

# An Expert System for Depression Diagnosis

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**Abstract: Background:** Depression (major depressive disorder) is a common and serious medical illness that negatively affects how you feel, the way you think and how you act. Fortunately, it is also treatable. Depression causes feelings of sadness and/or a loss of interest in activities once enjoyed. It can lead to a variety of emotional and physical problems and can decrease a person's ability to function at work and at home. Depression affects an estimated one in 15 adults (6.7%) in any given year. And one in six people (16.6%) will experience depression at some time in their life. Depression can strike at any time, but on average, first appears during the late teens to mid-20s. Women are more likely than men to experience depression. Some studies show that one-third of women will experience a major depressive episode in their lifetime. **Objectives:** The main goal of this expert system is to get the appropriate diagnosis of disease and the correct treatment and give the appropriate method of treatment through several tips that concern the disease and how to treat it and we will see it through the application on the expert system. **Methods:** in this paper the design of the proposed Expert System which was produced to help Psychologist in diagnosing depression disease through its symptoms such as: a loss of energy, a change in appetite, sleeping more or less, anxiety, reduced concentration, indecisiveness, restlessness, feelings of worthlessness, guilt or hopelessness and thoughts of self-harm or suicide. The proposed expert system presents an overview about depression disease is given, the cause of diseases is outlined and the treatment of disease whenever possible is given out. SL5 Object Expert System language was used for designing and implementing the proposed expert system. **Results:** The proposed depression disease diagnosis expert system was evaluated by psychologist students and they were satisfied with its performance. **Conclusions:** The Proposed expert system is very useful for psychologist, patients with depression and newly graduated psychologist.

**Keywords:** Artificial Intelligence, Expert Systems, SL5 Object, Depression, Language and psychologist.

## 1. INRODUCTION

While we all feel sad, moody or low from time to time, some people experience these feelings intensely, for long periods of time (weeks, months or even years) and sometimes without any apparent reason. Depression is more than just a low mood, it's a serious condition that affects your physical and mental health.

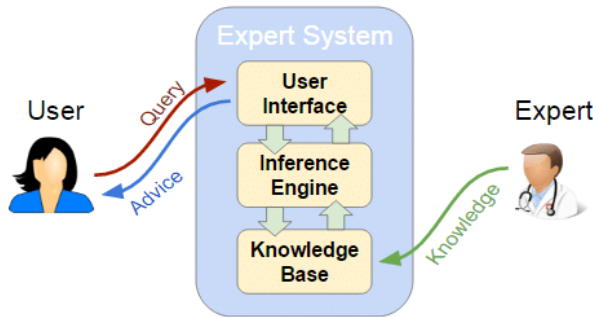
Before adolescence, depression is rare and occurs at about the same rate in girls and boys. However, with the onset of puberty, a girl's risk of developing depression increases dramatically to twice that of boys.

Depression can run in families. When it does, it generally starts between ages 15 and 30. A family link to depression is much more common in women. However, there is not always an apparent genetic or hereditary link to explain why someone may develop clinical depression.

Diagnosis of depression is a very complex because it has many symptoms and may affect on human health. So, they need Psychologist with wide experience of depression. For all the aforementioned reasons, we have developed this expert system to help psychologist in diagnosing the depression, in order to prescribe the appropriate treatment. Expert System is a computer application of Artificial Intelligence (AI) which contains a knowledge base and an inference engine the main components and details are represented in figure 2.



**Figure 1:** The figure presents the situation of depressed person



**Figure 2:** The figure presents the Main Components of an Expert System

The proposed Expert System for Depression Diagnosis was implemented using, SL5 Object language which stands for Simpler Level 5 Object. It is a forward chaining reasoning expert system that can make inferences about facts of the world using rules, objects and take appropriate actions as a result. The SL5 Object engine is implemented in Delphi Embarcadero RAD Studio XE6. SL5 Object executes any Expert System looks like frames. It's easy for the knowledge engineer to build the Expert System and for the end users when they use the system.

