

Expert System for COVID-19 Diagnosis

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Abstract: Background: Coronavirus is a family of viruses that can cause disease such as severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). In 2019, Coronavirus was identified as the cause of the outbreak in China. Therefore, in this paper we will review what the Coronavirus is and explore the symptoms associated with it. **Objectives:** The main objective of this expert system is to obtain appropriate diagnosis of the disease. **Methods:** In this paper, the expert system is designed for the ability of doctors to detect and diagnose symptoms of coronavirus, a common symptom of this disease are **fever, cough, pneumonia in both lungs and shortness of breath**. This system presents the disease symptoms, which day will be recognizing symptoms, survival and spread, favorable conditions and image of this symptoms. Clips and Delphi expert system languages are used for designing and implementing the proposed expert system. **Result:** The expert system in the diagnosis of Coronavirus disease was assessed by doctors and they were satisfied and accepted with its quality of performance. **Conclusions:** The expert system is easy for doctors and people have interested in the coronavirus to detect and diagnosis the symptoms that may face this disease.

Keywords: Artificial Intelligence, Expert Systems, CLIPS, Delphi, Coronavirus, COVID-19.

1. INTRODUCTION

Coronavirus disease 2019 (COVID-19) is an infectious disease caused by a newly discovered coronavirus. Most people infected with the COVID-19 virus will experience mild to moderate respiratory illness and recover without requiring special treatment. Older people, and those with underlying medical problems like cardiovascular disease, diabetes, chronic respiratory disease, and cancer are more likely to develop serious illness.



Figure 1: Coronavirus

The best way to prevent and slow down transmission is be well informed about the COVID-19 virus, the disease it causes and how it spreads. Protect yourself and others from infection by washing your hands or using an alcohol-based rub frequently and not touching your face.



Figure 2: Washing hand



Figure 3: How to wash your hands



Figure 4: When to Wash Hands?

Also, stay at home and avoid all non-essential contact with others, limit trips for groceries, gas and other essentials, if you must go out, stay at least 6 feet away from others at all times.

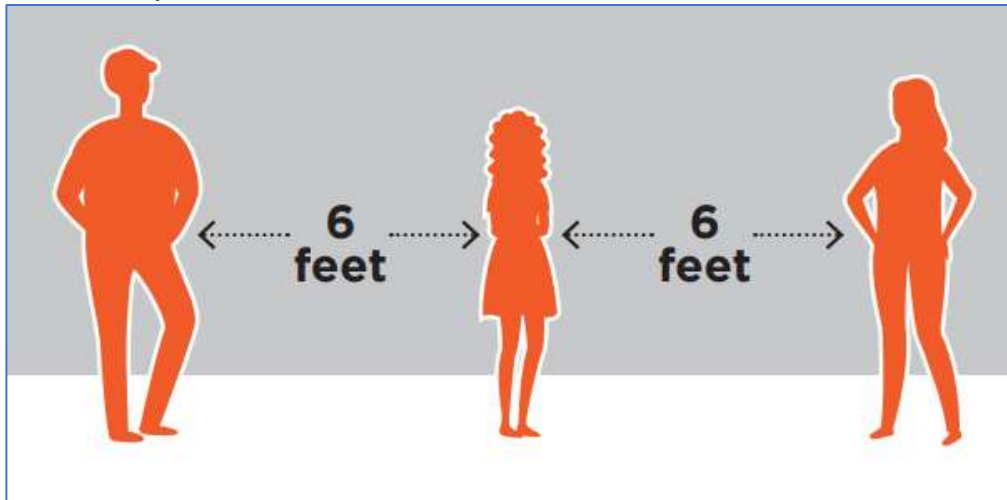


Figure 5: Stay at least 6 feet

The COVID-19 virus spreads primarily through droplets of saliva or discharge from the nose when an infected person coughs or sneezes, so it's important that you also practice respiratory etiquette (for example, by coughing into a flexed elbow)

At this time, there are no specific vaccines or treatments for COVID-19. However, there are many ongoing clinical trials evaluating potential treatments. World Health Organization (WHO) will continue to provide updated information as soon as clinical findings become available. [1]

To prevent infection and to slow transmission of COVID-19, do the following:

- Wash your hands regularly with soap and water or clean them with alcohol-based hand rub.
- Maintain at least 1-meter distance between you and people coughing or sneezing.
- Avoid touching your face.
- Cover your mouth and nose when coughing or sneezing.
- Stay home if you feel unwell.
- Refrain from smoking and other activities that weaken the lungs.
- Practice physical distancing by avoiding unnecessary travel and staying away from large groups of people.

An expert system is a computer system that emulates, or acts in all respects, with the decision-making capabilities of a human expert. Its main components are: Knowledge base, it's obtainable from books, magazines, knowledgeable persons, etc. Inference engine, it draws conclusions from the knowledge base [2,12-18]. Figure 6 displays the main components.

