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Rule Based System for Watermelon Diseases and Treatment

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Abstract: Background: Watermelon is a summer vegetable whose plant has extended branches, producing spherical or cylindrical fruits of light green or dark green color, with a red core that is spread by black seeds and white pulp. Recent studies have shown many health benefits for watermelon, especially with regard to intestinal and kidney safety. Studies have shown that watermelon moisturizes the skin, refreshes the body and may serve as a powerful laxative for intestines, a substance that helps digestion, strengthens the blood, and breaks the kidney stones. The researchers found that the natural compounds found in it help to reduce the severity of skin diseases, as well as its seeds in the reduction of high blood pressure, and can be used to stop bleeding. **Objectives**: The main objective of this expert system is to assist farmers in detecting watermelon diseases and solutions. **Methods**: In this paper the design of the proposed Expert System which was produced to help farmers in diagnosing many of the watermelon diseases such as : Downy mildew, Powdery mildew, Anthracnose, Alternaria leaf spot, Fusarium wilt, Bud necrosis disease and Cucumber mosaic disease. The proposed expert system presents an overview about watermelon diseases are given, the cause of diseases are outlined and the treatment of disease whenever possible is given out .E-clips Expert System language was used for designing and implementing the proposed expert system. **Results**: The proposed watermelon diseases diagnosis expert system was evaluated by group of farmers and they were satisfied with its performance. **Conclusions**: The Proposed expert system is very useful for farmers, to diagnosing watermelon diseases and treatment it whenever possible is given.

Keywords: Watermelon, Diseases, Treatment, Expert System, CLIPS, Delphi.

1. INTRODUCTION

Watermelon is a nutritious food and not as it is said to be water and sugar only. It provides many vitamins and minerals with high levels, antioxidants and a few calories.
Watermelon has become the favorite fruit in the summer for many reasons: heat control, refreshing, sweet taste and summer sweets. It contains about 90% water [1].
Watermelon benefits

Heart Health

The presence of large amounts of potassium, which is a building factor of the cells and controls the blood pressure and heart rate [2].

Anti-cancer Properties

Contains a lot of Lycopene and is a powerful anti-oxidant and beneficial in the prevention of breast cancer and lung and colon cancer [2].

Normalizes High Blood Pressure

A small amount of potassium helps to increase blood pressure [2].

Improves Sleep

The presence of amounts of carbohydrates helps to improve the body's production of the serotonin [2].

Natural Viagra

Improving circulation and relaxing blood circulation [2].

Weight Loss

It contains high levels of a compound called citrulline which is converted into the essential amino acid, arginine inside the body [2].
Relieves Sore Muscles

Watermelon contain a citrullline gets converted to L-arginine, an essential amino acid which helps treat muscle soreness [2].
Watermelon is more prone to diseases affecting roots, leaves and fruits in the summer. Sometimes these diseases are difficult, such as Downy Mildew and anthracnose, often treatment of these diseases is simple but the most important type of disease. This is why we have developed this expert system that helps farmers diagnose many diseases and find out how to treat them [3].
Artificial Intelligence (AI) has many branches and one of this branch is expert systems that were developed in the mid 1960's by AI community. Expert systems are a branch of computer science aimed at transferring human intelligence into computers [21]. In AI, an expert system is an intelligent computer program that aims to use task-specific knowledge and inference techniques to solve problems at the level of a human expert [22]. It imitates the decision making ability of a human expert in a particular domain and can also give advices and explanations. There are two types of expert systems: rule-based expert systems and knowledge-based expert systems. The main difference between these expert systems is the knowledge representation in the knowledge base [23]. The knowledge representation is more significant in expert system because the approach used to represent knowledge affects the development, efficiency, speed and the maintenance of the system [24].
The rule-based expert system has domain knowledge encoded in the form of rules from a human expert [25]. A rule is a conditional statement that links given conditions to actions [26]. In a rule-based expert system, a knowledge base

is usually stored in terms of if-then rules which can be used to reach conclusions. A rule-based expert system is constructed based on an efficient algorithm called the Rete pattern matching algorithm [27]. This algorithm matches facts against the patterns in rules to determine which rules have had their conditions satisfied. Hence it uses a set of rules to analyse information about a specific class of problems and recommend one or more possible solutions [28].

