International Journal of Academic Engineering Research (IJAER)
ISSN: 2000-001X
Vol. 3 Issue 3, March – 2019, Pages: 1-11

Knowledge Based System for Apple Problems Using CLIPS

Mohammed Al-Shawwa, Samy S. Abu-Naser

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

Abstract: *It is a plant species that follows the apple genus, which is a fruit because it contains seeds of the pink family. It is one of the most fruit trees in terms of agriculture. The apple tree is small in length from 3 to 12 meters. Several recent studies have shown many health benefits of apples. It helps with the strengthening of the brain, heart, and stomach. It is used in the treatment of joint pain and limberness. It is opposite. It stops vomiting. It goes to dyspnea. It corrects the liver, purifies the blood of toxins, strengthens the heart muscle, and kills the abdominal dentures. Which are richer in cell nutrition and development, bone strengthening and neuronal regeneration is an important source of detoxification. Viruses, bacteria, and microbes in the body.* ***Objectives:*** *The main objective of this expert system is to assist farmers in detecting apple diseases and solutions.* ***Method:*** *In this paper, the proposed expert system was design and developed to help farmers diagnose many apple diseases such as: Apple scab, Black rot canker, Powdery mildew, Core rot, Brown rot, White rot / root rot Seedling blight. The proposed system of experts provides an overview of apple diseases identifies the cause of disease and treats the disease whenever possible. The language of the expert system was used to design and implement the proposed expert system.* ***Results:*** *A proposed expert system for the diagnosis of apple diseases was presented to group of farmers for evaluating it and they were satisfied with its performance.* ***Conclusions:*** *The proposed expert system is extremely useful for farmers to diagnose and treat apple diseases whenever possible.*

Keywords: Artificial Intelligence, Expert Systems, CLIPS, Apple disease.

1. INTRODUCTION

Apples are rich in vitamins A, B, C, and sugary substances, protein, fatty substances, organic acids and mineral salts such as potassium, calcium, sodium and others [1].
Apple benefits:

- **Good for Weight Loss**
  Apples are high in fiber and water — two qualities that make them filling.
  In one study, people who ate apple slices before a meal felt fuller than those who consumed applesauce, apple juice, or no apple products.
  In the same study, those who started their meal with apple slices also ate an average of 200 fewer calories than those who didn't. [2].

- **Good for Your Heart**
  Apples have been linked to a lower risk of heart disease.
  One reason may be that apples contain soluble fiber - the kind that can help lower your blood cholesterol levels.
  They also contain polyphenols, which have antioxidant effects. Many of these are concentrated in the peel.
  One of these polyphenols is the flavonoid epicatechin, which may lower blood pressure.
  An analysis of studies found that high intakes of flavonoids were linked to a 20% lower risk of stroke [2].

- **Promote Good Gut Bacteria**
  Apples contain pectin, a type of fiber that acts as a prebiotic. This means it feeds the good bacteria in your gut.
  Your small intestine doesn't absorb fiber during digestion. Instead, it goes to your colon, where it can promote the growth of good bacteria. It also turns into other helpful compounds that circulate back through your body.
  New research suggests that this may be the reason behind some of the protective effects of apples against obesity, type 2 diabetes, and heart disease [2].

- **Help Prevent Cancer**
  Test-tube studies have shown a link between plant compounds in apples and a lower risk of cancer.
  Additionally, one study in women reported that eating apples was linked to lower rates of death from cancer.
  Scientists believe that their antioxidant and anti-inflammatory effects may be responsible for their potential cancer-preventive effects [2].

- **Help Fight Asthma**
  Antioxidant-rich apples may help protect your lungs from oxidative damage.
  A large study in more than 68,000 women found that those who ate the most apples had the lowest risk of asthma. Eating about 15% of a large apple per day was linked to a 10% lower risk of this condition.

Apple skin contains the flavonoid quercetin, which can help regulate the immune system and reduce inflammation. These are two ways in which it may affect asthma and allergic reactions [2].

