Throat Problems Expert System Using SL5

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Abstract: Background: the throat is a tube that carries food to your esophagus and air to your windpipe and larynx. The technical name for the throat is the pharynx. Throat problems are common. You've probably had a sore throat. The cause is usually a viral infection, but other causes include allergies, infection with strep bacteria or the leaking of stomach acids back up into the esophagus, called GERD**. Other problems that affect the throat include**: Tonsillitis inflammation of the tonsils, Cancer, Croup inflammation: usually in small children, which causes a barking cough, Laryngitis: swelling of the voice box, which can cause a hoarse voice or loss of voice[1]. Most throat problems are minor and go away on their own. Treatments, when needed, depend on the problem. ***Objectives:*** The main goal of this paper is to get the appropriate diagnosis of disease and the correct treatment by presenting suggestions on Throat disease to the user by asking about symptoms. ***Methods***: SL5 Object language were used as the main tools for designing our Knowledge based system.

Keywords: Artificial Intelligence, Knowledge Based, Expert Systems SL5 Object language, Throat problems

1- INTRODUCTION:

- **What is a sore throat?**
  Sore throats range from a mere scratch to pain so severe that even swallowing saliva hurts. They can be caused by heavy cigarette smoking and infections of the throat, tonsils, or nasal passages from a virus, fungus, or bacteria such as streptococcus, the one that causes strep throat[2] **.** The throat (pharynx) is a muscular tube that runs from the back of your nose down into your neck. It contains three sections: the nasopharynx, oropharynx and laryngopharynx, which is also called the hypopharynx. Figure 1 show The sections View of Internal Throat Structure[3].
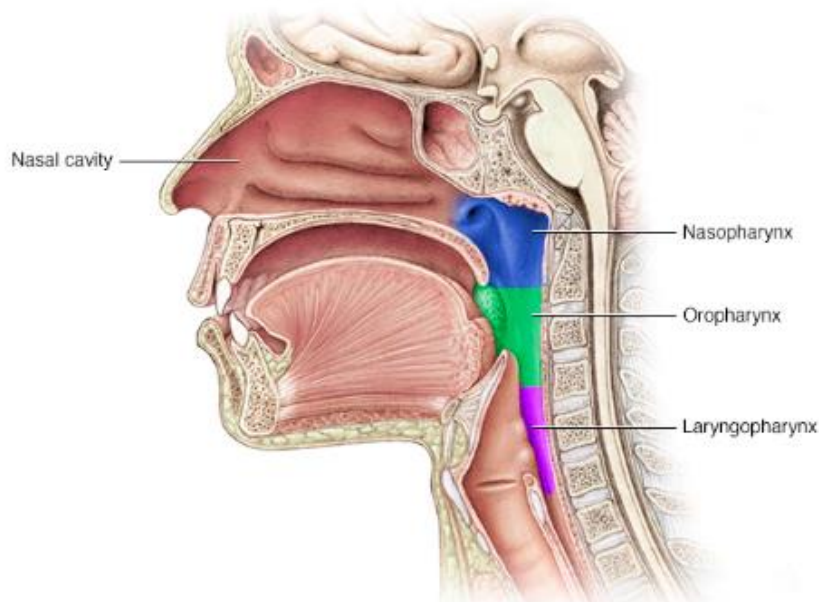

Figure 1: The sections View of Internal Throat Structure

- **What causes throat symptoms?**
  Throat symptoms may be caused by a wide array of conditions, including infectious diseases, allergies, and gastroesophageal reflux disease (GERD), in which stomach acid backs up into the esophagus. Certain types of head and neck cancers may also cause throat symptoms that include difficulty swallowing, sore throat, and the development of throat growths or sores. Infectious causes of throat symptoms Throat symptoms can be caused by a variety of infectious diseases including:

- Chickenpox
- Common cold (viral respiratory infection)
- Croup (viral illness)
- HIV
- Influenza (flu)
- Mononucleosis
- Pharyngitis (inflammation of the throat often caused by an infection)
- Strep throat (streptococcal bacteria infection characterized by a sore, red throat and occasionally white spots on the tonsils)
- Tonsillitis (inflammation of the tonsils often caused by an infection).

