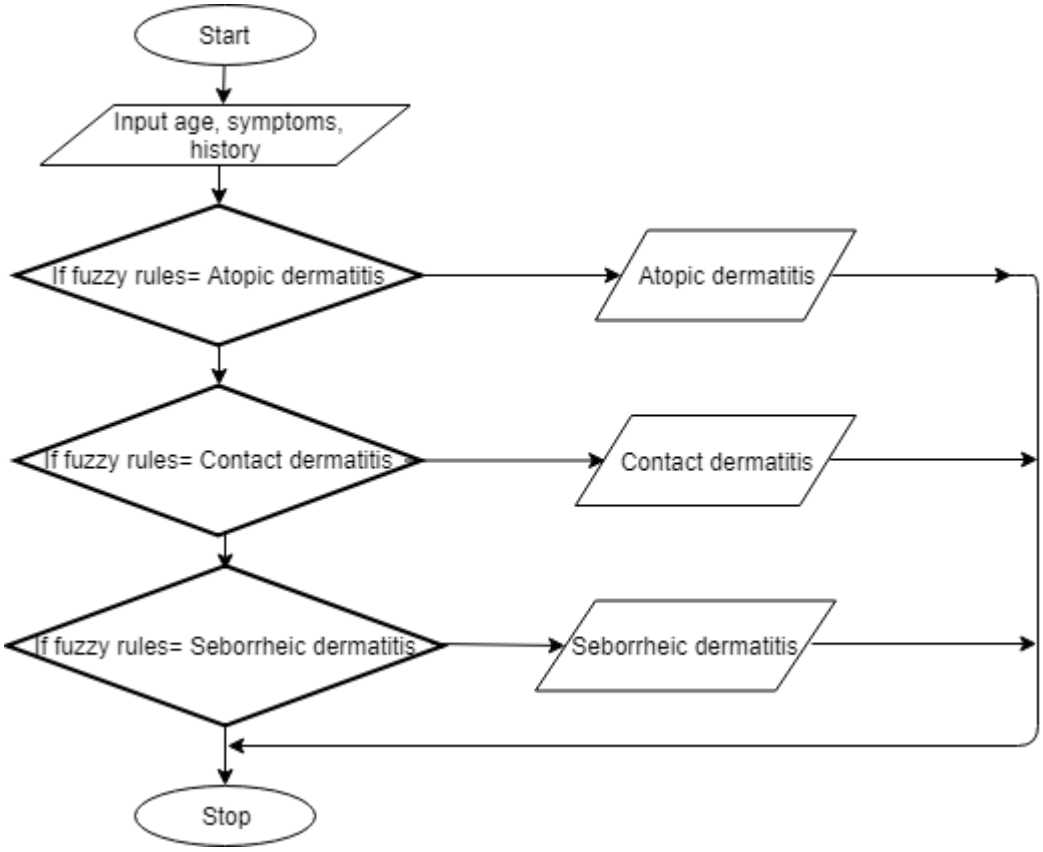

Figure 3.2 Flowchart of SDDSS

3.4 Gantt chart

The purpose of Gantt chart is to show the phases from the beginning till the research complete. From this, the planning will be running smoothly. All tasks must be completed within the milestone. Refer Appendix A for Gantt chart.

3.5 Data preparation

Data preparation is how the data is collected in order to create the fuzzy rules. To identify the types of skin disease such as Atopic dermatitis, Contact dermatitis and Seborrheic dermatitis. The data is collected from the authorized medical websites. Ten websites will be selected, they are MedicalNewsToday, Mayo Clinic, Healthline, WebMD, Everyday Health, DermNet NZ, emedicinehealth.com, Drugs.com, Family Doctor and Medlineplus. From the websites, data such as age, symptoms and history are collected. The data collected is different from each type of skin disease.

For Atopic dermatitis, the ages show are infants, school-aged child that range between six to 11 years old, adolescence range between 12 to 18 years old and adults that in range of 18 to 60 years. Meanwhile, the symptoms are divided into colour, condition and location of the affected skin. For the colour, there are three types of colours assigned which are red-brownish grey, yellow-light brown and red. The conditions of skin are divided into five, they are dry, scaly, itchy, thick and rough. Furthermore, for locations affected by Atopic dermatitis, they are categorized into twelve which are neck, hands, wrists, buttock, legs, inside elbows, inside knees, feet, ankles, eyelids, scalp and face. Other than that, history are classified into dandruff, family experience of any of skin diseases, have allergy and experience of hay fever and asthma. Atopic dermatitis is a disease that is not caused by dandruff. However, if the patient experienced of asthma and hay fever, the percentage they lead to Atopic dermatitis is high. Allergy reaction also contributes the Atopic. Other than, if the family history had experienced by Atopic, the individual may have the possibility to have that disease. Refer to Appendix A for the data preparation of Atopic dermatitis.

Moreover, the ranges of the ages of Contact dermatitis are infants, school-aged child and adults. Infants are range of seven to 12 months old while school-aged child is between six to 11 years old and the adults are between 18 to 60 years old. For the colour that normally shows the sign of Contact dermatitis is red. The skin conditions that show the individual already affected by this disease are divided into nine, they are dry, scaly, itchy, thick, rough, crusty, ooze, burn and sore. Meanwhile, for the locations are specific into eight parts which are neck, hands, wrists, legs, ankles, face, fingers and palms. Contact dermatitis is not caused by hay fever, asthma, dandruff and family history. However the allergy reaction is caused by many substances. The examples of the substances are latex, rubber, nickel, jewelry, soaps, cosmetics, fragrance, gold, hair dyes, shampoo, watches, belt, detergent, water and nail polish. Some plants also caused the infection of this disease such as poison ivy and poison oak. Refer Appendix A for the data preparation for Contact dermatitis.

Seborrheic eczema normally affected by infants that aged between seven to 12 months, school-aged children aged between six to 11 years old. Furthermore, adults are more frequently affected by this disease. The colours that show the symptoms of Seborrheic are red, salmon-pink and pink. The condition of the skin will dry, scaly,

itchy, burn, sore and oily. Moreover, the locations normally show the individual affected this disease are on neck legs, chest, eyelids, scalp, groin, mustache, hair, beard, eyebrows and nose. Dandruff is the main caused of Seborrheic. Allergy reaction, asthma and hay fever not the cause of this skin disease. Family history also may be the factor of this skin can be occurred. (Refer Appendix A for the data preparation for the Seborrheic eczema)

3.5.1 Normalization of data preparation

The data normalization is to minimize the data preparation that is collected from the ten authorized medical websites. This normalizes data is used to generate the fuzzy rules. The factors which contribute on creating the fuzzy rules are age, symptoms which are colour, condition and locations of affected skin and also the patient history. Each skin disease produces different types of factors. The value one to ten in the skin disease columns in Table 3.4 represent the majority of how many authorized medical website prove which factors contribute in classifying the type of skin diseases. However, the values selected are in the range of five to ten. Ten is the maximum value while five is minimum value. This is because the range shows different result of each type of skin diseases.

Table 3.4 The majority of authorized medical websites

1	10	3
7	0	0
5	0	0
0	0	5
0	0	6

Firstly, one of the selected age which is school-aged children contribute in Atopic and Contact but with different values. While, one of the age which is infants contribute to Atopic and Seborrheic. However, the other ages will show the differences between the three types of skin diseases. The selected ages for Atopic dermatitis are school-aged children and adults. The values of school-aged children are eight and adults are ten. Meanwhile, the frequent age that affected by Contact dermatitis is infants which are the value is five and school-aged children value of five. Furthermore, for Seborrheic

eczema, it normally occurred by the infants and adults. The value of infants is seven while the adults are nine. Table 3.5 shows the values of the age for Atopic dermatitis, Contact dermatitis and Seborrheic eczema.

Table 3.5 Age values of three os skin diseases

Age			
	Skin disease		
	Atopic	Contact	Seborrheic
Infants (7-12 months)	1	5	8
School-aged Child (6-11 years)	8	5	0
Adolescence(12-18 years)	1	0	0
Middle-agedAdults (18-60 years)	10	1	9

Secondly, for the colours selected for Atopic dermatitis are red-brownish grey and yellow-light brown. Value for red-brownish grey is seven, while yellow-light brown is five. Colour that contributes to Contact dermatitis is red with value of ten. The colours of Seborrheic are salmon-pink and pink. The value of salmon-pink and pink are five and six respectively. Table 3.6 shows the values of the colour of each type of skin disease.

Table 3.6 Colour values of skin diseases

Symptoms		Skin disease		
		Atopic	Contact	Seborrheic
Colour	Red	1	10	3
	Red-brownish grey	7	0	0
	Yellow-light brown	5	0	0
	Salmon-pink	0	0	5
	Pink	0	0	6

Thirdly, some selected condition such as dry and itchy are contribute in Atopic and Contact but with different values. However, other conditions will show the differences between the two types of skin diseases. The selected conditions of Atopic dermatitis are dry, itchy and thick with values of eight, ten and five respectively. Meanwhile, the conditions of skin that determine the Contact dermatitis are dry, itchy, crusty and sore. Patient that affected by Seborrheic eczema will be experienced of scaly and oily skin. The value of the scaly skin is seven and oily skin is five. Table 3.7 shows the conditions of the three skin diseases.

Table 3.7 Conditions values of skin diseases

Symptoms		Atopic	Contact	Seborrheic
Condition	Dry	8	6	2
	Scaly	4	3	7
	Itchy	10	7	4
	Thick	5	1	0
	Rough	1	1	0
	Crusty	0	6	0
	Ooze	0	3	0
	Burn	0	3	4
	Sore	0	5	1
	Oily	0	0	5

Table 3.8 shows the locations of skin affected by Atopic dermatitis, Contact dermatitis and Seborrheic eczema. The locations that normally show the symptom of Atopic dermatitis are neck, wrists, inside elbows, inside knees and ankles. The values are of neck is six, for the ankles and wrists are five respectively. Both inside knees and elbows share the same values which are eight. Other than that, location affected skin by Contact dermatitis are hands, fingers and palms. The values are eight, five and six. Meanwhile, Seborrheic eczema frequently occurred on chest, eyelids, scalp, groin, eyebrows and nose. The values of eyelids, groin are same which are five, for scalp and nose are six while for chest and eyebrows give the highest value which is eight.

Table 3.8 Locations values of affected by skin diseases

Symptoms		Atopic	Contact	Seborrheic
Location	Neck	6	2	1
	Hands	4	8	0
	Wrists	5	2	0
	Buttock	1	0	0
	Legs	3	1	2
	Inside elbows	8	0	0
	Inside knees	8	0	0
	Chest	0	0	8
	Feet	3	0	0
	Ankles	5	1	0
	Eyelids	4	0	5
	Scalp	1	0	6
	Face	3	4	0
	Groin	0	0	5
	Fingers	0	5	0
	Palms	0	6	0
	Mustache	0	0	1
	Hair	0	0	3
	Beard	0	0	3
	Eyebrows	0	0	8
	Nose	0	0	6

Next, the history will discuss either the skin disease is related or not to certain classification. History is classified based on hay fever, asthma, dandruff, allergy, dandruff and family history of any of the skin diseases. Patient who have experienced of hay fever and asthma are more likely to get Atopic dermatitis while Contact and Seborrheic will not experience the same. Table 3.9 shows the comparison values.

Table 3.9 Values of experienced by asthma and hay fever

		Atopic	Contact	Seborrheic
Hay fever	Yes	10	1	2
	No	0	8	8
	N/A	0	1	0
Asthma	Yes	10	1	2
	No	0	8	8
	N/A	0	1	0

The highest value in Table 3.10 shows that patient who have allergy leads to Contact dermatitis.

Table 3.10 Values of allergy

		Atopic	Contact	Seborrheic
Allergy	Yes	0	10	0
	No	2	0	8

Meanwhile, if the patient has dandruff, the type of skin diseases affected lead to Seborrheic eczema that shown in Table 3.11. However, the values are same between have and do not have but the other two skin diseases do not have dandruff.

Table 3.11 Values of causing by dandruff

		Atopic	Contact	Seborrheic
Dandruff	Yes	0	0	5
	No	0	0	5

Lastly, if family history experienced by Atopic dermatitis, the patient may also have the possibility to get affected by the disease. Meanwhile, Contact dermatitis is not caused by family history. However Seborrheic may be caused or may be not caused by family history. Table 3.12 shows the values of contribution by family history.

Table 3.12 Values of family history

		Atopic	Contact	Seborrheic
History				
Family	Yes	10	1	5
	No	0	9	5

3.5.2 Generate the fuzzy rules

The fuzzy rules are created based on the normalization of the data preparation in the previous subchapter. The fuzzy rules are the combination of the factors which are age, symptoms and history. Atopic dermatitis has 60 rules while Contact dermatitis has the total of 28 rules and for Seborrheic dermatitis has 48 rules. Table 3.13 till Table 3.15 below show the sets of Atopic dermatitis, Contact dermatitis and Seborrheic eczema rules. The rules is built using IF THEN statements.

Table 3.13 shows the Atopic dermatitis rules. The rules created were combined from age, symptoms and history. Atopic dermatitis has two ages which are school-aged child and adults. For the symptoms specify into colour, condition and location of

affected skin where the colours are red-brownish grey and yellow-light brown. For condition divided into dry, itchy and thick. The locations are neck, wrists, inside elbows, inside knees and ankles. History is divided into three which are fever, asthma and family history.

Table 3.13 Atopic dermatitis rules

Rule	Number	Rules
1	1	IF school-aged child AND red-brownish grey AND dry AND neck AND fever AND asthma AND family THEN Atopic dermatitis
	2	IF school-aged child AND red-brownish grey AND dry AND wrists AND fever AND asthma AND family THEN Atopic dermatitis
	3	IF school-aged child AND red-brownish grey AND dry AND inside elbows AND fever AND asthma AND family THEN Atopic dermatitis
	4	IF school-aged child AND red-brownish grey AND dry AND inside knees AND fever AND asthma AND family THEN Atopic dermatitis
	5	IF school-aged child AND red-brownish grey AND dry AND ankles AND fever AND asthma AND family THEN Atopic dermatitis
2	1	IF school-aged child AND red-brownish grey AND itchy AND neck AND fever AND asthma AND family THEN Atopic dermatitis
	2	IF school-aged child AND red-brownish grey AND itchy AND wrists AND fever AND asthma AND family THEN Atopic dermatitis

	3	IF school-aged child AND red-brownish grey AND itchy AND inside elbows AND fever AND asthma AND family THEN Atopic dermatitis
	4	IF school-aged child AND red-brownish grey AND itchy AND inside knees AND fever AND asthma AND family THEN Atopic dermatitis
	5	IF school-aged child AND red-brownish grey AND itchy AND ankles AND fever AND asthma AND family THEN Atopic dermatitis
3	1	IF school-aged child AND red-brownish grey AND thick AND neck AND fever AND asthma AND family THEN Atopic dermatitis
	2	IF school-aged child AND red-brownish grey AND thick AND wrists AND fever AND asthma AND family THEN Atopic dermatitis
	3	IF school-aged child AND red-brownish grey AND thick AND inside elbows AND fever AND asthma AND family THEN Atopic dermatitis
	4	IF school-aged child AND red-brownish grey AND thick AND inside knees AND fever AND asthma AND family THEN Atopic dermatitis
	5	IF school-aged child AND red-brownish grey AND thick AND ankles AND fever AND asthma AND family THEN Atopic dermatitis
4	1	IF school-aged child AND yellow-light brown AND dry AND neck AND fever AND asthma AND family THEN Atopic dermatitis

	2	IF school-aged child AND yellow-light brown AND dry AND wrists AND fever AND asthma AND family THEN Atopic dermatitis
	3	IF school-aged child AND yellow-light brown AND dry AND inside elbows AND fever AND asthma AND family THEN Atopic dermatitis
	4	IF school-aged child AND yellow-light brown AND dry AND inside knees AND fever AND asthma AND family THEN Atopic dermatitis
	5	IF school-aged child AND yellow-light brown AND dry AND ankles AND fever AND asthma AND family THEN Atopic dermatitis
5	1	IF school-aged child AND yellow-light brown AND itchy AND neck AND fever AND asthma AND family THEN Atopic dermatitis
	2	IF school-aged child AND yellow-light brown AND itchy AND wrists AND fever AND asthma AND family THEN Atopic dermatitis
	3	IF school-aged child AND yellow-light brown AND itchy AND inside elbows AND fever AND asthma AND family THEN Atopic dermatitis
	4	IF school-aged child AND yellow-light brown AND itchy AND inside knees AND fever AND asthma AND family THEN Atopic dermatitis
	5	IF school-aged child AND yellow-light brown AND itchy AND ankles AND fever AND asthma AND family THEN Atopic dermatitis

