I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Name, Last name:

Signature:

Date:

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To my family…

ABSTRACT

In this thesis, the integration of fuzzy-logic and neural-networks is proposed for identification of an erythematous squamous disease. The study considered an analysis of the research works that have been carried out in this field. The main characteristics of erythematous squamous illness have been explained, after which the statistical data is obtained and analyzed. The statistical data after preprocessing is used for the design of Fuzzy Neural Networks (FNN). The special procedure is applied to deal with the missing values. This methodology has been utilized to handle missing values that cause its research errors, or loss of values, within the context of this thesis.

The structure of the fuzzy neural system is presented for identification of the erythematous squamous disease. Using FNN structure and gradient learning algorithm the design of the identification system is carried out. The obtained simulation results demonstrated the strength of FNN which has a way of working with a set of data collected from an integer world so as to be able to carry-out medical-diagnosis of erythematous squamous illness (ESI). In this research work, the machine-learning properties of fuzzy-logic and neural networks are applied for the system development. During the simulation, by increasing the number of hidden neurons accuracy of the FNN system is increased. The highest precision of the system was achieved as 99.45 % with 512 hidden layers.

Keywords: Erythematous squamous illness; medical diseases; dermatology; fuzzy neural networks

ÖZET

Bu tezde, cilt hastalıkları arasındaki mükemmellik için bulanık mantık ve sinir ağı sürecine bağlı bir paradigma geliştiriyoruz. Seçim avantajımız, cilt hastalığının tipini en iyi şekilde bulmak için belirleyici olan bulanık mantık ve sinir ağları çalışma niteliklerine bağlıdır.

Çalışmada, veri setini analiz ettik ve sistem yürütme sırasında hata yapmaktan kaçınan normalize edilmiş bilgileri gözden geçirdik. Eksik veya eksik olan değerlerin denetlenmesinde hatalara neden olduğu ya da değer kaybına yol açtığımızda, bu yöntemden tez bağlamında bahsettik.

Bu tez, eritematöz skuamöz hastalığın (ESI) tıbbi teşhisini yapabilmek için bir tamsayı dünyasından toplanan bir dizi veriyle çalışmanın bir yolu olan FNN'nin gücünü göstermiştir. Çalışmamızda, cihaz bulanık mantık ve sinir ağlarının makine öğrenme özellikleriyle birleştirildi.

Deneyim için 64 gizli katmanla başladık ve kademeli olarak 512 gizli katmanla% 99,45'e varan en yüksek hassasiyete ulaşana kadar kural sayısını artırdık.

Anahtar Kelimeler:Eritemli skuamöz hastalık; tıbbi bakım;dermatolog; dermal;

biyo-sinir ağları; gizli nöronlar

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LIST OF ABBREVIATIONS

FLS:	Fuzzy logic system
FLC:	Fuzzy Logic Controllers
IFSFS:	Improved F-score and Sequential Forward Search
ESI:	Erythematosus Squamous illness
SVM:	Support Vector Machines
ANN:	Artificial Neural Network
CWW:	computing with words
NN:	Neural Network
PRP:	Pityriasis Rubra Pilaris
MIMO:	Multi-Input And Multi-Output
RMSE:	Root Medium Square Error
TSK:	Tangential Rules Of Sugino Kang
ANFIS:	Adaptive Neuro-fuzzy Inference System

CHAPTER 1

INTRODUCTION

1.1. Overview

In many medical areas, data extraction methods are utilized for the extraction of data, analysis, and diagnosis of illnesses. To obtain medical data and discover knowledge is very significant for any accurate diagnosis of diseases (Çataloluk and Kesler, 2012).

Analyzing and performing a differential diagnosis of a squamous illness that is often seen in this division and is very important for treatment of the disease. In this group of squamous illness, the symptoms seen in the early phase of the disease might be very similar due to the lack the differences. It is important to note that only the clinical countenance is not enough for diagnosis. Dermatologists after using clinical countenance in the discovery of the pathological lineaments obtained biopsy result to make the diagnosis. However, the extra number of pathological countenance make it complicated.

In the medical field, the data extraction aims to provide a new horizon for searching healthy life. We, therefore, suggest a model for producing a solution to real-life problems using data extraction.

The automated learning approach has been applied to predict illness and find correct output results. Considering skin illness, inductive learning is a popular approach for the acquisition of knowledge automatically rather than extracting knowledge from human experts.

Since 1965, among new algorithms, the fuzzy logic theory that has been developed by Professor Zadeh, is the first used to design fuzzy diagnostic systems. The idiom “fuzzy" means that it is a mysterious, or vague, unclear and inaccurate. Fuzzy systems identify an unclear and undefined event. Fuzzy logic system (FLS) is able to concurrently deal with linguistic knowledge and numerical data. Fuzzy logic and fuzzy set theory create the details the nonlinear mapping. The fuzzy logic system is an approximation mode that is able to integrate both types of acknowledgment in a uniform mathematical way. Fuzzy Logic Controllers (FLC) consists of the Knowledge Base, which includes the information provided

by the human operator in the form of If-Then rules. The knowledge base that comprises the expert knowledge about the controlled system is used in Fuzzy Logic Controllers. Therefore, it is just a component of FLC based on the concrete application (Mende, 1995).

In this study is considering the design of a programming tool capable of helping doctors and dermatologists. Also, the designed product model will help in extracting of information for many of the dilemmas in health services. This type of medical program becomes very necessary, especially with the use of computer technology. This will help doctors for proper diagnosis of patients and their treatments.

For skin research, the ability to perform a diagnosis of the allergic scleroderma condition, which is skin illness, is very important for the treatment of the illness. Exceptionally, their symptoms appear in early stages of illness. The symptoms are close in appearance and their similarity complicate the identification of the diseases. Thus, manifestations are not adequate for knowledge of the disease. Dermatologists use the knowledge about the pathological features obtained from biopsies. However, there is an excessive number of features that complicate the determination of the type of diseases. These difficult conditions caused by the existence of unknown illnesses (Güvenir et al., 1998).

The great importance to human knowledge is the vast progress which contributes to the information age; therefore, there need for a hypothesis that could systematically subedit human knowledge and integrate it into mathematics and also engineering systems. One of the peculiar forms for representation and using of knowledge is fuzzy neural networks.

Due to the vague surrounding of the medical-diagnosis of some illness, the designed systems combines fuzzy logic and neural network to take advantage of their respective attributes. The system classifies the types of squamous illness. Those unclear countenances of ESI which have six types of illness, and overlap in symptoms. This study tried the ability of the fuzzy logic system and neural networks to solve the vague symptoms of the illness with high accuracy up to 99.45 % using 512 hidden layers (rules).

As one of the most common sickness, in the field of skin diseases, squamous diseases are often encountered in outpatient dermatology departments. Some patients show sample clinical characteristics of sickness. While others show typical localization in skin diseases,

differential diagnosis of erythematosus-squamous illness is difficult. Different classes of disease share the clinical features of the measurement and erythema, with very few variations.

This study used soft computing technology for regular routine tasks including the most complex creative processes of humans. In medicine, Artificial Intelligence (AI) applications are utilized. For example, utilizing the fuzzy expert system with help in determining skin type, diagnosis, and treatment of the diseases. One of the characteristics of skin diseases is the change in the color of the skin.

1.2. Statement of the problem

Differential diagnosis the illnesses of ESI is a major challenge in the field of dermatology. There are similarities between the six types of illness. In addition, the symptoms of the disease are very close and interrelated.

Especially in the early stages of erythematous squamous illness, the clinical appearance of diseases and their sizes have tiny divergence. The capability to identify erythema squamous illness is almost impossible because of the overlapping of the input data and similarities for six illness categories:

1. Psoriasis-illness.
2. Seborrheic- dermatitis.
3. Lichen- planus.
4. Pityriasis- rosea.
5. Chronic- dermatitis.
6. Pityriasis Rubra -pilaris.

Schistosomiasis is a major problem in skin illness. All the diseases that affect the acidity of the body share the clinical aspects of the bath and the expansion with very few differences.

Chronic dermatitis and rosacea are associated with the same symptoms as red skin

1.3. Objectives of the study

The objective of the thesis is to design an intelligent system using artificial intelligence techniques and by this way to support researchers and doctors and to provide the best identification system for the healthcare sector. The usage of artificial intelligence techniques such as neural networks and fuzzy logic in system design will help to combine learning property of neural networks with the knowledge representation of fuzzy logic and develop the high-performance system.

This system will offer the patients online and high- speed determination of the type of illness.

The thesis will help to the following fields:

1. Medical practitioners and the healthcare sector.

2. The designed model can infer the character of the predicted class from the combination of input data or symptoms.

3. Predict the possible diagnosis of squamous disease using the patient's data set.

4. Develop a dynamic, intelligent and accurate diagnostic system for diagnosing skin diseases.

1.4. The importance of the study

This thesis significant because it uses artificial intelligence technology and statistical data about diseases in order to design a system that will solve the problem faced by physicians in the field of health services.

The system will provide the correct diagnosis of the disease and its treatment. The success of the fuzzy neural network method, which has achieved a high accuracy of up to 99.45% using 512 rules

1.5. The relevance of the study

This study uses the fuzzy Neural Network (FNN) classifier and a real-world data-set for the diagnosis of erythema-squamous illness. The learning capabilities of neural networks are

combined with the uncertain nature of the differential-diagnosis of erythema-squamous illness that can be presented using fuzzy-logic. This uncertainty arises due to imprecise boundaries between the six classes of the disease. This study implored fuzzy logic to handle the uncertainty at the construction phase of the classifier, leading to obtaining high performance of the system. The fuzzy Neural-Network (FNN) classifier was utilized to adequately sort the datum space of the domain into the corresponding classes of the erythema-squamous diseases. Based on an analysis of our proposed system (FNN), various deductions about the usefulness of features of the classification of erythematous-squamous illness were achieved.

