International Journal of Academic Information Systems Research (IJAISR)
ISSN: 2000-002X
Vol. 2 Issue 8, August – 2018, Pages: 9-16

Black Pepper Expert System

Alaa M. Barhoom, Samy S. Abu-Naser

Department of Information Technology,
Faculty of Engineering & Information Technology,
Al-Azhar University, Gaza, Palestine

Abstract: Background*: Plant production provides human and animal life with different requirements. The concern of workers in agriculture in general and those interested in plant diseases, in particular, has been focused on protection from all that is expected to have problems of production. As environmental conditions play a critical role in the treatment of diseases, the plant is prepared and rendered more susceptible to production, which is exposed and may result in the loss of the entire crop.*
Objectives*: The main goal of this expert system is to get the appropriate diagnosis of Black Pepper disease and the correct treatment.* ***Methods****: In this paper the design of the proposed Expert System which was produced to help Farmers, people interested in agriculture and agricultural engineers in diagnosing many of the black pepper diseases such as : Foot rot /quick, wilt disease, Pollu disease /anthracnose, Slow decline /slow wilt, Stunt disease, Phyllody disease, Basal wilt, Leaf rot and blight. The proposed expert system presents an overview about black pepper diseases are given, the cause of diseases are outlined and the treatment of disease whenever possible is given out. CLIPS with Delphi were used for designing and implementing the proposed expert system.* ***Results****: The proposed black pepper diseases diagnosis expert system was evaluated by Farmers, Agricultural experts and Agriculture teachers and they were satisfied with its performance.* ***Conclusions****: The Proposed expert system is very useful for farmers, and those interested in agriculture with black pepper disease and recent graduate students.*

Keywords: Black Pepper, Expert System, CLIPS, Delphi

1. INTRODUCTION

Black pepper is an important food crop in the world after rice and wheat and the leading vegetable crop in the United States

A high intake of fruits and vegetables can benefit health and reduce the risk of many lifestyle-related health conditions. Black pepper contains important nutrients, even when cooked that can benefit human health in various ways.

The black pepper contributes to a healthful lifestyle, including preventing osteoporosis, maintaining heart health, and reducing the risk of infect.

Figure 1: The figure shows benefits of black pepper[1]

Although black pepper can be very easy to grow in different places, there are many diseases, pests and other issues which can affect black pepper growth. Identifying these problems is the first step to solving them, and catching the problem early can make the disease treatment. So we have developed this expert system to help Agricultural engineer and farmers in diagnosing many of the black pepper diseases, in order to suggest the appropriate treatment.

Expert System is a program designed to simulate the intelligence of an expert in a particular field. It is mainly developed using artificial intelligence concepts, tools and technologies. An expert system is typically designed to provide capabilities similar to those of a human expert when performing a task. Moreover, it can be used to drive vehicles, provide financial forecasts or do things that human experts do [2].

An expert system usually has the following core components [2]:

The first part in an expert system is the rule base. This is comprised of two parts: a rule set and a dictionary. The rule set defines expert knowledge in the form of rules that can be thought of as a collection of cause and effect sentences. An example rule is "if your eyes are brown and your hair is brown then you are likely to have glasses". Furthermore, rules can also carry uncertainty information.

The dictionary defines the metadata for all of the knowledge variables, such as type, domain, and name. In the previous example the dictionary would contain at least three variables eye color, hair color, and whether or not they need glasses. Specifically the dictionary would define hair color is a discrete value and it can be white, blonde, brown, or black.

The second part of the expert system is the working memory. This is a collection of preconditions, which are a collection of variables defined in the dictionary. Using the previous example, a sample working memory could assert that student A's eyes are blue and their hair is blond. The working memory and rule base are then used by an inference engine and which will attempt to assert new conditions. The process

of processing rules can be different depending on what type of inference engine you are using. Two of the most commonly used algorithms are forward chaining and backwards chaining. Forward chaining attempts to take the preconditions and see if the rule base can assert anything from them. Backwards chaining works by supplying the post condition and then asserts the preconditions. If the preconditions match what is in working memory it can assert that something is true.

