A Proposed Expert System for Skin Diseases Diagnosis

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Abstract: There are many skin diseases having similar symptoms, therefore, the most important objective - in order to prescribe the appropriate treatment - is the right diagnosis of the disease. In this paper the design of the proposed Expert System which was produced to help dermatologists in diagnosing some of the skin diseases (Psoriasis, Eczema, Ichthyosis, Acne, Meningitis, Measles, Scarlet Fever, Warts, Insect Bites and Stings) are presented, an overview about the skin diseases are displayed, the cause of diseases are outlined and the treatment of disease whenever is possible is given. CLIPS language for designing the proposed expert system is used.

Key words: Artificial Intelligence, Expert Systems, CLIPS, Skin diseases

INTRODUCTION

Skin is the biggest organ in the body, it's mass is 4-5 kg, and the surface area is about 1.2 - 2.2 m². Skin is very important for the body; it has many functions:

- Protecting body
- Is used for the sense of touch
- Adjusting the temperature of the body

The skin has three layers (as in figure 1):

- Epidermis
- Dermis
- Subcutaneous

Fig. 1: The structure of the skin.

Skin diseases are very common these days, some of them are simple and easy to recover from, others are very harmful and may be no cure for them; so we must take care of this important organ in our body.

Diagnosis of skin diseases is a very complex especially when more than one disease has about the same symptoms; so they need dermatologists with wide experience of skin diseases. For all the reasons above, we have developed this expert system to help dermatologists in diagnosing some of the skin diseases, in order to prescribe the appropriate treatment.

Expert Systems: An Expert System is a computer application of Artificial Intelligence (AI), which contains a knowledge base and an inference engine, see figure 2 for details.

Fig. 2: Main Components of an Expert System.
The proposed Expert System for Skin Diseases Diagnosis was implemented using, CLIPS language\textsuperscript{(7)} which stands for C Language Integrated Production System\textsuperscript{(5,7)}. It is a forward reasoning expert system shell that can make inferences. The advantages of CLIPS expert system shell are: Implemented in C language for efficiency and portability, developed by NASA, object oriented language and Rule-Based Language.

**Background/ Literature Review:** There are many expert Systems that were designed to diagnose diseases in general; but a few for skin diseases diagnosis; MYCIN is a well known expert system for diagnosing bacterial infections\textsuperscript{(8)}. Wollina and Yoon developed expert systems in the domain of dermatology\textsuperscript{(6,10)}. Güvenir and Emeksz have developed an expert system for differential diagnosis of erythematous-squamous diseases\textsuperscript{(9)}. Rubin has designed an expert system 'dermDx', intended to aid in the interpretation and diagnosis of biopsies of inflammatory diseases of the skin\textsuperscript{(9)}. Meyer, Niedelman and Thomas have discussed the treatment of common skin diseases in infants and children\textsuperscript{(11,12)}.

These Expert Systems are specialized in one specific disease, but the current proposed expert system is specialized in the diagnosis of nine skin diseases (Psoriasis, Eczema, Ichthyosis, Acne, Meningitis, Measles, Scarlet Fever, Warts, Insect Bites and Stings).

In fact, Alaa Akkila (co-author of this paper) have a good experience about some of the skin diseases, especially his son's case (Ichthyosis); the boy was born with this very rare and chronic disease and his age now is 12 years old.

**MATERIALS AND METHODS**

In this expert system the nine diseases were divided into three main categories:

- Skin rashes without fever
- Skin rashes with fever
- Skin infections

The proposed expert system will ask the user to choose the correct option of the displayed ones in each screen (see figure 3 for main menu screen); starting with the most general information and ending with the diagnosis of the disease. When diagnosing, the system will display to the user an overview about the disease, causes of disease and appropriate treatment and advices for the disease. Figure 4 shows the decision tree of the expert system for diagnosing the skin diseases.

**Knowledge Representation:** The main sources of the knowledge for this expert system are dermatologists and specializes websites for skin diseases. The captured knowledge have been converted into CLIPS Knowledge base syntax (facts and rules). Currently the expert

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*Fig. 3: Main menu of the expert system.*

*Fig. 4: Decision tree of the expert system.*
system has more than 60 rules which cover nine skin diseases. Here is a brief identification of each of the nine skin diseases\textsuperscript{[13,14,15]} that the expert system can help the user with:

**Psoriasis:** Bright red areas of raised patches (plaques) on the skin often covered with loose, silvery scales. Plaques can occur anywhere, but commonly they occur on the knees, elbows, scalp, hands, feet, or lower back. Figure 5 shows a person infected with Psoriasis skin disease.