6	1	IF school-aged child AND yellow-light brown AND thick AND neck AND fever AND asthma AND family THEN Atopic dermatitis
	2	IF school-aged child AND yellow-light brown AND thick AND wrists AND fever AND asthma AND family THEN Atopic dermatitis
	3	IF school-aged child AND yellow-light brown AND thick AND inside elbows AND fever AND asthma AND family THEN Atopic dermatitis
	4	IF school-aged child AND yellow-light brown AND thick AND inside knees AND fever AND asthma AND family THEN Atopic dermatitis
	5	IF school-aged child AND yellow-light brown AND thick AND ankles AND fever AND asthma THEN Atopic dermatitis
7	1	IF adult AND red-brownish grey AND dry AND neck AND fever AND asthma AND family THEN Atopic dermatitis
	2	IF adult AND red-brownish grey AND dry AND wrists AND fever AND asthma AND family THEN Atopic dermatitis
	3	IF adult AND red-brownish grey AND dry AND inside elbows AND fever AND asthma AND family THEN Atopic dermatitis
	4	IF adult AND red-brownish grey AND dry AND inside knees AND fever AND asthma AND family THEN Atopic dermatitis
	5	IF adult AND red-brownish grey AND dry AND ankles AND fever AND asthma AND family THEN Atopic dermatitis
8	1	IF adult AND red-brownish grey AND itchy AND neck AND fever AND asthma AND family THEN Atopic dermatitis

	2	IF adult AND red-brownish grey AND itchy AND wrists AND fever AND asthma AND family THEN Atopic dermatitis
	3	IF adult AND red-brownish grey AND itchy AND inside elbows AND fever AND asthma AND family THEN Atopic dermatitis
	4	IF adult AND red-brownish grey AND itchy AND inside knees AND fever AND asthma AND family THEN Atopic dermatitis
	5	IF adult AND red-brownish grey AND itchy AND ankles AND fever AND asthma AND family THEN Atopic dermatitis
9	1	IF adult AND red-brownish grey AND thick AND neck AND fever AND asthma AND family THEN Atopic dermatitis
	2	IF adult AND red-brownish grey AND thick AND wrists AND fever AND asthma AND family THEN Atopic dermatitis
	3	IF adult AND red-brownish grey AND thick AND inside elbows AND fever AND asthma AND family THEN Atopic dermatitis
	4	IF adult AND red-brownish grey AND thick AND inside knees AND fever AND asthma AND family THEN Atopic dermatitis
	5	IF adult AND red-brownish grey AND thick AND ankles AND fever AND asthma AND family THEN Atopic dermatitis
10	1	IF adult AND yellow-light brown AND dry AND neck AND fever AND asthma AND family THEN Atopic dermatitis
	2	IF adult AND yellow-light brown AND dry AND wrists AND fever AND asthma AND family THEN Atopic dermatitis
	3	IF adult AND yellow-light brown AND dry AND inside elbows AND fever AND asthma AND family THEN Atopic dermatitis
	4	IF adult AND yellow-light brown AND dry AND inside knees

		AND fever AND asthma AND family THEN Atopic dermatitis
	5	IF adult AND yellow-light brown AND dry AND ankles AND fever AND asthma AND family THEN Atopic dermatitis
11	1	IF adult AND yellow-light brown AND itchy AND neck AND fever AND asthma AND family THEN Atopic dermatitis
	2	IF adult AND yellow-light brown AND itchy AND wrists AND fever AND asthma AND family THEN Atopic dermatitis
	3	IF adult AND yellow-light brown AND itchy AND inside elbows AND fever AND asthma AND family THEN Atopic dermatitis
	4	IF adult AND yellow-light brown AND itchy AND inside knees AND fever AND asthma AND family THEN Atopic dermatitis
	5	IF adult AND yellow-light brown AND itchy AND ankles AND fever AND asthma AND family THEN Atopic dermatitis
12	1	IF adult AND yellow-light brown AND thick AND neck AND fever AND asthma AND family THEN Atopic dermatitis
	2	IF adult AND yellow-light brown AND thick AND wrists AND fever AND asthma AND family THEN Atopic dermatitis
	3	IF adult AND yellow-light brown AND thick AND inside elbows AND fever AND asthma AND family THEN Atopic dermatitis
	4	IF adult AND yellow-light brown AND thick AND inside knees AND fever AND asthma AND family THEN Atopic dermatitis
	5	IF adult AND yellow-light brown AND thick AND ankles AND fever AND asthma AND family THEN Atopic dermatitis

Table 3.14 shows the rules for Contact dermatitis. The rules were combination of age, symptoms and history. The selected ages for Contact dermatitis are infants and school-aged child. The colour selected is red while the conditions of the skin are dry, crusty, sore and itchy. The locations selected are hands, fingers and palms. History is selected only for allergy.

Table 3.14 Contact dermatitis rules

Rule	Number	Rules
1	1	IF infants AND red AND dry AND hands AND allergy THEN Contact dermatitis
	2	IF infants AND red AND dry AND fingers AND allergy THEN Contact dermatitis
	3	IF infants AND red AND dry AND palms AND allergy THEN Contact dermatitis
2	1	IF infants AND red AND crusty AND hands AND allergy THEN Contact dermatitis
	2	IF infants AND red AND crusty AND fingers AND allergy THEN Contact dermatitis
	3	IF infants AND red AND crusty AND palms AND allergy THEN Contact dermatitis
3	1	IF infants AND red AND sore AND hands AND allergy THEN Contact dermatitis
	2	IF infants AND red AND sore AND fingers AND allergy THEN Contact dermatitis
	3	IF infants AND red AND sore AND palms AND allergy THEN Contact dermatitis
4	1	IF infants AND red AND itchy AND hands AND allergy THEN

		Contact dermatitis
	2	IF infants AND red AND itchy AND fingers AND allergy THEN Contact dermatitis
	3	IF infants AND red AND itchy AND palms AND allergy THEN Contact dermatitis
5	1	IF school-aged child AND red AND dry AND hands AND allergy THEN Contact dermatitis
	2	IF school-aged child AND red AND dry AND fingers AND allergy THEN Contact dermatitis
	3	IF school-aged child AND red AND dry AND palms AND allergy THEN Contact dermatitis
6	1	IF school-aged child AND red AND crusty AND hands AND allergy THEN Contact dermatitis
	2	IF school-aged child AND red AND crusty AND fingers AND allergy THEN Contact dermatitis
	3	IF school-aged child AND red AND crusty AND palms AND allergy THEN Contact dermatitis
7	1	IF school-aged child AND red AND sore AND hands AND allergy THEN Contact dermatitis
	2	IF school-aged child AND red AND sore AND fingers AND allergy THEN Contact dermatitis
	3	IF school-aged child AND red AND sore AND palms AND allergy THEN Contact dermatitis
8	1	IF school-aged child AND red AND itchy AND hands AND allergy THEN Contact dermatitis

	2	IF school-aged child AND red AND itchy AND fingers AND allergy THEN Contact dermatitis
	3	IF school-aged child AND red AND itchy AND palms AND allergy THEN Contact dermatitis

Table 3.15Table 3.15 shows the rules for Seborrheic dermatitis. The ages selected for Seborrheic eczema are infants and adults. For the colours are salmon-pink and pink. Conditions of the skin are scaly and oily. The locations selected are chest, eyelids, scalp, groin, eyebrows and nose. Meanwhile, for history selected are dandruff and family history.

Table 3.15 Seborrheic eczema rules

Rule	Number	Rules
1	1	IF infants AND salmon-pink AND scaly AND chest AND dandruff AND family THEN Seborrheic eczema
	2	IF infants AND salmon-pink AND scaly AND eyelids AND dandruff AND family THEN Seborrheic eczema
	3	IF infants AND salmon-pink AND scaly AND scalp AND dandruff AND family THEN Seborrheic eczema
	4	IF infants AND salmon-pink AND scaly AND groin AND dandruff AND family THEN Seborrheic eczema
	5	IF infants AND salmon-pink AND scaly AND eyebrows AND dandruff AND family THEN Seborrheic eczema
	6	IF infants AND salmon-pink AND scaly AND nose AND dandruff AND family THEN Seborrheic eczema
2	1	IF infants AND salmon-pink AND oily AND chest AND dandruff AND family THEN Seborrheic eczema

	2	IF infants AND salmon-pink AND oily AND eyelids AND dandruff AND family THEN Seborrheic eczema
	3	IF infants AND salmon-pink AND oily AND scalp AND dandruff AND family THEN Seborrheic eczema
	4	IF infants AND salmon-pink AND oily AND groin AND dandruff AND family THEN Seborrheic eczema
	5	IF infants AND salmon-pink AND oily AND eyebrows AND dandruff AND family THEN Seborrheic eczema
	6	IF infants AND salmon-pink AND oily AND nose AND dandruff AND family THEN Seborrheic eczema
3	1	IF infants AND pink AND scaly AND chest AND dandruff AND family THEN Seborrheic eczema
	2	IF infants AND pink AND scaly AND eyelids AND dandruff AND family THEN Seborrheic eczema
	3	IF infants AND pink AND scaly AND scalp AND dandruff AND family THEN Seborrheic eczema
	4	IF infants AND pink AND scaly AND groin AND dandruff AND family THEN Seborrheic eczema
	5	IF infants AND pink AND scaly AND eyebrows AND dandruff AND family THEN Seborrheic eczema
	6	IF infants AND pink AND scaly AND nose AND dandruff AND family THEN Seborrheic eczema
4	1	IF infants AND pink AND oily AND chest AND dandruff AND family THEN Seborrheic eczema
	2	IF infants AND pink AND oily AND eyelids AND dandruff AND

		family THEN Seborrheic eczema
	3	IF infants AND pink AND oily AND scalp AND dandruff AND family THEN Seborrheic eczema
	4	IF infants AND pink AND oily AND groin AND dandruff AND family THEN Seborrheic eczema
	5	IF infants AND pink AND oily AND eyebrows AND dandruff AND family THEN Seborrheic eczema
	6	IF infants AND pink AND oily AND nose AND dandruff AND family THEN Seborrheic eczema
5	1	IF adult AND salmon-pink AND scaly AND chest AND dandruff AND family THEN Seborrheic eczema
	2	IF adult AND salmon-pink AND scaly AND eyelids AND dandruff AND family THEN Seborrheic eczema
	3	IF adult AND salmon-pink AND scaly AND scalp AND dandruff AND family THEN Seborrheic eczema
	4	IF adult AND salmon-pink AND scaly AND groin AND dandruff AND family THEN Seborrheic eczema
	5	IF adult AND salmon-pink AND scaly AND eyebrows AND dandruff AND family THEN Seborrheic eczema
	6	IF adult AND salmon-pink AND scaly AND nose AND dandruff AND family THEN Seborrheic eczema
6	1	IF adult AND salmon-pink AND oily AND chest AND dandruff AND family THEN Seborrheic eczema
	2	IF adult AND salmon-pink AND oily AND eyelids AND dandruff AND family THEN Seborrheic eczema

	3	IF adult AND salmon-pink AND oily AND scalp AND dandruff AND family THEN Seborrheic eczema
	4	IF adult AND salmon-pink AND oily AND groin AND dandruff AND family THEN Seborrheic eczema
	5	IF adult AND salmon-pink AND oily AND eyebrows AND dandruff AND family THEN Seborrheic eczema
	6	IF adult AND salmon-pink AND oily AND nose AND dandruff AND family THEN Seborrheic eczema
7	1	IF adult AND pink AND scaly AND chest AND dandruff AND family THEN Seborrheic eczema
	2	IF adult AND pink AND scaly AND eyelids AND dandruff AND family THEN Seborrheic eczema
	3	IF adult AND pink AND scaly AND scalp AND dandruff AND family THEN Seborrheic eczema
	4	IF adult AND pink AND scaly AND groin AND dandruff AND family THEN Seborrheic eczema
	5	IF adult AND pink AND scaly AND eyebrows AND dandruff AND family THEN Seborrheic eczema
	6	IF adult AND pink AND scaly AND nose AND dandruff AND family THEN Seborrheic eczema
8	1	IF adult AND pink AND oily AND chest AND dandruff AND family THEN Seborrheic eczema
	2	IF adult AND pink AND oily AND eyelids AND dandruff AND family THEN Seborrheic eczema
	3	IF adult AND pink AND oily AND scalp AND dandruff AND

		family THEN Seborrheic eczema
	4	IF adult AND pink AND oily AND groin AND dandruff AND family THEN Seborrheic eczema
	5	IF adult AND pink AND oily AND eyebrows AND dandruff AND family THEN Seborrheic eczema
	6	IF adult AND pink AND oily AND nose AND dandruff AND family THEN Seborrheic eczema

3.6 Conceptual model

Figure 3.3 shows the conceptual model for skin disease diagnosis using Fuzzy Logic.

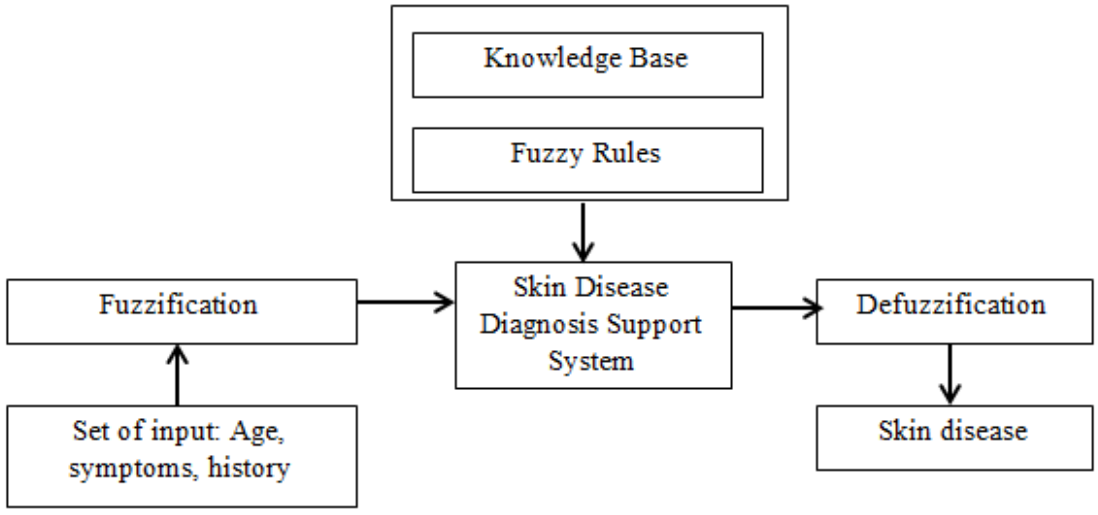

Figure 3.3 Conceptual model

This system will use the Fuzzy Logic rules to diagnose the human skin disease. Fuzzy logic system also known as nonlinear mapping of and input data set to an output

data. This model consists of seven parts which are knowledge base, fuzzy rules, fuzzification, sets of input data, system, defuzzification and output.

Knowledge base is when this system collects all input data to identify the type of skin disease affected by a person. Knowledge base that refers to data collected such as age, symptoms and history also known as investigating factors. The combination of all the knowledge base will give the result to the users suffer which type of skin diseases, either Atopic, Contact or Seborrheic dermatitis.

Fuzzy rule uses simple IF-THEN rule for a condition and conclusion. Fuzzy rules are creating from inputting enter by users. Observe the symptom of every disease based on symptom happen to the users and relate the symptom with their history. After get the two factors, relate them with the another factor which is age. Based on these three factors, the fuzzy rules will be produced.

The set of inputs which are age, symptoms and history are collected from users. Each disease produces variety type of symptoms. This system will provide some items for user to click any items related to them that ask them about the age, symptoms happen to them and history. After users input all the data, system will process a set of fuzzy rules that related to what items users already click and output of the type of skin disease will be produced.

Fuzzification is the process to change a real scale value of a fuzzy value. The inputs entered by the users will transform into fuzzy rules.

The SDDSS will diagnose types of skin diseases that affected by the user. Users will be asked to question several answers based on symptoms, history and age related to them. These are the input that required user to input. Every symptoms and history different with each skin disease. The input will process by forming the fuzzy rules. Based on the fuzzy rules, the output that determines the skin disease will be produced. Other than that, user SDDSS also will display home remedies in the last interface.

Defuzzification is the process where the fuzzy rules will be processed to determine which type of skin disease affected by the users.

The output produced will give the single accurate result on which type of eczema affected by the user.

3.7 Evaluation

This research will develop a decision support system to identify the type of skin disease which are Atopic dermatitis, Contact dermatitis and Seborrheic eczema. The input is based on what input click by the users while the output is based on the fuzzy rules created. The input items will ask about the age, symptoms and history and other several input items to complete the interface. The accuracy of the fuzzy rules is measured based on the determination of which type of skin disease affected by the users. The factors to create the fuzzy rules are collected based on ten authorized medical websites. This is because there are limitations to do research due to the difficulty to collect the data from real patients at the hospital.