- **Good for Bone Health**
  Eating fruit is linked to higher bone density, which is a marker of bone health.
  Researchers believe that the antioxidant and anti-inflammatory compounds in fruit may help promote bone density and strength.
  Some studies show that apples, specifically, may positively affect bone health.
  In one study, women ate a meal that either included fresh apples, peeled apples, applesauce, or no apple products. Those who ate apples lost less calcium from their bodies than the control group [2].

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. The basic idea of expert systems is the knowledge that is transferred from the expert to the computer. This knowledge is stored in the computer and then used by the human to get advice instead of going to an expert person [3].

2. MATERIALS AND METHODS

The proposed expert system performs diagnosis for apple 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.

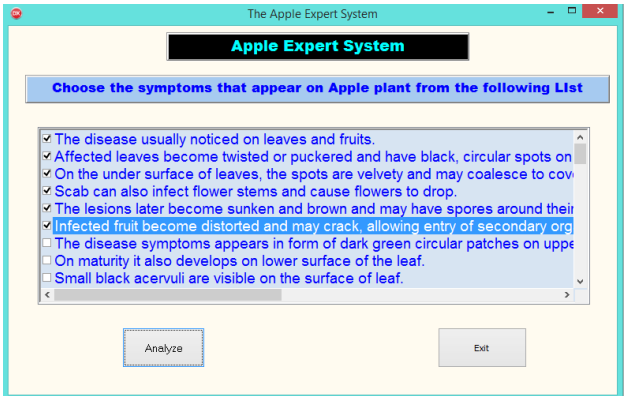

Figure 1: The figure presents shows when the system asks the user.

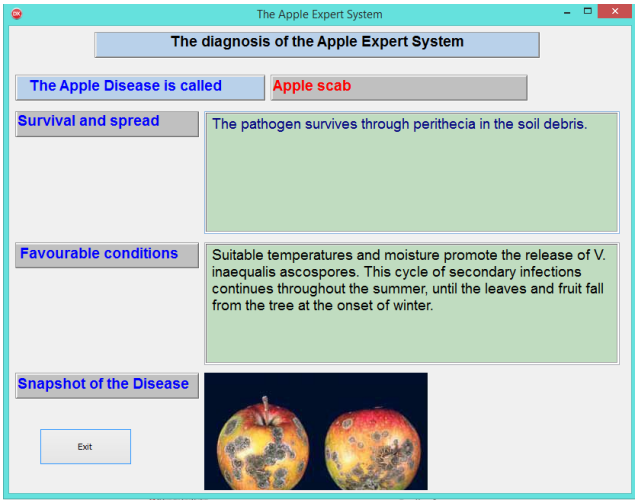

Figure 2: The figure shows diagnosis and recommendation of the expert system.

3. LITERATURE REVIEW

There are many expert systems that are developed for diagnosing human medical problems like [45-50, 52, 54-56, 58], plant and trees problem like: general plant [4], mango [17], Black pepper [18], banana [19, 51] onion [29], potato [43], Pineapple [53], watermelon [57] and other kinds of diseases. But there is no specialized expert system for diagnosing Apple diseases available free. Although many plant diseases have common symptoms. The proposed expert system was designed and developed specifically to aid farmers in diagnosing Apple diseases.

4. KNOWLEDGE REPRESENTATION

The main sources of knowledge for expert systems either from an expert in the field of agriculture or a website specialized in apple diseases, these sources are transferred to Clips. There are currently in the expert system a number of rules that help to treat twelve diseases of apple [4]:

A. Apple scab: A serious disease of apples and ornamental crabapples, apple scab (Venturia inaequalis) attacks both leaves and fruit. The fungal disease forms pale yellow or olive-green spots on the upper surface of leaves. Dark, velvety spots may appear on the lower surface. Severely infected leaves become twisted and puckered and may drop early in the summer [5].
Disease symptoms:

- The disease usually noticed on leaves and fruits.
- Affected leaves become twisted or puckered and have black, circular spots on their upper surface.
- 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.