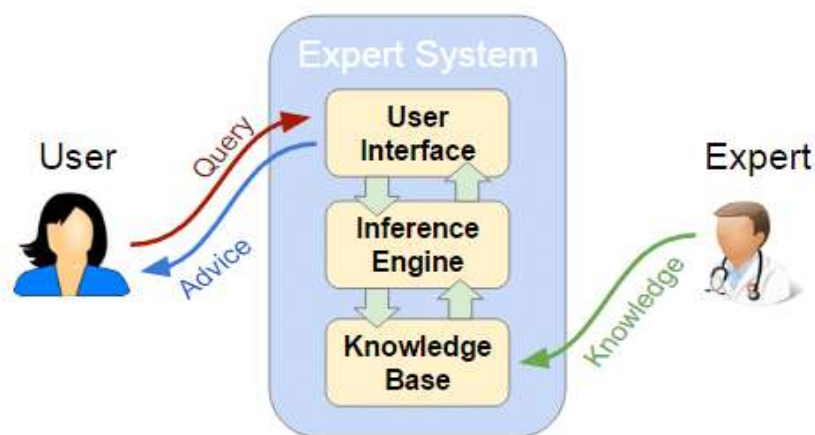


Figure 6: Displays the main components of expert system

The Expert system for Castor Diseases Diagnosis was implemented using CLIPS shell and Delphi language. CLIPS is a decent example of an expert system shell, it illustrates many of the concepts and methods used in other expert system shells, it allows the representation of knowledge, and its use for solving suitable problems [19-23].

2. MATERIALS AND METHODS

The expert system accomplish diagnosis for coronavirus, can applied by display all symptoms in list and select it to analysis the disease. The expert system will ask the user to choose the symptoms that appear on human from the list. Then click analyze button to diagnosis the day of recognizing symptoms, survival and spread, favorable conditions and snapshot of the status. The expert system has been designed for change the theme for user interface like font color, background color, font name, and font size. Also, it has may form display specific format. For example, figure 7 display the basic data for the expert system such as name and image. In figure 8 display the format of the first user interface include name of expert system and whom designed it and background about the system. In figure 9 display the format of symptoms screen that display all symptoms in the list. In figure 10 display the format of result screen that include all details that diagnosis of the disease. In figure 11 display the format of screen entering details of disease. In figure 12 display the format of screen entering details of symptom in each day of disease occur.

