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A Ruled Based System for Ear Problem Diagnosis and Treatment

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Abstract

The ear is one of the most important senses of living creatures, whether they are sea or land, where it is the sound sensor in what is known hearing. The ear is divided into two parts, the outer part, the visible and which can be seen. The second part is the internal one which is responsible for processing and treatment of the initial sound. The location of the ear differs from one organism to another.

The ear is a sensory living organism which enables hearing. The human (man) communicates with each other through speech, and such thing depends mainly on hearing. Hearing is a complicated process where everything is moving creates sound waves, and then such wave enter to the ear which is converted to nerve signals to the brain, which in turn the brain translates these signals into what we hear from the voice.

The ear has another function is to maintain the balance. It includes organisms that give the brain information on any change in the head position who shall send neurological messages to various muscles to keep the head and body balanced in all modes and movements of the human being.

Keywords: Expert Systems, SL5 Object, Ear problem Diagnosis

Introduction

Ear pain is mainly a common condition, in children. Ear pain may stem from inflammation of the ear or from various organisms and parts, or it may be painful caused by other part. In general such pain may be as a result of the pharynx or thyroid (Thyroid gland)[3]. Although the diagnosis of acute ear pain is easy, but the chronic ear pain will be hard for diagnosis and a challenge for the physician. Ear pain may stem from a number of problems in various parts of ear. Mostly the ear pains result from inflammation of the external ear (pinna), or inflammation of the middle ear. The severe ear pains without results in the examination of the ear by a self-endoscopy device (auto scope) - can be caused by contamination of the herpes virus. In the case of contamination with the herpes virus we can see small blisters (Blister) on the external ear canal. The continuous ear pain with purulent secretions from the ear may indicate to osteomyelitis (osteomyelitis) of the bones of the skull base, or even the process of the development of a malignant tumor (cancer) in the bone. It is important to note that there are many reasons for the pain of the ears which are not related to the ear itself [3].

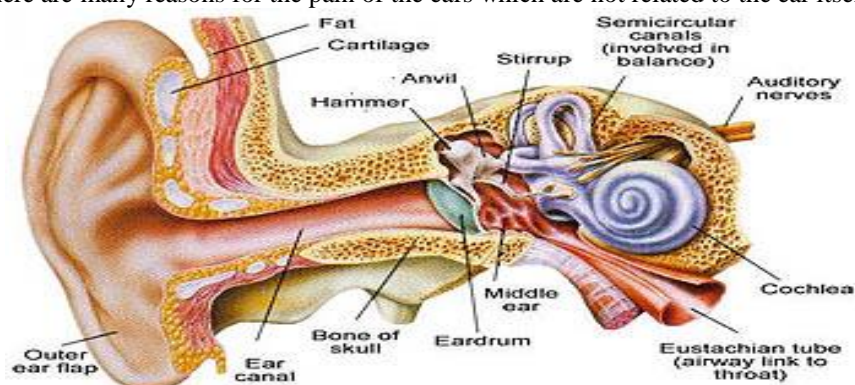


Fig. 1⁽¹⁰⁾

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Rule Bases Systems: is a computer Application of Artificial Intelligence (AI) [2, 4, 6]; which contains a knowledge base and an inference engine [3]; as seen in figure 2.

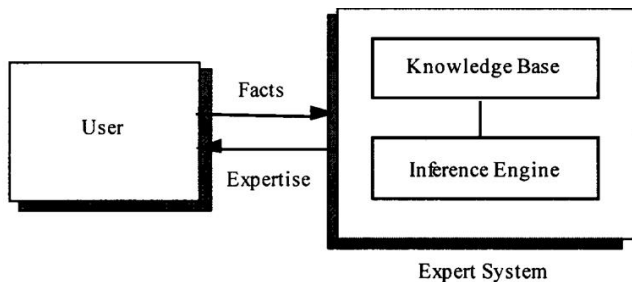


Fig. 2: Main Components of an Ruled Based System

The proposed Ruled Based System for Ear Problem Diagnosis was implemented using, SL5 Object language. It is a forward reasoning expert system language that can make inferences from the knowledge base stored. The some advantages of SL5 expert system language are: easy to use, its rule syntax is English like IF-Condition-Then statements ELSE statements, supports facts and Object Oriented[1].