![Fig. 5: Person with Psoriasis skin disease.](image)

**Eczema:** Itching, often intense and sometimes worsening in the evening and at night acute lesions may be intensely itchy, small red raised bumps sub-acute lesions may be thicker, paler, scaly, red patches. An infected person with Eczema skin disease is shown in figure 6.

![Fig. 6: Person with Eczema skin disease.](image)

**Ichthyosis:** Ichthyosis is the most commonly inherited skin disorder. It leads to a varcharacteristic skin rash. Usually the disease begins in early childhood. The rash may disappear for many years only to return. The rash is most prominent on the elbow, knees and hands. During the winter months, the rash tends to be more severe. An infected person with Ichthyosis skin disease is shown in figure 7.

![Fig. 7: Person with Ichthyosis skin disease.](image)

**Acne:** Acne is an inflammatory skin condition characterized by skin eruptions on the face, chest and back. Acne occurs more commonly in adolescent males than females and is usually chronic. Acne may reappear throughout life. Figure 8 shows a person infected with Acne skin disease.

![Fig. 8: Person with Acne skin disease.](image)

**Meningitis:** Meningitis is an inflammation that occurs in the meninges, or linings of the brain. This can be due to infectious processes as well as non-infectious inflammatory conditions. The most common forms of meningitis are caused by viruses. Less commonly, bacteria produce meningitis. Figure 9 shows a Person with Meningitis skin disease.

![Fig. 9: Person with Meningitis skin disease.](image)
Measles: Measles is an extremely contagious viral illness. It is also known as rubella. The infection is spread through the respiratory tract. It is most common in children, but can affect all ages, although fewer incidences are noted due to immunization. It predominantly produces symptoms of the skin and respiratory tract. The disorder in contagious prior to the development of the rash, and remains contagious until the rash disappears. See figure 10 for a sample case.

Insect Bites and Stings: Cause is due to a bites or stings from mosquitoes, fleas, chiggers, bed-bugs, ants, spiders, bees, scorpions and other insects. The may release of venom or toxin into the skin. They may release compounds which produce an allergic reaction. Figure 12 shows a person with an Insect Bites.

Scarlet Fever: Scarlet fever, once a common infection, is now relatively rare disease. It is caused by bacteria that produces a specific type of toxin. It produces a red, rough rash, usually on the neck and chest (see figure 11 for details).

Warts: Warts are non cancerous, contagious, tumors caused by a virus in the outer skin layer. They occur most often on the fingers, hands and arms, but can occur anywhere. They are most common in children and young adults between ages 1 and 30. Figure 13 shows a sample case.

System Evaluation: In a preliminary evolution of the expert system, a few dermatologists have tested it and they were satisfied with the system; furthermore, some patients having skin diseases tried this expert system, in order to evaluate it, and they were surprised by the accuracy of the diagnosis of the skin diseases.
Conclusion: In this paper, a proposed expert system was presented for helping dermatologists in diagnosing patients with nine possible skin diseases. Dermatologists and skin diseases patients can get the diagnosis faster and more accurate than the traditional diagnosis. This expert system does not need intensive training to be used; it has simple and user friendly interface. It was developed using CLIPS language.

Future Work: This expert system is considered to be a base of future ones; more skin diseases are planned to be added and to make it more accessible to users from anywhere at any time.

Good Habits for Healthy Skin: Here are some good habits for taking care of your skin:

- Avoid sun
- Shave carefully
- Avoid smoking
- Don't use hot water in shower (use cold or warm)
- Moisturize your skin

