

An Expert System for Diagnosing Coronavirus (COVID-19) Using SL5

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Abstract: Coronavirus is one of the common viruses that cause upper respiratory tract infection, sinuses, and throat infections. The virus is transmitted between humans from an infected person to another person through direct contact without protection (splashes, nasal secretions, saliva). The proposed expert system is designed to help patients know whether they are infected or not and what instructions to follow, and implemented using SL5 Object language.

Keywords: Expert Systems, SL5 Object, Coronavirus COVID-19

1. INTRODUCTION

Corona viruses are a large group of viruses that can infect both animals and humans, as they cause respiratory illnesses, whether they are mild as colds or as severe as pneumonia. Corona viruses rarely infect humans and then spread among them. SARS (Severe Acute Respiratory Syndrome) was an example of the Coronavirus, which was transmitted from animals to humans. That spread between 2002 and 2003, which was transmitted from animals to humans. Another prominent new strain of the Corona virus called MERS (respiratory syndrome of the Middle East) appeared in the Middle East in 2012, and scientists say it initially passed from a camel to a human. [1]

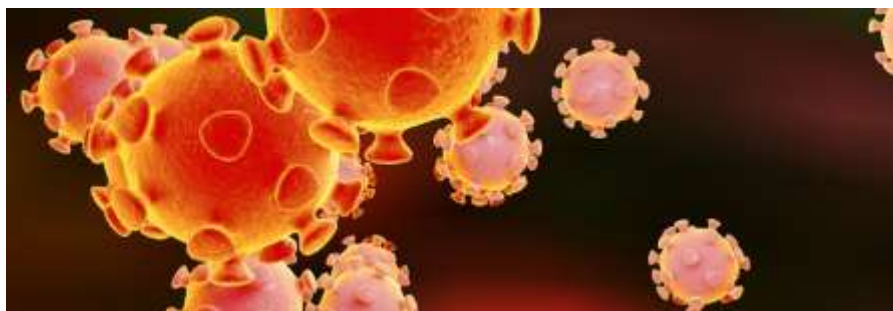


Figure 1 Coronavirus COVID-19 [2]

Signs and symptoms of COVID-19 can appear and include two to fourteen days after exposure:

- Fever
- Cough
- Shortness of breath or difficulty breathing

Other symptoms can include:

- Tiredness
- Aches
- Runny nose
- Sore throat
- Some people have experienced the loss of smell or taste.

People with chronic illnesses such as heart disease, lung disease or diabetes or with a weakened immune system may have an increased risk of serious illnesses, and older people may develop serious illnesses with this virus more often.

This is similar to what is seen in other respiratory diseases like the flu.

For all the reasons mentioned above, we built this expert system to help people who have symptoms diagnose themselves and prescribe an appropriate treatment. Symptoms can vary depending on the situation.

The expert system is a computer application of artificial intelligence (AI) [3] that contains a knowledge base reasoning engine, And the user interface as in Figure 3.

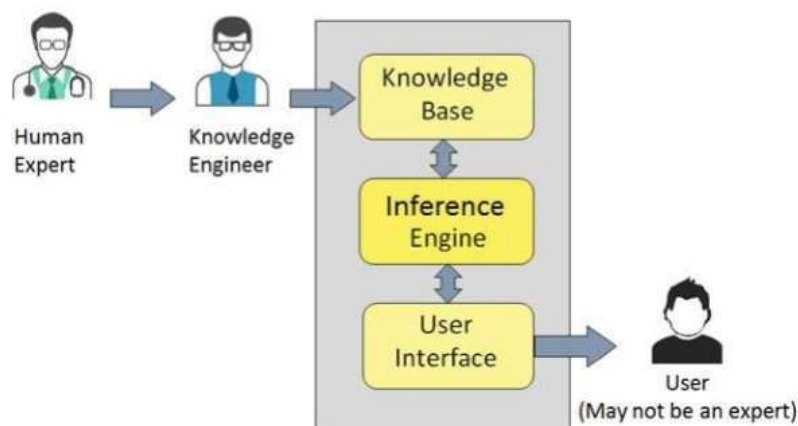


Figure 3 show the Main Components of an Expert System [3]

2. LITERATURE REVIEW

There are many expert systems designed and applied designed to diagnose diseases such as Eye, Endocrine, skin and other types of disease [4- 41]. However, there is no specialized expert system for diagnosis of Coronavirus COVID-19 symptoms available free.

3. KNOWLEDGE ACQUISITION

Find out the symptoms of the COVID-19 virus and the methods of care collected through medical sites such as the NHS Trust [42].

