Problems of Teeth and Gums Expert System

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Abstract: Our gums (gingiva) act as a significant barricade in guarding our teeth and their neighboring support structures. A tiny known fact is that gum disease is the foremost cause of tooth loss in grown persons. Healthy, strong, teeth are reliant on on healthy gums. The core culprit for gum problems is bacteria in dental plaque. The bacteria in plaque yield harmful toxins that generate an inflammatory process that happens in the gum tissue. If left for a sufficient period of time, bacterial plaque causes hurt to our teeth as well as our gums. In this paper, we present a knowledge based system that help people with teeth and gums problems to diagnose their problems and get recommendation for the treatment. This expert system was designed and implemented using SL5 Object language for knowledge based system.

Keywords: Artificial Intelligence, knowledge based system, SL5 Object.

1. INTRODUCTION

The most common gum problem is gingivitis. Gingivitis is defined as inflammation of the gums. Signs of gum inflammation include bleeding during tooth-brushing, swollen-looking gums, and red gums. Healthy gums generally appear firm, coral-pink, and do not bleed with stimulation. Gums can appear dark from pigmentation in certain ethnic populations, and this is considered normal.

The second most common gum problem is gum disease, also called "periodontitis. Periodontitis exhibits similar signs to gingivitis except it also can result in gum tissue and jawbone loss. The damage of periodontitis is particularly concerning in that the loss of gum tissue and bone loss cannot be recovered. Periodontitis typically progresses over time and may not produce painful symptoms until the disease reaches the later stages of damage. Unfortunately, this explains why gum disease is the leading cause of tooth loss[10,11].

A common adult gum problem is gum recession. Gum recession is when the root of the tooth becomes exposed as gum pulls away from its original attachment. This could be a result of gum disease as the jawbone surrounding the teeth is lost. Wherever jawbone is lost, gums will follow, and this exposes the root of the tooth. Exposed roots can be sensitive to temperature, are more prone to decay, and can present a cosmetic concern. Other causes for gum recession include teeth grinding, use of chewing tobacco, brushing too aggressively, hereditary weak gums, orthodontic treatment, or trauma.

Another gum problem is a gum abscess (or "periodontal abscess"). It presents as a blister or a bump in the gum that contains pus. It is caused by a bacterial infection that takes place in a deep gum pocket and causes pain and swelling.

A less common gum problem is oral cancer. Oral cancer can occur on all soft-tissue structures within the mouth. On the gums, it may appear as a red or white patch or a sore that does not heal [10].

2. KNOWLEGE BASED SYSTEM

In artificial intelligence (AI), a knowledge based system is a computer system that emulates the decision-making ability of a human expert.[1] Knowledge based system are designed to solve complex problems by reasoning about knowledge, represented mainly as if–then rules rather than through conventional procedural code.[2] The first knowledge based system were created in the 1970s and then proliferated in the 1980s [3]. Knowledge based system were among the first truly successful forms of artificial intelligence software [4-8].

A knowledge based system is divided into two subsystems: the inference engine and the knowledge base. The knowledge base represents facts, rules and objects. The inference engine applies the rules to the known facts to generate new facts. Inference engines can also include explanation and debugging subsystems [9].

3. ADVANTAGES OF KNOWLEGE BASED SYSTEM

The goal of knowledge-based systems is to make the critical information required for the system to work explicit rather than implicit.[31] In a traditional computer program the logic is embedded in code that can typically only be reviewed by an IT specialist. With a knowledge based system the goal was to specify the rules in a format that was intuitive and easily understood, reviewed, and

even edited by domain experts rather than IT experts. The benefits of this explicit knowledge representation were rapid development and ease of maintenance.

Ease of maintenance is the most obvious benefit. This was achieved in two ways. First, by removing the need to write conventional code, many of the normal problems that can be caused by even small changes to a system could be avoided with knowledge based system. Essentially, the logical flow of the program (at least at the highest level) was simply given for the system, simply invoke the inference engine. This also was a reason for the second benefit: rapid prototyping. With a knowledge based system shell it was possible to enter a few rules and have a prototype developed in days rather than the months or year typically associated with complex IT projects.