- **What are the signs of throat problems?**

Symptoms of the throat, or pharynx, include a variety of abnormal or unusual sensations or problems of the throat. Your throat is a tube that begins at the back of the mouth and transports air to your trachea (windpipe) and larynx (voice box). The throat also delivers food to the esophagus, which is connected to the stomach. In addition, the throat contains the epiglottis, which prevents the inhalation of food into the windpipe; and the hyoid bone, which serves as an anchor point for the tongue. Throat symptoms can vary greatly in character and severity depending on the underlying disease, disorder or condition. **Common throat symptoms include**:

- Change in voice, such as muffled or altered speech or hoarseness
- Dry throat
- Feelings of itchiness or tickling in the throat
- Persistent irritation
- Phlegm or mucus buildup due to postnasal drip, infection, or inflammation
- Sore throat
- Swallowing problems, such as difficulty swallowing (dysphagia) or painful swallowing (odynophagia)
- Swollen tonsils
- Throat lumps or growths
- Throat pain
- White patches on the tonsils and throa

Depending on the cause, throat symptoms can last briefly and disappear relatively quickly, such as when symptoms develop during the common cold. Throat symptoms can also recur over a longer period of time, such as when symptoms are caused by throat cancer.

While some throat symptoms are minor and may go away on their own over time, certain underlying causes of throat symptoms can be serious or life threatening. Seek immediate medical careif you, or someone you are with, are choking or have difficulty breathing; a change in alertness; or swelling of the throat, lips, mouth or face[4].

2. EXPERT SYSTEM:
- **What is an Expert System?**
  An expert system is a computer program that is designed to solve complex problems and to provide decision-making ability like a human expert. It performs this by extracting knowledge from its knowledge base using the reasoning and inference rules according to the user queries .The performance of an expert system is based on the expert's knowledge stored in its knowledge base. The more knowledge stored in the KB, the more that system improves its performance. One of the common examples of an ES is a suggestion of spelling errors while typing in the Google search box.**Below is the block diagram that represents the working of an expert system[5]:**
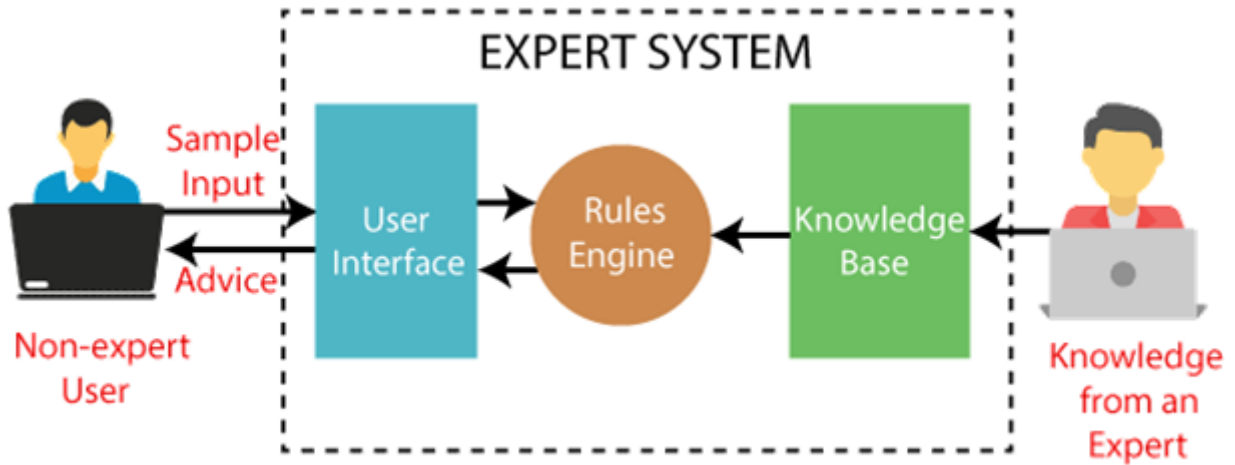
Figure 2: the block diagram that represents the working of an expert system