The knowledge-based expert system encodes heuristics and rules into decision making framework [29]. A knowledge-based system uses artificial intelligence techniques in problem solving methods to support human decision making, learning, and action. The knowledge base of expert systems contains both factual and heuristic knowledge [30]. Factual knowledge is the knowledge that is widely shared, typically found in textbooks or journals, and commonly agreed upon by human experts in that particular domain [31]. Heuristic knowledge refers to an experiential, logical and judgmental knowledge used to speed up decision making [32]. Some applications applied by knowledge based expert systems are: medical treatment, waste management, production management, knowledge management, financial analysis, etc. [33].

2. ARCHITECTURE OF AN EXPERT SYSTEM

Expert system consists of four major components which are: knowledge base, working memory, an inference engine and a user interface [34]. Figure 1 below represents the structure of an expert system.

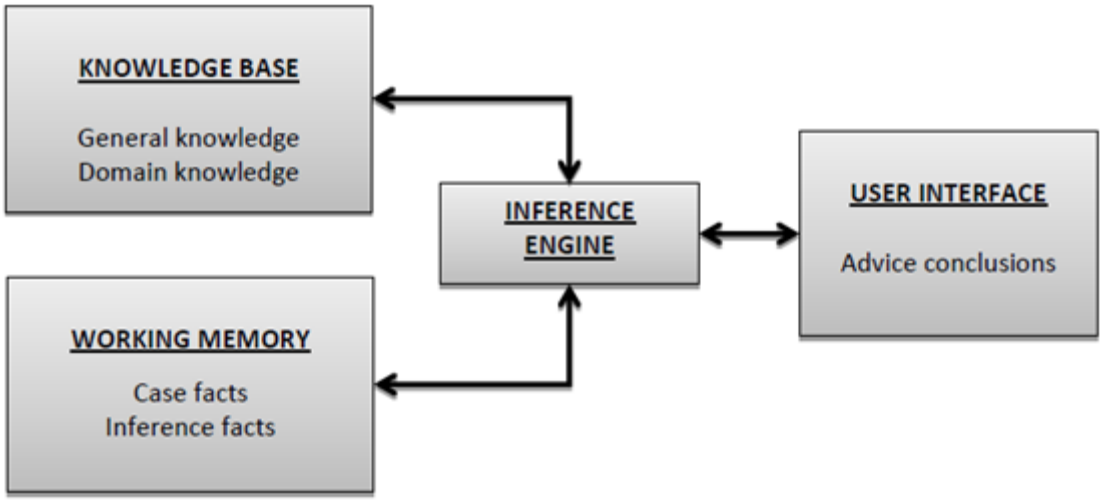

Figure 1: The structure of a knowledge-based expert system

Knowledge base : is the heart of an expert system; it contains a collection of facts and rules which describe all the knowledge about the problem domain. Therefore, it stores all relevant information, data, rules, cases and relationships used by the expert system [35]. A knowledge base is not a database system.

Working memory : is comparable to a relational database system. It contains information that is supplied by the end user. This information is used to evaluate antecedents in the knowledge base [36]. A change in the knowledge base results in creation of new values, thus the working memory will update its old values.

Inference engine: implements the reasoning process of artificial intelligence; it is an analogy to human reasoning [37]. Its role is to work with the available data from the system and the user to derive a solution to the problem. The purpose of inference engine is to seek information and relationship from the knowledge base and to provide answers, predictions and suggestions in the way a human expert would. There are two kinds of inference engines: the backward chaining and forward chaining [38]. In backward chaining, the system first establishes a desired solution and works backwards to find facts that support the solution [39]. Backward chaining is goal-driven, thus it is used when the solution is known. In forward chaining the system first collects data which is used when the solution is known [40]. Forward chaining is data-driven; therefore it is used when the absolute solution is not known.

User Interface : controls the dialog between the user and the system [41]. Thus, it is an intermediary that allows communication between the user and the system. The purpose of the user interface is to ease the usage of expert system by developers, users and administrators.

