

# Expert System for the Diagnosis of Mango Diseases

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**Abstract:** Mango fruit is known as a type of fruit, containing within it a nucleus. Mango fruit is a branch of mangier. This species contains many different types of fruits, especially tropical fruits. The plant species is known as the botanical plant species. Mango is not a modern plant discovered in this age, it is an old plant, as it was known about four thousand years ago, and it was among the plants known to the Arabs, they called it (Anabj).

Its root length in the soil can be up to six meters, and the height of the mango tree grows between 35 and 40 meters. The leaves are evergreen, with a length of about fifteen and thirty-five centimeters, and the width can be about sixteen centimeters. This type of fruit has many diseases which threaten its production. In this research, we proposed an expert system for diagnosing mango diseases. This expert system was designed and implemented using CLIPS and Delphi languages. A group of farmers, people interested in mango production, agriculture instructors had tested the proposed expert system and found it very useful.

**Keywords:** Expert System, CLIPS, Delphi, Mango, Diseases

## 1. INTRODUCTION

A program that help in creating more than ITS with relatively easy way and provide the experience of crating ITS without the need of expert programmer to made it.

Mango tree grows to 35-40 m (115-131 feet). Mango is an ancient fruit as seen in figure 1, where it was grown 4,000 years ago. In the soil, the main root extends to a depth of 6 m (20 ft) with a number of many widespread nutritious roots [1]. It was known to the Arabs as "Anabj". This name is the most famous name. It is a Persian, and there are many other names: Grapes, and grapes, as stated in the large lexicon of the complex of the Arabic language, and came also that the name of the species of this tree is Mango [2].

Mango leaves are evergreen and simple, length 15-35 cm (5.9-13.8 inches) and width 6-16 cm (2.4-6.3 inches). When the plant leaves are immature, the color is orange pink, and quickly changes to dark red, then dark green where they become mature. Flowers grow in peripheral clusters, ranging from 10 to 40 centimeters (3.9-16 inches); each small flower is white with five petals of 5-10 millimeters (0.20-0.39 inches) with a sweet scent that resembles the scent of the lily of the valley. The fruit of the mango takes three months to mature [3].



Figure 1: Figure shows mango fruit

Mango seeds are either fibrous or fibrous. Mature fruits vary in color and size. Usually they are orange, red or green, with a nucleus that is either fibrous or radiant surface, and cannot be easily separated from the core. The thickness of the nucleus is 1-2 millimeters (0.039-0.079 inches) and inside the nucleus is a thin line covering the seed, length 4-7 mm (0.16-0.28 inches). The seed contains the plant embryo. Inference the main components and details are represented in figure 2.

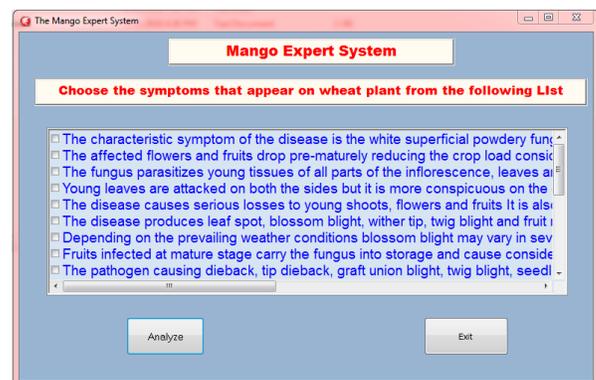


Figure 2: Figure shows Mango Expert System

The proposed system of experts has been implemented to diagnose mango diseases using the CLIPS and Delphi 10.2 languages. It is an expert system of forward-chaining that uses rules and facts.

The proposed expert system uses rules and facts for taking the appropriate action as a result. The CLIPS interface is executed in Delphi Embarcadero RAD Studio XE10.2. CLIPS performs any expert system that resembles frames. It is easy for the knowledge engineer to build an expert system make it easy for the end user to use the system.

