An Expert System for a Better Sleep using CLIPS

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Abstract: We sleep a third of our lives, and sleep is just as important as oxygen, water and food. What is certain is that our body needs sleep to renew itself and form new cells. Sleep is vital to memory and strengthens our system. Thus lack of sleep or naps can have a negative impact on our health, especially if sleep disturbances occur frequently. The proposed expert system is designed to help people with sleep disturbances get better sleep, using both CLIPS and Delphi languages.

Keywords: Expert Systems, CLIPS, Delphi, Sleep

1. INTRODUCTION

We sleep through a third of our lives, but it is clear that our body needs sleep to regenerate and form new cells. Sleep is important for the memory and strengthens our immune system. Poor or short sleep can therefore have a negative impact on our health - especially if sleep disorders occur frequently.

Figure 1 Sleep [1]

It was only with the invention of electroencephalography (EEG) and the associated possibility of measuring brain activity - waves with different frequencies and amplitudes - that science realized that sleep is its own dynamic process, with special activities of the brain that are carried out by different mechanisms regulated and controlled. Figure 2 EEG examination [2].

Figure 2 EEG examination [2]

During sleep, the brain processes important daily impressions and transmits it from short-term memory to long-term memory, so we discover that exercise is possible before bed or naps, and those who sleep well are less at risk of disease, because most of

the substances that the system produces are excreted during sleep in Darkness, which resists bacteria and viruses respectively. When sleeping, growth hormones that stimulate muscle growth or wound healing are released. Also, when sleeping, the metabolism is organized to provide energy for metabolism and body functions.

Sleep Phases

There are five stages in the normal sleep, these stages were divided after scientists studied the forms of electrical planning of the human brain during sleep and wakefulness. A full cycle takes around 90 to 110 minutes. [3]
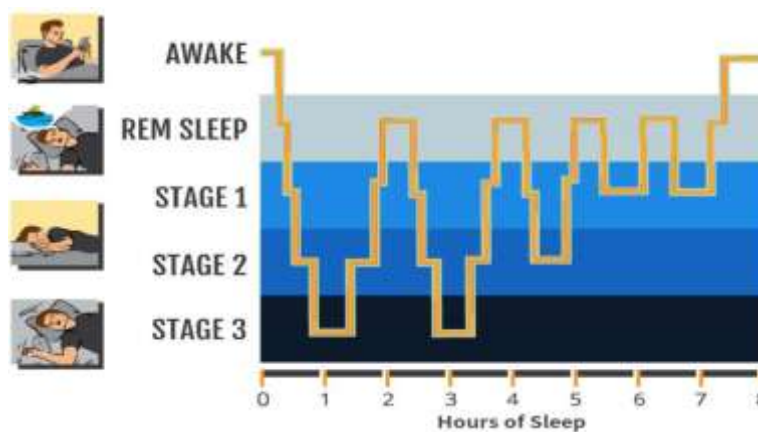

Figure3: Sleep Cycle

Figure 4 The human sleep cycle during a night of sleep.

Good knowledge of sleep symptoms and disorders helps us to manage and deal with these symptoms such as hypersomnia, insomnia, loud snoring, short-term pauses in breathing, leg movements, sleep walking, and night terrors (nightmares) in order to achieve normal sleep.

For all of the above mentioned reasons, an expert system has been built to help people with sleep difficulties to assess themselves and provide possible advice so that they can get better sleeping.