Total performance accuracy of the FNN classifier was 99.45% for 512 rules. Taken together, it is concluded that our proposed classifier could be applied for classifying erythema to-squamous diseases due to its high-performance accuracy. The study aims to design a software tool to aid students and dermatologists. At the same time, this request indicates that data extraction techniques can be applied to many medical problems.

1.5. Thesis Layout

This thesis consists of five chapters and references.

Chapter One presents the introduction of the thesis

Chapter Two reviews some relevant studies using different algorithms used to diagnose skin diseases. An overview of the design of FNN for the skin diseases is given

Chapter Three describes the characteristics of skin diseases, their symptoms and features. The proposed methodology, particularly the integration of neural networks and fuzzy systems, is described. The structure of Fuzzy Neural network (FNN) used for diagnosis Erythemato-squamous is explained.

Chapter Four presents the experimental results of the proposed system. The structura of the system used for diagnosis of skin diseases is presented.

Chapter Five contains the conclusion obtained from the thesis.

CHAPTER 2

LITERATURE REVIEW

This section reveals some relevant studies using different algorithms used to diagnose skin diseases. The brief overview of these studies begins with the classification through the use of K-NN, to the application of VF15 and use of decision tree. It concludes with the different results obtained from the use or application of these algorithms.

2.1. Literature Review

The researches have developed a lot of algorithms on Artificial Intelligence (AI). These algorithms imitate different behaviours of human, and also other living things. Some of these algorithms imitate the learning behaviours of humans. Inductive learning is a famous process for gaining the automatic knowledge of those paradigm and taxonomic knowledge of examples.

The AI algorithms are designated to solve different classification, recognition, control, regression, forecasting etc. problems. In recent years the clustering algorithms such as K-means, K-NN are efficiently used for solving the classification problem. Another version is weighted K-NN algorithm which uses weights in classification (Çataloluk and Kesler, 2012).

In literature, a lot of data AI algorithms have been applied to the medical field for solving different problems. One of these areas is dermatology. Çataloluk and Kesler in their study applied the normalization to the skin dataset for scaling the data between 0 and 1. The scaling allows improving the performance of the classification system. For classification K-NN algorithm was used. (Çataloluk and Kesler, 2012).

Guvenir and Demiroz, applied VFI5 for classification of erythematosus-squamous diseases. In their paper, every attribute has been analysed individually. The authors used a genetic algorithm to train the comparative weights of their system. The VFI5 calculate likelihood distribution on all portions.

Menai and Altayash had discovered the effectiveness of the decision tree as a collaborative method for the diagnosis of skin. They used two decision tree models, pruned decision tree and normal decision tree. Empirical results obtained on the UCI skin disease data set demonstrated that decision tree algorithm can improve the accuracy of results by 5.3%. Comparing decision tree results with the result with K-NN, it demonstrated that the

untrimmed decision tree algorithm has more advantageous. The accuracy was obtained as 96.7% which was better than the result of K-means clustering (Menai and Altayash, 2014).

Ubeyli and Guler have suggested an adaptive neural reasoning systems approach to detecting squamous diseases-erythematosus and the study discovered a classic resolution of more than 95% (Ubeyli and Guler, 2005).

Lippalampi and Luukka recorded a 97% accuracy level using fuzzy-system for classification of erythematosus-squamous illness. Luukka and Leppalampi developed fuzzy-system weighted pre-treatment using K-NN. Polat and Gunes has utilized the decision trees for diagnostics of the erythematosus-squamous illness and obtained accuracies as 88%, 98%, and 99% (Polat and Gunes, 2006).

Luukka study on erythematosus-squamous illness shows the result of a diagnosis around 97% while Ubeyli obtained 98% of the class precision on the diagnosis of squamous illness by utilizing multi-category vector support machines with a debug output codes line. Nanni earned 97.2%, 97.5%, 98.1%, 97.5%, 97.8%, and 98.3% utilizing LS-VM, B1 5, RS, B1 15, B1 10, B2 10, B2 5, and B2 15 algorithms (Nanni, 2006).

Ubeyli has obtained 97.77% on ranking resolution utilizing collected neural- networks model to proof paradigm selection for known diagnosis of erythema-squamous illness. Sun and Liu had obtained 92.18%, 96.72%, 92.20%, and 95.08% utilizing the characteristic selection algorithm with dynamic cross information, which was projected utilizing 4 sample classifiers. (Liu et al., 2009).

Weixin Xie, Wang and Xinbo Gao's study explored the diagnostic model on the basis of the Support-Vector-Machines (SVM). They used attribute selection that procedure using Sequential-Forward Search (IFSFS) for the diagnosis of squamous disease erythematosus (named as Improved F-score and Sequential Forward floating Search) (Xie et al., 2009).

From the fuzzy logic across the NN structure. This FNN is designed by creating a suitable database rule for them "IF-THEN" Building. It is necessary to define an accurate description of both the hypothesis of the IF-THEN base is ambiguous and the resulting part Classification system using learning ability (Abiyev and Abizaide, 2016). This research have achieved this is by assessing the error response of the built frame. Also, the fuzzy rules of Sugino Kang (TSK) type were used respectively to design frames (Takagi and Sugeno.1985).

This study demonstrates the advantage of the fuzzy neural network (FNN) technique in an integrative attribute neural networks and fuzzy logic for the diagnosis of ESI with high accuracy of 99.45%. This thesis is examining the competence of FNN to provide information to be utilized in the real world for the squamous illness.

CHAPTER 3
MATERIALS AND METHODS

In this chapter, the characteristics of skin diseases, symptoms and their features, determination of diseases are described. Collection of input data, their estimation are presented. The proposed methodology, particularly the integration of neural networks and fuzzy systems, is described. The structure of Fuzzy Neural network (FNN) used for diagnosis Erythemato-squamous is explained.

3.1. Dermatology. Why skin diseases studies are important?

Dermatology is a medical branch that studies the skin and external tissues of the human body in order to detect the natural and abnormal components of the skin and differentiate the normal skin from abnormal. For example, mucosal tissue of the mouth, nails, and hair (Chiang and Verbov, 2014).

Detection of skin diseases is difficult for doctors and practitioners. Because of different skin diseases have very close countenances like erythema and sizing with very slight variations. Skin disease is a general disease that affects more than half of the world's population. The disease is seriously life-threatening and danger to life.

The side effects of the diseases lead to psychological damage such as awkwardness and social and professional habits.

3.2. Erythematous-squamous

It is one of the diseases that spread around the world and affects various age groups, such as, the old people, adolescents and children. The squamous diseases are often encountered in outpatient clinics frequently; at the beginning to the symptoms of the illness, similarity to illness in the size and erythema. When analyzing the status of some of the patients the properties of sickness is appearing. While others are appearing in a typical location in skin diseases. Differential diagnosis of erythematosus-squamous illness is difficult to analyse. Species of illness overlap with each other in clinical profiles according to size.

As mentioned above, the six patterns of erythematous-squamous illness are the main challenge in the skin illness. For example, Psoriasis is the most common disease of ESI that is almost roughly and 3% of the population is affected by Psoriasis. Because of the interference between the signals of Erythematosus Squamous (ES) symptoms, the diagnosis between the types of ES is very hard (Menai and Altayash, 2014).

Those illnesses are usually seen in the outpatient section for the skin. Both Erythematosus Squamous (ES) is the same conditions in sizing and colouring, but when carefully examining some patients have clinical properties which is a sample of the disease (Güvenir et al., 1998). Detecting this group of diseases can help the doctor to make a decision automatically.

Classify squamous diseases to :

1. Psoriasis-illness.
2. Seborrheic-dermatitis.
3. Lichen-planus.
4. Pityriasis-rosea.
5. Chronic-dermatitis.
6. Pityriasis Rubra-pilaris.

3.2.1. Psoriasis-illness

Psoriasis is a non-infectious chronic disease which causes disability and pain. It has no treatment and has a serious negative factor in the patient's life. It can happen at different ages.

If there is a small defect in the skin then skin tissue multiplies rapidly up to ten times. The hard red spots wrapped in a white area occurs in a pile of skin. It can be increased everywhere, but its maximum surface is on the scalp, knees, elbows and lowers back.

Psoriasis cannot be distributed as an infection from one individual to another. Sometimes occurs in more than one individual from a single family.

Psoriasis ordinarily occurs in early puberty. For a most human, it only affects a few areas. In a serious situation, psoriasis could cover major parts of a body. The spots could cure and then back during the individual's life.

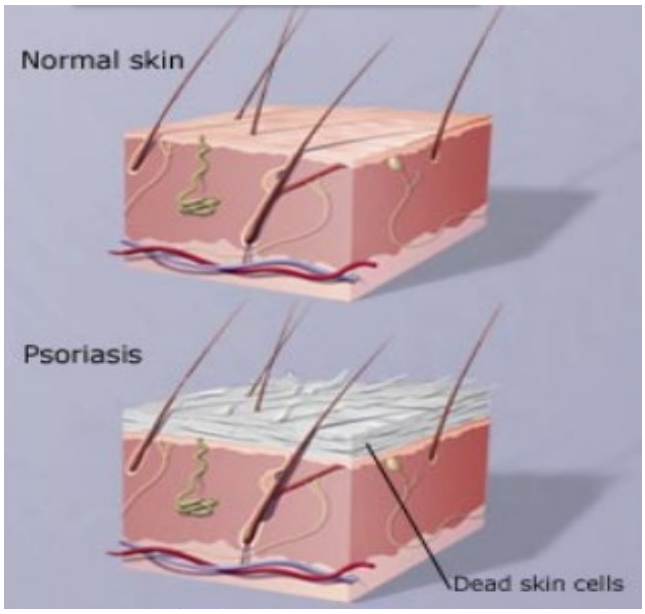

Figure 3.1: The negative effect of Psoriasis illness (Stephanie S,2018)

3.2.1.1. Symptoms Of Psoriasis-illness

• Red leather plaques usually cover white space. Those spots might be sore and itchy, occasionally bleeding and cracking. In future states, the spots will be merged and grew.