CHAPTER 4

IMPLEMENTATION

4.1 Introduction

This chapter will discuss the overall implementation of the Skin Disease Diagnosis Support System using Fuzzy Rules (SDDSS). In this section also discuss how the fuzzy rules are generated using PHP language. Moreover, the design interface for SDDSS also will be elaborated.

4.2 Development environment

In this subchapter will talk about the development environment in which the processes and programming tools that used in order to develop the SDDSS. To enable the functionality of the system, it is a must to set up the development environment.

The first essential thing is having the source editor that has been designed working for HTML, CSS and JavaScript. In order to launch the HTML, CSS and the JavaScript, Notepad++ is used. The CSS is to design the interface. The interface of Notepad++ shows in Figure 4.1 below. Secondly, in this development environment, the laptop use must set up to become the server. XAMPP is used to perform the setup. XAMPP is an easy, lightweight Apache distribution that help the developer create a local web based server. Figure 4.2 shows interface of XAMPP control panel in the laptop. First thing first, the developer has to start the Apache as shown in the Figure 4.2.

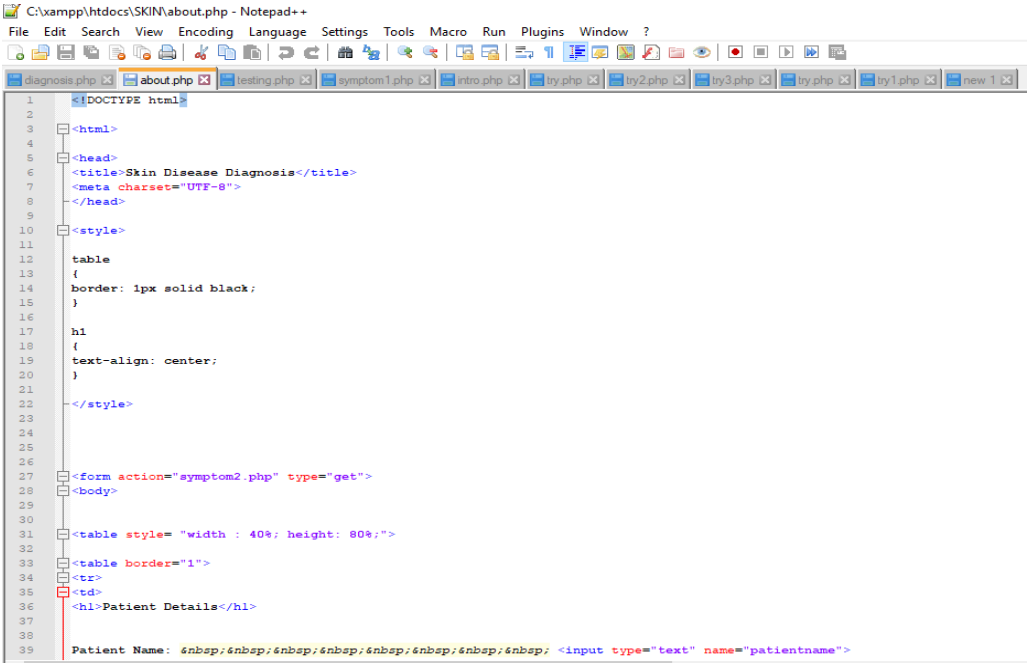

Figure 4.1 Notepad++ interface

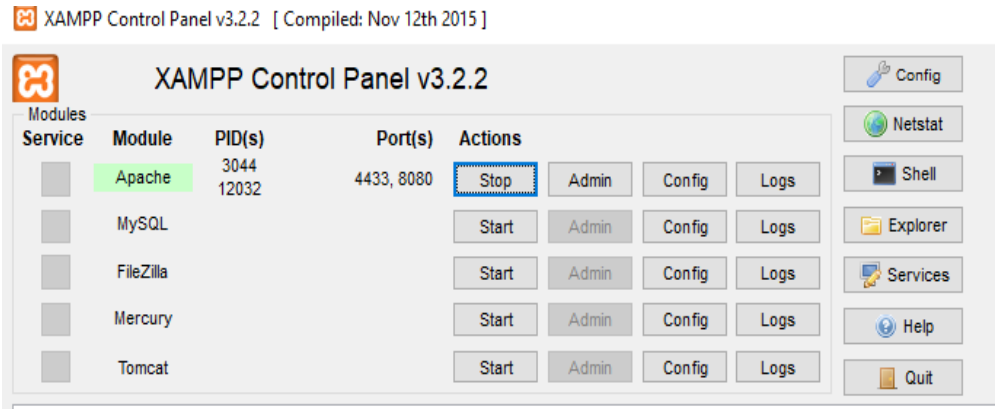

Figure 4.2 XAMPP interface

4.3 Code implementation

The system is implemented by using HTML and CSS. To make the system function, PHP language is used. Diagrams below show a part of the coding that has been implemented to create fuzzy rules to determine the three types of skin diseases. Refer Appendix B to show the rest of the coding. All fuzzy rules in Chapter 3 are transformed into the coding. All coding has been written in the same way, the different

only for the age, symptoms and history. Atopic dermatitis has two ages which are school-aged child and adults. For the symptoms specify into colour, condition and location of affected skin where the colours are red-brownish grey and yellow-light brown. For condition divided into dry, itchy and thick. The locations are neck, wrists, inside elbows, inside knees and ankles. History is divided into three which are fever, asthma and family history. Meanwhile, the ages selected for Contact dermatitis are infants and school-aged child. The colour selected is red while the conditions of the skin are dry, crusty, sore and itchy. The locations selected are hands, fingers and palms. History is selected only for allergy. Furthermore, ages selected for Seborrheic eczema are infants and adults. For the colours are salmon-pink and pink. Conditions of the skin are scaly and oily. The locations selected are chest, eyelids, scalp, groin, eyebrows and nose. Meanwhile, for history selected are dandruff and family history. Atopic dermatitis has 60 rules while Contact dermatitis has the total of 28 rules and for Seborrheic eczema has 48 rules.

Figure 4.3 shows the first Atopic dermatitis rule. As display in the diagram, the age, symptoms and history are combined. For age selected is school-aged child while for the symptoms selected are red-brownish grey for colour, dry skin and the location is neck. Meanwhile, for the history selected are fever, asthma and family history. The coding is translated as follows. If the age equal to school-aged child, the colour is equal to red-brownish grey, the skin condition is dry, location of affected skin is neck, user has fever and asthma and the family has Atopic dermatitis, so it will produce Atopic dermatitis. If what the users entered followed the rules, so it will return the Atopic dermatitis. If what the users entered does not matched with this rule, so it will not be returned.

```php
<?php
if (!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Red-brownish grey" AND
(!empty($_GET["dry"]) AND (!empty($_GET["neck"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])=="TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
```

Figure 4.3 Atopic dermatitis rule 1

Figure 4.4 shows the second rule of Atopic dermatitis which is display the same age, colour, condition of affected skin, family have Atopic and user has fever and

asthma. The difference shows at the location of the affected skin which is wrists. If what the users entered does not matched with this rule, so it will not be returned. If what the users entered followed the rules, so it will return the Atopic dermatitis.

```
elseif(!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Red-brownish grey" AND
(!empty($_GET["dry"]) AND (!empty($_GET["wrists"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])=="TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
```

Figure 4.4 Atopic dermatitis rule 2

Figure 4.5 shows the third Atopic dermatitis rule. The rule entered only different at the location which is inside elbows. The result of the Atopic dermatitis will be produced if what the users entered followed the rules. If not, the type of the skin disease will not be produced.

```
elseif (!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Red-brownish grey" AND
(!empty($_GET["dry"]) AND (!empty($_GET["inside elbows"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])=="TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
```

Figure 4.5 Atopic dermatitis rule 3

The fourth rule of Atopic dermatitis shows in Figure 4.6. The rule is same with the previous rules but shows the different at location of affected skin which is inside knees. The result of the Atopic dermatitis will be produced if what the users entered followed the rules. If what the users entered does not matched with this rule, so it will not be returned.

```
elseif (!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Red-brownish grey" AND
(!empty($_GET["dry"]) AND (!empty($_GET["inside knees"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])=="TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
```

Figure 4.6 Atopic dermatitis rule 4

In Figure 4.7 shows the fifth rules of Atopic dermatitis which is different at the location only. The location is on the ankles area. If what the users entered does not

matched with this rule, so it will not be returned. If what the users entered followed the rules, so it will return the Atopic dermatitis. Refer Appendix B to see the remaining Atopic dermatitis rules.

```
26  elseif(!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Red-brownish grey" AND
27  (!empty($_GET["dry"]) AND (!empty($_GET["ankles"]) AND (!empty($_GET["fever"])== "TRUE" AND
28  (!empty($_GET["asthma"])=="TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
29  {
30      echo "Atopic dermatitis";
31  }
```

Figure 4.7 Atopic dermatitis rule 5

Figure 4.8 shows the first Contact dermatitis rule. The age selected is infants. For the colour selected is red, condition of affected skin is dry and the location is hands. Contact dermatitis is caused of allergy. The coding is translated as follows. If the age equal to infants, the colour is equal to red, the skin condition is dry, location of affected skin is hands area, user has allergy, so it will produce Contact dermatitis result. If what user entered contains the same condition, so Contact dermatitis will be the result of the skin disease. Otherwise, the result will not be displayed.

```
256  elseif (!empty($_GET["age"])== "Infants" AND (!empty($_GET["colour"])== "Red" AND
257  (!empty($_GET["dry"]) AND (!empty($_GET["hands"] AND(!empty($_GET["allergy"])== "TRUE"))))))
258  {
259      echo "Contact dermatitis";
260  }
```

Figure 4.8 Contact dermatitis rule 1

The second rule of Contact dermatitis is shown Figure 4.9. The condition for age, colour, condition and allergy is same but the different only for the location of the skin affected which is fingers area. If what user input related with this rule, so the Contact dermatitis will be displayed.

```
261  elseif (!empty($_GET["age"])== "Infants" AND (!empty($_GET["colour"])== "Red" AND
262  (!empty($_GET["dry"]) AND (!empty($_GET["fingers"] AND(!empty($_GET["allergy"])== "TRUE"))))))
263  {
264      echo "Contact dermatitis";
265  }
```

Figure 4.9 Contact dermatitis rule 2

Figure 4.10 shows the third rule of Contact dermatitis that shows the different at the location which is palms area. The result will return if user entered same input as the rule below. Refer Appendix B to see the rest rules of Contact dermatitis.

```
elseif (!empty($_GET["age"])== "Infants" AND (!empty($_GET["colour"])== "Red" AND
(!empty($_GET["dry"]) AND (!empty($_GET["palms"] AND(!empty($_GET["allergy"])== "TRUE"))))))
{
    echo "Contact dermatitis";
}
```

Figure 4.10 Contact dermatitis rule 3

Figure 4.11 shows first Seborrheic eczema rule. The rule is the combination of age, symptoms and history. For age selected is infants while for the symptoms selected are salmon-pink for colour, scaly skin and the location is chest. Meanwhile, for the history selected family history has Seborrheic eczema and if the users have dandruff, so it will lead to infected by this disease. The coding is translated as follows. If the age equal to infants, the colour is equal to salmon-pink, the skin condition is scaly, the location of affected skin is chest, user has dandruff and family has Seborrheic eczema, so it will produce Seborrheic eczema. If user input the same characteristics as rule below, so this skin disease will be displayed.

```
elseif (!empty($_GET["age"])== "Infants" AND (!empty($_GET["colour"])== "Salmon-pink" AND
(!empty($_GET["scaly"]) AND (!empty($_GET["chest"] AND (!empty($_GET["dandruff"])== "TRUE" AND
(!empty($_GET["family"])== "Seborrheic dermatitis")))))))
{
    echo "Seborrheic eczema";
}
```

Figure 4.11 Seborrheic eczema rule 1

The second rule of Seborrheic eczema is shown in Figure 4.12. The different between the first rule is the location which is eyelids. If what user entered contains the same condition, so Seborrheic eczema will be the result of the skin disease. Otherwise, the result will not be displayed.

```
elseif (!empty($_GET["age"])== "Infants" AND (!empty($_GET["colour"])== "Salmon-pink" AND
(!empty($_GET["scaly"]) AND (!empty($_GET["eyelids"] AND (!empty($_GET["dandruff"])== "TRUE" AND
(!empty($_GET["family"])== "Seborrheic dermatitis")))))))
{
    echo "Seborrheic eczema";
}
```

Figure 4.12 Seborrheic eczema rule 2

Figure 4.13 shows the third rule of Seborrheic eczema. The other factors are same but the different only at the location which is scalp. If user inputs are match with this rule, the Seborrheic eczema will be displayed.

```
367  elseif (!empty($_GET["age"])== "Infants" AND (!empty($_GET["colour"])== "Salmon-pink" AND
368  (!empty($_GET["scaly"]) AND (!empty($_GET["scalp"] AND (!empty($_GET["dandruff"])== "TRUE" AND
369  (!empty($_GET["family"])== "Seborrheic dermatitis")))))))
370  {
371      echo "Seborrheic eczema";
372  }
```

Figure 4.13 Seborrheic eczema rule 3

The forth rule is shown in Figure 4.14. Same goes to the previous rule, the different between the other rules are at the location which is in this rule, that selected location is groin area.

```
373  elseif (!empty($_GET["age"])== "Infants" AND (!empty($_GET["colour"])== "Salmon-pink" AND
374  (!empty($_GET["scaly"]) AND (!empty($_GET["groin"] AND (!empty($_GET["dandruff"])== "TRUE" AND
375  (!empty($_GET["family"])== "Seborrheic dermatitis")))))))
376  {
377      echo "Seborrheic eczema";
378  }
```

Figure 4.14 Seborrheic eczema rule 4

Figure 4.15 depicts the fifth rule of Seborrheic eczema. The location is eyebrows. The other factors are same with the previous rules. If users input corresponding to this rule, so the Seborrheic eczema will be displayed.

```
379  elseif (!empty($_GET["age"])== "Infants" AND (!empty($_GET["colour"])== "Salmon-pink" AND
380  (!empty($_GET["scaly"]) AND (!empty($_GET["eyebrows"] AND (!empty($_GET["dandruff"])== "TRUE" AND
381  (!empty($_GET["family"])== "Seborrheic dermatitis")))))))
382  {
383      echo "Seborrheic eczema";
384  }
```

Figure 4.15 Seborrheic eczema rule 5

The sixth rule depicts in Figure 4.16. The other factors are same exclude the location which is the location for this rule is nose area. The same inputs entered by user

followed the rule, Seborrheic dermatitis will be displayed. Refer Appendix B to see the whole rules of Seborrheic eczema.

```
385    elseif (!empty($_GET["age"])== "Infants" AND (!empty($_GET["colour"])== "Salmon-pink" AND
386    (!empty($_GET["scaly"]) AND (!empty($_GET["nose"] AND (!empty($_GET["dandruff"])== "TRUE" AND
387    (!empty($_GET["family"])== "Seborrheic dermatitis")))))))
388    {
389        echo "Seborrheic eczema";
390    }
```

Figure 4.16 Seborrheic eczema rule 6

4.4 Interface design for SDDSS

This section will show the interfaces of SDDSS. There are four interfaces for this support system. The purpose of this interface is made for SDDSS is to allow users input the data inputs where the data entered will be processed into fuzzy rules to produce what types of skin diseases they are affected. Below are the interfaces of this support system.

4.4.1 Introduction interface

Figure 4.17 shows the first interface which is called introduction interface. The interface is only to display and tell the user about the system in the overview. The Next button will take the user to the second interface which is patient information interface.