3. MATERIALS AND METHODS

The proposed expert system performs diagnosis for watermelon diseases by asking select number of options. The proposed expert system will ask the user to choose the

correct options in screen. At the end of the dialogue session, the proposed expert system provides the diagnosis and recommendation of the disease to the user. Figure 1 shows a sample dialogue between the expert system and the user. Figure 2 shows how the users get the diagnosis and recommendation.

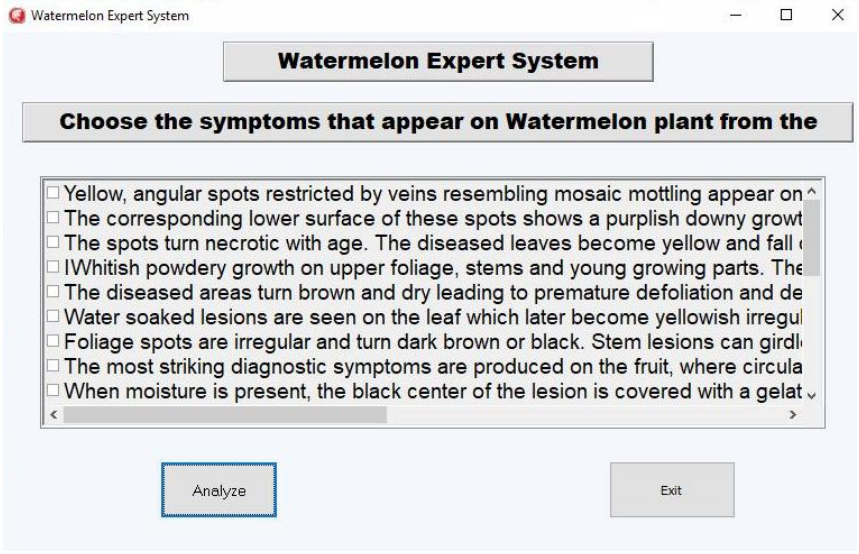

Figure 1: The figure presents shows when the system asks the user.

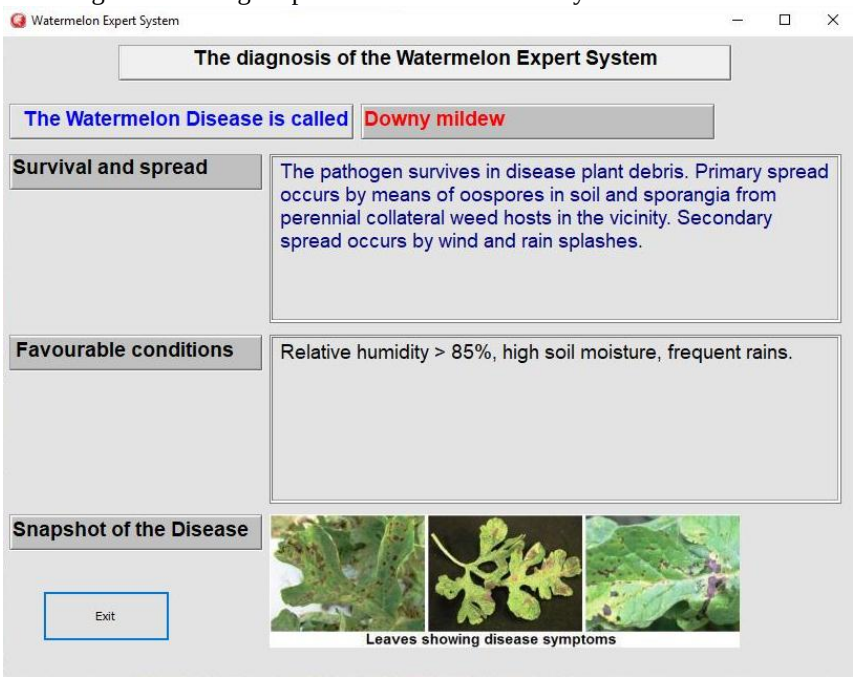

Figure 2: The figure shows diagnosis and recommendation of the expert system.