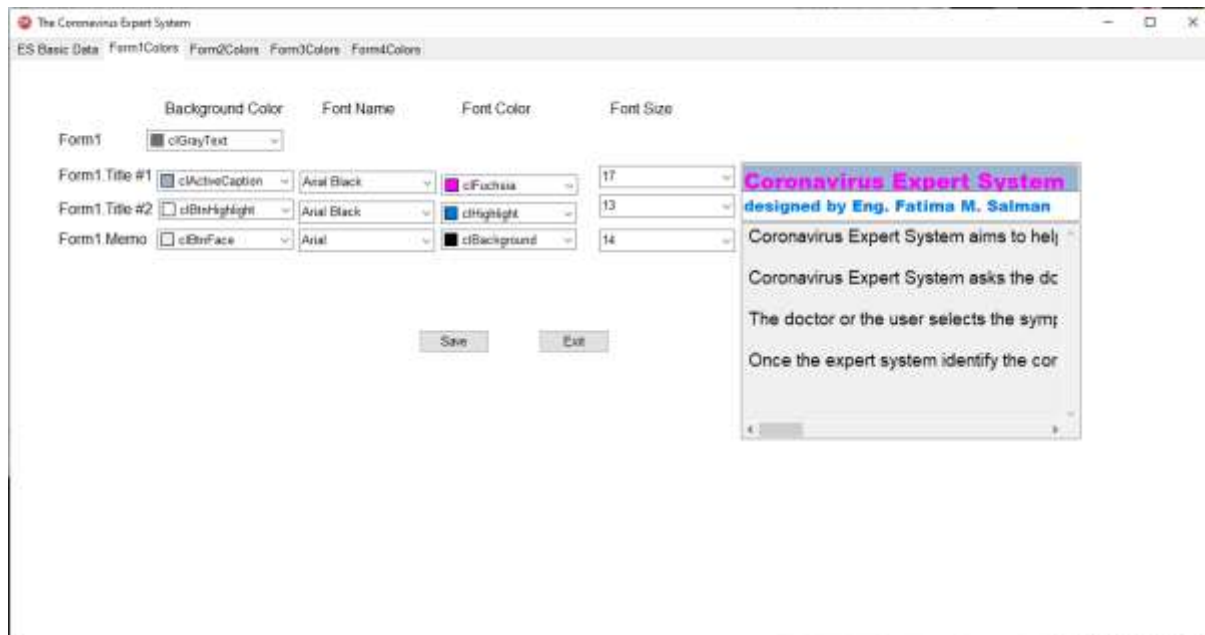


Figure 7: Display the basic data for expert system

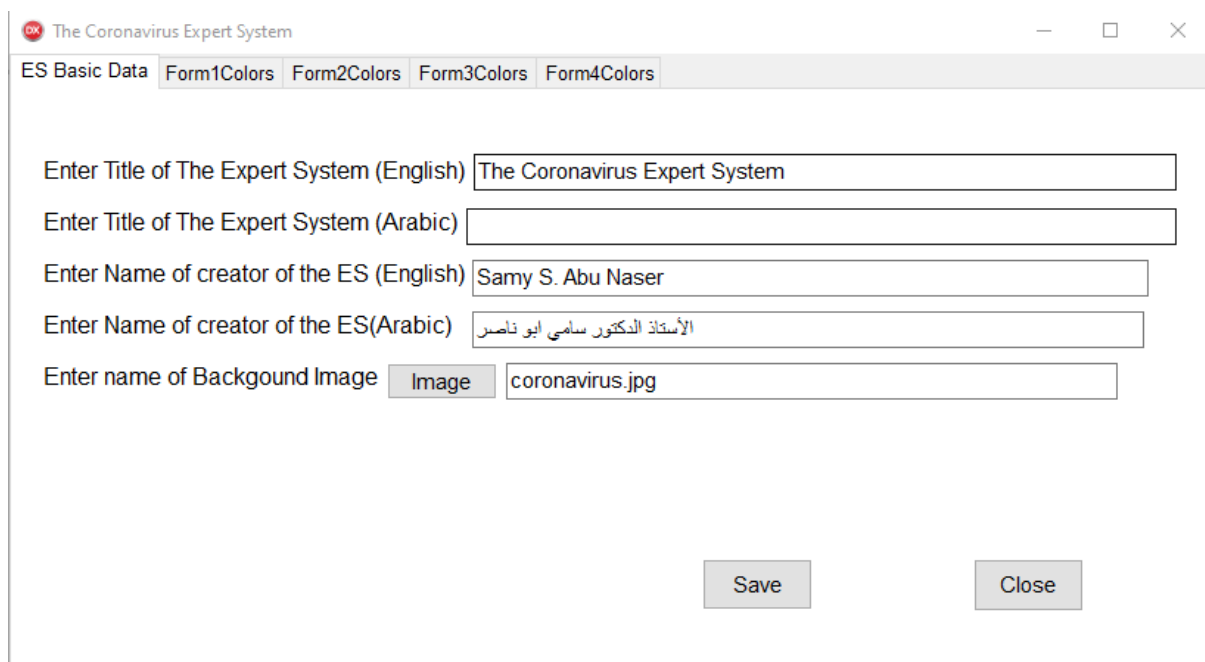


Figure 8: Display format of the main page in expert system

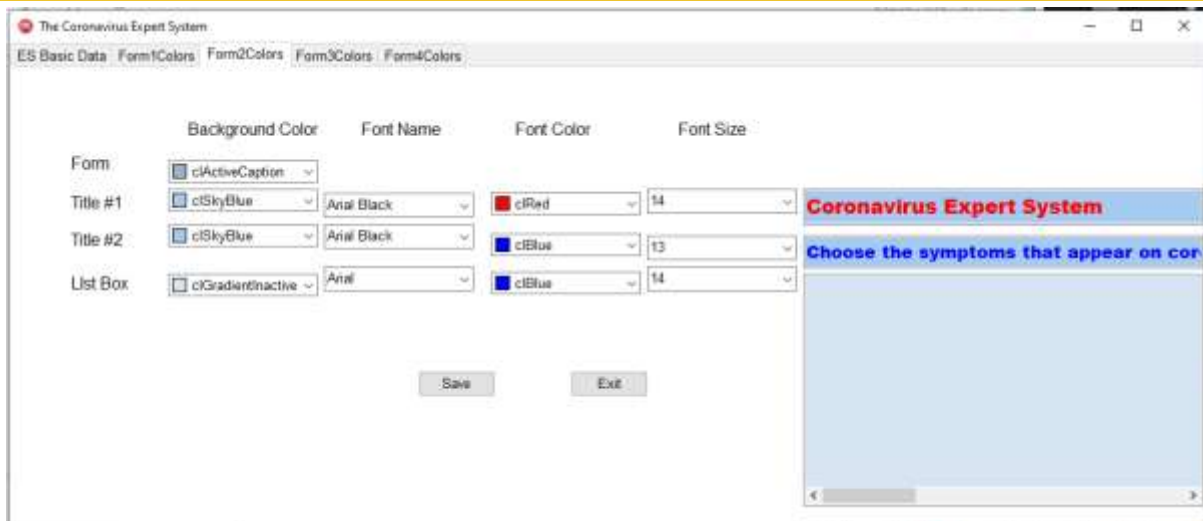


Figure 9: Display format of selection symptoms.