Related Work

There are a lot of expert systems, which are designed to diagnose diseases like skin, eye, neck, male Infertility and

foot [5-9,13-17], but none is of them specializes in ear problems; MYCIN is a well-known expert system for diagnosing Bacterial infections [6]. This ruled based system is specialized in the diagnosis of some ear infections, inflammation of the middle ear and auditory canal and ear Otitis Externa.

Materials and Methods

In this ruled based system ear problems were divided into three main categories[3]:

- 1- External ear problems
- 2- Middle ear problems
- 3- Inflammation of the inner ear

The proposed ruled based system is a TRUE/FALSE questions, as seen in fig. 3 and fig. 5, for the patient and the response should be True or False, where there is a logical sequence of questions inquiring about the symptoms to be diagnosed with the disease and give instructions that help the patient to act. Fig. 4 Shows the final conclusion of the ruled based system that consists of diagnosis of the problem and a recommendation for the treatment of the problem.

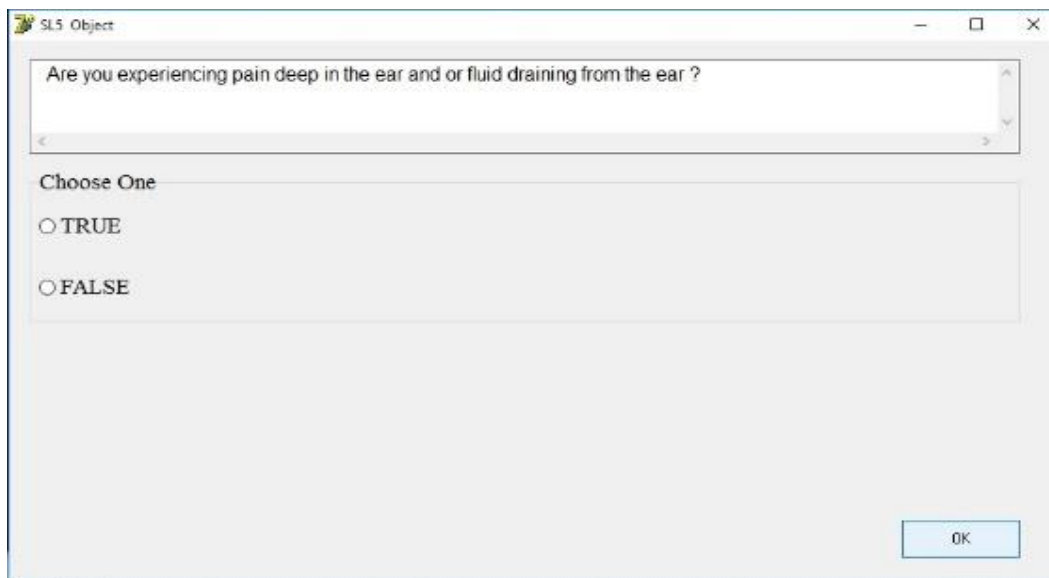


Fig. 3: Frame questions page

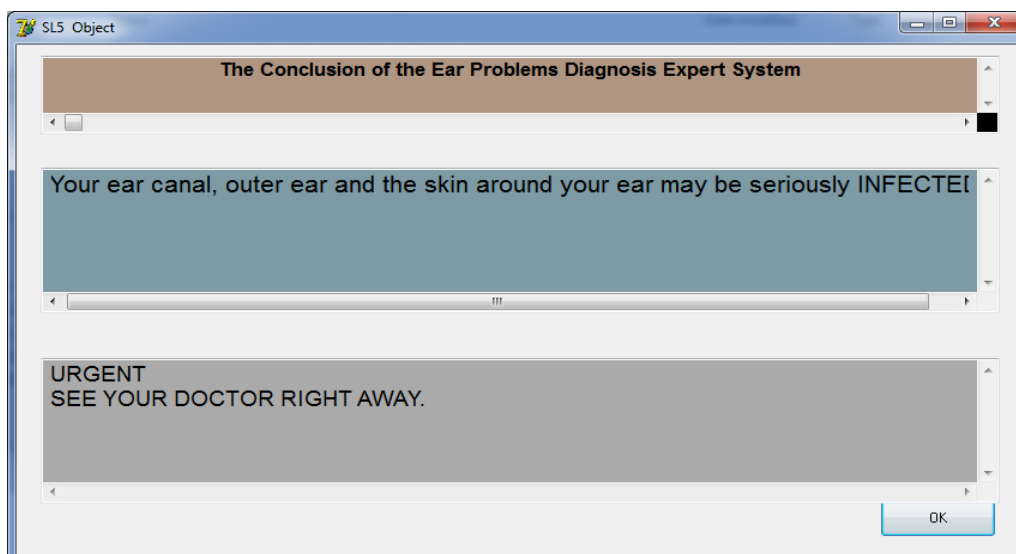


Fig 4: Conclusion of the Ruled Based System