Expert System Source Code:
(deffacts init (start))
(defrule mainmenu
  (start)
  ?ml <- (start)
  =>
  (printout t crlf crlf crlf crlf crlf crlf crlf crlf crlf crlf)
  (printout t "An expert system for Diagnosis of some skin diseases" crlf crlf
  "Main Menu" crlf
  "="*=" crlf crlf crlf
  "1- Skin rashes without fever" crlf crlf crlf
  "2- Skin rashes with fever" crlf crlf crlf
  "3- Skin infections" crlf crlf crlf crlf crlf
  "0- Quit the program" crlf crlf crlf
  "Type number of your choice then hit return key" crlf crlf
  "Choice: ")
  (bind ?response (read))
  (if (eq ?response 1) (assert (type 0-1)))
  (if (eq ?response 2) (assert (type 0-2)))
  (if (eq ?response 3) (assert (type 0-3)))
  (if (eq ?response 0) (assert (type quit)))
  (printout t crlf)
  (retract ?ml) )
(defrule user-quits
  (type quit)
  =>
  (printout t "You have QUIT the program." crlf)
  (halt))
(defrule without
  ?p <- (type 0-1)
  =>
  (printout t crlf crlf crlf)
  (retract ?p)
  (printout t "Diagnosis of some skin diseases" crlf crlf crlf
  "Skin rashes without fever menu" crlf
  "="*=" crlf crlf crlf
  "1- red patches of skin, painful joints, " crlf
  "pitted nails, poorly controlled dandruff" crlf crlf
  "2- blackheads or whiteheads on face, neck, " crlf
  "shoulders or back, oily skin, pimples " crlf
  "and cysts beneath skin, most common in " crlf
  "adolescents and young adults" crlf crlf
  "3- A varicose rash develops. It appears " crlf
  "like (fish scales), after which it is named. " crlf
  "It occurs mostly on the knees, elbows and hands, " crlf
  "Usually the disease begins in early childhood " crlf crlf
  "0- go to Main Menu " crlf crlf crlf
  "Type number of your choice then hit return key" crlf crlf
  "Choice: ")
  (bind ?response (read))
  (if (eq ?response 1) (assert (type 0-1-1)))
  (if (eq ?response 2) (assert (type 0-1-2)))
  (if (eq ?response 3) (assert (type 0-1-3)))
  (if (eq ?response 0) (assert (start))) )
(defrule with
  ?p <- (type 0-2)
  =>
  (printout t crlf crlf crlf)
  (retract ?p)
  (printout t "Diagnosis of some skin diseases" crlf crlf crlf crlf)
Skin rashes with fever menu

1- severe headache, stiff neck, fever and chills, confusion, skin rash, occurs in late winter or early spring, outbreaks in crowded living conditions
2- cough, fever and runny nose red, itchy rash that spreads

all over the body small grayish bumps, surrounded by a red halo in mouth sore throat loss of appetite mainly affects children

0- go to Main Menu

Type number of your choice then hit return key

Choice: 

(bind ?response (read))
(if (eq ?response 1) (assert (type 0-2-1)))
else
(if (eq ?response 2) (assert (type 0-2-2)))
else (assert (type previous 0-1)))

(defrule previous0-1
?p <- (type previous 0-1)
=>
(retract ?p)
(assert (type 0-1))
)

(defrule Meningitis
?p <- (type 0-2-1)
=>
(printout t crlf crlf crlf)
(retract ?p)
(printout t
"Diagnosis of some skin diseases"
"Skin rashes with fever menu"
"severe headache, stiff neck, fever and chills, confusion, skin rash, occurs in late winter or early spring, outbreaks in crowded living conditions"
"crowded living conditions"
"Dependent on your answers and my good experience, you have Meningitis disease"

"Overview of Meningitis"
"Meningitis is an inflammation that occurs in the meninges, or linings of the brain. This can be due to infectious processes as well as non-infectious inflammatory conditions. The most common forms of meningitis are caused by viruses. Less commonly, bacteria produce meningitis. Non-infectious meningitis or chemical meningitis can occur when some agent leads to intense inflammation in the subarachnoid space."

"Causes of Meningitis"
"Viral meningitis often includes Coxsackie virus as well as the virus that causes mumps. Outbreaks of viral meningitis often occur in outbreaks in the summer. Bacterial meningitis may occur spontaneously. Often bacterial meningitis spreads from the respiratory tract. Fungal or tuberculosis meningitis often attacks an individual with a weakened immune system. This can occur in chronic infection, HIV infection or in those..."
people with cancer. Chemical meningitis can occur from substances injected into the spinal fluid. This can lead to chemical or allergic meningitis. Also, infectious processes or tumors may release substances into the spinal fluid which incite an inflammatory response in the spinal fluid.

Chemical meningitis can occur from substances injected into the spinal fluid. This can lead to chemical or allergic meningitis. Also, infectious processes or tumors may release substances into the spinal fluid which incite an inflammatory response in the spinal fluid.

Treatment of Meningitis

See your health professional.

Bacterial or severe viral meningitis may require treatment in a hospital.

Enter any key then press Enter to continue ...

Consult your doctor, Topical treatments: Salicylic acid, Tar, Tazorac.

Diagnosis of some skin diseases

Skin rashes without fever menu.

Skin rashes without fever menu.

Small blisters develop on the affected skin.

the involved skin, swollen red legs.

Depending on your answers and my good experience, you have Psoriasis disease.

Overview of Psoriasis.

Psoriasis is a recurrent skin disorder.

It is varcharyized by fluctuations in the appearance of scaly, red patches of skin.

The areas most commonly affected include the skin of the scalp, elbows, knees, chest, back, arms, legs and fold between the buttocks. Frequently, abnormalities of the nail may also occur. About 10% of people that develop Psoriasis will eventually develop arthritis.