Figure 10: Display format of details screen of disease

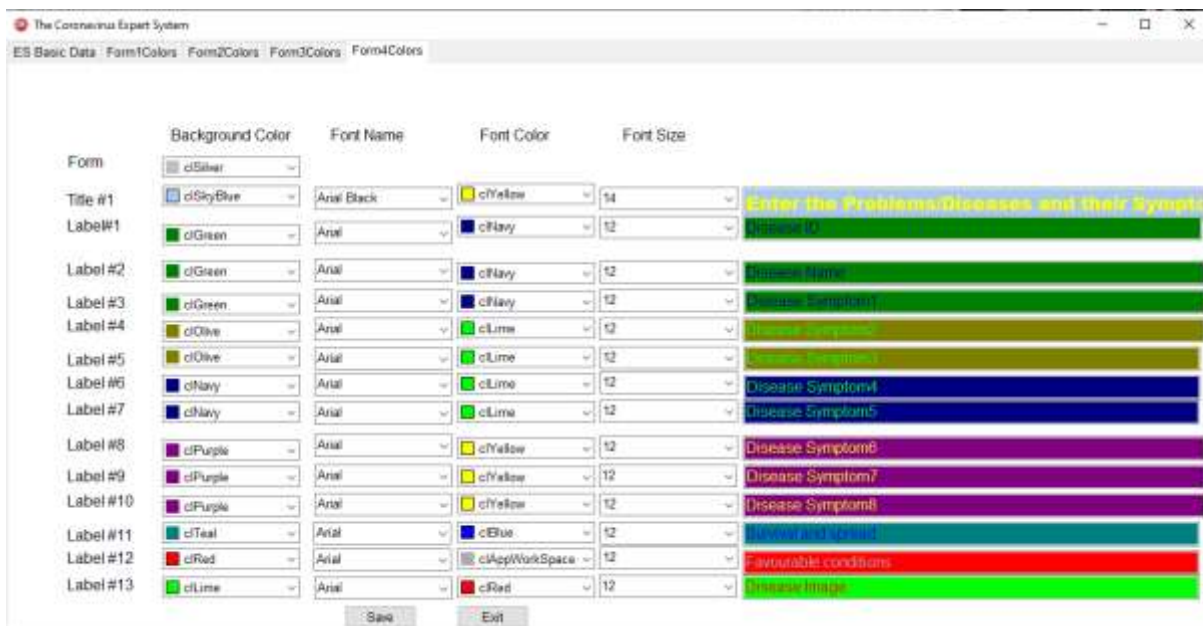


Figure 11: Display the format of entering diseases details

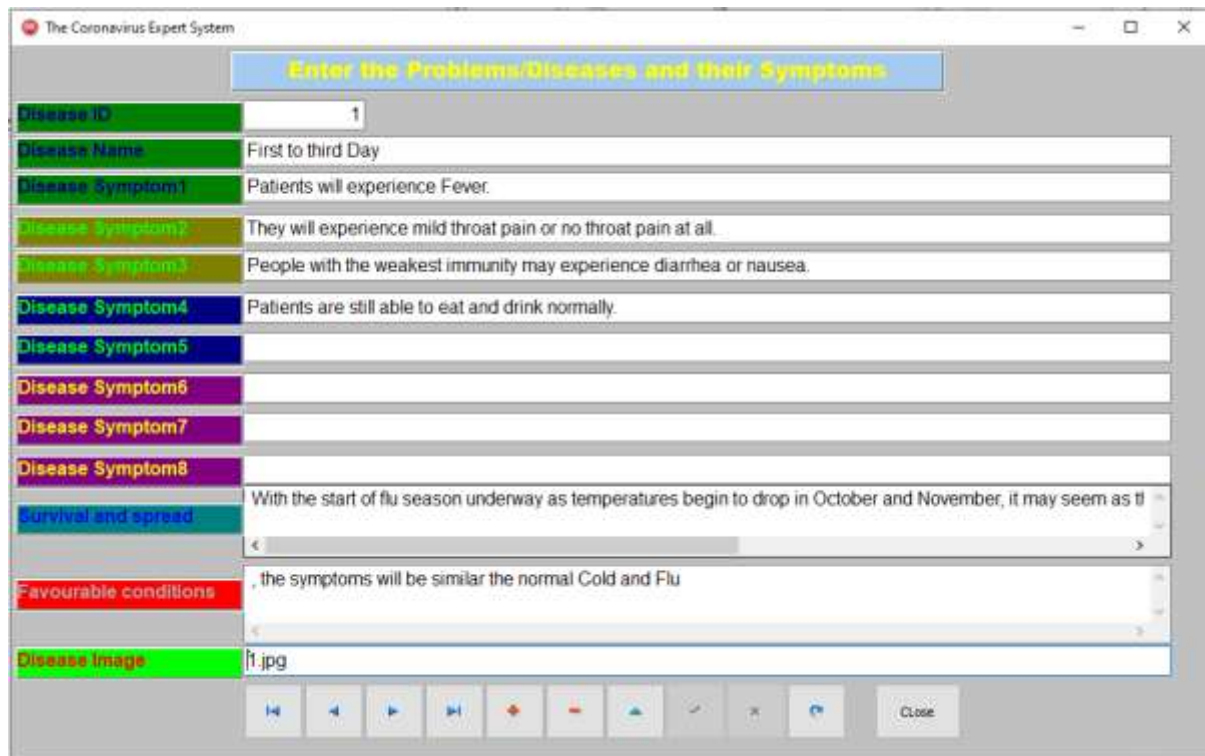


Figure 12: Display the format of entering diseases and symptoms details

In the Figure 13 display the main page of the coronavirus expert system include the details and the important of the coronavirus expert system.