**Benefits of mango:**

- Helps to prevent cancer diseases such as breast cancer, colon cancer, prostate, and blood.
- Because it contains a good proportion of vitamin C, as well as fiber, and pectin, it works to reduce the amounts of cholesterol in the blood, in addition to strengthening the heart, and stop bleeding blood, except for the possibility of revitalizing the mind.
- Helps to bring freshness and beauty to the face, which can be used for all skin types.
- Helps to protect the skin from acne by preventing blockages, which prevents the appearance of acne.
- Boil five to six leaves of her leaves and soak during the night and drinking in the morning helps regulate the proportion of insulin in human blood, and thus regulate the proportion of diabetes in the blood.
- Contains vitamin A, which protects the eye from dehydration and night blindness.

**2. MATERIALS AND METHODS**

Mango is grown in the shade if the agricultural sites are desert to protect the fruits from the sun, and the mango grows well in the soil type medium acidity, but not in mud or wet, and it is necessary to trim the tree after the fall of the corals to get the desired results. In the warm environment, trees need to be irrigated daily until harvest time, and strict irrigation can damage the pulp. Mango trees are very sensitive to chemical nutrients but require regular nitrogen and iron supplements.

It is possible to mix the fertilized soil and put it around the trees every two weeks until July, and the need to put gloves when dealing with these trees, leaves and fruit shells contain a toxic juice that may lead to painful skin infections. Trees should be trimmed in late winter or early spring to improve shape and size. In order to avoid the annual rotation of fruiting, it is necessary to remove some flowers in the years when the flowers are very large. Reducing fruits will also stimulate the annual load of trees.

In terms of reproduction, we find that these trees grow by Almtaim or ready-made in the centers of agricultural care. The fruits of this type of tree usually ripen during the period of 100 to 180 days after flowering. The fruit period here is in the form of kidney or oval. The maturity of the mature fruit is pale green or yellow in color, with a soft texture. When ripe, it smells good. Fruits must be harvested at low temperatures and can be cooked inside, provided that the fruit stalks are placed on the floor of trays covered with wet cloths to prevent shrinkage. Mango must be preserved at temperatures of at least 10 ° C, and mature fruits can be kept in a cool atmosphere for 3 weeks.

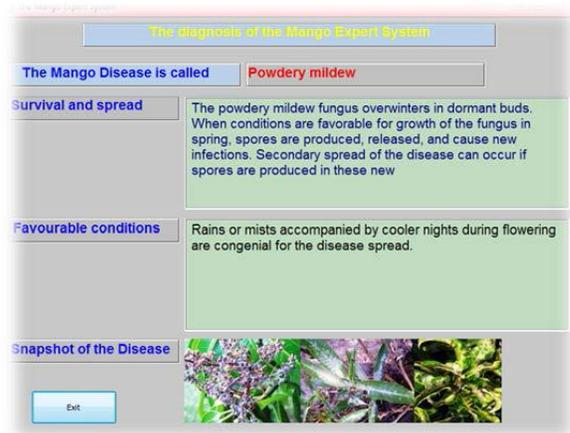


Figure 3: Figure shows conclusion and display the disease

**3. LITERATURE REVIEW**

There are many expert systems that are designed to diagnose plant, fruit and other kinds of diseases. But there is no expert system for diagnosing manga diseases available for free.

Although many plant diseases have common symptoms. The proposed expert system was developed specifically to help farmers diagnose mango diseases.

**4. REPRESENTATION OF KNOWLEDGE**

The main sources of knowledge for this system of experts are the farmer or the agricultural engineer and specialized web sites for fruits and vegetables of these diseases.

The captured knowledge was converted to Knowledge Base syntax for CLIPS (facts, rules, and objects). The expert system currently has 13 bases covering 13 mango diseases:

**4.1 Mildew disease**

The characteristic symptoms of the disease are superficial growth of surface whiteness on leaves, stems of foliage, flowers and small fruits.

Flowers and fruits affected before the ripening of the crop load are significantly reduced or the fruit group may be prevented.

Young mushrooms thrive in all parts of flowering, leaves and fruit.