Psoriasis typically has an onset in late childhood or young adulthood and continues throughout life.

It is most common in white-skinned people.

The cause is unknown. The disease develops from a genetic predisposition that speeds up the life cycle of the skin cells. It may be an autoimmune disorder.
"The exact etiology for eczema is not known. However, people who develop eczema often will "
"demonstrate allergic reactions to a wide variety of things, including foods such as eggs, "
"wheat, milk or seafood. Similar allergic reactions can also arise from wool clothing, "
"skin lotions, ointments, soaps, detergents, cleansers, plants, tanning agents used for shoe "
"leather, dyes, and topical medications. " treatment of Eczema" 
" ask your doctor, Topical (applied to the skin) medication is frequently prescribed" 
" Enter any key then press Enter to continue ... please 
" (bind ?response (read)) (assert (start)) 
(defrule blackheads 
?p <- (type 0-1-2) => 
(printout t crlf crlf crlf) 
(retract ?p) 
(printout t crlf crlf crlf) 
(retract ?p) 
(printout t crlf crlf crlf) 

"Acne is an inflammatory skin condition characterized by skin eruptions on the face, "
"chest and back. Acne occurs more commonly in adolescent males than females and "
"is usually chronic. Acne may reappear throughout life. " 
" Causes of Acne" crlf 
" 
"Acne is caused from hormonal changes occurring during adolescence. These " 
"changes result in oil glands in the skin becoming plugged. The reasons for this are " 
"unknown. The bacteria, normally present in the oil glands, proliferate and form " 
"infections due to the oil build up, which can cause acne. Acne is not caused by dirt, " 
"masturbation or certain foods. Hygiene can help with the oily skin. " treatment of Acne" 
" ask your doctor , some medicines : ClearSkin - A Acne Gel , DermaClear " 
" Enter any key then press Enter to continue ... please 
" (bind ?response (read)) (assert (start)) 
(defrule fish-scales 
?p <- (type 0-1-3) => 
(printout t crlf crlf crlf) 
(retract ?p) 
(printout t crlf crlf crlf) 

"Ichthyosis leads to a variecharacteristic skin rash. Usually the disease "
"begins in early childhood 
"Depending on your answers and my good experience, you have Ichthyosis disease" 
" Overview of Ichthyosis" 
" Medical treatments for ICHTHYOSIS" 
" Consult a dermatologist for the evaluation and treatment of the skin. " 
"Consult an ophthalmologist for the evaluation and management of " 
"ectropion from birth. Consult a genetics counselor for a discussion of " 
"the risks of subsequent children being affected. Surgical
treatment is " crlf
"occasionally needed." crlf
"Emollients should be applied after showering or bathing " crlf
" Enter any key then press Enter to continue ... please " crlf crlf
(bind ?response (read))
(assert (start))

(derule cough-fever
?p <- (type 0-2-2)
=>
(printout t crlf crlf crlf)
(retract ?p)
(printout t
" Diagnosis of some skin diseases" crlf crlf crlf
" Skin rashes with fever menu" crlf
" cough, fever and runny nose red, itchy rash that spreads" crlf
" all over the body small grayish bumps, surrounded by a red " crlf
" halo in mouth sore throat loss of appetite mainly affects children " crlf
" =================================" crlf

1- disease usually begins with fever, which may be quite high. " crlf
" There is a sore throat, cough, sneezing, and runny nose. Fatigue " crlf
" and loss of appetite occurs. " crlf crlf crlf
" 2- disease usually produces a sudden sore throat. The tonsils in " crlf
" the back of the throat are commonly red and swollen and may " crlf
" have a whitish coating on them. " crlf crlf crlf
" 0- go to Previous Menu " crlf crlf crlf
" Type number of your choice then hit return key" crlf crlf
" Choice: " )
(bind ?response (read))
(if (eq ?response 1) then (assert (type 0-2-2-1))
else
 (if (eq ?response 2) then (assert (type 0-2-2-2))
 else
 (if (eq ?response 0) then (assert (type previous 0-2)) )
)

(derule previous0-2
?p <- (type previous 0-2)
=>
(retract ?p)
(assert (type 0-2)) )

(derule measles
?p <- (type 0-2-2-1)
=>
(printout t crlf crlf crlf)
(retract ?p)
(printout t
" Diagnosis of some skin diseases" crlf
" Skin rashes with fever menu" crlf
" cough, fever and runny nose red, itchy rash that spreads" crlf
" all over the body small grayish bumps, surrounded by a red " crlf
" halo in mouth sore throat loss of appetite mainly affects children " crlf
" disease usually begins with fever, which may be quite high." crlf
" There is a sore throat, cough, sneezing, and runny nose. Fatigue " crlf
" and loss of appetite occurs. " crlf crlf
" =================================================" crlf
" Depending on your answers and my good experience , you have measles disease " crlf
" Overview of measles " crlf
" ================================ " crlf