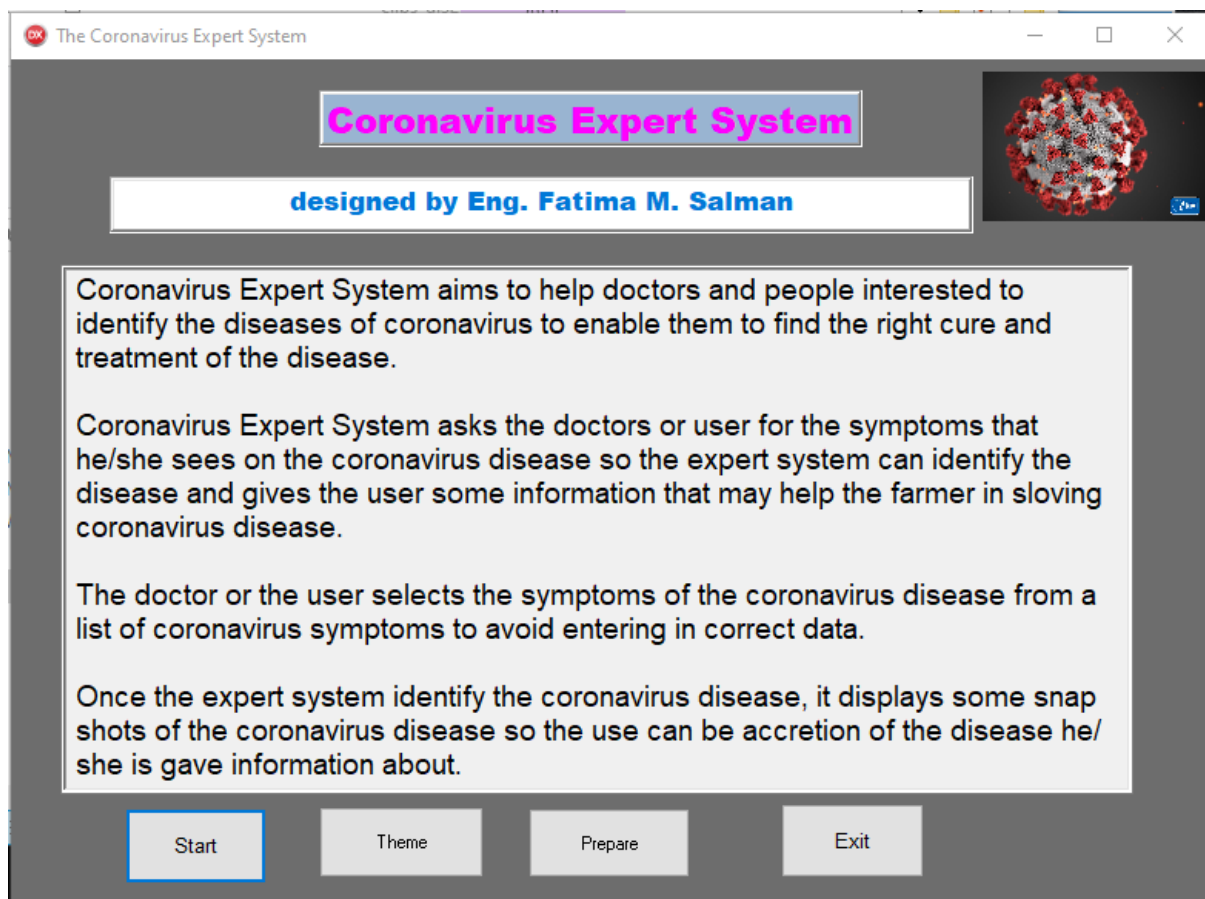


Figure 13: Main page of castor expert system

In figure 14 user interface for choosing the symptoms that appear on a castor plant and click in the button analyze to display the details that is displayed in figure 15.