• Nails disorders, smashing nails or splitting them from the nail bed and also discolouring

• Crusts on the scalp.

3.2.1.2. Types Of Psoriasis-illness

• Psoriasis pimples, which cause red skin and peeling with small pimples on the palm of the hand and soles of the foot.

- Guttation psoriasis, which often times begins in adulthood or childhood, do causes small red blisters, especially on the limbs and trunk.

- Reverse psoriasis, which produces bright red shiny lesions that show in the folds of the body. For example under the breasts, the armpits and thighs.

- Erythroderma psoriasis, which carries burning of erythroderma of the epidermis.

3.2.1.3. Causes Of Psoriasis-Illness

The cause of illness still unknown, but scientist supposes that it has a set of reasons. However, in the distortion of the immune system, there is the speedy creation of new epidermis. In natural epidermis are replaced every 9 to 29 days. With this disease, new epidermis grows every 4 days. Psoriasis might be arisen from family history which has a gene that carries a genetic colour of disease.

3.2.1.4. Things That Can Contribute To The Spread Of Psoriasis-Illness

1 Surgery, cutting, or clipping.

2 Emotional pressure

3 Streptococcus infection

4 Medications, including

5 Blood-pressure medications

6 An antimalarial drug like Hydroxychloroquine

3.2.1.5. Detection Of Illness

Physical test. It is commonly simple for the doctor to define psoriasis illness, principally if there are blisters in a zone:

1 Ear: There are small blisters and redness.

2 Scalp: Note that our cortex in the scalp.

3 The knee: Rash in and around the knee.

4 Nail: Crack and change the colour of the nail.

5 Navel: Redness and blisters around.

3.2.2. Pilaris-illness

Pilaris is an typical innocuous dermatitis nevertheless needs treatment. Some of the patients who have a tumour, also possess have the possible trigger of this disease. It manifest as a roughly dry and bumpy surfaces. Pilaris can take place within 1 - 6 years of age, culminating from the first birthday of a patient to the fifth and fully develops at the tenth year.

3.2.2.1 The disease is assessed in terms of twelve genealogies which includes:

- The point of scaling and erythema.
- Subsistence or non-attendance of its particular limits.
- Koebner original sin.
- Papule forming.
- Family-history.
- Participation of the oral-mucosa.
- Knee.
- Elbow.
- Scalp.
- Itching.

Psoriasis is diagnosed examining bumps in the soft area of epidermis e.g. under armpits. In the same manner, plankton is recognized on the main areas. Permeation take place and the vanishing of a crystallized layer, and a stripe reveals the manifestation of the teeth from the hills, the structure and the damaging of the fundamental layer.

Perifollicular parakeratosis, as well as the cap of follicular horns are signs of pilaris.

3.2.3. Chronic-dermatitis

Chronic-dermatitis is known as a common skin illness that causes a rash. It is a popular fiery skin illness that might appear on teenagers and children (Al-Ammari et al., 2013). When this rash appears on the epidermis looks like this:

1. Reddish.
2. Adipose appearance and swelling.
3. Measure of white or yellowish crust on the surface.

One or more of those rashes could appear on the body. Sometimes, itchy skin is infected. It could have a lot of reasons and happen in different forms.

Also, it is a common expression that characterizes dermatitis. It usually encompasses the eruption of the itchy, blushful epidermis and bulging. Epidermis influenced by an injured skin might bubbles and enhance dandruff or flakes. Instances include atopic dermatitis, skin rash and dandruff happened by touch of any of the material; like poison ivy, soap, and jewelry with nickel in it.

Chronic dermatitis comes to hurt the skin and goes and continues the cycle over time.

It results in the very dry and sentient epidermis and could be made worse by exposure to a lot of several other circumstances, including allergens like pet or dust.

Another is comprised of soaps, cleaners, and lotions with intensive perfumes.

Exposure to redolence and cleaning production could irritate and instigate eczema. For some people, weather changes particularly dry winter air make eczema worse.

Cradle cap is a kind of seborrheic dermatitis and it is harmless.

A lot of infants have cradle cap that develops in babies. Greasy patches makes crusty form on the baby's scalp. The spots could become scaly and thick. Cradle cap usually goes away on its own.

Figure 3.2: The infant cradle Cap (Full White Moon,2019)

3.2.4. Lichen-Planus

Lichen-Planus is a flaming mucous skin case with special purple ribbed flat-topped plaques and papules. Pruritus is often times heavy. Skin injury might be disfiguring, and shading of the oral mucosa. Oral lichen planus might lead to the eruption of squamous cell cancer within lesions.

Shading of the nails and scalp might also happen. While general cause of lichen planus is anonymous, some might be cause by the rise in the ingestion of sure treatment or related to hepatitis C microbe contagion.

Patients with centre on lichen planus are commonly cured with strong local steroids, while systemic steroids are utilized to treat patients with that generally suffer from lichen planus (Katta, R, 2000).

Flat lichen: Lichen planus is a fiery skin sickness, identify rash and itching on the arms and legs. It is of teeny, flat covered red cusp or pink. The lichen has dwelled at oral mucosa while psoriasis was found within the elbow, scalp, and knee.

Pityriasis Rubra Pilaris happen during childhood. In general, it exists in a family history of psoriasis.

Those clinical lineaments are used only to diagnose some patients, while a conclusive and whole diagnosis is ordinarily made utilizing a biopsy.

The first stage, the illness might offer the sickness countenance of another sickness and might have special characteristics in the next stages while the latest stage includes hardness considered in variation of diagnosis. Specific patterns might display perfect sick attributes of the illness, while others might not.

Melanin is a distinctive of Planus lichen, and papillary dermis fibrosis was distinctive in deep-seated dermatitis. A lot of granulocytes could be spotted in lichen plankton, rosacea, seborrheic and dermatitis. Species of scales of acanthosis and parakeratosis might be seen in all an illness.

A large number of skin specialists believe he may have an autoimmune disease.

3.2.4.1. Notes About Lichen:

- Lichen planus is a fiery, not contagious.
- The reality cases of it are Unknown.
- People who have hepatitis C might appear to have "lichen planus.
- The therapy for lichen planus might include antihistamines, steroid creams, or phototherapy.

3.2.5. Pityriasis-rosea

Pityriasis is a comparatively moderate skin turmoil describe by a salmon or pink coloured, crusty rash. It is often impacts adults and children. In an abundant person with pityriasis rosea, the distinctive rash improves after ambiguous, nonspecific symptoms like those related with an upper respiratory contagion.

The rash is generally situated on the chest, back and stomach and dissolves on its own within 1 to 3 months. Sure therapy might minimize the period of the rash. Investigator presumes that pityriasis rosea is given rise to an intended pathogen, but they have been helpless to insulate and differentiate like a pathogen.

Anomaly pityriasis rosea occurs in 20% of patients (Ridha.2011). Pityriasis rosea: It is active, bounded that is ordinarily spotted in otherwise healthy, adult and young children. Although it might evolve at any age.

3.2.6. Pityriasis Rubra-Pilaris (PRP)

It is a rare inflammatory papule-squamous disorder of unknown aetiology. There are six distinct sub-types which happen in both children and adult creates striking variation. Fundamental elements noted across all sub-types contain various are well-demarcated

plaques of several sizes with a distinctive reddish hue, at varying degrees of the measure. More popularize sub-types often times show interfering areas of unaffected skin, famous as "islands of sparing," that is a signature peculiar of PRP.

There is a spectrum of width from modest illness solitary to extremities to intense illness at times improve into spread erythroderma.

3.3. Analysis of Data

In this work, the standard skin disease data set was used by UCI Learning Repository, developed by the University of California, Faculty of Information and Computer Science. This dataset was set up by Shadi Guvenir of Bilkent University and Nilsel Elter of Ghazi University and Shadi Guvenir of Bilkent University (Menai and Altayash, 2014).

The skin illness data set contains 366 patterns and 34 characteristics.

As described in Table 3.1.

Table 3.1: Anatomical properties of data set

Features No	Description
12	Melanin smoothness
13	Ejaculation in infiltration
14	PNL Infiltration
15	Fibrosis of papillary- dermis
16	Cellular expulsion
17	Sticks
19	Paracetamol
20	Reaching the retinal hills
21	Elongation of retinal hills
22	Thinning the skin over the skin
23	Spongy berry
24	Monroe microbes
25	Hyper-focal coordination
26	The disappearance of the granular-layer
27	Evacuation and damage of the basal- layer
28	Sponges
29	The appearance of the ridges of the retina

30	Plug the porous horn
32	Inflammation of unicorns
33	Bands-like infiltrate

Table 3.2: The clinical characteristics of the patients in the data set

Features No	Description
1	Erythema
2	Scaling
3	Definite- borders
4	Itching
5	Koebners
9	Knee and elbow
10	Scalp
11	Family- history
4	Itching

Family -history and ages are continuous and ranged between 0-1, respectively.

The clinical and pathological for each other feature has been given a result in the area of 0 to 3 which indicates the greatest possible amount, 1, 2 refers to the average relative values and 0 signal that the feature does not exist.

Newly, patient ID numbers and their names have been removed from the database.

The database was created to identify and distinguish the types of squamous disease. The field includes forty-three characteristic, of which thirty-three are linear figures and one is noted as nominal.

In skin illness, the diagnosis of the illness is a hard task because all six groups have the clinical countenance of scaling with slight divergence.

These six categories of schistosomiasis include:

1. Rheumatic fever .
2. Chronic dermatitis.
3. Dermatitis.
4. Rheumatic rash.
5. Flat lichen.

6. Psoriasis.

The biopsy is usually important in diagnosing these diseases.