A claim for expert system shells that was often made was that they removed the need for trained programmers and that experts could develop systems themselves. In reality, this was seldom if ever true. While the rules for a knowledge based system were more comprehensible than typical computer code, they still had a formal syntax where a misplaced comma or other character could cause havoc as with any other computer language. Also, as knowledge based system moved from prototypes in the lab to deployment in the business world, issues of integration and maintenance became far more critical. Inevitably demands to integrate with, and take advantage of, large legacy databases and systems arose. To accomplish this, integration required the same skills as any other type of system [32].

4. KNOWLEDGE REPRESENTATION AND REASONING (KR)

KR is the field of artificial intelligence dedicated to representing information about the world in a form that a computer system can utilize to solve complex tasks such as diagnosing a medical condition or having a dialog in a natural language. Knowledge representation incorporates findings from psychology about how humans solve problems and represent knowledge in order to design formalisms that will make complex systems easier to design and build. Knowledge representation and reasoning also incorporates findings from logic to automate various kinds of reasoning, such as the application of rules or the relations of sets and subsets [1,3[.

Examples of knowledge representation formalisms include semantic nets, systems architecture, frames, rules, and ontologies. Examples of automated reasoning engines include inference engines, theorem proofers, and classifiers

Our knowledge based system uses SL5 Object language to represent the teeth and gums problems [12,45]. There are many questions described in the program, which are 13 questions answered by the patient B yes or no and through them lies the control of the quality of the disease and the quality of treatment.

5. GUMS PROBLEMS:

Black matter secretes acid substances that damage the gum tissue and cause swelling, redness and ease of blood bleeding. It is worth mentioning that gingivitis occurs without feeling any pain until the condition worsens and lead to late stages of tooth decay and fall The accumulation of plaque on the teeth without removing them daily leads to the formation of a more solid material called lime and cannot be removed by brush teeth and the only way to escape from these calcareous deposits is through special devices at the dentist It is worth mentioning that the accumulation of lime is usually near the gum hurts and causes The spacing of the gums from the teeth and then the tooth decay and fall [10-11].

Symptoms of Gums problems:

Breath or bad taste, inhalation of teeth and the emergence of some spaces between them Redness of the gums, swelling and ease of blood bleeding, especially when brushing teeth and sometimes when waking up from sleep The appearance of a white substance between teeth and gum called pus.
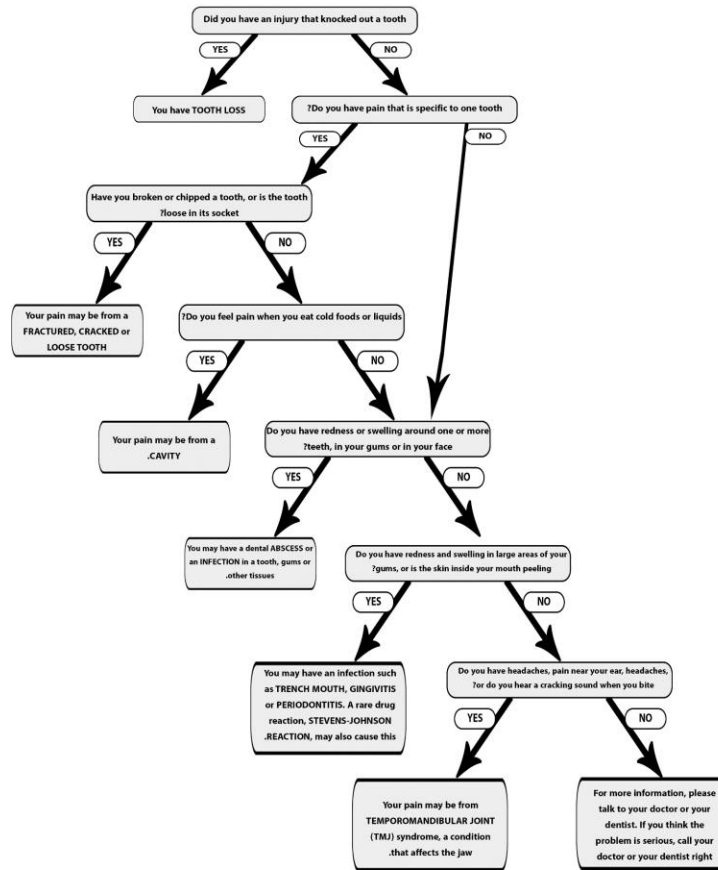
Figure 1: The figure presents the expert system for Tooth Problems.