4. LITERATURE REVIEW

There is a lot of Expert System that were designed to diagnose diseases such as plant, tomato and other types of disease [5,6]. But there is no specialized expert system for diagnosis of watermelon available to help farmers in diagnosing plant diseases using CLIPS language and Delphi XE10.2 language [5]. The current proposed expert system is specialized in the diagnosis of seven watermelon diseases: Downy mildew, Powdery mildew, Anthracnose, Alternaria leaf spot, Fusarium wilt, Bud necrosis disease and Cucumber mosaic disease.

5. KNOWLEDGE REPRESENTATION

The main sources of knowledge for expert systems either from an expert in the field of agriculture or a website specialized in watermelon diseases, these sources are

transferred to CLIPS . There are currently in the expert system a number of rules that help to treat seven diseases of watermelon [5]

Downy Mildew: is notable for the angular leaf spots it creates as it works its way through watermelon leaves. They may start as yellow areas, but soon turn brown with purple spores on the undersides of infected leaves. Fortunately, downy mildew won't attack fruit, but it can reduce yields by weakening your plants. Neem oil can control this nasty mildew [7].

Figure 3: The figure shows the downy mildew diseases effect [8]

Powdery Mildew: One of the most common diseases of plants in general, powdery mildew doesn't spare watermelons. Leaves will appear to have a white powdery substance on them when the infection is active, though fruits aren't generally affected. As the powdery mildew moves through the plant, leaves brown and die, leaving fruits to sunburn and weakening plants. Neem oil is an excellent treatment, but increasing air circulation around your watermelon plant by pruning can be equally effective [7].

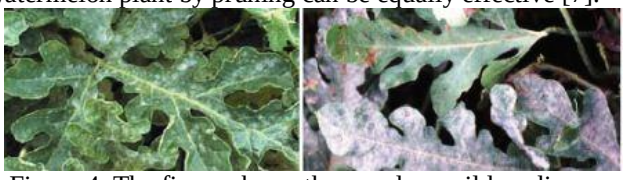

Figure 4: The figure shows the powdery mildew diseases effect [8].

Anthracnose : This seed-borne fungus is hard to detect initially, as it may only appear as small spots on your plants and fruits. As it grows, these spots expand and turn black or gray and new sunken areas may appear on your fruit. Crop rotation combined with an aggressive treatment of neem oil will help preserve this and future harvests from anthracnose [7].

Figure 5: The figure shows the Anthracnose diseases effect [8]

Alternaria Leaf Spot : Lesions are round to irregular target spots on older leaves .The symptoms are first observed at the crown of the plant. As the spots enlarge, concentric rings are formed in the lesion. The disease is favored by continuous wet conditions. The fungus is controlled with a 2 year cucurbit-free rotation, destruction of the previous crop residue and application of fungicides as needed. At the end of the growing season, plow under crop residue [9].

Figure 6: The figure shows the Alternaria Leaf Spot diseases effect

Fusarium wilt :is characterized by loss of turgor pressure of the vines. Vines may recover during the evening, but eventually wilt permanently. Initial symptoms often include a dull, gray green appearance of leaves that precedes a loss of turgor pressure and wilting [10].

Figure 7: The figure shows the Fusarium wilt diseases effect [8]

Bud necrosis disease: found in India with symptoms of leaf crinkling, mottling, yellowing, and necrotic streaks on vines; shortened internodes; upright branches; and necrosis and dieback of the buds was shown to be caused by the watermelon strain of tomato spotted wilt virus [11].

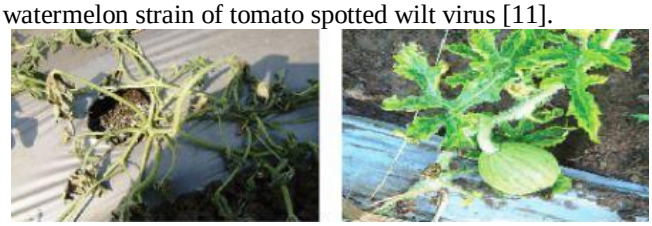

Figure 8: The figure shows the Bud necrosis disease effect [8]

Cucumber mosaic disease: important viruse of cucurbit crops, and are present together with their aphid vectors in New Zealand. This study investigated the effects of infection by these viruses on S. australis growth, and the incidence of cucurbit virus diseases in remnant population .Symptoms included leaf distortion, mosaic, vein chlorosis, reduced leaf size[12].