## 2. LITERATURE REVIEW

Here is a summary of expert systems found in the literature:

- An expert system for nausea and vomiting problems in infants and children [54] to aid users in getting the right diagnosis of problems of nausea and vomiting in infants and children (Gastro-esophageal reflux, Gastroenteritis, Systemic Infection, Bowel obstruction, Tumors, A bleeding disease, tonsillitis, and Hepatitis pharynx). Additionally, this expert system offers information about the disease and how to deal with it.
- An expert system for feeding problems in infants and children [36] to diagnose feeding problems in infants and children.
- Detecting Health Problems Related to Addiction of Video Game Playing Using an Expert System [39] to assist users in getting the correct diagnosis of the health problem of video game addictions that range from (Musculoskeletal issues, Vision problems and Obesity). Furthermore, this expert system delivers information about the problem and tells us how we can solve it.
- An Expert System for Endocrine Diagnosis and treatments using JESS [66] was developed to help in diagnosing endocrine glands diseases.
- A Proposed Expert System for Skin Diseases Diagnosis [64] was developed using CLIPS(C Language Integrated Production System) to help user diagnose the following skin diseases (Psoriasis,

Eczema, Ichthyosis, Acne, Meningitis, Measles, Scarlet Fever, Warts, Insect Bites and Stings).

- Lower Back Pain Expert System Diagnosis and Treatment [41] can be used to positively diagnose low back pain concentration.
- Expert System for Problems of Teeth and Gums [38] assist people with teeth and gums problems to diagnose their problems and receive a recommendation for the treatment. This knowledge based system was developed using SL5 Object language.
- Ear Diseases Diagnosis Expert System Using SL5 Object [32] swiftly diagnoses patient's condition and proposes a appropriate answer for the problem.
- A Proposed Expert System for Foot Diseases Diagnosis [60] diagnoses eighteen foot problems of all phases of the human life beginning with baby to the grownup by examining with yes/no questions.
- A Knowledge Based System for Neck Pain Diagnosis [46] can diagnose seven neck diseases of different phases of the human life beginning by asking the user many questions according to their pain symptoms.
- An expert system for shoulder problems using CLIPS [58] can help in diagnosing shoulder problems.
- Expert system urination problems diagnosis [62] can diagnose some of the Urination diseases (Pyelonephritis, Kidney Stone, Bladder infection, Prostatitis, Urethritis, Gonorrhea, Interstitial cystitis, Stress incontinence, Trauma in kidney or bladder).
- A Proposed Rule Based System for Breasts Cancer Diagnosis [54] was developed to help people in preventing and early detecting breast cancer; since it is known that this disease does not have medication or cure yet.
- An Expert System for Genital Problems in Infants [52] diagnoses genital problems in infants which is one of the most common problems that need quick intervention in the newly born stage.
- An expert system for men genital problems diagnosis and treatment [45] to assist men diagnose their genital problems and give them the suitable treatment. Genital problems and injuries usually occur through: recreational activities (such as: Basketball, Football, Hooky, Biking), work-related tasks (such as: contact to irritating chemicals), downhill drop, and sexual activities. SL5 Object expert system language was used to develop this expert system.
- Male Infertility Expert System Diagnoses and Treatment [43] for male infertility diagnosis which helps men to explore everything related to the problems of infertility and infertility diseases such

as: Azoospermia, O.T.A syndrome which mean oligo-terato-astheno spermia, Aspermia and Sexual transmitted disease.