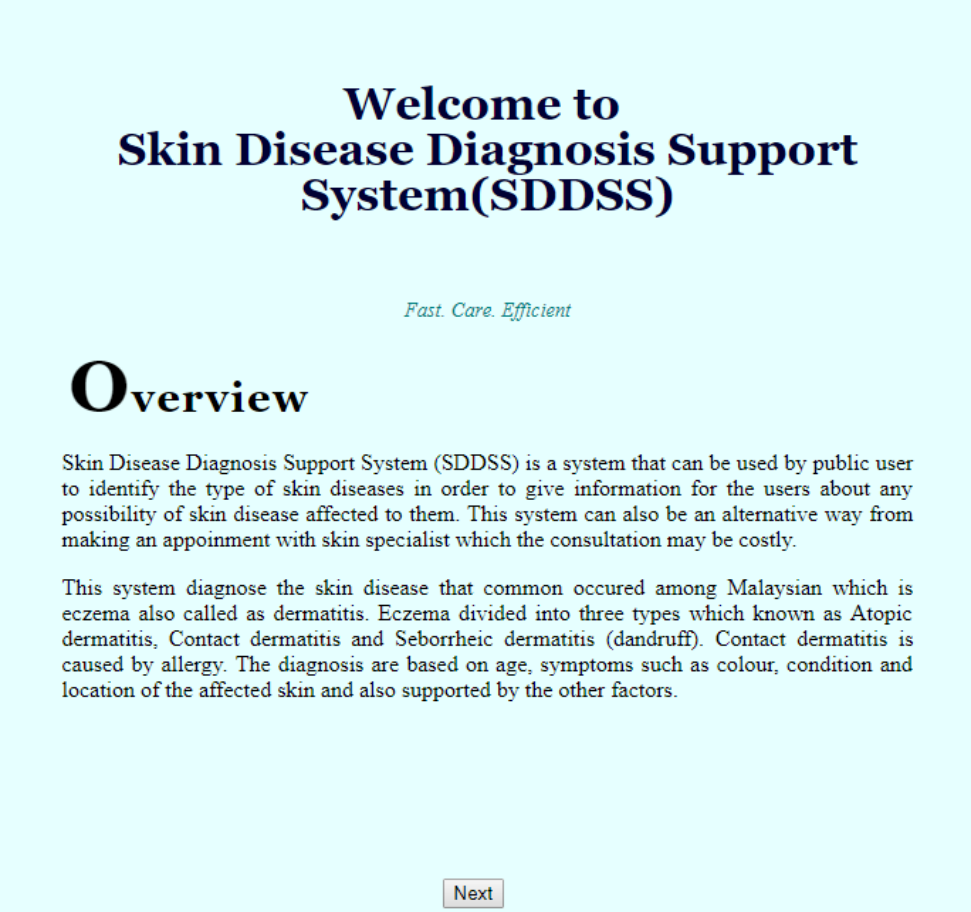

Figure 4.17 Introduction interface

4.4.2 Patient information

The second interface is patient information as shown in Figure 4.18. The aim of the interface is to allow users to input about themselves. The first thing, users have to insert their name in the patient name text box. This is compulsory because if user not entered the name, they will not be allowed to go to the next page. Second, users have to choose the age where it is classified as radio button, so user can select only one item. There are four age selections which are infants, school-aged child, adolescence and adult. The gender also classify in the radio button. They are grouped together under patient details. For the colours of affected skin are specified in the drop-down list. The colours are red, red-brownish grey, yellow-light brown, salmon-pink and pink. Other than that, the conditions and location of the affected skin are classified in checkbox. Users have to tick at least three of them or more. The colours, skin condition and location are grouped together symptoms. Furthermore, under history section, there are

four items classified using radio button which are experiences of hay fever, asthma, allergy reaction and have dandruff. For each item, users only can select only one either Yes or No. In the history section also has one drop-down list that categorized the family history affected by skin disease such as Atopic dermatitis and Seborrheic or No. Contact dermatitis is not related to family history so it is not included in the drop-down list. The Next button will bring user to the Next page which is the patient diagnosis result interface. If user clicks the Back button, it will bring user to the first interface.

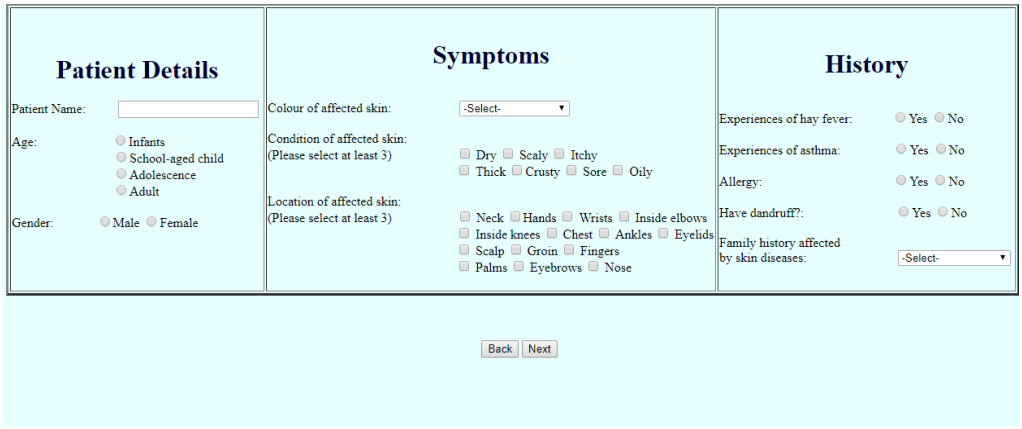

Figure 4.18 Patient information

4.4.3 Patient skin disease result

This third interface is to display what does the user had been selected. Figure 4.19 shows the example how the result and all the information input by the users are displayed. The Atopic dermatitis depicts on the top of the box is the example how result of the skin disease will be displayed. If users press the Next button, the will be displayed with home remedies interface. The Back button will carry the user to the previous page.

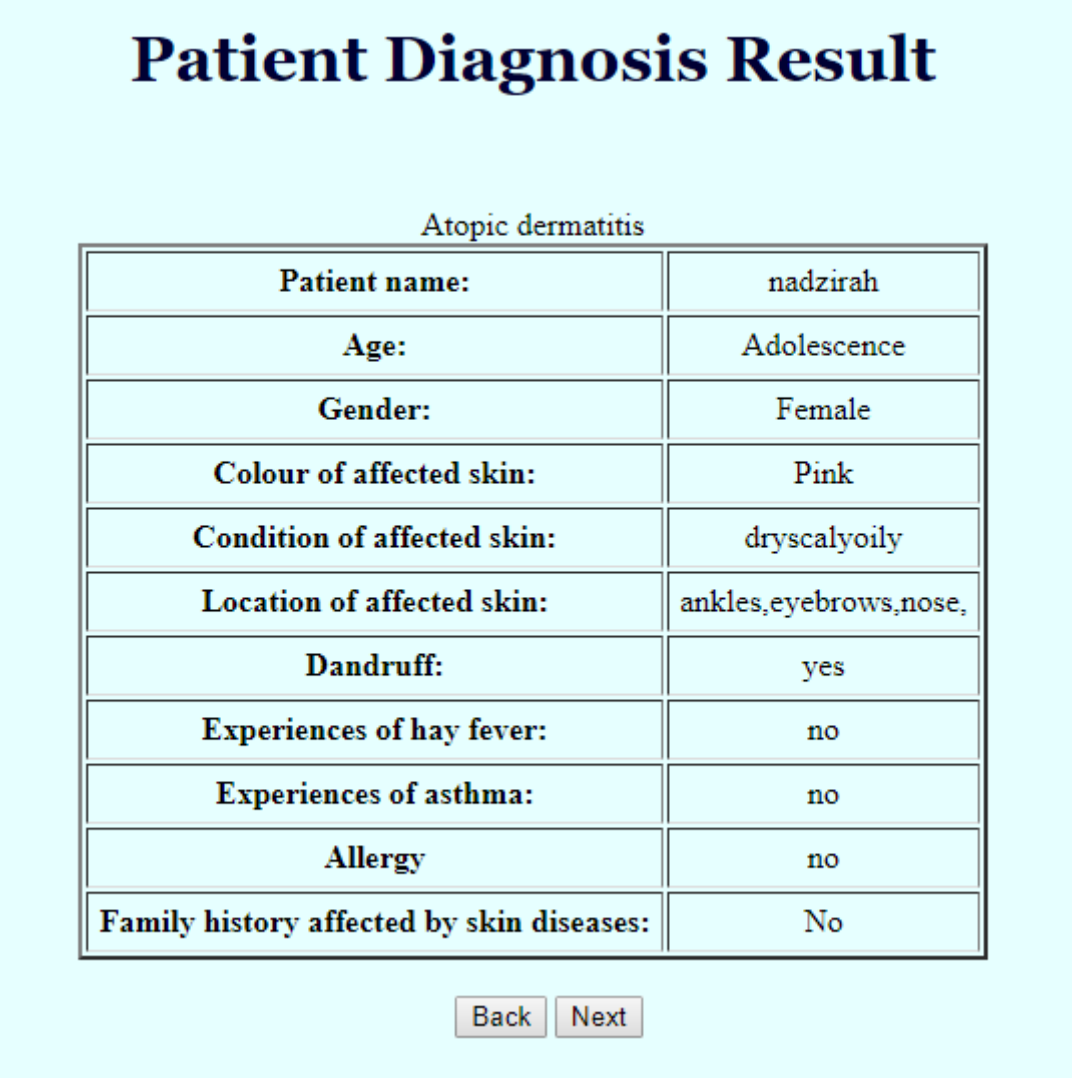

Figure 4.19 Patient result interface

4.4.4 Home remedies interface

This is the fourth interface also the last interface of SDDSS. This interface only a display interface that does not ask user to input anything in this interface. Users only have to read what has been written and it is also benefit information for the patients to know how to take care of their skin in the right way. This interface has two buttons which are Back button and Home button. The Home button will go back to the main page which is the first interface. Meanwhile, if users click the Back button, the previous page will be appeared. Figure 4.20 shows the home remedies interface.

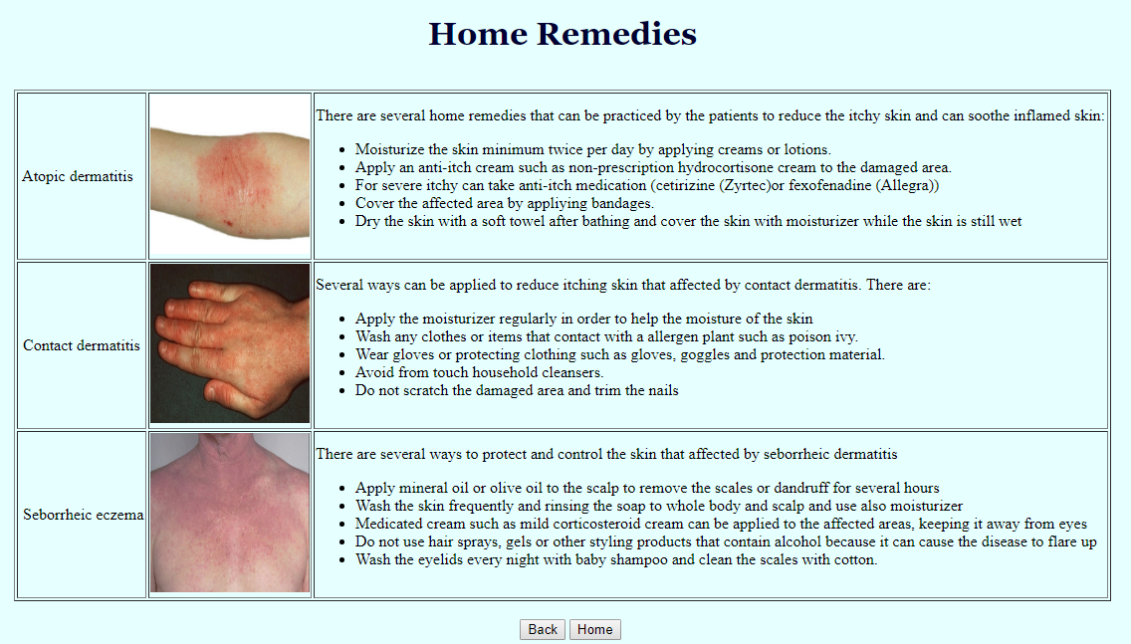

Figure 4.20 Home remedies interface

4.5 Conclusion

In this chapter already discussed about what is the development tool has been used which is Notepad++ in order to implement the fuzzy rules. The HTML, PHP and CSS are to generate the fuzzy rules and designing the interface for SDDSS. There are four interfaces for SDDSS. They are introduction interface, patient information interface, patient skin disease result interface and home remedies interface. The implementation code of fuzzy logic also has been discussed in this chapter. The implementation code of fuzzy logic also has been discussed in this chapter.

CHAPTER 5

TESTING & RESULT DISCUSSION

5.1 Introduction

This chapter describesd the testing phase that has been done in order to test the functionality of this system. The result also will be discussed in order to prove the fuzzy rules to diagnose the type of skin disease affected by the user or patient.

5.2 Patient diagnosis result

Below are the examples of result produced based on the three types of skin diseases which are Atopic dermatitis, Contact dermatitis and Seborrheic eczema. If input entered by users match with the rules created the results of skin diseases are produced.

Figure 5.1 shows the information or inputs entered by patient. The user selects the adult for the age. For the colour selected is red-brownish grey. The three selected skin conditions are dry, itchy and thick. Then, the locations selected are hands, neck, wrists and ankles. For hay fever and asthma, the user tick Yes while for the dandruff and allergy click No. The family history is Atopic dermatitis.

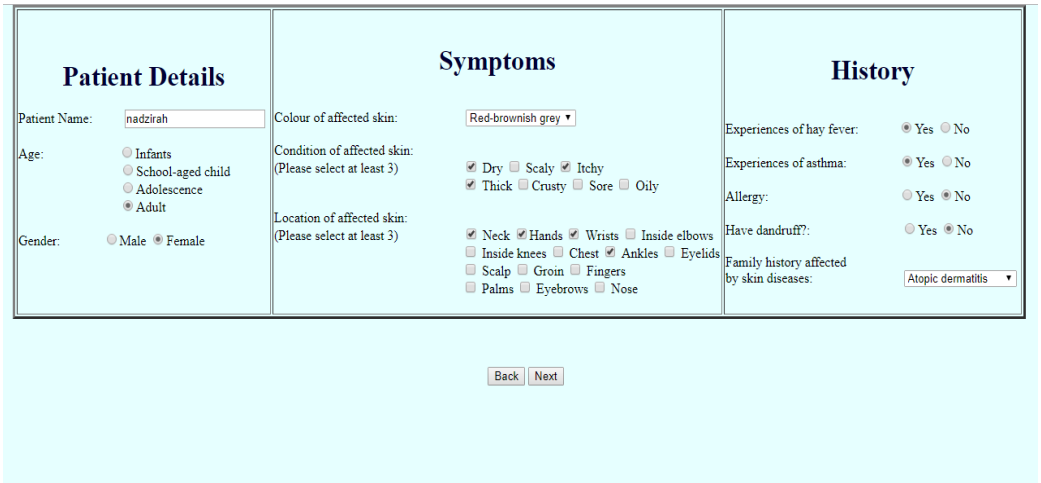

Figure 5.1 Patient input

Figure 5.2 shows the result of what the user has been selected. The diagnosis result shows that the user affected by Atopic dermatitis.

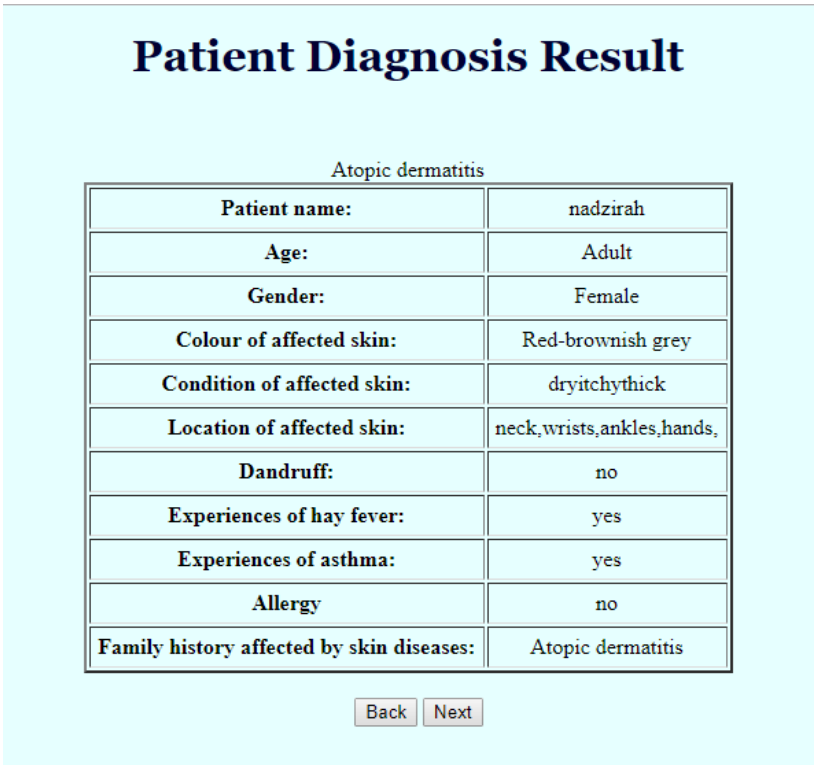

Figure 5.2 Diagnosis result of Atopic dermatitis

As shown in the Figure 5.3, the user select other inputs differ from the previous one. Based on that figure, the user selects adult for the age, the colour chosen is red. For the three selected skin conditions are dry, itchy and crusty. Meanwhile, for location of the affected skins are hands, palms and fingers. For the information about history, the user select No for hay fever, asthma and dandruff. However, for allergy user click Yes. In the drop-down list for family history, the No option has been selected.