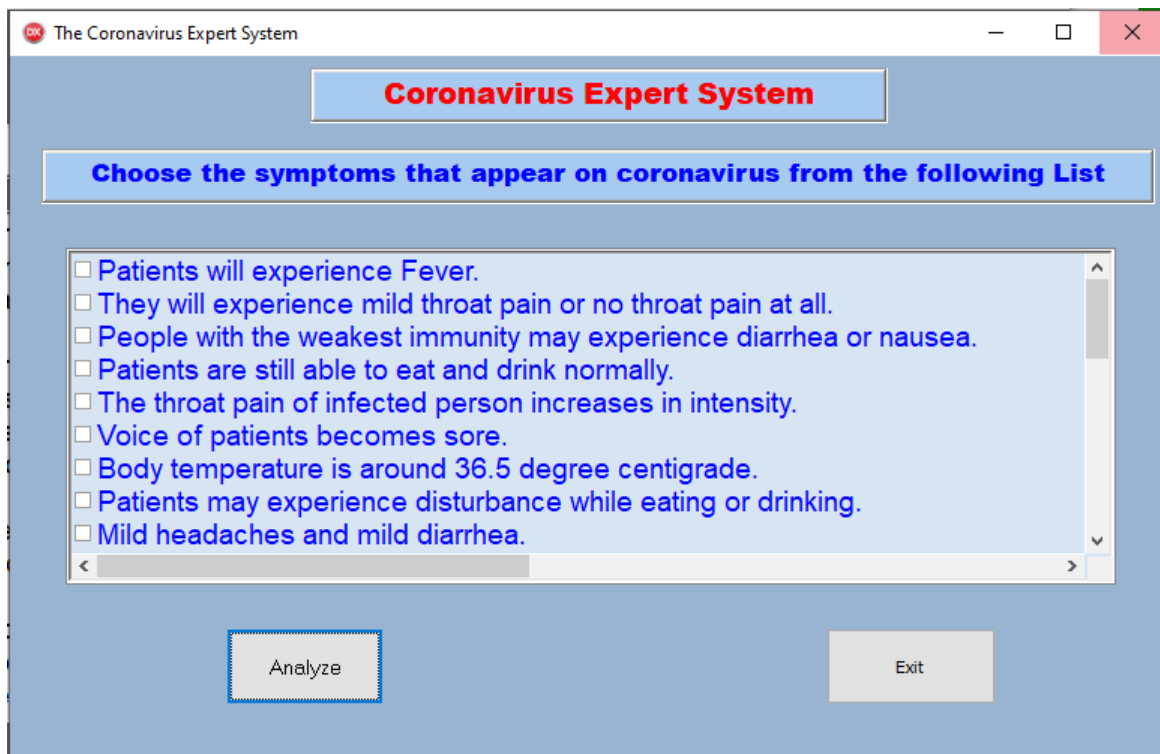


Figure 14: User interface to select the purpose symptoms

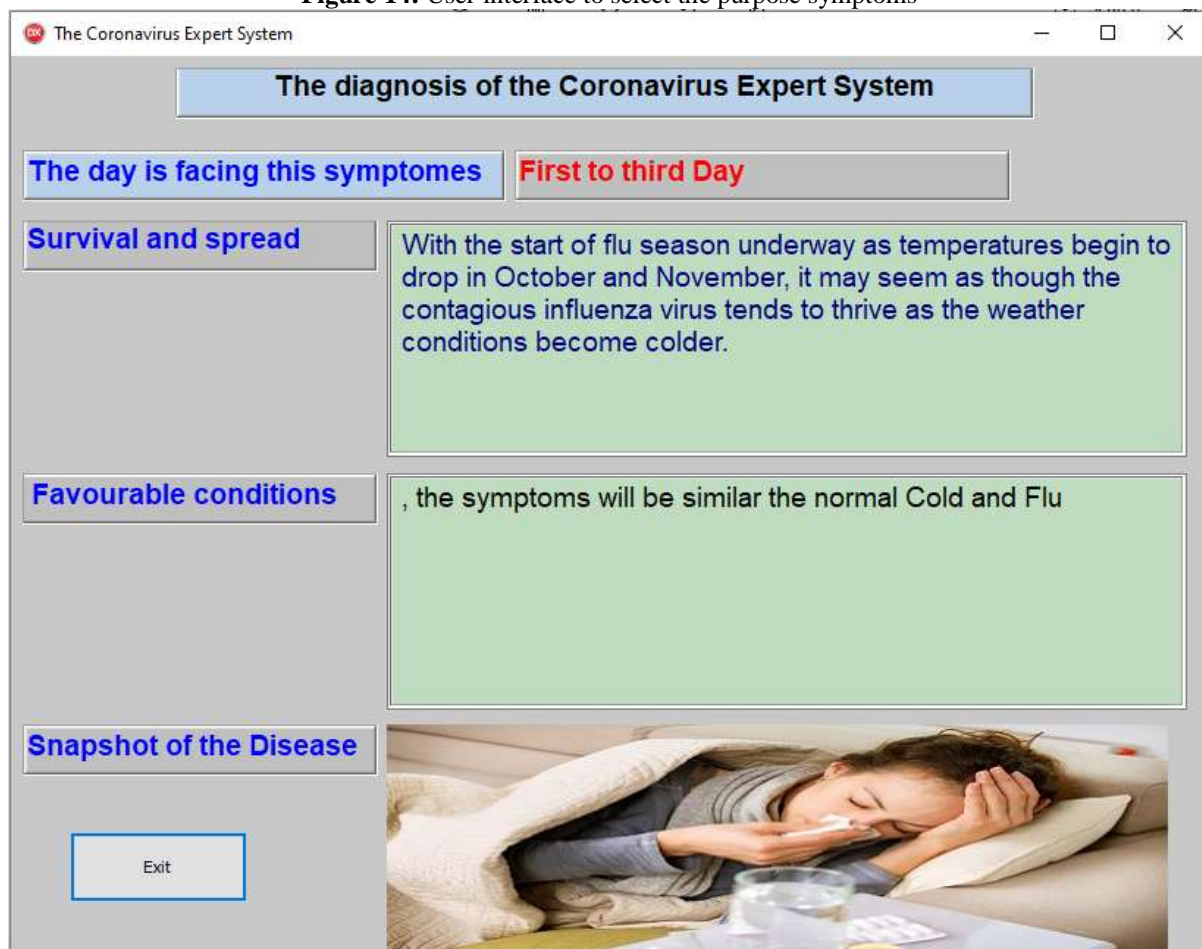


Figure 15: User interface display the details for coronavirus disease

3. LITERATURE REVIEW

Many expert systems designed to diagnose human diseases like [2, 24], an expert system that helps doctors and specialists to diagnose and get appropriate advice on human organs problem such as: Teeth and Gums [2], Shortness of Breath in Infants and Children [3], Skin Diseases [5], Foot Diseases [6], Eye Diseases [7], breasts cancer [8,14], neck pain [9], Uveitis Disease [10], Rickets [11], Anemia Diseases [13], Kidney Diseases [15], Polymyalgia Rheumatic [17], Silicosis [18], Endocrine [19], Arthritis Diseases [20], Long-term Abdominal Pain (Stomach Pain) [23], Hair Loss Diagnosis and Treatment [24], and another kinds of diseases. However there is no expert system found to diagnosis the coronavirus diseases.