Regardless of the inference technique if a rule is satisfied, new facts will be added to working memory. This process usually continues until no new assumptions can be made. At this point working memory can be parsed to find out what information can be derived from the preconditions.

The rule base is the cornerstone of the expert system. The rule base defines a domain experts knowledge into a codified form, and defines what attributes are important. These attributes are then defined in the dictionary and used in working memory. Due to its importance the goal of the expert system generator will be to create the rule base for a given expert system.

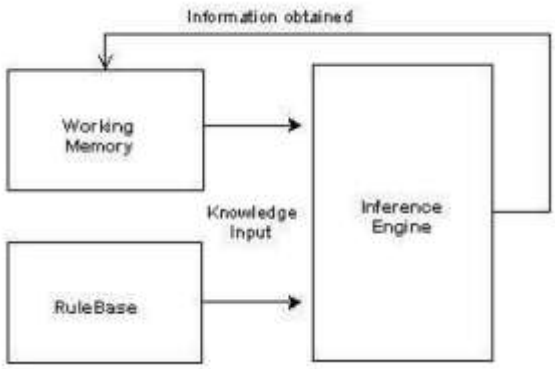

Figure 2: The figure presents the Main Components of an Expert System

The proposed Expert System for black pepper Diseases Diagnosis was implemented using, CLIPS language with Delphi. It is a forward chinning reasoning expert system that can make inferences about facts of the world using rules, objects and take appropriate actions as a result. CLIPS execute 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.

1. MATERIALS AND METHODS

The proposed expert system performs diagnosis for seven Black Pepper diseases as shown in Figure 3. The proposed expert system will ask the user to choose the correct Symptoms of black pepper disease 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.

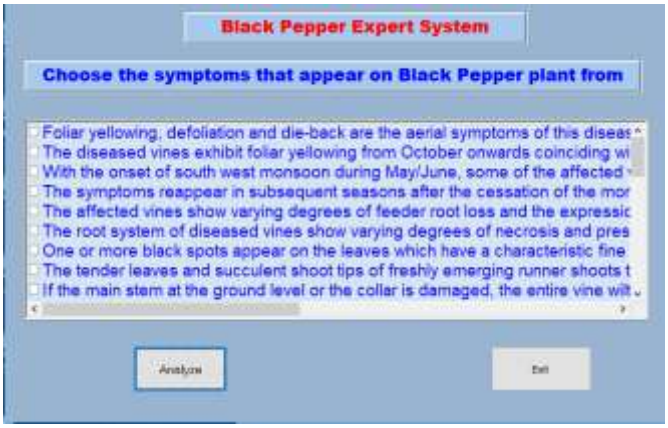

Figure 3 shows a sample dialogue between the expert system and the user.

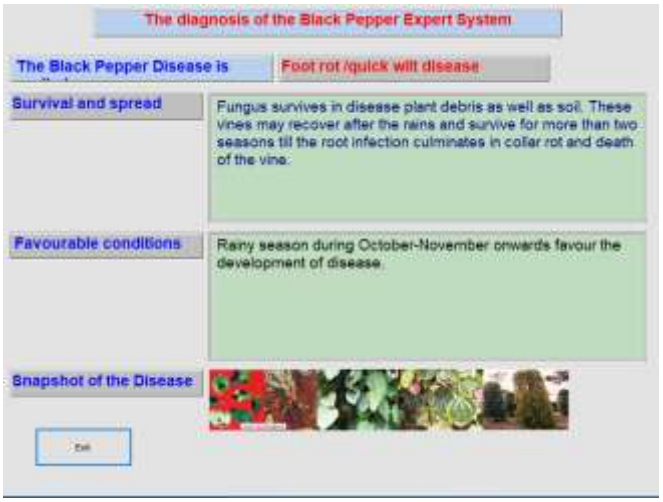

Figure 4 shows how the users get the diagnosis and recommendation

2. LITERATURE REVIEW.

There is a lot of Expert System that were designed to diagnose Plant Diseases. But there is no specialized expert system for diagnosis of black pepper diseases available free and use a language CLIPS Linked with Delphi. This expert system is easy to use by farmers and people concerned. This is due to the coordinated application interface

Some of these Expert Systems are specialized in one specific disease and others in five diseases. But the current proposed expert system is specialized in the diagnosis of seven black pepper diseases.