The leaves are attacked on both sides but more clearly on the surface of the stairs. Often these patches accumulate and occupy larger areas that turn into purplish brown



Figure 4: Figure shows Displays the mild white disease

**Survival and spread**

The powdery mildew fungus overwinters in dormant buds. When conditions are favorable for growth of the fungus in spring, spores are produced, released, and cause new infections. Secondary spread of the disease can occur if spores are produced in these new infections

**Favorable conditions**

Rains or mists accompanied by cooler nights during flowering are congenial for the disease spread

**4.2 Anthracnose**

**Disease symptoms**

The disease causes serious losses to young shoots, flowers and fruits It is also affects fruits during storage.

The disease produces leaf spot, blossom blight, wither tip, twig blight and fruit rot symptoms. Tender shoots and foliage are easily affected which ultimately cause “die back” of young branches. Older twigs may also be infected through wounds which in severe cases may be fatal.

Depending on the prevailing weather conditions blossom blight may vary in severity from slight to a heavy infection of the panicles. Black spots develop on panicles as well as on fruits. Severe infection destroys the entire inflorescence resulting in no setting of fruits. Young infected fruits develop black spots, shrivel and drop off.

Fruits infected at mature stage carry the fungus into storage and cause considerable loss during storage, transit and marketing.



Figure 5: Figure shows Anthracnose’s is offered

**Survival and spread**

Fungus survives in dead twig and other host for long time which is the source of primary infection.

**Favorable conditions**

High humidity, frequent rains and a temperature of 24-32oC favors the development of disease.

**4.3 Die back**

**Disease symptoms**

The pathogen causing dieback, tip dieback, graft union blight, twig blight, seedling rot, wood stain, stem- end rot, black root rot, fruit rot, dry rot, brown rot of panicle etc. The disease is most conspicuous during October November.

It is characterized by drying back of twigs from top downwards, particularly in older trees followed by drying of leaves which gives an appearance of fire scorch. Internal browning in wood tissue is observed when it is slit open along with the long axis.

Cracks appear on branches and gum exudes before they die out. When graft union of nursery plant is affected, it usually dies



Figure 6: Figure shows The disease is presented again

**Survival and spread**

Pathogens survive in plant debris which is the source of primary inoculums.

**Favorable conditions**

High humidity and moist conditions favors the development of disease. The disease is most common in October-November.

**4.4 Phoma blight:**

**Disease symptom**

The symptoms of the disease are noticeable only on old leaves. Initially, the lesions are angular, minute, irregular, yellow to light brown, scattered over leaf lamina.

As the lesions enlarge their color changes from brown to cinnamon and they become almost irregular. Fully developed spots are characterized by dark margins and dull grey necrotic centers. In case of severe infection such spots coalesce forming patches measuring 3.5-13 cm in size, resulting in complete withering and defoliation of infected leaves.



Figure 7: Figure shows Fuma is supplied for ruff

### Survival and spread

The pathogen is seed borne fungus and inoculums present in the seeds are source of primary infection. Fungus also survives on glumes, fruit and plant debris.

### Favorable conditions

Rainy seasons favor the development of disease.

### 4.5 Bacterial canker:

#### Disease symptoms

The disease is noticed on leaves, leaf stalks, stems, twigs, branches and fruits, initially producing water soaked lesions, later turning into typical canker.

On leaves, water soaked irregular satellite to angular raised lesions measuring 1-4 mm in diameter are formed. These lesions are light yellow in color, initially with yellow halo but with age enlarge or coalesce to form irregular necrotic cankerous patches with dark brown color.

On fruits, water-soaked, dark brown to black colored lesions are observed which gradually developed into cankerous, raised or flat spots. These spots grow bigger usually up to 1 to 5 mm in diameter, which covers / almost the whole fruit.

These spots often, burst extruding gummy substances containing highly contagious bacterial cells.



Figure 8: Figure shows Bacterial canker

### Survival and spread

In lesions on plant parts and can also survive for long periods in diseased plant tissues.

### Favorable conditions

Spring session is responsible for the development of diseases.

