

Rule Based System for Diagnosing Apple Trees

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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 Apple 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 apple diseases such as : Apple scab, Marssonina leaf blotch (pre mature leaf fall) , Black rot canker, Collar rot , Powdery mildew ,Sooty blotch and fly speck, Apple mosaic and other virus diseases , Alternaria leaf spot/blight , Core rot , Brown rot , White rot / root rot , Seedling blight . The proposed expert system presents an overview about apple 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 apple diseases diagnosis expert system was evaluated by Farmer, Agricultural experts and teachers of the Gaza School of Agriculture and they were satisfied with its performance. **Conclusions:** The Proposed expert system is very useful for Farmers, and those interested in agriculture with apple disease and recent graduate students.

Keywords: Expert System, Apple, Diseases, CLIPS.

1. INTRODUCTION

Apples are 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. apple contain important nutrients, even when cooked, that can benefit human health in various ways.

the apple contribute to a healthful lifestyle, including preventing osteoporosis, maintaining heart health, and reducing the risk of infection.



Figure 1: apple fruit

Although apple can be very easy to grow in different places, there are many diseases, pests and other issues which can affect apple 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 apple diseases, in order to prescribe the appropriate treatment[1,2].

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 [9-14].

An expert system usually has two core components [15-25]:

- Knowledge base -- This component consists of data, facts and rules for a certain topic, industry or skill, usually equivalent to that of a human expert.
- Inference engine -- This component uses the facts and rules in the knowledge base to find and learn new knowledge or patterns.

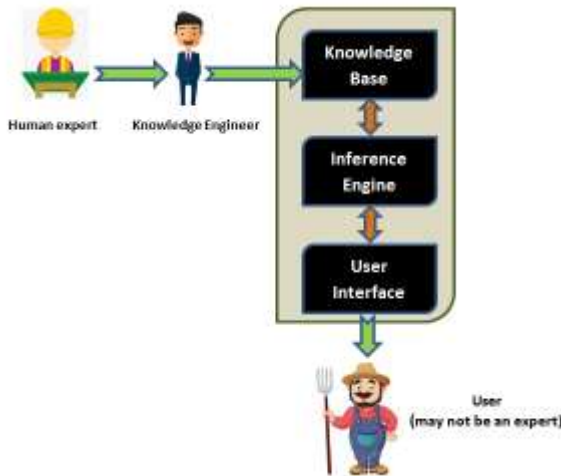


Figure 2: Expert System Architecture

The proposed Expert System for apple Diseases Diagnosis was implemented using, CLIPS language with Delphi. 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. CLIPS 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 [26-30].

2. MATERIALS AND METHODS

The proposed expert system performs diagnosis for twelfth apple diseases by displaying the symptoms. The proposed expert system will ask the user to choose the correct Symptoms of apple 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 [3-8].

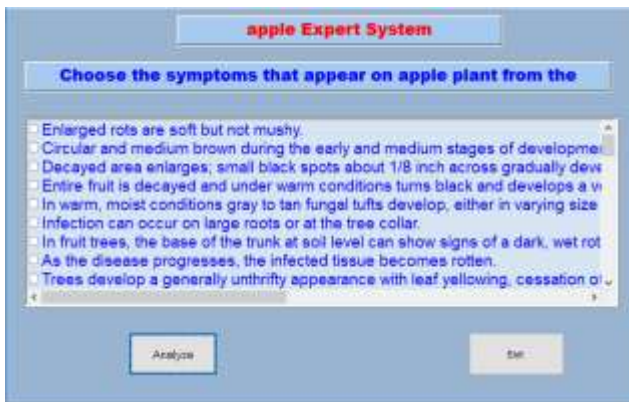


Figure 3 shows a sample dialogue between the expert system and the user.



Figure 4 shows how the users get the diagnosis and recommendation

3. LITERATURE REVIEW.

There is a lot of Expert System that were designed to diagnose Plant Diseases [31-40]. But there is no specialized expert system for diagnosis of apple diseases available free and Use a language CLIPS Linked with Delphi. This expert system was characterized to be 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 10 diseases. But the current proposed expert system is specialized in the diagnosis of 12 apple diseases.

4. KNOWLEDGE REPRESENTATION

The main sources of the knowledge for this expert system are Agricultural expert and specializes websites for apple diseases. The captured knowledge has been converted into CLIPS syntax. Currently the expert system has 43 rules which cover 12 diseases.