- Scab can also infect flower stems and cause flowers to drop.
- The lesions later become sunken and brown and may have spores around their margins.
- Infected fruit become distorted and may crack, allowing entry of secondary organisms.

Figure 3: The figure the Symptoms apple scab [7].

B. Marssonina leaf blotch: Leaf spots first appear on the upper surface of mature leaves late summer. They are 5-10 mm in diameter, grayish, brown, and tinged purple at the periphery. Small black acervuli (small asexual fungal fruiting body) are often visible on the surface. When lesions are numerous, they coalesce, the surrounding tissue turns yellow, and defoliation results. Cultivars do not differ significantly in susceptibility to the disease. This fungus can also infect fruit; however, it is uncommon, and we have yet to observe fruit infection in Pennsylvania. Reports have shown trees with numerous leaf infections most likely will have fruit infections [6].

Disease symptoms:

- 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.
- On maturity it also develops on lower surface of the leaf.
- Small black acervuli are visible on the surface of leaf.
- When lesions are numerous, they coalesce and to form large dark brown blotches and the surrounding areas turn yellow.

Figure 4: The figure the Symptoms Marssonina leaf blotch [7].

C. Black rot canker: is an important disease of apple caused by the fungus Botryosphaeria obtusa. Black rot fungus infects a wide variety of hardwood trees, including apple and pear. Infected trees are often a source of infection for nearby younger bearing blocks. Northern Spy, Cortland, Gala, Honeycrisp, McIntosh and Empire are most often infected, although all apple cultivars are susceptible [8].

Disease symptoms:

- Leaf symptoms first occur early in the spring when the leaves are unfolding.
- 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.
- 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.
- Heavily infected leaves become chlorotic and defoliation occurs.
- 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.
- Lesions resulting in canker formation usually are associated with a wound in the bark.

Figure 5: The figure the Symptoms Black rot canker [7].

D. Collar rot: is a disease of the scion portion of the tree, affecting bark tissues of the lower trunk at or above the soil line. In the UK collar rot is sporadic and a disease of mature trees [15].

Disease symptoms:

- Phytophthora collar rot attacks the lower 30 inches (76 cm) of apple trunks.
- Most infections start at the junction of a lateral root with the trunk.
- Infected bark becomes brown and is often soft and mushy or slimy when wet.
- 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.
- 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 6: The figure of the Symptoms Collar rot [7].

E. Powdery mildew: is a disease caused by the fungus Podosphaera leucotricha, affects leaves, buds, shoots and fruits, and forms a dense white fungal growth (mycelium) on the host tissue. The disease stunts the growth of trees and is found wherever apples are grown [9].

Disease symptoms:

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

Figure 7: The figure of the Symptoms Powdery mildew [7].

F. **Sooty blotch and fly speck:** is a diseases cause a discoloration or blemish of near-mature fruit. The discoloration is superficial, and while neither disease actually damages the fruit, the presence of disease reduces the grade and market value of the fruit. Although all apple varieties are susceptible to infection by both fungi, symptoms are most severe on yellow or light-colored varieties such as Golden Delicious or Grimes. Both diseases are most common during years with a cool, wet spring, rains in late summer, and low temperatures in early fall [10].

Disease symptoms:

- Sooty Blotch: Sooty blotch appears as sooty or cloudy blotches on the surface of the fruit. The blotches are olive green with an indefi nite outline.
- The blotches are usually one fourth of an inch in diameter or larger, and may coalesce to cover much of the fruit.
- The “smudge” appearance results from the presence of hundreds of minute, dark pycnidia that are interconnected by a mass of loose, interwoven dark hyphae.
- The sooty blotch fungus is generally restricted to the outer surface of the cuticle. In rare cases, the hyphae penetrate between the epidermal cell walls and the cuticle.
- Flyspeck: Groups of a few to 50 or more slightly raised, black and shiny round dots that resemble fly excreta, appear on the apple fruit.