An expert system (ES) also called a Knowledge Based System (KBS) is a computer application of artificial intelligence (AI) designed to simulate the problem-solving behavior of an expert in in a field and computerize it so that it is readily available for use [4] that contains a knowledge base reasoning engine, And the user interface as in Figure 5 displays the main components.
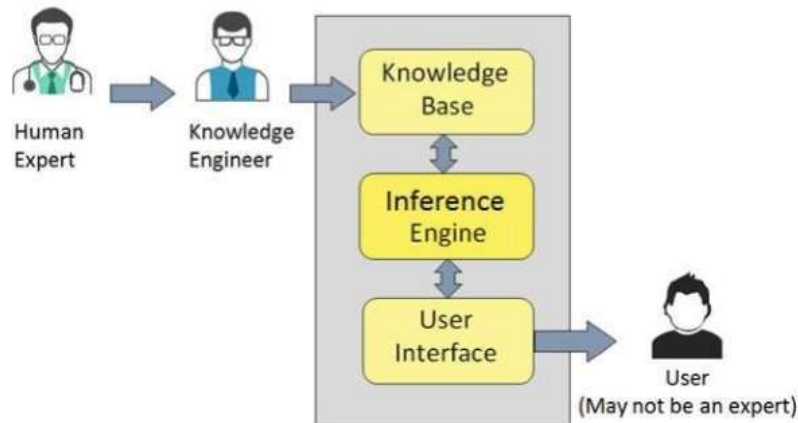
Figure 5 Main Components of an Expert System [4]

2. LITERATURE REVIEW

Despite the fact that there are many specialized systems that have been introduced to diagnose plant diseases and human diseases [05-43], for example, dental and gum problems, skin diseases, rickets and various types of diseases. However, there is no expert system for diagnosing sleep disorders, available for free. The proposed expert system is explicitly designed and developed to help people get better sleep.

3. MATERIALS AND METHODS

The proposed expert system diagnoses sleep disruption by displaying all symptoms in the list. The user was asked to answer questions and based on his answers, the proposed expert system provides diagnosis and recommendations to the user. In figure 6 display the main page of expert system. In figure 7 display user interface to select the symptoms. In figure 8 display the diagnosis and recommendation of the problem.

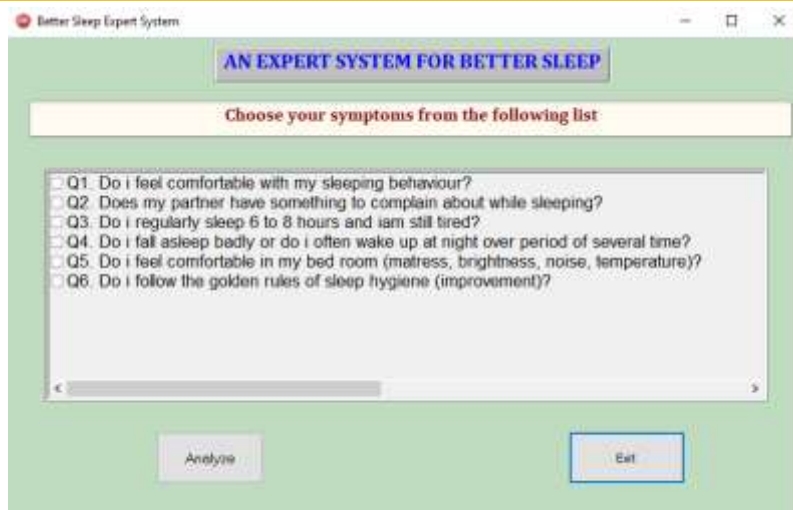Figure 6 the main page of expert system

Figure 7 user interface to select the symptoms.

Figure 8 diagnosis and recommendation of the problem.

4. KNOWLEDGE ACQUISITION

Sleep symptoms and disorders have been identified by collecting information from medical portals and news, such as Germany's largest news portal BILD [44].