Some diseases and symptoms of apple [5-8]:

Apple scab

Disease symptoms

1. The disease usually noticed on leaves and fruits.
2. Affected leaves become twisted or puckered and have black, circular spots on their upper surface.
3. On the under surface of leaves, the spots are velvety and may coalesce to cover the whole leaf surface. Severely affected leaves may turn yellow and drop.
4. Scab can also infect flower stems and cause flowers to drop.
5. The lesions later become sunken and brown and may have spores around their margins
6. Infected fruit become distorted and may crack, allowing entry of secondary organisms.



Figure 5: The figure shows the Symptoms of the disease Apple scab

Marssonina leaf blotch (pre mature leaf fall)

Disease symptoms

1. The disease symptoms appears in form of dark green circular patches on upper surface of leaf giving rise to 5-10 mm brown leaf spots which become dark brown in due course.
2. On maturity it also develops on lower surface of the leaf.
3. Small black acervuli are visible on the surface of leaf.
4. When lesions are numerous, they coalesce and to form large dark brown blotches and the surrounding areas turn yellow.



Figure 6: The figure shows the Symptoms of the disease Marssonina leaf blotch (pre mature leaf fall)

Black rot canker

Disease symptoms

1. Leaf symptoms first occur early in the spring when the leaves are unfolding.
2. They appear as small, purple specks on the upper surface of the leaves that enlarge into circular lesions 1/8 to 1/4 inch (3-6 mm) in diameter.
3. The margin of the lesions remains purple, while the center turns tan to brown. In a few weeks, secondary enlargement of these leaf spots occurs.

4. Heavily infected leaves become chlorotic and defoliation occurs.
5. As the rotted area enlarges, a series of concentric bands of uniform width form which alternate in color from black to brown. The flesh of the rotted area remains firm and leathery. Black pycnidia are often seen on the surface of the infected fruit.
6. Lesions resulting in canker formation usually are associated with a wound in the bark.

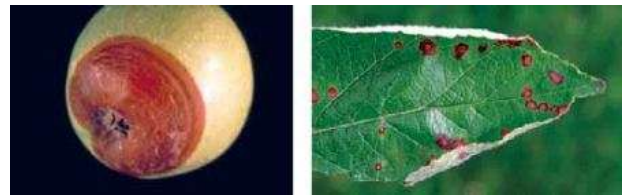


Figure 7: The figure shows the Symptoms of the disease Slow Black rot canker

Collar rot

Disease symptoms

1. Phytophthora collar rot attacks the lower 30 inches (76 cm) of apple trunks.
2. Most infections start at the junction of a lateral root with the trunk.
3. Infected bark becomes brown and is often soft and mushy or slimy when wet.
4. Dark streaks often occur near the cambium and extend beyond the canker margin. If a canker enlarges for several years, only the marginal areas show the typical color and texture of newly killed tissue.
5. The development of the canker is rapid, horizontally and vertically. The ultimate effect of collar rot is to girdle the affected limb, roots, or trunk, resulting in the death of that organ or of the entire tree.



Figure 8: The figure shows the Symptoms of the disease Collar rot .

Powdery mildew disease

Disease symptoms

1. Disease appears when the buds develop into new leaves and shoots.
2. Small patches of white or grey powdery masses on under surface of leaves occur.
3. Leaves grow longer and narrower than normal leaves and the margin is curled.
4. Twigs covered with powdery mass.
5. Affected fruits remain small and deformed and tend to develop roughened surface.

5. LIMITATIONS

The current proposed expert system is specialized in the diagnosis only the following twelve apple diseases: Apple scab, Marssonina leaf blotch (pre mature leaf fall), Black rot canker, Collar rot, Powdery mildew, Sooty blotch and fly speck , Apple mosaic and other virus diseases, Alternaria leaf spot/blight, Core rot , Brown rot, White rot / root rot, Seedling blight .

6. SYSTEM EVALUATION

As a preliminary evolution, many agricultural engineers, Agricultural teachers at Hani Naim School and other Agriculture students 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 Farmers as well as those interested in agriculture in apple disease with 12 different possible apple diseases. Farmers as well as those interested in agriculture diseases 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 CLIPS with Delphi language.

8. 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.