- The individual "fly specks" are more widely scattered and much larger than the pycnidia of the sooty blotch fungus.
- The flyspecks are sexual fruiting bodies (pseudothecia) of the fungus, and are interconnected by very fine hyphae. The blemishes can be removed by vigorous rubbing or bleaching.

Figure 8: The figure the Symptoms Sooty blotch and fly speck [7].

G. Apple mosaic and other virus diseases: is a disease caused by Apple mosaic virus. It is often found in mixed infections with several other viruses.There is no indication of field spread other than potentially through root grafting. ApMV, besides many Malus spp. and pear, occurs naturally in more than 30 mostly woody hosts including hazelnut, hop, Prunus spp., Rubus spp., Rosa spp., Betula spp., Chenomeles spp., and Aesculus spp [11].

Disease symptoms:

- Apple trees infected with apple mosaic virus develop pale to bright cream spots on spring leaves as they expand.
- These spots may become necrotic after exposure to summer sun and heat.
- Other viral diseases are symptomless in most commercial cultivars, but may cause symptoms in certain cultivars, scionl / rootstock combinations, and ornamental varieties. Symptoms of apple chlorotic leaf spot virus may include chlorotic leaf spots, leaf distortion, chlorotic rings and line patterns, reduced leaf size, and stunting.
- Apple stem grooving virus produces symptoms on 'Virginia Crab' such as chlorotic leaf spots, stern grooving and pitting, union necrosis, and swelling of the stem above the graft union.

Figure 9: The figure the Symptoms Apple mosaic and other virus diseases [7].

H. Alternaria leaf spot/blight: Caused by Alternaria mali, the fungus can overwinter as mycelium on dead leaves on the orchard floor, in mechanical injuries in twigs, or in dormant buds. Primary infection takes place about one month after petal fall. The disease advances rapidly in the optimum temperature range of 77 to 86 °F and wet weather. At optimum temperatures infection occurs with 5.5 hours of wetting, and lesions can appear in the orchard two days after infection, causing a serious outbreak. The fungus produces a chemical toxin which increases the severity of the disease on susceptible cultivars [12].

Disease symptoms:

- Leaf spots appear on the leaves in late spring and early summer. Initially, they are 1/8 to 1/4 inch in diameter, round, brown, and occasionally have a purple border.
- As spots age, they often turn tan to ash gray. Some spots undergo secondary enlargement, becoming irregularly shaped.
- Heavily infected leaves often abscise, resulting in defoliation. (Defoliation is greater when mites are present.) Fruit infections result in small, dark, raised pimple-like lesions associated with the lenticels.
- Twig lesions, which are somewhat sunken, round, blackish spots bordered by cracks, occur on susceptible cultivars such as Indo but have not been observed on Delicious.

Figure 10: The figure the Symptoms Alternaria leaf spot/blight [7].

I. **Core rot:** is especially devastating because it is difficult to detect before harvest, thus infected apples easily slip through defect sorting efforts during harvest and packing. Core rot affected apples soften and turn yellow on the tree well before other apples on the tree, so pre-harvest scouting for this symptom can provide some help by triggering more intensive harvest sorting in the field and packing shed [13].

Disease symptoms:

- Common injuries that can lead to Alternaria rot include mechanical or chemical injury, sunscald, or chilling injury.
- Browning occurred most frequently with the occurrence rates of core rot.
- Infection can occur before or after harvest, although it is more commonly a post-harvest problem.

Figure 11: The figure the Symptoms Core rot [7].

J. **Brown rot:** is one of the most important causes of rotting in stored apples and also causes significant losses in the orchard pre-harvest, The fungus attacks fruit and also causes spur cankers, If not controlled, the disease can build up to a significant incidence over several seasons [14].

Disease symptoms:

- Enlarged rots are soft but not mushy.
- Circular and medium brown during the early and medium stages of development.
- Decayed area enlarges; small black spots about 1/8 inch across gradually develop at the lenticels.
- Entire fruit is decayed and under warm conditions turns black and develops a velvety sheen.
- In warm, moist conditions gray to tan fungal tufts develop, either in varying size patches or scattered over the decayed surface.