Fig. 5: Decision tree of the expert system

Knowledge Representation

The main sources of the knowledge for this ruled based system for problems of the ear and hearing diagnosis is specializes websites the problems of the ear. The solicited knowledge have been converted into SL5 Object knowledge base syntax (facts, rules and objects)[1]. Currently the ruled based system has 12 rules which cover

some of the ear and hearing problems that the expert system can help the user with[3]:

Otitis media is inflammation of the mucous membrane that lines the middle ear inflammation that usually occurs with upper respiratory tract infection(see fig. 6).

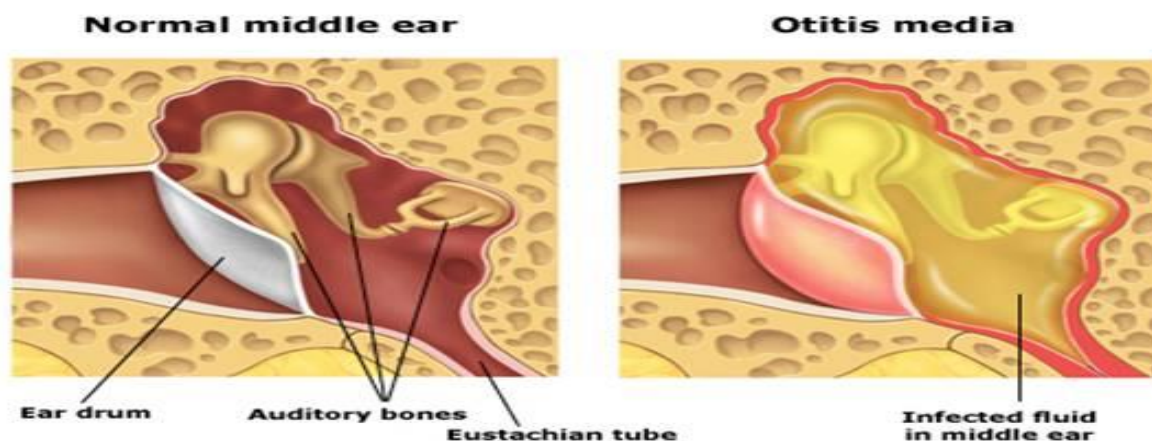
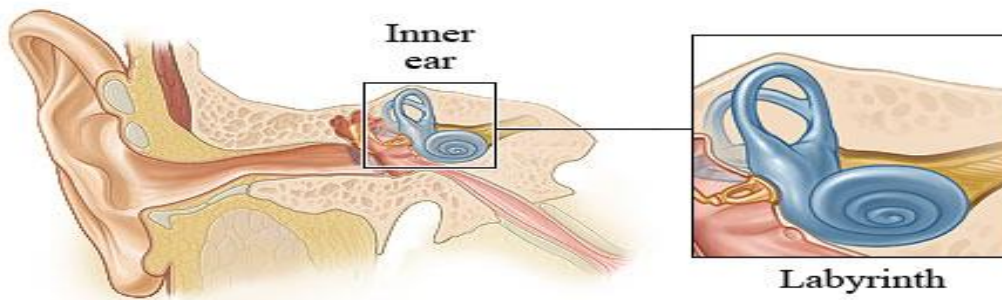


Fig. 6: Otitis Media⁽¹¹⁾

4.2 Inflammation of the inner ear

Such thing occur after the arrival of the bacteria through the blood stream, or directly from a neighbor of the middle ear, and these infections affect all ages, and affect men and women. The relationship of the inner ear balance and

hearing functions are influenced by different degrees of the type and severity of the inflammation. The inner ear infections cause a group of symptoms, including: sudden dizziness, hearing loss, upset the balance and Buzz(as shown in Fig. 7).