- An expert system for diagnosing eye diseases using clips [34] provides the patient with background for suitable diagnosis of a few of the eye diseases.
- An Expert System for Mouth Problems in Infants and Children [46] ask the user to answer the questions about the symptoms of the patient and end up with some information about the disease and some advices telling the user how to deal with the baby.
- Knowledge Management in ESMDA: Expert System for Medical Diagnostic Assistance [37] deals with the design of a prototype expert system that assists patients to diagnose their diseases and offer them the suitable advice.
- Knowledge Based System for Long-term Abdominal Pain (Stomach Pain) Diagnosis and Treatment [57] was made to aid internist physicians in diagnosing numerous of the abdomen diseases for example: gastritis, hiatal hernia, ulcer or heartburn; the proposed expert system offers a summary about abdomen diseases are given, the cause of diseases are drew and the cure of disease when possible is shown up.
- A Ruled Based System for Ear Problem Diagnosis and Treatment [48] was used to classify ear problems into three main sets: a- Inflammation of the inner ear b- Middle ear problems c- External ear problems.
- Knowledge Based System for Ankle Diseases Diagnosis [44] recognized seven ankle diseases: Ankle Sprain, Fracture (of Fibula), Rheumatoid Arthritis, Rheumatoid Fever, Gout, and Osteoarthritis (Degenerative Joint) and they developed the expert system for those ankle diseases using SL5 Object Expert System Language.
- An Expert System for Diagnosing Shortness of Breath in Infants and Children [35] for diagnosing infants and children patients with twelve various shortness of breath in infants and children diseases.
- Polymyalgia Rheumatic Expert System [65] outlined an expert system for classification criteria for PMR, recent advances of diagnostic and therapeutic procedures.
- Expert System for Chest Pain in Infants and Children [51] to assist doctors, parents, and care giver in diagnosing chest pain in infants and children.
- Rickets Expert System Diagnoses and Treatment [40] assist doctors to discover everything connected to the problems of rickets.

- Expert System for Hair Loss Diagnosis and Treatment [63] for diagnosing eleven diverse hair loss diseases of the human stages from childhood to adults by asking questions with a Yes or No answer.

Even though, there are many expert systems that are developed for diagnosing human problems; there is no specialized expert system for diagnosing the *depression disease* available free. The proposed expert system was designed and developed specifically to aid doctors in diagnosing the *depression disease*.

### 3. MATERIALS AND METHODS

The proposed expert system performs diagnosis for depression of all stages of the human life starting with simple symptoms by asking yes or no questions. The proposed expert system will ask the user to choose the correct answer in each screen. At the end of the dialogue session, the proposed expert system provides the diagnosis and recommendation of the disease to the user. Figure 3 shows a sample dialogue between the expert system and the user. Figure 4 shows how the users get the diagnosis and recommendation.

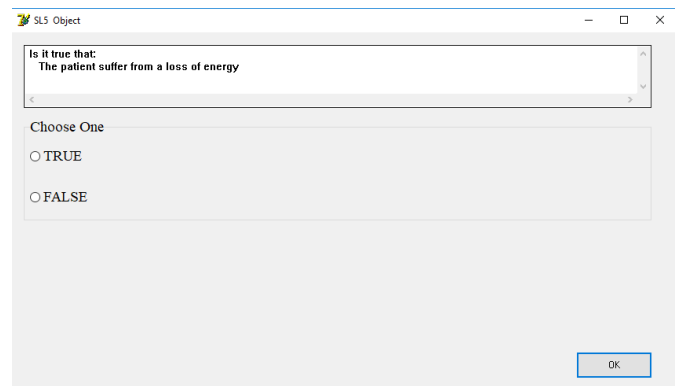


Figure 3: The figure presents shows when the system asks the user

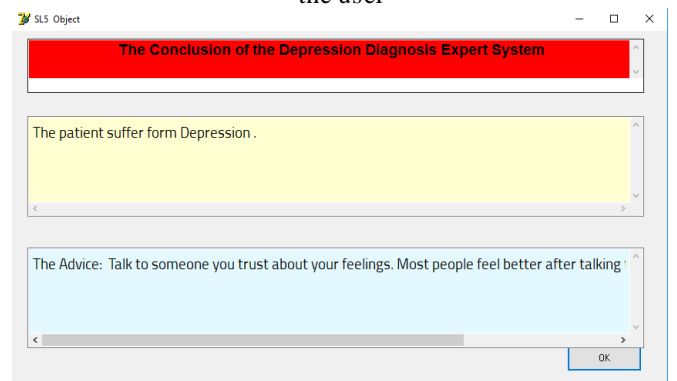


Figure 4: The figure shows diagnosis and recommendation of the expert system

### 4. LITERATURE REVIEW

There is a lot of Expert System that were designed to diagnose diseases such as Eye, Endocrine, skin and other types of disease. But there is no specialized expert system for diagnosis of depression available free. Although it's linked to several human diseases.