4. KNOWLEDGE REPRESENTATION

The language of the expert system selected is SL5 Object, the Simpler Level 5 Object Expert System Language is developed by Professor Sami Abu Nasser [43]. SL5 Object is a rule-based language, production system executing and a declarative language for specifying expert systems. SL5 Object is a rule-based expert system language that fits our expert system.

The SL5 Object engine is implemented in Delphi Embarcadero RAD Studio XE6 [10]. The Coronavirus COVID-19 Symptom Expert System decision Tree is shown in Figure 2

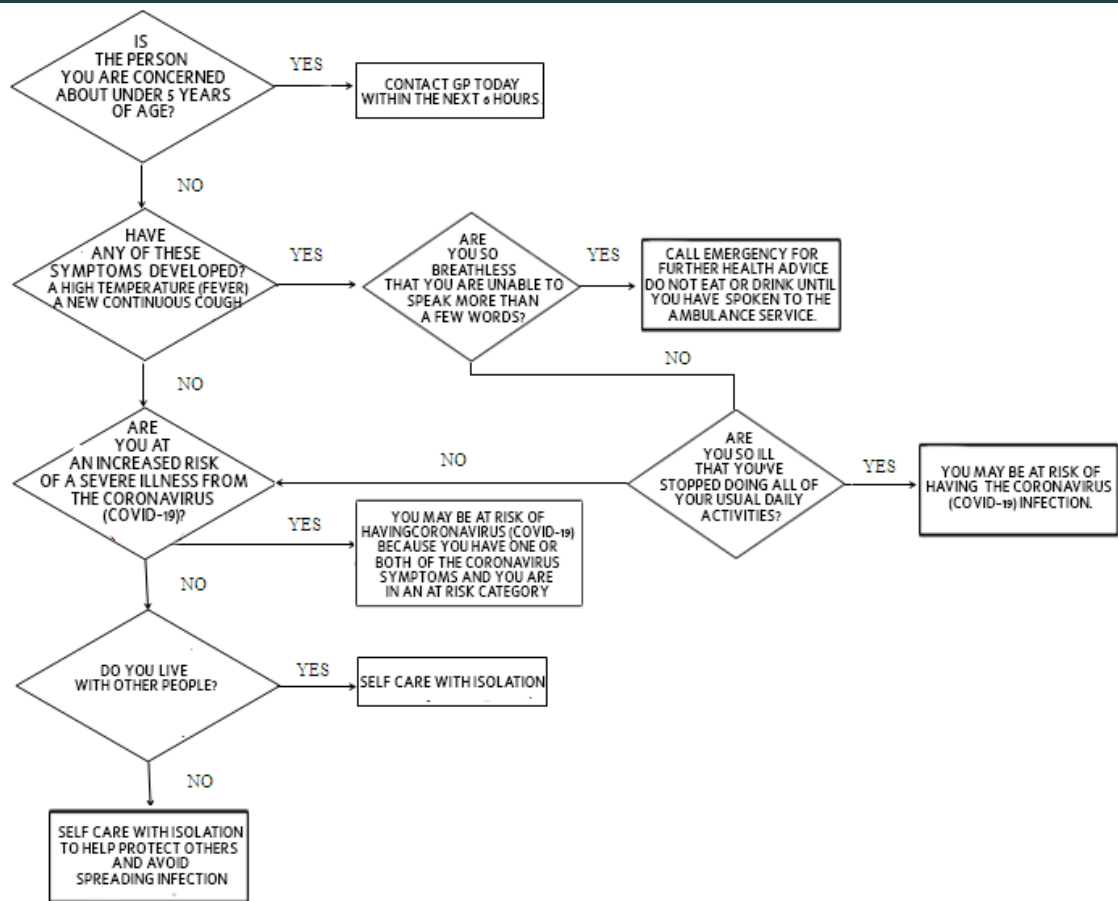


Figure 3 Coronavirus COVID-19 Symptom Expert System decision Tree

5. EXPERT SYSTEM USER INTERFACE

The proposed expert system is able to diagnose the symptoms of coronavirus (COVID-19) that may appear to people suspected of carrying the disease, starting with questions to the patient and through which the patient's condition is evaluated. The questions that will be asked are true and false questions. Figure 4 show the starting screen of proposed expert system, Figure 5 and 6 show the dialog between the expert system and the user, Figure 7 show the result and recommendations.