### 4.6 Red Rust

#### Disease symptoms

Red rust disease, caused by an alga, has been observed in mango growing areas. The algal attack causes reduction in photosynthetic activity and defoliation of leaves thereby lowering vitality of the host plant.

The disease can easily be recognized by the rusty red spots mainly on leaves and sometimes on petioles and bark of young twigs and is epiphytic in nature.

The spots are greenish grey in color and velvety in texture. Later, they turn reddish brown. The circular and slightly elevated spots sometimes coalesce to form larger and

irregular spots. The disease is more common in closely planted orchards



Figure 9: Figure shows red rust

### Survival and spread

The pathogens reproduce and survive in spots on leaves or stems and in fallen plant host debris.

### Favorable conditions

Frequent rains and warm weather are favorable conditions for these pathogens. For hosts, poor plant nutrition, poor soil drainage, and stagnant air are predisposing factors to infection by the algae

### 4.7 Sooty mould

#### Disease symptoms

The disease is common in the orchards where mealy bug, scale insect and hopper are not controlled efficiently. The disease in the field is recognized by the presence of a black velvety coating, i.e., sooty mould on the leaf surface. In severe cases the trees turn completely black due to the presence of mould over the entire surface of twigs and leaves.

The severity of infection depends on the honey dew secretion by the above said insects. Honey dew secretions from insects sticks to the leaf surface and provide necessary medium for fungal growth.



Figure 10: Figure shows Sooty mould

### Survival and spread

The severity of infection depends on the honey dew secretions by the scale insects which provide the necessary medium for the fungal growth. Transmission occurs by air-borne as co-spores.

### Favorable conditions

High humidity and moist situation favors the development of disease.

### 4.8 Mango malformation

### Disease symptoms

**Vegetative malformation:** Vegetative malformation is pronounced in young seedlings. The affected seedlings develop vegetative growths which are abnormal growth, swollen and have very short internodes.

**Floral malformation:** The flower buds are transformed into vegetative buds and a large number of small leaves and stems, which are characterized by appreciably reduced internodes and give an appearance of witches' broom. The flower buds seldom open and remain dull green.



Figure 11: Figure shows Mango malformation

### Survival and spread

The disease is mainly spread via infected plant material. Mango malformation disease spreads slowly within affected orchards.

The mango bud mite, *Aceria mangiferae*, has been associated with mango malformation disease as wounds from the mites' feeding activity are thought to facilitate fungal infection.

### Favorable conditions

Moist weather favors the development of disease.

### 4.9 Gummosis:

#### Disease symptoms

The disease is characterized by the presence of profuse oozing of gum on the surface of the affected wood, bark of the trunk and also on larger branches but more common on the cracked branches.

In severe cases, droplets of gum trickle down on stem, bark turn dark brown with longitudinal cracks, rots completely and the tree dries up because of cracking, rotting and girdling effects.



Figure 12: Figure shows Gummosis

### Survival and spread

Pathogen survives in disease plant debris.

### Favorable conditions

Warm weather favors the development of disease

### 4.10 Root rot & Damping off:

#### Disease symptoms

The disease is characterized by sudden dropping of leaves after the emergence of seedlings from the soil.

During prolonged rainy and humid weather, infection occurs at / or below the ground level with circular to irregular water soaked patches.

These patches enlarge and ultimately girdle the entire base of the seedlings.



Figure 13: Figure shows Root rot & Damping off

### Survival and spread

Disease is soil borne and pathogen survives in soils of orchards. Primary infection occurs by soil and secondary by conidia through rain or wind.

### Favorable conditions

High humidity, high soil moisture, cloudiness and low temperatures below 24° C for few days are ideal for infection and development of disease.

### 4.11 Scab:

#### Disease symptoms

The scab fungus attack leaves, panicles, blossoms, twigs, bark of stems and mango fruits. Spots are circular, slightly angular, elongated, 2-4 mm in diameter, brown but during rainy season, lesions differ in size, shape and color.

Symptoms produced by the disease are very much like those of anthracnose.