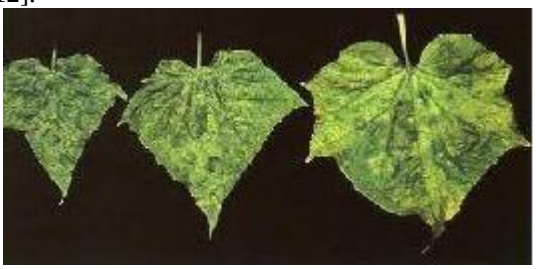

Figure 9: The figure shows the Cucumber mosaic diseases effect [8]

6. LIMITATIONS

The current proposed expert system is specialized in the diagnosis of seven watermelon diseases: Downy mildew, Powdery mildew, Anthracnose, Alternaria leaf spot, Fusarium wilt, Bud necrosis disease and Cucumber mosaic disease

7. SYSTEM EVALUATION

As a preliminary evaluation, a gGroup of farmers 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 farmers in diagnosing disease with seven different possible watermelon diseases. Farmers 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 and Delphi XE10.2 languages.

9. FUTURE WORK

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

REFERENCES

1. https://www.medicalnewstoday.com/articles/266886.php
2. https://www.healthbeckon.com/watermelon-benefits
3. Saha, S. (2014). Watermelon. University of Kentucky Cooperative Extension Service & University of Kentucky College of Agriculture, Food and Environment.
4. S.-H. Liao, "Expert system methodologies and applications—a decade review from 1995 to 2004," Expert Systems with Applications, vol. 28, no. 1, pp. 93–103, 2005.
5. C. Yialouris and A. Sideridis, "An expert system for tomato diseases," Computers and Electronics in Agriculture, vol. 14, no. 1, pp. 61–76, 1996.
6. https://www.gardeningknowhow.com/edible/fruits/watermelon/watermelon-disease-control.htm
7. http://vikaspedia.in/agriculture/crop-production/integrated-pest-managment/ipm-for-fruit-crops/ipm-strategies-for-watermelon/watermelon-diseases-and-symptoms
8. https://aggie-horticulture.tamu.edu/vegetable/watermelon/foliar-diseases/alternaria-leaf-spot/
9. D. S. Egel and R. D. Martyn. 2007. Fusarium wilt of watermelon and other cucurbits. The Plant Health Instructor. DOI: 10.1094/PHI-I-2007-0122-01. Updated 2013.
10. S. Singh and M. Krishnareddy, "Watermelon Bud Necrosis: A New Tospovirus Disease," Acta Horticulturae, no. 431, pp. 68–77, 1996.
11. C. Delmiglio and M. N. Pearson, "Effects and incidence of Cucumber mosaic virus, Watermelon mosaic virusandZucchini yellow mosaic virusin New Zealands only native cucurbit, Sicyos australis," Australasian Plant Pathology, vol. 35, no. 1, p. 29, 2006.
12. 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.
13. 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.
14. 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.
15. 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.
16. 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.
17. 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.
18. 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.
19. 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.
20. 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).
21. 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.
22. Abu Naser, S. S. (1993). A methodology for expert systems testing and debugging. North Dakota State University, USA.
23. 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.