Abu Naser And Izzeddin developed an expert system to diagnosis coconut diseases using CLIPS language Some of these Expert Systems are specialized in one specific disease with restrictions. but the current proposed expert system is specialized in the diagnosis of depression with nine symptoms: a loss of energy, a change in appetite, sleeping more or less, anxiety, reduced concentration, indecisiveness, restlessness, feelings of worthlessness, guilt or hopelessness and thoughts of self-harm or suicide.

### 5. KNOWLEDGE REPRESENTATION

The main sources of the knowledge for this expert system are Psychologist and specializes websites for depression. The captured knowledge has been converted into SL5 Object Knowledge base syntax (Facts, Rules and Object). Currently the expert system has 9 rules which cover depression disease.

### 6. LIMITATIONS

The current proposed expert system is specialized in the diagnosis only depression with the following symptoms: a loss of energy, a change in appetite, sleeping more or less, anxiety, reduced concentration, indecisiveness, restlessness, feelings of worthlessness, guilt or hopelessness and thoughts of self-harm or suicide.

### 7. SYSTEM EVALUATION

As a preliminary evolution, Dr. Abdelazeez Noman and other Psychologist students tested this proposed Expert System and they were satisfied with its performance, efficiency, user interface and ease of use.

### 8. CONCLUSION

In this paper, a proposed expert system was presented for helping Psychologist in diagnosing patients with nine different symptoms possible depression. Psychologist and depression patients 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 developed using SL5 Object Expert System language.

### 9. EXPERT SYSTEM SOURCE CODE

! Written by SAMI AND IZZEDDIN

ATTRIBUTE start SIMPLE

ATTRIBUTE The patient suffer from a loss of energy  
SIMPLE

ATTRIBUTE The patient suffer from a change in appetite  
SIMPLE

ATTRIBUTE The patient suffer from sleeping more or less  
SIMPLE

ATTRIBUTE The patient suffer from anxiety SIMPLE

ATTRIBUTE The patient suffer from reduced concentration  
SIMPLE

ATTRIBUTE The patient suffer from indecisiveness  
SIMPLE

ATTRIBUTE The patient suffer from restlessness SIMPLE

ATTRIBUTE The patient suffer from feelings of  
worthlessness guilt or hopelessness SIMPLE

ATTRIBUTE The patient suffer from thoughts of self harm  
or suicide 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 := 236,170,236  
WITH justify IS left  
WITH font := "Cairo"  
WITH font style IS bold  
WITH font size := 14  
WITH text :="

Depression Diagnosis Expert  
System

Written By IZZEDDIN

This Expert System diagnoses depression Problems 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."

INSTANCE Conc ISA display

WITH wait := TRUE

WITH delay changes := FALSE

WITH items [1] := title textbox

WITH items [2] := problem textbox

WITH items [3] := advise textbox

INSTANCE title textbox ISA textbox

WITH location := 20,10,800,70

WITH pen color := 0,0,0

WITH fill color := 255,0,0

WITH justify IS center

WITH font := "Arial"

WITH font style IS bold

WITH font size := 14

WITH text := " The Conclusion of the Depression  
Diagnosis Expert System"

INSTANCE problem textbox ISA textbox

WITH location := 20,110,800,130

WITH pen color := 0,0,0

WITH fill color := 255,255,209

WITH justify IS left

WITH font := "Cairo"

WITH font size := 14

WITH text := " -----"

INSTANCE advise textbox ISA textbox

WITH location := 20,280,800,130

WITH pen color := 0,0,0

WITH fill color := 228,249,255

WITH justify IS left

WITH font := "Cairo"

WITH font size := 14

WITH text := " -----"