- **Components of Expert System**

An expert system mainly consists of three components:
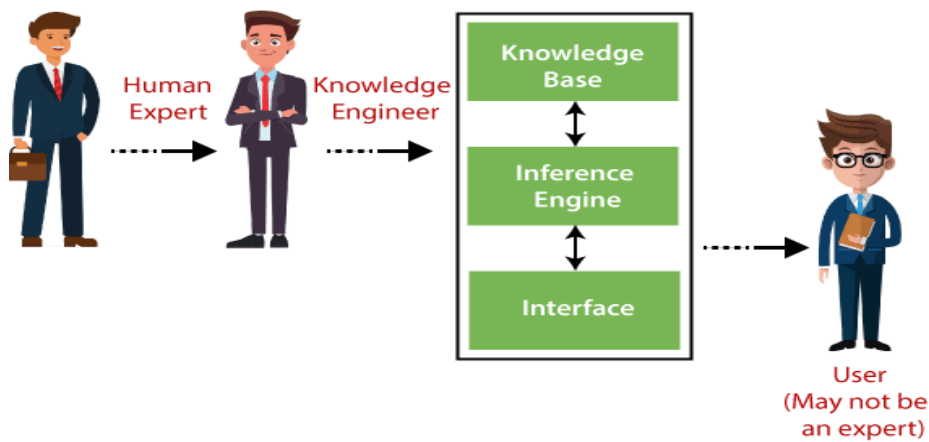 - User Interface
  - Inference Engine
  - Knowledge Base

Figure 3: Components of Expert System
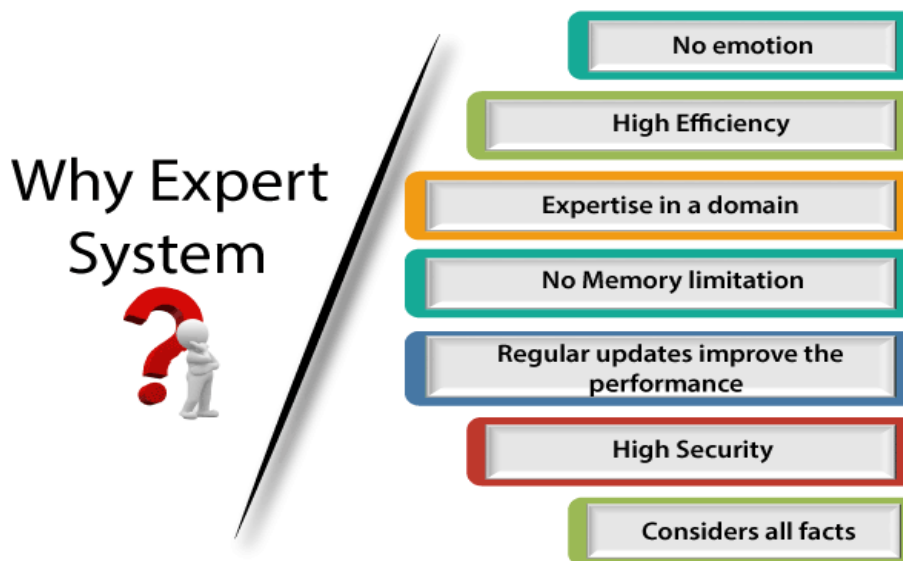
- **Why Expert System?**

Figure 4: Why Expert System

3. LITERATURE REVIEW

Despite the fact that, there are numerous expert systems that are produced for diagnosing plants diseases and human diseases[6-48] such as Problems of Teeth and Gums, Skin Diseases, Rickets and other types of Illness. But there is no expert system for diagnosing throat diseases available free of charge. The proposed expert system was planned and developed explicitly to help specialists in diagnosing throat problems.