3. KNOWLEDGE REPRESENTATION

The main sources of the knowledge for this expert system are Agricultural expert and specializes websites for black pepper diseases. The captured knowledge has been converted into CLIPS syntax. Currently the expert system has rules which cover eleven black pepper diseases.

Black Pepper diseases:

a) Foot rot /quick wilt disease

Disease symptoms

1. One or more black spots appear on the leaves which have a characteristic fine fibre like projections at the advancing margins which rapidly enlarge and cause defoliation.
2. The tender leaves and succulent shoot tips of freshly emerging runner shoots trailing on the soil turn black when infected. The disease spreads to the entire vine, from these infected runner shoots and leaves, during intermittent showers due to rain splash.
3. If the main stem at the ground level or the collar is damaged, the entire vine wilts followed by shedding of leaves and spikes with or without black spots. The branches break up at nodes and the entire vine collapses within a month.
4. If the damage is confined to the feeder roots, the expression of symptoms is delayed till the cessation of rain and the vine starts showing declining symptoms such as yellowing, wilting, defoliation and drying up of a part of the vine.

Figure 5: shows the Symptoms of the disease **Foot rot /quick wilt**

b) Pollu disease /anthracnose

Disease symptoms

1. It can be distinguished from the pollu (hollow berry) caused by the beetle by the presence of characteristic cracks on the infected berries.
2. The disease appears towards the end of the monsoon.
3. The affected berries show brown sunken patches during early stages and their further development is affected.
4. In later stages, the discolouration gradually increases and the berries show the characteristic cross splitting.
5. Finally, the berries turn black and dry. The fungus also causes angular to irregular brownish lesions with a chlorotic halo on the leaves

Figure 6: shows the Symptoms of the disease Pollu disease /anthracnose

c) Slow decline /slow wilt

Disease symptoms

1. Foliar yellowing, defoliation and die-back are the aerial symptoms of this disease. The affected vines exhibit varying degrees of root degeneration due to infestation by plant parasitic nematodes.
2. The diseased vines exhibit foliar yellowing from October onwards coinciding with depletion of soil moisture.
3. With the onset of south west monsoon during May/June, some of the affected vines recover and put forth fresh foliage.
4. The symptoms reappear in subsequent seasons after the cessation of the monsoon and the diseased vines gradually lose their vigour and productivity.
5. The affected vines show varying degrees of feeder root loss and the expression of symptoms on the aerial parts occur after a considerable portion of the feeder roots are lost.
6. The root system of diseased vines show varying degrees of necrosis and presence of root galls due to infestation by plant parasitic nematodes such as Radopholus similis and Meloidogyne incognita leading to rotting of feeder roots. The damage to feeder roots is caused by these nematodes and P. capsici either independently or together in combination.

Figure 7: shows the Symptoms of the disease Slow decline /slow wilt

d) Stunt disease

Disease symptoms

1. This disease which is caused by viruses is noticed in parts of Kannur, Kasargod, Kozhikode, Wayanad and Idukki Districts of Kerala and Kodagu, Hassan and Uthara Kannada districts of Karnataka.
2. The vines exhibit shortening of internodes to varying degrees.
3. The leaves become small and narrow with varying degrees of deformation and appear leathery, puckered and crinkled.
4. Chlorotic spots and streaks also appear on the leaves occasionally. The yield of the affected vines decreases gradually.
5. Two viruses namely Cucumber Mosaic Virus and a Badna virus are associated with the disease.

International Journal of Academic Information Systems Research (IJAISR)
ISSN: 2000-002X
Vol. 2 Issue 8, August – 2018, Pages: 9-16

Figure 8: shows the Symptoms of the disease Stunt disease

e) Philology disease

Disease symptoms

1. This disease which is caused by Phytoplasma is noticed in parts of Wayanad and Kozhikode districts of Kerala.
2. The affected vines exhibit varying stages of malformation of spikes. Some of the floral buds are transformed into narrow leaf like structures.
3. Such malformed spikes show leafy structures instead of floral buds, exhibiting Phyllody symptoms.
4. In advanced stages, the leaves become small and chlorotic, and the internodes are also shortened.
5. The affected fruiting laterals give a witches broom appearance. Severely affected vines become unproductive.
6. In severely affected vines the entire spike is converted into small branches which appear chlorotic and the vines decline rapidly.
7. The infected vine becomes unproductive within two to three years.