On young fruits, the infection is grey to grayish brown with dark irregular margins. As the fruit attains in size, spots also enlarge and the center may become covered with the crack fissure and corky tissues.



Figure 14: Figure shows Scab

### Survival and spread

The pathogen survives in the form of resting spore in the soil debris.

### Favorable conditions

Suitable temperatures and moisture promote the release of *Elsinoemangiferae* spores. This cycle of secondary infections continues throughout the summer, until the leaves and fruit fall from the tree at the onset of winter.

### 4.12 Postharvest diseases:

The mango fruit is susceptible to many postharvest diseases caused by anthracnose (*C. gloeosporioides*) and stem end rot (*L. theobromae*)

during storage under ambient conditions or even at low temperature. Aspergillus rot is another postharvest disease of mango.



Figure 15: Figure shows Postharvest diseases

## 5. LIMITATIONS:

The current system of experts proposed specializes in the diagnosis of only the following 12 diseases: Powdery mildew. Anthracnose. Die back. Phoma blight. Bacterial canker. Red rust. Sooty mould. Mango malformation. Gummosis. Root rot & Damping off. Scab.

## 6. SYSTEM EVALUATION:

As an initial evaluation, engineering students and others interested people in mango production, farmers, and agriculture instructors tested this proposed system. They were satisfied with its performance, efficiency, user interface and ease of use.

## 7. CONCLUSION:

In this paper, a proposed expert system was introduced to assist agricultural engineers and farmers to treat plants with twelve different potential mango diseases. Agricultural engineers and farmers can get a faster and more accurate diagnosis than traditional diagnosis. This expert system does not require extensive training to use; it's easy to use and has an easy-to-use interface. It was developed using the CLIPS and Delphi languages.

## 8. FUTURE WORK:

This system of experts is a basis for the future. It is planned to add more plant diseases and make them easier for users from anywhere and at any time.

## 9. EXPERT SYSTEM SOURCE CODE:

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

(defrule disease2
(Mango-symptom 4 yes)
```

```
(Mango-symptom 5 yes)
(Mango-symptom 6 yes)
(Mango-symptom 7 yes)
(not (Mango disease identified))
=>
(assert (Mango disease identified))
(printout fdatao "2" crlf )
)

(defrule disease3 (Mango-symptom 8 yes)
(Mango-symptom 9 yes)
(not (Mango disease identified))
=>
(assert (Mango disease identified))
(printout fdatao "3" crlf )
)

(defrule disease4
(Mango-symptom 10 yes)
(Mango-symptom 11 yes)
(Mango-symptom 12 yes)
(Mango-symptom 13 yes)
(not (Mango disease identified))
=>
(assert (Mango disease identified))
(printout fdatao "4" crlf )
)

(defrule disease5
(Mango-symptom 14 yes)
(Mango-symptom 15 yes)
(Mango-symptom 16 yes)
(Mango-symptom 17 yes)
(Mango-symptom 18 yes)
(not (Mango disease identified))
=>
(assert (Mango disease identified))
(printout fdatao "5" crlf )
)

(defrule disease6
(Mango-symptom 19 yes)
(Mango-symptom 20 yes)
(Mango-symptom 21 yes)
(not (Mango disease identified))
=>
(assert (Mango disease identified))
(printout fdatao "6" crlf )
)

(defrule disease7
(Mango-symptom 22 yes)
(Mango-symptom 23 yes)
(Mango-symptom 24 yes)
(not (Mango disease identified))
=>
```

```
(assert (Mango disease identified))
(printout fdatao "7" crlf )
)

(defrule disease8

(Mango-symptom 25 yes)
(Mango-symptom 26 yes)
(Mango-symptom 27 yes)
(not (Mango disease identified))
=>
(assert (Mango disease identified)) (printout fdatao "8" crlf )
)

(defrule disease9
(Mango-symptom 28 yes)
(Mango-symptom 29 yes)
(not (Mango disease identified))
=>
(assert (Mango disease identified))
(printout fdatao "9" crlf )
)