"Measles is an extremely contagious viral illness. It is also known as rubeola. The infection is spread " crlf
"through the respiratory tract. It is most common in children, but can affect all ages, although fewer " crlf
"incidences are noted due to immunization. " crlf crlf
" Causes of Measles" crlf
" ================================ " crlf crlf
"Measles is caused by a rubeola-virus infection. It mostly affects the skin and respiratory tract. Following " crlf
"exposure, there is a 7 to 14 day incubation period, before clinical symptoms develop. The disease usually " crlf
"lasts 10-14 days. " crlf crlf
" treatment of Measles" crlf
" ================================ " crlf crlf
"consult a dermatologist , Antibiotics are given only if there is a bacterial infection " crlf
" Enter any key then press Enter to continue ... please" crlf crlf
) (bind ?response (read)) (assert (start)) )
(defrule scarlet-fever
  (?p <- (type 0-2-2-2)) =>
  (printout t crlf crlf crlf)
  (retract ?p)
  (printout t
    "    Diagnosis of some skin diseases" crlf
    "    Skin rashes with fever menu" crlf
    "    cough, fever and runny nose red, itchy rash that spreads" crlf
    "    all over the body small grayish bumps, surrounded by a red " crlf
    "    halo in mouth sore throat loss of appetite mainly affects children " crlf
    "    disease usually produces a sudden sore throat. The tonsils in" crlf
    "    the back of the throat are commonly red and swollen and may " crlf
    "    have a whitish coating on them. " crlf
    "=" crlf
    "    Depending on your answers and my good experience, you have scarlet fever disease" crlf
    ""
  )

(overview of scarlet fever)

Scarl et fever, once a common infection, is now relatively rare. It is caused by a bacteria that " crlf
"    produces a specific type of toxin. It produces a vcharacteristic red, rough rash, usuall y on " crlf
"    the neck and chest. " crlf
"    Causes of scarlet fever" crlf
"    
" crlf
crlf
"    Scarlet fever is by a strain of streptococcus, a microorganism. The bacteria usually develop in " crlf
"    the throat or tonsils. They produce a specific type of toxin, called erythrogenic toxin. The toxin " crlf
"    leads to the development of a bright red, rough skin rash and red, swollen tongue. " crlf
crlf
"    treatment of scarlet fever" crlf
"    
" crlf
crlf
"    consult a dermatologist , can be treated with antibiotics" crlf
"    Enter any key then press Enter to continue ... please " crlf
crlf
  (bind ?response (read))
  (assert (start)) )

(defrule infections
  (?p <- (type 0-3)) =>
  (printout t crlf crlf crlf)
  (retract ?p)
  (printout t
    "    Diagnosis of some skin diseases" crlf
    "    Skin infections" crlf
    "    Insect bites or sting red, painful lump painful ulcer " crlf
    "    nausea and vomiting fever local numbness and tingling " crlf
    "    Depending on your answers and my good experience, you have Insect Bites And Stings disease "
  ))
The symptoms of insect bites and stings result from the injection of material into the host. This material can include toxins, or may be proteins or other materials capable of initiating an allergic reaction in the host. Most bites result in local symptoms only.

Causes of Insect Bites and Stings

Causes are due to bites or stings from mosquitoes, fleas, chiggers, bed-bugs, ants, spiders, bees, scorpions and other insects. The may release of venom or toxin into the skin. They may release compounds which produce an allergic reaction.

Treatment of Insect Bites and Stings

Consult a dermatologist, treatment depends on insect.

Diagnosis of some skin diseases

Skin infections

Most common in children and young adults firm round lump with rough surface dotted with tiny, black spots lumps grow in groups usually occur on hands.

Depending on your answers and my good experience, you have Warts disease.

Warts are non cancerous, contagious, tumors caused by a virus in the outer skin layer. They occur most often on the fingers, hands and arms, but can occur anywhere. They are most common in children and young adults between ages 1 and 30.

Causes of Warts

Warts are caused by an invasion of the outer skin layer, the epidermis, by the papilloma virus. This virus stimulates cells to grow more rapidly. By adulthood, 90% of all people have had at least one wart infection.

Treatment of Warts

Consult a dermatologist, treatment based on the age of the individual.

Enter any key then press Enter to continue... please

References