Figure 9: shows the Symptoms of the Phyllody disease

f) Basal wilt

Disease symptoms

1. Grayish lesions appear on stems and leaves.
2. On the leaves white mycelium are seen at the advancing edges of the lesions.
3. The mycelial threads later girdle the stem resulting in drooping of leaves beyond the point of infection and in advanced stages the rooted cuttings dry up.
4. Small whitish to cream coloured grain like sclerotial bodies appear on the mature lesions.

Figure 10: shows the Symptoms of the Basal wilt

g) Leaf rot and blight

Disease symptoms

1. Greyish sunken spots and mycelial threads appear on the leaves and the infected leaves are attached to one another with the mycelial threads.
2. Leaf spots caused by Colletotrichum sp. are characterized by yellow halo surrounding the necrotic spots.
3. On stems, the infection occurs as dark brown lesions which spread both upwards and downwards. The new flushes subtending the points of infection gradually droop and dry up.

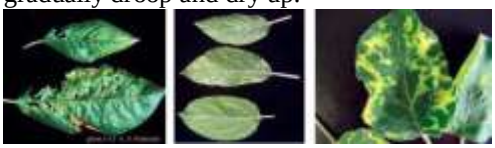

Figure 11: shows the Symptoms of **Leaf** rot and blight

4. LIMITATIONS

The current proposed expert system is specialized in the diagnosis only the following seven black pepper diseases : Foot rot /quick wilt disease, Pollu disease /anthracnose, Slow decline /slow wilt, Stunt disease, Phyllody disease, Basal wilt.

5. SYSTEM EVALUATION

As a preliminary evolution, many agricultural engineers, Agricultural teachers and Agriculture students tested this proposed Expert System and they were satisfied with its performance, efficiency, user interface and ease of use.

6. CONCLUSION

In this paper, a proposed expert system was presented for helping Farmers as well as those interested in agriculture in black pepper disease with seven different possible black pepper diseases. Farmers as well as those interested in agriculture diseases 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 CLIPS with Delphi language.

7. FUTURE WORK

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

8. EXPERT SYSTEM SOURCE CODE

```
(defrule disease1
(black-pepper-symptom 1 yes)
(black-pepper-symptom 2 yes)
(black-pepper-symptom 3 yes)
(black-pepper-symptom 4 yes)
 (not (black-pepper disease identified))
=>
(assert (black-pepper disease identified))
(printout fdatao "1"  crlf )
)


(defrule disease2
(black-pepper-symptom 5 yes)
(black-pepper-symptom 6 yes)

(black-pepper-symptom 7 yes)
(black-pepper-symptom 8 yes)
(black-pepper-symptom 9 yes)
 (not (black-pepper disease identified))
=>
(assert (black-pepper disease identified))
(printout fdatao "2"  crlf )
)
(defrule disease3
(black-pepper-symptom 10 yes)
(black-pepper-symptom 11 yes)
(black-pepper-symptom 12 yes)
(black-pepper-symptom 13 yes)
(black-pepper-symptom 14 yes)
(black-pepper-symptom 15 yes)
 (not (black-pepper disease identified))
=>
(assert (potato disease identified))
(printout fdatao "3"  crlf )
)
(defrule disease4
(black-pepper-symptom 16 yes)
(black-pepper-symptom 17 yes)
(black-pepper -symptom 18 yes)
(black-pepper -symptom 19 yes)
(black-pepper -symptom 20 yes)
 (not (black-pepper disease identified))
=>
(assert (black-pepper disease identified))
(printout fdatao "4"  crlf )
)
(black-pepper -symptom 21 yes)
(black-pepper -symptom 22 yes)
(black-pepper -symptom 23 yes)
(black-pepper -symptom 24 yes)
(black-pepper -symptom 25 yes)
(black-pepper -symptom 26 yes)
(black-pepper -symptom 27 yes)
(not (black-pepper disease identified))
=>
(assert (black-pepper disease identified))
(printout fdatao "5"  crlf )
)
(defrule disease6
(black-pepper -symptom 28 yes)
(black-pepper -symptom 29 yes)
(black-pepper -symptom 30 yes)
(black-pepper -symptom 31 yes)

(not (black-pepper disease identified))
=>
(assert (black-pepper disease identified))
(printout fdatao "6"  crlf )
)
(defrule disease7
(black-pepper -symptom 32 yes)
(black-pepper -symptom 33 yes)
(black-pepper -symptom 34 yes)
(not (black-pepper disease identified))
=>
(assert (black-pepper disease identified))
(printout fdatao "7"  crlf )
)

 (defrule endline
(potato 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 (read fdata))
  (bind ?symptom2 (read fdata))
  (bind ?symptom3 (read fdata))
  (bind ?symptom4 (read fdata))
  (bind ?symptom5 (read fdata))
  (bind ?symptom6 (read fdata))
  (bind ?symptom7 (read fdata))
  (bind ?symptom8 (read fdata))
  (assert
    (black-pepper-symptom ?symptom1 yes)
    (black-pepper-symptom ?symptom2 yes)
    (black-pepper-symptom ?symptom3 yes)
    (black-pepper-symptom ?symptom4 yes)
    (black-pepper-symptom ?symptom5 yes)
```

```
   (black-pepper-symptom ?symptom6 yes)
   (black-pepper-symptom ?symptom7 yes)
   )
  (close fdata)
)
```