RULE R0

IF start

THEN ASK The patient suffer from a loss of energy

RULE R1

IF The patient suffer from a loss of energy

THEN ASK The patient suffer from a change in appetite

RULE R2

IF The patient suffer from a loss of energy

AND The patient suffer from a change in appetite

THEN ASK The patient suffer from sleeping more or less

RULE R3

IF The patient suffer from a loss of energy

AND The patient suffer from a change in appetite

AND The patient suffer from sleeping more or less

THEN ASK The patient suffer from anxiety

RULE R4

IF The patient suffer from a loss of energy

AND The patient suffer from a change in appetite

AND The patient suffer from sleeping more or less

AND The patient suffer from anxiety

THEN ASK The patient suffer from reduced concentration

RULE R5

IF The patient suffer from a loss of energy

AND The patient suffer from a change in appetite

AND The patient suffer from sleeping more or less

AND The patient suffer from anxiety

AND The patient suffer from reduced concentration

THEN ASK The patient suffer from indecisiveness

RULE R6

IF The patient suffer from a loss of energy

AND The patient suffer from a change in appetite

AND The patient suffer from sleeping more or less

AND The patient suffer from anxiety

AND The patient suffer from reduced concentration

AND The patient suffer from indecisiveness

THEN ASK The patient suffer from restlessness

RULE R7

IF The patient suffer from a loss of energy

AND The patient suffer from a change in appetite

AND The patient suffer from sleeping more or less

AND The patient suffer from anxiety

AND The patient suffer from reduced concentration

AND The patient suffer from indecisiveness

AND The patient suffer from restlessness

THEN ASK The patient suffer from feelings of

worthlessness guilt or hopelessness

RULE R8

IF The patient suffer from a loss of energy

AND The patient suffer from a change in appetite

AND The patient suffer from sleeping more or less

AND The patient suffer from anxiety

AND The patient suffer from reduced concentration

AND The patient suffer from indecisiveness

AND The patient suffer from restlessness

AND The patient suffer from feelings of worthlessness guilt  
or hopelessness

THEN ASK The patient suffer from thoughts of self harm or  
suicide

RULE R9

IF The patient suffer from a loss of energy

AND The patient suffer from a change in appetite

AND The patient suffer from sleeping more or less

AND The patient suffer from anxiety

AND The patient suffer from reduced concentration

AND The patient suffer from indecisiveness

AND The patient suffer from restlessness

AND The patient suffer from feelings of worthlessness guilt  
or hopelessness

AND The patient suffer from thoughts of self harm or  
suicide

THEN text OF problem textbox := "The patient suffer form Depression."  
AND text OF advise textbox := "The Advice: Talk to someone you trust about your feelings. Most people feel better after talking to someone who cares about them"  
ELSE text OF problem textbox := "The patient does not suffer form Depression."  
AND text OF advise textbox := "The Advice: Keep the good think "  
END

## REFERENCES

1. <https://www.psychiatry.org/patients-families/depression/what-is-depression>
2. <https://www.beyondblue.org.au/the-facts/depression>
3. <https://www.webmd.com/depression/guide/depression-women#1>
4. Almadhoun, H. R., et al. (2018). Banana Knowledge Based System Diagnosis and Treatment. International Journal of Academic Pedagogical Research (IJAPR), 2(7), 1-11.
5. Barhoom, A. M., et al. (2018). Black Pepper Expert System. International Journal of Academic Information Systems Research (IJASIR), 2(8), 9-16.
6. Alajrami, M. A., et al. (2018). Onion Rule Based System for Disorders Diagnosis and Treatment. International Journal of Academic Pedagogical Research (IJAPR), 2(8), 1-9.
7. Abu-Nasser, B. S., et al. (2018). Cognitive System for Helping Farmers in Diagnosing Watermelon Diseases. International Journal of Academic Information Systems Research (IJASIR), 2(7), 1-7.
8. Nassr, M. S., et al. (2018). Knowledge Based System for Diagnosing Pineapple Diseases. International Journal of Academic Pedagogical Research (IJAPR), 2(7), 12-19.
9. Elqassas, R., et al. (2018). Expert System for the Diagnosis of Mango Diseases. International Journal of Academic Engineering Research (IJAEER), 2(8), 10-18.
10. Abu Ghali, M. J., et al. (2017). Expert System for Problems of Teeth and Gums. International Journal of Engineering and Information Systems (IJEAIS), 1(4), 198-206.
11. Akkila, A. N., et al. (2016). Proposed Expert System for Calculating Inheritance in Islam. World Wide Journal of Multidisciplinary Research and Development, 2(9), 38-48.
12. Al Rekhawi, H. A., et al. (2017). Rickets Expert System Diagnoses and Treatment. International Journal of Engineering and Information Systems (IJEAIS), 1(4), 149-159.
13. Akkila, A. N., et al. (2008). A Proposed Expert System for Skin Diseases Diagnosis. INSInet Publication. Journal of Applied Sciences Research, 4(12), 1682-1693.
14. El Agha, M., Jarghon, A., et al. (2017). Polymyalgia Rheumatic Expert System. International Journal of Engineering and Information Systems (IJEAIS), 1(4), 125-137.
15. Al-Dahdooh, R., et al. (2010). Knowledge management in ESMDDA: expert system for medical diagnostic assistance. AIML Journal, 10(1), 31-40.
16. AbuEl-Reesh, J. Y., et al. (2017). A Knowledge Based System for Diagnosing Shortness of Breath in Infants and Children. International Journal of Engineering and Information Systems (IJEAIS), 1(4), 102-115.
17. El Haddad, I., et al. (2016). An Expert System for Genital Problems in Infants. World Wide Journal of Multidisciplinary Research and Development (WWJMRD), 2(5).
18. Alamawi, W. W., et al. (2016). Rule Based System for Diagnosing Wireless Connection Problems Using SL5 Object. International Journal of Information Technology and Electrical Engineering, 5(6), 26-33.
19. Almurshidi, S. H., et al. (2018). EXPERT SYSTEM FOR DIAGNOSING BREAST CANCER. Al-Azhar University, Gaza, Palestine.
20. Alawar, M. W., et al. (2016). An expert system for feeding problems in infants and children. International Journal of Medicine Research, 1(2), 79-82.
21. Nabahin, A., et al. (2017). Expert System for Hair Loss Diagnosis and Treatment. International Journal of Engineering and Information Systems (IJEAIS), 1(4), 160-169.
22. Al-Bayed, M. H. et al. (2016). Detecting Health Problems Related to Addiction of Video Game Playing Using an Expert System. World Wide Journal of Multidisciplinary Research and Development, 2(9), 7-12.