(defrule disease10
(Mango-symptom 30 yes)
(Mango-symptom 31 yes)
(Mango-symptom 32 yes)
(not (Mango disease identified))
=>
(assert (Mango disease identified))
(printout fdatao "10" crlf )
)

(defrule disease11 (Mango-symptom 33 yes)
(Mango-symptom 34 yes)
(Mango-symptom 35 yes)
(Mango-symptom 36 yes)
(Mango-symptom 37 yes)
(Mango-symptom 38 yes)
(assert (Mango disease identified))
(printout fdatao "11" crlf )
)

(defrule disease12
(Mango-symptom 39 yes)
(Mango-symptom 40 yes)
(Mango-symptom 41 yes)
(not (Mango disease identified))
=>
(assert (Mango disease identified))
(printout fdatao "12" crlf )
)

(defrule disease13
(Mango-symptom 42 yes)
(Mango-symptom 43 yes)
```

```
(Mango-symptom 44 yes)
(not (Mango disease identified))
=>
(assert (Mango disease identified))
(printout fdatao "13" crlf )
)

(defrule endline (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
(Mango-symptom ?symptom1 yes)
(Mango-symptom ?symptom2 yes)
(Mango-symptom ?symptom3 yes)
(Mango-symptom ?symptom4 yes)
(Mango-symptom ?symptom6 yes)
(Mango-symptom ?symptom7 yes)
)
(close fdata)
)
```

## REFERENCES

1. Dutta S, Strategies For Implementing Knowledge Based Systems. IEEE Trans. Engineering Management. 1997; 44(1):79-90. Available: <http://dx.doi.org/10.1109/17.552810>
2. <http://vikaspedia.in/agriculture/crop-production/integrated-pest-management/ipm-for-vegetables/ipm-strategies-for-potato/potato-diseases-and-symptoms>
3. <https://www.organicfacts.net/>
4. Techopedia <https://www.techopedia.com/definition/613/expert-system>.
5. 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.
6. 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.
7. 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.
  8. 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.
  9. 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.
  10. 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.
  11. 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.
  12. 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.
  13. 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).
  14. 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.
  15. Abu Naser, S. S. (1993). A methodology for expert systems testing and debugging. North Dakota State University, USA.
  16. 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.
  17. Abu Naser, S. S. (1999). Big O Notation for Measuring Expert Systems complexity. *Islamic University Journal Gaza*, 7(1), 57-70.
  18. Hilles, M. M., & Abu Naser, S. S. (2017). Knowledge-based Intelligent Tutoring System for Teaching Mongo Database. *EUROPEAN ACADEMIC RESEARCH*, 6(10), 8783-8794.
  19. Almurshidi, S. H., & Naser, S. S. A. (2018). Expert System For Diagnosing Breast Cancer. Al-Azhar University, Gaza, Palestine.
  20. 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.
  21. 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.
  22. 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.
  23. 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.
  24. 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 (IJDMP)*, 1, 1-13.
  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. Abu-Nasser, B. S. (2017). Medical Expert Systems Survey. *International Journal of Engineering and Information Systems*, 1(7), 218-224.
  27. 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.
  28. Abu-Nasser, B. S., & Abu-Naser, S. S. (2018). Rule-Based System for Watermelon Diseases and Treatment. *International Journal of Academic Information Systems Research (IJASIR)*, 2(7), 1-7.
  29. 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.
  30. 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.
  31. 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.
  32. 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.
  33. 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.

34. 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.
35. 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.
36. 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.
37. 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.
38. 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.
39. 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).
40. 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.
41. Almurshidi, S. H., & Abu Naser, S. S. (2017). Design and Development of Diabetes Intelligent Tutoring System. *EUROPEAN ACADEMIC RESEARCH*, 6(9), 8117-8128.
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. 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.
44. 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.
45. 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.
46. Abu Naser, S. S., Alamawi, W. W., & Alferra, 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.
47. 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.
48. 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.
49. 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).
50. 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.
51. 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.
52. 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.
53. 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).
54. 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.
55. 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.