Figure 12: The figure the Symptoms Brown rot [7].

K. **White rot / root rot:** Crown rot is a disease of the rootstock portion of the tree affecting bark tissues of the root crown region, is usually important on young trees in orchard establishment [15].

Root rot is a disease of the root system and is usually in association with crown rot but can occur in the absence of crown rot, is usually important on young trees in orchard establishment [15].

Disease symptoms:

- Infection can occur on large roots or at the tree collar.
- In fruit trees, the base of the trunk at soil level can show signs of a dark, wet rot, especially if kept moist by weeds or wet weather.
- As the disease progresses, the infected tissue becomes rotten.
- Trees develop a generally unthrifty appearance with leaf yellowing, cessation of root growth,

small leaves, premature leaf fall and small, shrivelled fruit. Infected trees will eventually die.

Figure 13: The figure the Symptoms White rot / root rot [7].

L. Seedling blight: are caused by various fungi. Depending on the fungus involved, they can survive in the seed, soil and infested crop residue, disease is usually promoted by adverse growing conditions and stress during seed germination and emergence. Low soil temperatures from 50 to 60 degrees F and high soil moisture are favorable to disease development. Low, wet areas of fields are likely to show the first symptoms of the disease , minimum tillage fields may be more prone to disease as are seed of lower germination and poor seed quality, herbicide injury or insect damage to young seedlings may also increase seedling diseases, especially those caused by Rhizoctonia and Pythium [16].

Disease symptoms:

- Apple: Diseases and Symptoms The most distinct symptoms and signs occur at the collar of the tree.
- Small, round, light brown to yellow resting structures of the pathogen, known as sclerotia, can be found appressed to or in the soil adjacent to infected trees.
- If conditions are moist, a white web-like mycelial growth may also be present.
- Affected cortical tissues in the collar of the tree are often shredded.

Figure 14: The figure the Symptoms Seedling blight [7].

5. LIMITATIONS

The current proposed expert system is specialized in the diagnosis of 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, a group of farmers 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 in diagnosing disease with twelve different possible apple 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 Expert System language and Delphi XE10.2.