REFERENCE

1. https://www.organicfacts.net/
2. Techopedia https://www.techopedia.com/definition/613/expert-system
3. http://www.theorganicfarmer.org/Articles/bacterial-wilt-big-threat-potato-growing
4. http://vikaspedia.in/agriculture/crop-production/integrated-pest-managment/ipm-for-vegetables/ipm-strategies-for-potato/potato-diseases-and-symptoms
5. https://www.britannica.com/science/late-blight
6. http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/vegetable/potato-diseases/common-scab-of-potatoes
7. https://potatoes.ahdb.org.uk/media-gallery/detail/13214/2636
8. https://www.daera-ni.gov.uk/articles/potato-spindle-tuber-viroid-pstvd
9. Abu Naser, S. S., & ALmursheidi, S. H. (2016). A Knowledge Based System for Neck Pain Diagnosis. World Wide Journal of Multidisciplinary Research and Development (WWJMRD), 2(4), 12-18.
10. Abu Ghali, M. J., Mukhaimer, M. N., Abu Yousef, M. K., & Abu Naser, S. S. (2017). Expert System for Problems of Teeth and Gums. International Journal of Engineering and Information Systems (IJEAIS), 1(4), 198-206.
11. Abu Naser, S., & Akkila, A. N. (2008). A Proposed Expert System for Skin Diseases Diagnosis. INSInet Publication. Journal of Applied Sciences Research, 4(12), 1682-1693.
12. Akkila, A. N., & Abu Naser, S. S. (2016). Proposed Expert System for Calculating Inheritance in Islam. World Wide Journal of Multidisciplinary Research and Development, 2(9), 38-48.
13. Abu-Naser, S. S., Kashkash, K. A., & Fayyad, M. (2010). Developing an expert system for plant disease diagnosis. Journal of Artificial Intelligence ; Scialert, 3(4), 269-276.
14. Al Rekhawi, H. A., Ayyad, A. A., & Abu Naser, S. S. (2017). Rickets Expert System Diagnoses and Treatment. International Journal of Engineering and Information Systems (IJEAIS), 1(4), 149-159.
15. Abu Naser, S., Al-Dahdooh, R., Mushtaha, A., & El-Naffar, M. (2010). Knowledge management in ESMDA: expert system for medical diagnostic assistance. AIML Journal, 10(1), 31-40.
16. Azaab, S., Abu Naser, S., & Sulisel, O. (2000). A proposed expert system for selecting exploratory factor analysis procedures. Journal of the College of Education, 4(2), 9-26.
17. Abu Naser, S., & El Haddad, I. (2016). An Expert System for Genital Problems in Infants. World Wide Journal of Multidisciplinary Research and Development (WWJMRD), 2(5).
18. Bakeer, H. M. S., & Naser, S. S. A. (2017). Photo Copier Maintenance Expert System V. 01 Using SL5 Object Language. International Journal of Engineering and Information Systems (IJEAIS), 1(4), 116-124.
19. Abu Naser, S. S. (1993). A methodology for expert systems testing and debugging. North Dakota State University, USA.
20. El Agha, M., Jarghon, A., & Abu Naser, S. S. (2017). Polymyalgia Rheumatic Expert System. International Journal of Engineering and Information Systems (IJEAIS), 1(4), 125-137.
21. Abu Naser, S. S. (1999). Big O Notation for Measuring Expert Systems complexity. Islamic University Journal Gaza, 7(1), 57-70.
22. Hilles, M. M., & Abu Naser, S. S. (2017). Knowledge-based Intelligent Tutoring System for Teaching Mongo Database. EUROPEAN ACADEMIC RESEARCH, 6(10), 8783-8794.
23. Almurshidi, S. H., & Naser, S. S. A.(2018). Expert System For Diagnosing Breast Cancer. Al-Azhar University, Gaza, Palestine.
24. Abu Naser, S., & Aead, A. M. (2013). Variable Floor for Swimming Pool Using an Expert System. International Journal of Modern Engineering Research (IJMER), 3(6), 3751-3755.
25. Dahouk, A. W., & Abu-Naser, S. S. (2018). A Proposed Knowledge Based System for Desktop PC Troubleshooting. International Journal of Academic Pedagogical Research (IJAPR), 2(6), 1-8.
26. Abu Naser, S. S. (2012). A Qualitative Study of LP-ITS: Linear Programming Intelligent Tutoring System. International Journal of Computer Science & Information Technology, 4(1), 209.
27. Almadhoun, H. R., & Abu-Naser, S. S. (2018). Banana Knowledge Based System Diagnosis and Treatment. International Journal of Academic Pedagogical Research (IJAPR), 2(7), 1-8.
28. Abu-Naser, S., Al-Masri, A., Sultan, Y. A., & Zaqout, I. (2011). A prototype decision support system for optimizing the effectiveness of elearning in educational institutions. International Journal of Data Mining & Knowledge Management Process (IJDKP), 1, 1-13.
29. Hilles, M. M., & Abu Naser, S. S. (2017). Knowledge-based Intelligent Tutoring System for Teaching Mongo Database. EUROPEAN ACADEMIC RESEARCH, 6(10), 8783-8794.
30. Abu-Nasser, B. S. (2017). Medical Expert Systems Survey. International Journal of Engineering and Information Systems, 1(7), 218-224.