4. MATERIALS AND METHODS

The proposed expert system performs diagnosis for nine throat diseases by presenting all symptoms. The proposed expert system will ask the user to choose the type of problem symptoms. At the end of the dialogue session, the proposed expert system provides diagnosis and recommendations for the user. Figure 5 shows the main interface of the system and the user system. Figure 6 shows symptoms disease, Figure 7 Obtain diagnosis and recommendation.
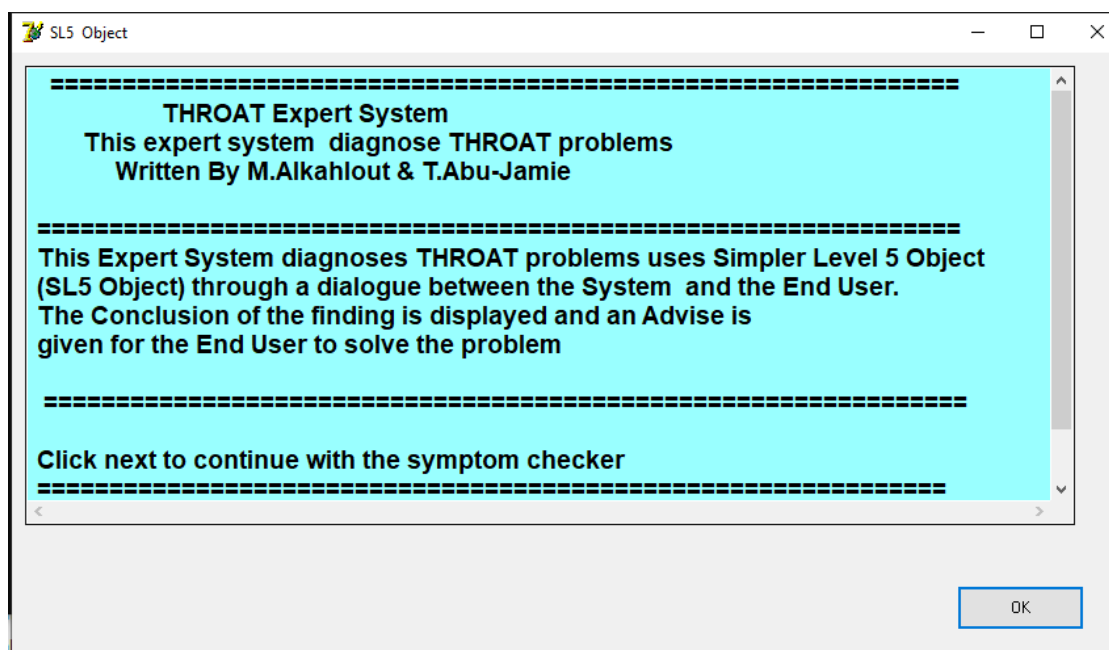

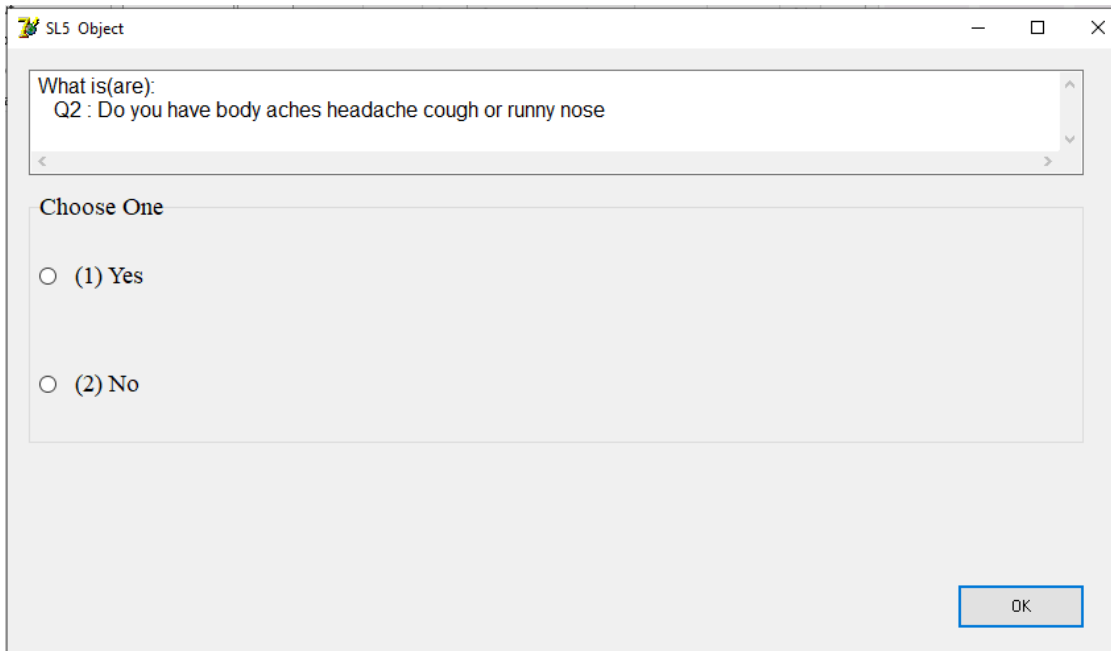*Figure 5: shows the main interface of the system*