Unfortunately, pathological anatomy features are also shared among diseases. The disease may have other disease features in the initial stage and another characteristic advanced stage, which is another difficulty faced by dermatologists when the performance of this differential illness as shown in Table 3.3

Table 3.3: The species of ESI

ID type	type
1	Psoriasis-illness
2	Seborrheic- dermatitis
3	Lichen- planus
4	Pityriasis- rosea
5	chronic-dermatitis
6	pityriasis rubra- pilaris

Each type of illness has a testicular similarity to another disease characteristic in the ESI denomination.

In this thesis the used database recognized in the field of dermatology research as first research. The study distinguished the species of ESI consisting of forty-three special property, thirty-threes are linear variable and nominal for one variable.

With the anatomy of the biopsy the properties were determined. The value of the family-history in the data set is denoted by a number of 1 if any of those illness were spotted in the family and 0 if no one were spotted. The age of the patient was used to indicate age. Other lineaments are anatomy and clinical anatomy were customize a variable between 0 - 3.as in Table 3.4

Table 3.4: Display customize a variable as described below

Variable	Customize the variable features
0	lack of features
1	relative median values

2	relative median values
3	higher quantity

Where 0 points no feature, 1 and 2 point proportional median variables, and 3 points the highest degree of indication.

3.4. Normalize Data

To guarantee equal concern to all datum and outputs, and to remove their dimensions.

The main characteristic of data adjustment before utilizing AI methods are

- Cancel using attributes in larger numeric ranges.
- Cancel numerical difficulties in arithmetic.

The equation of normalization is

$$E_n = \frac{E_i - E_{min}}{E_{max} - E_{min}} i = 1, 2, \dots, n \quad (1)$$

Whereas E_n, E_i , E_{min} and E_{max} show the measured values, the actual numbers, the min numbers, and the max numbers, respectively.

3.5. Method of Calculating Lost -Value

The missing information is the problem we encountered at this work. This is when one or more data are lost from the registering notes, there are some different and diverse operators that cause information loss.

For example, human errors, forgotten or lost value, and incorrect measurements. Majority scientists deal with the missing data problem by basically skipping or deleting all records that essentially have lost the value of attributes. That problem does not resolve when the missing information is dropped. Because it may be a specific coefficient of prediction and classification. Researchers and practitioners have explored different approaches to dealing with lost values where the problem of missing data has been remedied (Kang, 2013); (Guvenir 1998).

In this study, for the lost variable, it utilized the min distance technique for creating the variables which are lost. That technique has two phases:

In the first phase, specifying the cluster area according to the output signals, the data set is classified according to the output signals.

In the second phase, the study progresses by finding the min value for the total distances.

The missing values were created according to the corresponding assembly space. To achieve that, the missing row that is the distance between the input data has a missing value and another description in the assembly space that the other input data samples are selected. In calculating distances, Hamming distance or distance is used.

After calculating the spacing between the missing row and the other rows of the assembly space, the minimum value of the sum of the spaces is determined from all the cluster distances lost values were created according to the values of the row parameters at a lower distance. The lost value was replaced by the value of the identical input parameter of this row. This process was duplicated for other cluster spaces with lost values.

3.6. Rotation Estimation Method

It is a technique for verifying the model to resolve how to circulate a statistical analytic result on a split up the data set. It utilized mutual verification in settings where prediction is the goal.For example, to assess the accuracy of predictive model performance.

For a particular predictive problem, the known data (training-data) is usually fed to the training objectives model, and the test data set (for invisible data) is used to validate the sample. However, the common averages for validation/combining the scales of appropriateness (prediction error) is to infer a more accurate estimation of the performance of the model prediction.

Our goal of using the validation technique in this study was to characterize the data set to test the model at the training stage (the validation data set), with a definite final goal of restricting over mounting cases and providing knowledge on how to circulate the model to an independent data set (first Data set was seen).

3.7. Randomly- dividing the Dataset

This work has carried out using cross validation where the native piece was divided into ten randomly equal subsamples.

One of the ten sub-samples was considered as the validation data for the paradigm test, and the remaining 9 subsamples were used as the training- data set.

That operation was refined 10 times, with every of the 10 subsamples being utilized precisely once as a validation data-set. These ten results were then averaged to produce one prediction. The main advantage of this technique of randomly duplicated sub-samples is that all perceptions are used in both validation and training, and each visualization is utilized for accurate authentication once.

3.8. Fuzzy- Neural Networks (FFN)

In this thesis a fuzzy neural networks is prposed to classify squamous erythematosus illness. The integration of neural networks and fuzzy logic is called Fuzzy Neural Networs (FNN) canused to approximate any non-linear function, by representation of standard fuzzy rules with the neurons of neural networks.

The results show that the integrative procedure for these two different techniques identify non-linear systems. Reverse propagation and gradient ratios are always utilized to adjust parameters of fuzzy neural network. A fuzzy logic is invented by the Prof. Lotfi Zadeh. The fuzzy logic is used for modelling human perception process, fuzzy logic imueleate the thought processes of the human brain.

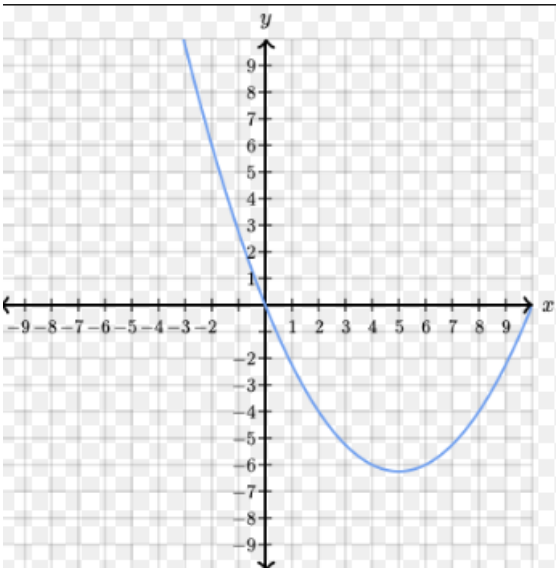

Figure 3.3: The diagram shows a non-linear function (Khan Academy,2019)

The foundations fuzzy logic have become more cohesive and the implementation have increased on basic sciences, especially in physics and mathematics.

A major contribution fuzzy logic methodology is the operations and also calculating is based on words. In the traditional sense, computing often involves manipulation of symbols and numbers. The term "people are often used in computing, logic, to reach the expressed conclusions", which are expressed in any language or natural form of mental concepts.

This same goes for the role of words in computing in words. The concepts of computing in words are rooted in many papers through which the concepts of granulation began .

The foundations of computing with theb word have been developed for some time, their evolution into several methodologies in itself reflects many developments in our understanding of fuzzy logic and soft computing developments have occurred over the last few years.

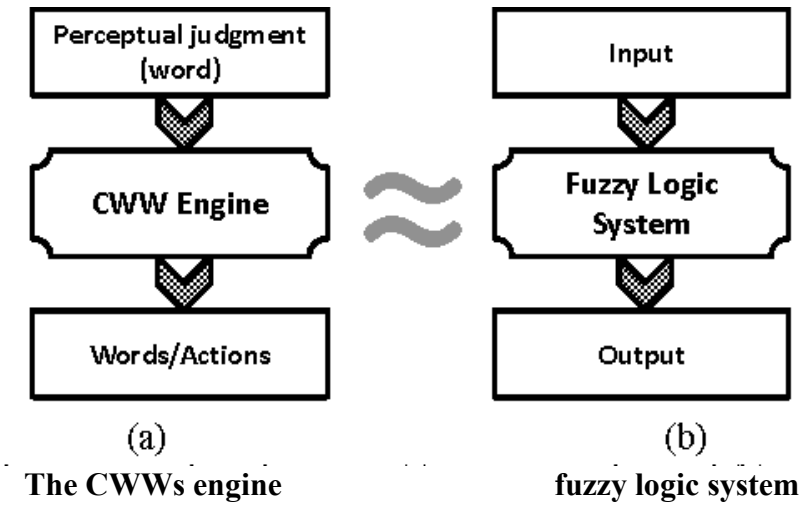

Figure 3.4: The diagram of Analog between the CWW engine and fuzzy logic system

The rationale for word computing depends on two main cases:

1. Computerization of words is a necessity when the available data is not sufficiently accurate to justify the use of number.
2. When there is tolerance with inaccuracy that can be exploited to achieve traceability, low cost of solution, durability, better connectivity with reality.

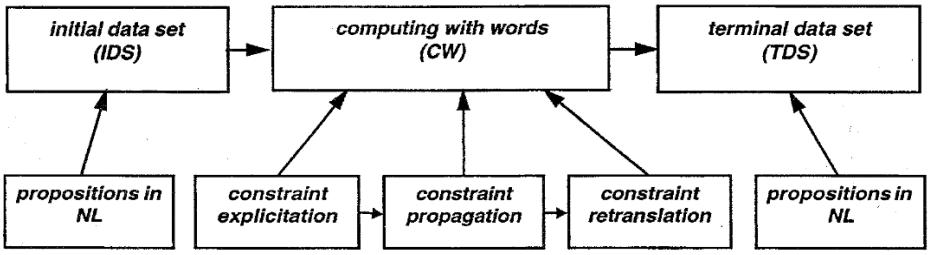

Figure 3.5: The diagram structure of CWW

FNS or FNN are the learning machine that get it the parameters of the FS (i.e., fuzzy sets, fuzzy rules) by using the mechanisms of NN. The theory of the fuzzy group was studied on a large scale its application to control theory became successful and revolutionary, especially in the 1970s and 1980s. The applications of data analysis, artificial intelligence, and computational intelligence have been developed intensively, especially since the 1990s.

The theory has also been expanded and disseminated by the theories of rules, membersip degres, and aggregators. The expansion of the mathematical models of real phenomena was influenced by the mystery of slang. Attempts to use computing technology to address these models have pointed to the event that the classical eventuality treatment of doubt is not adequate for the characteristics of fuzzy.