REFERENCES

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 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.
10. Abu Naser, S. S. (1993). A methodology for expert systems testing and debugging. North Dakota State University, USA.
11. Abu Naser, S. S. (1999). Big O Notation for Measuring Expert Systems complexity. *Islamic University Journal Gaza*, 7(1), 57-70.
12. Abu Naser, S. S. (2015). SI5 Object: Simpler Level 5 Object Expert System Language. *International Journal of Soft Computing, Mathematics and Control (IJSCMC)*, 4(4), 25-37.
13. 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.
14. 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.
15. 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.
16. 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).
17. 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.
18. 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.
19. 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.
20. 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.
21. 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.
22. 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.
 23. 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).
 24. 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.
 25. 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.
 26. 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.
 27. 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).
 28. 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.
 29. 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).
 30. Abu Naser, S., Al-Dahdooh, R., Mushtaha, A., & El-Naffar, M. (2010). Knowledge management in ESMDA: expert system for medical diagnostic assistance. *Artificial Intelligence and Machine Learning Journal*, 10(1), 31-40.
 31. Abu Naser, S., Baker, J., Cruz, I., Liotta, G., Tamassia, R., & Cooper, M. & Heller, R. (1996). Information Visualization. *Information Technology Journal*, 7(2).
 32. AbuEl-Reesh, J. Y., & Abu Naser, S. S. (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.
 33. Abu-Naser, S. S., & Akkila, A. N. (2008). A Proposed Expert System for Skin Diseases Diagnosis. *Journal of Applied Sciences Research*, 4(12), 1682-1693.
 34. 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.
 35. 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.
 36. Abu-Naser, S., Kashkash, K., Fayyad, M., Azaab, S., Naser, S., & Sulisel, O. (1995). & Beattie, GA (2000). Expert system methodologies and applications-a decade review from, 9-26.
 37. Abu-Naser, S., Kashkash, K., Fayyad, M., Azaab, S., Riley, M., Williamson, M., . . . Maloy, O. (2005). Expert system methodologies and applications-a decade review from 1995 to 2004. *Journal of Artificial Intelligence*, 1(2), 9-26.
 38. 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.
 39. Abu-Nasser, B. S., & Abu-Naser, S. S. (2018). Cognitive System for Helping Farmers in Diagnosing Watermelon Diseases. *International Journal of Academic Information Systems Research (IJAISR)*, 2(7), 1-7.
 40. Abu-Saqer, M. M., & Abu-Naser, S. S. (2019). Developing an Expert System for Papaya Plant Disease Diagnosis. *International Journal of Academic Engineering Research (IJAER)*, 3(4), 14-21.
 41. Abu-Saqer, M. M., & Abu-Naser, S. S. (2019). Developing an Expert System for Uveitis Disease Diagnosis. *International Journal of Academic Information Systems Research (IJAISR)*, 3(5), 18-25.
 42. Abu-Saqer, M. M., & Abu-Naser, S. S. (2019). Knowledge Based System for Uveitis Disease Diagnosis. *International Journal of Academic Information Systems Research (IJAISR)*, 3(5), 18-25.
 43. Ahmed, A., Masri, N., Sultan, Y. A., Akkila, A. N., Almasri, A., Mahmoud, A. Y., . . . Abu-Naser, S. S. (2019). Knowledge-Based Systems Survey. *International Journal of Academic Engineering Research (IJAER)*, 3(7), 1-22.
 44. 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.
 45. Akkila, A. N., Almasri, A., Ahmed, A., Al-Masri, N., Sultan, Y. A., Mahmoud, A. Y., . . . Abu-Naser, S. S. (2019). Survey of Intelligent Tutoring Systems up to the end of 2017. *International Journal of Academic Information Systems Research (IJAISR)*, 3(4), 36-49.
 46. 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.
 47. Alajrami, M. A., & Abu-Naser, S. S. (2018). Onion Rule Based System for Disorders Diagnosis and Treatment.