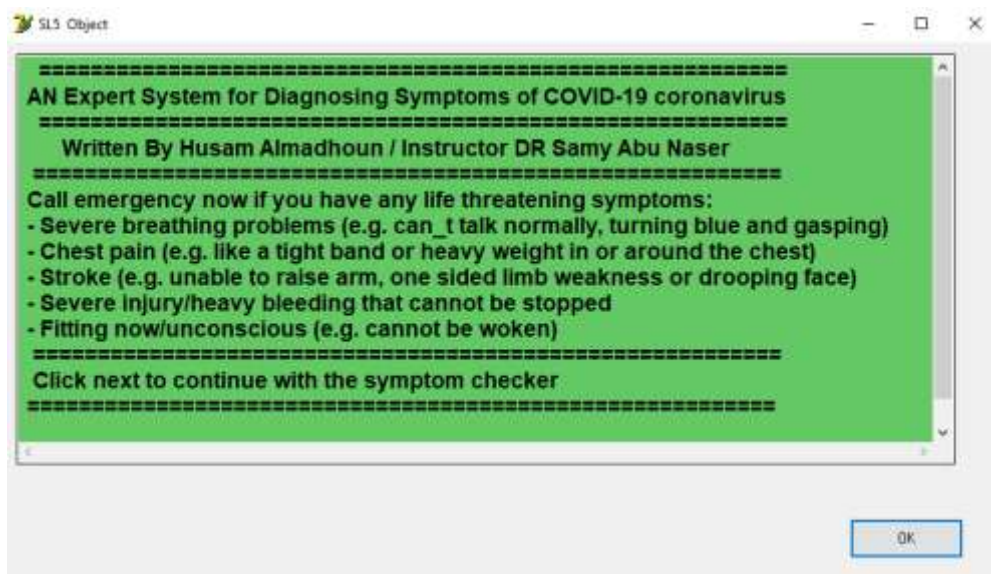
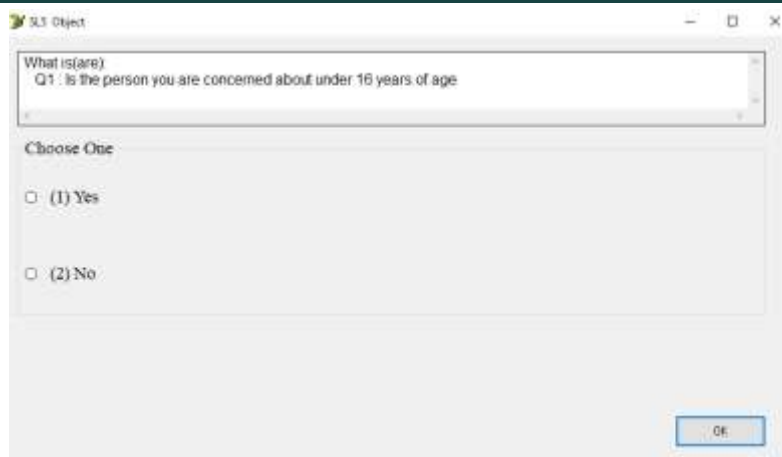


Figure 4 show the starting screen of proposed expert system



SL3 Object

What is(are):
Q1 : Is the person you are concerned about under 16 years of age

Choose One

☐ (1) Yes

☐ (2) No

OK

Figure 5 show the dialog between the expert system and the user



SL3 Object

What is(are):
Q1 : Is the person you are concerned about under 5 years of age

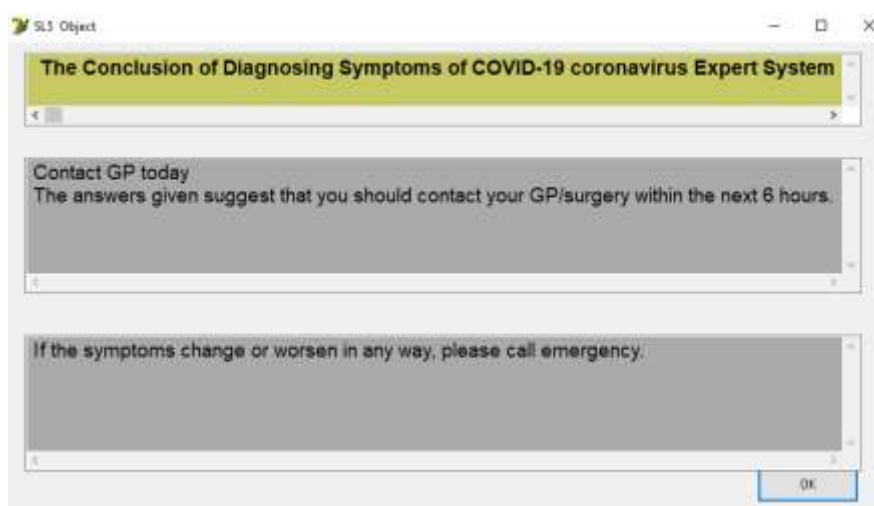
Choose One

☐ (1) Yes

☐ (2) No

OK

Figure 6 show the dialog between the expert system and the user



SL3 Object

The Conclusion of Diagnosing Symptoms of COVID-19 coronavirus Expert System

Contact GP today
The answers given suggest that you should contact your GP/surgery within the next 6 hours.