4. KNOWLEDGE REPRESENTATION

The main sources of the knowledge for this expert system are medical and specializes websites for coronavirus diseases. The captured knowledge has been converted into CLIPS Knowledge base. Currently the expert system has recognizing day-by-day symptoms of coronavirus. From 1st to 3rd days, the symptoms will be similar the normal Cold and Flu and some of symptoms are:

1. Patients will experience Fever.
2. They will experience mild throat pain or no throat pain at all.
3. People with the weakest immunity may experience diarrhea or nausea.
4. Patients are still able to eat and drink normally.



Figure 16: Normal cold and flu

On the 4th day the symptoms are following:

1. The throat pain of infected person increases in intensity.
2. Voice of patients becomes sore.
3. Body temperature is around 36.5 degree centigrade.
4. Patients may experience disturbance while eating or drinking.
5. Mild headaches and mild diarrhea.



Figure 17: Throat pain



Figure 18: Mild headaches and mild diarrhea

On the 5th day of infection, Things start to get a little messy. Also,

1. There is intense pain in the throat.
2. Pain while patients try to eat or drink something.
3. Soreness of voice increases.
4. Feeling of pain on movement or moving any body part.
5. Weakness all over the body with joint pains.



Figure 19: Feeling of pain on movement or moving any body parts

On the 6th day the symptoms are increasing by steps as the following as:

1. Fever is still mild at 37 Centigrade.
2. There is dry cough with painful throat.
3. Painful throat while eating, swallowing or talking.
4. Feeling of being exhausted and severe nausea.
5. Occasionally the patient face difficulty in breathing.
6. The pain from joints extends to fingers.
7. The intensity of diarrhea and vomiting increases.



Figure 20: Occasionally the patient face difficulty in breathing.

On the 7th day, the symptoms are:

1. Intensity of fever increases up to 38 Centigrade.
2. Excessive coughing with sputum.
3. Body pain, headache, diarrhea and vomiting worsens increase.



Figure 21: Body pain, headache, diarrhea and vomiting worsens increase

On the 8th day, Severe difficulty in breathing every time the patients breathe. And other like:

1. Chest becomes very heavy.
2. Coughing, headaches and joint pains increases more.
3. Body temperature rises above 38 Centigrade.

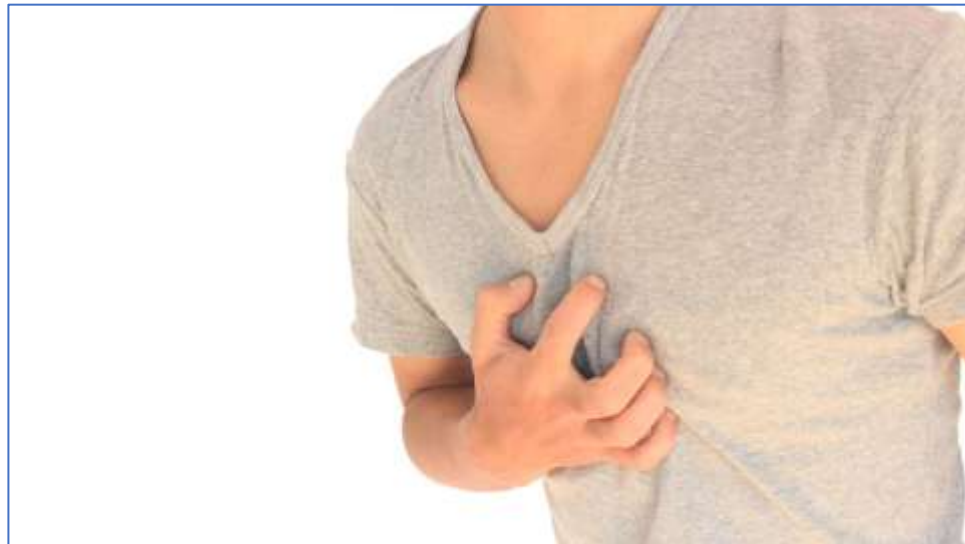


Figure 22: Chest becomes very heavy.

On the 9th day, all of the symptoms shown, starts getting worse.