6. LITERATURE REVIEW

Knowledge Based System (KBS) is software that follows the decision-making skill of a human expert. KBS is aimed to solve complicated problems by thinking about the knowledge which is represented mainly as if – Conditions – then rules rather than through conventional programming languages [12-30]. There are many Knowledge Based System designed to diagnose some diseases like: Ear, hearing, Endocrine, skin [33-44, 46-47]. However there is no special knowledge based system specializes in teeth and gum disease offered free. In this paper we designed and developed a new knowledge based system related to teeth and gum disease to help people diagnosing the disease related to teeth and gum pain they face.

7. MATERIALS AND METHODS

The suggested KBS is capable of diagnosing several teeth and gum diseases of different stages of the human life starting by asking the patient many questions based on their pain symptoms as in figure 3. This KBS gives the patient clear idea about the disease and the diagnosis of his/her pain. At the end, the proposed KBS provides recommendation of how to treat the disease. Figure 2 shows the main screen of the KBS Figure 3 shows a question type of Yes or No related with the disease and Figure 4 shows the diagnosis and recommendation about the disease.
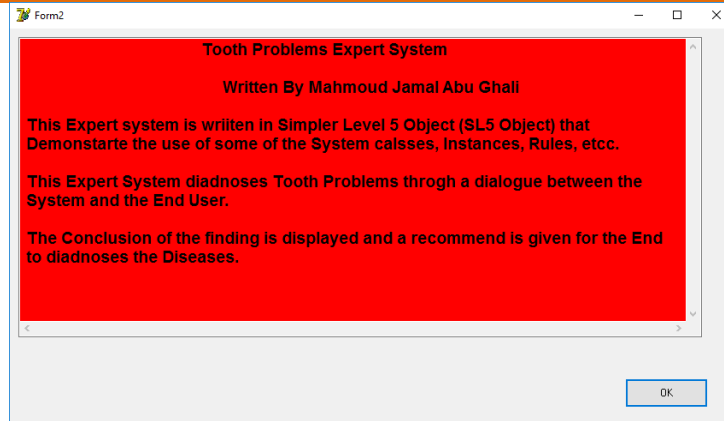
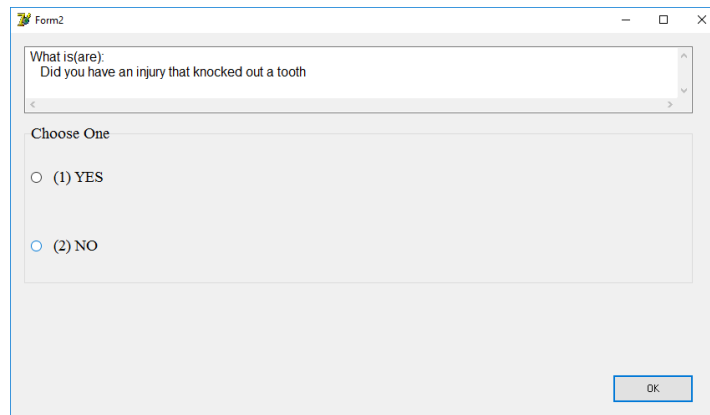**Figure 2:** The figure presents the screen expert system.