5. KNOWLEDGE REPRESENTATION

The Medical information is required from a specialist doctor [45] to build an expert system, this information is collected by a set of rules is created where each rule contains in IF part that has the symptoms and in THEN part that has the disorder that should be realized. The inference engine (forward reasoning) is a mechanism through which rules are selected to be fired. It is based on a pattern matching algorithm whose main purpose is to associate the facts (input data) with applicable rules from the rule base. Finally, the sleep problems are produced by the inference engine. In Figure 9 display sleep symptom expert system decision Tree
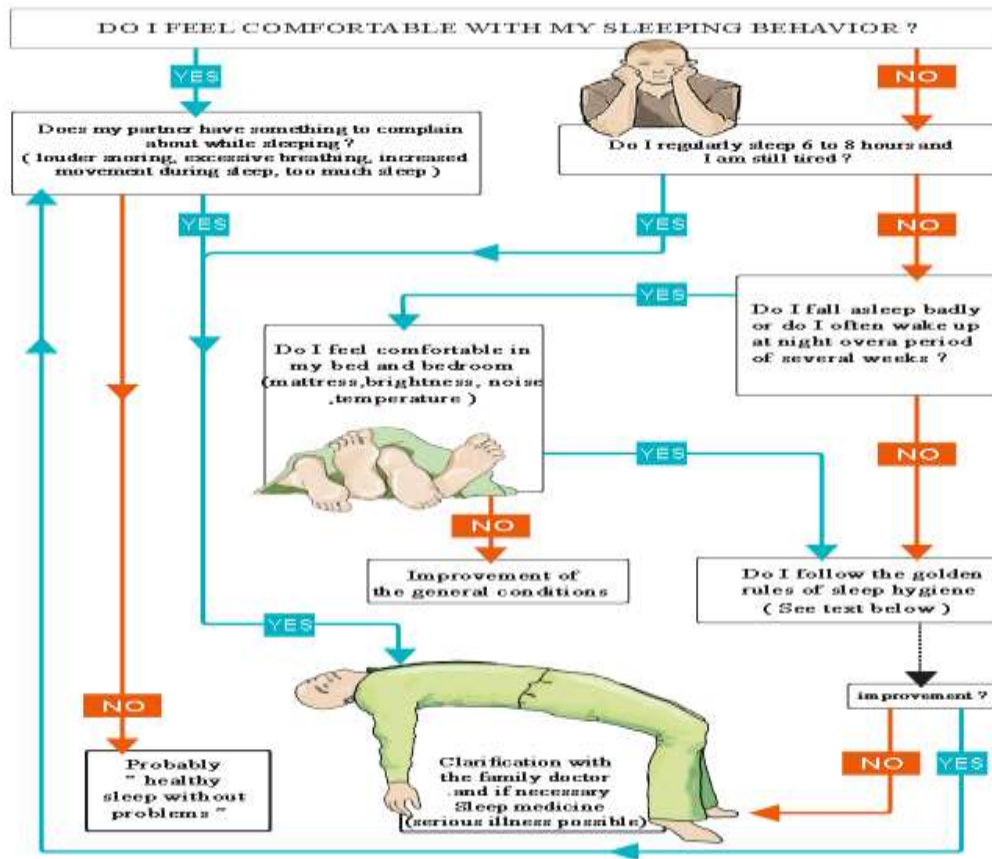
Figure 9 Sleep Symptom Expert System decision Tree

Some common types of sleep disorders include:

- Insomnia
  Difficulty falling asleep or staying asleep throughout the night.
- Sleep apnea
  Abnormal patterns in breathing while you are asleep.
- Restless legs syndrome (RLS)
  Restless legs syndrome, also called Willis-Ekbom disease, causes an uncomfortable sensation and an urge to move the legs while you try to fall asleep.
- Narcolepsy
  Extreme sleepiness during the day and falling asleep suddenly during the day.

Healthy sleep habits are often referred to as having good sleep hygiene, so try to keep the following sleeping practices Figure 10 display Rules of healthy sleep. [46]

Figure 10 Rules of healthy sleep

The proposed expert system will diagnose the six sleep problems by employing the knowledge obtained from a specialized site [4] 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.