For example, any side of the coin surface, harvesting could be foreseeable, etc., Is fuzzy dissection of the vague classification of present and previously known operator, “Somewhat Purple "or" nearly blue "?" Is the sick's temperature higher, or is it the fever?” Etc. Models of this kind proved to be necessary to resolve problems connected to control, economic (store dissection), behavioural (Mutual strategy) and another attributive of effectiveness that is influenced by fuzzy human communication.

Neurons are a key cellular component underlying the action of a nervous system, inclusive the brain, peripheral conscious system, intestinal nervous system, and spinal cord. The organizational variance of those neurons are large, but the general arrangement and echo to electricity and ropes permit those cells to be classified as neurons.

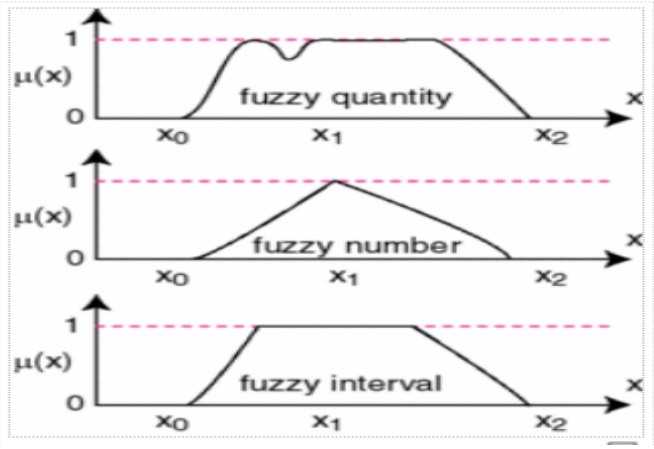

Figure 3.6: The diagram of fuzzy questions

Neural networks (NNs) is a system utilized to process information where it contains a similar method with the characteristics of artificial neural systems that stimulate the operation of learning.

Artificial neural networks (ANNs) are an alternative arithmetic model with roots in neuro-biology known as "artificial-neural net-works" which is an arithmetical device similar to a correlation inter alia neurons in the humanitarian brain and those of other organisms.

Bio-neural-Networks (BNNs) is the equivalent that happens for ANNs.

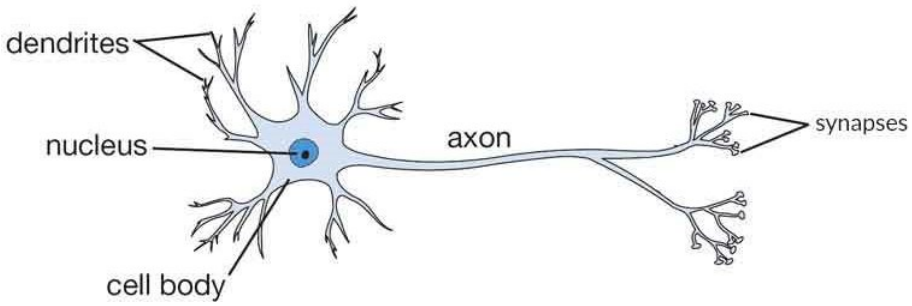

Figure 3.7: Biological Neuron(Gill N,2018)

Together BNNs and ANNs are network-systems created by atomistic compounds known as "nerve cells".

Artificial neural net-works are various from the biological network, though

a lot of characteristics and connotation of biological methods are transcribe in artificial methods.

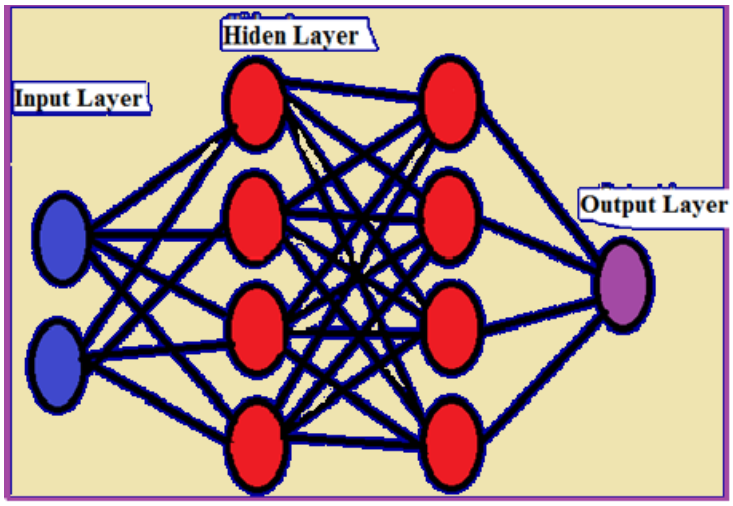

Figure 3.8: Neural network architecture

Synthetic nervous grids are a kind from non-linear handling method that was well convenient to an enormous area of functions, especially those where was no actual algorithms for function consummation. ANNs could utilized to fix the specific problem utilizing a sample data and teaching method. In this way, ANN could be utilized similarly to do several labor relying on the practice received.

For practicing properly, that to be able to generalize, the ability to recognize the similarities between different inputs types, particularly types that have been created by noise.

Neurons organized in an assortment of ways where loads (correspondence between neurons) could frame an assortment of examples called neural system designing where the correspondence between neurons with different neurons shapes a layered design in ANN.

ANN engineering comprises of three distinct layers. The main layer is known as the information layer there are various sorts of models, this layer goes about as a collector of information or contribution from the outer improvements. Coming information is then sent to the accompanying layer. In this layer, there are no committed guidelines for deciding the number of neurons; the number of neurons could be multiple.

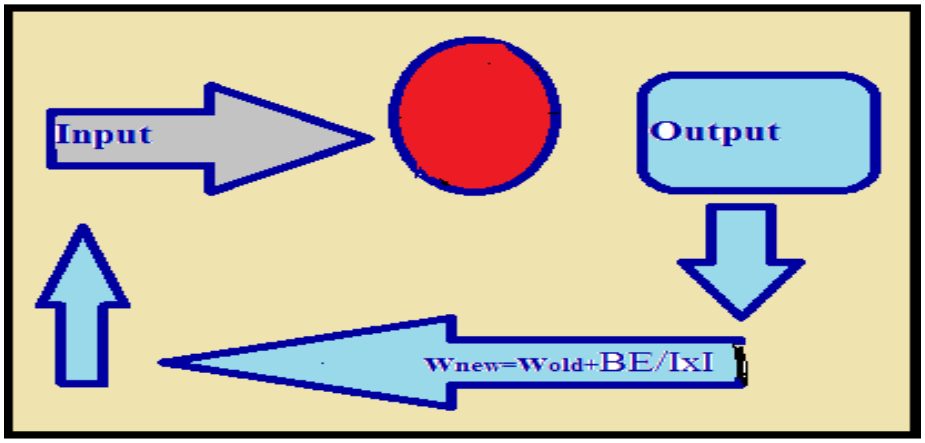

Figure 3.9: A node in the layer

Neural network point to both biological and structural variables; the expression is usually utilized to point to the artificial system only. Neural computation is nonlinear.

Each layer constitutes a nonlinear composition of nonlinear tasks from the past layer. Each neuron is a multi-inputs and multi-outputs system (MIMO) that receives signal from the input, create the resulting signal, and transmits those signals to whole output. Operationally, the nerve cells in ANN are arranged in layers (Figure 3.10).

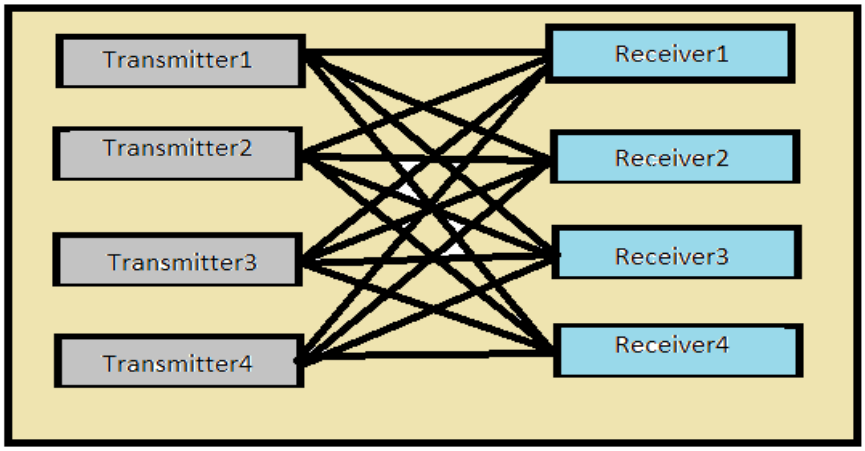

Figure 3.10: The multi-input and multi-output system

The info layer is the primary layer that communicates with the earth to get input. The yield layer can be said to have the last layer that interfaces with the yield to give the prepared information. The shrouded layer is the layers between the yield and the info layer that have no communication with the earth. Expanding the intricacy of ANN, following its

computational limit, requires the expansion of progressively inconspicuous layers, and more neurons in each layer. The multi-input and multi-yield numerical model can be depicted as

$$\begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_N \end{bmatrix} = \begin{bmatrix} h_{11} & h_{12} & \cdots & h_{1M} \\ h_{21} & h_{22} & \cdots & h_{2M} \\ \vdots & & \ddots & \vdots \\ h_{N1} & \cdots & \cdots & h_{NM} \end{bmatrix} \begin{bmatrix} s_1 \\ s_2 \\ \vdots \\ s_M \end{bmatrix} + \begin{bmatrix} n_1 \\ n_2 \\ \vdots \\ n_N \end{bmatrix}$$

The natural neuron is connected in incredibly convoluted systems. A few zones of the human mind, for example, the cerebellum are made out of ordinary examples of neurons. Different districts of the mind, for instance, the cerebrum have less ordinary courses of action.

An ordinary organic neural framework has billions or a large number of cells, each with a great many interfaces with different neurons. Present counterfeit frameworks unfit to accomplish that dimension of confounded, and can't be used to repeat the conduct of natural frameworks decisively. Utilization of neural systems counterfeit neural systems has various attributes that make them an appealing option in contrast to exemplary critical thinking methods.