- International Journal of Academic Pedagogical Research (IJAPR), 2(8), 1-9.
48. Alajrami, M. A., & Abu-Naser, S. S. (2019). Grapes Expert System Diagnosis and Treatment. *International Journal of Academic Engineering Research (IJAER)*, 3(5), 38-46.
49. Aldaour, A. F., & Abu-Naser, S. S. (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., & Abu-Naser, S. S. (2019). Anemia Expert System Diagnosis Using SL5 Object.
51. Almadhoun, H. R., & Abu Naser, S. S. (2018). Banana Knowledge Based System Diagnosis and Treatment. *International Journal of Academic Pedagogical Research (IJAPR)*, 2(7), 1-11.
52. Almasri, A., Ahmed, A., Al-Masri, N., Sultan, Y. A., Mahmoud, A. Y., Zaout, I., . . . Abu-Naser, S. S. (2019). Intelligent Tutoring Systems Survey for the Period 2000-2018. *International Journal of Academic Engineering Research (IJAER)*, 3(5), 21-37.
53. Almurshidi, S. H., & Abu-Naser, S. S. (2018). Breast Cancer Knowledge Based System. *International Journal of Academic Health and Medical Research (IJAHMR)*, 2(12), 7-22.
54. Almurshidi, S. H., & Abu-Naser, S. S. (2018). EXPERT SYSTEM FOR DIAGNOSING BREAST CANCER. Al-Azhar University, Gaza, Palestine.
55. Al-Qumboz, M. N. A., & Abu-Naser, S. S. (2019). Spinach Expert System: Diseases and Symptoms. *International Journal of Academic Information Systems Research (IJAISR)*, 3(3), 16-22.
56. Al-Qumboz, M. N. A., Elsharif, A. A., Samy, I. M. D., & Abu-Naser, S. S. (2019). Kidney Expert System Diseases and Symptoms. *International Journal of Academic Engineering Research (IJAER)*, 3(5), 1-10.
57. Alshawwa, I. A., Elkahlout, M., El-Mashharawi, H. Q., & Abu-Naser, S. S. (2019). An Expert System for Depression Diagnosis. *International Journal of Academic Health and Medical Research (IJAHMR)*, 3(4), 20-27.
58. Alshawwa, I. A., Elsharif, A. A., & Abu-Naser, S. S. (2019). An Expert System for Coconut Diseases Diagnosis. *International Journal of Academic Engineering Research (IJAER)*, 3(4), 8-13.
59. Al-Shawwa, M. O., & Abu-Naser, S. S. (2019). A Proposed Expert System for Diagnosing Skin Cancer Using SL5 Object. *International Journal of Academic Information Systems Research (IJAISR)*, 3(4), 1-9.
60. Al-Shawwa, M., & Abu-Naser, S. S. (2019). Knowledge Based System for Apple Problems Using CLIPS. *International Journal of Academic Engineering Research (IJAER)*, 3(3), 1-11.
61. AlZamily, J. Y., & Abu-Naser, S. S. (2018). A Cognitive System for Diagnosing Musa Acuminata Disorders. *International Journal of Academic Information Systems Research (IJAISR)*, 2(8), 1-8.
62. Ashqar, B. A. M., & Abu-Naser, S. S. (2019). Identifying Images of Invasive Hydrangea Using Pre-Trained Deep Convolutional Neural Networks. *International Journal of Academic Engineering Research (IJAER)*, 3(3), 28-36.
63. Ashqar, B. A. M., & Abu-Naser, S. S. (2019). Image-Based Tomato Leaves Diseases Detection Using Deep Learning. *International Journal of Academic Engineering Research (IJAER)*, 2(12), 10-16.
64. Ashqar, B. A., Abu-Nasser, B. S., & Abu-Naser, S. S. (2019). Plant Seedlings Classification Using Deep Learning. *International Journal of Academic Information Systems Research (IJAISR)*, 3(1), 7-14.
65. 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.
66. Bakeer, H., & Abu Naser, S. S. (2017). Photo Copier Maintenance Expert System V. 01 Using SL5 Object Language. *International Journal of Engineering and Information Systems (IJEAIS)*, 1(4), 116-124.
67. Barhoom, A. M., & Abu-Naser, S. S. (2018). Black Pepper Expert System. *International Journal of Academic Information Systems Research (IJAISR)*, 2(8), 9-16.
68. Buhisi, N. I., & Abu Naser, S. S. (2009). Dynamic programming as a tool of decision supporting. *Journal of Applied Sciences Research*; www.aensiweb.com/JASR/, 5(6), 671-676.
69. 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.
70. Dheir, I. M., Mettleq, A. S. A., Elsharif, A. A., Al-Qumboz, M. N. A., & Abu-Naser, S. S. (2019). Knowledge Based System for Diabetes Diagnosis Using SL5 Object. *International Journal of Academic Pedagogical Research (IJAPR)*, 3(4), 1-10.
71. Dheir, I., & Abu-Naser, S. S. (2019). Knowledge Based System for Diagnosing Guava Problems. *International Journal of Academic Information Systems Research (IJAISR)*, 3(3), 9-15.
72. 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.
73. El Kahlout, M. I., & Abu-Naser, S. S. (2019). An Expert System for Citrus Diseases Diagnosis. *International Journal of Academic Engineering Research (IJAER)*, 3(4), 1-7.
74. El Kahlout, M. I., Alshawwa, I. A., El-Mashharawi, H. Q., & Abu-Naser, S. S. (2019). Silicosis Expert System Diagnosis and Treatment. *International Journal of*