In this present paper the problem of the sleep disorder 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 CLIPS (production system). CLIPS keep in memory a fact list, a rule list, and an agenda with activations of rules. Facts in CLIPS are simple expressions consisting of fields in parentheses. Groups of facts in CLIPS, 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 6 CLIPS rules. Below, we present the rules for sleep distribution.

```
 (defrule disease1

(Q1. Do i feel comfortable with my sleeping behaviour?)

(not (disease identified))

=>

(assert (disease identified))

(printout fdatao "1"  crlf )

)

 (defrule disease2

(Q1. Do i feel comfortable with my sleeping behaviour?)

(Q2. Does my partner have something to complain about while sleeping?)

(not (disease identified))

=>

(assert (disease identified))

(printout fdatao "2"  crlf )

)

 (defrule disease3
```

(Q3. Do i regularly sleep 6 to 8 hours and iam still tired?)

 (not (disease identified))

=>

(assert (disease identified))

(printout fdatao "3" crlf)

)

(defrule disease4

(Q4. Do i fall asleep badly or do i often wake up at night over period of several time?)

 (not (disease identified))

=>

(assert (disease identified))

(printout fdatao "4" crlf)

)

 (defrule disease5

(Q4. Do i fall asleep badly or do i often wake up at night over period of several time?)

(Q5. Do i feel comfortable in my bed room (matress, brightness, noise, temperature)?)

(not (disease identified))

=>

(assert (disease identified))

(printout fdatao "5" crlf)

)

(defrule disease6

(Q4. Do i fall asleep badly or do i often wake up at night over period of several time?)

(Q5. Do i feel comfortable in my bed room (matress, brightness, noise, temperature)?)

(Q6. Do i follow the golden rules of sleep hygiene (improvement)?)

(not (disease identified))

=>

(assert (disease identified))

(printout fdatao "6" crlf)

)

 (defrule disease7

(Q2. Does my partner have something to complain about while sleeping?)

(Q4. Do i fall asleep badly or do i often wake up at night over period of several time?)

(Q5. Do i feel comfortable in my bed room (matress, brightness, noise, temperature)?)

(Q6. Do i follow the golden rules of sleep hygiene (improvement)?)

(not (disease identified))

=>

(assert (disease identified))

(printout fdatao "7" crlf)

)

 (defrule disease8

 (Q2. Does my partner have something to complain about while sleeping?)

(Q6. Do i follow the golden rules of sleep hygiene (improvement)?)

(not (disease identified))

=>

(assert (disease identified))

```
(printout fdatao "8"  crlf )
)
 (defrule endline
(disease identified)
=>
  (close fdatao)
)
(defrule readdata
  (declare (salience 1000))
  (initial-fact)
  ?fx <- (initial-fact)
=>
  (retract ?fx)
  (open "data.txt" fdata "r")
  (open "result.txt" fdatao "w")
  (bind ?symptom1 (readline fdata))
  (bind ?symptom2 (readline fdata))
  (bind ?symptom3 (readline fdata))
  (bind ?symptom4 (readline fdata))
  (bind ?symptom5 (readline fdata))
  (bind ?symptom6 (readline fdata))
  (bind ?symptom7 (readline fdata))
  (bind ?symptom8 (readline fdata))
  (bind ?symptom9 (readline fdata))
  (assert-string (str-cat "(" ?symptom1 ")"))
  (assert-string (str-cat "(" ?symptom2 ")"))
  (assert-string (str-cat "(" ?symptom3 ")"))
  (assert-string (str-cat "(" ?symptom4 ")"))
  (assert-string (str-cat "(" ?symptom5 ")"))
  (assert-string (str-cat "(" ?symptom6 ")"))
  (assert-string (str-cat "(" ?symptom7 ")"))
  (assert-string (str-cat "(" ?symptom8 ")"))
  (assert-string (str-cat "(" ?symptom9 ")"))
  (close fdata)
)
```

6. FUNCTION OF THE SYSTEM5.

The proposed system performs many functions. It will conclude the sleep disturbance 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 problem 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. CONCLUSION

The utilization of expert system in medicine is very interesting. The proposed expert system can help specialists and patients in providing decision support system, interactive training tool and expert advice. The system constitutes part of intelligent system of diagnosis of sleep disturbance. 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 CLIPS Expert System language and Delphi 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 sleep issues.

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