23. Azaab, S., et al. (2000). A proposed expert system for selecting exploratory factor analysis procedures. *Journal of the College of Education*, 4(2), 9-26.
  24. AlDahdooh, R. M., et al. (2016). Lower Back Pain Expert System Diagnosis and Treatment. *Journal of Multidisciplinary Engineering Science Studies (JMESS)*, 2(4), 441-446.
  25. Bakeer, H., et al. (2017). Photo Copier Maintenance Expert System V. 01 Using SL5 Object Language. *International Journal of Engineering and Information Systems (IJEAIS)*, 1(4), 116-124.
  26. Alhabbash, M. I., et al. (2016). Male Infertility Expert system Diagnoses and Treatment. *American Journal of Innovative Research and Applied Sciences*, 2(4).
  27. Khella, R., et al. (2017). Rule Based System for Chest Pain in Infants and Children. *International Journal of Engineering and Information Systems*, 1(4), 138-148.
  28. Al-Hanjori, M. M., et al. (2016). An expert system for men genital problems diagnosis and treatment. *International Journal of Medicine Research*, 1(2), 83-86.
  29. Dahouk, A. W., et al. (2018). A Proposed Knowledge Based System for Desktop PC Troubleshooting. *International Journal of Academic Pedagogical Research (IJAPR)*, 2(6), 1-8.
  30. ALmursheidi, S. H., et al. (2016). A Knowledge Based System for Neck Pain Diagnosis. *World Wide Journal of Multidisciplinary Research and Development (WWJMRD)*, 2(4), 12-18.
  31. Musleh, M. M., et al. (2018). Rule Based System for Diagnosing and Treating Potatoes Problems. *International Journal of Academic Engineering Research (IJAEER)*, 2(8), 1-9.
  32. Baraka, M. H., et al. (2008). A Proposed Expert System For Guiding Freshman Students In Selecting A Major In Al-Azhar University, Gaza. *Journal of Theoretical & Applied Information Technology*, 4(9).
  33. Mrouf, A., et al. (2017). Knowledge Based System for Long-term Abdominal Pain (Stomach Pain) Diagnosis and Treatment. *International Journal of Engineering and Information Systems (IJEAIS)*, 1(4), 71-88.
  34. Bastami, B. G., et al. (2016). A proposed rule based system for breasts cancer diagnosis. *World Wide Journal of Multidisciplinary Research and Development*, 2(5), 27-33.
  35. Hasanein, H. A. A., et al. (2016). Ear Diseases Diagnosis Expert System Using SL5 Object. *World Wide Journal of Multidisciplinary Research and Development*, 2(4), 41-47.
  36. El-Najjar, A. E. A., et al. (2016). An expert system for nausea and vomiting problems in infants and children. *International Journal of Medicine Research*, 1(2), 114-117.
  37. Qwaider, S. R., et al. (2017). Expert System for Diagnosing Ankle Diseases. *International Journal of Engineering and Information Systems (IJEAIS)*, 1(4), 89-101.
  38. Hamed, M. A., et al. (2016). An Expert System for Mouth Problems in Infants and Children. *Journal of Multidisciplinary Engineering Science Studies (JMESS)*, 2(4), 468-476.
  39. AlZamily, J. Y., et al. (2018). A Cognitive System for Diagnosing Musa Acuminata Disorders. *International Journal of Academic Information Systems Research (IJASIR)*, 2(8), 1-8.
  40. Mahdi, A. O., et al. (2016). A proposed Expert System for Foot Diseases Diagnosis. *American Journal of Innovative Research and Applied Sciences*, 2(4), 155-168.
  41. Ola, A. Z. A., et al. (2008). AN EXPERT SYSTEM FOR DIAGNOSING EYE DISEASES USING CLIPS. *Journal of Theoretical & Applied Information Technology*, 4(10).
  42. Naser, S. S. A., & Hilles, M. M. (2016). An expert system for shoulder problems using CLIPS. *World Wide Journal of Multidisciplinary Research and Development*, 2(5), 1-8.
  43. Shaath, M. Z., et al. (2016). Expert system urination problems diagnosis. *World Wide Journal of Multidisciplinary Research and Development*, 2(5), 9-19.
  44. El-Hissi, H., et al. (2010). An expert system for endocrine diagnosis and treatments using JESS. *Journal of Artificial Intelligence; Scialert*, 3(4), 239-251.
  45. Ashqar, B. A. M., et al. (2019). Plant Seedlings Classification Using Deep Learning. *International Journal of Academic Information Systems Research (IJASIR)*, 3(1), 7-14.
-