24. Abu Naser, S. S. (1999). Big O Notation for Measuring Expert Systems complexity. Islamic University Journal Gaza, 7(1), 57-70.
25. Hilles, M. M., & Abu Naser, S. S. (2017). Knowledge-based Intelligent Tutoring System for Teaching Mongo Database. EUROPEAN ACADEMIC RESEARCH, 6(10), 8783-8794.
26. 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.
27. 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.
28. 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.
29. 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.
30. 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.
31. 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.
32. 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.
33. 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.
34. 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.
35. 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).
36. 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.
37. Almurshidi, S. H., & Abu Naser, S. S. (2017). Design and Development of Diabetes Intelligent Tutoring System. EUROPEAN ACADEMIC RESEARCH, 6(9), 8117-8128.
38. 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.
39. 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.
40. 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.
41. 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.
42. 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.
43. 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.
44. 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.
45. 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.
46. 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).
47. 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.
48. 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.
49. 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.
50. 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).
51. 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.
52. 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.
53. Almurshidi, S. H., & Naser, S. S. A.(2018). Expert System For Diagnosing Breast Cancer. Al-Azhar University, Gaza, Palestine.
54. 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.
55. 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.
56. 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.
57. Hilles, M. M., & Abu Naser, S. S. (2017). Knowledge-based Intelligent Tutoring System for Teaching Mongo Database. EUROPEAN ACADEMIC RESEARCH, 6(10), 8783-8794.
58. Abu-Nasser, B. S. (2017). Medical Expert Systems Survey. International Journal of Engineering and Information Systems, 1(7), 218-224.
59. 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.
60. 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.
61. Mohammed S. 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.
62. Li, L., Chen, N., He, C., Lang, F., Li, H., Wang, H., Liu, B., Abu-Naser, S.S., Yang, G.Y., Gong, P.Q., & Wang, X.X. (2011). Hybrid Quantum-inspired genetic algorithm for extracting association rule in data mining. Information Technology Journal, 12(4), 1437-1441.
63. Ng, S., Wong, C., Lee, T., Lee, F., Abu-Naser, S., El-Hissi, H., . . . James, A. (2010). Ad hoc networks based on rough set distance learning method. Information Technology Journal, 10(9), 239-251.
64. Abu-Naser, S. S., Hissi, H. E., Rass, M. A., khozondar, N. E., Abu-Naser, S. S., Kashkash, K. A., ... & Fallat, R. J. (2008). Medical Informatics: Computer Applications in Health Care and Biomedicine. Journal of Artificial Intelligence, 3(4), 78-85.
65. Chen, R. S., Tsai, C. H., Abu-Naser, S. S., Bishop, A. P., Bishop, C., Arbaugh, J. B., ... & Boomsma, A. (2008). Evaluating structural equation models with unobservable variables and measurement error. Information Technology Journal, 10(2), 1055-1060.
66. Abu Naser, S. S., Abu Naser, S. S., Sulisel, O., Abu Naser, S. S., Abu Naser, S. S., Abu-Naser, S. S., ... & Corbett, A. T. (2000). Growth and Maturity of Intelligent Tutoring Systems. Information Technology Journal, 7(7), 9-37.
67. Abu-Naser, S. S., Kashkash, K. A., Fayyad, M., Azaab, S., Naser, S. A., Sulisel, O., ... & Beattie, G. A. (2000). Expert system methodologies and applications-a decade review from 1995 to 2004. Journal of Artificial Intelligence, 1(2), 9-26.
68. Owaied, H. H., Abu-Ara, M. M., Qasem, M. M., Fahmy, H. I., Douligeris, C., Aha, D., ... & Vossos, V. (1999). Using rules to support case-based reasoning for harmonizing melodies. Journal of Applied Sciences, 11(14), pp.31.
69. Abu Naser, S. S., Baker, J., Cruz, I., Liotta, G., Tamassia, R., Cooper, M. L., ... & Heller, R. (1996). Information Visualization. Information Technology Journal, 7(2), pp-403.
70. Abu Naser, S. S., Anderson, J. R., Corbett, A. T., Koedinger, K. R., Pelletier, R., Beal, C., ... & Person, S. (1995). Adaptation of Problem Presentation and Feedback in an Intelligent Mathematics Tutor. Information Technology Journal, 5(5), 167-207.
71. Al-Ani, I. A. R., Sidek, L. M., Desa, M. M., Basri, N. A., Burns, J. W., Bhutani, J., ... & Waterman, D. A. (1972). Water pollution and its effects on human health in rural areas of Faisalabad. Journal of Environmental Science and Technology, 5(5), 1-17.