8. FUTURE WORK

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

9. EXPERT SYSTEN SOURCE CODE

```
(defrule disease1
(apple-symptom 1 yes)
(apple-symptom 2 yes)
(apple-symptom 3 yes)
(apple-symptom 4 yes)
```

```
(apple-symptom 5 yes)
(apple-symptom 6 yes)
(not (apple disease identified))
=>
(assert (apple disease identified))
(printout fdatao "1" crlf )
)

(defrule disease2
(apple-symptom 7 yes)
(apple-symptom 8 yes)
(apple-symptom 9 yes)
(apple-symptom 10 yes)
(not (apple disease identified))
=>
(assert (apple disease identified))
(printout fdatao "2" crlf )
)

(defrule disease3
(apple-symptom 11 yes)
(apple-symptom 12 yes)
(apple-symptom 13 yes)
(apple-symptom 14 yes)
(apple-symptom 15 yes)
(apple-symptom 16 yes)
(not (apple disease identified))
=>
(assert (apple disease identified))
(printout fdatao "3" crlf )
)

(defrule disease4
(apple-symptom 17 yes)
(apple-symptom 18 yes)
(apple-symptom 19 yes)
(apple-symptom 20 yes)
(apple-symptom 21 yes)
(not (apple disease identified))
=>
(assert (apple disease identified))
(printout fdatao "4" crlf )
)

(defrule disease5
(apple-symptom 22 yes)
(apple-symptom 23 yes)
(apple-symptom 24 yes)
(apple-symptom 25 yes)
(apple-symptom 26 yes)
(not (apple disease identified))
=>
(assert (apple disease identified))
(printout fdatao "5" crlf )
)

(defrule disease6
(apple-symptom 27 yes)
(apple-symptom 28 yes)
(apple-symptom 29 yes)
(apple-symptom 30 yes)
(apple-symptom 31 yes)
(apple-symptom 32 yes)
(apple-symptom 33 yes)
(not (apple disease identified))
=>
(assert (apple disease identified))
(printout fdatao "6" crlf )
)

(defrule disease7
(apple-symptom 34 yes)
(apple-symptom 35 yes)
(apple-symptom 36 yes)
(apple-symptom 37 yes)
(not (apple disease identified))
=>
(assert (apple disease identified))
(printout fdatao "7" crlf )
)

(defrule disease8
(apple-symptom 38 yes)
(apple-symptom 39 yes)
(apple-symptom 40 yes)
(apple-symptom 41 yes)
(not (apple disease identified))
=>
(assert (apple disease identified))
(printout fdatao "8" crlf )
)

(defrule disease9
(apple-symptom 42 yes)
(apple-symptom 43 yes)
(apple-symptom 44 yes)
(not (apple disease identified))
=>
(assert (apple disease identified))
(printout fdatao "9" crlf )
)

(defrule disease10
(apple-symptom 45 yes)
(apple-symptom 46 yes)
(apple-symptom 47 yes)
(apple-symptom 48 yes)
(apple-symptom 49 yes)
(not (apple disease identified))
=>
(assert (apple disease identified))
(printout fdatao "10" crlf )
```

```
)

(defrule disease11
(apple-symptom 50 yes)
(apple-symptom 51 yes)
(apple-symptom 52 yes)
(apple-symptom 53 yes)
(not (apple disease identified))
=>
(assert (apple disease identified))
(printout fdatao "11"  crlf )
)

(defrule disease12
(apple-symptom 54 yes)
(apple-symptom 55 yes)
(apple-symptom 56 yes)
(apple-symptom 57 yes)
(not (apple disease identified))
=>
(assert (apple disease identified))
(printout fdatao "12"  crlf )
)

(defrule endline
(apple 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))

  (assert
    (apple-symptom ?symptom1 yes)
    (apple-symptom ?symptom2 yes)
    (apple-symptom ?symptom3 yes)
    (apple-symptom ?symptom4 yes)
    (apple-symptom ?symptom5 yes)
    (apple-symptom ?symptom6 yes)
    (apple-symptom ?symptom7 yes)
    )
    (close fdata)
)
```

REFERENCES

1. https://en.wikipedia.org/wiki/Apple
2. https://www.healthline.com/nutrition/10-health-benefits-of-apples#section1
3. 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.
4. 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.
5. https://www.planetnatural.com/pest-problem-solver/plant-disease/apple-scab/
6. https://extension.psu.edu/apple-disease-marssonina-blotch
7. http://vikaspedia.in/agriculture/crop-production/integrated-pest-managment/ipm-for-fruit-crops/ipm-strategies-for-apple/apple-diseases-and-symptoms
8. http://www.omafra.gov.on.ca/english/crops/facts/blackrot.htm
9. http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/fruit-and-nuts/pome-fruit-diseases/powdery-mildew-of-apples
10. https://ohioline.osu.edu/factsheet/plpath-fru-41
11. https://pnwhandbooks.org/plantdisease/host-disease/apple-malus-spp-apple-mosaic
12. https://extension.psu.edu/apple-disease-alternaria-leaf-blotch
13. https://www.farmprogress.com/orchard-crops/core-rot-fuji-apples
14. http://apples.ahdb.org.uk/brown-rot-additional.asp
15. http://apples.ahdb.org.uk/crown-rot-and-collar-rot-additional-information.asp
16. https://ipm.ca.uky.edu/content/seedling-blights-soybeans
17. Almadhoun, H. R., et al. (2018). Banana Knowledge Based System Diagnosis and Treatment. International Journal of Academic Pedagogical Research (IJAPR), 2(7), 1-11.
18. Barhoom, A. M., et al. (2018). Black Pepper Expert System. International Journal of Academic Information Systems Research (IJAISR), 2(8), 9-16.
19. Alajrami, M. A., et al. (2018). Onion Rule Based System for Disorders Diagnosis and Treatment. International Journal of Academic Pedagogical Research (IJAPR), 2(8), 1-9.
20. Abu-Nasser, B. S., et al. (2018). Cognitive System for Helping Farmers in Diagnosing Watermelon Diseases. International Journal of Academic Information Systems Research (IJAISR), 2(7), 1-7.