- Academic Information Systems Research (IJAISR), 3(5), 1-8.
75. El-Mashharawi, H. Q., & Abu-Naser, S. S. (2019). An Expert System for Sesame Diseases Diagnosis Using CLIPS. *International Journal of Academic Engineering Research (IJAER)*, 3(4), 22-29.
76. El-Mashharawi, H. Q., Alshawwa, I. A., Elkahlout, M., & Abu-Naser, S. S. (2019). An Expert System for Arthritis Diseases Diagnosis Using SL5 Object. *International Journal of Academic Health and Medical Research (IAHMR)*, 3(4), 28-35.
77. Elqassas, R., & Abu-Naser, S. S. (2018). Expert System for the Diagnosis of Mango Diseases. *International Journal of Academic Engineering Research (IJAER)*, 2(8), 10-18.
78. Elsharif, A. A., & Abu-Naser, S. S. (2019). An Expert System for Diagnosing Sugarcane Diseases. *International Journal of Academic Engineering Research (IJAER)*, 3(3), 19-27.
79. Elsharif, A. A., Al-Qumboz, M. N. A., Alshawwa, I. A., AbuMettleq, A. S., Dheir, I. M., & Abu-Naser, S. S. (2019). Hepatitis Expert System Diagnosis Using SL5 Object. *International Journal of Academic Information Systems Research (IJAISR)*, 3(4), 10-18.
80. Khella, R., & Abu Naser, S. S. (2017). Rule Based System for Chest Pain in Infants and Children. *International Journal of Engineering and Information Systems*, 1(4), 138-148.
81. Mansour, A. I., & Abu-Naser, S. S. (2019). Expert System for the Diagnosis of Wheat Diseases. *International Journal of Academic Information Systems Research (IJAISR)*, 3(4), 19-26.
82. Mansour, A. I., & Abu-Naser, S. S. (2019). Knowledge Based System for the Diagnosis of Dengue Disease. *International Journal of Academic Health and Medical Research (IAHMR)*, 3(4), 12-19.
83. Masri, N., Sultan, Y. A., Akkila, A. N., Almasri, A., Ahmed, A., Mahmoud, A. Y., . . . Abu-Naser, S. S. (2019). Survey of Rule-Based Systems. *International Journal of Academic Information Systems Research (IJAISR)*, 3(7), 1-23.
84. Mettleq, A. S. A., & Abu-Naser, S. S. (2019). A Rule Based System for the Diagnosis of Coffee Diseases. *International Journal of Academic Information Systems Research (IJAISR)*, 3(3), 1-8.
85. Mettleq, A. S. A., Dheir, I. M., Elsharif, A. A., & Abu-Naser, S. S. (2019). Expert System for the Diagnosis of Seventh Nerve Inflammation (Bell's palsy) Disease. *International Journal of Academic Information Systems Research (IJAISR)*, 3(4), 27-35.
86. 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.
87. Musleh, M. M., & Abu-Naser, S. S. (2018). Rule Based System for Diagnosing and Treating Potatoes Problems. *International Journal of Academic Engineering Research (IJAER)*, 2(8), 1-9.
88. 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.
89. Naser, S. S. A., & Al-Nakhil, 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.
90. 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.
91. 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.
92. Nassr, M. S., & Abu Naser, S. S. (2018). Knowledge Based System for Diagnosing Pineapple Diseases. *International Journal of Academic Pedagogical Research (IJAPR)*, 2(7), 12-19.
93. 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.
94. Salman, F. M., & Abu-Naser, S. S. (2019). Expert System for Castor Diseases and Diagnosis. *International Journal of Engineering and Information Systems (IJEAIS)*, 3(3), 1-10.
95. Salman, F. M., & Abu-Naser, S. S. (2019). Thyroid Knowledge Based System. *International Journal of Academic Engineering Research (IJAER)*, 3(5), 11-20.