Figure 6: shows symptoms disease
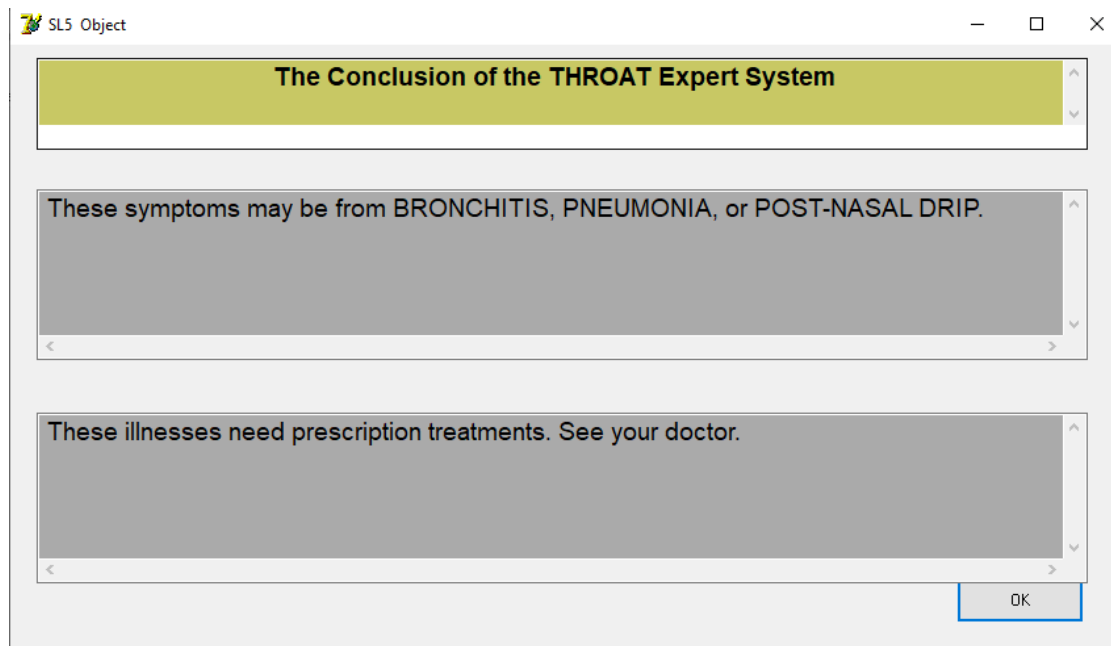
Figure 7: Obtain diagnosis and recommendation

5. KNOWLEDGE REPRESENTATION

- **What is knowledge representation?**

Humans are best at understanding, reasoning, and interpreting knowledge. Human knows things, which is knowledge and as per their knowledge they perform various actions in the real world. **But how machines do all these things comes under knowledge representation and reasoning**. Hence we can describe Knowledge representation as following:

- Knowledge representation and reasoning (KR, KRR) is the part of Artificial intelligence which concerned with AI agents thinking and how thinking contributes to intelligent behavior of agents.

- It is responsible for representing information about the real world so that a computer can understand and can utilize this knowledge to solve the complex real world problems such as diagnosis a medical condition or communicating with humans in natural language.
- It is also a way which describes how we can represent knowledge in artificial intelligence. Knowledge representation is not just storing data into some database, but it also enables an intelligent machine to learn from that knowledge and experiences so that it can behave intelligently like a human.