46. Ashqar, B. A. M., et al. (2019). Image-Based Tomato Leaves Diseases Detection Using Deep Learning. International Journal of Academic Engineering Research (IJAER), 2(12), 10-16.
47. El\_Jerjawi, N. S., et al. (2018). Diabetes Prediction Using Artificial Neural Network. International Journal of Advanced Science and Technology, 121, 55-64.
48. Al-Shawwa, M., et al. (2019). Knowledge Based System for Apple Problems Using CLIPS. International Journal of Academic Engineering Research (IJAER), 3(3), 1-11.
49. Aldaour, A. F., et al. (2019). An Expert System for Diagnosing Tobacco Diseases Using CLIPS. International Journal of Academic Engineering Research (IJAER), 3(3), 12-18.
50. Aldaour, A. F., et al. (2019). An Expert System for Diagnosing Tobacco Diseases Using CLIPS. International Journal of Academic Engineering Research (IJAER), 3(3), 12-18.
51. Ashqar, B. A. M., et al. (2019). Identifying Images of Invasive Hydrangea Using Pre-Trained Deep Convolutional Neural Networks. International Journal of Academic Engineering Research (IJAER), 3(3), 28-36.
52. Mettleq, A. S. A., et al. (2019). A Rule Based System for the Diagnosis of Coffee Diseases. International Journal of Academic Information Systems Research (IJASIR), 3(3), 1-8.
53. Dheir, I., et al. (2019). Knowledge Based System for Diagnosing Guava Problems. International Journal of Academic Information Systems Research (IJASIR), 3(3), 9-15.
54. Al-Qumboz, M. N. A., et al. (2019). Spinach Expert System: Diseases and Symptoms. International Journal of Academic Information Systems Research (IJASIR), 3(3), 16-22.
55. Salman, F. M., et al. (2019). Expert System for Castor Diseases and Diagnosis. International Journal of Engineering and Information Systems (IJEAIS), 3(3), 1-10.