21. Nassr, M. S., et al. (2018). Knowledge Based System for Diagnosing Pineapple Diseases. International Journal of Academic Pedagogical Research (IJAPR), 2(7), 12-19.
22. Elqassas, R., et al. (2018). Expert System for the Diagnosis of Mango Diseases. International Journal of Academic Engineering Research (IJAER), 2(8), 10-18.
23. Abu Ghali, M. J., et al. (2017). Expert System for Problems of Teeth and Gums. International Journal of Engineering and Information Systems (IJEAIS), 1(4), 198-206.
24. Akkila, A. N., et al. (2016). Proposed Expert System for Calculating Inheritance in Islam. World Wide Journal of Multidisciplinary Research and Development, 2(9), 38-48.
25. Al Rekhawi, H. A., et al. (2017). Rickets Expert System Diagnoses and Treatment. International Journal of Engineering and Information Systems (IJEAIS), 1(4), 149-159.
26. Akkila, A. N., et al. (2008). A Proposed Expert System for Skin Diseases Diagnosis. INSInet Publication. Journal of Applied Sciences Research, 4(12), 1682-1693.
27. El Agha, M., Jarghon, A., et al. (2017). Polymyalgia Rheumatic Expert System. International Journal of Engineering and Information Systems (IJEAIS), 1(4), 125-137.
28. Al-Dahdooh, R., et al. (2010). Knowledge management in ESMDA: expert system for medical diagnostic assistance. AIML Journal, 10(1), 31-40.
29. AbuEl-Reesh, J. Y., et al. (2017). A Knowledge Based System for Diagnosing Shortness of Breath in Infants and Children. International Journal of Engineering and Information Systems (IJEAIS), 1(4), 102-115.
30. El Haddad, I., et al. (2016). An Expert System for Genital Problems in Infants. World Wide Journal of Multidisciplinary Research and Development (WWJMRD), 2(5).
31. Alamawi, W. W., et al. (2016). Rule Based System for Diagnosing Wireless Connection Problems Using SL5 Object. International Journal of Information Technology and Electrical Engineering, 5(6), 26-33.
32. Almurshidi, S. H., et al. (2018). EXPERT SYSTEM FOR DIAGNOSING BREAST CANCER. Al-Azhar University, Gaza, Palestine.
33. Alawar, M. W., et al. (2016). An expert system for feeding problems in infants and children. International Journal of Medicine Research, 1(2), 79-82.
34. Nabahin, A., et al. (2017). Expert System for Hair Loss Diagnosis and Treatment. International Journal of Engineering and Information Systems (IJEAIS), 1(4), 160-169.
35. Al-Bayed, M. H. et al. (2016). Detecting Health Problems Related to Addiction of Video Game Playing Using an Expert System. World Wide Journal of Multidisciplinary Research and Development, 2(9), 7-12.
36. Azaab, S., et al. (2000). A proposed expert system for selecting exploratory factor analysis procedures. Journal of the College of Education, 4(2), 9-26.
37. AlDahdooh, R. M., et al. (2016). Lower Back Pain Expert System Diagnosis and Treatment. Journal of Multidisciplinary Engineering Science Studies (JMESS), 2(4), 441-446.
38. Bakeer, H., et al. (2017). Photo Copier Maintenance Expert System V. 01 Using SL5 Object Language. International Journal of Engineering and Information Systems (IJEAIS), 1(4), 116-124.
39. Alhabbash, M. I., et al. (2016). Male Infertility Expert system Diagnoses and Treatment. American Journal of Innovative Research and Applied Sciences, 2(4).
40. Khella, R., et al. (2017). Rule Based System for Chest Pain in Infants and Children. International Journal of Engineering and Information Systems, 1(4), 138-148.
41. Al-Hanjori, M. M., et al. (2016). An expert system for men genital problems diagnosis and treatment. International Journal of Medicine Research, 1(2), 83-86.
42. Dahouk, A. W., et al. (2018). A Proposed Knowledge Based System for Desktop PC Troubleshooting. International Journal of Academic Pedagogical Research (IJAPR), 2(6), 1-8.
43. ALmursheidi, S. H., et al. (2016). A Knowledge Based System for Neck Pain Diagnosis. World Wide Journal of Multidisciplinary Research and Development (WWJMRD), 2(4), 12-18.
44. Musleh, M. M., et al. (2018). Rule Based System for Diagnosing and Treating Potatoes Problems. International Journal of Academic Engineering Research (IJAER), 2(8), 1-9.
45. Baraka, M. H., et al. (2008). A Proposed Expert System For Guiding Freshman Students In Selecting A Major In Al-Azhar University, Gaza. Journal of Theoretical & Applied Information Technology, 4(9).
46. Mrouf, A., et al. (2017). Knowledge Based System for Long-term Abdominal Pain (Stomach Pain) Diagnosis and Treatment. International Journal of Engineering and Information Systems (IJEAIS), 1(4), 71-88.
47. Bastami, B. G., et al. (2016). A proposed rule based system for breasts cancer diagnosis. World Wide Journal of Multidisciplinary Research and Development, 2(5), 27-33.