The proposed expert system will diagnose the ten throat problems by employing the knowledge obtained from a specialized site to the user in the form of a question and will be asked to answer, and through it the proposed expert system will provide the diagnosis and recommendations to the user Below is the list of Question system will diagnose the ten throat problems.

Table 1:list of Question

Q1:Do you have a fever?
Q2:Do you have body aches, headache, cough, or runny nose?
Q3:Are you vomiting or do you have nausea or diarrhea?
Q4:When you look at the back of your throat, do you see white patches on your tonsils?
Q5:Do you have a persistent cough or are you coughing mucus?
Q6:Is the person a child with a harsh barking cough?
Q7:Do you have small, open sores on your tongue, inside your lips, or on the sides or back of your mouth?
Q8:Is the skin in your mouth peeling, and are your tongue and gums swollen and red?
Q9:Do you have white patches and redness on your tongue or on the sides or back of your mouth?
Q10:Does your tongue look like the outside of strawberry?

The main source of the knowledge for this expert system is based on Family Doctor website. [59] The diagnosis is based on the Decision Trees shown in figure 8
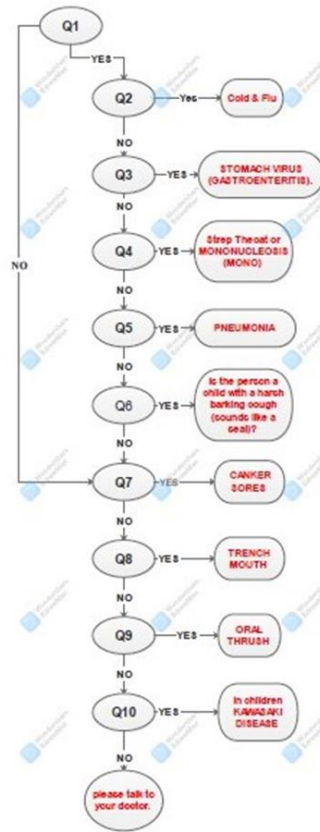
Figure 8: Decision Tree for Throat Diagnosis

In this present paper the problem of the throat diseases are implemented by methodology of rule based systems. One of the well-known methods of representation of knowledge in the expert systems is the productive representation as the sl5 (production system). Sl5 keep in memory a fact list, a rule list, and an agenda with activations of rules. Facts in Sl5 are simple expressions consisting of fields in parentheses. Groups of facts in sl5 , usually follow a fact-template, so that to be easy to organize them and thus design simple rules that apply to them. The proposed expert system contains sl5 rules.Below, we present the rules for throat problems.

! Written bu Mohammed Alkahlout
ATTRIBUTE Q1:Do you have a fever? COMPOUND Yes, No
ATTRIBUTE Q2:Do you have body aches headache cough or runny nose? COMPOUND Yes, No
ATTRIBUTE Q3:Are you vomiting or do you have nausea or diarrhea? COMPOUND Yes, No
ATTRIBUTE Q4:When you look at the back of your throat do you see white patches on your tonsils? COMPOUND Yes, No
ATTRIBUTE Q5:Do you have a persistent cough or are you coughing mucus? COMPOUND Yes, No
ATTRIBUTE Q6:Is the person a child with a harsh barking cough? COMPOUND Yes, No
ATTRIBUTE Q7:Do you have small open sores on your tongue inside your lips or on the sides or back of your mouth? COMPOUND Yes, No
ATTRIBUTE Q8:Is the skin in your mouth peeling and are your tongue and gums swollen and red? COMPOUND Yes, No
ATTRIBUTE Q9:Do you have white patches and redness on your tongue or on the sides or back of your mouth? COMPOUND Yes, No
ATTRIBUTE Q10:Does your tongue look like the outside of strawberry? COMPOUND Yes, No
ATTRIBUTE start SIMPLE
INSTANCE the domain ISA domain
  WITH start := TRUE
INSTANCE the application ISA application
 WITH title display := introduction
 WITH conclusion display := Conc
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 := 153,255,255
  WITH justify IS left
  WITH font := "Arial"
  WITH font style IS bold
  WITH font size := 14
  WITH text :="
 ==================================================================
          THROAT Expert System
    This expert system  diagnose THROAT problems
         Written By M.Alkahlout & T.Abu-Jamie
 ==================================================================
 This Expert System diagnoses THROAT problems uses Simpler Level 5 Object
 (SL5 Object) 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
 ==================================================================
 Click next to continue with the symptom checker
 ================================================================= "
 INSTANCE Conc ISA display
  WITH wait := TRUE
  WITH delay changes := FALSE
  WITH items [1] := title textbox
  WITH items [2 ] := Diagnosis textbox
  WITH items [3 ] := Recommend textbox
 INSTANCE title textbox ISA textbox
  WITH location := 20,10,800,70
  WITH pen color := 0,0,0
  WITH fill color := 200,200,100
  WITH justify IS center
  WITH font := "Arial"
  WITH font style IS bold
  WITH font size := 14
  WITH text := " The Conclusion of the THROAT Expert System"
 INSTANCE Diagnosis textbox ISA textbox
  WITH location := 20,110,800,130
  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 :=" --===--"