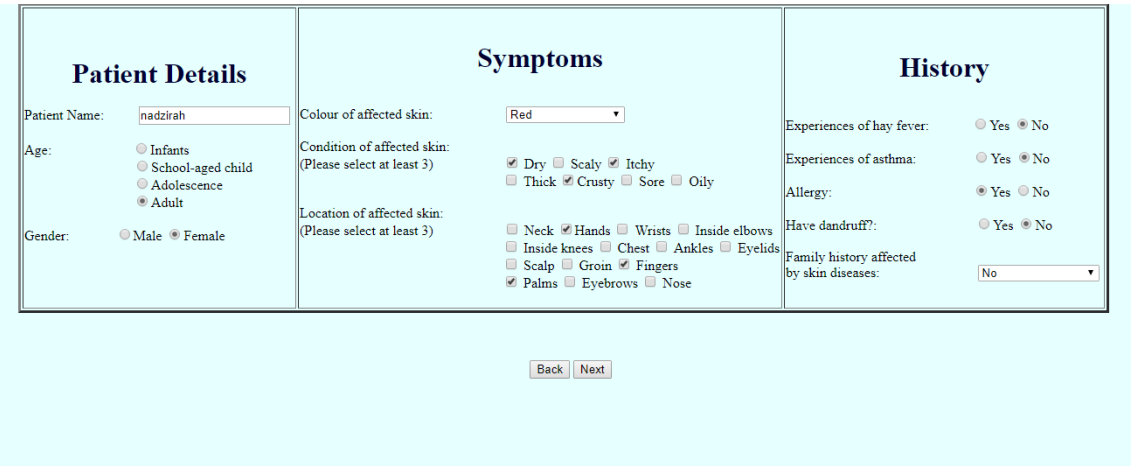

Figure 5.3 Input select by user

Based on what the users has been selected, the result show that the user is affected by Contact dermatitis. The result shows in the Figure 5.4.

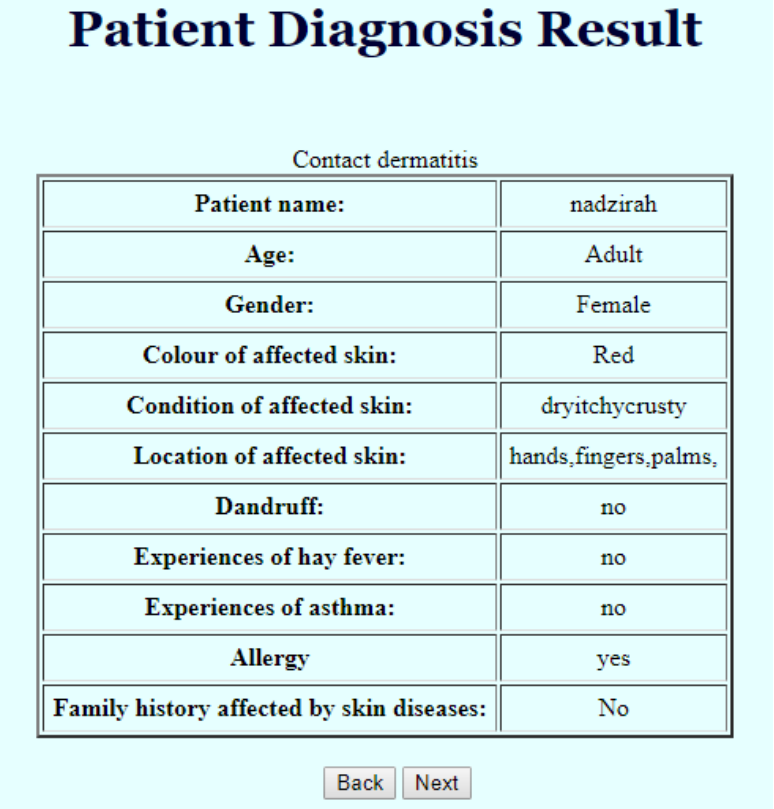

Figure 5.4 Patient diagnosis result for Contact dermatitis

Figure 5.5 shows the other inputs select by user. The user selects adult for the age. For the skin colour selected is salmon-pink. The conditions of the skin are scaly and oily. The locations selected are chest, scalp, groin and eyebrows. For history, the user clicks No for hay fever, asthma and allergy. However, the user clicks Yes for dandruff. Meanwhile, for the family history, the user selects Seborrheic dermatitis.

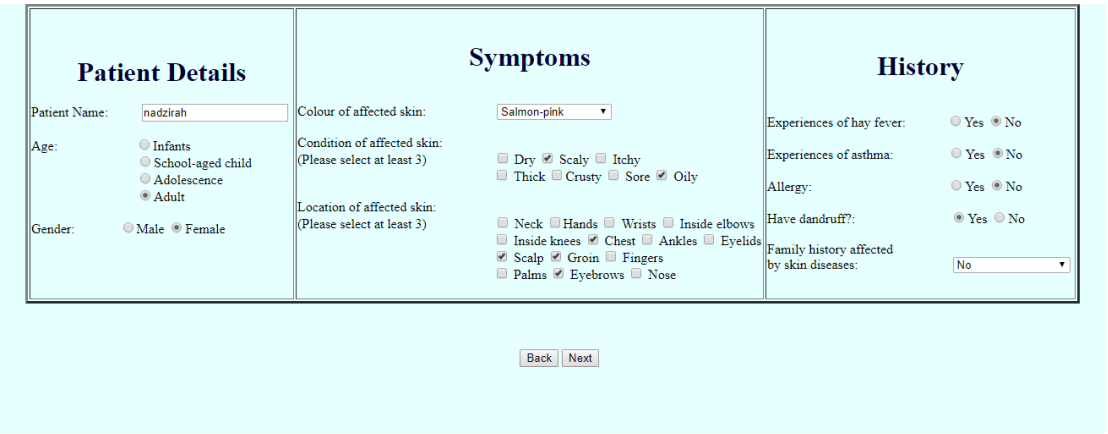

Figure 5.5 Input select by user

Figure 5.6 depicts the result for what input has been selected by the users. From that, the result produced is Seborrheic dermatitis.

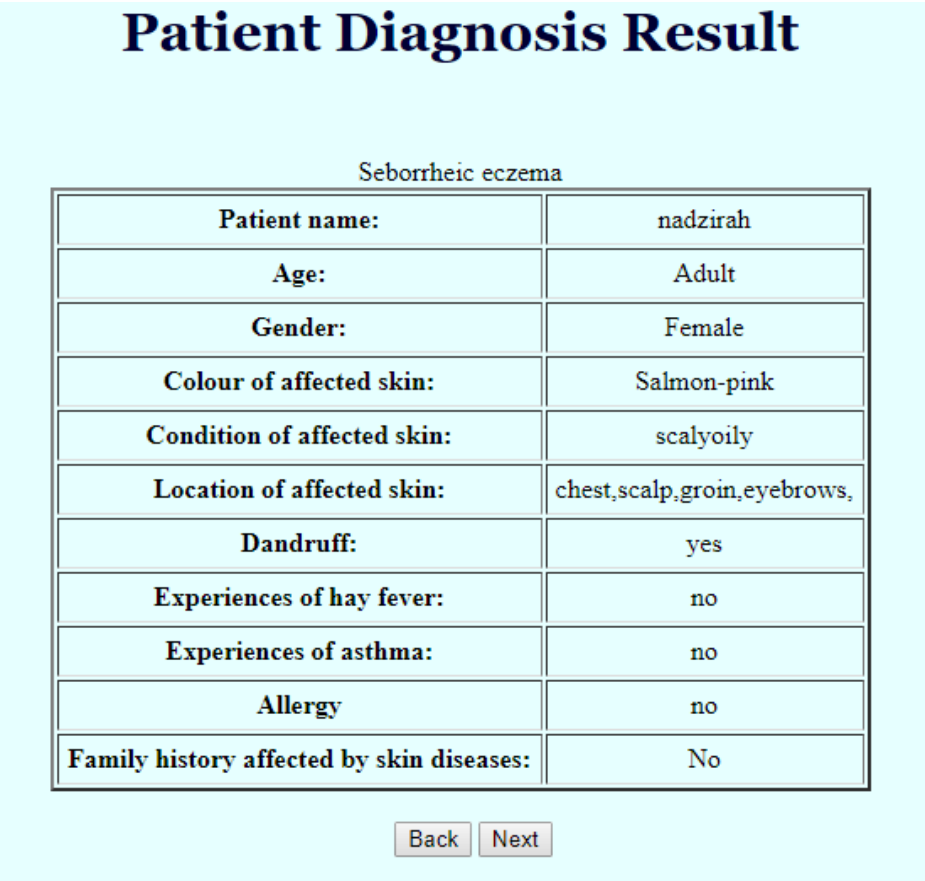

Figure 5.6 Patient diagnosis result of Seborrheic eczema

5.3 User knowledge testing

User knowledge testing is to measure the user knowledge about eczema. To test the knowledge, users have to answer a few questions before and after used the system Users has been given eight questions. Four questions have to answer before used the system while the other four questions must be answered after used the system Therefore, the Google form was created in order to test the user knowledge.

5.3.1 Google form

There were eight questions that users need to answer in this Google form. Four of them must be answered before use the system and the rest have to fill in after use the system. The first four questions were put in Section A while the last four questions were put in Section B. To do this survey, there 30 respondents were taken to complete this survey. Figure 5.7 shows the first page of the form. It only explains the purpose of the survey.

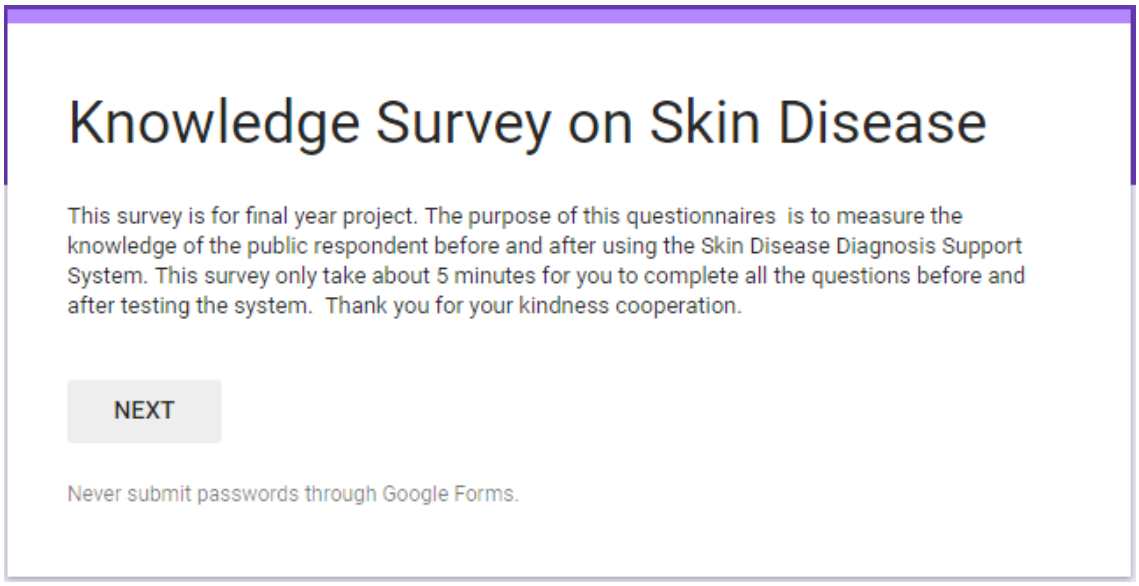

Figure 5.7 First interface of Google form

Figure 5.8 shows the second page of the form. Users were compulsory to fill their name. The first question is asked user either they know what is eczema. The purpose of this question is to know the knowledge of the users either they are familiar with eczema or not. The answer options are Yes, No and Maybe.

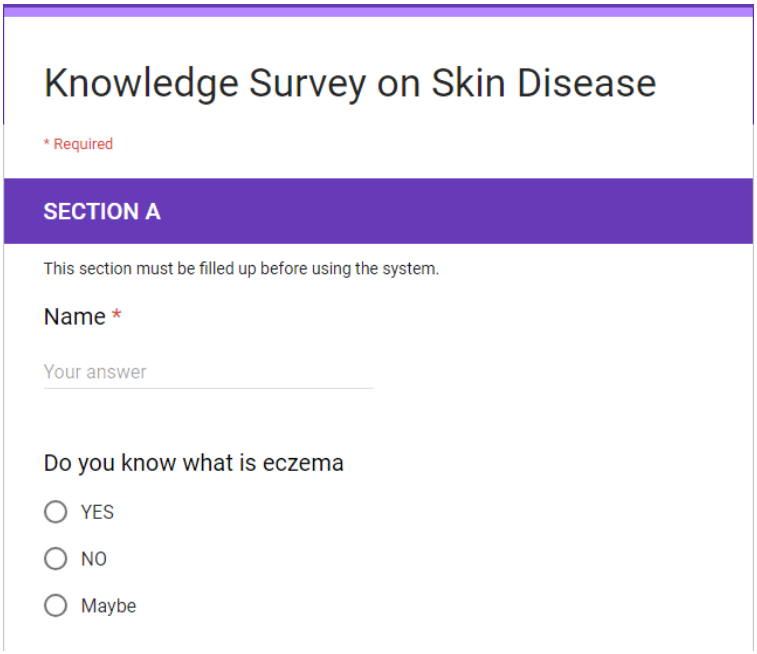

Figure 5.8 Question 1

Second question to forth question were shown in Figure 5.9. The second question asked user about the cause of eczema. This purpose of this question is to know either they are concern about cause of eczema. This question has two selection answers which are Yes, No or Maybe. The third question gives an example of eczema which is Atopic dermatitis. This question is to know either they ever heard about the type of eczema or not. The selected answers are Yes and No. Furthermore, the forth question is asked user either they able to diagnose their skin disease. This purpose of this question is to know before they use the system, they are able to identify their skin on their own. The answer options are Yes and No.

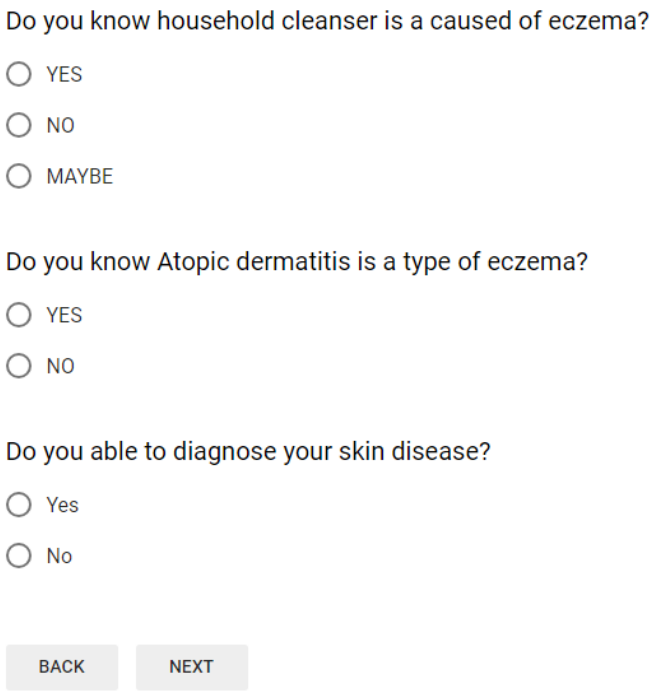

Figure 5.9 Question 2 to Question 4

Figure 5.10 depicts question five and six. All questions in Section B were asked after users tested the system. The purpose of the questions is to see whether there is increase of knowledge after this system. Questions 5 asked users whether the system gives better information to them and indirectly increase their knowledge. Meanwhile, Question 6 asked them about the home remedies provided is beneficial for them or not.