If the symptoms change or worsen in any way, please call emergency.

OK

Figure 7 show the result and recommendations.

6. CONCLUSION

In this paper, a new knowledge based system was developed and presented for helping patients in diagnosing Coronavirus COVID-19 symptoms such as Fever, Cough, Shortness of breath or difficulty breathing, Tiredness, Aches, Runny nose, Sore throat

The system was developed using SL5 Object expert system language.

7. EXPERT SYSTEM SOURCE CODE

! Written by Husam Almadhoun

! Instructor DR Samy Abu Naser

ATTRIBUTE Q1:Is the person you are concerned about under 16 years of age? COMPOUND Yes, No

ATTRIBUTE Q2:Have any of these symptoms developed A high temperature fever or A new continuous cough?
COMPOUND Yes, No

ATTRIBUTE Q3:Are you at an increased risk of a severe illness from the coronavirus COVID 19? COMPOUND Yes, No

ATTRIBUTE Q4:Are you so breathless that you are unable to speak more than a few words? COMPOUND Yes, No

ATTRIBUTE Q5:Are you so ill that you've stopped doing all of your usual daily activities? COMPOUND Yes, No

ATTRIBUTE Q6:Do you live with other people? 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

I

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 :="

=====

AN Expert System for Diagnosing Symptoms of COVID-19 coronavirus

=====

Written By Husam Almadhoun / Instructor DR Samy Abu Naser

=====

Call emergency now if you have any life threatening symptoms:

- Severe breathing problems (e.g. can't talk normally, turning blue and gasping)
 - Chest pain (e.g. like a tight band or heavy weight in or around the chest)
 - Stroke (e.g. unable to raise arm, one sided limb weakness or drooping face)
 - Severe injury/heavy bleeding that cannot be stopped
 - Fitting now/unconscious (e.g. cannot be woken)
- =====

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 Diagnosing Symptoms of COVID-19 coronavirus 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:Is the person you are concerned about under 16 years of age?

RULE Q1Yes
IF Q1:Is the person you are concerned about under 16 years of age? IS Yes
THEN text OF Diagnosis textbox := "Contact GP today
The answers given suggest that you should contact your GP/surgery within the next 6 hours."

AND text OF Recommend textbox := "If the symptoms change or worsen in any way, please call emergency."

RULE Q1No
IF Q1:Is the person you are concerned about under 16 years of age? IS No
THEN ASK Q2:Have any of these symptoms developed A high temperature fever or A new continuous cough?

RULE Q2Yes
IF Q2:Have any of these symptoms developed A high temperature fever or A new continuous cough? IS Yes
THEN ASK Q4:Are you so breathless that you are unable to speak more than a few words?

RULE Q2No
IF Q2:Have any of these symptoms developed A high temperature fever or A new continuous cough? IS No
THEN ASK Q3:Are you at an increased risk of a severe illness from the coronavirus COVID 19?

RULE Q3yes

IF Q3:Are you at an increased risk of a severe illness from the coronavirus COVID 19? IS Yes
THEN text OF Diagnosis textbox := "Self Care You do not need to speak to anybody right now as you:
do not have a high temperature do not have a continuous cough It is unlikely that you are currently experiencing symptoms of
the coronavirus (COVID-19) infection."

AND text OF Recommend textbox := "If you develop symptoms during home isolation, you should re-use the expert system
symptom to check your symptoms."

RULE Q3no

IF Q3:Are you at an increased risk of a severe illness from the coronavirus COVID 19? IS No
THEN ASK Q6:Do you live with other people?

RULE Q4yes

IF Q4:Are you so breathless that you are unable to speak more than a few words? IS Yes
THEN text OF Diagnosis textbox := "Call emergency for further health advice. "
AND text OF Recommend textbox := "Do not eat or drink until you have spoken to the ambulance service."

RULE Q4no

IF Q4:Are you so breathless that you are unable to speak more than a few words? IS No
THEN ASK Q5:Are you so ill that you've stopped doing all of your usual daily activities?

RULE Q5yes

IF Q5:Are you so ill that you've stopped doing all of your usual daily activities? IS Yes
THEN text OF Diagnosis textbox := "Your answers indicate that you may be at risk of developing a Coronavirus (COVID-19)
infection.
Please call the emergency number now and let them know."