By understanding the information and the hypothetical connection between the information, it is conceivable to straightforwardly figure the obscure arrangements of the tissue region. The ordinary PCs can utilize von Newman to figure these connections rapidly and productively from a numerical calculation. Unexpectedly, master frameworks are used in conditions where there are hypothetical foundations and deficient information to make any kind of dependable issue model.

In such cases, the learning and method of reasoning of human specialists are arranged in the master framework. Master frameworks recreate the conclusions made by a human master, by gathering data and passing the arrangement space in a focused on way.

Master frameworks are normally ready to play out their assignments very well without the accurate issue model and full information. Be that as it may, if adequate information or computational arrangement is accessible, the master frameworks are not exactly the perfect

choice. Synthetic neural nets are valuable for situations where there is abundant information, however minimal central reasonable. Synthetic neural systems are helpful for circumstances where there is a bounty of information, yet somewhat fundamental calculated.

Information, which is generally made by broad experimentation might be nonlinear, tumultuous, or non-deflationary, thus may not be displayed promptly. Info and yield separations might be complex to the point that sensible cross with master frameworks is anything but an agreeable alternative. Important, neural systems don't require any development suspicions about the issue space, nor even information about the measurable dissemination, not even information about the factual appropriation. Despite the fact that these suppositions are not required, it has been discovered that the expansion of development data, for example, the factual appropriation of information space could accelerate the preparation. Numerous scientific issues model slanted to assume that the data falls into a standard dissemination design.

A lot of scientific issues model slanted to assume that the data falls into a standard conveyance design, for example, Maxwell Boltzmann or Gauss dispersions.

Neural systems don't necessitate that presumption. The neural system plays out the fundamental explanatory work during preparing, which requires a great deal of exertion with respect to the investigator if there are different approaches to use them.

3.8.1. Average Neurons In The Invisible Layer:

Concealed nervous are nerves cells which utilized for preparing of data. The using of extra layers of hidden nervous allows best treatment system adaptability. That adaptability comes at additional expenditure multifaceted nature of the preparation calculation.

Learning is a fundamental normal for a shrewd framework, adapting, for the most part, happens during a lot of the preparation stage. When the system is prepared, it enters the creation organize where it produces free outcomes .Training can incorporate a mix of learning models, learning principles and learning calculations.

A system with learning and generation stages is defined as a fixed web. Nets able to continue knowing while using generation called dynamic processes. The knowing model can be observe, non-observe or crossbred, and reflects ways in that training inputs are given to the neural net.

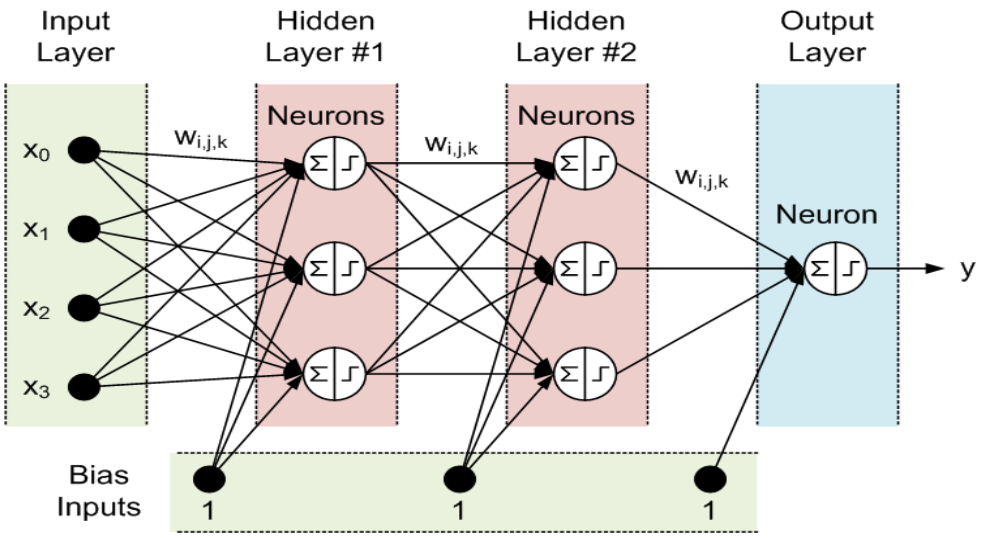

Figure 3.12: The number of neurons in the hidden layer (Stack Overflow Business Solutions,2017)

The technique of combining observe and non- observe training is defined in a crossbred technique.

The learning algorithm was a specific mathematical technique utilized to update the unknown weights between neurons during training iterations. down each knowing institution, there is a diversity of likely science algorithms to utilize. All most algorithms utilized a singular learning foundation. Rule learning and algorithms learning utilized with observe, non-observe models, but, each of which shall create various effects. Overtraining is problems that appear when as well training cases are as long as, and the system is unable of valuable popularization.

A various parameters should be determined when styling nervous nets. The number of layers there are amongst parameters, the practicing repetitions, neurons number in layer, and so on. Several significant parameters at phrases of practicing and net amplitude were numbers of neurons hidden, momentum parameters and learning rates.

The finding weights are a solution to the learning problem that reduces the error function. By using the equation after the output value to minimize the fault function of the multi-layered feed forward a neural network algorithm is then calculated using the algorithm of the posterior propagation neural network.

The back propagation algorithm: Learning gradient descent. This research has revealed the multi-layered networks is capable at the expense of the wider range of tasks of the logical

networks from one layer of the computing units. However, the computational effort needed to find the correct combination of weights large increase when more complex

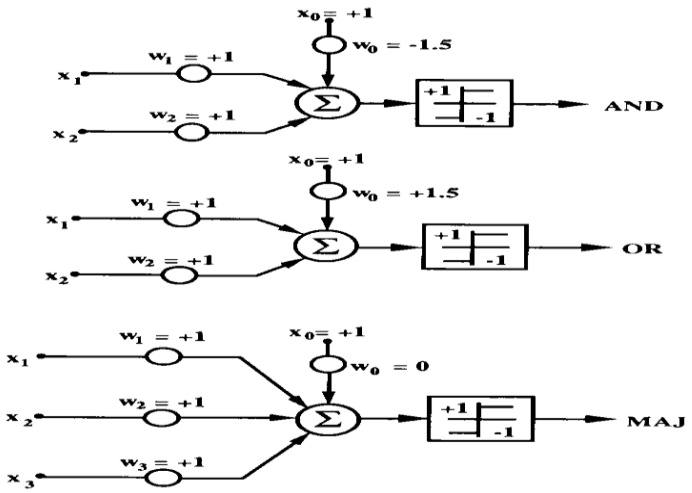

Figure 3.13: Display the fixed weights

The group weights that minimize the error is a solution to the problem of learning Activation functions for backpropagation networks is usually a sigmoid function.

3.8.2. Neural -Network Parameters' Learning using Back Propagation

• Learning Rate: The rate is used for updating network parameters. The value of the learning rate is between 0 and 1.

• Momentum Rate: This determines the speed of learning and is also used to solve the local minimum problem during training.

The value of the momentum rate is between 0 and 1.

Activation function: It is a transsmisson function that is used to set the output of one layer to another. The function is applied to the neurons for finding the outputs of the neurons. In NN usually sigmoid activation function is used.

The Sigmoid function of any real number and reaffirms the figure of production, which is located in the range of 0 to 1, according to the Convention, it could be expected that the value of the production of a range of -1 to 1.

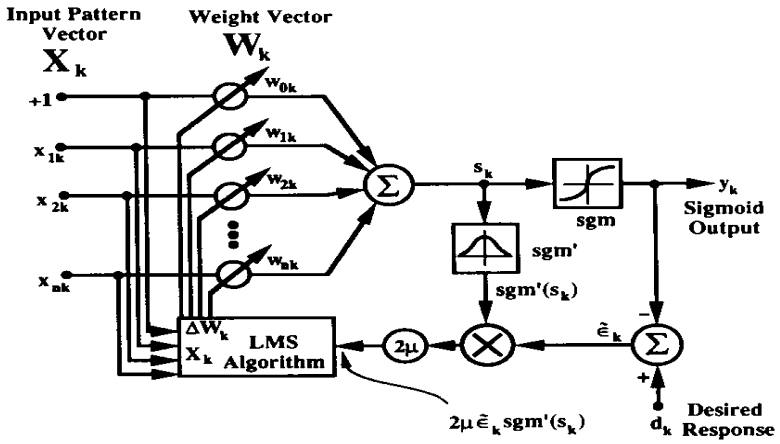

Figure 3.14: The operation of backpropagation for a sigmoid function

3.8.3. Combining Fuzzy System with Neural Networks

Neural networks collection of neurons connected with each other. They can be utilized to solve different problems such as pattern recognition, regression or density estimation, if there is no mathematical model for the specific problem. They only have some disadvantages and advantages that almost completely disappear by combining both concepts.

Neural networks could play their role only if the problem is expressed in sufficient quantity of observed examples. These notes are used to train the black box. On the one hand, there should be no prior knowledge of the problem.

On the other hand, it is not easy to draw understandable rules from the neural network structure.

On the contrary, the mysterious system requires linguistic rules rather than learning examples as a piece of prior knowledge. In addition, input and output variables must be described linguistically. If knowledge is incomplete, wrong, or contradictory, the mysterious system must be set. Since there is no formal approach to this, it is set in a guideline. This is usually a waste of time and prone to error.