 INSTANCE Recommend 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 Q1:Do you have a fever?

 RULE Q1Yes
 IF Q1:Do you have a fever? IS Yes
```

THEN ASK Q2:Do you have body aches headache cough or runny nose?

RULE Q2Yes
IF Q2:Do you have body aches headache cough or runny nose? IS Yes
THEN text OF Diagnosis textbox := "You probably have a COLD or FLU."
AND text OF Recommend textbox := "Drink plenty of fluids and get plenty of rest. Children should be given non-aspirin medicine (acetaminophen and/or ibuprofen) for the fever.
Do not give cough/cold medications to children under 5 years. If the cold lasts longer than two to three days, see your doctor."

RULE Q2No
IF Q2:Do you have body aches headache cough or runny nose? IS No
THEN ASK Q3:Are you vomiting or do you have nausea or diarrhea?

RULE Q3Yes
IF Q3:Are you vomiting or do you have nausea or diarrhea? IS Yes
THEN text OF Diagnosis textbox := "You may have a STOMACH VIRUS (GASTROENTERITIS)."
AND text OF Recommend textbox := "Drink plenty of water and get plenty of rest. Use an anti-nausea and/or antidiarrheal medicine.
See your doctor if symptoms get worse, if they last longer than a week

RULE Q3No
IF Q3:Are you vomiting or do you have nausea or diarrhea? IS No
THEN ASK Q4:When you look at the back of your throat do you see white patches on your tonsils?

RULE Q4Yes
IF Q4:When you look at the back of your throat do you see white patches on your tonsils? IS Yes
THEN text OF Diagnosis textbox := "You may have STREP THROAT or MONONUCLEOSIS (MONO)."
AND text OF Recommend textbox := "See your doctor."

RULE Q4no
IF Q4:When you look at the back of your throat do you see white patches on your tonsils? IS No
THEN ASK Q5:Do you have a persistent cough or are you coughing mucus?

RULE Q5Yes
IF Q5:Do you have a persistent cough or are you coughing mucus? IS Yes
THEN text OF Diagnosis textbox := "These symptoms may be from BRONCHITIS, PNEUMONIA, or POST-NASAL DRIP."
AND text OF Recommend textbox := "These illnesses need prescription treatments. See your doctor."

RULE Q5no
IF Q5:Do you have a persistent cough or are you coughing mucus? IS No
THEN ASK Q6:Is the person a child with a harsh barking cough?

RULE Q6Yes
IF Q6:Is the person a child with a harsh barking cough? IS Yes
THEN text OF Diagnosis textbox := "Is the person a child with a harsh barking cough (sounds like a seal)?."
AND text OF Recommend textbox := "A dry barking cough often means a viral infection called CROUP or, less commonly, EPIGLOTTITIS, which is an emergency."

RULE Q6noQ1no
IF Q6:Is the person a child with a harsh barking cough? IS No
OR Q1:Do you have a fever? IS No
THEN ASK Q7:Do you have small open sores on your tongue inside your lips or on the sides or back of your mouth?

RULE Q7Yes
IF Q7:Do you have small open sores on your tongue inside your lips or on the sides or back of your mouth? IS Yes
THEN text OF Diagnosis textbox := "These sores are called CANKER SORES or APHTHOUS ULCERS. They usually occur by themselves or potentially with stress or other viral illnesses."
AND text OF Recommend textbox := "Most of these sores will heal in 7 to 14 days. Use an anesthetic spray or an analgesic medicine. If the sores are severe,last longer than expected"

RULE Q7no
IF Q7:Do you have small open sores on your tongue inside your lips or on the sides or back of your mouth? IS No
THEN ASK Q8:Is the skin in your mouth peeling and are your tongue and gums swollen and red?

RULE Q8Yes