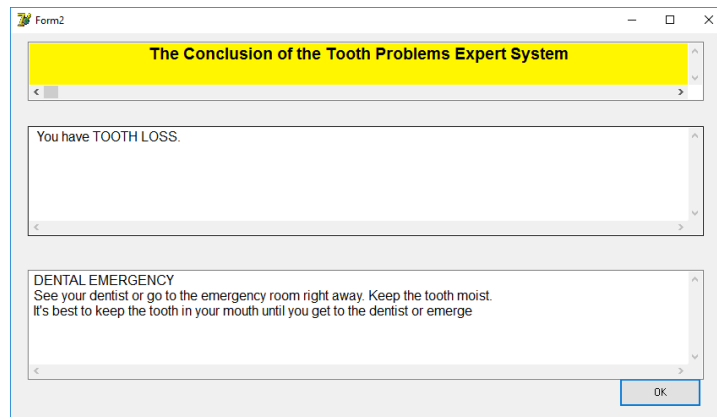**Figure 3:** The figure presents the male infertility diseases.

Figure 4: The figure presents the result.

8. SYSTEM EVALUATION

In this step a preliminary test was carried out by patients suffering from teeth and gum pain problems. All patients who tested this expert system were satisfied and very comfortable with it.

9. CONCLUSION

In this paper, a new knowledge based system was developed and presented for helping patients in diagnosing their teeth and gum pain problems. The expert system currently covers the several teeth and gum diseases. Patients can get the diagnosis faster than the

traditional way so they can save their time and effort. The system was developed using SL5 Object expert system language with an simple user interface to use so patients can use this system easily without any complication.

10. EXPERT SYSTEM SOURCE CODE

```
! This is a demo
! Written By Mahmoud Jamal
!
ATTRIBUTE Did you have an injury that knocked out a tooth? COMPOUND YES, NO
ATTRIBUTE Do you have pain that is specific to one tooth? COMPOUND YES, NO
ATTRIBUTE Have you broken or chipped a tooth or is the tooth loose in its socket? COMPOUND YES, NO
ATTRIBUTE Do you feel pain when you eat cold foods or liquids? COMPOUND YES, NO
ATTRIBUTE Do you have redness or swelling around one or more teeth in your gums or in your face? COMPOUND YES, NO
ATTRIBUTE Do you have redness and swelling in large areas of your gums or is the skin inside your mouth peeling?
COMPOUND YES, NO
ATTRIBUTE Do you have headaches pain near your ear headaches or do you hear a cracking sound when you bite? 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
  WITH simple query text := '
 *
is
 *'
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 := 255,0,0
  WITH justify IS left
  WITH font := "Arial"
  WITH font style IS bold
  WITH font size := 14
  WITH text :="
                    Tooth Problems Expert System

              Written By Mahmoud Jamal Abu Ghali And his Team


This Expert system is wriiten in Simpler Level 5 Object (SL5 Object) that
Demonstarte the use of some of the System calsses, Instances, Rules, etcc.


This Expert System diadnoses Tooth Problems throgh a dialogue between the
System and the End User.


The Conclusion of the finding is displayed and a recommend is given for the End User
to diadnoses the Diseases."
```

```
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 := 255,2550,0
  WITH justify IS center
  WITH font := "Arial"
  WITH font style IS bold
  WITH font size := 14
  WITH text := " The Conclusion of the Tooth Problems Expert System"

INSTANCE diagnosis textbox ISA textbox
  WITH location := 20,110,800,130
  WITH pen color := 0,0,0
  WITH fill color := 255,255,255
  WITH justify IS left
  WITH font := "Arial"
  WITH font size := 12
  WITH text :=" --===--"

INSTANCE recommend textbox ISA textbox
  WITH location := 20,280,800,130
  WITH pen color := 0,0,0
  WITH fill color := 255,255,255
  WITH justify IS left
  WITH font := "Arial"
  WITH font size := 12
  WITH text :=" --===--"

RULE R0
IF start
THEN ASK Did you have an injury that knocked out a tooth?

RULE R1
IF Did you have an injury that knocked out a tooth? IS YES
THEN  text OF diagnosis textbox := " You have TOOTH LOSS.  "
AND text OF recommend textbox := "DENTAL EMERGENCY
See your dentist or go to the emergency room right away. Keep the tooth moist.
It's best to keep the tooth in your mouth until you get to the dentist or emergency room. The tooth may be saved."

RULE R2
IF Did you have an injury that knocked out a tooth? IS NO
THEN ASK Do you have pain that is specific to one tooth?

RULE R3
IF Do you have pain that is specific to one tooth? IS YES
THEN ASK Have you broken or chipped a tooth or is the tooth loose in its socket?

RULE R4
IF Do you have pain that is specific to one tooth? IS NO
```