48. Hasanein, H. A. A., et al. (2016). Ear Diseases Diagnosis Expert System Using SL5 Object. World Wide Journal of Multidisciplinary Research and Development, 2(4), 41-47.
49. El-Najjar, A. E. A., et al. (2016). An expert system for nausea and vomiting problems in infants and children. International Journal of Medicine Research, 1(2), 114-117.
50. Qwaider, S. R., et al. (2017). Expert System for Diagnosing Ankle Diseases. International Journal of Engineering and Information Systems (IJEAIS), 1(4), 89-101.
51. Hamed, M. A., et al. (2016). An Expert System for Mouth Problems in Infants and Children. Journal of Multidisciplinary Engineering Science Studies (JMESS), 2(4), 468-476.
52. AlZamily, J. Y., et al. (2018). A Cognitive System for Diagnosing Musa Acuminata Disorders. International Journal of Academic Information Systems Research (IJAISR), 2(8), 1-8.
53. Mahdi, A. O., et al. (2016). A proposed Expert System for Foot Diseases Diagnosis. American Journal of Innovative Research and Applied Sciences, 2(4), 155-168.
54. Ola, A. Z. A., et al. (2008). AN EXPERT SYSTEM FOR DIAGNOSING EYE DISEASES USING CLIPS. Journal of Theoretical & Applied Information Technology, 4(10).
55. 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.
56. Shaath, M. Z., et al. (2016). Expert system urination problems diagnosis. World Wide Journal of Multidisciplinary Research and Development, 2(5), 9-19.
57. El-Hissi, H., et al. (2010). An expert system for endocrine diagnosis and treatments using JESS. Journal of Artificial Intelligence; Scialert, 3(4), 239-251.
58. Ashqar, B. A. M., et al. (2019). Plant Seedlings Classification Using Deep Learning. International Journal of Academic Information Systems Research (IJAISR), 3(1), 7-14.
59. Ashqar, B. A. M., et al. (2019). Image-Based Tomato Leaves Diseases Detection Using Deep Learning. International Journal of Academic Engineering Research (IJAER), 2(12), 10-16.
60. El_Jerjawi, N. S., et al. (2018). Diabetes Prediction Using Artificial Neural Network. International Journal of Advanced Science and Technology, 121, 55-64.