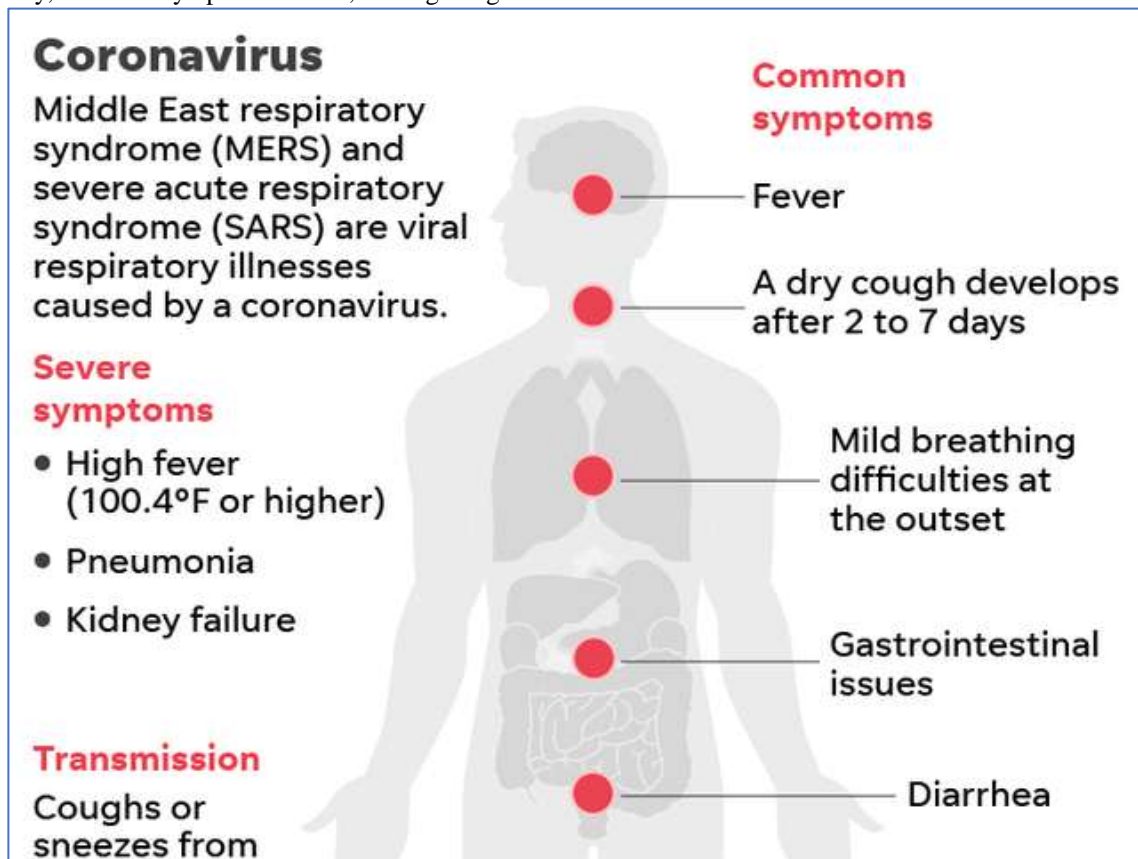


Figure 23: All of the symptoms

This list of symptoms was released by Ministry of Health, Singapore. **Emergency warning signs for COVID-19 are:**

1. Difficulty breathing
2. Pain in chest
3. Bluish lips or face

This list is not all inclusive. If you ever feel the four symptoms: **fever, cough, pneumonia in both lungs and shortness of breath, seek medical attention immediately**

Coronavirus spreads

Coronaviruses are a family of viruses common in animals, with the newest deadly strain (Novel Coronavirus) identified in Wuhan, China. Now the first case has been detected in the U.S.



Transmission

Coronaviruses are zoonotic, meaning they are transmitted between animals and people.



Human-to-human transmission:

Coronaviruses are most commonly spread from an infected person by:

- Coughing and sneezing.
- Close personal contact, such as touching or shaking hands.
- Touching an object or surface with the virus on it, and then touching your mouth, nose, or eyes before washing your hands.
- Fecal contamination.

Source: WHO, CDC, Getty Images

Signs of coronavirus infection

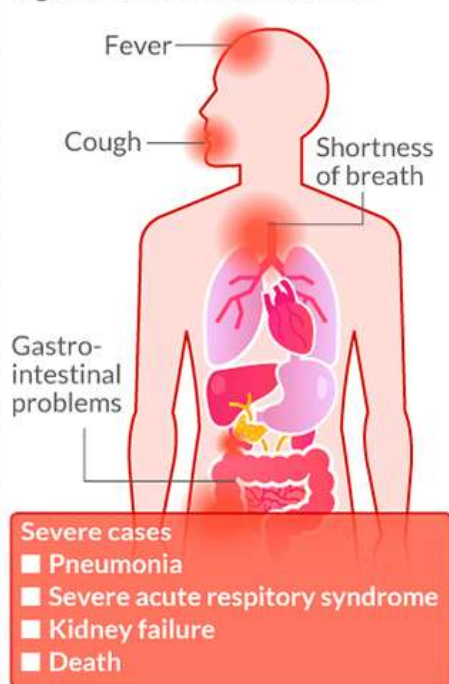


Figure 24: Overview of coronavirus

5. LIMITATIONS

Currently the proposed expert system is specialized in the diagnosis multi symptoms of coronavirus disease appear in nine days through facing this disease. The major symptoms are fever, cough, pneumonia in both lungs, and shortness of breath.

6. SYSTEM EVALUATION

As an introductory evolution, a group of doctors and medical specializations tested this proposed Expert System and they were satisfied with its performance, efficiency, user interface and ease of use.

7. CONCLUSION

In this paper, a proposed expert system was presented for helping a group of doctors and medical specializations in diagnosing patients with different possible coronavirus disease symptoms. Doctors and medical specializations can get the diagnosis faster and more accurate than the traditional diagnosis. This expert system does not need intensive training to be used; it is easy to use and has user friendly interface. It was using CLIPS and Delphi XE10.2 languages.

8. FUTURE WORK

This expert system is considered to be a base of future ones; more castor diseases are planned to be added and to make it more accessible to users from anywhere at any time.

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