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Fig. 7: Inner ear⁽¹²⁾

Otitis Externa is an inflammation of the external ear and ear canal, and it is sometimes called (swimmers ear). There are different causes of the external ear infection, may be

because of bacteria or fungi or mostly from dermatitis skin(as shown in Fig. 8).

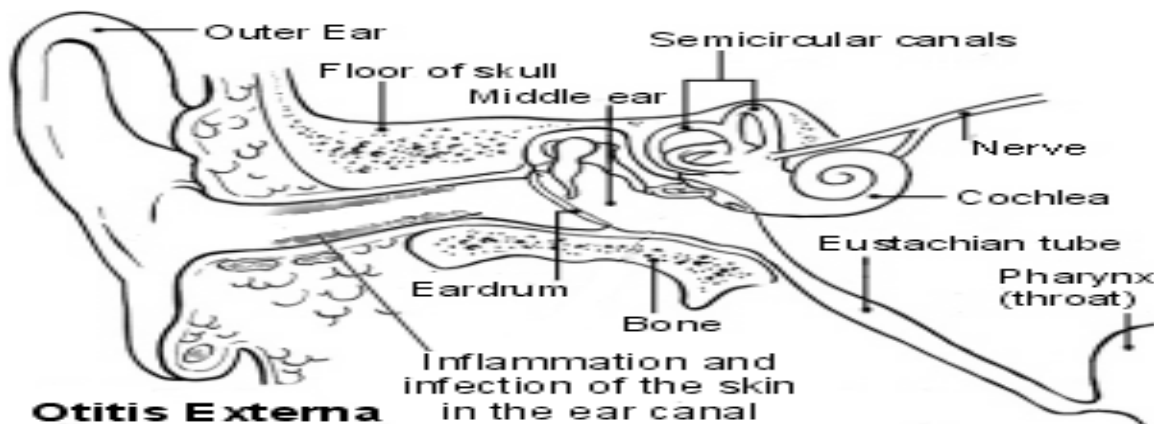


Fig. 8: Otitis Externa⁽¹³⁾

Conclusion

The paper presents a proposed a rule based system to help in diagnosing ear and hearing problems for patients who suffer from hearing problems, where he/she can get a diagnosis and give a recommendation for the treatment faster and more accurate diagnoses than normal diagnosis. This rule based system does not require extensive training to be ready for use, where it is easy and simple to be used and it has been developed using SL5 Object language.

Future Work

This rule based system can be developed by adopting future plan. It can be also modified and developed to be more accurate in diagnosing the problems of ear and make it more flexible in using while treating and dealing with patients.

These tips for ear protection:-

- Use ear plugs to avoid high noise.
- Stop listening to high-volume music.
- Take a break from the loud speakers so as to give an opportunity for the ear to take rest.
- Listening to music in a confined space increases the risk of hearing damage.
- According to Research done in UK, you need not less than 16 hours of rest for your ears to recover to normal position, after listening to about two hours to the sound of 100 dB strong.

Expert System Source Code:

- ATTRIBUTE start SIMPLE
- ATTRIBUTE Do you have a fever SIMPLE
- ATTRIBUTE Are you experiencing pain deep in the ear and or fluid draining from the ear SIMPLE
- ATTRIBUTE Do you have redness and swelling of the outer ear and the surrounding skin SIMPLE
- ATTRIBUTE Do you have a headache type pain and redness behind your ear or tenderness when you touch the bone behind SIMPLE
- ATTRIBUTE Do you have thick pus filled or bloody drainage from the ear canal that started after a sharp sudden pain SIMPLE
- ATTRIBUTE Is your ear swollen and does it itch or hurt when you pull on your ear or earlobe SIMPLE
- ATTRIBUTE Does your jaw joint crack when you chew or open your mouth or do you feel tenderness in your jaw SIMPLE
- ATTRIBUTE Do you hear fluid in your ear and feel pressure or stuffiness that cant be cleared with coughing yawning SIMPLE
- ATTRIBUTE Do you have tooth pain on the same side as the ear pain when you bite down SIMPLE
- ATTRIBUTE Did your ear pain start during an airplane flight or right after you traveled on an airplane SIMPLE
- ATTRIBUTE Can you see or feel a pimple in the ear canal SIMPLE
- ATTRIBUTE Is the affected person a child who doesn't

have ear pain or redness but is having problems hearing
SIMPLE

INSTANCE the domain ISA domain
WITH start := TRUE

INSTANCE the application ISA application
WITH title display := introduction
WITH conclusion display := Conc
WITH numeric precision := 8
WITH simple query text " =:
?*" is
" *
WITH numeric query text := "What is the value of:
*
of
"*

INSTANCE introduction ISA display
WITH wait := TRUE
WITH delay changes := FALSE
WITH items [1] := textbox 1

INSTANCE textbox 1 ISA textbox
WITH location := 10,10,800,350
WITH pen color := 0,0,0
WITH fill color := 100,200,100
WITH justify IS left
WITH font := "Arial "
WITH font style IS bold
WITH font size := 14
WITH text " =:
Ear Problems Diagnosis Expert System

Written By Mohammed Nakhil ,DI:2015017

This Expert System diagnoses Ear Problems through a dialogue between the System and the End User .

The Conclusion of the finding is displayed and an Advise is given for the End User to solve the problem ".

INSTANCE Conc ISA display
WITH wait := TRUE
WITH delay changes := FALSE
WITH items [1] := title textbox
WITH items [2] := problem textbox
WITH items [3] := advise textbox

INSTANCE title textbox ISA textbox
WITH location := 20,10,800,70
WITH pen color := 0,0,0
WITH fill color := 175,150,130
WITH justify IS center
WITH font := "Arial "
WITH font style IS bold
WITH font size := 13
WITH text := " The Conclusion of the Ear Problems Diagnosis Expert System "

INSTANCE problem textbox ISA textbox
WITH location := 20,110,800,130

WITH pen color := 0,0,0
WITH fill color := 125,154,165
WITH justify IS left
WITH font := "Arial "
WITH font size := 16
WITH text := " "

INSTANCE advise textbox ISA textbox
WITH location := 20,280,800,130
WITH pen color := 0,0,0
WITH fill color := 170,170,170
WITH justify IS left
WITH font := "Arial "
WITH font size := 14
WITH text:= " "

RULE R0
IF start
THEN ASK Do you have a fever

RULE R1
IF Do you have a fever
THEN ASK Are you experiencing pain deep in the ear and or fluid draining from the ear
ELSE ASK Do you have thick pus filled or bloody drainage from the ear canal that started after a sharp sudden pain

RULE R2
IF Are you experiencing pain deep in the ear and or fluid draining from the ear
THEN text OF problem textbox := "You may have OTITIS MEDIA, an infection of the middle ear "
AND text OF advise textbox := "See your doctor. Many ear infections will safely clear up on their own, but others require antibiotics " .
AND exit OF the application := TRUE
ELSE ASK Do you have redness and swelling of the outer ear and the surrounding skin

RULE R3
IF Do you have redness and swelling of the outer ear and the surrounding skin
THEN text OF problem textbox := "Your ear canal, outer ear and the skin around your ear may be seriously INFECTED " .
AND text OF advise textbox := "URGENT SEE YOUR DOCTOR RIGHT AWAY " .
AND exit OF the application := TRUE
ELSE ASK Do you have a headache type pain and redness behind your ear or tenderness when you touch the bone behind

RULE R4
IF Do you have a headache type pain and redness behind your ear or tenderness when you touch the bone behind
THEN text OF problem textbox := "Your pain may be from MASTOIDITIS, an infection of the bone behind the ear, or from an ENLARGED LYMPH NODE " .
AND text OF advise textbox := "URGENT SEE YOUR DOCTOR RIGHT AWAY " .
AND exit OF the application := TRUE
ELSE ASK Do you have redness and swelling of the outer ear and the surrounding skin