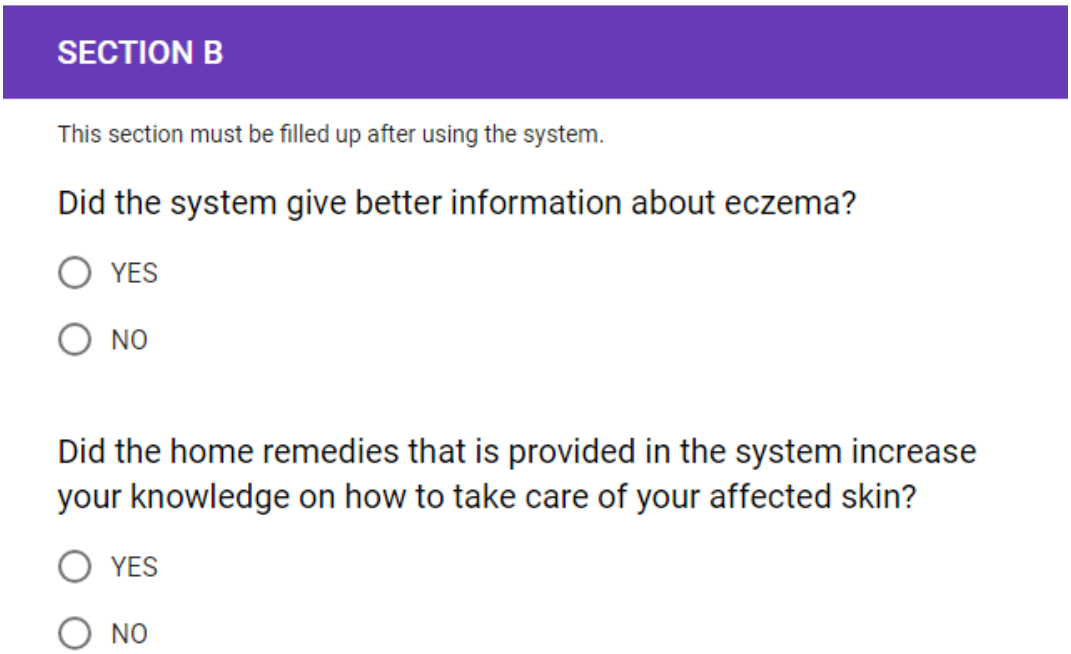

Figure 5.10 Question 5 and Question 6

Figure 5.11 shows the Question 7 and Question 8. The seventh question asked the users about they know that there are three types of eczema. The last question asked whether they system help them to diagnose the skin disease affected to them.

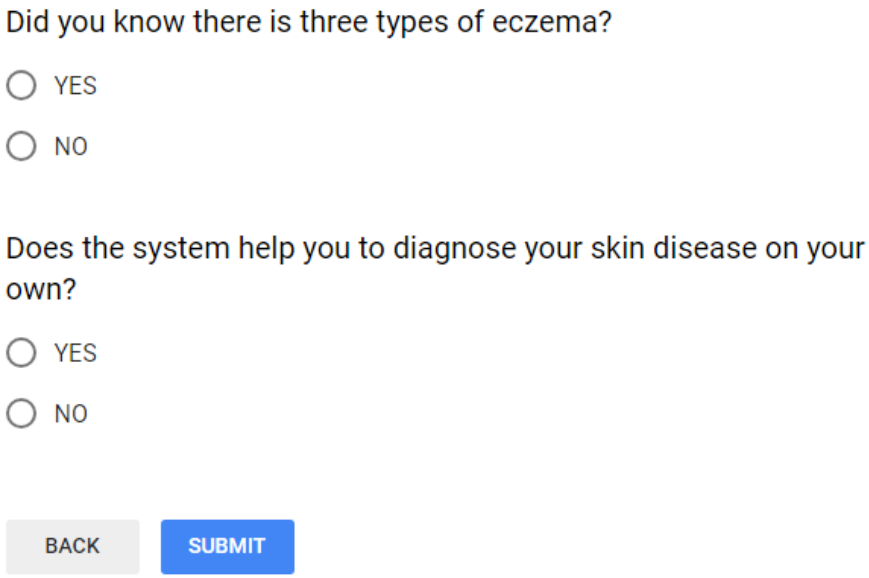

Figure 5.11 Question 7 and Question 8

5.3.2 User knowledge test result

The user knowledge testing has been conducted by 33 respondents, the user knowledge about eczema was identified. Before the user uses the system, they need to answer a few questions regarding of user knowledge about eczema, knowledge about treatment eczema at home, knowledge about eczema type and the knowledge about eczema diagnosis. The respondents have been asked to use the system. After use the system, again the respondents need to answer same categories of questions to check either the knowledges were improved or not.

Figure 5.12 shows the results before and after users used the system for user knowledge about eczema type. The results show 30% users know about eczema, 57% did not know what is eczema and 13% not sure about eczema. The comparison was made because the both questions have similar meaning. Based on the figure, the users showed positive feedback after used the system. The percentage of users knowledge about eczema was increased to 51 % after used the system compared to before knowledge. After used that system, users got better information about eczema and this is indirectly increase their knowledge about eczema after testing that system.

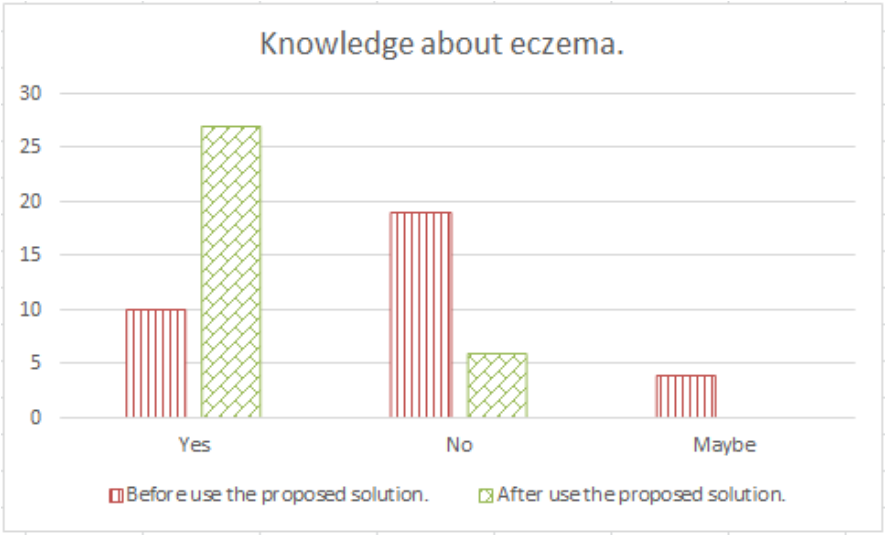

Figure 5.12 Comparison result for user know ledge about eczema

Figure 5.13 depicts the results before and after users used the system for knowledge about treatment eczema at home. The result shows 24% users know how to

do the treatment about eczema. Meanwhile, there was 57% did not know how to treat the disease. However, there is also 18% users did not know about the treatment. Based on that result, the percentage of users knowledge about treatment of eczema was increased to 60% after used the system. From the result, it can be proved that the home remedies that provided in that system gave beneficial knowledge to do the treatment at home.

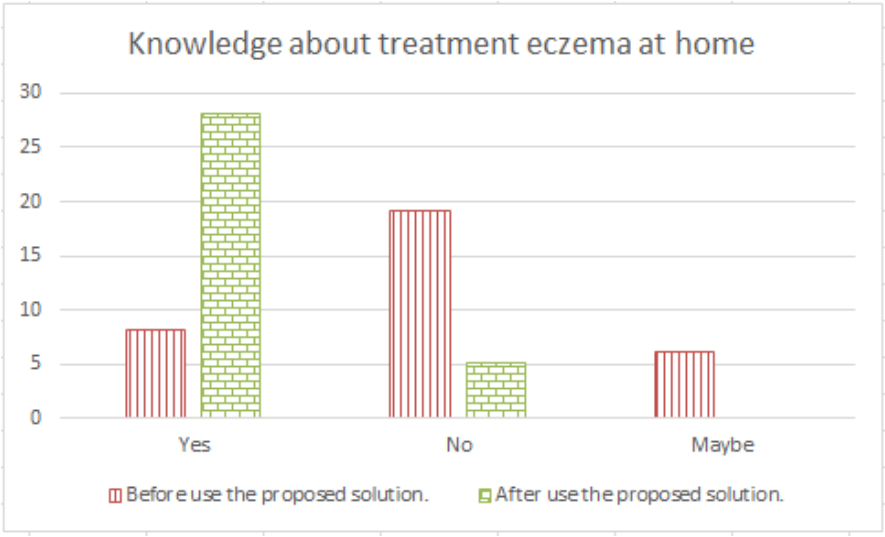

Figure 5.13 Comparison result for knowledge about eczema at home

Figure 5.14 shows the results for knowledge about eczema type. The result shows 18% users know the eczema type. Meanwhile, there was 81% users did not know what of eczema Based on the figure, the users showed positive feedback about the system. The percentage of users knowledge about eczema type was increased to 54 % after used the system. After used that system, users got better information about eczema type and this is indirectly increase their knowledge about eczema type after testing that system.

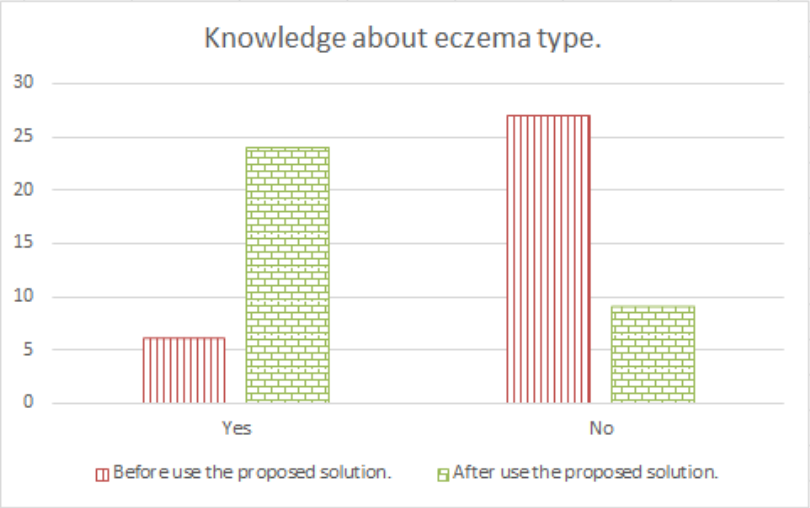

Figure 5.14 Comparison result for knowledge about eczema type

Figure 5.15 depicts the shows the results for knowledge about eczema diagnosis. The result shows 15% users know about to diagnose eczema. Meanwhile, there was 78% users did not know about diagnosis of eczema Based on the figure, the users showed positive feedback about the system. The percentage of users knowledge about eczema diagnosis was increased to 63 % after used the system. After used that system, users got better information about eczema diagnosis and this is indirectly increase their knowledge about eczema diagnosis after testing that system.

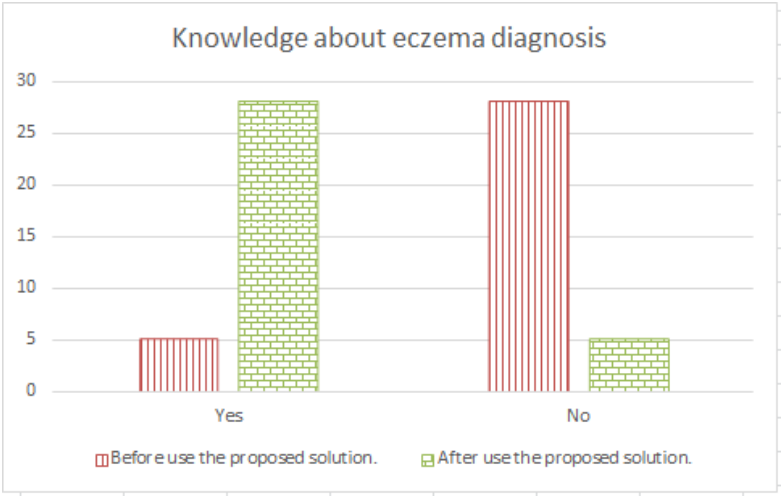

Figure 5.15 Comparison result for knowledge about eczema diagnosis

5.4 Conclusion

From the results collected, it can be proved that the knowledge of the users about eczema was very poor before use this system. Only certain of them know what is eczema was. The result after used this system is impressive because show the improvement of users knowledge about the skin disease. In other hand, this system can help users to diagnose their skin disease affected.

CHAPTER 6

CONCLUSION

6.1 Introduction

This chapter will discuss about the overall conclusion for this research. The research constraint also will be discussed. Other than that, the suggestion of future works also will be stated.

This research title is Skin Disease Diagnosis Support System using Fuzzy Logic. The diagnosis of eczema has been made. There are only three types of eczema selected in this research. This research uses fuzzy rule to do the diagnosis of the type of skin disease. In order to create the fuzzy rules, the data about the factors of the skin disease are collected from ten authorized medical websites. The factors identified are age, symptoms and history. To create the fuzzy rules, the HTML and PHP is used. The tool uses is Notepad++ in order to launch the HTML and PHP coding. The purpose of the development the system is to prove that the rules that have been generated using fuzzy logic rule based. There are 60 rules for Atopic dermatitis while Contact dermatitis has the total of 28 rules and for Seborrheic dermatitis has 48 rules are created. The functionality testing based on user knowledge about the skin disease was made. To do the testing, a survey has been made. Total of 30 respondents are selected to finish the survey. Based on the result collected, the user knowledge about eczema is increase after the users use this system.

6.2 Research constraints

There are two limitations in this system that was founded. This research only does the research only for one type of skin disease which is eczema. There are only three types of eczema that focused in this research which are Atopic dermatitis, Contact dermatitis and Seborrheic eczema. Moreover, to construct the fuzzy rules take longer time because there are so many rules need to be constructed in the HTML coding.

6.3 Future work

There are a few future works that can be done in the future. In the future, the numbers of skin diseases can be added for research purpose. Other than that, fuzzy logic can be implemented using MATLAB. Other than that, the fuzzy logic can be cooperated with the neural network because the neural network has the ability of self-learning, self-tuning and high computational task performance. Furthermore, more skin disease can be done.

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APPENDIX A
DATA PREPARATION

Data preparations for Atopic dermatitis, Contact dermatitis and Seborrheic eczema.

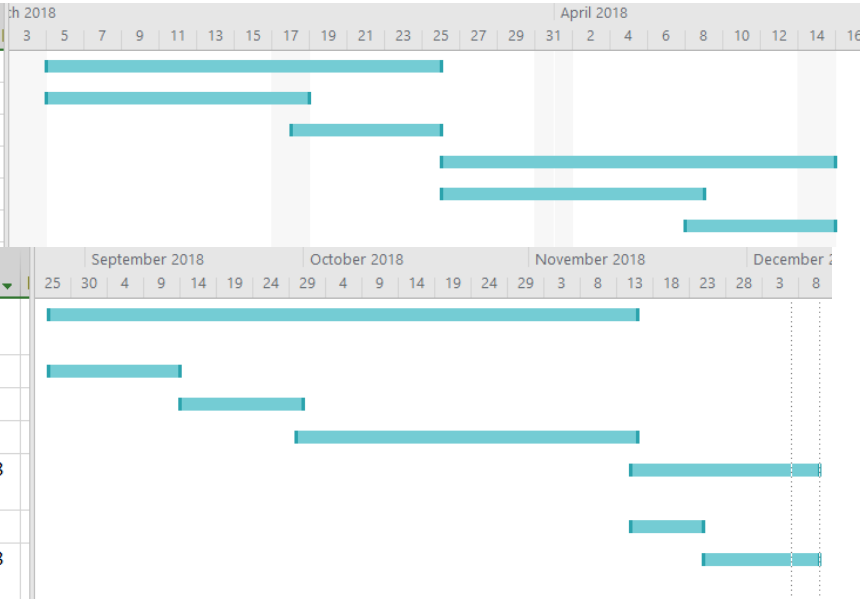
ECZEMA: Atopic Dermatitis		AUTHORIZED MEDICAL WEBSITES									
		MedicalNews Today	Mayo Clinic	Healthline	WebMD	Everyday Health	DermNet NZ	emedicinehealth.com	Drugs.com	Family Doctor	Medlineplus
Age		Children <5, Adulthood	Children, adults	Infants, children, adults	Children, adults	Children, adults	Infants, children, adults	Infants, children, adult	Infants, Children <5 adolescence,	Infants, adults, children	Infants 2 to 6 months, adulthood
Symptom	Colour	Red-Brownish grey	Red-Brownish grey,	Red-Brownish grey, yellow-light brown	Yellowish- light brow	Red-Brownish grey	Red-Brownish grey	Yellow-light brown	Red-brownish grey, yellow-light brown	Red-Brownish gre	Red, yellow-light brown
	Skin Condition	Dry, itchy	Dry, scaly, itchy	Dry, scaly, itchy, thick	Dry, itchy, thick	Rough, thick, itchy	Dry, thick, itchy	Itchy, scaly,	Dry, itchy, thick	Itchy, dry	Scaly, itchy, dry
	Location	Neck, wrists, ankles, buttock, legs, inside elbows and knees	Neck, upper chest, feet, hands, ankles, wrist, eyelids	Scalp, cheek, inside elbows and knees	Hands, neck, face, legs, inside knees and elbows	Face, hands, feet, wrists, ankles, neck, around mouth, inside elbows and knees	Wrists, inside elbows, ankles, inside knees, genitals, hands, eyelids	Neck, arms, legs, eyelids, torso, face, outer ears, inside elbows and knees	Neck, knees, feet, ankles, wrists, upper chest, eyelids, inside elbows and knees	Inside knees, cheeks, buttocks	Face, chest, inside elbow
History	Dandruff	No	No	No	No	No	No	No	No	No	No
	Family	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Allergy	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No
	Hay fever	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Asthma	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