31. Nassr, M.S, & Abu-Naser, S. S. (2018). Knowledge Based System for Diagnosing Pineapple Diseases. International Journal of Academic Pedagogical Research (IJAPR), 2(7), 9-15.
32. Abu-Nasser, B. S., & Abu-Naser, S. S. (2018). Rule-Based System for Watermelon Diseases and Treatment. International Journal of Academic Information Systems Research (IJAISR), 2(7), 1-7.
33. Khella, R. A., & Abu Naser, S. S. (2017). Expert System for Chest Pain in Infants and Children. International Journal of Engineering and Information Systems (IJEAIS), 1(4), 138-148.
34. Abu-Naser, S., El-Hissi, H., & Abu-Rass, M. (2010). An Expert System for Endocrine Diadnosis and Treatment using JESS. Journal Of Artificial Intelligence, 4, 239-251.
35. AbuEl-Reesh, J. Y., & Abu Naser, S. S. (2017). An Expert System for Diagnosing Shortness of Breath in Infants and Children. International Journal of Engineering and Information Systems (IJEAIS), 1(4), 102-115.
36. Abu Naser, S. S., & Mahdi, A. O. (2016). A proposed Expert System for Foot Diseases Diagnosis. American Journal of Innovative Research and Applied Sciences, 2(4), 155-168.
37. Mrouf, A., Albatish, I., Mosa, M., & Abu Naser, S. S. (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.
38. Abu Naser, S. S. (2015). Sl5 Object: Simpler Level 5 Object Expert System Language. International Journal of Soft Computing, Mathematics and Control (IJSCMC), 4(4), 25-37.
39. Nabahin, A., Abou Eloun, A., & Abu Naser, S. S. (2017). Expert System for Hair Loss Diagnosis and Treatment. International Journal of Engineering and Information Systems (IJEAIS), 1(4), 160-169.
40. Abu Naser, S. S., & Al-Bayed, M. H. (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.
41. Naser, S. S. A., & Al-Nakhal, M. A. (2016). A Ruled Based System for Ear Problem Diagnosis and Treatment. World Wide Journal of Multidisciplinary Research and Development, 2(4), 25-31.
42. Qwaider, S. R., & Abu Naser, S. S. (2017). Expert System for Diagnosing Ankle Diseases. International Journal of Engineering and Information Systems (IJEAIS), 1(4), 89-101.
43. Abu Naser, S. S., Baraka, M. H., & Baraka, A. (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).
44. Naser, S. S. A., & Hasanein, H. A. A. (2016). Ear Diseases Diagnosis Expert System Using SL5 Object. World Wide Journal of Multidisciplinary Research and Development, 2(4), 41-47.
45. Almurshidi, S. H., & Abu Naser, S. S. (2017). Design and Development of Diabetes Intelligent Tutoring System. EUROPEAN ACADEMIC RESEARCH, 6(9), 8117-8128.