IF Q8:Is the skin in your mouth peeling and are your tongue and gums swollen and red? IS Yes
THEN   text OF Diagnosis textbox:= "This may be from TRENCH MOUTH, an infection of the gums, teeth, and other tissues. A rare drug
reaction, STEVENS-JOHNSON REACTION, may also cause this."
AND text OF Recommend textbox:= "See your dentist or doctor. Poor dental hygiene may lead to this disease. Brush your teeth and floss as recommended
by your dentist. Use over-the-counter pain "

RULE Q8no
IF Q8:Is the skin in your mouth peeling and are your tongue and gums swollen and red? IS No
THEN ASK Q9:Do you have white patches and redness on your tongue or on the sides or back of your mouth?

RULE Q9Yes
IF Q9:Do you have white patches and redness on your tongue or on the sides or back of your mouth? IS Yes
THEN text OF Diagnosis textbox := "You may have ORAL THRUSH, a yeast infection in your mouth."
AND text OF Recommend textbox := "This may be a simple infection, or it may come from another, more serious illness.
You may be able to control the infection by eating unsweetened yogurt (with live "

RULE Q9no
IF Q9:Do you have white patches and redness on your tongue or on the sides or back of your mouth? IS No
THEN ASK Q10:Does your tongue look like the outside of strawberry?

RULE Q10yes
IF Q10:Does your tongue look like the outside of strawberry? IS Yes
THEN text OF Diagnosis textbox := "In children, this can be KAWASAKI DISEASE, a condition that can also affect their heart. "
AND text OF Recommend textbox := "See your doctor immediately or take your child to the closest emergency room or call an ambulance. "

RULE Q10no
IF Q10:Does your tongue look like the outside of strawberry? IS No
THEN   text OF Diagnosis textbox := "Unknown"
AND text OF Recommend textbox :="For more information, please talk to your doctor. If you think your problem is serious, call your doctor right away. "
END

6. FUNCTION OF THE SYSTEM
The proposed system performs many functions. It will conclude the throat problems diagnosis based on answers of the user to specific question that the system asks the user. The questions provide the system for explanation for the symptoms of the patient that helps the expert system for diagnosis the disease by inference engine. It stores the facts and the conclusion of the inference of the system, and the user, for each case, in data base. It processes the data base in order to extract rules, which complete the knowledge base.

7. LIMITATIONS
The current proposed expert system is specialized in the diagnosis only the following nine throat diseases: COLD or FLU, GASTROENTERITIS, STREP THROATBRONCHITIS, PNEUMONIA, A dry barking cough, BACTERIAL DIARRHEA, TRENCH MOUTH, ORAL THRUSH.

8. CONCLUSION
The application of expert systems in medicine is very interesting and has created considerable importance systems of diagnosis. The proposed system can help doctors and patients in providing decision support system, interactive training tool and expert advice. The system constitutes part of intelligent system of diagnosis of throat problems. This expert system does not need intensive training to be used; it is easy to use and has user friendly interface. It was developed using sl5 Expert System language. An initial evaluation of the expert system was carried out and a positive feedback was received from the users. As future work we will constitute the expert system to cover all throat problems.

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