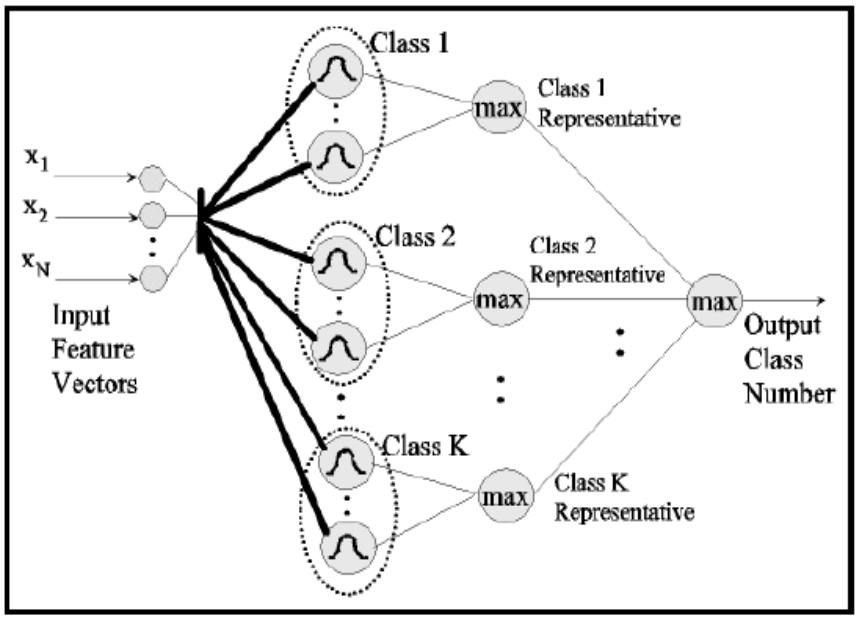

Figure 3.15: The simple fuzzy neural network (Carl G. Looney and Sergiu Dascalu ,2007)

Table 3.5: Comparison of neural control and fuzzy control

Neural Networks	Fuzzy Systems
Mathematical style is not necessary	Mathematical methods are not necessary
Many learning algorithms	Unable to learn
Learning from scratch	Prior knowledge is necessary
Behaviour of the Black Box	Simple implementation and interpretation

In thh Table , the characteristics of both approaches that demonstrated.

Features: Compared to a general neural network, the communication weights and activation functions and activation of the fuzzy neural networks are much different. Although there are

many different ways to design a fuzzy neural networks (Buckley and Hayashi, 1995); (Nauck and Kruse, 1996), Certain characteristics are given below:

1. A neural system based on a basic fuzzy logic is trained by a data-driven learning method derived from neural network theory. This process takes into account local information to make local changes in the underlying mystery system.

2. It could be represented as a set of fuzzy rules at any time in the learning process, i.e. during, before and after.

3. The system can be configured with or without prior knowledge in terms of fuzzy rules

4. The learning procedure is restricted to ensure the semantic characteristics of FS.

5. The fuzzy neurodevelopmental system approaches an unknown function of n dimensions, which is partly represented by training examples.

6. The fuzzy rules could, therefore, be interpreted as vague preliminary examples of training.

7. A neural-fuzzy system is represented as a neural network of three layers:

The first layer is the input layer, the second layer symbolizes the ambiguous rules and the third layer represents the output variables. Fuzzy sets are converted as connection weights. Some methods also use five layers where the scrambled groups are encoded in the second and fourth layer units, respectively.

However, these forms can be converted into a three-tier structure. One can distinguish mainly between three different types of disorganized neural networks .i.e. synchronous. Collaborative, and hybrid FNN networks (Nauck et al., 1997).

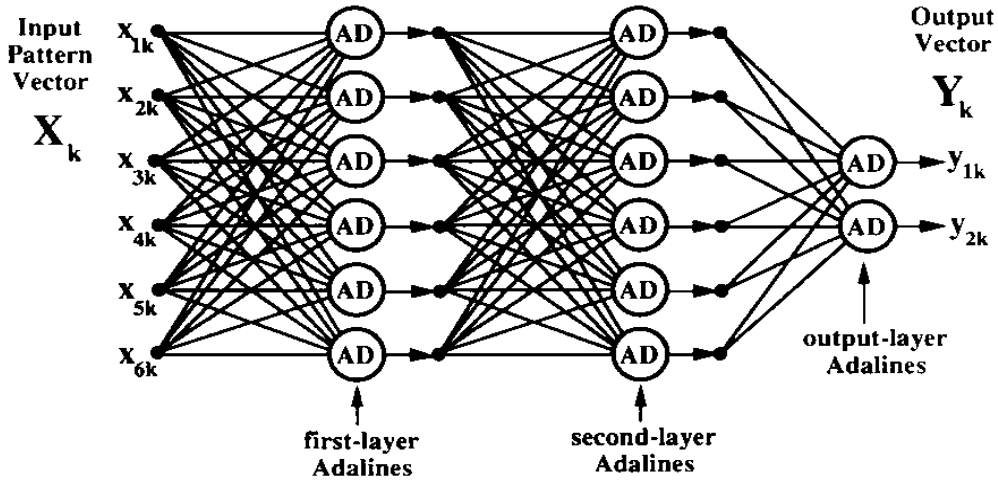

Figure 3.16: Typical function Pattern recognition system

Fuzzy logic systems are used to solve many problems, including prediction, classification, control, and identification. One of the most convenient and easy logic to set the input space to the corresponding output space is fuzzy logic. The assignment is achieved using the if-then rule with both previous and previous parts. While precedents part includes input variables, result. The part includes system output variables.

Typical function Pattern recognition system Input variables are set to the corresponding output variables, where the inputs represent the patterns while the outputs are the corresponding chapters. Essentially, linguistic terms or ambiguous values are used to describe.

Variables of fuzzy neural networks are the membership functions that characterizes each ambiguous value. Membership functions allow the assessment of language terms.

One of the effective techniques is the use of NN for construction of the if - then the rules. They have properties such as circularization, self-learning ability, nonlinear mapping, and bio-arithmetic parallelism. Here, self-learning properties have improved the accuracy of the NN base model. The implementation of ambiguous logic has reduced the complex nature of data and addressed uncertainty and inaccuracy. The combination of fuzzy logic and non-specific names (NN) allows us to design nonlinear systems characterized by the

inaccuracy described by the quick learning system. Here, it combined these two methods to build FNNs Solve problems with classifying styles.

Data collection obtained from the diagnosis of erythema-squamous illness. Fuzzy Neuron inputs represent the base of the workbook. Class entry flags are assigned to the specified six layers. The algorithm designed (FNN) has achieved this process

From the fuzzy logic across the NN structure. This FNN is designed by creating a suitable database rule for them "IF-THEN" Building. It is necessary to define an accurate description of both the hypothesis of the IF-THEN base is ambiguous and the resulting part Classification system using learning ability (Abiyev and Abizaide, 2016). This research have achieved this is by assessing the error response of the built frame. Also, the fuzzy rules of Sugino Kang (TSK) type were used respectively to design frames (Takagi and Sugeno.1985).

Linear and Non-linear rounding approximated by fuzzy systems have the following structure:

$$\text{if } x_1 \; is \; A_{1j} \; and \; x_{2i} \; is \; A_{2i} and \; x_m \; is \; A_m then \; y_j = \mathrm{b}_j \sum_{i=1}^{m} a_{ij} \, x_i$$

y_j and x_i are signals of the system's output and input,. i=1,...,m mean a number of input signal and j=1,…,r are a number of the principles.

Pointing to the A_{1j} as ambiguous adjust the input, b_j, and b_j as parameters.

The offer FNN formed from six layers:

- The first layer, xi input signals (i = 1... m) are equally circulate.
- The second layer that describes the membership functions in lingual terms.

Given each input signal entered in the form, the grade of fuzzy set membership to which the input value belongs is calculated.

$$\mu 1_{\mathrm{j}} (\mathrm{x_i}) = \mathrm{e}^{\frac{(\mathrm{x_{i-c_{ij}}})^2}{\sigma_{\mathrm{j}}^2}}, \mathrm{i} = 1..\mathrm{m}, \mathrm{j} = 1..\mathrm{r} \qquad (2)$$

A number of input signals are appearing m, hidden neurons.

In the third layer, known as the number of fuzzy rules referred to as r.

I symbolize at the centre and Gaussian display membership functions, respectively. $\mu 1_j\,(x_i)$ perform a membership job of the jth input variable of a word jth

The base layer is installed in the third layer where the number of rules is equal to the number of node.Rules are represented as R1, R2... Rr. The t-norm min operation was used to calculate the output signal for this layer.

$$\mu_j(x) = Min(\mu 1_j(x_i)), i = 1,..,m, j = 1, \ldots, \quad (3)$$

A precise operation is indicated as.. π

In the fifth layer, these signals indicate μj (x) to input signals.

The bring layer is loaded in 4th layer. That layer creates from linear systems n. After that, I studied the production values like:

$$y1_j = b_j + \sum_{i=1}^{m} a_{ij}\, x_i \quad (4)$$

From Layer 4 signals, the output of the third layer is produced, creating the fifth layer, the next layer. Then select the jth node output:

$$y_j = \mu_j(x) y_j \quad (5)$$

I utilized the GOA membership to calculate the output signal. For calculating FNN's output signals in the sixth layer as follows:

$$u_k = \frac{\sum_{j=1}^{r} w_{jk} y_j}{\sum_{j=1}^{r} \mu_j(x)} \quad (6)$$

For calculating the fuzz's output signal from the base

3.8.4. FNN Learning

Initially, FNN parameters are created randomly. I have referred to it in equation (2) from the basis in equation (1)

When designing FNN, the parameters for cij (t) and σij (t), where i = 1, .., m and j = 1, .., r, are trained using learning algorithm. I utilized gradient algorithms to update FNN parameters.

On networks product, the value of the fault cost job was calculated as follows:

$$E = \frac{1}{2}\sum_{k=1}^{n} u_k^d - u_k \qquad (7)$$

Where n is the number of output signals for the grid and the desired and current network output values (k = 1, .., n), respectively.