AND text OF Recommend textbox := "Please do not attend doctor, pharmacy, accident or emergency surgery. To help reduce
the risk of infection spreading, you need:

If you go out, go home right away

If you use public transportation, stay as far away from other people as possible and go home in the most direct way

Keep at least 2 meters (about 3 steps) away from people if you can

At home, stay alone (self-isolating) in a room where the door can be closed

Avoid touching surfaces or objects that are shared with others

If symptoms worsen during isolation at home, you should call the emergency number again

You do not need to get a note from a general practitioner."

RULE Q5no

IF Q5:Are you so ill that you've stopped doing all of your usual daily activities? IS No
THEN ASK Q3:Are you at an increased risk of a severe illness from the coronavirus COVID 19?

RULE Q6yes

IF Q6:Do you live with other people? IS Yes
THEN text OF Diagnosis textbox := "Self care with isolation
To help protect others and avoid spreading infection
If you live with others and you are the first in the household to have symptoms of coronavirus, then you must stay at home for
7 days, but all other household members that remain well must stay at home and not leave the house for 14 days. The 14 day
period starts from the day when the first person in the household became ill. See this explanatory diagram for further guidance
on household isolation.

You do not need to stay at home if you just have a cough after 7 days. A cough can last for several weeks after the infection
has gone.

To help protect others and lower the risk of spreading the infection, you need to:

If out, go home immediately

If using public transport, stay as far away as possible from other people and go home by the most direct route.

Stay at least 2 metres (about 3 steps) away from people if you can

At home, remain alone (self-isolate) in a room where the door can be kept shut

Avoid touching surfaces or objects that are shared with other people

PLEASE DO NOT ATTEND YOUR GP SURGERY, PHARMACY OR ACCIDENT AND EMERGENCY"

AND text OF Recommend textbox := "How to look after your symptoms at home rest and drink plenty of fluids
take paracetamol as prescribed on the packaging unless you have any underlying condition that prevents you from doing so
cover the mouth with a tissue when coughing or sneezing

put used tissues in a bin

wash your hands regularly with warm water and soap for at least 20 seconds

Vulnerable/at risk groups

Some people are more vulnerable to self-limiting illnesses (like viruses) for example:

have had an organ transplant

are having certain types of cancer treatment

have blood or bone marrow cancer, such as leukaemia

have a severe lung condition, such as cystic fibrosis, COPD or severe asthma

have a condition that makes you much more likely to get infections

are taking medicine that weakens your immune system

are over 70 years of age

Diabetes are pregnant and have a serious heart condition

If you can, move any vulnerable people (the elderly and those with underlying conditions) out of your home, for the whole isolation period. If you cannot do this, stay away from vulnerable people as much as possible.

For further information on staying at home, click here.

For further information on ending isolation click here.

Get an isolation note to give to your employer

You can send an isolation note to your employer as proof you need to stay off work because of coronavirus.

You do not need to get a note from a GP."

RULE Q6no

IF Q6:Do you live with other people? IS No

THEN text OF Diagnosis textbox := "Self Care and isolation

If you live alone and you have symptoms of coronavirus (COVID-19), however mild, stay at home for 7 days from when your symptoms started.

You need to self-isolate (stay away) from other people for 7 days from when your symptoms started, or until your symptoms have gone. You do not need to stay at home if you just have a cough after 7 days. A cough can last for several weeks after the infection has gone.

To help protect others and lower the risk of spreading the infection, you need to:

If out, go home immediately

If using public transport, stay as far away as possible from other people and go home by the most direct route

Stay at least 2 metres (about 3 steps) away from people if you can

At home, remain alone (self-isolate) in a room where the door can be kept shut

Avoid touching surfaces or objects that are shared with other people

PLEASE DO NOT ATTEND YOUR GP SURGERY, PHARMACY OR ACCIDENT AND EMERGENCY .

You do not need to call emergency to go into self-isolation. If your symptoms worsen during home isolation, you should call emergency. ."

AND text OF Recommend textbox := "How to look after your symptoms at home

rest and drink plenty of fluids

take paracetamol as prescribed on the packaging unless you have any underlying condition that prevents you from doing so
cover the mouth with a tissue when coughing or sneezing

put used tissues in a bin wash your hands regularly with warm water and soap for at least 20 seconds

For further information on staying at home, click here.

For further information on ending isolation click here.

Get an isolation note to give to your employer

You can send an isolation note to your employer as proof you need to stay off work because of coronavirus.

You do not need to get a note from a GP. "

END

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