46. 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.
47. Abu-Naser, S. S., El-Hissi, H., Abu-Rass, M., & El-Khozondar, N. (2010). An expert system for endocrine diagnosis and treatments using JESS. Journal of Artificial Intelligence; Scialert, 3(4), 239-251.
48. Abu Naser, S. S., & Hamed, M. A. (2016). An Expert System for Mouth Problems in Infants and Children. Journal of Multidisciplinary Engineering Science Studies (JMESS), 2(4), 468-476.
49. Abu Naser, S. S., & Al-Bayed, M. H. (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.
50. Abu Naser, S. S., Alamawi, W. W., & Alfarra, M. F. (2016). Rule Based System for Diagnosing Wireless Connection Problems Using SL5 Object. International Journal of Information Technology and Electrical Engineering, 5(6), 26-33.
51. Abu Naser, S. S., & Alawar, M. W. (2016). An expert system for feeding problems in infants and children. International Journal of Medicine Research, 1(2), 79--82.
52. Abu Naser, S. S., & AlDahdooh, R. M. (2016). Lower Back Pain Expert System Diagnosis and Treatment. Journal of Multidisciplinary Engineering Science Studies (JMESS), 2(4), 441-446.
53. Abu Naser, S. S., & Alhabbash, M. I. (2016). Male Infertility Expert system Diagnoses and Treatment. American Journal of Innovative Research and Applied Sciences, 2(4).
54. Abu Naser, S. S., & Al-Hanjori, M. M. (2016). An expert system for men genital problems diagnosis and treatment. International Journal of Medicine Research, 1(2), 83-86.
55. Abu Naser, S. S., & Bastami, B. G. (2016). A proposed rule based system for breasts cancer diagnosis. World Wide Journal of Multidisciplinary Research and Development, 2(5), 27-33.
56. Abu Naser, S. S., & El-Najjar, A. E. A. (2016). An expert system for nausea and vomiting problems in infants and children. International Journal of Medicine Research, 1(2), 114-117.
57. Abu Naser, S. S., & Ola, A. Z. A. (2008). An Expert System For Diagnosing Eye Diseases Using CLIPS.

Journal of Theoretical & Applied Information Technology, 4(10).
58. Abu Naser, S. S., & Shaath, M. Z. (2016). Expert system urination problems diagnosis. World Wide Journal of Multidisciplinary Research and Development, 2(5), 9-19.
59. Abu Naser, S. S., & Zaqout, I. S. (2016). Knowledge-based systems that determine the appropriate students major: In the faculty of engineering and information technology. World Wide Journal of Multidisciplinary Research and Development, 2(10), 26-34.