ECZEMA: Contact Dermatitis		AUTHORIZED MEDICAL WEBSITES									
		MedicalNewsToday	Mayo Clinic	Healthline	WebMD	EverydayHealth	DermNet NZ	emedicinehealth.com	Drugs.com	FamilyDoctor	Medlineplus
Age		Children	Infants, children	Infants	Infants, children	Children	Infants, children, adults	No	No	Infants	N/A
Symptom	Colour	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red
	Skin conditions	Dry, itchy, flaky, crust	Itchy, dry, scaly, crack, crusty, ooze	Dry, flaky, scaly, oozing, burns, sore	Itchy, crusty, oozing sores	Crusty, sores, itchy	Dry, cracks, think, sore	Itchy, crusty, sore	Itchy, burns, dry, scaly, crusty skin	Dry, rough, flaky, itchy	Burn
	Locations	Hands, palms	Wrist, face, palms	Fingers, hands, palm, neck, eyes, faces	Wrist, ankle, neck, palm, legs, stomach	Fingers, hands, palms	Hands, fingers	Hands, fingers	Face, hands	Hands, fingers	Hands, face, palms
History	Dandruff	No	No	No	No	No	No	No	No	No	No
	Family	No	No	No	No	No	No	No	No	Yes	No
	Allergy	Latex, rubber	Nickel, jewelry, bubkles, soaps, cosmetics, fragrances, plants	Jewelry, nickel, gold, latex gloves	Hair dyes, poison ivy, nickel, leather, latex rubber, citrus fruit(peel), shampoo, soap, lotion, perfume, watches, chains, belt buckles, earings	Solvents, pesticides, delergents, poison ivy, cosmetics, nickel	Nickel, water, soaps, delergents, bleaches, polishes	Poison sumac, poison ivy, poison oak, hair dyes, metallic nickel(jewelry, belt buckels), leathers tanning agents, rubber, fragrance, shampoo, lotions, perfume, cosmetics	Soaps, lotions, makeup, cleaning product, poison plants(poison ivy or poison oak) chromium or nickel, rubber, steroid cream	Poison plants(poison oak or ivy), latex, chemicals, textile dyes, glues, adhesives, soaps, detergents, acids, alkalis, water, heavy metals	Poison ivy, poison oak, latex gloves, perfumes, soaps, cosmetics, hair dyes, nail polish
	Hay fever	No	No	No	No	No	No	No	No	Yes	N/A
	Asthma	No	No	No	No	No	No	No	No	Yes	N/A

ECZEMA: Seborrheic Eczema		AUTHORIZED MEDICAL WEBSITES									
		MedicalNewsToday	Mayo Clinic	Healthline	WebMD	Everyday Health	DermNet NZ	emedicinehealth.com	Drugs.com	Family Doctor	Medlineplus
Age		All ages	Infants, adults	Infants, adults	Infants, adults(aged 20-60)	Infants, adults	Infants 6-12 months, adults	Adults	Infants, children, teenagers, adults	Babies<3 months, adolescents,	Infants, adults
Symptom	Colour	Salmon-pink, pink	Salmon-pink, white or yellow scales	Salmon-pink, white or yellowish patches	Pink, yellow or brown scales	Pink	Salmon-pink patches	Pink or red skin, white flakes	Salmon-pink	Pink	Pink
	Skin conditions	Scaly patches, flaky, dandruff	Scaly patches, skin flakes(dandruff), cradle cap	Scaly patches, dandruff, greasy, oily	Dandruff, cradle cap, itchy, burn, oily	Itchy, dandruff, dry, burn, scaly, flaky	Scaly, oily	Itchy, scaly, dry, sore	Itchy, burning irritation, oily, flaky, dandruff(adults), cradle cap(infants)	Oily, scaly	Burn
	Locations	Scalp, hair, beard, mustache, eyebrows, face, nose, eyelids, ears, chest, armpits, groin	Oily areas(face, sides of nose, ears, eyelids, chest, eyebrows), scalp, hair, beard, mustache	Oily areas(around ears, nose, chest, eyebrows), scalp, hairs, beard, groin	Nose, eyebrows, eyelids, behind the ears, arms, legs, in the groin	Oily areas(eyebrows,eyelids , center of the face), ears, chest, upper back, armpits	Scalp, face,armpits, groin folds, nose, behind ears, eyebrows, eyelids	Eyebrows, nose, ears, beard, chest	Scalp, neck creases, armpits, groin, eyebrows, eyelids, forehead, nose creases, outer ear, chest	Face, chest, legs, groin	Scalp, face, inside ear
History	Dandruff	White or yellowish	White or yellowish	White or yellowish	Yellow or brown	N/A	N/A	White	N/A	N/A	White or yellowish
	Family	No	No	No	Yes	Yes	Yes	No	No	Yes	Yes
	Allergy	Yes	No	No	No	Yes	No	No	No	No	No
	Hay fever	Yes	No	No	No	Yes	No	No	No	No	No
	Asthma	Yes	No	No	No	Yes	No	No	No	No	No

GANTT CHART

Task Name	Duration	Start	Finish
PHASE 1: LITERATURE REVIEW	16 days	Mon 3/5/18	Sun 3/25/18
Search related papers	11 days	Mon 3/5/18	Sun 3/18/18
Analyze to get the information	7 days	Sun 3/18/18	Sun 3/25/18
PHASE 2: IDENTIFY FACTORS OF SDDSS	16 days	Mon 3/26/18	Sun 4/15/18
Analyze article to identify factors	11 days	Mon 3/26/18	Sun 4/8/18
Finalized list of factors and parameters	7 days	Sun 4/8/18	Sun 4/15/18
PHASE 3: IMPLEMENT SDDSS USING FUZZY LOGIC	59 days	Mon 8/27/18	Thu 11/15/18
Make comparison between previous method	14 days	Mon 8/27/18	Thu 9/13/18
New rules generated from the factors	12 days	Fri 9/14/18	Sun 9/30/18
Develop SDDSS using fuzzy logic approach	35 days	Sun 9/30/18	Thu 11/15/18
PHASE 4: EVALUATE THE SDDSS USING FUZZY LOGIC	18 days	Thu 11/15/18	Mon 12/10/18
New set of rules generated	8 days	Thu 11/15/18	Sat 11/24/18
Results evaluated based on user knowledge before and after using SDDSS	12 days	Sun 11/25/18	Mon 12/10/18



APPENDIX B
CODE IMPLEMENTATION

Atopic dermatitis code implementation

```
elseif(!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Red-brownish grey" AND
(!empty($_GET["itchy"]) AND (!empty($_GET["neck"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])=="TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Red-brownish grey" AND
(!empty($_GET["itchy"]) AND (!empty($_GET["wrists"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])=="TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Red-brownish grey" AND
(!empty($_GET["itchy"]) AND (!empty($_GET["inside elbows"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])=="TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Red-brownish grey" AND
(!empty($_GET["itchy"]) AND (!empty($_GET["inside knees"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])=="TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Red-brownish grey" AND
(!empty($_GET["itchy"]) AND (!empty($_GET["ankles"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Red-brownish grey" AND
(!empty($_GET["thick"]) AND (!empty($_GET["neck"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
```

```
elseif(!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Red-brownish grey" AND
(!empty($_GET["thick"]) AND (!empty($_GET["wrists"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Red-brownish grey" AND
(!empty($_GET["thick"]) AND (!empty($_GET["inside elbows"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Red-brownish grey" AND
(!empty($_GET["thick"]) AND (!empty($_GET["inside knees"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Red-brownish grey" AND
(!empty($_GET["thick"]) AND (!empty($_GET["ankles"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Yellow-light brown" AND
(!empty($_GET["dry"]) AND (!empty($_GET["neck"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Yellow-light brown" AND
(!empty($_GET["dry"]) AND (!empty($_GET["wrists"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
```

```
elseif(!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Yellow-light brown" AND
(!empty($_GET["dry"]) AND (!empty($_GET["inside elbows"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Yellow-light brown" AND
(!empty($_GET["dry"]) AND (!empty($_GET["inside knees"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Yellow-light brown" AND
(!empty($_GET["dry"]) AND (!empty($_GET["ankles"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Yellow-light brown" AND
(!empty($_GET["itchy"]) AND (!empty($_GET["neck"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Yellow-light brown" AND
(!empty($_GET["itchy"]) AND (!empty($_GET["wrists"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Yellow-light brown" AND
(!empty($_GET["itchy"]) AND (!empty($_GET["inside elbows"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
```

```
elseif(!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Yellow-light brown" AND
(!empty($_GET["itchy"]) AND (!empty($_GET["inside knees"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Yellow-light brown" AND
(!empty($_GET["itchy"]) AND (!empty($_GET["ankles"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Yellow-light brown" AND
(!empty($_GET["thick"]) AND (!empty($_GET["neck"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Yellow-light brown" AND
(!empty($_GET["thick"]) AND (!empty($_GET["wrists"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Yellow-light brown" AND
(!empty($_GET["thick"]) AND (!empty($_GET["inside elbows"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Yellow-light brown" AND
(!empty($_GET["thick"]) AND (!empty($_GET["inside knees"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
```

```
elseif(!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Yellow-light brown" AND
(!empty($_GET["thick"]) AND (!empty($_GET["ankles"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Red-brownish grey" AND
(!empty($_GET["dry"]) AND (!empty($_GET["neck"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Red-brownish grey" AND
(!empty($_GET["dry"]) AND (!empty($_GET["wrists"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Red-brownish grey" AND
(!empty($_GET["dry"]) AND (!empty($_GET["inside elbows"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Red-brownish grey" AND
(!empty($_GET["dry"]) AND (!empty($_GET["inside knees"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Red-brownish grey" AND
(!empty($_GET["dry"]) AND (!empty($_GET["ankles"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
```

```
elseif(!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Red-brownish grey" AND
(!empty($_GET["itchy"]) AND (!empty($_GET["neck"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Red-brownish grey" AND
(!empty($_GET["itchy"]) AND (!empty($_GET["wrists"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Red-brownish grey" AND
(!empty($_GET["itchy"]) AND (!empty($_GET["inside elbows"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Red-brownish grey" AND
(!empty($_GET["itchy"]) AND (!empty($_GET["inside knees"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Red-brownish grey" AND
(!empty($_GET["itchy"]) AND (!empty($_GET["ankles"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Red-brownish grey" AND
(!empty($_GET["thick"]) AND (!empty($_GET["neck"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
```

```
elseif(!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Red-brownish grey" AND
(!empty($_GET["thick"]) AND (!empty($_GET["wrists"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Red-brownish grey" AND
(!empty($_GET["thick"]) AND (!empty($_GET["inside elbows"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Red-brownish grey" AND
(!empty($_GET["thick"]) AND (!empty($_GET["inside knees"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Red-brownish grey" AND
(!empty($_GET["thick"]) AND (!empty($_GET["ankles"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Yellow-light brown" AND
(!empty($_GET["dry"]) AND (!empty($_GET["neck"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Yellow-light brown" AND
(!empty($_GET["dry"]) AND (!empty($_GET["wrists"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
```

```
elseif(!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Yellow-light brown" AND
(!empty($_GET["dry"]) AND (!empty($_GET["inside elbows"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Yellow-light brown" AND
(!empty($_GET["dry"]) AND (!empty($_GET["inside knees"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Yellow-light brown" AND
(!empty($_GET["dry"]) AND (!empty($_GET["ankles"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Yellow-light brown" AND
(!empty($_GET["itchy"]) AND (!empty($_GET["neck"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Yellow-light brown" AND
(!empty($_GET["itchy"]) AND (!empty($_GET["wrists"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Yellow-light brown" AND
(!empty($_GET["itchy"]) AND (!empty($_GET["inside elbows"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
```

```
elseif(!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Yellow-light brown" AND
(!empty($_GET["itchy"]) AND (!empty($_GET["inside knees"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Yellow-light brown" AND
(!empty($_GET["itchy"]) AND (!empty($_GET["ankles"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Yellow-light brown" AND
(!empty($_GET["thick"]) AND (!empty($_GET["neck"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Yellow-light brown" AND
(!empty($_GET["thick"]) AND (!empty($_GET["wrists"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Yellow-light brown" AND
(!empty($_GET["thick"]) AND (!empty($_GET["inside elbows"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
```

```
elseif(!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Yellow-light brown" AND
(!empty($_GET["thick"]) AND (!empty($_GET["inside knees"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis")))))))
{
    echo "Atopic dermatitis";
}
elseif(!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Yellow-light brown" AND
(!empty($_GET["thick"]) AND (!empty($_GET["ankles"]) AND (!empty($_GET["fever"])== "TRUE" AND
(!empty($_GET["asthma"])== "TRUE" AND (!empty($_GET["family"])== "Atopic dermatitis"))))))
{
    echo "Atopic dermatitis";
}
```

Contact dermatitis code implementation

```
elseif (!empty($_GET["age"])== "Infants" AND (!empty($_GET["colour"])== "Red" AND
(!empty($_GET["crusty"]) AND (!empty($_GET["hands"] AND(!empty($_GET["allergy"])== "TRUE"))))))
{
    echo "Contact dermatitis";
}
elseif (!empty($_GET["age"])== "Infants" AND (!empty($_GET["colour"])== "Red" AND
(!empty($_GET["crusty"]) AND (!empty($_GET["fingers"] AND(!empty($_GET["allergy"])== "TRUE"))))))
{
    echo "Contact dermatitis";
}
elseif (!empty($_GET["age"])== "Infants" AND (!empty($_GET["colour"])== "Red" AND
(!empty($_GET["crusty"]) AND (!empty($_GET["palms"] AND(!empty($_GET["allergy"])== "TRUE"))))))
{
    echo "Contact dermatitis";
}
elseif (!empty($_GET["age"])== "Infants" AND (!empty($_GET["colour"])== "Red" AND
(!empty($_GET["sore"]) AND (!empty($_GET["hands"] AND(!empty($_GET["allergy"])== "TRUE"))))))
{
    echo "Contact dermatitis";
}
elseif (!empty($_GET["age"])== "Infants" AND (!empty($_GET["colour"])== "Red" AND
(!empty($_GET["sore"]) AND (!empty($_GET["fingers"] AND(!empty($_GET["allergy"])== "TRUE"))))))
{
    echo "Contact dermatitis";
}
elseif (!empty($_GET["age"])== "Infants" AND (!empty($_GET["colour"])== "Red" AND
(!empty($_GET["sore"]) AND (!empty($_GET["palms"] AND(!empty($_GET["allergy"])== "TRUE"))))))
{
    echo "Contact dermatitis";
}
elseif (!empty($_GET["age"])== "Infants" AND (!empty($_GET["colour"])== "Red" AND
(!empty($_GET["itchy"]) AND (!empty($_GET["hands"] AND(!empty($_GET["allergy"])== "TRUE"))))))
{
    echo "Contact dermatitis";
}
```

```
elseif (!empty($_GET["age"])== "Infants" AND (!empty($_GET["colour"])== "Red" AND
(!empty($_GET["itchy"]) AND (!empty($_GET["fingers"] AND(!empty($_GET["allergy"])== "TRUE"))))))
{
    echo "Contact dermatitis";
}
elseif (!empty($_GET["age"])== "Infants" AND (!empty($_GET["colour"])== "Red" AND
(!empty($_GET["itchy"]) AND (!empty($_GET["palms"] AND(!empty($_GET["allergy"])== "TRUE"))))))
{
    echo "Contact dermatitis";
}
elseif (!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Red" AND
(!empty($_GET["dry"]) AND (!empty($_GET["hands"] AND(!empty($_GET["allergy"])== "TRUE"))))))
{
    echo "Contact dermatitis";
}
elseif (!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Red" AND
(!empty($_GET["dry"]) AND (!empty($_GET["fingers"] AND(!empty($_GET["allergy"])== "TRUE"))))))
{
    echo "Contact dermatitis";
}
elseif (!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Red" AND
(!empty($_GET["dry"]) AND (!empty($_GET["palms"] AND(!empty($_GET["allergy"])== "TRUE"))))))
{
    echo "Contact dermatitis";
}
elseif (!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Red" AND
(!empty($_GET["crusty"]) AND (!empty($_GET["hands"] AND(!empty($_GET["allergy"])== "TRUE"))))))
{
    echo "Contact dermatitis";
}
elseif (!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Red" AND
(!empty($_GET["crusty"]) AND (!empty($_GET["fingers"] AND(!empty($_GET["allergy"])== "TRUE"))))))
{
    echo "Contact dermatitis";
}
```

```
elseif (!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Red" AND
(!empty($_GET["crusty"]) AND (!empty($_GET["palms"] AND(!empty($_GET["allergy"])== "TRUE"))))))
{
    echo "Contact dermatitis";
}
elseif (!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Red" AND
(!empty($_GET["sore"]) AND (!empty($_GET["hands"] AND(!empty($_GET["allergy"])== "TRUE"))))))
{
    echo "Contact dermatitis";
}
elseif (!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Red" AND
(!empty($_GET["sore"]) AND (!empty($_GET["fingers"] AND(!empty($_GET["allergy"])== "TRUE"))))))
{
    echo "Contact dermatitis";
}
elseif (!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Red" AND
(!empty($_GET["sore"]) AND (!empty($_GET["palms"] AND(!empty($_GET["allergy"])== "TRUE"))))))
{
    echo "Contact dermatitis";
}
elseif (!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Red" AND
(!empty($_GET["itchy"]) AND (!empty($_GET["hands"] AND(!empty($_GET["allergy"])== "TRUE"))))))
{
    echo "Contact dermatitis";
}
elseif (!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Red" AND
(!empty($_GET["itchy"]) AND (!empty($_GET["fingers"] AND(!empty($_GET["allergy"])== "TRUE"))))))
{
    echo "Contact dermatitis";
}
elseif (!empty($_GET["age"])== "School-aged child" AND (!empty($_GET["colour"])== "Red" AND
(!empty($_GET["itchy"]) AND (!empty($_GET["palms"] AND(!empty($_GET["allergy"])== "TRUE"))))))
{
    echo "Contact dermatitis";
}
```