Parameters w_{je}, a_v,b(i = 1, .., m, j = 1, .., r, k = 1, .., n) for membership parameter and networks ,c_v and δ_v (i = 1, .., m, j = 1, .., r) of the FNN structures were updated utilizing :

$$\begin{aligned}
w_{jk}(t+1) &= w_{jk}(t) - \gamma\frac{\partial E}{\partial w_{jk}} + \lambda(w_{jk}(t) - w_{jk}(t-1));\\
a_{ij}(t+1) &= a_{ij}(t) - \gamma\frac{\partial E}{\partial a_{ij}} + \lambda(a_{ij}(t) - a_{ij}(t-1));\\
b_j(t+1) &= b_j(t) - \gamma\frac{\partial E}{\partial b_j} + \lambda(b_j(t) - b_j(t-1));\\
c_{ij}(t+1) &= c_{ij}(t) - \gamma\frac{\partial E}{\partial c_{ij}} + \lambda(c_{ij}(t) - c_{ij}(t-1));\\
\sigma_{ij}(t+1) &= \sigma_{ij}(t) - \gamma\frac{\partial E}{\partial \sigma_{ij}} + \lambda(\sigma_{ij}(t) - \sigma_{ij}(t-1));\\
i &= 1,..,m;\ j = 1,..,r;\ k = 1,..,n.
\end{aligned} \qquad (8)$$

The derivative of this formula is shown in other research Works (Abiyev and Helwan, 2018).

CHAPTER 4

EXPERIMENTS AND RESULTS

The FNN algorithms described above have been applied to the classification of schistosomiasis.Simulation of the system has been done using PC has Radeon(tm) processor 2.00 GHz and RAM 8 GB. Here, the data sets that characterize these diseases were from H. Altay Guvenir and Nilsel Ilter. The data set included a set of values that characterize 33 input parameters. The number of data elements was 366.

The main problem is the exact classification of the six erythema to-squamous illness layers. During the simulation, input data were normalized and expanded over periods of 0-1 (Abiyev R.,2009). The normalization of input data allowed the rapid training and input of input and output data to reduce training time.

Next normalization, these data were used as input signals of classifiers FNNs. Noted, the extraction technique was used to extract the parameters. By using these features, FNN was executed. To implement the label, the input data set is grouped according to output groups. According to the groups, the sub data sets were obtained. Then, the input data sets are grouped separately for each subset.

The data set utilized to design the classification system included 33 signals and 6 output signals. The Inputs / Output data set was used to prepare training, evaluation, and testing of the data set.

During modelling, the various number of rules was used for testing of the qualifier. At the beginning of the function of membership of the previous part and consecutive parameters of a part were randomly made. Using entrance signals and structure of FNN, output signals were defined; then, in products of FNN, the deviation of the current productivities from target was defined. For calculating RMSE I use this equation:

$$RMSE = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(y_i^d - y_i)^2}$$

i, y and d and output, and N The measurement of the patterns. For calculating the rate recognition, utilizing equation as shown below:

$$Recog\ rate = \frac{Number\ of\ items\ correctly\ classified}{Total\ number\ of\ items}$$

4.1. The structure of the proposed System

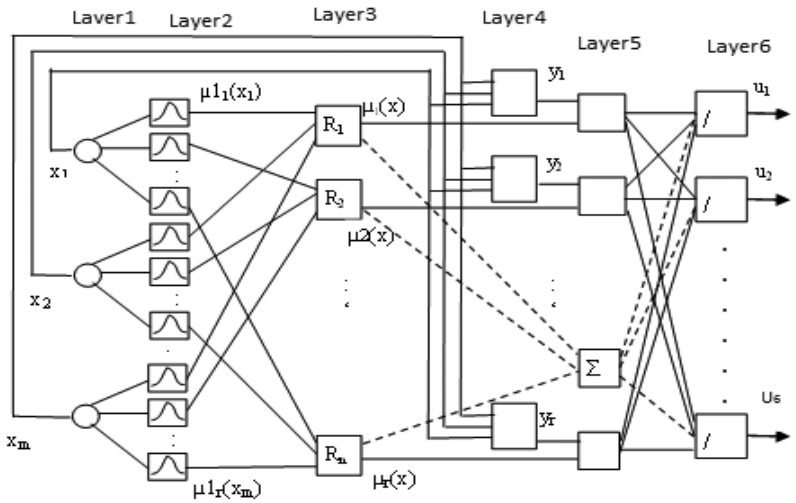

Figure 4.1: Architecture of fuzzy neural network (FNN)

4.2. The Results of the Experimental Model FNN

Table 4.1: Experimental result of proposed FNN system

Number of Rules	Final Training result (%)	Final Testing result (%)	(%)Evaluation	Accuracy (%)
64	0.273584	0.272517	0.276185	98.6338
128	0.252580	0.251746	0.255074	98.9071
256	0.247841	0.247338	250270	99.180328
512	0.252859	0.252495	0.255210	99.453552

The Training stage was continued within 100 Epochs. The examining utilize 64,128, 256 and 512 hidden layers

At the beginning start the experiment, the research used 64 bases, then gradually increase the number of rules.

The first experiment , this study used was sixty-four rules, with the accuracy of 98.6338%.

The second experiment raised the number of bases to 128, and its accuracy was 98.9071%.

The third experience, the research have increased the number of hidden layer to 256 where accuracy has the percentage up to 99.180%.

The fourth experience, the rules were 512 and accuracy 99.453552%. As seen the highest accuracy up to 99.45% for the proposed method (FNN).

Table 4.2: Comparison between the proposed system and other methods

	Accuracy (%)
Weighted K-NN	95,53
Basic K-NN	94,14
FNN	99.453552

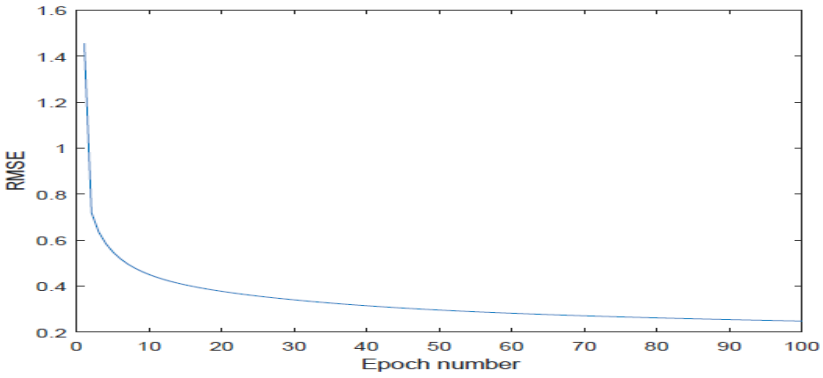

Figure 4.2: The graph of the root medium square error

This graph shows RMSE of examining with 256 hidden layers(rules)

CHAPTER 5
CONCLUSIONS

This thesis aims to develop a system that tests the possibility of the FNN-method to diagnosis of erythematous squamous disease. The developed system incorporates the fuzzy logic and neural networks for solving of the problem.

The structura of FNN system for presented. The learning algorithm and operation principles of the system are described. Gradient decsent algorithm is applied for training of the system.

The data sets taken from UCI learning Reprisotory is applied for the development of the system. The simulations of the system have been done using different numbers of fuzzy rules (hidden neurons). The towering execution precision which our system has achieved up to 99.45 % with 512 hidden neurons. This empowers to construct built-in system for diagnosing many kinds of skin-illness.

This is an achievement in a computer science and biology, where an implementation procedure on the database were carried out and the satisfactory classification results were obtained. In the thesis the special procedure is used for treating the missing data. This process was helped to obtain more accurate classification results.

In this study, the presented methodology take the advantages of fuzzy logic and neural network and contributes in the accurate determination the types of disease due to particular type of the symptoms.

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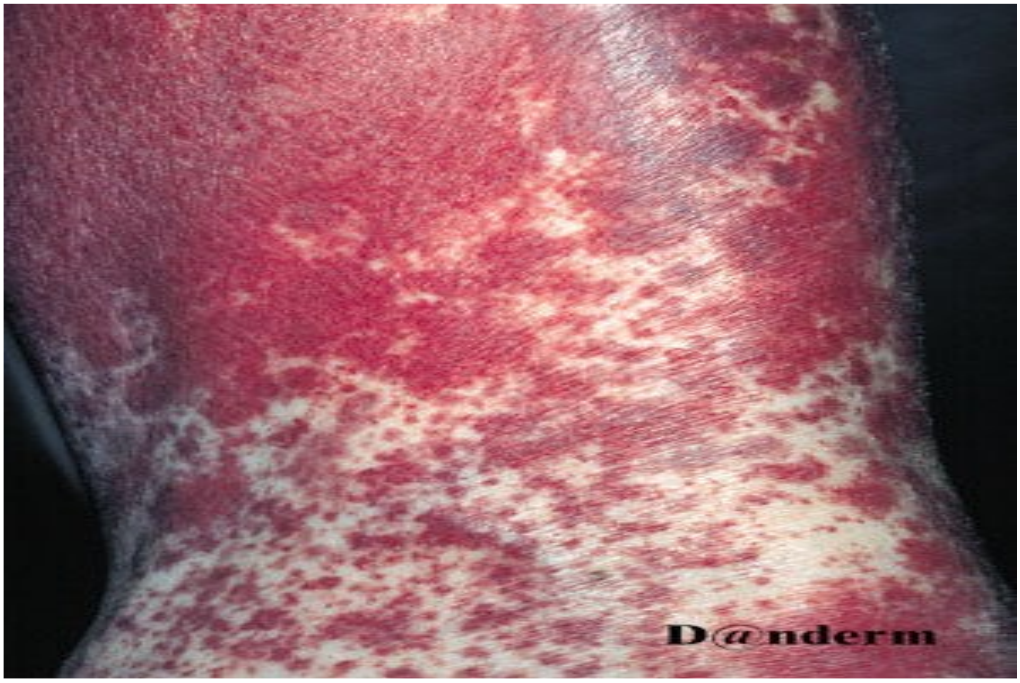
APPENDIX

Palmar erythema



palpable small vessel vasculitis

Pityriasis versicolor

Psoriasis

Erythema nodosum

Plaque psoriasis