RULE R5

IF Do you have thick pus filled or bloody drainage from the ear canal that started after a sharp sudden pain
THEN text OF problem textbox := "You may have a RUPTURED EAR DRUM".
AND text OF advise textbox := "See your doctor. Avoid infection by keeping your ear dry while it's healing. Putting a warm heating pad on your ear may help relieve the pain".
AND exit OF the application := TRUE
ELSE ASK Is your ear swollen and does it itch or hurt when you pull on your ear or earlobe

RULE R6

IF Is your ear swollen and does it itch or hurt when you pull on your ear or earlobe
THEN text OF problem textbox := "Your pain may be caused by OTITIS EXTERNA, an infection of the ear canal that is also called swimmer's ear".
AND text OF advise textbox := "See your doctor. Keep your ear dry while it's healing. Putting a warm heating pad over your ear may help relieve the pain".
AND exit OF the application := TRUE
ELSE ASK Does your jaw joint crack when you chew or open your mouth or do you feel tenderness in your jaw

RULE R7

IF Does your jaw joint crack when you chew or open your mouth or do you feel tenderness in your jaw
THEN text OF problem textbox := "TEMPOROMANDIBULAR JOINT (TMJ) SYNDROME, a disorder that affects the jaw joint, may be the source of your pain".
AND text OF advise textbox := "Try an anti-inflammatory medicine. Try massaging the sore muscles around your jaw moist heat or cold packs may also help relieve the pain".
AND exit OF the application := TRUE
ELSE ASK Do you hear fluid in your ear and feel pressure or stuffiness that cant be cleared with coughing yawning

RULE R8

IF Do you hear fluid in your ear and feel pressure or stuffiness that cant be cleared with coughing yawning
THEN text OF problem textbox := "Your ear discomfort may be caused by a BLOCKED EUSTACHIAN TUBE . Colds and the flu often lead to this condition".
AND text OF advise textbox := "Try an over-the-counter decongestant medicine for a few days .Putting a warm heating pad on your ear may help relieve the pain".
AND exit OF the application := TRUE
ELSE ASK Do you have tooth pain on the same side as the ear pain when you bite down

RULE R9

IF Do you have tooth pain on the same side as the ear pain when you bite down
THEN text OF problem textbox := "A tooth problem can radiate pain to the ear on the same side".
AND text OF advise textbox := "Try a mild over-the-counter pain reliever, and see your dentist".
AND exit OF the application := TRUE
ELSE ASK Did your ear pain start during an airplane flight or right after you traveled on an airplane

RULE R10

IF Did your ear pain start during an airplane flight or right after you traveled on an airplane
THEN text OF problem textbox := "You may have BAROTRAUMA, also called airplane ear ,which is caused by changes in altitude and air pressure".
AND text OF advise textbox := "If your symptoms don't improve in a few hours or if the pain is severe, see your doctor".
AND exit OF the application := TRUE
ELSE ASK Can you see or feel a pimple in the ear canal

RULE R11

IF Can you see or feel a pimple in the ear canal
THEN text OF problem textbox := "A small INFECTION in the ear canal may be the cause".
AND text OF advise textbox := "The infection will probably go away by itself in 2 to 5 days .A mild pain reliever and warm compresses may help relieve the pain".
AND exit OF the application := TRUE
ELSE ASK Is the affected person a child who doesn't have ear pain or redness but is having problems hearing

RULE R12

IF Is the affected person a child who doesn't have ear pain or redness but is having problems hearing
THEN text OF problem textbox := "This may be caused by a buildup of fluid SEROUS OTITIS or a buildup of wax in the ear canal CERUMINOSIS".
AND text OF advise textbox := "Talk to your doctor. He or she can tell you how to treat the wax or fluid buildup".
AND exit OF the application := TRUE
ELSE text OF problem textbox := "For more information, please talk to your doctor .
If you think your problem is serious, call your doctor right away".
AND text OF advise textbox := ""
END

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