THEN ASK Do you have redness or swelling around one or more teeth in your gums or in your face?

RULE R5
IF Have you broken or chipped a tooth or is the tooth loose in its socket? IS YES
THEN text OF diagnosis textbox := " Your pain may be from a FRACTURED, CRACKED or LOOSE TOOTH."
AND text OF recommend textbox := "Save any pieces of the tooth, wrap them in a cool,
moist cloth and see your dentist as soon as possible. "

RULE R6
IF Have you broken or chipped a tooth or is the tooth loose in its socket? IS NO
THEN ASK Do you feel pain when you eat cold foods or liquids?

RULE R7
IF Do you feel pain when you eat cold foods or liquids? IS YES
THEN text OF diagnosis textbox := " Your pain may be from a CAVITY. "
AND text OF recommend textbox := "Make an appointment to see your dentist. Proper brushing and flossing
along with fluoride rinses and coatings, as suggested by your dentist, may prevent tooth decay. "

RULE R8
IF Do you feel pain when you eat cold foods or liquids? IS NO
THEN ASK Do you have redness or swelling around one or more teeth in your gums or in your face?

RULE R9
IF Do you have redness or swelling around one or more teeth in your gums or in your face? IS YES
THEN text OF diagnosis textbox := "You may have a dental ABSCESS or an INFECTION in a tooth gums or other tissues"
AND text OF recommend textbox := "URGENT See your dentist or doctor right away."

RULE R10
IF Do you have redness or swelling around one or more teeth in your gums or in your face? IS NO
THEN ASK Do you have redness and swelling in large areas of your gums or is the skin inside your mouth peeling?

RULE R11
IF Do you have redness and swelling in large areas of your gums or is the skin inside your mouth peeling? IS YES
THEN text OF diagnosis textbox := "You may have an infection such as TRENCH MOUTH, GINGIVITIS or PERIODONTITIS.
A rare drug reaction, STEVENS-JOHNSON REACTION, may also cause this."
AND text OF recommend textbox := "See your dentist or doctor right away. You may be given antibiotics to stop the
 infection. Over-the-counter pain relievers, such as acetaminophen, may relieve discomfort.
  Many of these infections can be prevented with proper dental care, such as brushing and flossing regularly."

RULE R12
IF Do you have redness and swelling in large areas of your gums or is the skin inside your mouth peeling? IS NO
THEN ASK Do you have headaches pain near your ear headaches or do you hear a cracking sound when you bite?

RULE R13
IF Do you have headaches pain near your ear headaches or do you hear a cracking sound when you bite? IS YES
THEN text OF diagnosis textbox := "Your pain may be from TEMPOROMANDIBULAR JOINT (TMJ) syndrome, a condition that affects
the jaw."
AND text OF recommend textbox := "Try relaxing your jaw when you are tense or nervous. Stop chewing gum. Try a mild
anti-inflammatory medicine, such as ibuprofen. If you don't get better, see your dentist."

RULE R14
IF Do you have headaches pain near your ear headaches or do you hear a cracking sound when you bite? IS NO
THEN text OF diagnosis textbox := "--- "
AND text OF recommend textbox := "For more information, please talk to your doctor or your dentist. If you think the
problem is serious, call your doctor or your dentist right away."

END

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