Seborrheic eczema code implementation

```
elseif (!empty($_GET["age"])== "Infants" AND (!empty($_GET["colour"])== "Salmon-pink" AND
(!empty($_GET["oily"]) AND (!empty($_GET["chest"] AND (!empty($_GET["dandruff"])== "TRUE" AND
(!empty($_GET["family"])== "Seborrheic dermatitis")))))))
{
    echo "Seborrheic eczema";
}
elseif (!empty($_GET["age"])== "Infants" AND (!empty($_GET["colour"])== "Salmon-pink" AND
(!empty($_GET["oily"]) AND (!empty($_GET["eyelids"] AND (!empty($_GET["dandruff"])== "TRUE" AND
(!empty($_GET["family"])== "Seborrheic dermatitis")))))))
{
    echo "Seborrheic eczema";
}
elseif (!empty($_GET["age"])== "Infants" AND (!empty($_GET["colour"])== "Salmon-pink" AND
(!empty($_GET["oily"]) AND (!empty($_GET["scalp"] AND (!empty($_GET["dandruff"])== "TRUE" AND
(!empty($_GET["family"])== "Seborrheic dermatitis")))))))
{
    echo "Seborrheic eczema";
}
elseif (!empty($_GET["age"])== "Infants" AND (!empty($_GET["colour"])== "Salmon-pink" AND
(!empty($_GET["oily"]) AND (!empty($_GET["groin"] AND (!empty($_GET["dandruff"])== "TRUE" AND
(!empty($_GET["family"])== "Seborrheic dermatitis")))))))
{
    echo "Seborrheic eczema";
}
elseif (!empty($_GET["age"])== "Infants" AND (!empty($_GET["colour"])== "Salmon-pink" AND
(!empty($_GET["oily"]) AND (!empty($_GET["eyebrows"] AND (!empty($_GET["dandruff"])== "TRUE" AND
(!empty($_GET["family"])== "Seborrheic dermatitis")))))))
{
    echo "Seborrheic eczema";
}
elseif (!empty($_GET["age"])== "Infants" AND (!empty($_GET["colour"])== "Salmon-pink" AND
(!empty($_GET["oily"]) AND (!empty($_GET["nose"] AND (!empty($_GET["dandruff"])== "TRUE" AND
(!empty($_GET["family"])== "Seborrheic dermatitis")))))))
{
    echo "Seborrheic eczema";
}
```

```
elseif (!empty($_GET["age"])== "Infants" AND (!empty($_GET["colour"])== "Pink" AND
(!empty($_GET["scaly"]) AND (!empty($_GET["chest"] AND (!empty($_GET["dandruff"])== "TRUE" AND
(!empty($_GET["family"])== "Seborrheic dermatitis")))))))
{
    echo "Seborrheic eczema";
}
elseif (!empty($_GET["age"])== "Infants" AND (!empty($_GET["colour"])== "Pink"
AND (!empty($_GET["scaly"]) AND (!empty($_GET["eyelids"] AND (!empty($_GET["dandruff"])== "TRUE" AND
(!empty($_GET["family"])== "Seborrheic dermatitis")))))))
{
    echo "Seborrheic eczema";
}
elseif (!empty($_GET["age"])== "Infants" AND (!empty($_GET["colour"])== "Pink" AND
(!empty($_GET["scaly"]) AND (!empty($_GET["scalp"] AND (!empty($_GET["dandruff"])== "TRUE" AND
(!empty($_GET["family"])== "Seborrheic dermatitis")))))))
{
    echo "Seborrheic eczema";
}
elseif (!empty($_GET["age"])== "Infants" AND (!empty($_GET["colour"])== "Pink" AND
(!empty($_GET["scaly"]) AND (!empty($_GET["groin"] AND (!empty($_GET["dandruff"])== "TRUE" AND
(!empty($_GET["family"])== "Seborrheic dermatitis")))))))
{
    echo "Seborrheic eczema";
}
elseif (!empty($_GET["age"])== "Infants" AND (!empty($_GET["colour"])== "Pink" AND
(!empty($_GET["scaly"]) AND (!empty($_GET["eyebrows"] AND (!empty($_GET["dandruff"])== "TRUE" AND
(!empty($_GET["family"])== "Seborrheic dermatitis")))))))
{
    echo "Seborrheic eczema";
}
elseif (!empty($_GET["age"])== "Infants" AND (!empty($_GET["colour"])== "Pink" AND
(!empty($_GET["scaly"]) AND (!empty($_GET["nose"] AND (!empty($_GET["dandruff"])== "TRUE" AND
(!empty($_GET["family"])== "Seborrheic dermatitis")))))))
{
    echo "Seborrheic eczema";
}
```

```
elseif (!empty($_GET["age"])== "Infants" AND (!empty($_GET["colour"])== "Pink" AND
(!empty($_GET["oily"]) AND (!empty($_GET["chest"] AND (!empty($_GET["dandruff"])== "TRUE" AND
(!empty($_GET["family"])== "Seborrheic dermatitis")))))))
{
    echo "Seborrheic eczema";
}
elseif (!empty($_GET["age"])== "Infants" AND (!empty($_GET["colour"])== "Pink" AND
(!empty($_GET["oily"]) AND (!empty($_GET["eyelids"] AND (!empty($_GET["dandruff"])== "TRUE" AND
(!empty($_GET["family"])== "Seborrheic dermatitis")))))))
{
    echo "Seborrheic eczema";
}
elseif (!empty($_GET["age"])== "Infants" AND (!empty($_GET["colour"])== "Pink" AND
(!empty($_GET["oily"]) AND (!empty($_GET["scalp"] AND (!empty($_GET["dandruff"])== "TRUE" AND
(!empty($_GET["family"])== "Seborrheic dermatitis")))))))
{
    echo "Seborrheic eczema";
}
elseif (!empty($_GET["age"])== "Infants" AND (!empty($_GET["colour"])== "Pink" AND
(!empty($_GET["oily"]) AND (!empty($_GET["groin"] AND (!empty($_GET["dandruff"])== "TRUE" AND
(!empty($_GET["family"])== "Seborrheic dermatitis")))))))
{
    echo "Seborrheic eczema";
}
elseif (!empty($_GET["age"])== "Infants" AND (!empty($_GET["colour"])== "Pink" AND
(!empty($_GET["oily"]) AND (!empty($_GET["eyebrows"] AND (!empty($_GET["dandruff"])== "TRUE" AND
(!empty($_GET["family"])== "Seborrheic dermatitis")))))))
{
    echo "Seborrheic eczema";
}
elseif (!empty($_GET["age"])== "Infants" AND (!empty($_GET["colour"])== "Pink" AND
(!empty($_GET["oily"]) AND (!empty($_GET["nose"] AND (!empty($_GET["dandruff"])== "TRUE" AND
(!empty($_GET["family"])== "Seborrheic dermatitis")))))))
{
    echo "Seborrheic eczema";
}
```

```
626     elseif (!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Salmon-pink" AND
627     (!empty($_GET["scaly"]) AND (!empty($_GET["chest"] AND (!empty($_GET["dandruff"])== "TRUE" AND
628     (!empty($_GET["family"])== "Seborrheic dermatitis")))))))
629     {
630         echo "Seborrheic eczema";
631     }
632     elseif (!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Salmon-pink" AND
633     (!empty($_GET["scaly"]) AND (!empty($_GET["eyelids"] AND (!empty($_GET["dandruff"])== "TRUE" AND
634     (!empty($_GET["family"])== "Seborrheic dermatitis")))))))
635     {
636         echo "Seborrheic eczema";
637     }
638     elseif (!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Salmon-pink" AND
639     (!empty($_GET["scaly"]) AND (!empty($_GET["scalp"] AND (!empty($_GET["dandruff"])== "TRUE" AND
640     (!empty($_GET["family"])== "Seborrheic dermatitis")))))))
641     {
642         echo "Seborrheic eczema";
643     }
644     elseif (!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Salmon-pink" AND
645     (!empty($_GET["scaly"]) AND (!empty($_GET["groin"] AND (!empty($_GET["dandruff"])== "TRUE" AND
646     (!empty($_GET["family"])== "Seborrheic dermatitis")))))))
647     {
648         echo "Seborrheic eczema";
649     }
650     elseif (!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Salmon-pink" AND
651     (!empty($_GET["scaly"]) AND (!empty($_GET["eyebrows"] AND (!empty($_GET["dandruff"])== "TRUE" AND
652     (!empty($_GET["family"])== "Seborrheic dermatitis")))))))
653     {
654         echo "Seborrheic eczema";
655     }
656     elseif (!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Salmon-pink" AND
657     (!empty($_GET["scaly"]) AND (!empty($_GET["nose"] AND (!empty($_GET["dandruff"])== "TRUE" AND
658     (!empty($_GET["family"])== "Seborrheic dermatitis")))))))
659     {
660         echo "Seborrheic eczema";
661     }
```

```
662     elseif (!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Salmon-pink" AND
663     (!empty($_GET["oily"]) AND (!empty($_GET["chest"] AND (!empty($_GET["dandruff"])== "TRUE" AND
664     (!empty($_GET["family"])== "Seborrheic dermatitis")))))))
665     {
666         echo "Seborrheic eczema";
667     }
668     elseif (!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Salmon-pink"
669     AND (!empty($_GET["oily"]) AND (!empty($_GET["eyelids"] AND (!empty($_GET["dandruff"])== "TRUE" AND
670     (!empty($_GET["family"])== "Seborrheic dermatitis")))))))
671     {
672         echo "Seborrheic eczema";
673     }
674     elseif (!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Salmon-pink" AND
675     (!empty($_GET["oily"]) AND (!empty($_GET["scalp"] AND (!empty($_GET["dandruff"])== "TRUE" AND
676     (!empty($_GET["family"])== "Seborrheic dermatitis")))))))
677     {
678         echo "Seborrheic eczema";
679     }
680     elseif (!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Salmon-pink" AND
681     (!empty($_GET["oily"]) AND (!empty($_GET["groin"] AND (!empty($_GET["dandruff"])== "TRUE" AND
682     (!empty($_GET["family"])== "Seborrheic dermatitis")))))))
683     {
684         echo "Seborrheic eczema";
685     }
686     elseif (!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Salmon-pink" AND
687     (!empty($_GET["oily"]) AND (!empty($_GET["eyebrows"] AND (!empty($_GET["dandruff"])== "TRUE" AND
688     (!empty($_GET["family"])== "Seborrheic dermatitis")))))))
689     {
690         echo "Seborrheic eczema";
691     }
692     elseif (!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Salmon-pink" AND
693     (!empty($_GET["oily"]) AND (!empty($_GET["nose"] AND (!empty($_GET["dandruff"])== "TRUE" AND
694     (!empty($_GET["family"])== "Seborrheic dermatitis")))))))
695     {
696         echo "Seborrheic eczema";
697     }
```

```
698     elseif (!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Pink" AND
699     (!empty($_GET["scaly"]) AND (!empty($_GET["chest"] AND (!empty($_GET["dandruff"])== "TRUE" AND
700     (!empty($_GET["family"])== "Seborrheic dermatitis")))))))
701     {
702         echo "Seborrheic eczema";
703     }
704     elseif (!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Pink" AND
705     (!empty($_GET["scaly"]) AND (!empty($_GET["eyelids"] AND (!empty($_GET["dandruff"])== "TRUE" AND
706     (!empty($_GET["family"])== "Seborrheic dermatitis")))))))
707     {
708         echo "Seborrheic eczema";
709     }
710     elseif (!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Pink" AND
711     (!empty($_GET["scaly"]) AND (!empty($_GET["scalp"] AND (!empty($_GET["dandruff"])== "TRUE" AND
712     (!empty($_GET["family"])== "Seborrheic dermatitis")))))))
713     {
714         echo "Seborrheic eczema";
715     }
716     elseif (!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Pink" AND
717     (!empty($_GET["scaly"]) AND (!empty($_GET["groin"] AND (!empty($_GET["dandruff"])== "TRUE" AND
718     (!empty($_GET["family"])== "Seborrheic dermatitis")))))))
719     {
720         echo "Seborrheic eczema";
721     }
722     elseif (!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Pink" AND
723     (!empty($_GET["scaly"]) AND (!empty($_GET["eyebrows"] AND (!empty($_GET["dandruff"])== "TRUE" AND
724     (!empty($_GET["family"])== "Seborrheic dermatitis")))))))
725     {
726         echo "Seborrheic eczema";
727     }
728     elseif (!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Pink" AND
729     (!empty($_GET["scaly"]) AND (!empty($_GET["nose"] AND (!empty($_GET["dandruff"])== "TRUE" AND
730     (!empty($_GET["family"])== "Seborrheic dermatitis")))))))
731     {
732         echo "Seborrheic eczema";
733     }
```

```
734     elseif (!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Pink" AND
735     (!empty($_GET["oily"]) AND (!empty($_GET["chest"] AND (!empty($_GET["dandruff"])== "TRUE" AND
736     (!empty($_GET["family"])== "Seborrheic dermatitis")))))))
737     {
738         echo "Seborrheic eczema";
739     }
740     elseif (!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Pink" AND
741     (!empty($_GET["oily"]) AND (!empty($_GET["eyelids"] AND (!empty($_GET["dandruff"])== "TRUE" AND
742     (!empty($_GET["family"])== "Seborrheic dermatitis")))))))
743     {
744         echo "Seborrheic eczema";
745     }
746     elseif (!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Pink" AND
747     (!empty($_GET["oily"]) AND (!empty($_GET["scalp"] AND (!empty($_GET["dandruff"])== "TRUE" AND
748     (!empty($_GET["family"])== "Seborrheic dermatitis")))))))
749     {
750         echo "Seborrheic eczema";
751     }
```

```
752     elseif (!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Pink" AND
753     (!empty($_GET["oily"]) AND (!empty($_GET["groin"] AND (!empty($_GET["dandruff"])== "TRUE" AND
754     (!empty($_GET["family"])== "Seborrheic dermatitis")))))))
755     {
756         echo "Seborrheic eczema";
757     }
758     elseif (!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Pink" AND
759     (!empty($_GET["oily"]) AND (!empty($_GET["eyebrows"] AND (!empty($_GET["dandruff"])== "TRUE" AND
760     (!empty($_GET["family"])== "Seborrheic dermatitis")))))))
761     {
762         echo "Seborrheic eczema";
763     }
764     elseif (!empty($_GET["age"])== "Adult" AND (!empty($_GET["colour"])== "Pink" AND
765     (!empty($_GET["oily"]) AND (!empty($_GET["nose"] AND (!empty($_GET["dandruff"])== "TRUE" AND
766     (!empty($_GET["family"])== "Seborrheic dermatitis")))))))
767     {
768         echo "Seborrheic eczema";
769     }
770     ?>
```